

**The 2003 KDI-KAEA Conference on “Aging
Population, Emerging China, and Sustainable
Growth in Korea”**

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Foreword

This collection of conference papers is an accumulation of materials for “*The 2003 KDI-KAEA Conference on Aging Population, Emerging China, and Sustainable Growth in Korea*,” held between July 11~12, 2003 at the Korea Development Institute (KDI) in Seoul, Korea.

The purpose of this conference was to gather papers that are in-line with the 2003 five major research projects, which were carefully selected by KDI in order to enhance economic development of Korea. In addition, our aim was to internationalize and upgrade the quality of economic research by strengthening relationships with international sources, collect opinions from national as well as international academic circles, and ultimately commit to extensive exchange of information and resources in step with the Information Society. Currently, most of the papers presented during the conference are in review process for publication in the *Journal of Economic Policy*. This conference was possible thanks to the support of the Knowledge Partnership (KP) 2 Project and collaboration from the Korea-America Economic Association (KAEA).

The sessions were divided into eight relevant categories and they are as follows: Session I-*The Effects of Aging Population on the Economy*; Session II-*Public Pension*; Session III-*The Changes of Industrial Structure in Northeast Asia*; Session IV-*Public Sector Reform*; Session V-*Education Policy*; Session VI-*Financial Sector Reform*; Session VII-*Socially Sustainable Development: Income distribution and Social Welfare*; and Session VIII-*Other Issues*. This volume comprises of papers that have already been revised by the authors after the pertinent discussion notes were reflected, which are also included in the proceedings. Furthermore, the discussion notes have contributed substantial amount of input into the original papers.

My acknowledgement goes out to all participants and particularly to those who were on the Screening Board with me including Dr. Lee Bong Soo and Dr. Hwang Hae Shin for assisting in the preliminary paper selection. Moreover, I would like to extend my gratitude to Mr. Ho-Jung Yoon and Ms. Nanhee Kim for administrative arrangement and overall coordination along with Ms. Dong-Young Shin and Mr. Kwang Sung Kim for their support for the conference.

Shim, Sangdal
Chief Editor
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The Middle Generations Saves More: Analytical Approach with Habit Formation in Three Generation Overlapping Generations Economy

by
Sei-Wan Kim, Kiseok Nam*

Abstract

In this work, we extend Constantinides, Donaldson and Mehra's work (2002) by incorporating habit formation in a three period overlapping-generations economy. Using comparative static analysis and model calibrations, we verify that there is a positive impact of habit formation on the savings levels of middle-aged investors. The findings imply that taking into account habit formation within the overlapping-generations framework provides a more convincing explanation of the equity premium puzzle than what would be obtained from a non-habit forming model.

JEL Classification: D0; E0; E2; G0

Key words: Habit formation utility; Overlapping-generations model; Savings; Equity premium

1. Introduction

Habit formation has been widely used in recent studies of financial economics as an important motive to explain the savings and portfolio decision. For example, Constantinides (1990) and Abel (1990) show that habit-forming consumption, with its flexibility in modeling risk aversion and consumption paths, can partially resolve the equity premium puzzle posed by Mehra and Prescott (1985).¹ This finding has indeed motivated a line of habit formation approaches in dynamic modeling of optimal savings and portfolio decisions (e.g., Sundaresan, 1989; Jermann, 1998; Campbell and Cochrane, 1999; and Lettau and Uhlig, 2000).

On the other hand, in an attempt to resolve the premium puzzle, Constantinides, Donaldson, and Mehra (2002) (hereafter CDM) propose an overlapping-generations (hereafter OLG) model that explicitly captures the saving and dissaving behavior of

* Corresponding author. Comments from seminar participants at Texas A&M University-College Station, University of Central Florida, University of New Hampshire, California State University-Fullerton, and Western Economic Association International (2002) conference are greatly appreciated.

¹ See Cochrane and Hansen (1992) and Kocherlakota (1996) for surveys on the equity premium puzzle.

consumers subject to a borrowing constraint. CDM show that, with a simple time separable Constant Relative Risk Averse (hereafter CRRA) utility function and a borrowing constraint, consumers in a three-period overlapping-generations economy have an incentive to hold a diversified portfolio for different stages over their life cycle. The key feature of the CDM's OLG approach is that, the inability of the young-aged generation to hold equity together with high fluctuations of equity income reduce the demand for equity and, consequently, raise the net demand for bonds by the middle-aged (generation) investors. Thus, the middle-aged investors' savings decision has a substantial impact on the equity premium (*i.e.*, a low risk-free rate and a high risk premium).

In this paper, we extend CDM's work by incorporating habit formation into the OLG economy, such that the habit-forming consumers' optimal savings decision is derived from an overlapping-generations framework.² Using comparative statics and model calibration, we verify a positive impact of habit formation on the middle-aged investors' savings level under a reasonable parameter set. The main findings imply that incorporating habit formation in an overlapping-generations framework yield more plausible results on the role of the middle-aged investors' savings condition (*i.e.*, higher incentives to save) than the results generated by CDM.³

In CDM's framework, a borrowing constraint prevents the young-aged generation from holding equity, such that equity prices are assumed to be exclusively determined by the middle-aged investors. Knowing that their future retirement income is either zero or deterministic and that their future consumption is highly correlated with equity income, the middle-aged investors will save more by holding more bonds and less equity. Therefore, the middle-aged investors' savings decision has a dominant impact on the level of the equity premium and the bond yield.

Under the habit formation utility and the OLG economy, however, the impact of the middle-aged investors' savings decision on the demand for equity and bonds is affected by not only the presence of a borrowing constraint but also by the habit formation process. With a stronger incentive to secure their future consumption, the habit-forming middle-aged investors will save even more than do the middle-aged investors in the CDM's case (with non-habit formation utility).⁴ Thus, habit formation causes even higher demand for bonds (yielding a lower risk-free rate) and less demand for equity (yielding a higher required return for holding equity), thereby yielding a higher equity premium than does the CDM's framework. This implies that incorporating habit formation within the OLG framework can provide more satisfactory explanations on the equity premium puzzle.⁵

The rest of the paper is organized as follows. In section 2, we build up a model of habit formation utility in an overlapping-generations economy. The effect of habit formation utility on the middle-aged investors' savings is evaluated in section 3. Section 4 concludes the paper.

² As far as we know, researchers have not incorporated habit formation in a three-period overlapping-generations model. For example, Constantinides (1990) and Abel (1990) suggest the habit formation utility in an infinite horizon model, while Constantinides, Donaldson and Mehra (2002) propose the CRRA utility in an overlapping-generations economy.

³ CDM (2002) assume a representative consumer with the CRRA utility.

⁴ The Relative Risk Averse (hereafter RRA) coefficient of the habit formation utility is greater than that of the CRRA utility, so that a habit-forming consumer is presumed to have a less incentive to hold equity due to its riskiness. Consequently, the habit-forming middle generation should have a stronger preference on bonds to equity than non-habit formation utility.

⁵ Calibrating the equity premium defined as the difference between the return for equity and that of bonds in the OLG framework, Kim (2003) derives a higher equity premium than that obtained from the CDM framework by introducing the habit formation utility.

2. The Model

We consider a utility-maximizing representative consumer in an overlapping-generations economy, where each generation lives for three discrete periods as a member of the young, middle, and old generations. The representative consumer born at $t = 0$ with no endowment assets receives labor income w_0 in period $t = 0$, w_1 in period $t = 1$, and zero labor income in period $t = 2$. In the first period, the consumer receives a relatively low labor income sufficient only to satisfy his or her first period consumption. In the second period, the consumer receives wage income, and wants to accumulate assets for the third period consumption due to an expected zero labor income for this period. In the third and last period, the consumer retires and consumes the assets accumulated during the second period. Savings for smoothing lifetime consumption is done by holding a diversified portfolio with equity and bonds. However, following the setting by CDM (2002), we also introduce the borrowing constraint that prevents the young-aged generation from borrowing at the risk-free rate to hold equity, such that only the middle-aged generation is allowed to save with a diversified portfolio of equity and bonds. Therefore, over the life cycle each generation can be characterized as the borrowing-constrained young generation, the saving middle generation, or the dissaving old generation.

Following Sundaresan (1989) and Constantinides (1990),⁶ we assume that the representative consumer's utility exhibits habit formation preferences, such that the habit level of consumption at time t , X_t , is a positive fraction of the consumer's own previous consumption level, i.e., $X_t = \delta C_{t-1}$. δ is the constant habit persistence parameter and it is assumed to have a value between 0 and 1, which characterizes the consumption of non-durable goods and services.⁷ Since the representative consumer in the first period does not have the previous period consumption for habit formation, the consumer is assumed to have a habit formation utility function from the second period on. Consequently, the consumer has the following sum of discounted utility flows over three periods:

$$U_0 = \frac{[C_0]^{1-\gamma}}{1-\gamma} + \beta \frac{[C_1 - X_1]^{1-\gamma}}{1-\gamma} + \beta^2 \frac{[C_2 - X_2]^{1-\gamma}}{1-\gamma}, \quad (1)$$

where C_0 , C_1 and C_2 are consumption at $t = 0$, $t = 1$ and $t = 2$, respectively, and all are assumed to be positive.⁸ Habit level at time t is determined by $X_t = \delta C_{t-1}$. β is the constant subjective discount factor, and $\gamma > 0$ is the constant risk averse parameter.

The representative consumer then faces the following budget constraints over life cycle:

⁶ Abel (1990) proposes another type of habit formation, i.e., *Catching up with the Joneses*, where the habit-forming behavior is based upon the consumption of other consumers. Comparing his or her own consumption to that of others, a consumer could get utility from knowing that he or she is consuming more than others.

⁷ The standard CRRA utility is a special case of habit formation utility with $\delta = 0$.

⁸ To be specific, excess consumption over the habit, $C_t - X_t$, should be positive for each period's

$$C_0 \leq w_0 - S_0, \quad (2)$$

$$C_1 \leq w_1 + R_1 S_0 - S_1, \text{ and} \quad (3)$$

$$C_2 \leq R_2 S_1 \quad (4)$$

where S_0 and S_1 are savings of young and middle generations, R_1 and R_2 are the gross rates of return in the middle and old periods, and w_0 and w_1 represent the labor income of young and middle generations. With Eq. (2), (3) and (4), the objective function U_0 becomes the following value function, V_0 .

$$V_0 = \frac{[w_0 - S_0]^{1-\gamma}}{1-\gamma} + \beta \frac{[(w_1 + R_1 S_0 - S_1) - \delta(w_0 - S_0)]^{1-\gamma}}{1-\gamma} + \beta^2 \frac{[R_2 S_1 - \delta(w_1 + R_1 S_0 - S_1)]^{1-\gamma}}{1-\gamma} \quad (5)$$

It should be noted that the RRA coefficient of the habit formation utility is $\frac{\gamma \cdot W_t}{C_t - X_t}$, where wealth W_t is defined as $W_t = C_t + S_t$.⁹ Since $W_t > C_t - X_t$, $\frac{\gamma \cdot W_t}{C_t - X_t}$ is greater than γ , which is the RRA coefficient of the CRRA utility. This implies that a habit-forming consumer has a lower (a higher) incentive to put more weight on equity (bonds) investment than a consumer with the CRRA utility.

3. Optimum Savings of the Habit-Forming Middle Generation

CDM (2002) assume that the young generation bears a restriction on borrowing against future labor income, which is realistic in that human capital alone does not collateralize major loans in modern economies for reasons of moral hazard and adverse selection. In addition to the constraint, the young-aged generation's labor income (w_0) is assumed to be at a lower level than w_1 , so that it is enough only for the consumption at $t = 0$. These two assumptions together rationalize zero savings of the young-aged generation, i.e., $S_0 = 0$. Since the young-aged generation is excluded from participating in the equity market, then the equity price (and, thus, the equity premium) is exclusively determined by the middle-aged (generation) investors' savings decision. Assuming only the CRRA utility in the overlapping generation economy, CDM (2002) show that imposing a borrowing constraint to the young-aged generation reduces the risk-free rate and increases the risk premium.

Compared with the CDM's framework as a benchmark model, the combination of the habit formation utility and an overlapping-generations economy yields better results that can be used for explaining the equity premium. The main idea is that (a) an introduction of habit formation preferences results in a stronger incentive to save in the middle period for the old period's consumption than the non-habit formation utility such as the CRRA utility suggested by CDM, (b) a habit-forming consumer will have a lower incentive to take equity investment to secure a stable consumption for the next period than a consumer with the CRRA utility. A habit-forming middle-aged generation, with a higher RRA coefficient, will

instantaneous utility to be defined.

⁹ With $W_t = C_t + S_t$, $RRA = -W_t \cdot \frac{U''}{U'} = W_t \cdot \frac{\gamma(C_t - X_t)^{-\gamma-1}}{(C_t - X_t)^{-\gamma}} = \gamma \cdot \frac{W_t}{C_t - X_t}$.

put more weight on bond relative to equity for his/her diversified portfolio, thereby causing an even higher demand for bonds but less demand for equity.

Using comparative statics on the optimum savings decision of the middle-aged investors, we examine the effect of habit-formation preferences on the optimum savings level. First, we derive the optimum savings level of the middle-aged generation from solving the maximization problem of the discounted utility over the life cycle. Then, we show the positive impact of the habit formation preferences on the optimum savings level of the middle-aged.

Differentiating V_0 (with $S_0 = 0$) of Eq. (5) with respect to S_1 yields the first order condition Q as follows:

$$Q: \beta^2(R_2 + \delta)[R_2 S_1^* - \delta(w_1 - S_1^*)]^{-\gamma} - \beta[(w_1 - S_1^*) - \delta w_0]^{-\gamma} = 0, \quad (6)$$

where S_1^* is the optimal savings level of the middle-aged generation.¹⁰ If the first and second order conditions are satisfied, the effect of habit formation on the optimum savings level of the middle-aged generation is determined by the sign of $\frac{dS_1^*}{d\delta}$, where

$\frac{dS_1^*}{d\delta} = -\frac{\partial Q}{\partial \delta} / \frac{\partial Q}{\partial S_1^*}$. Thus, $\frac{dS_1^*}{d\delta}$ can be expressed as follows:

$$\frac{\beta^2[R_2 S_1^* - \delta(w_1 - S_1^*)]^{-\gamma} + \beta^2 \gamma (R_2 + \delta)(w_1 - S_1^*)[R_2 S_1^* - \delta(w_1 - S_1^*)]^{-\gamma-1} - \gamma \beta w_0 [w_1 - S_1^* - \delta w_0]^{-\gamma-1}}{\gamma \beta [w_1 - S_1^* - \delta w_0]^{-\gamma-1} + \beta^2 \gamma (R_2 + \delta)^2 [R_2 S_1^* - \delta(w_1 - S_1^*)]^{-\gamma-1}} \quad (7)$$

Using the budget constraints, Eq. (7) can be rewritten as follows.

$$\frac{dS_1^*}{d\delta} = \frac{\beta^2 [C_2 - \delta C_1]^{-\gamma} + \beta^2 \gamma (R_2 + \delta) C_1 [C_2 - \delta C_1]^{-\gamma-1} - \gamma \beta C_0 [C_1 - \delta C_0]^{-\gamma-1}}{\gamma \beta [C_1 - \delta C_0]^{-\gamma-1} + \beta^2 \gamma (R_2 + \delta)^2 [C_2 - \delta C_1]^{-\gamma-1}} \quad (8)$$

Since the implied result for the CDM's framework is that $\frac{dS_1^*}{d\delta} = 0$, $\frac{dS_1^*}{d\delta} > 0$ implies that habit formation has a positive impact on the optimum savings level, thereby showing a higher incentive to save more than the CDM's framework. We calibrate Eq. (8) to determine the sign of $\frac{dS_1^*}{d\delta}$ under a plausible range of parameters and the consumption set. Since it is always the case that $C_1 > \delta C_0$ and $C_2 > \delta C_1$ (in order to have positive utility levels), the denominator of Eq. (8) is positive. Thus, the sign of $\frac{dS_1^*}{d\delta}$ is determined by the sign of the numerator of Eq. (8).

¹⁰ The second order condition for the maximization problem is also satisfied as follows.

$-\gamma \beta [(w_1 - S_1^*) - \delta w_0]^{-\gamma-1} - \gamma \beta^2 (R_2 + \delta)^2 [R_2 S_1^* - \delta(w_1 - S_1^*)]^{-\gamma-1} < 0$.

Given permissible parameter values for β , δ , γ and R_2 under several combinations of consumption paths over the life cycle, calibrating the model readily confirms the following inequality:¹¹

$$\beta^2[C_2 - \delta C_1]^{-\gamma} + \beta^2\gamma(R_2 + \delta)C_1[C_2 - \delta C_1]^{-\gamma-1} - \gamma\beta C_0[C_1 - \delta C_0]^{-\gamma-1} > 0. \quad (9)$$

The above inequality indicates that $\frac{dS_1^*}{d\delta} > 0$, which implies that habit formation preferences have a positive impact on the optimum savings level. The calibration result verifies that a habit-forming consumer saves in the middle period more than a nonhabit-forming consumer.

4. Conclusion

In this study, we extend Constantinides, Donaldson and Mehra's work (2002) by incorporating habit formation into an overlapping-generations economy. Using comparative statics and model calibrations, we have shown that incorporating habit formation preferences in the three-period OLG model has a positive impact on the savings level of the middle-aged generation. When compared to the CDM's case, where non-habit formation preferences are assumed, the explicit inclusion of habit formation within an overlapping-generations model results in a stronger incentive for agents to secure their future consumption, so that the habit-forming middle-aged investors will save even more than do the middle-aged investors in the CDM's case. This higher incentive to save causes a higher demand for bonds and less demand for equity, thereby yielding a lower risk-free rate and a higher required return for holding equity than does the CDM's framework. Therefore, accounting for habit formation preferences in the OLG framework can provide a more satisfactory explanation of the equity premium puzzle.

¹¹ Boundaries of parameters and variables are determined as follows. For the value of discount factor, β , we assign around 0.955 per year. By recalculating β in terms of 20 years period (one generation period), we get 0.3982. For the habit persistence parameter, δ , we use the value 0.615 following Otrok, Ravikumar and Whiteman (2002). The value of γ is set between 1 and 10 following Mehra and Prescott (1985) and many other studies that utilize this range of values. For the value of consumption over different age cohorts, we use values between 20,000 and 40,000, which are consistent with the real Consumer Expenditure (conducted by the Bureau of Labor Statistics) Survey from 1984 to 1996.

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Comments on “The Middle Generations Save More”

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To begin with, what I appreciate most about this paper is its brevity. In a space less than ten pages, the authors effectively summarized the achievements made by the literature on habit formation and the literature on an overlapping generations model with credit constraints. Based on the summary, they clearly pointed out their motivation of combining these two setups in order to explain so called Equity Premium Puzzle better.

However, it would be more desirable if the authors were more deliberate in addressing what benefits can be obtained from the combination of OLG and Habit formation. We already know habit formation and OLG with credit constraint help in solving or alleviating so called Equity Premium Puzzle separately. Accordingly, it is an easy guess that the inclusion of the two will explain the puzzle better. However, we don't know the combination of OLG and habit formation can bring about any chemical reactions. The authors did not come far to show that there exists an interaction term between habit formation and OLG with credit constraint, which contributes to the alleviation of the Equity premium puzzle.

In regard to the details of the paper, there is a minor point to make regarding the process of obtaining a qualitative result in p.7. It seems that a closed form solution for \ast , the amount of saving of middle generation, is available and the partial derivative of \ast with respect to δ is directly derived from the solution. Thus, the implicit differentiation is not necessary.

I am afraid that it is too early to judge the value of the paper because I got the impression that the paper might be just a part of another paper. Unfortunately, I didn't have the luck to read the more self-containing version this time.

CHAPTER 1-2

The Impact of Aging Population in Korea on Household Saving Rate Behavior

by
*Sung Yeung Kwack**

Abstract

Korea is entering into the class of an aging population nation. The aging of a population raises some important issues. This paper investigates to what extent does the aging population affect the saving rate, using the life-cycle/permanent income hypothesis, and the tests are carried out with Korean household data from 1977 to 2002. The result of the investigation reveals that real saving rates increase when the duration of lifetime and per household real disposable income rise, and they decrease when the growth rate of income and net worth-to-GDP ratio rises. The growth rate of per household real disposable income has negative effects, suggesting that the households calculate their life cycle income in a forward looking manner. The elasticities with respect to a change in the lifetime horizon and the growth rate of per household income are 0.58 and -0.03, respectively. A one percent rise in the net worth to GDP ratio reduces the saving rate by 0.3 percent. A one percent rise in per household income increases the saving rate by 0.33. Hence, the saving rates are inelastic to a change in the determinants. The younger age and the elder age dependency ratios have insignificant effects on the household saving rate behavior. When the life expectancy rises, while all other things remaining unchanged, the private saving rate modestly decline and the government saving rate is expected to decline significantly. The economy's real net saving rate decline from 33 percent in 2002 to 30 percent by the year 2030.

JEL Classification: D1, E21, J1

Keywords: Korea, household, saving, population, aging

I. Introduction

As life expectancy increases, the old aged population has been growing rapidly in Korea. As a result, Korea is entering into the class of an "aging population nation". So far, it appears that the aging of the population has not affected the social, political, and economic conditions

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of Korea. However, as the aging population increases, it is expected to have an impact on the economy.

The aging of a population raises some important issues and challenges ahead that need to be addressed, i.e. health care, housing, and other related services for the purpose of improving the welfare of the elderly. Providing the above-mentioned services raises some macroeconomic issues for any nation, in particular, their implications on government budgets, productivity, economic growth, financial markets, and foreign exchange markets.¹

We are interested in investigating the macroeconomic implication of an aging population on economic growth in Korea. To what extent does the aging population affect the saving rate? How would the aging population affect economic growth of the nation? In light of the importance of the saving rate, which determines the growth per head in a growing economy, the primary focus of this paper is on the effect of an aging population on the household savings rate, using the life-cycle/permanent income hypothesis. We attempt to test the life cycle income hypothesis with the Korean household data from 1977 to 2002.

Following this introductory section, section II discusses the trend of the aging population and labor force in Korea. The old aged dependency ratio and the two aging population indices show an upward trend of aging population in Korea. Section III shows that the saving rate determines the output growth per head, using Solow neo-classical and AK growth models. The main channels through which aging population influences economic growth are its effects on the savings rate and productivity of labor. Section IV presents the saving rate choice of individual consumers under the intertemporal utility maximization rule. Section V sets up the econometric specification of the saving rate hypothesis and discusses the empirical results obtained with the annual data of household in Korea from 1977 to 2002. Section VI offers a summary and some concluding remarks.

II. Age Profile of Population and Labor Force

II-1. Population

The population of Korea was estimated to be 25 million in 1960 and the Male and female population were 12.5 and 12.4 million, respectively (see Table 1). The population growth rate declined from 2 percent per year in the 1960s to less than one percent per year in the 1990s. The growth rate of Korean population in the year 2002 was about 0.6 percent. The life expectancy in Korea increased greatly, from about 55 years in the 1960s to 75 years in the 1990s. In the recent years, the life expectancy of female population was 8 years longer than the life expectancy of male population. Currently the life expectancy is growing at 0.7 percent per year.²

The share of the population under the age 14 years steadily declined from 43 percent in the 1960s to 21 percent in 2002. The share of the population between the ages 15 and 64 years,

¹ For research on the implications, and other related issues, see the Cutler, Poterba, Sheiner and Summers (1990), De Serres and Pelgrin (2002), Kohl and O'Brien (1998), Turner, Giorno, De Serres, Vourh and Richardson (1998), Masson and Tryon (1990). For descriptive analysis of the possible effects in Korea, see Lee Bang (2003), Korea Development Bank (2003), Lee Hae Hoon (2002), and Lee Eun Mi (2002).

² For descriptions of aging population phenomenon in Korea, see Lee, Eun Mi (2002) and Bang (2003).

which is the economically active population, rose from 54 percent in the 1960s to 71 percent in the year 2002 (see Table 2).

The share of the elderly or aged population, i.e., those age 65 years old and older, rapidly increased from 3.4 percent in the 1960s to 8 percent in the year 2002.³ As a result of longer life expectancy and lower total fertility rate, the share of the elderly population above the age 80 years increased from 0.3 percent in the 1960s to 1.2 percent in 2002.

The elderly dependency ratio is defined as the ratio of the elderly population to the economically active population. The Korean elderly dependency ratio increased from 6.3 percent in the 1960s to 11.1 percent in the year 2002 and has been rising at an increasing rate (see Table 3). In the recent years, the elderly dependency ratio grew at a higher than 4 percent rate per year. Korea has experienced a rise in the elderly dependency ratio almost equal to that of OECD countries.

In Korea, the elderly population has been rising while the younger population has been decreasing since 1960. The ratio of the elderly population to the population under the age 14 years increased from about 7.9 percent in the 1960s to 38.5 percent in 2002. The ratio has grown at an increasing rate from a negative 0.6 percent rate in 1960 to 5.9 percent rate in 2002. Although the ratio is called in the literature an index of aging population, it could also be called a burden index of aging population. This non-traditional term reflects more appropriately how many elderly persons would be cared by one young person.

We introduce an aging index of the population, defined as an average of each age group's rank weighted by its share in the total population. We assigned the numbers 1, 2, and 3 to the ranks for the younger, active, and elderly population, respectively. This index shows a trend of the mixture in the population i.e. in the 1960s the index was 1.6 and rose to 1.9 in the year 2002, indicating that the population is moving toward a more aged population.

People in more recent years expect to live longer than in earlier years. This is clearly confirmed by the figures given in Table 4. In 1981, the people 1-4 year old are expected to live 67.1 more years, and there are no age groups higher than 80~84 age group. In 1999, the 1-4 old age group is expected to live 75.6 years more. The age group of 85~89 is expected to live 5 more years. Table 5 contains the population projection. While the rate of increase in Korean population is estimated to fall in immediate future, it will become negative in the remote future. But, the population aging is projected to grow further. It seems clear that Korea is entering into the class of an aging country.

While the aged population is growing, the education of the working population has been greatly enhanced in recent years. As shown in Table 6, about 28 percent and 9 percent of the population in 1970 completed the primary and middle school education, respectively. About 2 percent of the population completed the university and higher education. In 1995, about 17 percent and 16 percent of the population achieved the primary and middle school education, respectively. The population educated in university and graduate schools is 16 percent of the total population. In 2000, the table shows that the education level of the population is higher. The population who completed the university and graduate schools is about 1.2 percent of the population.

³ The share of the elderly population is lower than the average share of OECD countries of about 13 percent.

II-2. Labor Force

As the age composition of the population varies, the age composition of Korean labor forces changes in a similar manner. As revealed in Table 7, the shares of younger age groups tend to decline, while the shares of older age groups tend to rise. Hence, the Korean labor force in recent years has more elderly people.

The rate at which people participate in economic activity is calculated in two different methods. The first method is the traditional measure used in the literature dealing with the issues of aging population and is defined as the ratio of those actively working to the population 15 years old and more. The second method we suggest here is the ratio of the active working labor force to the total population and this measure incorporates the population under the age of 14 years. The rate of population participation by the first method, as indicated in the table, is 54 percent in 1960 and 60 percent in the year 2002, increasing at a very low rate. The participation rate measured by the second method is 30 percent in 1960 and 48 percent in the year 2002, and it increased at a higher rate than the first measure. This is due to a decreasing trend of the population under the age of 14 years.

In 1981, 56 percent of labor employed in Korea were graduates of primary school and under, while only 10 percent of them were the graduates of university and higher education. (see Table 8). In 2001, the graduates of primary school and under decreased to 13 percent of the labor employed, while graduates of university and higher institutions increased to 25 percent of those employed. If we take into account the numbers of the students currently enrolled at university and higher institutions, the employed who were educated at university and higher will be substantially higher. In addition, the workers in the ages of 25~39, the younger groups of the laborers, educated at higher education institutions, are more than the elderly group of the workers in the age of 40 years and over.

III. Growth Framework.

In order to show the mechanism through which aging population affects economic growth, we will use the well-known neoclassical growth model and the AK model.⁴ In these models, we assume that the saving rate is constant and predetermined for expository purposes.

III-1. Models

First, we consider the Solow growth model.⁵ It assumes there is a diminishing return to rising capital to labor ratio. The production function takes the form

$$y = f(k) = Bk^{\alpha} \quad (1)$$

⁴ For extensive discussions and references, see Aghion and Howitt (1998, chapter 1), Barro and Sala-i-Martin (1995), Obstfeld and Rogoff (1997, chapter 7), and Stiglitz and Uzawa (1969)

⁵ Solow (1956), and see Barro and Sala-i-Martin (1995), pp. 14-37.

where y is output per unit of labor, Y/L , and k is capital per unit of labor; $k = K/L$. Y and K are output and capital.

Labor input in the production function is man-hours worked adjusted for quality, including aging. When n , ϕ , and λ are the growth rates of population, age-augmented labor productivity, and labor participation, respectively, labor grows at the rate $n + \phi + \lambda$. It is written as:

$$\dot{L} = (n + \phi + \lambda)L \quad (2)$$

where a dot over a variable denotes a derivative with respect to time (that is, \dot{X} is shorthand for $dX/dt = dX(t)/dt$).

Output is divided between consumption and investment. Total output saved is the sum of private saving, government saving, and foreign borrowing. Note that foreign borrowing equals the negative international balance on goods and services. Defining the sum of government saving and foreign borrowing as a proportion of private saving, σ , the proportion of the amount saved to output is private saving rate times $(1 + \sigma)$. The private saving rate, s , is assumed to be exogenous.

Output devoted to gross investment yields new capital and covers depreciation of the existing capital. The existing capital depreciates at rate δ . In equilibrium, the fraction of output devoted to saving equals the fraction of output to gross investment. This is written

$$\dot{k} = (1 + \sigma)sBk^\alpha - (n + \phi + \lambda + \delta)k \quad (3)$$

where $1/(1 + n + \phi + \lambda) \approx 1$ is assumed.

In the long run equilibrium, output, capital, and the rate of return on capital are described by

$$\bar{y} = \left[\frac{(1 + \sigma)sB}{n + \phi + \lambda + \delta} \right]^{\frac{\alpha}{1-\alpha}} \quad (4)$$

$$\bar{k} = (y/B)^{\frac{1}{\alpha}} = \left[\frac{(1 + \sigma)sB}{n + \phi + \lambda + \delta} \right]^{\frac{1}{1-\alpha}} B^{\frac{-1}{\alpha}} \quad (5)$$

$$f'(\bar{k}) = B\alpha\bar{k}^{\alpha-1} \quad (6)$$

where \bar{y} and \bar{k} are the long run equilibrium values of y and k .

From (4) to (6), it is clear that $\frac{\partial y}{\partial s} > 0$, $\frac{\partial k}{\partial s} > 0$, and $\frac{\partial f'(k)}{\partial s} < 0$.

The output level depends on the saving rate. A rise in the saving rate temporarily raises the rate of capital accumulation. It will have no long-run effect on the growth rate, but it will have the long-run effect on the level of output and capital per labor. This level effect differs from the growth rate effects to be obtained from the AK model, as we will discuss later. A rise in the saving increases output, capital, and decreases the return on capital.

Now, we consider the AK model.⁶ The AK model provides the essential macro mechanics of endogenous growth model. The production function assumes that output is linear to capital, so that there is constant return to raising the capital-to-labor ratio. The production function takes the following form:

$$y = Ak \quad (7)$$

The path of capital accumulation follows

$$\dot{k} = (1 + \sigma) s A k - (n + \phi + \lambda + \delta) k \quad (8)$$

The growth rate of k is denoted by h :

$$\dot{k} = h k \quad (9)$$

We know that the rate of growth in output equals h ; hence, the rate of output growth is described by

$$h = (1 + \sigma) s A - (n + \phi + \lambda + \delta) \quad (10)$$

Figure 1 shows the working mechanism of the AK model. Let us assume that A is given by A_0 . Line A is horizontal at A_0 . Line h is positively sloping. The equilibrium is attained at h_0 where line A intersects line h . When the saving rate and capital productivity rise, line h shifts to right, resulting in a higher h . Comparing equations (4) and (10), we find that the direction of a change in an exogenously given parameter is the same in the two models. Thus, our discussions below are based on the results of the AK model.

III-2. The implications of an aging population

We examine the effects of an aging population on growth from the above AK model. We consider here two cases where the aging population leads to a fall in the saving rate and a decrease in the age-augmented labor productivity. If the aggregate saving ratio decreases, it will lower growth in output per worker. Lowering growth in the labor force resulting from a general decline in the productivity of labor is reflected in a slowdown in the growth in output per worker. While the life expectancy rises, if the elder workers are encouraged to stay in the labor force, while the lifetime expectancy rises, i.e., a rise in λ , it would prevent the decrease in the growth of the working age population and economic growth.

One can extend the framework to an open-macroeconomic prospective. A rise in capital productivity causes capital inflows and an appreciation of home currency. Consequently the current account will be in a deficit. Hence, σ rises, resulting in a rise in output growth. A decrease in the government saving induced by a rise in the health costs and pension

⁶ For detailed discussions, see Aghion and Howitt (1998, pp.24-30), Barro and Sala-i-Martin (1995, pp.39-42), and Pagano (1993).

commitment for the elder persons reduces σ and thus national saving. This would lower the capital stock or crowd out net exports.

The above theoretical growth models provide the basis of a general structured simulation model for analyzing macro economic issues of an aging population. A simulation model needs to incorporate the saving rate and the growth rates of population, labor efficiency, and participation rate in different age groups.⁷ To make it richer, it would extend to link the sector of the government saving, foreign saving, capital inflows, exchange rate, interest rates, and monetary policy feedback rules in an open economy.

III-3. Aggregation over ages

The aggregate saving rate and labor productivity are related to the structure of aging. They are written implicitly as $s = (s_1, s_2, \dots, s_j)$, and $\phi = (\phi_1, \phi_2, \dots, \phi_j)$, where s_j and ϕ_j are the saving rate and labor productivity of age group j . A plausible weight would be based on the income shares.

Aggregate income and saving are the sum of income and saving of individual aging groups. Let N_j , Y_j , and S_j be the number of persons, output, and saving in j th age group. Aggregate saving and output are

$$S = N_1 S_1 Y_1 + N_2 S_2 Y_2 + \dots = \sum_{i=1} N_i S_i Y_i \quad (11)$$

$$Y = N_1 Y_1 + N_2 Y_2 + \dots = \sum_{i=1} N_i Y_i \quad (12)$$

The aggregate saving rate may be expressed as,

$$s = \frac{S}{Y} = \frac{N_1 Y_1}{Y} s_1 + \frac{N_2 Y_2}{Y} s_2 + \dots = \sum_{i=1} \frac{N_i Y_i}{Y} s_i = \sum_{i=1} \mu_i s_i \quad (13)$$

$$\text{where } \mu_i = \left(\frac{N_i}{N} \right) \left(\frac{Y_i}{Y} \right), \quad \bar{Y} = \left(\sum_i N_i Y_i \right) / N, \quad N = \sum_i N_i.$$

Equation (13) shows that the aggregate saving rate is the weighted average of each age group's saving rate and the weights are each individual age group's share in total population times the shares in aggregate income. Equation (13) indicates that to investigate the impact on the aggregate saving rate of a change in the age structure, the age profile of income information is necessary. The growth rate of aggregate labor efficiency or productivity can be generated in similar schemes.

⁷ Kwack and Lee (2003) covers the cost and production structure of the Korean economy in details.

IV. Saving Rate under the Life-Cycle/Permanent-Income Hypothesis

The saving rate plays an important role in determining the macroeconomic effects of population aging.⁸ Instead of the saving rate assumed earlier, this section discusses the behavior of the saving rate under the life-cycle/permanent income theory (Friedman (1957) and Modigliani and Brumberg (1954)).⁹

Consider an individual who lives for T periods where there are perfect capital markets. His /her utility is

$$U = u(C_t) \quad u'(\cdot) > 0, \quad u''(\cdot) < 0, \quad (14)$$

where $u(\cdot)$ is the instantaneous utility function and C_t is consumption in period t. The individual has net wealth of W_{t-1} and labor income of Y_t . The individual's budget constraint is

$$\dot{W}_t = r_t W_{t-1} + Y_t - C_t \quad (15)$$

We assume that he determines his consumption over his lifetime. We set the lagrangian

for his utility maximization problem subject to the budget constrain as

$$L = \int_0^{\infty} [U(C_t) + \lambda_t (\dot{W}_t - r_t W_{t-1} - Y_t + C_t)] e^{-\rho t} dt \quad (16)$$

The first-order conditions are

$$u'(C_t) = \lambda_t \quad \frac{\dot{\lambda}_t}{\lambda_t} = (\rho - r_t) \quad (17)$$

From (17), the time path of consumption is described by

$$\frac{\dot{C}_t}{C_t} = \frac{1}{\theta} (r_t - \rho), \quad \theta = -\frac{u''(c)C_t}{u'(c)} \quad (18)$$

Let us assume that the consumer has time-additive isoelastic preferences given by

$$U_t = \frac{C_t^{1-\theta}}{1-\theta}, \quad \theta > 0 \quad (19)$$

Equilibrium per capita consumption from (18) obeys the familiar first-order Euler condition

⁸ The life cycle income hypothesis together with the neo-classical growth theory is close to the growth model of Ramsey (1928).

⁹ I follow, more or less, the descriptions of Romer (1996, chapter 7). For further details, see Barro and Sala-i-Martin (1995, pp.60-66), and Weil (1989).

$$\frac{\dot{C}_t}{C_t} = \frac{1}{\theta}(r_t - \rho) \quad (20)$$

In the long-run equilibrium, consumption is constant. This case arises when the time rate of discount equals interest rate. For simplicity without loss of generality, we assume that the individual's time rate of discount and interest rate are equal and are zero, as done by Romer (1996, p310).¹⁰ When the interest rate and the discount rate are not equal, the assumption would have only modest effects on the analysis in this section.

Under the assumption of zero interest rates, the budget condition over his lifetime is written in a discrete form:

$$C_t = \frac{1}{T} \left(W_0 + \sum_{\tau=1}^T Y_{t+\tau} \right) \quad (21)$$

W_0 is his initial net worth and labor incomes of $Y_t, Y_{t+1}, Y_{t+2}, \dots, Y_{t+T}$ in the T periods of his life.

The individual's saving in period t is the difference between income and consumption. Saving is high and low when income is high and low relative to its permanent-income or life-cycle income. Thus, saving is utilized to smooth the path of consumption over the consumer's lifetime. Saving is described by

$$S_t = \left(Y_t - \frac{1}{T} \sum_{\tau=1}^T Y_{t+\tau} \right) - \frac{1}{T} W_0 \quad (22)$$

The saving rate, s_t , is S_t/Y_t , that is,

$$s_t = \left(1 - \frac{1}{TY_t} \left(\sum_{\tau=0}^T Y_{t+\tau} \right) \right) - \frac{W_0}{TY_t} \quad (23)$$

Let us assume that the individual expects his future income to grow at the current rate of growth, g , until he retires at $t + \omega$:

$$\sum_{\tau=0}^T Y_{t+\tau} = Y_t \sum_{\tau=0}^{\omega} (1+g)^{\tau} = Y_t \left(\frac{1-(1+g)^{\omega+1}}{-g} \right) \quad (24)$$

According to the binomial theorem,

$$(1+g)^{\omega} = 1 + \omega g + \frac{\omega(\omega-1)}{2!} g^2 + \frac{\omega(\omega-1)(\omega-2)}{3!} g^3 + \dots \quad (25)$$

Substitution of $(1+g)^{\omega}$ in (24) by the second order approximation of equation (25) yields:

$$\sum_{\tau=1}^T Y_{t+\tau} = Y_t \frac{\omega}{2} g \quad (26)$$

Combining of (23) and (26) leads to

¹⁰ Our presentation below follows the description of Romer (1996) on life cycle hypothesis, until the specification of life cycle/permanent income..

$$s_t = \left(1 - \frac{\nu g}{T}\right) - \frac{A_0}{TY_t}, \quad \nu = \omega / 2 \quad (27)$$

Equation (27) is our theoretical specification of life cycle income hypothesis on individual household saving rates.¹¹

The properties of the saving rate given in (27) are:

$$\frac{\partial s}{\partial T} = (\nu g + (A_0 / Y_t))T^{-2} > 0$$

$$\frac{\partial s}{\partial \nu} = -\frac{g}{T} < 0$$

$$\frac{\partial s}{\partial g} = -\frac{\nu}{T} < 0$$

$$\frac{\partial s}{\partial Y_t} = (A_0 / T)Y_t^{-2} > 0$$

$$\frac{\partial s}{\partial A_0} = -(TY_t)^{-1} < 0$$

A rise in the expected length of earning periods relative to the life expectancy, ν/T , decreases the saving rate, as shown by Modiglian and Sterling (1983). It is worth pointing that the current rate of income growth represents the expected rate of future income growth. The effect of a rise in the growth rate of income on the saving rate is negative. A negative relationship between the growth rate of income and saving rate comes about as a result of a rise in the expected growth rate of future income leads to a rise in the life cycle or permanent income. Modiglian and Rhomberg (1954) presented a positive relationship. Farrell (1970) carefully analyzed the magnitude of growth rate effects on aggregate saving and concluded that the growth rate effects are not necessarily positive.¹² For growth rate of 4 percent, the saving to income ratio will be negative. Russell (1977) argued that Modiglian and Rhomberg (1954) did not assume perfect foresighted knowledge of future income. They assume that in each year, he extrapolates his current income over his future earning-span. Earlier Modigliani (1966) noted that even if he did correctly foresee his income stream, he used his current income, because of the difficulty to borrow due to capital market imperfection.¹³ If we assume that the income at the preceding period represents the life cycle / permanent income,

¹¹ Life cycle income hypothesis is better suitable in explaining individual household saving behaviors than national saving including government saving and foreign saving.

¹² Fry and Mason (1982) argue that the sign on the growth rate of effect on aggregate saving rate is either positive or negative. Were saving concentrated among younger (or older) households, the effect would be positive (or negative).

¹³ See Modiglian (1986) for summarized description of life-cycle hypothesis.

the transitory income equals a change in the income, and, thus, equation (23) yields a positive growth rate effect.¹⁴

V. Econometric Specification and Empirical Results

V-1. Equation Specification

In Section IV, we set up a life-cycle/permanent-income hypothesis on saving rates. We assume that the amount saved is the sum of α portion of the current income and $(1-\alpha)$ portion of the transitory income which is the current income minus life cycle income. The saving rate hypothesis can be written:

$$s_t = \alpha + (1-\alpha)\left(1 - \frac{vg}{T}\right) - (1-\alpha)\frac{W_0}{TY_t} \quad (28)$$

If the estimated α equals zero, (28) is the same as equation (27), a pure form of life cycle hypothesis of the saving rate.

Korean financial markets were not perfect and were extensively regulated by the government, even though the intervention of the government has been greatly restrained in recent years. Especially, loans by banks to individuals were very restrictive. Until recently, no significant credit and mortgage loans were available to consumers. Restrictions and imperfections in consumer loan markets are likely to raise household saving rates.¹⁵ In light of this expectation, let us introduce a measure of the restriction on loans by banks to households. It is very hard to find appropriate measures of the capital market imperfections, namely actual loans relative to the amount households are willing to borrow from banks. Outstanding commercial bank loan to the individual sector as the proportion of Korean GDP is considered here to be a proxy for such imperfections.¹⁶ As we will discuss later, the Korean household sector is divided into eight groups by age. The information on net worth of an individual age group is unavailable.¹⁷ Instead, the available net worth of the individual sector of the economy is utilized.

In addition, the saving rate of individuals at a higher per capita income level would be higher than at a lower per capita income level. Hence, we introduce per capita income. The age interval is a period of five years beginning from 25 years age up to 54 years old. However, there are two distinct groups; 24 years old and below, and 55 years old and above. These two groups differ from the other groups in terms of the age interval. To capture the possible

¹⁴ Bentzel and Berg (1983) assume that life cycle /Permanent income is a geometrically declining weighted average of past income. $Y_t^p = \sum_{i=0}^n \lambda^i Y_{t-1-i} = Y_{t-1} + \sum_{i=1}^n \lambda^i Y_{t-1-i}$. They assume that the value of weight parameter is small enough to ignore the second term.

¹⁵ See Deaton, Angus, (1991), Ando, A., L. Guiso, D. Terlizzes, and D. Dorsantivil, (1992), and Jappelli, and Pagano, (1989), and Zeldes (1989).

¹⁶ Bentzel and Berg (1983) uses a similar credit-to-GDP ratio in Sweden.

¹⁷ The National Statistical Office, *Annual Report on the Family Income and Expenditure Survey* does not contain net worth or asset holding information by ages. It seems no such data are available in Korea.

differential effects, let us introduce two dummy variables, i. e. D24, and D55 for the group of age 24 and below, and age 55 years and above, respectively..

The proposed econometric specification takes into account the life-cycle saving rate hypothesis and the other determinants we have introduced- the imperfections in consumer loan markets, per capita income level, and the two dummy variables. It is specified in a linear form:¹⁸

$$s_j = \beta_{1j} + \beta_{2j}T_j + \beta_{3j}g_j + \beta_{4j}\frac{W}{GDP} + \beta_{5j}\frac{LB}{GDP} + \beta_{6j}Y_j + \beta_{7j}D24 + \beta_{8j}D65 \quad (29)$$

In (29), for age group j , s_j is real saving per unit of the household real disposable income, T_j is the years of lifetime horizon of the household, which is the nationwide average life expectancy minus the mean ages of age group j , g_j is the growth rate of the household real disposable income, and Y_j is the household real disposable labor income. W is real net worth of the individual sector of the economy at the beginning of period; LB is real loans outstanding of commercial banks to the individual sector of the economy; $D24$ is the dummy variable for 24 and under age group; $D65$ is the dummy variable for 55 and older age group.

V-2. Empirical Results

Since our interest is the saving rate behavior of households in different ages, let us consider eight different age groups, i.e, the ages of, 24 years & below, 25~29 years, 30~34 years, 35~39 years, 40~44 years, 45~49 years, 50~54 years, and 55 years & above, based on the breakdown in the National Statistical Office, *Annual Report on the Family Income and Expenditure Survey*, and *Report on Population and the Housing Survey*. It would have been more informative if it were possible to break down further the age group of 55 years and older into several different age groups, for example, the ages of 55~59 years, 60~64 years, 65~69 years, and 70 years and older. Since the mean ages of the group of 55 years and older are in the range of 58 to 60 years old, we regard this group as the age group of 55~64 years.

Equation (29) was estimated with the pooled cross-age session time series annual data of the Korean household sector between 1977 and 2002. The primary sources of the data are *Annual Report on the Economically Active Population Survey*, *Annual Report on the Family Income and Expenditure Survey*, *Report on Population and Housing Census in Korea*, *Major Statistics of the Korean Economy*, *Korea Statistical Yearbook* and www.nso.go.kr by the National Statistical Office (NSO); *National Account*, and *Flow of Fund Accounts in Korea* published by the Bank of Korea; and *Report on Wage Survey by Occupational Category* published by the Ministry of Labor.

Computation of household nominal income, disposable income, consumption, and saving for different age groups was done using data from the National Statistical Office, *Annual Report on the Family Income and Expenditure Survey* and *Report on Population and Housing Survey*. The real disposable income and consumption are obtained by dividing the nominal disposable income and consumption by the implicit GDP deflator and consumption deflator, respectively.¹⁹ The real saving is the difference between the real disposable income and the

¹⁸ Time subscript is dropped in the text, unless it is necessary to avoid ambiguities.

¹⁹ Theoretically, it is real labor income. Household income data contains regular income – labor income,

real consumption, and the savings rate is the ratio of the real saving to the real disposable income.

To compute the expected lifetime horizons of each individual age group, the data used are the Korean average life expectancy data from the NSO's *Major Statistics of the Korean Economy*, *Korea Statistical Yearbook* and www.nso.go.kr, while the mean ages of each individual age group are from the NSO's *Annual Report on the Family Income and Expenditure Survey*. The lifetime horizon of an age group is the difference between the Korean average life expectancy and the mean age of each individual age group.

The household real net worth is the net worth of the individual sector divided by the implicit GDP price deflator. The net worth of the individual sector is from the Bank of Korea's *Flow of Fund Accounts in Korea*. The loans of commercial banks to the individual sector are also from the Bank of Korea's *Flow of Fund Accounts in Korea*. The real bank loans are the bank loan outstanding divided by the implicit GDP deflator.

Before presenting the regression results, let us observe the real saving rates by the age groups in Table 9. The Korean household saving rates appear to be humped shapes.²⁰ The saving rates in the four age groups covering the ages from 30 to 49 years are higher, around 28 percent, while the saving rates for the younger and elderly groups, are lower, about 24 and 25 percent, respectively. The saving rate of the age group of 55 years & above is slightly higher than the saving rate of the age group of 50~54 years, particularly in the recent years. The higher saving rate instead of more dissaving according to the life-cycle hypothesis would be a reflection of Korean retirement plans to let retirees receive lump sum payment at the time of their retirement.²¹ In addition, the persons in the ages of 55 years and older realize the need for more saving for the future, as they believe that their life expectancy is longer.²² Chart 1 shows the trend of saving rates by ages over time. The trend follows, more or less, the prediction of the life cycle hypothesis, although it does not follow by a 100 percent

The preliminary regression finding is that the bank loans to the GDP ratio, LB/GDP, were found to be marginally significant.²³ Regressions were run with and without this variable. We found that the estimated equations had low Durbin-Watson statistics. This is not surprising, as our equations are likely to miss many factors affecting the behavior of household saving rates. However, the overall results are very satisfactory.

Table 10 presents four regressions. The saving rate of a one year time lag was tried to estimate a rate of adjustment of the saving rate. The coefficient estimates of the one year

business income, asset income and transfers—and non-regular income—retirement allowance and gifts. But, the household's non-labor income is very small, and thus the household's disposable income is used.

²⁰ Hump phenomenon also is reported to have happened in Japan. See Horio (1990), and Takayama and Kitamura (1994).

²¹ The lump payment is a legal option, see Hyun and Cho (2000). For a discussion on Korean corporate retirement system, see Bang (1998)

²² In the presence of lifetime uncertainty, individuals want to undertake precautionary wealth accumulation. In this case, the saving rate will not be negative among retirees. See Abel (1985), Hayashi and Ando (1988) and Yaari (1965).

²³ The variable with a lag of one year was tried, but did not yield significant coefficient estimates. Also, the consumer loans by financial institutions yielded very insignificant coefficient estimates. Collins (1994, p.249) used the growth in domestic credit to GDP as an indicator of consumer credit constraints. She reported no significant relationship between the national saving rate and this variable.

lagged saving rate variable are about 0.45 in equations (10.3), indicating that the adjustment of the saving rate is slow.

As it can be observed from the estimated equations, all the variables have expected signs of their coefficient estimates. The coefficient estimates of the variables excluding the ratio of the bank loan to GDP are highly significant. Other things being equal, the coefficient estimates for the lifetime horizon, T , indicate that as a longer lifetime horizon is expected, the saving rate of the household rises. The sign on the growth rate of per household real disposable income is consistently negative. This suggests that the households calculate their life cycle income in a forward-looking manner. The result of a negative growth rate effect differs from the finding of a significant positive relationship between the national and private saving to GDP ratios and unanticipated real GDP growth by Collins (1994) in the household sample period of 1971-1988. Collins (1994) inferred that Koreans regarded current income growth as transitory income.²⁴ In the period from 1989 to 2002 that is included in our sample, but not included in the sample period of Collins, the Korean economy has continued to maintain high growth rates and has become highly open and more liberalized. In this period, we expect that Koreans would have expected their income to grow at higher rate and hence regarded their income changes as permanent income change.²⁵ A closer look at our result and Collins's finding suggest that our result does not contradict to the Collins's finding and the difference is due to the difference in the sample periods under investigation. A rise in the ratio of the real net worth per GDP is found to reduce the saving rate, as expected. The household real disposable income has a positive effect on the saving rate, namely, as real income per household is higher, households save more than what would be when their income were low.

The coefficients of two dummy variables are statistically significant. D_{24} has a negative coefficient, and D_{65} has a positive coefficient. The saving rate of the age group of 24 years and lower is lower than the average ratio of the saving to the current income. The saving rate of the age group of 55 years and older is higher than the average ratio. This might be a reflection of the individual decision to save more for precautionary purpose as they get closer to their retirement.

The duration of lifetime expectancy, T , is a demographic factor in the specification. We have not seen empirical studies on saving rates that used the lifetime horizon. Hence, we are interested in testing whether the results obtained with and without the variable differ statistically. We computed the F statistics, 162 from equations (10.3) and (10.4). These statistics exceed the critical value of $F_{(1,201)}$ ratio at one percent level of significance, 6.85. Hence, we reject the null hypothesis that the coefficient of T variable is zero. Hence, the lifetime horizon variable is one of the most statistically significant determinants and greatly contributes to the explanation of saving rate variations.

²⁴ In Collins (1988, p.344), she stated that "current income is negatively related to income in the previous 2 years" Her interpretation of this result is that high current income is viewed as transitory.

²⁵ Fry and Mason (1982) found a positive effect on the national saving rates, using the pooled cross country time series data of seven Asian developing countries, Burma, India, Korea, Malaysia, Philippines, Singapore and Taiwan in the sample period of 1962-1972. Most studies for OECD countries appear to suggest that the coefficient estimates on growth rate variables are unstable, and the signs on them also vary. See Graham (1987, 1989) and Koskela and Viren (1989).

Table 11 summarizes the computed elasticities of saving rates with respect to a change in the determinants at their sample mean values. The elasticities computed from equations (10.1)-(10.3). Our discussions are made on the elasticities computed with equation (10.2). The elasticities with respect to a change in the lifetime horizon and the growth rate of real disposable income are 0.58 and -0.03, respectively. A one percent rise in the net worth to GDP ratio reduces the saving rate by 0.3 percent. On the other hand, a one percent rise in per household real disposable income increases the saving rate by 0.33. Hence, the saving rates are inelastic to a change in the determinants.

Large numbers of past empirical studies on economy-wide national saving rates found the importance of younger age dependency ratio and older age dependency ratio.²⁶ On testing (not reported here) whether the two dependency ratios serve as additional determinants of the household saving rates, the test results were not affirmative. In light of negative outcomes, we decided to run regressions of a variant of the specification commonly used.²⁷ The specification is follows:

$$s = \beta_1 + \beta_2 g + \beta_3 D24 + \beta_4 55 + \beta_5 YDEP + \beta_6 ODEP \quad (30)$$

where YDEP is younger age dependency ratio defined as the ratio of the population of 14 years old and under to total population, and ODEP is older age dependency ratio as the ratio of the population of 65 years old and above. The two dependency ratios are constructed using the data from the *Annual Report on the Economically Active Population Survey*, and *Major Statistics of the Korean Economy*, and www.nso.go.kr. The regression results are given in Table 12. The coefficient estimates of the growth rate in income variables are close to those given in Table 10 and are negative. The coefficient estimates of D24 are significantly negative, as the same as in Table 10. The sign of the coefficient estimates of D65 differs from a positive sign reported in Table 10. The estimates are insignificant at a 5 percent level of significance. The younger age dependency ratio has a negative coefficient. The estimates are insignificant. The elder age dependency ratio has insignificant coefficient estimates. In the light of this evidence, the two dependency ratio variables do not seem to be of importance in explaining the household saving rate behavior in Korea during our sample period.²⁸

Heller and Symansky (1997, p. 35) reported their regression results which indicated that for the Asia "Tigers", the national saving rates were positively related to the growth rate and negatively to the dependency ratios. They also maintained that the private saving rates were not statistically related to the economic growth and the dependency ratios. This would raise an interesting issue: why would the national and private saving rates behave differently? Statistically, the younger age and older age dependency ratio variables are downward and

²⁶ Leff (1969) introduced a relationship between aggregate saving ratios and dependency ratios. Since then, many empirical studies reported statistically significant negative relationship and also insignificant relationship. It seems that the empirical results are inconclusive. For a summary of the empirical studies that obtained a negative reshaping, see De Serres and Pelgrim (2002), Heller and Symansky (1997, p.11), Meredith (1995, p.37), Ram (1982), Turner, Giorno, De Seees, Vourch, and Richardosn (1998, p. 46).

²⁷ The specification without D24 and D55 is the one used by Heller and Symansky (1997).

²⁸ Collins (1994) reported no statistically significant relationship between the national saving and the economy's dependency ratios (shares of the population under age 15 or over 65) in the Korean case.

upward time trend variables, respectively. When the dependency ratio variables enter into the time series regression equations, a careful interpretation of the coefficients of dependency ratio variables is needed.

Finally, we want to estimate the movements of saving rates resulting from future aging population in Korea. Let us assume that all other variables except the duration of lifetime horizon remain unchanged. The National Statistical Office has published population projection by age and average life expectancy in Korea. Using the data, the age profile of the population projection was constructed in accordance with the age groups we used. For the years 2010, 2020, and 2030, we choose two benchmarks for the age groups. The first benchmark, called survey mark, is the number of households in individual age groups, as included in the NSO's *Annual Report on the Family Income and Expenditure Survey* for the year 2002. The second benchmark, called population projection, is the numbers of people in individual age groups, as included in the NSO's *Population Projections* for 2002. The growth rates of the numbers of households for individual age groups from the year 2002 are assumed to be equal to the growth rates of projected populations for individual age groups. We computed the lifetime duration, T_j , that is the average life expectancy of Korea minus the mean years of individual j th age group in the year 2002. We generated s_j using the elasticity of the saving rate with respect to a change in T_j , namely,

$$s_{j,t} = s_{j,t-1}(1 + E_{j,t}), \quad E_{j,t} = (0.45 \times T_{j,t-1} / s_{j,t-1}) \times \Delta T_{j,t} / T_{j,t-1}.$$

Further, we assumed that the income share of j th age group remains at the level of the income share that existed in the year 2002. With this assumption, we generated the mean saving rates of household sector, which are the income share weighted averages of individual age group's saving rates.

The results are provided in Table 13. Whether we use the survey mark distribution of population or the population projection distribution, saving rates of individual age groups are identical. This is due to our use of the growth rates of projected populations in both cases. However, the two different benchmark figures bring out different mean household saving rates because the levels of relative household shares affect the weights. All other things remaining unchanged, the projected rise in the Korean life expectancy and the resulting rise in the duration of lifetime lead to higher saving rates for all age groups in the household. The mean saving rate aggregated on the basis of survey distribution changes from 27.7 percent in the year 2002 to 29.5 percent in the year 2030, about 6.5 percent increase. On the other hand, the mean saving rate aggregated on the basis of population projections changes to 29.7 percent in the year 2030, about 7.2 percent increase. The rise in the saving rates enables households to save more during the period of income earning working ages, to smoothen consumption over longer life span.

Would the aggregate economy wide aggregate domestic saving rate rise or fall, when the life expectancy rises? Before providing an answer to this question, we pay attention to two measures of domestic saving rates. They are given in Table 14. The domestic saving rate measured in real term is higher than the saving rate measured in nominal term. The reason for the difference is owing to the differential movements in the price levels. The rates of change in the levels of the implicit price deflators for consumption expenditures are higher than the rate of change in the levels of the GDP deflators.

As shown in the table, the real net domestic saving rate depends on the private and government real net saving rates.²⁹ We consider first the private saving rate. It requires statistics on the saving rates of age groups and the distribution of both population and income by different age groups. For simplicity, we consider three broad age groups: (a) 14 years old and less, (b) between 15 years old and 64 years old, and (c) 65 years and above. We have the data on the age group distributions of population. It needs to be recalled that the mean saving rates of households in Table 13 are regarded as the saving rates of the group of ages 15 years and 64 years. It is difficult, or impossible, to obtain statistics on saving rates of (a) 14 years old and less and (c) 65 years and above, and to obtain the income profile of three age groups. Considering this difficulty, we need to make some heroic assumptions. First, the per capita income shares of the group of 14 years and less, the group of between 15 years old and 64 years and the group of 65 years old and above are 0, 0.77 and 0.23, respectively.³⁰ The assumption of zero income shares to the group of 14 years old and below is reasonable given the child labor regulations and leads to no need for its saving rate information. The assumption to the two other groups is made without reliable statistical basis from Korea and on the basis of U.S. experience. According to Faruquee and Laxton (2000) that contain the age profile of earnings in the United States, available from the Bureau of Census, U.S. Department of Labor, the earning of the age group of 65 years old and older seems be approximately 70 percent of the earning of the age group of between 25 years and 64 years old. Since the earning of the age group of 65 years old and older is likely to be lower in Korea, we assume that the earning of the age group of 65 years old and older is 30 percent of the earning of the age group of between 25 years and 64 years. This assumption leads the per capita income share of the age group of between 15 years old and 64 years to be 77 percent and the per capita income share of the age group of 65 years old and older to be 23 percent.³¹ Secondly, the saving rate of the group of 65 years old and above is assumed to be 50 percent of the saving rate of the group of between 15 years and 64 years old, using U.S. experience given by Atanasio (1994).

In addition to the above assumptions and the projected age population shares, we assumed that the labor participation rates of the age group of 65 years old and older are 0.2, 0.15, and 0.1 during 2002-2010, 2011-2020, and 2021-2030. We calculated the average household figures, and using the growth rate of the household figures and the actual private saving rate for the year 2002, 23.19, the private net domestic saving rates are computed and presented in Table 15. The private real net saving rate is predicted to rise to 24.31 percent by the year 2020 and decline to 22.45 percent in the year 2030. The fall in the year 2030 is due to the increase in the population share of the group of 65 years old and above and to the reduction of the population share of the group of between 15 years old and 64 years old. It appears that the decline in private saving rates is smaller.

Next, we consider the impact on the government saving rate of lifetime changes. We project the government revenues and expenditures on the basis of assumed growth rates of

²⁹ Professor Kiseok Hong suggested private and government saving rates to be considered separately. Accordingly, I revised my discussions. It makes the discussions clearer. I thank him.

³⁰ From a life-cycle prospective, the time profile of income rises with age when young, to reach the peak earning, and then, begins to decline with retirement, when old.

³¹ 0.77 income share comes from $1/(1+0.3)$, and $0.23=0.769 \times 0.3$.

8.5 percent and 8.4 percent.³² The control solution of the saving rates is 63.65 percent in 2010 and 64.32 percent in 2030. We expect that an extension of lifetime induces additional government expenditures to take care of elder population. We assume that additional government expenditures rise at a 0.5 percent per year in 2003-2010, a 1.0 percent in 2011-2020, and a 1.5 percent in 2021-2030. With these additional government spending rises, the government saving rate is lowered to 62.28 percent in 2010 and 53.44 percent in 2030.

We obtain the net domestic saving rate by making use of the projected private and government saving rates. As shown in Table 15, the net real saving rate of Korea decline from 33 percent in 2002 to 30.2 in 2030. Even though the estimate is subject to further detailed analysis, we conclude that the real net saving rate of Korea is expected to fall after some times in the future.

VI. Conclusion

Korea will face an increase in aging population in the next 20 years and beyond. The increasing population distribution towards the elderly age groups will have an influence on the economic growth and the social development in Korea. This paper deals with the effects of the aging population in Korea on saving rates.

Under the extended life cycle income hypothesis on saving rates, the real saving rate of household is affected by the duration of lifetime, growth rates of income, credit availability, and per household real disposable income. We have empirically tested the saving rate hypothesis with the Korean data of cross-age pooled time series data over the period of years, 1977-2002.

Recognizing the limitations of the data, our empirical results suggest that the patterns of the Korean household saving rates are consistent with the life-cycle income hypothesis. Real saving rates increase when the duration of lifetime and per household real income rise, and they decrease when the growth rate of real income and net worth-to-GDP ratio rise. Young age and old age dependency ratios are found to have played an insignificant role in determining the saving rates.

Other things being equal, a rise in the life expectancy and larger shares of elder population are expected to bring out a reduction in the private and government saving rates, resulting in a decline in the economy wide real net saving rate. This in turn is likely have an adverse effect on economic growth of Korea. This conclusion is based on the assumption of all other things being equal. Needless to mention, appropriate policy implementations will prevent a reduction in economic growth from occurring.

It is best to conclude with caveats. In order to gain more and obtain parameter estimates, further analysis is desirable, with different sets of data to include age distribution of assets holdings and the distribution of saving and income by more extended age groups of age 55 years old and older. Parameter estimates and their assumptions play the important role in the conduct of policy analysis.

³² The assumption is from Global Insight, *Quarterly Review and Outlook*, First Quarter 2003, pp. 97. Since we are interested in government saving rate, budget surplus divided by revenues, the nominal growth rates do not matter.

This paper is far from providing the required conclusive answers concerning to what extent and by how much would the aging population influence the economy in Korea. In the light of all the above discussions in this paper, it sheds some light on how useful it would be if issues related to economic growth could be analyzed with simulations of a well-structured framework of the Korean economy. It is important to note the urgency to design the policies to cope with the issues raised by the increasing aging of Korean population.

Figure 1. The AK model

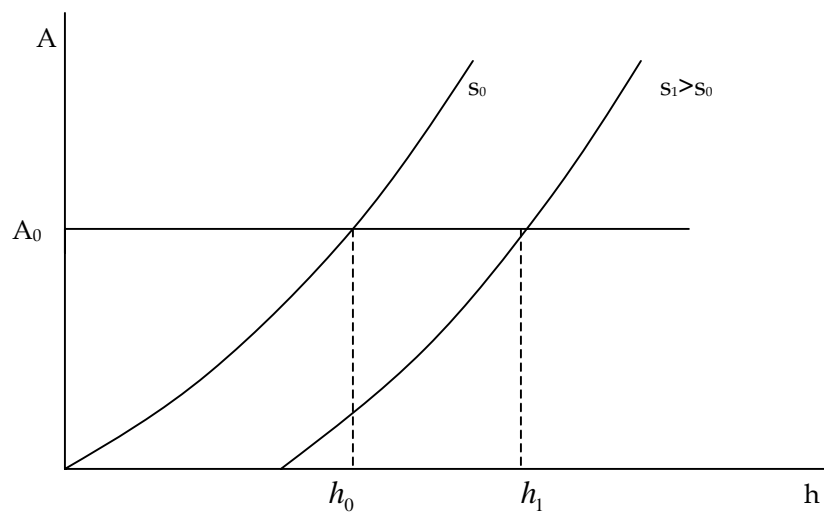


Table 1. Population and Life Expectancy by Sex

year	Population (1000persons)			Life Expectancy (years)			Growth Rate(%)					
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
1960	24989	12544	12445	52.4	51.1	53.7						
1961	25632	12873	12759	53.9	52.4	55.2	2.54	2.59	2.49	2.74	2.56	2.74
1962	26291	13211	13080	55.4	53.8	56.7	2.54	2.59	2.49	2.74	2.56	2.74
1963	26968	13558	13410	56.9	55.2	58.3	2.54	2.59	2.49	2.74	2.56	2.74
1964	27662	13914	13747	58.5	56.6	59.9	2.54	2.59	2.49	2.74	2.56	2.74
1965	28373	14279	14094	60.1	58.1	61.6	2.54	2.59	2.49	2.74	2.56	2.74
1966	29160	14684	14476	61.9	59.7	64.1	2.74	2.79	2.68	2.97	2.76	4.01
1967	29708	14948	14759	62.2	59.7	64.7	1.86	1.78	1.94	0.52	0.04	0.99
1968	30266	15217	15048	62.5	59.7	65.4	1.86	1.78	1.94	0.52	0.04	0.99
1969	30834	15491	15343	62.9	59.8	66.0	1.86	1.78	1.94	0.52	0.04	0.99
1970	31435	15780	15655	63.2	59.8	66.7	1.93	1.85	2.01	0.52	0.04	1.01
1971	32052	16097	15956	63.5	60.1	67.0	1.94	1.99	1.90	0.45	0.52	0.39
1972	32682	16420	16262	63.8	60.4	67.2	1.94	1.99	1.90	0.45	0.52	0.39
1973	33323	16749	16575	64.1	60.7	67.5	1.94	1.99	1.90	0.45	0.52	0.39
1974	33978	17085	16893	64.3	61.1	67.8	1.94	1.99	1.90	0.45	0.52	0.39
1975	34678	17445	17233	64.6	61.4	68.0	2.04	2.09	1.99	0.45	0.52	0.39
1976	35203	17659	17544	64.9	61.7	68.3	1.50	1.22	1.79	0.45	0.52	0.39
1977	35737	17876	17861	65.2	62.0	68.6	1.50	1.22	1.79	0.45	0.52	0.39
1978	36278	18095	18183	65.5	62.4	68.8	1.50	1.22	1.79	0.45	0.52	0.39
1979	36828	18317	18511	65.8	62.7	69.1	1.50	1.22	1.79	0.46	0.54	0.40
1980	37407	18549	18858	66.3	63.0	69.9	1.56	1.26	1.86	0.78	0.43	1.09
1981	38343	19172	19171	66.8	63.2	70.6	2.47	3.30	1.65	0.78	0.43	1.09
1982	39326	19837	19489	67.4	63.5	71.4	2.53	3.41	1.64	0.78	0.43	1.09
1983	39910	20129	19781	67.9	63.8	72.2	1.47	1.46	1.49	0.79	0.44	1.12
1984	40406	20375	20031	68.2	64.1	72.5	1.24	1.21	1.26	0.40	0.51	0.43
1985	40806	20576	20230	68.4	64.5	72.8	0.99	0.98	0.99	0.40	0.51	0.43
1986	41214	20772	20442	69.1	65.1	73.4	0.99	0.95	1.04	0.95	1.02	0.83
1987	41622	20960	20662	69.8	65.8	74.0	0.99	0.90	1.07	0.96	1.03	0.83
1988	42031	21155	20876	70.3	66.3	74.6	0.98	0.93	1.03	0.75	0.80	0.70
1989	42449	21357	21092	70.8	66.8	75.1	0.99	0.95	1.03	0.76	0.80	0.70
1990	42869	21568	21301	71.3	67.3	75.5	0.98	0.98	0.99	0.63	0.67	0.55
1991	43268	21775	21493	71.7	67.7	75.9	0.93	0.96	0.90	0.63	0.67	0.56
1992	43663	21979	21684	72.3	68.2	76.4	0.91	0.93	0.88	0.75	0.74	0.64
1993	44056	22177	21879	72.8	68.8	76.9	0.90	0.90	0.90	0.76	0.75	0.64
1994	44453	22376	22077	73.2	69.2	77.2	0.90	0.89	0.90	0.49	0.58	0.33
1995	45093	22705	22388	73.5	69.6	77.4	1.43	1.46	1.40	0.49	0.59	0.33
1996	45545	22939	22606	74.0	70.1	77.8	1.00	1.03	0.97	0.58	0.70	0.46
1997	45991	23170	22821	74.4	70.6	78.1	0.97	1.00	0.95	0.58	0.71	0.46
1998	46430	23396	23034	75.0	71.1	78.7	0.95	0.97	0.93	0.77	0.81	0.70
1999	46858	23617	23241	75.6	71.7	79.2	0.92	0.94	0.89	0.78	0.81	0.70

Table 1. Continued

year	Population (1000persons)			Life Expectancy (years)			Growth			Rate (%)		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
2000	47275	23831	23444	76.1	72.3	79.8	0.89	0.90	0.87	0.77	0.81	0.70
2001	47343	23835	23508	76.7	72.9	80.3	0.14	0.02	0.27	0.77	0.81	0.70
2002	47640	23984	23656	77.3	73.5	80.9	0.63	0.62	0.63	0.77	0.81	0.70

Korea Statistical Office, Major Statistics of Korean Economy; Economic Planning Board, Korean Economic Yearbook, 1984.

Some life expectancy figures are not available. The figures are made by a linear interpolation between two benchmark year figures. For life expectancy, www.nso.go.kr.

Table 2. Population by Age

year	Total	(in thousand)							Shares of Age Group(%)						
		0~14	15~64	65~80+	65~69	70~74	75~79	80+	0~14	15~64	65~80+	65~69	70~74	75~79	80+
1960	24989	10687	13458	844	379	255	126	84	42.8	53.9	3.4	1.5	1.0	0.5	0.3
1961	25632	10980	13772	861	388	257	133	84	42.8	53.7	3.4	1.5	1.0	0.5	0.3
1962	26291	11286	14094	880	397	259	139	84	42.9	53.6	3.3	1.5	1.0	0.5	0.3
1963	26968	11603	14427	898	407	261	147	84	43.0	53.5	3.3	1.5	1.0	0.5	0.3
1964	27662	11934	14769	917	416	263	154	84	43.1	53.4	3.3	1.5	1.0	0.6	0.3
1965	28373	12279	15121	937	426	265	162	84	43.3	53.3	3.3	1.5	0.9	0.6	0.3
1966	29160	12684	15516	960	437	267	172	84	43.5	53.2	3.3	1.5	0.9	0.6	0.3
1967	29708	12803	15899	978	436	278	173	90	43.1	53.5	3.3	1.5	0.9	0.6	0.3
1968	30266	12931	16294	997	436	290	173	97	42.7	53.8	3.3	1.4	1.0	0.6	0.3
1969	30834	13069	16703	1017	435	302	174	105	42.4	54.2	3.3	1.4	1.0	0.6	0.3
1970	31435	13241	17153	1040	435	316	175	114	42.1	54.6	3.3	1.4	1.0	0.6	0.4
1971	32052	13234	17712	1070	454	318	180	118	41.3	55.3	3.3	1.4	1.0	0.6	0.4
1972	32682	13227	18294	1101	474	320	186	121	40.5	56.0	3.4	1.5	1.0	0.6	0.4
1973	33323	13220	18900	1134	495	321	192	125	39.7	56.7	3.4	1.5	1.0	0.6	0.4
1974	33978	13213	19533	1168	517	323	197	129	38.9	57.5	3.4	1.5	1.0	0.6	0.4
1975	34678	13208	20263	1206	543	325	204	134	38.1	58.4	3.5	1.6	0.9	0.6	0.4
1976	35203	13093	20813	1249	557	342	209	141	37.2	59.1	3.5	1.6	1.0	0.6	0.4
1977	35737	12979	21385	1294	572	361	214	147	36.3	59.8	3.6	1.6	1.0	0.6	0.4
1978	36278	12868	21979	1341	587	380	218	155	35.5	60.6	3.7	1.6	1.0	0.6	0.4
1979	36828	12759	22597	1389	603	401	224	162	34.6	61.4	3.8	1.6	1.1	0.6	0.4
1980	37407	12656	23305	1445	620	425	229	171	33.8	62.3	3.9	1.7	1.1	0.6	0.5
1981	38343	12759	24060	1500	639	442	241	179	33.3	62.7	3.9	1.7	1.2	0.6	0.5
1982	39326	12886	24878	1560	659	460	254	187	32.8	63.3	4.0	1.7	1.2	0.6	0.5
1983	39910	12801	25496	1614	674	475	270	195	32.1	63.9	4.0	1.7	1.2	0.7	0.5
1984	40406	12592	26140	1673	691	489	288	205	31.2	64.7	4.1	1.7	1.2	0.7	0.5
1985	40806	12305	26759	1741	712	506	308	215	30.2	65.6	4.3	1.7	1.2	0.8	0.5
1986	41214	12030	27383	1800	739	518	317	226	29.2	66.4	4.4	1.8	1.3	0.8	0.5
1987	41622	11746	27998	1876	774	536	328	238	28.2	67.3	4.5	1.9	1.3	0.8	0.6
1988	42031	11487	28583	1962	817	554	341	250	27.3	68.0	4.7	1.9	1.3	0.8	0.6
1989	42449	11261	29135	2053	866	571	353	263	26.5	68.6	4.8	2.0	1.3	0.8	0.6
1990	42869	11078	29648	2144	904	596	368	276	25.8	69.2	5.0	2.1	1.4	0.9	0.6

Table 2. Continued

Table 2. Continued

year	Total	0~14	15~64	65~80+	(in thousand)				Shares of Age Group(%)				65~69	70~74	75~79	80+
					65~69	70~74	75~79	80+	0~14	15~64	65~80+					
1991	43268	10948	30108	2212	919	620	386	287	25.3	69.6	5.1	2.1	1.4	0.9	0.7	
1992	43663	10833	30547	2283	935	647	403	298	24.8	70.0	5.2	2.1	1.5	0.9	0.7	
1993	44056	10727	30968	2363	958	681	415	309	24.3	70.3	5.4	2.2	1.5	0.9	0.7	
1994	44453	10581	31421	2450	989	721	421	319	23.8	70.7	5.5	2.2	1.6	0.9	0.7	
1995	45093	10537	31901	2656	1048	767	459	382	23.4	70.7	5.9	2.3	1.7	1.0	0.8	
1996	45545	10411	32360	2775	1098	790	483	404	22.9	71.1	6.1	2.4	1.7	1.1	0.9	
1997	45991	10292	32792	2908	1158	812	514	424	22.4	71.3	6.3	2.5	1.8	1.1	0.9	
1998	46430	10217	33162	3051	1221	838	552	440	22.0	71.4	6.6	2.6	1.8	1.2	0.9	
1999	46858	10202	33452	3205	1288	872	588	457	21.8	71.4	6.8	2.7	1.9	1.3	1.0	
2000	47275	10233	33672	3371	1366	911	614	480	21.6	71.2	7.1	2.9	1.9	1.3	1.0	
2001	47343	9860	33903	3579	1465	967	632	515	20.8	71.6	7.6	3.1	2.0	1.3	1.1	
2002	47640	9792	34074	3773	1534	1029	657	553	20.6	71.5	7.9	3.2	2.2	1.4	1.2	

Sources: Korea Statistical Office, Major Statistics of Korean Economy. Economic Planning Board,
Korea Economic Yearbook, 1984, for 1860-80 figures.

The figures between the beginning and end periods are estimated by linear interpolations.

Population figures are in 1000 persons; Other figures are in percent.

Table 3. Dependency Ratios and Index of Aging

Year	Young Age		Elderly		Index of Aging		Age Index of Aging	
	Dependency Ratio		Dependency Ratio					
		%		%		%		%
1960	79.41		6.27		7.90		1.61	
1961	79.73	0.40	6.26	-0.25	7.85	-0.66	1.60	-0.14
1962	80.07	0.43	6.24	-0.24	7.79	-0.67	1.60	-0.12
1963	80.43	0.45	6.23	-0.23	7.74	-0.68	1.60	-0.10
1964	80.81	0.47	6.21	-0.22	7.69	-0.69	1.60	-0.08
1965	81.21	0.49	6.20	-0.21	7.63	-0.70	1.60	-0.06
1966	81.75	0.66	6.19	-0.19	7.57	-0.85	1.60	0.01
1967	80.53	-1.51	6.15	-0.59	7.64	0.92	1.60	0.13
1968	79.36	-1.46	6.12	-0.55	7.71	0.91	1.60	0.17
1969	78.25	-1.41	6.09	-0.50	7.78	0.91	1.61	0.21
1970	77.19	-1.36	6.06	-0.39	7.85	0.97	1.61	0.35
1971	74.72	-3.26	6.04	-0.35	8.09	2.91	1.62	0.40
1972	72.30	-3.29	6.02	-0.35	8.33	2.93	1.63	0.44
1973	69.94	-3.31	6.00	-0.36	8.58	2.96	1.63	0.48
1974	67.65	-3.34	5.98	-0.36	8.84	2.98	1.64	0.52
1975	65.18	-3.71	5.95	-0.43	9.13	3.28	1.65	0.74
1976	62.91	-3.56	6.00	0.83	9.54	4.39	1.66	0.42
1977	60.69	-3.58	6.05	0.82	9.97	4.40	1.67	0.47
1978	58.55	-3.60	6.10	0.80	10.42	4.40	1.68	0.52
1979	56.46	-3.63	6.15	0.79	10.89	4.41	1.69	0.57
1980	54.31	-3.89	6.20	0.86	11.42	4.75	1.70	0.80
1981	53.03	-2.37	6.24	0.56	11.76	2.94	1.71	0.29
1982	51.80	-2.36	6.27	0.56	12.11	2.92	1.71	0.40
1983	50.21	-3.12	6.33	0.95	12.61	4.06	1.72	0.46
1984	48.17	-4.14	6.40	1.10	13.29	5.24	1.73	0.58
1985	45.98	-4.65	6.51	1.64	14.15	6.29	1.74	0.65
1986	43.93	-4.57	6.57	1.03	14.96	5.59	1.75	0.61
1987	41.95	-4.61	6.70	1.91	15.97	6.52	1.76	0.63
1988	40.19	-4.30	6.86	2.41	17.08	6.71	1.77	0.60
1989	38.65	-3.90	7.05	2.62	18.23	6.52	1.78	0.54
1990	37.37	-3.38	7.23	2.59	19.35	5.98	1.79	0.48
1991	36.36	-2.72	7.35	1.58	20.20	4.30	1.80	0.36
1992	35.46	-2.50	7.47	1.71	21.07	4.22	1.80	0.34
1993	34.64	-2.35	7.63	2.08	22.03	4.43	1.81	0.34
1994	33.67	-2.82	7.80	2.16	23.15	4.99	1.82	0.38
1995	33.03	-1.93	8.33	6.56	25.21	8.49	1.83	0.45
1996	32.17	-2.63	8.58	2.95	26.65	5.59	1.83	0.39
1997	31.39	-2.48	8.87	3.36	28.25	5.83	1.84	0.39
1998	30.81	-1.85	9.20	3.68	29.86	5.53	1.85	0.33
1999	30.50	-1.02	9.58	4.05	31.42	5.07	1.85	0.27

Table 3. Continued

Year	Young Age Dependency Ratio		Elderly Dependency Ratio		Index of Aging		Age Index of Aging	
		%		%		%		%
2000	30.39	-0.35	10.01	4.39	32.94	4.75	1.85	0.23
2001	29.08	-4.40	10.56	5.30	36.30	9.70	1.87	0.67
2002	28.74	-1.20	11.07	4.78	38.53	5.97	1.87	0.34

Young age dependency ratio is the ratio of 14 age and under to ages of 15 - 64 years population.

Elderly dependency ratio is the ratio of 65 age and above to ages of 15 - 64 years population.

Index of aging is the ratio of the elderly population to the population under age 14 years.

Age index of aging is an average of three age groups, weighted by the population shares;

1,2, and 3 are assigned to the population under age 14, active, and elderly population, respectively.

Table 4. Abridged Life by Age (in Years)

Age	Time	Total	Male	Female	Time	Total	Male	Female
0 year old	1981	66.19	62.28	70.54	1999	75.55	71.71	79.22
1~4	1981	67.11	63.09	71.57	1999	75.01	71.16	78.69
5~9	1981	63.71	59.67	68.21	1999	71.15	67.3	74.82
10~14	1981	59.1	55.05	63.6	1999	66.24	62.4	69.9
15-19	1981	54.35	50.31	58.84	1999	61.31	57.48	64.96
20-24	1981	49.75	45.75	54.18	1999	56.47	52.67	60.07
25-29	1981	45.2	41.25	49.55	1999	51.65	47.91	55.19
30-34	1981	40.64	36.75	44.92	1999	46.85	43.16	50.32
35-39	1981	36.12	32.28	40.31	1999	42.09	38.46	45.48
40-44	1981	31.72	27.98	35.77	1999	37.41	33.87	40.68
45-49	1981	27.51	23.93	31.31	1999	37.41	33.87	40.68
50-54	1981	23.51	20.14	27	1999	28.47	25.28	31.25
55-59	1981	19.72	16.64	22.86	1999	24.21	21.26	26.67
60-64	1981	16.18	13.43	18.86	1999	20.16	17.51	22.21
65-69	1981	12.97	10.62	15.13	1999	16.35	14.06	17.96
70-74	1981	10.12	8.22	11.74	1999	12.83	10.96	14.02
75-79	1981	7.6	6.2	8.76	1999	9.76	8.32	10.57
80-84	1981	5.37	4.62	6.19	1999	7.23	6.18	7.73
85-89					1999	5.29	4.56	5.55
90-94					1999	3.82	3.4	3.94
95 & over					1999	2.74	2.57	2.79

National Statistical Office, Abridged Life Tables, 1999;www.nso.go.kr, 05/01/03

Table 5. Population Projections for Korea

Age groups	2003		2010		2020		2050	
	millions	%	millions	%	millions	%	millions	%
total	47.9	100.0	49.6	100.0	50.7	100.0	44.3	100.0
0~14	9.7	20.3	8.6	17.2	7.0	13.9	4.6	10.5
15~64	34.2	71.4	35.7	72.1	35.9	71.0	24.4	55.1
15~19	3.2	6.8	3.5	7.0	2.7	5.4	1.8	4.1
20~24	4.0	8.4	3.1	6.2	3.2	6.2	2.0	4.4
25~29	3.9	8.2	3.8	7.7	3.4	6.8	2.0	4.6
30~34	4.4	9.2	3.8	7.7	3.1	6.0	2.1	4.6
35~39	4.1	8.6	4.3	8.7	3.8	7.5	2.3	5.2
40~44	4.3	9.0	4.2	8.4	3.8	7.4	2.5	5.5
45~49	3.6	7.4	4.2	8.4	4.2	8.4	2.6	6.0
50~54	2.6	5.3	3.9	7.9	4.1	8.1	3.0	6.9
55~59	2.1	4.4	2.8	5.7	4.0	8.0	3.3	7.4
60~64	1.9	4.0	2.2	4.5	3.7	7.3	2.9	6.4
65~95+	4.0	8.3	5.3	10.7	7.7	15.1	15.3	34.4
65~69	1.6	3.3	1.8	3.6	2.6	5.1	3.4	7.6
70~74	1.1	2.3	1.5	3.1	1.9	3.8	3.2	7.1
75~79	0.7	1.4	1.0	2.1	1.4	2.7	3.2	7.1
80~84	0.0	0.1	0.6	1.2	1.0	2.0	2.5	5.6
85~89	0.0	0.0	0.3	0.6	0.5	1.1	1.7	3.9
90~94	0.0	0.0	0.1	0.2	0.2	0.4	1.0	2.2
95+	0.0	0.0	0.0	0.0	0.1	0.1	0.4	0.9
Population growth rate	a0.61		0.49		0.21		-0.44	
elder dependency	8.3		10.7		15.1		34.4	
burden Index of aging	40.8		62.0		109.0		328.4	
index of aging	1.9		1.9		2.0		2.2	

National Statistical Office, Population Projection for Korea, www.nso.go.kr, 05/02/03

a) compound growth rate from 2002 to 2003.

Table 6. Educational Attainment of Population by Age

Year	\ Age	15~19	20~24	25~29	30~34	35~39	40~44	45~49	50~54	55~59	60+	Total
1970	Primary School	4.82	3.75	3.68	3.91	3.24	2.34	1.75	1.12	0.75	0.70	28.14
	Middle School	1.77	2.02	1.60	1.27	0.87	0.60	0.43	0.25	0.11	0.13	9.10
	High School	0.55	2.10	1.51	1.26	0.85	0.43	0.25	0.12	0.07	0.06	7.21
	Jr.College	0.00	0.13	0.14	0.12	0.10	0.07	0.06	0.04	0.02	0.03	0.72
	University and Higher	0.00	0.19	0.49	0.51	0.37	0.20	0.10	0.05	0.02	0.02	1.96
1995	Primary School	0.02	0.05	0.11	0.35	0.78	1.12	1.44	1.72	1.90	3.46	10.97
	Middle School	0.13	0.30	0.54	1.19	1.97	1.83	1.49	1.10	0.79	0.82	10.17
	High School	1.28	5.38	5.54	5.32	4.80	3.03	1.97	1.22	0.83	0.77	30.14
	Jr.College	0.01	0.68	0.86	0.64	0.42	0.18	0.08	0.03	0.02	0.05	2.98
	University	0.00	0.79	2.34	2.40	1.70	0.99	0.68	0.46	0.34	0.42	10.06
	Graduate School	0.00	0.01	0.14	0.21	0.22	0.16	0.10	0.07	0.05	0.05	1.02
2000	Primary School	0.01	0.02	0.04	0.09	0.35	0.80	1.16	1.42	1.57	4.06	9.54
	Middle School	0.07	0.11	0.21	0.42	1.08	1.79	1.63	1.29	0.92	1.22	8.75
	High School	0.91	2.85	4.48	4.97	4.84	4.26	2.64	1.67	1.01	1.29	28.9
	Jr.College	0.01	0.98	1.39	1.27	0.95	0.63	0.29	0.16	0.09	0.15	6.20
	University	0.00	0.56	2.04	2.19	1.94	1.25	0.69	0.47	0.32	0.47	9.93
	Graduate School	0.00	0.01	0.14	0.22	0.24	0.23	0.15	0.09	0.06	0.07	1.20
	Master	0.00	0.01	0.13	0.19	0.19	0.17	0.11	0.07	0.04	0.05	0.97
	Doctor	0.00	0.00	0.00	0.02	0.05	0.06	0.04	0.02	0.01	0.02	0.23

Sources: National Statistical Office, Korea Statistical Yearbook 2002; 1995 Population and Housing Census Report; 1970 Population and Housing Census Report

The figures in the cells are the shares of the numbers of population(6 years &over) completed their education by age groups. to total population, (%).They do not cover the population under school attendance, not completed,and never attending.

Table 7. Labor Forces by Age (in 1000 persons)

	Population Total	Population 15&Older	Active Population	Age 15~19	Shares %									Participation Rate	
					20~24	25~29	30~34	35~39	40~44	45~49	50~54	55~59	60+	1st Method	2nd Method
1960	24989	14302													
1966	29160	16476	8957	13.4	11.6	13.7	13.9	12.0	10.8	8.9	7.1	4.8	3.8	54.4	30.7
1970	31435	18193	10062	14.0	10.6	11.4	14.0	12.9	11.1	9.9	6.6	4.9	4.4	55.3	32.0
1975	34678	21469	12193	12.5	11.7	12.3	12.4	13.3	11.4	8.7	7.4	5.4	4.9	56.8	35.2
1980	37407	24750	14431	8.3	13.7	12.8	12.6	12.4	12.2	10.6	7.2	5.4	5.0	58.3	38.6
1981	38343	25798	14683	7.0	13.6	13.3	12.5	11.9	12.4	11.0	7.5	5.4	5.3	56.9	38.3
1982	39326	26438	15032	6.3	13.8	14.4	12.7	11.8	12.3	10.2	7.5	5.6	5.4	56.9	38.2
1983	39910	27110	15118	5.4	13.2	15.0	13.4	11.8	12.0	10.6	7.7	5.3	5.5	55.8	37.9
1984	40406	27813	14997	4.9	12.7	15.8	13.0	12.5	11.7	11.1	7.7	5.2	5.5	53.9	37.1
1985	40806	28500	15592	4.6	12.0	16.1	13.7	12.7	11.3	10.8	8.0	5.3	5.7	54.7	38.2
1986	41214	29183	16116	4.3	12.0	16.0	14.4	12.5	10.8	10.6	8.3	5.2	5.9	55.2	39.1
1987	41622	29874	16873	4.4	11.1	15.9	14.9	12.6	10.7	10.6	8.3	5.2	6.2	56.5	40.5
1988	42031	30545	17305	3.8	10.7	15.6	15.5	12.3	11.0	10.5	8.8	5.6	6.3	56.7	41.2
1989	42449	31188	18023	3.7	10.5	15.1	15.5	11.8	11.3	10.1	9.1	6.0	6.7	57.8	42.5
1990	42869	31792	18539	3.4	10.8	14.4	15.4	12.3	11.4	9.9	8.9	6.4	6.9	58.3	43.2
1991	43268	32320	19048	3.3	11.1	14.0	15.2	12.9	11.3	9.6	8.9	6.7	7.1	58.9	44.0
1992	43663	32830	19426	3.0	11.0	13.4	15.2	13.5	11.0	9.4	8.9	6.8	7.7	59.2	44.5
1993	44056	33331	19803	2.6	11.0	13.6	15.8	14.6	10.8	9.2	8.2	6.6	7.5	59.4	44.9
1994	44453	33871	20326	2.4	10.9	13.6	15.2	15.0	10.8	9.5	8.0	6.7	8.0	60.0	45.7
1995	45093	34557	20797	2.1	10.5	13.5	14.7	15.1	11.7	9.5	8.0	6.5	8.4	60.2	46.1
1996	45545	35135	21188	2.0	10.1	13.6	14.0	15.1	12.4	9.7	7.8	6.5	8.7	60.3	46.5
1997	45991	35700	21604	2.0	9.6	13.8	13.4	14.8	12.9	9.7	7.9	6.8	9.2	60.5	47.0
1998	46430	36213	21456	1.9	8.1	13.4	13.3	16.0	13.7	10.0	7.8	6.7	9.1	59.2	46.2
1999	46858	36657	21634	2.0	7.8	12.8	13.0	15.6	14.5	10.2	8.0	6.5	9.5	59.0	46.2
2000	47275	37043	21950	2.0	7.6	12.6	12.5	14.9	14.8	11.2	8.4	6.3	9.8	59.3	46.4
2001	47343	37482	22417	1.8	8.3	13.1	13.8	14.6	14.5	11.0	7.8	5.7	9.3	59.8	47.4
2002	47640	37847	22877	1.5	8.4	12.5	13.8	14.1	14.6	11.5	8.0	5.8	9.7	60.4	48.0

National Statistical Office, Comprehensive Time Series Report on the Economically Active Population

Survey, 1963-1993; National Statistical Office, Annual Report on the Economically Active Population

Survey; Economic Planning Board, Major Statistics of Korean Economy, 1978; Economic Planning

Board, Major Statistics of Korean Economy, 1984

1st method is active population / 15 years and older. 2nd method is active population / total population.

Table 8. Educational Attainment of Labors in All Industries by Age

\ Age	~19	20~24	25~29	30~34	35~39	40~44	45~49	50~54	55~59	60+	Total
1981											
Middle School and Lower	11.6	17.2	6.9	5.9	5.1	4.4	2.7	1.5	0.5	0.3	56.2
High School	1.8	2.9	7.8	4.9	2.9	1.9	1.0	0.5	0.2	0.1	31.5
Jr.College	0.0	0.4	0.9	0.5	0.3	0.2	0.1	0.1	0.0	0.0	2.5
University and Higher	0.0	0.3	2.3	2.4	1.8	1.4	0.8	0.5	0.2	0.1	9.8
2001											
Middle School and Lower	0.1	0.2	0.2	0.5	1.1	2.6	3.1	2.6	1.6	1.4	13.4
High School	0.9	6.8	8.7	8.3	7.1	6.5	4.1	2.3	1.3	0.9	46.9
Jr.College	0.0	2.6	4.5	3.2	1.8	1.4	0.6	0.2	0.1	0.1	14.5
University and Higher	0.0	0.8	5.2	6.5	5.1	3.6	1.8	1.0	0.6	0.6	25.2

Source: Ministry of Labor, Survey Report on Wage Structure

The figures in the cells are the shares of age groups in total labor for the year, (%).

Table 9. Real Saving Rates by Age Groups (%)

\ Year	1985	1990	1995	2000	2002
Under 25	20.32	17.75	27.63	16.39	28.35
25-29	28.64	24.44	28.89	25.71	25.83
30-34	29.68	26.81	32.47	27.22	28.68
35-39	27.21	23.23	27.15	24.48	28.44
40-44	21.58	17.35	27.27	24.22	26.61
45-49	17.95	14.31	26.45	21.55	28.18
50-54	20.35	17.39	30.07	17.23	26.68
55 &over	17.80	22.41	29.26	23.94	28.47
Average	24.89	21.57	28.97	23.67	27.71

Table 10. Household Saving Rates Equations

Eq. No.	10.1	10.2	10.3	10.4
Constant	10.3 [8.67]	10.1 [8.64]	4.77 [4.16]	22.7 [24.3]
T	0.45 [13.3]	0.45 [13.2]	0.31 [9.51]	
G	-0.13 [5.91]	-0.13 [5.96]	-0.03 [1.41]	-0.11 [3.82]
W/GDP	-13.6 [4.27]	-14.5 [4.77]	-11.9 [4.62]	8.83 [2.62]
LB/GDP	-4.81 [0.91]			
YD	0.51 [5.19]	0.51 [5.15]	0.36 [4.21]	-0.11 [0.95]
D24	-7.62 [8.74]	-7.62 [8.76]	-5.19 [6.64]	-2.61 [2.44]
D55	7.26 [7.75]	7.23 [7.73]	4.87 [5.86]	-1.39 [1.51]
s(-1)			0.44 [9.12]	
Adj R2	0.55	0.55	0.68	0.17
SEE	3.16	3.17	2.66	4.32
DW	1.01	1.02	1.72	0.63

Figures in [] are t-statistic.

Table11. Long-Run Elasticities of Household Saving Rates

Eq. No.	10.1	10.2	10.3
T	0.58	0.58	0.72
g	-0.03	-0.03	-0.01
W/GDP	-0.28	-0.30	-0.44
YD	0.33	0.33	0.41

Long run elasticities are at the sample mean values.

Table 12. Saving Rates Equations: Demographic Factors

Eq. No.	12.1	12.2	12.3
constant	26	25.5	25.4
	[3.41]	[3.30]	[63.]
g	-0.11	-0.11	-0.15
	[3.79]	[3.78]	[4.74]
D24-	-2.08		-2.08
	[2.29]		[2.19]
D55+	-1.43		-1.42
	[1.57]		[1.49]
YDEP	-0.14	-0.14	
	[0.85]	[0.84]	
ODEP	0.59	0.59	
	[0.92]	[0.91]	
Adj R2	0.18	0.18	0.11
SEE	4.28	4.34	4.48
DW	0.58	0.56	0.58

Figures in [] are t-statistic.

Table 13. Prediction of Household Saving Rates

	2002	2010	2020	2030
life expectancy	77.3171	78.80	80.70	81.50
Survey distribution				
mean	27.75	28.38	29.25	29.51
%		2.25	3.02	0.89
age group				
15~24	28.35	29.00	29.85	30.20
25~29	25.83	26.48	27.32	27.68
30~34	28.68	29.33	30.17	30.53
35~39	28.44	29.10	29.93	30.29
40~44	26.61	27.27	28.10	28.46
45~49	28.18	28.83	29.66	30.02
50~54	26.68	27.33	28.15	28.51
55~above	28.47	29.11	29.92	30.27
Population Distribution				
mean	27.77	28.40	29.27	29.69
%		2.24	3.02	1.40
age group				
15~24	28.35	29.00	29.85	30.20
25~29	25.83	26.48	27.32	27.68
30~34	28.68	29.33	30.17	30.53
35~39	28.44	29.10	29.93	30.29
40~44	26.61	27.27	28.10	28.46
45~49	28.18	28.83	29.66	30.02
50~54	26.68	27.33	28.15	28.51
55~above	28.47	29.11	29.92	30.27

The population projection figures are from National Statistical Office,
Population Projection. Life expectancy figures are from NSO.

*Predictions allow changes in life expectancy, all other factors being unchanged.

Table 14. Measures of Domestic Net Saving Rates

		(in percent)		
		2000	2001	2002
Nominal term	$(\text{GDPV}-\text{CCAV}-\text{CV}-\text{GV})/(\text{GDPV}-\text{CCAV})$	23.61	21.08	20.27
Real term	$(\text{GDP}-\text{CCA}-\text{C}-\text{G})/(\text{GDP}-\text{CCA})$	33.34	32.51	33.08
private	$(\text{GDP}-\text{CCA}-\text{C}-\text{T})/(\text{GDP}-\text{CCA}-\text{T})$	24.68	23.29	23.19
government	$(\text{T}-\text{G})/\text{T}$	60.55	61.29	63.38

GDP=real gross domestic products; C=real private consumption expenditures,
 G=real government consumption expenditures; GDPV=gross domestic products;
 CCA=real capital consumption allowance, CCAV divided by implicit fixed investment deflator;
 GV= government consumption expenditures; CCAV=capital consumption allowance;
 T=real general government taxes net of transfers, TV divided by GDP price deflator;
 TV= general government taxes net of transfers.

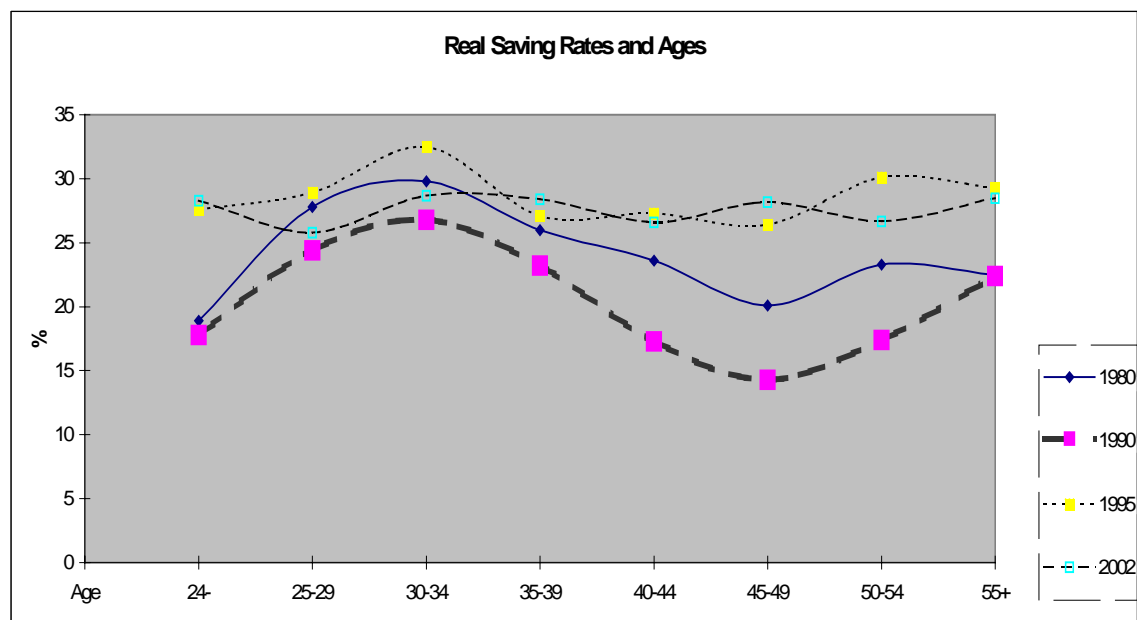
Table 15. Prediction of National Real Net Saving Rate with the Assumed Life Expectancy

		2002	2010	2020	2030
Population	0~14	0.21	0.17	0.14	0.12
Shares	5~64	0.72	0.72	0.71	0.65
	65+	0.08	0.11	0.15	0.23
Saving Rates					
Private					
	growth rate		0.031	0.015	-0.08
		23.19	23.91	24.31	22.45
Government					
	growth rate		0.00	0.01	0.01
	(A)	63.38	63.65	63.98	64.32
	Aging cost				
	Growth rate		-0.02	-0.05	-0.10
	(B)	63.38	62.28	59.04	53.44
Total	growth rate		0.01	-0.02	-0.09
	$0.75*(A)+0.25*(B)$	33.08	33.5	32.99	30.2

General rule used is as follows: aggregate saving rate is a weighted average of private and government saving rate, and weight for the private saving rate is 0.75, and 0.25 is $(\text{GDP}-\text{CCA}-\text{T})/(\text{GDP}-\text{CCA})$ in 2002. Private saving rate is the mean saving rate of 15~64 age group reported in Table 13 times the group's population shares times per labor earning rate ratio, 0.76,
 + 0.5 x the mean saving rate of 15~64 age group x the 65+ age group's population share x labor participation rate x per labor earning rate ratio, 0.24.

The 65+ age group's labor participation rates are assumed to be 0.2, 0.15, and 0.1 for 2010, 2020, and 2030. We computed the growth rates of the private saving rate so constructed. Using the growth rates and 23.19 for the year 2002, we generated the private saving rates for the future. We utilized the growth rates of government revenues and government expenditures, 8.5% and 8.4% per year, assumed in Global Insight, 1st Quarter of 2002. We assumed that additional government expenditures to account for elder population are 0.5% per year in 2003-2010, 1% per year in 2011-2020, and 1.5% per year in 2021-2030.

Chart 1: Real Saving Rates of Korean Households by Ages



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Comments on "The Impact of Aging population in Korea on Household Saving Behavior"

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This paper examines empirically the relationship between population aging and the aggregate saving rate in Korea. As is well known, Korea is one of the countries with most rapidly aging population in the world. While existing studies typically predict that the aging trend will have a negative effect on the aggregate saving rate, the quantitative importance of the effect is still uncertain. This paper reexamines the issue of population aging and aggregate savings by estimating out the saving rate equation for each age group and then aggregating the estimates over all age groups. Perhaps in contrast to common perception, the result suggests that the impact of aging population on aggregate savings in Korea will not be substantial. According to this paper, the aggregate household saving rate in Korea will increase to 31 percent by 2020 and decrease to about 29 percent in 2030.

The reason for the small estimates of the impact of population aging can be found in Table 9, where the actual household saving rate is reported for different age groups, and Table 10, where the saving rate equation is estimated for each age group. Table 9 shows that the household saving rate is not much different across age groups, particularly between the group of elderly households and the rest. Since the aggregate saving rate is merely a weighted average of the saving rates of different age groups, the small difference in saving rates among age groups suggests that the impact of population aging will also be small. Of course, population aging can affect the aggregate saving rate by not only changing the relative weights of each age group but also by changing saving behavior of each age group. If for some reason population aging decreases the saving rate of each age group, then the negative impact of population aging on the aggregate saving rate can be more evident. However, the author of this paper stresses that longer life expectancy (which is one of the driving forces of population aging) may make each age group want to save more in preparation for a longer post-retirement life. And this view is supported by the positive coefficient on T (the length of the remaining lifetime) in the saving rate equation in Table 10. This positive effect of population aging on individual savings combined with the small differences in the saving rates across age groups can explain the small impact of population aging on the aggregate saving rate reported in this paper.

Existing studies on the relationship between demographic factors and the saving rate can be divided into two groups depending on the nature of the data used. Similar to this paper, studies that use disaggregated data normally find that the household saving rate is not as diverse across different age groups as the life-cycle theory predicts. For example, Kotlikoff (1988) finds from his analysis of micro data little or no tendency for elderly people to run down their savings. Table 9 of this paper is consistent with this pattern. Studies that use aggregated data, however, suggest otherwise. Time series analysis of one country or cross-country analysis typically find that the aggregate saving rate is substantially negatively correlated with population aging. This conflict between the two groups of studies is still not fully resolved. One possible explanation is that, even if the

elderly households do not dissave, other households may cut their savings in response to an increase in the number of elderly households. For example, young people may save less when they expect more bequests from elderly people(Weil(1994)). Another possibility is that population aging may change the age structure of a typical household. While most studies classify households into age groups relying on the age of the household head, a household typically consists of multiple individuals. Population aging may reduce the household saving rate by increasing the proportion of elderly members in individual households. Considering the discrepancy between macro data analysis and micro data analysis, I believe that predictions of the aggregate saving rate calculated from disaggregated data analysis need to be taken with cautions.

Another interesting finding, even if not directly related to the issue of population aging, in this paper is that the household saving rate is negatively correlated with the GDP growth rate. The theory predicts that the correlation between the two variables can be either positive or negative. If a high level of the current GDP growth rate signals even higher levels of future GDP growth rates, households will lower their savings in response to high current growth rates. If, on the other hand, the high GDP growth rate this period signals lower GDP growth rates in the future, households will increase their savings. Empirically, the saving rate tends to be pro-cyclical, rising during economic booms and falling during recession. This pro-cyclical of the saving rate is consistent with the well-known pattern of the consumption growth rate being less volatile than the GDP growth rate. However, estimation results in Table 10 in this paper indicate the opposite. It will be interesting to check whether the results change when the sample is restricted to the periods prior to the 1997 Asian crisis. In 1998, the growth rate dropped and the saving rate increased, perhaps because people increased their saving rates out of precautionary motives. I wonder if this experience is partly responsible for the negative correlation between the saving rate and the growth rate reported in this paper.

Is the Population Aging Causing an Increase in Income Inequality? Evidence from Taiwan

by
Andrew Mason and Sang-Hyop Lee

Abstract

This paper explores how aging will influence inequality in societies where the family support system, in the form of multi-generation extended households, is the principal means by which resources are transferred from workers to retirees. On *a priori* grounds it is indeterminate whether aging leads to an increase or a decline in extended living arrangement, but if it leads to a *decline* in extended living arrangements the effect is to raise inequality. The model is applied to Taiwan. The evidence suggests that aging has led to an *increase* in extended living arrangements. The effect is greater than the compositional effects that previous studies identified. Thus, our conclusion is that aging has actually reduced income inequality in Taiwan.

1. Introduction

As the demographic transition has proceeded in countries around the world, attention has increasingly focused on the economic implications of population aging. Perhaps no issue has received more attention than the sustainability of public old-age security programs that have promised substantial transfers to seniors living in Japan, the West, and many developing countries in Latin America. How public transfer systems are reformed in response to demographic pressure will have important and lasting implications for levels of poverty and inequality.

In Asia the extended family is a much more important component of the old-age support system than in the West. In some of the most developed Asian countries about half of all seniors live with adult children. In many other Asian countries a much higher percentage of seniors live in multi-generation extended households. As the demographic transition proceeds and Asia's population age, the family support system

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will be subject to the same pressures as public support systems. Adult children may find that they are supporting their parents for more years and that they have fewer siblings with whom they can share the burden of old-age support. Alternatively seniors may find that the family support provided in the past is no longer forthcoming. How family support systems evolve is no less important than how public programs are reformed in response to demographic pressure.

These issues are especially pressing in Taiwan and other Asian countries that have experienced unusually rapid demographic transitions. As a consequence population aging will be especially rapid and the pressure on support systems particularly severe.

Although the implications of population aging for the family support system has received relatively little attention, the implications of aging for income inequality in Taiwan and elsewhere has been the subject of several important studies. A consensus has not been reached as to whether aging leads to a rise or a decline in inequality in Taiwan. Liu (1978) concludes that changes in the distributions of age of household head and household size were important contributors to a decline in inequality between 1964 and 1970. Chu (1997) examines the effects of age structure on family income using the *Gini* coefficient and shows that changes in Taiwan's demography reduced the inequality in family earnings between 1980 and 1990. In contrast, Deaton and Paxson (1997) concludes that aging is leading to greater inequality in household consumption and Schultz (1997) concludes that aging is leading to an increase in inequality in income per adult. These studies do not consider, however, how population aging is influencing living arrangements. Their focus is on the compositional effects of aging.

The analysis presented in this paper is based on a model of population aging and per capita income inequality that explicitly incorporates the effects of aging on the prevalence of multi-generation extended households (Mason and Lee, 2002; Lee and Mason, 2002). Based on analysis of Taiwan's experience from 1978 to 1998, we conclude that population aging has led to an increase in the proportion of non-senior adults living with their parents. Because of the increased extent to which incomes are being pooled, population aging has led to a decline in income inequality in Taiwan.

2. A Model of Income Inequality

Analysis is facilitated using a model that captures key features of the links between age structure, living arrangements, and inequality. The model abstracts from some issues that are potentially important, as will be discussed below. The use of a highly stylized model, however, allows us to focus on the changes in inequality when the population is aging and, thereby, influencing both the age composition of the population and the extent to which families are pooling their incomes by establishing multi-generational extended households.

The population we consider consists of one sex and two generations or age groups. The young members of the population are non-senior adults or *non-seniors* for short. The old members of the population, *seniors*, are the parents of non-senior adults. The population of non-seniors is designated by K , seniors by P , and the total population by $M=K+P$. The age structure of the population is measured in one of two ways, either by the dependency ratio, $D = P / K$, or by the share of non-seniors or seniors in the total population. The proportion of the adult population who are non-seniors is $m^k = 1/(1 + D)$, and the proportion of the adult population who are seniors is $m^p = D/(1 + D)$.

Individuals form either nuclear or extended households. Nuclear households consist of one member, either a non-senior or a senior. Extended households consist of one non-senior member and D_x senior members where D_x can take on fractional values. D_x is the dependency ratio within extended households. The subscripts n and x are used to distinguish the nuclear and extended populations; hence, K_x and K_n represent the total number of non-seniors living in extended and nuclear households, respectively. The proportion of individuals living in an extended household is designated by x and the proportion living in a nuclear household by n . The proportion of non-seniors living in an extended household is x^k ; the proportion of seniors living in extended households is x^p .

The mean incomes of non-seniors and seniors are designated by \bar{Y}^k and \bar{Y}^p , respectively, and the variances by $V(Y^k)$ and $V(Y^p)$, respectively. The co-variance between the income of non-seniors and seniors within extended household is $C(Y^k Y^p)$.

When individuals form extended households they fully pool their income. Hence, we do not consider any intra-household distributional issues. Per capita household income is designated by \bar{Y} , mean per capita household income by \bar{Y} , and the variance in per capita household income by $V(Y)$.¹ Except as noted, income inequality is measured by the variance in per capita household income.

Previous studies of age composition and inequality have shown that the relationship between age structure and the variance of per capita household income consists of two components: a difference in variances effect and a difference in means effect. The difference in variances effect arises because the variance in incomes varies by age. Changes in the age-composition of the population that increase the representation of age groups with high income variance leads to higher income variance for the population. The difference in means effect arises because mean income varies by age. Changes in the age composition of the population that increase the representation of age groups with mean income substantially different from the grand mean (or the mean income of other age groups) leads to greater income inequality (Lam 1997).

Lee and Mason (2002) generalize the age-inequality model to incorporate the effects of extended living arrangements. We make several key assumptions that simplify the analysis considerably. We assume that the choice of living arrangements is independent of income and that the dependency ratio within extended households is independent of the income of the household members. Under these simplifying assumptions, the variance of income is given by equation (1). The difference in variances component is a weighted average of the first three right-hand-side terms in equation(1): the variance of the per capita income of non-seniors, the variance of the per capita income of seniors, and the co-variance between the income of co-residing seniors and non-seniors.² The difference in means component is the fourth right-hand-side term in equation (1):

$$V(Y) = w_1 V(Y^k) + w_2 V(Y^p) + w_3 C(Y^k Y^p) + w_4 (\bar{Y}^k - \bar{Y}^p)^2 \quad (1)$$

where:

¹ The variance in income is calculated using the number of household members as weights as is standard in the literature on income inequality. Studies of earnings inequality frequently use the variance in the log of earnings to measure inequality, but the natural income of income is undefined for persons with no incomes or losses for the year.

² The first three coefficients sum to 1.

$$\begin{aligned}
w_1 &= m^k - m_x^k m_x^p m_x > 0 \\
w_2 &= m^p - m_x^k m_x^p m_x > 0 \\
w_3 &= 2m_x^k m_x^p m_x > 0 \\
w_4 &= m_n^k m_n^p m_n + m_n m_x (m_n^p - m_x^p)^2 > 0.
\end{aligned} \tag{2}$$

The variables m_x and m_n are the proportions of adults living in extended and nuclear households, respectively; m^k and m^p are the proportions of adults who are non-seniors and seniors, respectively; m_x^k and m_x^p are the proportions of extended household adult members who are non-seniors and seniors, respectively; and, m_n^k and m_n^p are the proportions of nuclear household adult members who are non-seniors and seniors, respectively.

If all adults lived in nuclear households, the inequality model is greatly simplified. The coefficients reduce to:

$$\begin{aligned}
w_1 &= m^k \\
w_2 &= m^p \\
w_3 &= 0 \\
w_4 &= m^k m^p.
\end{aligned} \tag{3}$$

In the simple model, the difference in variances effect is a weighted average of the variances of non-senior and senior incomes where the weights are the proportion of the population belonging to the non-senior and senior age groups. The difference in means effect is non-monotonic in age structure reaching a peak when the population is equally divided between the non-senior and senior age groups.

In the extended household model, the difference in variances effect, captured by the first three terms in equation (2), depends on the extent to which members in the population pool their income as measured by $m_x^k m_x^p m_x$. The variances of individual incomes carry a smaller weight and the co-variance term carries a larger weight the greater the extent of income pooling. If the co-variance of the income of co-resident seniors and non-seniors is negative, it is obvious that $V(Y)$ is reduced by greater pooling, i.e., an increase in the coefficient of the co-variance term. But even if there is a high positive correlation between the income of co-resident seniors and non-seniors, the effect of pooling is to reduce the variance in per capita income.³

The extent of income pooling, $m_x^k m_x^p m_x$, increases with the proportion of adults in extended households and balance between seniors and non-senior members within extended households. Given the proportion of adults in extended households, the pooling term reaches a maximum when extended households consist of equal numbers of seniors and non-seniors, i.e., $m_x^k = m_x^p = 0.5$.

Suppose that the extent of pooling were unaffected by population aging. In this case, the difference in variances effect of aging would be independent of the extent of co-

³ See Lee and Mason (2002) for a formal derivation. Also Lam (1997) shows that pooling of incomes will reduce the coefficient of variation if the correlation is less than perfect.

residence. The effect of an increase in the proportion senior is given by $\partial V(Y)/\partial m^p = V(Y^p) - V(Y^k)$. As we shall see in the next section, however, aging does have an important effect on the extent of pooling and the variance in income beyond that captured by the simpler specification.

The difference in means effect is captured by the last term in equation. The first additive term in w_4 captures the effect of the differences in the mean income of non-senior and senior nuclear households. The effect is larger the larger the proportion of persons living in nuclear households and the greater the balance in non-senior and senior households. The second additive term in w_4 captures the effect of differences in the mean income of nuclear and extended households. If the population shares of seniors in nuclear and extended households are equal, the mean incomes of extended and nuclear households will also be equal, and this term drops out.⁴ The greater the difference in the population shares of seniors, as captured by $(m_n^p - m_x^p)^2$, the greater the difference in the mean incomes of nuclear and extended households and the greater the difference in means effect. The effect also increases the greater the balance in the proportion of the population in nuclear and extended households as captured by $m_n m_x$.

Equation (1) is applied to the analysis of aging on income inequality by holding the characteristics of the income of seniors and non-seniors constant at observed levels and varying the weights. As we shall see, however, changes in age structure influence the weights directly as measured by m^k and m^p but also by influencing living arrangements.

3. Aging and Living Arrangements

The model of living arrangements incorporates the effects of aging in two distinctive ways. The first effect explored is that improvements in health, which lead to higher survival rates and population aging, may also lead to an increase in the extent to which seniors maintain separate households. If this effect is important, it would be a source of greater income inequality as explained above.

The second effect is that changes in age structure influence the availability of kin. An increase in the relative number of seniors in a population increases the relative number of surviving parents with whom non-senior adults may establish extended households. If the increased availability of seniors leads to a rise in extended households, this will serve to reduce income inequality.

A simple specification taken from Mason and Lee (2002) is used to estimate the effects of survival on living arrangements among seniors, defined as persons aged 60 and older. The proportion of seniors aged a living in nuclear households in year t ($n(a, t)$) depends on two cohort variables and an age variable. The cohort variables capture persistent characteristics of members of each birth cohort. The first variable, the year of birth or $BYear(t - a)$, is included to capture the effects of broad social and economic trends that may be influencing the extent to which seniors are choosing to live independently from their offspring. The second cohort variable, the sex ratio at age 60 or $SexRatio(t - a)$, is included to capture the effects of large imbalances in the sex ratio that influenced the

⁴ This follows given our assumption that living arrangements are independent of income.

extent to which cohort members married and produced offspring. This is an important and unusual feature of Taiwan's demography because it experienced large-scale, disproportionately male immigration from mainland China *circa* 1950. Note that cohort variables are indexed only by year of birth, $t - a$. The effect of survival is incorporated into the model using age-specific survival rates, $s(a, t)$. We use the log-odds of the proportion nuclear as the dependent variable so as to constrain the values of the proportion nuclear to between 0 and 1:⁵

$$\ln \left(\frac{n(a, t)}{1 - n(a, t)} \right) = \beta_0 + \beta_1 BYear(t - a) + \beta_2 SexRatio(t - a) + \beta_3 \ln s(a, t) \text{ for } a \geq 60. \quad (4)$$

Given the proportion of seniors living in extended households, the proportion of non-seniors ($30 \leq a < 60$) living in extended households may increase with a rise in the population dependency ratio, i.e., with an increase in the availability of senior kin. The effect is not a deterministic one, however, because a second possibility is that an increase in the dependency ratio will produce a rise in the dependency ratio within extended households.

The intergenerational demographic connections that influence extended living arrangements are modeled using an approach that in most respects is identical to the highly stylized model used to model income inequality in the preceding section. We continue to focus only on the adult population, which again is divided into two generations – non-seniors and seniors. The senior and non-senior populations, however, consist of multiple age groups.⁶ If $N(a, t)$ is the population aged a in year t , then those groups for which $g \leq a < 2g$ are classified as non-seniors and those for which $a \geq 2g$ are classified as seniors. We assume that all births occur at age g . Hence, at any point in time individuals aged a have parents aged $a + g$. $N(a)$ is the population aged a and $N(a + g)$ is both the population aged $a + g$ and the parents of persons aged a .⁷ Extended households are formed when persons aged a and persons aged $a + g$ choose to live together.

The intergenerational demographic connections are captured by the following identity:

$$x(a, t) \equiv ddx(a, t)x(a + g, t) \text{ for } a < 2g, \quad (5)$$

where:

$$\begin{aligned} ddx(a, t) &= D(a, t) / D^x(a, t), \\ D(a, t) &= N(a + g, t) / N(a, t), \text{ and} \\ D^x(a, t) &= N^x(a + g, t) / N^x(a, t) \text{ for } g \leq a < 2g. \end{aligned} \quad (6)$$

⁵ There may be time effects as well. For example, fluctuations in the unemployment rate may influence the extent of co-residence for all birth cohorts and age groups. The analysis here is concerned with long run trends, however, and the effects of annual fluctuations are absorbed in the error term in the statistical analysis presented below.

⁶ In the empirical section we use single-year age groups with those aged 30-59 classified as non-seniors and those 60 and older classified as seniors.

⁷ Some individuals in the $a + g$ age group may not be parents.

The interdependence between the proportion of seniors and non-seniors living in extended households is incorporated into the analysis using age-specific dependency ratios that approximate the age structure of families and extended households. The age in this formulation is the age of the non-senior members of the family and/or the extended household.

Equation (6) is particularly important to our analysis of income inequality because it shows that population aging will lead to changes in the extent of pooling. Given the proportion of seniors living in extended households, an increase in D must produce either an increase in the proportion of non-seniors living in extended households or an increase in $D^x = m_x^p / m_x^k$. In either event, the extent of pooling will change.

Mason and Lee (2002) provide a more detailed and formal treatment of the relationship between the relative dependency structure in the population (ddx), the demographic transition, and the form of extended living arrangements. Here, we confine ourselves to a simpler empirical strategy that allows us to analyze the effects of aging on living arrangements and to test a key issue – whether changes in the dependency ratio in extended households match, in percentage terms, changes in the population dependency ratio. If they do, then aging does not lead to a rise in the proportion of non-seniors living in extended households. The model we estimate below is:

$$\ln D^x(a, t) = \sum_{a=30}^{59} \alpha(a) Age(a, t) + \beta \ln D(a, t). \quad (7)$$

The variables $Age(a)$ are dummy variables that take the value of 1 depending on the current age of the cohort in question. If the coefficient β is significantly less than one, it follows that the increased availability of seniors in the population is leading to a rise in the proportion of non-seniors living in extended households.

4. Empirical Analysis

Data

We use the Survey of Family Income and Expenditure in Taiwan (FIES, also known as the Survey of Personal Income Distribution in Taiwan until 1993). The FIES was first conducted in 1964 and, then, every other year until 1970. Since then, the survey has been conducted annually and data are available for the 1976 and subsequent surveys. For technical reasons, we have confined our analysis to surveys conducted in 1978 and later until 1998. The number of household surveyed has varied over time, but the sample size is more than sufficient for our purposes. In 1998, about 0.4 percent of all households (14,031 households and 52,610 individuals) were covered. These are not panel data, but repeated cross-sections.

There are two features of the FIES that are important to the analysis presented below. First, the FIES has a complete household roster with age, sex, relationship to head, and other individual characteristics of household members. The household roster is used to partition households into groups of individuals belonging to the same generation and to define nuclear and extended households. For example, the head, spouse of the head, or sibling of the head would belong to one generation. The mother, father, aunt, or uncle of the head would belong to a different generation. All individuals who are related to the head are assigned to a generation. Extended households are defined as households consisting of two or more generations in which at least one member is 30 years of age or older. Note that marital status has no bearing on our definition of household type.

The second feature of the FIES is that household income is assigned to members of the household. Although there is a residual category for income that cannot be assigned to an individual, this category is rarely used. Consequently, we can calculate income characteristics separately for the non-senior and senior generation within extended households. Income is measured by total current income excluding depreciation. We analyze income per adult. All means and variances are weighted by the number of adults in the household or sub-unit.⁸

Nuclear households are designated as senior households or non-senior households based on the age of the primary income earner. If he or she is 60 or older the household is classified as senior. In extended households, the adult members are classified as senior or non-senior based on the generation to which they belong. The members of the youngest adult generation in the household are designated as non-senior adults; the members of all other adult generations are designated as senior adults.

The survey data are used to construct estimates of the means and variances of the income of seniors and non-seniors in equation (1). $V(Y)$ for seniors and non-seniors is calculated as the variance in household income per senior or non-senior using the number of seniors or non-seniors as weights. Hence, the estimated variances do not reflect any within household variation in income. The covariance term, $C(Y^k Y^p)$, is estimated using extended households only and is the covariance between household income per senior and household income per non-senior again using the number of seniors and non-seniors as weights. Note that in all calculations the household income is the income earned by seniors or by non-seniors as appropriate. Estimates are constructed for every survey year.

The living arrangements model is estimated using mean values of the proportions living in nuclear households, extended households, the dependency ratio, the dependency ratio in extended households, and other variables by current age (single years of age; 85 and older is the upper bracket⁹) and birth cohort. The senior population consists of all those who are 60 or older.¹⁰ The data set yields 546 observations, 21 years times 26 age groups. The oldest birth cohort was born in 1893 and the youngest birth cohort was born in 1938. For these two birth cohorts we have values for only one age – 85+ for the oldest cohort and 60 for the youngest cohort. For several birth cohorts we have values for 21 age groups, but no cohort can be followed over the entire aging period 60-85+. The non-senior population consists of all those who are 30-59. The data set yields 630 observations on non-seniors, 21 years times 30 age groups. The oldest cohort was born in 1923 and the youngest in 1968. Again we have only a single value for the youngest and oldest cohorts and values at 21 ages for those born around 1955.

Results

Components of Taiwan's income distribution are reported in Table 1. The mean income of seniors was about one-quarter of the mean income of non-seniors in every year, although the mean for seniors did increase somewhat faster, in percentage terms, than the mean for non-seniors. The variance of senior income was roughly 50 to 60 percent of the variance in non-senior income with substantial year-to-year fluctuations. The

⁸ For a discussion of some of the issues that arise in measuring income inequality see Lam (1997) or Schultz (1997).

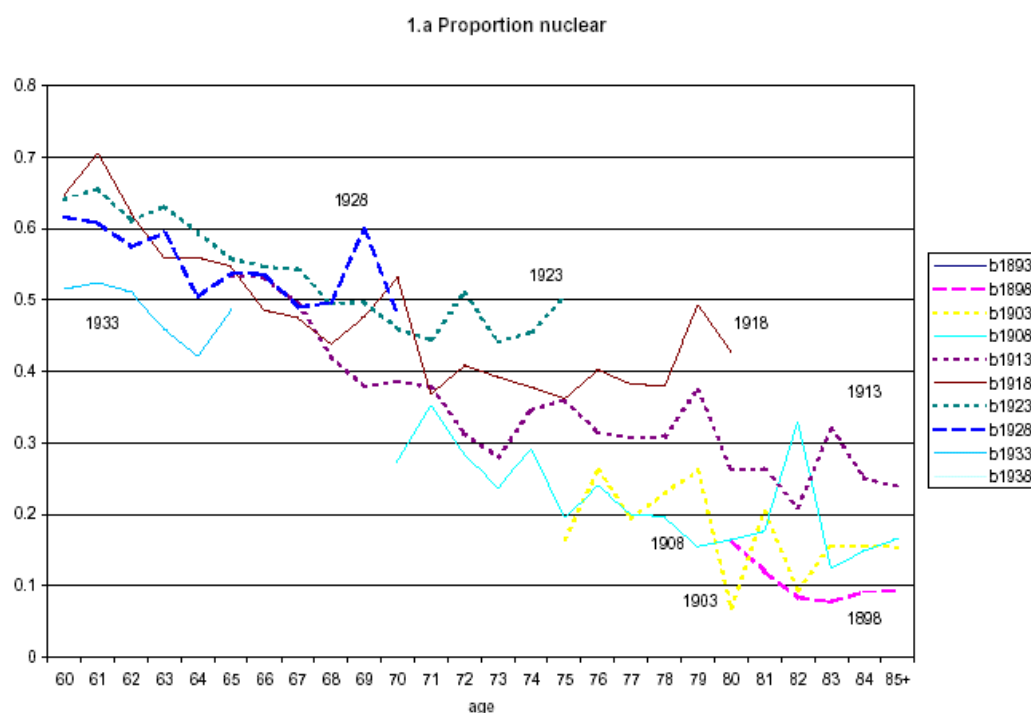
⁹ In some instances we use 89+ for the oldest cohort.

¹⁰ The generation length of 30 is based on the average differences in age found in extended households between prime-age adult members and their co-resident parents. Young non-seniors are 30 years younger than their parents for all birth cohorts. The generation length is shorter for older non-seniors. By age 50 the generation length was about 21 years in 1978 and about 26 years in 1992 and 1998.

variance in senior income has declined somewhat relative to the variance of non-senior income during the 21-year period. The covariance between the income of seniors and non-seniors in extended households is consistently negative. Given these values pooling income will significantly reduce the variance of per adult household income.

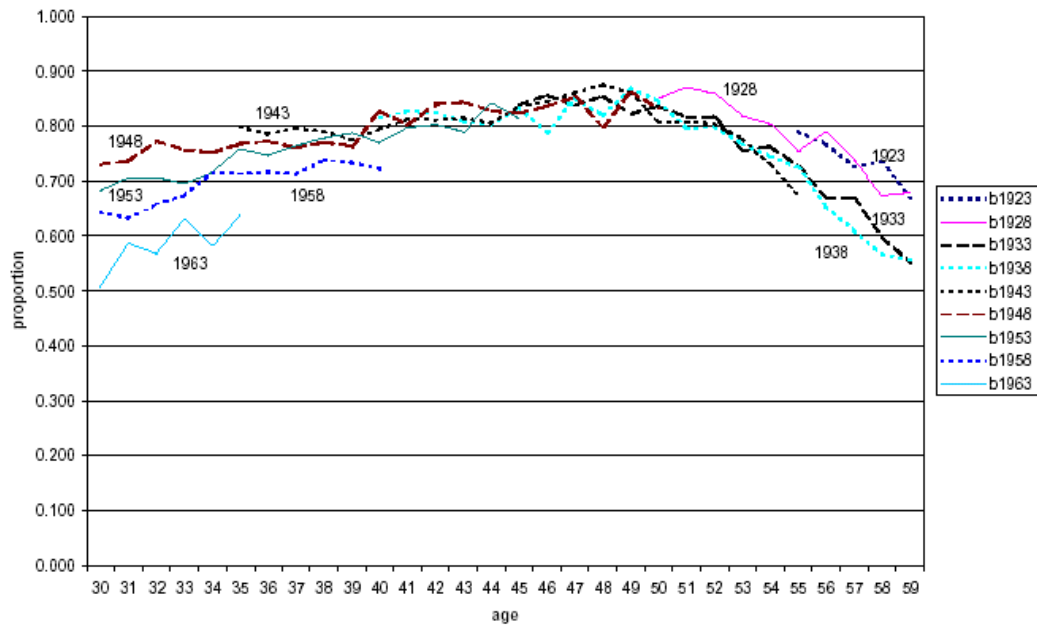
The data used to characterize living arrangements in Taiwan are plotted in Figure 1. Panel A shows the mean proportions of seniors living in nuclear households by age for selected birth cohorts. Panel B shows the mean proportions of non-seniors living in nuclear households by age for selected birth cohorts. And panel C shows the mean values of ddx by age for selected non-senior birth cohorts.¹¹ These data are drawn to emphasize cohort experience. For example, the solid line in panel A labeled 1918 follows the cohort born in 1918 from when its members were age 60 in 1978 and over 60 percent lived in nuclear households until the members were age 80 in 1998 and a little over 40 percent lived in nuclear households.

Figure 1. Proportion nuclear and relative dependency burden by age and year of birth

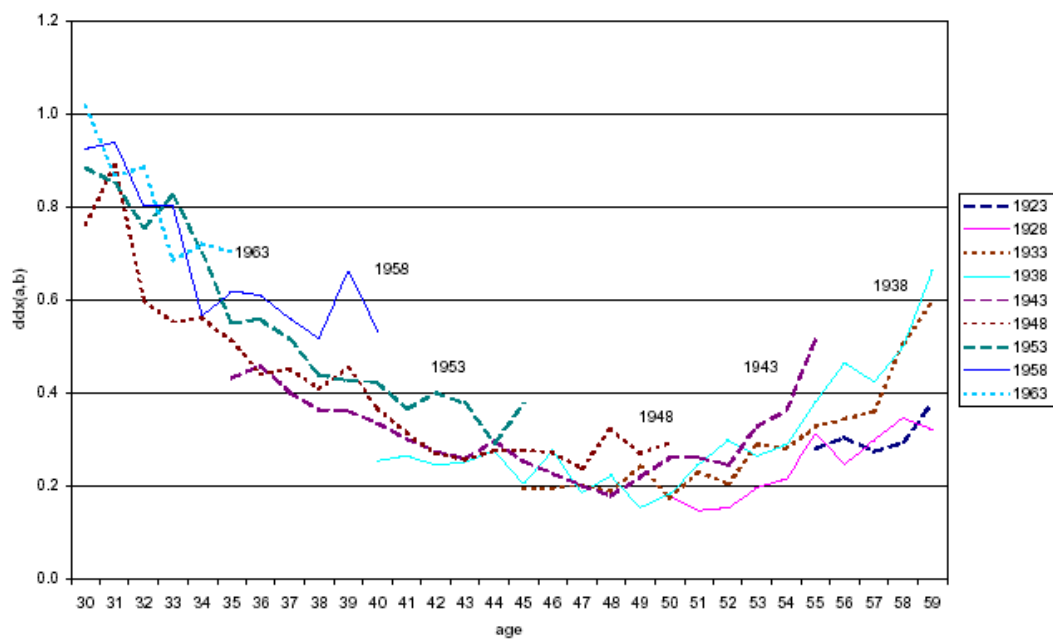


¹¹ To calculate the value of ddx we extended the upper age group to 89+. $D(59)$ is calculated as $N(89+)/N(59)$ and $Dx(59)$ is calculated in a similar manner.

1.b Proportion nuclear ages 30-59



1.c Relative dependency structure



Proportion of seniors in extended households

Several features of the proportion of seniors living in extended households (panel A) merit attention. First, the proportion of 60-year-olds living in nuclear households has actually *declined* in recent years. Second, the effect of age is very strong – as seniors age they are much more likely to move into extended households. Third, the effect of age appears to have declined over time. Compare, for example, the 1913, 1918, and 1923 birth cohorts. More comprehensive analysis of these data presented in Mason and Lee (2002) confirm these observations and offer an explanation of the seemingly inexplicable decline in the proportion of young seniors living in nuclear households. The proportion of young seniors living in nuclear households was temporarily elevated by the large surplus of males. The sex ratio exceeded 140 males per 100 females for the cohorts born in the mid- and late-1920s. Many men did not marry and raise children and, hence, could not establish extended households. By the time we reach the 1938 birth cohort, however, the sex ratio at age 60 had dropped to a more normal level somewhat below 100.

These aspects of the proportion of non-seniors living in extended households are captured using the regression model, equation(4), described in more detail above. The model was estimated using the consistent variance-covariance matrix estimator of White (1980). The standard errors are thus robust to heteroscedasticity. The estimated results with standard errors presented in parentheses are:

$$\ln(n/(1-n)) = -56.13 + 1.46\text{SexRatio} + 0.028\text{BYear} + 8.16\ln s \quad (8)$$

(3.77) (0.076) (0.02) (0.50)

N=546 $\bar{R}^2 = 0.86$

The sex ratio has a strong positive effect on the proportion of any cohort living in nuclear households. Controlling for the sex ratio the coefficient of birth year is significantly greater than zero. Over time there has been a gradual shift away from the extended family in Taiwan that has been masked by the large swings in the sex ratio. The model does not identify the source of the trend toward nuclear households. It may be increased income, higher educational attainment, urbanization, improvements in the non-family social support system, or other factors. Although any of these variables could in principle be used as regressors in the model, we do not think the model has sufficient power to distinguish among these alternative explanations using the data that are available.

The natural logarithm of the age-specific survival rate captures the influences of individual aging on the probability that a senior will live with an adult child. At any point in time age groups with a lower risk of death – those at younger ages – are more likely to live in nuclear households. Over time the survival rate at any given age is rising, producing an increase in the proportion living in nuclear households at each age. The shift in the age effect is consistent with Taiwan's experience as shown in Figure 1. However, the regression model tends to underestimate the shift in the age effects (Mason and Lee 2002).

The Relative dependency structure (ddx)

The model of living arrangements is completed by estimating the effect of changes in the population dependency ratios on the dependency ratios in extended households. Equation(7) is estimated using ordinary least-squares regression. The age dummy coefficients are available from the authors. The estimated equation, with standard error in parentheses, is:

Table 1. Income Distribution Variables, Taiwan, 1978-1998.

Year	Mean Income			Variance			C(YkYp)
	Non-Seniors	Seniors	Ratio	Non-Seniors	Seniors	Ratio	
1978	0.759	0.182	0.239	0.246	0.158	0.645	-0.032
1979	0.891	0.213	0.239	0.368	0.213	0.578	-0.020
1980	1.117	0.266	0.238	0.539	0.299	0.556	-0.058
1981	1.265	0.323	0.255	0.672	0.412	0.614	-0.059
1982	1.324	0.321	0.242	0.760	0.457	0.601	-0.042
1983	1.437	0.353	0.246	0.918	0.511	0.557	-0.043
1984	1.516	0.355	0.234	0.989	0.500	0.506	-0.047
1985	1.564	0.386	0.247	1.060	0.636	0.600	-0.073
1986	1.661	0.410	0.247	1.160	0.734	0.632	-0.070
1987	1.767	0.464	0.263	1.329	0.785	0.590	-0.124
1988	2.035	0.518	0.255	1.780	1.048	0.589	-0.117
1989	2.303	0.545	0.237	2.196	1.144	0.521	-0.182
1990	2.593	0.628	0.242	2.845	1.419	0.499	-0.213
1991	2.986	0.706	0.236	3.683	1.687	0.458	-0.108
1992	3.312	0.790	0.239	4.539	2.066	0.455	-0.280
1993	3.714	0.945	0.254	5.611	3.008	0.536	-0.365
1994	4.024	1.029	0.256	6.698	3.461	0.517	-0.519
1995	4.398	1.191	0.271	8.170	4.194	0.513	-0.464
1996	4.507	1.187	0.263	8.620	4.749	0.551	-0.745
1997	4.699	1.261	0.268	9.388	4.866	0.518	-0.601
1998	4.792	1.295	0.270	10.154	4.749	0.468	-0.753

Source: Taiwan Family Income and Expenditure Surveys, 1978-1998.

$$\ln D^x(a, t) = \sum_{a=30}^{59} \hat{\alpha}(a) \text{Age}(a) + 0.588 \ln D(a, t). \quad (0.018) \quad (9)$$

$N = 630 \quad \bar{R}^2 = 0.967$

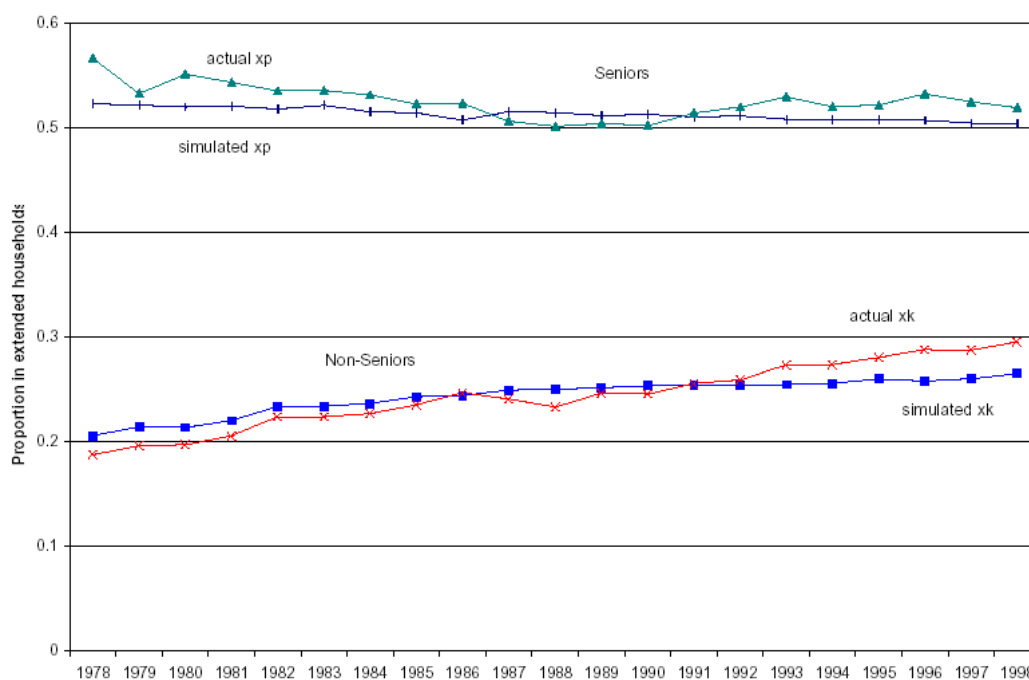
The elasticity of the dependency ratio in extended households with respect to the population dependency ratio is substantially less than one.

The Effect of Aging on Inequality and Living Arrangements

The influences of aging on inequality are sufficiently complex that the overall changes in inequality cannot be apportioned between the effects of the demographic transition and the effects of non-demographic variables. Consequently, we employ a simulation approach. The baseline simulation holds the mean and variances of the income of seniors and non-seniors and the co-variance between the income of co-resident seniors and non-seniors at the values observed in 1998 (see Table 1). Similarly, the two cohort variables – the sex ratio at age 60 and year of birth – are held constant at their 1998 values. The simulated change in inequality from 1978 to 1998 reflects the influences of improving survival on the proportion of seniors living in extended households, the influence of changes in the dependency ratio on the proportion of non-seniors living in extended households, and the influence of changes in the age composition of the population.

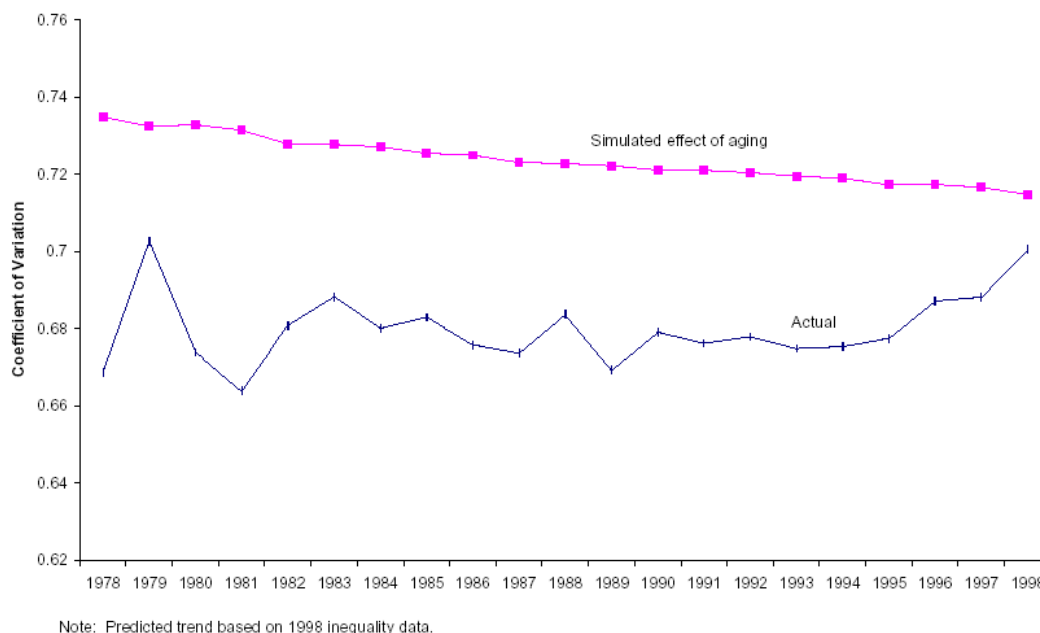
The baseline simulation of the proportions of seniors and non-seniors living in extended households is shown in Figure 2 and compared with the actual proportions for 1978 to 1998. The simulated decline in the proportion of seniors living in extended households due to increased survival rates is modest – from 52.3 percent in 1978 to 50.5 percent in 1998. The actual decline differed from the simulated decline because of the downward secular trend in the proportion in extended households, the effects of swings in the sex ratio at age 60, and estimation error. The simulated proportion of non-seniors living in extended increases from 20.6 percent in 1978 to 26.5 percent in 1998. The simulated increase differs from the actual because it incorporates only the simulated changes in the proportion of seniors living in extended households and because of estimation error.

Figure 2. Simulated Effect of Aging on Living Arrangements



The effect of aging on inequality in the baseline simulation is shown in Figure 3. To allow comparisons over time, we rely on the coefficient of variation (CV): $\sqrt{V(Y)} / \bar{Y}$. We use the simulated variance and the actual mean to calculate the simulated coefficient of variation. For the baseline simulation, the effect of aging is to reduce inequality – the coefficient of variation declines from 0.735 to 0.715 between 1978 and 1998.

Figure 3. Comparison of Simulated Age Effect to Actual Trend in Inequality



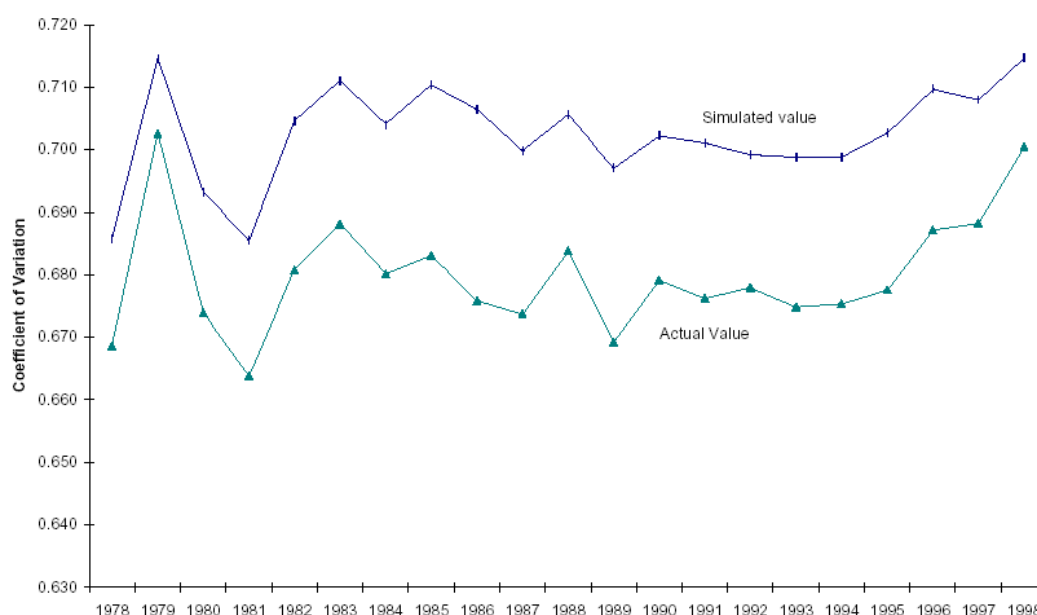
If we compare the simulated to the actual CV several differences are apparent. The actual CV fluctuates a great deal more than the simulated CV. This is to be expected given that demographic variables evolve slowly as compared with interest rates and unemployment, for example. There is no apparent trend in the actual CV with the exception of upward movement after 1995. Hence, the downward pressure of aging must have been counterbalanced by upward pressure from non-demographic forces, e.g., an increase in inequality within age groups.

One difference between the simulated and actual trend is one that merits additional attention. The actual CV is below the simulated CV in 1998 even though 1998 values are used in the baseline simulation. The simulated CV differs from the actual CV for two reasons. First, by design the simulated CV is based on simulated rather than actual values for the proportions living in extended households. If we used the actual values for the proportion living in extended households rather than the predicted values the simulated CV would decline to 0.709 from 0.715 as compared with an observed CV of 0.700. Hence, the use of simulated living arrangement values accounts for 40% of the difference between the observed and the simulated CV.

Second, equation (1), which is used to calculate the variance in income, holds exactly only if the assumptions on which it is based hold exactly. Of course they do not. Sixty percent of the difference between the observed and the simulated CV is accounted for by the approximation error. The size of the error is small relative to the CV, i.e., $0.009/0.700$ or only 1.3%, but it is large relative to the simulated effect of aging, i.e., $0.009/0.02$ or 45%. It is possible that changes in the size of the approximation error account for the difference between the simulated and actual trend. If this were the case, we could not exclude the possibility that a more complete accounting of the influences of aging would lead to a different conclusion about the effects of aging.

We examine this issue by calculating the CV for every year using the actual age distribution data, the predicted values of living arrangement variables, and the actual values of the mean, variance, and covariance of income variables (reported in Table 1). The calculated values are plotted along with the actual values in Figure 4. The difference between the two series is consistently small – never exceeding 0.031. The series move together with no more evidence of a trend in the calculated than in the actual values. The partial correlation between the two series is 0.89. Comparison of the two series strongly suggests that the simulated effect of aging shown in Figure 3 is not likely to be swamped by an undisclosed trend in the error term that is itself associated with aging.

Figure 4. Comparison of Simulated and Actual Coefficient of Variation Using Cohort and Income Variables for Each Year



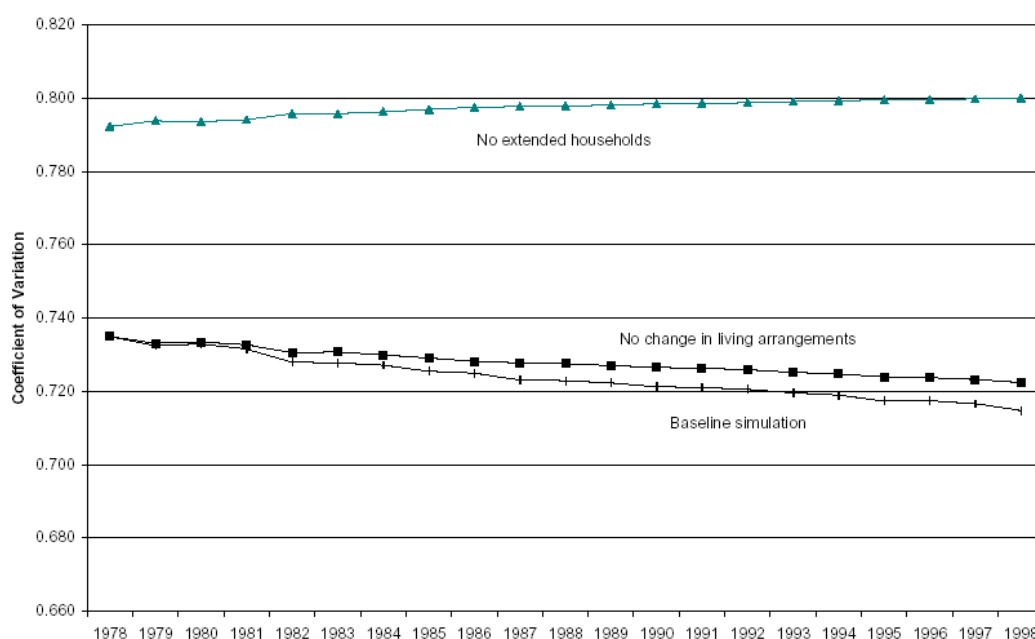
To this point we have only simulated the effects of aging holding other variables constant at their 1998 levels. Perhaps the results are sensitive to this choice. We have simulated the coefficient of variation holding the cohort variables and income distribution variables constant at the values observed in 1978, 1983, 1988, and 1993, in addition to 1998, as reported in Table 2. Depending on the year used the effect of aging is to reduce the CV by a value ranging from 0.015 to 0.024. The conclusion that aging has led to a decline in inequality appears to be robust.

Table 2. Alternative Simulations of the Effect of Aging on Inequality

Year of baseline data	Simulated Coefficient of Variation		Change in CV 1978-1998
	1978	1998	
1978	0.686	0.662	0.024
1983	0.717	0.695	0.022
1988	0.714	0.696	0.018
1993	0.709	0.694	0.015
1998	0.735	0.715	0.020

A final issue to consider is the importance of living arrangements in the assessment of the influence of aging on inequality. The issue can be framed in two distinct ways. Suppose that the proportion living in extended households remained constant at the predicted level for 1978. For this to occur the dependency ratio within extended households would have to increase as rapidly in percentage terms as the population dependency ratio. Under these conditions population aging would still have produced a decline in the CV but one that was more gradual than the baseline simulation (Figure 5).

Figure 5. Simulated Effect of Living Arrangements on Inequality



Now suppose that there were no extended households at all in Taiwan. In this case, the CV is calculated using equation (3). The coefficient of variation would have been substantially higher in 1978 and population aging would have led to a modest rise in the level of inequality. Of course, the impact on inequality would be tempered to the extent that other forms of support for seniors existed to compensate for the absence of private, family transfers.

5. Conclusions

The central contribution of this paper is to draw attention to an important issue that has received insufficient attention in studies of income inequality: population aging induces changes in the family support system. In societies where the family support system is important its erosion could adversely affect the economic status of the elderly and overall levels of inequality. Thus, the effect on inequality of changes in age structure

will depend on the compositional effects emphasized in previous studies and the effects on extended living arrangements.

On *a priori* grounds one cannot say whether population aging will lead to a rise or to a decline in extended living arrangements. What we observe in Taiwan is a mixed response – a modest decline in the proportion of seniors living in extended households matched with a more significant rise in the proportion of non-seniors living in extended households. In Taiwan's case, the rise of non-senior adults dominates leading to a net increase in the proportion of adults living in extended households. As a result, the effect of aging has been a small, gradual reduction in per capita income inequality between 1978 and 1998.

Although the emphasis in this paper is on the effects of aging, this is not the only factor that is influencing income inequality in Taiwan. Our analysis of living arrangements finds a gradual secular decline in the proportion of seniors living in extended households. If this trend continues or accelerates per capita income inequality will rise in Taiwan. If extended households were to disappear altogether the coefficient of variation would rise by 12% given the population age structure that prevailed in 1998. This provides direct quantification of the importance of the family support system in Taiwan.

Changes in the distribution of income within the broad age groups we are analyzing and changes in the differences in the mean incomes of seniors and non-seniors are also influencing the overall level of income inequality in Taiwan. These changes are not analyzed directly, but they are responsible for the difference between the actual trend in the coefficient of variation and the effect of aging. These other factors, then, are responsible for a gradual increase in inequality, which has been offset by the effects of aging except for the last few years for which data are available.

Other countries in East and Southeast Asia are experiencing demographic change that is every bit as rapid as that experienced by Taiwan. Moreover, the family support system is also important in these countries. Prominent examples are Japan, South Korea, Singapore, Thailand, and China. Their family support systems are subject to the same demographic pressures as Taiwan's. How those support systems will evolve in response to that pressure and how levels of inequality will be affected are questions that can only be answered by additional research.

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Discussion on “Is the Population Aging Causing and Increase in Income Inequality? Evidence from Taiwan”

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This paper addresses the effect of population aging on income distribution inequality. Population aging has very important economic implications on diverse issues, and its importance draws more and more public attention as the population structures, domestic and foreign, are rapidly aging. As such, I would not need to repeat the importance of the issue.

One of the concerns regarding population aging is its impact on income distribution. Generally income distribution is more unequal among the old than among the young, and one may quickly conclude that population aging will aggravate income distribution. But the authors show that the impact of population aging on income distribution may be otherwise if we consider the change in living arrangements, specifically the rise in the proportion of extended families – families composed of the young and the elderly – along with population aging.

The paper is short. But I found the paper a little bit hard to understand. Notation is confusing and too many symbols are defined. I think the notation can be simplified: For example, if the population is normalized with K ($K=1$), M is not needed since $M=D$, and both K and M can be dispensed with. Since $x_k + x_m = 1$, x_m can be substituted with $1 - x_k$, and so on. On page 4, x denotes ‘senior’ in D_x , and the proportions in x_k and x_m . As the authors are introducing too many symbols, notation becomes complicated and sometimes it confuses the readers. On page 6, a very important decomposition of variance of income is given (in equation 1.1). However I could not derive the decomposition myself. It seems that more explanation should be given if the readers are to derive the decomposition themselves. Or, I think a more intuitive or heuristic explanation of the meaning of the decomposition result would help the readers’ understanding.

The major question on this paper, I think, is whether we directly address the income transfers within the family members rather than relying on the simple assumption that families pool their incomes and distribute equally among them. In this paper, the authors simply assume that income distribution within family is determined by their living arrangement decisions – which is a highly simplified assumption. If they live together (extended HH), they will equally distribute their total income; if they decide to live separately (nuclear HH), they don’t care about their relatives. Under this assumption, the income of the elderly in extended families may be overestimated. Suppose that the young and the elderly are living separately in nuclear households. If the young transfer their income to the elderly, the income of the elderly in nuclear households would be equal to the actual receipt of transfer incomes. On the other hand, incomes of the elderly in extended families may be overestimated since their incomes are the same as the young’s in the household by assumption. Hence, empirical results on the impact of population aging on income distribution may not be very reliable as they are based upon such a somewhat strong assumption. Basically, living arrangement decisions regarding

distribution of incomes among household member may be completely from living arrangement decisions regarding living places. It seems that this part is not sufficiently addressed in this paper.

As the authors have emphasized early in the paper, the issue of the impact of population aging on income distribution may be an empirical issue in nature. The direction of the impact is not determined a priori, and the impact hinges upon the preference structure, the existing structure of financial assets, social and economic institutions including pension systems, etc. If the nature of issue is empirical, I think one need to look at the empirical facts in a greater detail as far as the data conditions allows. For example, If family relationship can be ascertained from the data, one may look at the transfers among the family members in different households, and infer the magnitudes of income transfers among family members within households. If the family relationship across households can not be identified from the data, one may look at private transfers in the incomes of the elderly and guess the amount of income transfers among the family members. In the Korean data, I could confirm that private transfers greatly reduces income distribution inequality among the elderly headed households—which implies that income transfers from their descendants are very important income sources among the elderly.

I think the paper would be much more interesting if the authors tried to identify empirical facts first and then theorize, rather than set up a theoretical model based upon strong assumptions and tried to verify the model using data.

Issues in Accounting and Reporting of the National Pension Fund of Korea

by
Hung Sik Shin

Abstract

In this paper, we introduce the new accounting standards for social insurance in the United States for the National Pension Fund (NPF) of Korea. Required supplementary stewardship information (RSSI) in annual reports of social insurance programs includes various actuarial estimates that show annual surplus or deficit of the plan, and actuarial present values that are needed to pay all promised benefit payments to participants during the projection period. Current annual report of the NPF does not provide any actuarial estimates that are important in assessing the long-term sustainability of the program. We suggest that the National Pension Corporation adopt social insurance accounting standards and provide both long-range actuarial estimates and actuarial present values of the NPF in order to enhance public trust toward the NPF.

I. Introduction

Korea is rapidly moving into an aging society. According to studies by the Korea Development Institute (KDI), reported in newspapers,¹ population of senior citizens aged 65 or older is projected to account for 14 percent of the total population by the year 2019, almost a twofold increase from 7.2 percent in 2000. In preparations for the aging society, the Korean government established the National Pension Scheme (NPS) in 1988.

Since its establishment, the sustainability of the National Pension has become an important public issue. Several studies have projected that the National Pension Fund (NPF) may be exhausted before the year 2050. For example, Tchoe (2002) reported that the NPF would be depleted by the year 2044, four years faster than his previous projection that the NPF would sustain until the year 2048. This significant change in his projection was attributed to a new population projection and low rates of return in financial markets. Yet, the general public often had limited access to details of those studies which typically use complicated economic and statistical models. In addition, the current accounting standards in Korea have not incorporated important pension accounting elements.

As a result, annual reports of the NPF do not provide information regarding long-term sustainability of the National Pension. Inadequacy and insufficiency of information regarding the plan sustainability often contribute to lack of public confidence of the National Pension Scheme. In order to build up public trust, the National Pension

¹ See, for example, Korea Times on May 28, 2002, May 31, 2002, December 8, 2002 and January 2, 2003.

Corporation (NPC) has established and implemented the "National Pension Vision 2010," which includes publication of annual reports of the NPF for the public, disclosure of periodic long-range projection of the NPF and/or introduction of pension accounting for the NPF. Yun and Kang (2002) reviewed long-term projection methods of Canada, Japan and the United States, and proposed a framework for the Report of Long-term Financial Balances of the National Pension Fund ("provisional title") to be published by the National Pension Corporation in 2003.

A plan for providing long-range actuarial information including the cost of the program and long-range estimates of future costs and obligations to participants of the National Pension will certainly be a significant progress in enhancing public trust toward the National Pension Scheme. It is also important for policy makers and plan administrators to reform the National Pension Scheme, if necessary.²

Long-range actuarial estimates provide information for long-term financial status of a plan. Most of long-range actuarial value projection models, including Tchoe (2002) and Yun and Kang (2002), focus on the identification of the year in which the plan exhausts its fund. However, long-range estimates do not show the required amount for the plan to pay the promised future benefits to all participants for the long-range projection period. For example, Tchoe's study predicts that the NPF runs out of assets by the year 2044, but it does not show how much additional funds (or assets) are required today in order to make all promised benefit payments to participants for the long-term period, for example, for the next 50 years³, as Yun and Kang (2002) proposed in their study, considering long-range economic and demographic data availability from the Bureau of Statistics of Korea.

In August 1999, the Federal Accounting Standards Advisory Board (FASAB) of the United States issued the Statements of Federal Financial Accounting Standards (SFFAS) No. 17, *Accounting for Social Insurance*, as the new accounting standards for U. S. federal social insurance programs to be effective for reporting periods that begin after September 30, 1999. Therefore, for example, the 2000 Social Security Trust Report for the fiscal year that ended on September 30, 2000 was the first report that was prepared under the new accounting standards. The purpose of the SFFAS No. 17 is to establish standards for reporting information on social insurance programs that will assist users in evaluating operations and aid in assessing the government's financial conditions and the sufficiency of future budgetary resources to sustain program services and meet obligations as they come due.

There are five federal social insurance programs in the U.S. that are subject to the SFFAS No. 17 standards: Old-Age, Survivors, and Disability Insurance (OASDI or "Social Security"), Hospital Insurance (HI) and Supplementary Medical Insurance (SMI), known collectively as "Medicare," Railroad Retirement benefits, Black Lung benefits, and Unemployment Insurance (UI) for the general public. The SFFAS No. 17 is applicable only to these federal social insurance programs. SFFAS No. 17 was a very significant development in accounting for social insurance, particularly for Social Security in the United States. SFFAS No. 17 can become a protocol for accounting standards for national pension plans in many countries that feature defined benefit types of social insurance, because few countries established separate accounting standards for their national pension or social security plans.

² The appropriate accounting for public pension costs is also an important issue to government accounts, public deficits and debt. Gillion et al. (2000) discuss various issues of pension costs on government debt, both explicit and implicit debt in Chapter 14 of *Social Security Pensions: Development and Reform*.

³ Canada projects estimates for a 100-year period, United States projects estimates for a 75-year period and Japan uses a 60-year projection period.

The primary objective of this paper is to introduce the new accounting standards for the U.S. Social Security for the National Pension Fund of Korea. This paper briefly describes background of the accounting for U.S. social insurance and discusses key elements of social insurance accounting. The social insurance accounting standards requires the social insurance program administrators to include various long-range actuarial estimates in the financial report as required supplementary stewardship information (RSSI). One of important RSSI is the "statement of social insurance" that is based on actuarial *present* values (APV). For example, the Social Security annual report is required to include the Statement of Social Security that is composed of the actuarial present value of future payments during the 75-year period, the actuarial present value of future contributions and income during the same period, and the net of the two actuarial present values.

This paper is organized as follows: Section II discusses problems of the current annual report of the NPF; Section III describes the accounting standards for the U.S. Social Security; and Section IV presents a summary and suggestions for the NPF reporting.

II. Current Accounting Standards for the National Pension Fund

The National Pension Fund was established by the Minister of Health and Welfare under the National Pension Act in order to "serve as a reserve fund to secure the finances necessary for the National Pension plan and to meet the pension benefits" (Article 82). The National Pension Corporation, under the delegation of authority by the Minister of Health and Welfare, manages and operates the NPF. Chapter Six of the Act and Chapter Six of Enforcement Decree of the Act contain various regulations of the NPF management and operation. For example, Article 83-4 of the Act states, "the Minister of Health and Welfare shall balance the account of the NPF to evaluate the operation results of the NPF and review the status of the NPF," and Article 53 of the Enforcement Decree states, "the accounting of the NPF shall be based on the facts of the case and administered in accordance with the principles of business accounting." Accordingly, the Ministry of Health and Welfare established the Special Accounting Standards for the NPF, which are consistent with business accounting standards.

The NPF Special Accounting standards require the annual report of the NPF to include the following financial statements: the trial balance, the balance sheet, the income statement, the statement of retained earnings, the statement of cash flows, and various detailed account statements and supplementary documents. In addition to required statements, the annual report of the NPF typically includes the summary of the report, the management discussion, the auditor's report, and other supplementary data.

While the annual report of the NPF meets the requirements of the NPF accounting standards that are consistent with business accounting standards in Korea, it does not provide any important information regarding the long-term financial status of the NPF. For example, the balance sheet of the NPF reports assets, liabilities and capital (equivalent to National Pension Fund) as of the end of the fiscal year. Assets are composed of current assets and long-term (invested) assets. Liabilities generally include short-term obligations such as unpaid expenses and unpaid benefits to plan participants, and they are relatively a very small amount. Capital or National Pension Fund is composed of contributed-capital, earnings surplus (retained earnings) and capital adjustments. The largest element of capital is the pension contributions reserve which is the difference between the participants' contribution to the National Pension Fund and actual pension benefit payments to participants. However, annual reports of the NPF do not include any actuarial information that is pertinent to assessing the sustainability of

the plan. It is because the current business accounting standards in Korea has not established standards for pension accounting. Consequently, the NPF Special Accounting standards are not consistent with international pension accounting standards.

Table 1 shows the balance sheet of the NPF as of December 31, 2002. The fair value of the NPF was over 96 trillion Korea *won* (or approximately 80 billion U.S. dollars) at the end of 2002. However, it does not provide any indication for the long-run sustainability of the NPF.

Table 1. National Pension Fund Balance Sheet (Abridged) December 31, 2002

(In Billions <i>Won</i>)			
Assets		Liabilities and Capital	
I. Current Assets	4,870	I. Current Liabilities	3,590
Money market securities	354	Unpaid pension benefits	0
Accrued investment income	1,156	Unpaid expenses	801
Securities	3,360	Prepaid contributions	2,789
Other prepaid expenses	4	II. Long-term Liabilities	0
II. Invested Assets	91,187	Total Liabilities	3,590
Invested securities	66,526	I. Contributed Capital	62,279
Deposits to Public Capital Management Fund	24,221	Pension contribution reserve	62,248
Other loans and investments	440	Other transfer & surplus	31
III. Other Assets	354	II. Earnings Surplus	32,122
Investments in real estate	208	Earnings reserve	32,122
Investments in welfare sector	89	III. Capital Adjustments	2,006
Others	57	Total Capital (NPF)	96,407
Total Assets	96,411	Total Liabilities & Capital	96,411

III. Accounting Standards for U. S. Social Security: SFFAS No. 17

1. Background of the Accounting for U. S. Social Insurance

Since the 1950s, there have been debates in the accounting community about how to apply accrual concepts in measuring costs and liabilities resulting from defined benefit type programs. Prior to the SFFAS No. 17, Social Security (Old-Age, Survivors, and Disability Insurance: OASDI) and other federal social insurance programs often used accounting standards similar to FASB Statement of Financial Accounting Standards (SFAS or FASB) No. 87, *Employer's Accounting for Pensions*, and followed accounting standards in other FASAB statements such as SFFAS No. 5, *Accounting for Liabilities of the Federal Government*, and SFFAS No. 8, *Supplementary Stewardship Reporting*.

In adopting the SFFAS No. 17, the Federal Accounting Standards Advisory Board (FASAB) agreed that liabilities from federal social insurance programs should be considered as non-exchange transactions obligations, different from exchange transactions obligations that are subject to SFFAS No. 5. In an exchange transaction, a liability is recognized when one party receives goods or services in return for a promise to provide money or other resources in the future. However, for a non-exchange transaction, a liability is recognized for any unpaid amounts due and payable as of the reporting date, including estimates of claims incurred but not yet reported.⁴

The FASAB also required the use of the open group method⁵ in estimating liabilities of federal social insurance programs, while FASB No. 87 and Government Accounting Standards Board (GASB) No. 25, *Financial Reporting for Defined Benefit Pension Plans and Note Disclosures for Defined Contributions Plans*, were based on the closed group method of estimation. In an open group method, liabilities (and surpluses) are estimated as the actuarial present values (APV) of future benefits for and future contributions and tax income from or on behalf of all current and future participants during the projection period normally used by the programs. For example, the OASDI (i.e., Social Security) program uses a 75-year projection period. Meanwhile, the closed group measure represents the actuarial net present value of (a) the future benefit payments to current participants, (b) future contributions to be made by them and their employers, and (c) the accumulated excess of cash receipts over cash disbursements within the social insurance program represented by fund balance at the valuation date.

2. Key Accounting and Reporting Standards of the SFFAS No. 17

1). Expense & Liability Recognition: The expense recognized for the reporting period should be the benefits paid during the reporting period plus any increase (or less any decrease) in the liability from the end of the prior period to the end of the current period. The liability should be social insurance benefits due and payable to or on behalf of beneficiaries at the end of the reporting period, including claims incurred but not reported.⁶

⁴ SFFAS No. 17, paragraphs 60 – 63.

⁵ SFFAS No. 17, par. 72 and 91.

⁶ SFFAS No. 17, par. 22.

The Social Security Administration (SSA) is required to provide the financial statements for all funds and accounts under SSA control⁷ including Old-Age, Survivors Insurance (OASI) Trust Fund and Disability Insurance (DI) Trust Fund. Required financial statements are the consolidated balance sheet, the consolidate statement of net cost for the year (income statement), the consolidated statement of changes in net position for the year, the combined statement of budgetary resources for the year, and the consolidated statement of financing for the year. SSA is also required to provide the financial statements for the major programs such as OASI and DI programs. The financial statements must be prepared on an accrual basis, in conformity with generally accepted accounting principles (GAAP) of the United States.

Table 2 Old-age, Survivors and Disability Trust Fund Consolidated Balance Sheet
September 30, 2002

(In Billions)	
Assets	
Intragovernmental:	
Fund Balance with Treasury	\$ 0*
Investments	1,329
Interest Receivable, Net	20
Accounts Receivable, Net	1
Other	<u>0</u>
Total Intragovernmental	1,350
Accounts Receivable, Net	3
Property, Plant and Equipment, Net	<u>1</u>
Total Assets	\$1,354
Liabilities	
Intragovernmental:	
Accrued Railroad Retirement Interchange	\$ 4
Other	<u>1</u>
Total Intragovernmental	5
Benefits Due and Payable	51
Accounts Payable	<u>0</u>
Total	<u>56</u>
Net Position	
Unexpended Appropriations	0
Cumulative Results of Operations	<u>1,298</u>
Total Net Position	<u>1,298</u>
Total Liabilities and Net Position	\$1,354

* Rounded figure of less than \$0.5 billion.

Table 2 shows the consolidated balance sheet of the OASDI Trust Fund as of September 30, 2002.⁸ The balance sheet is composed of assets, liabilities and net position

⁷ Currently, three trust funds, three deposit funds, and five general fund appropriations are under SSA control.

⁸ Author prepared the consolidate balance sheet of the OASDI from the SSA's FY2002 Performance

of the Trust Fund. The primary assets of the OASDI Trust fund are investments in U.S. Treasury securities. It is because that, under provisions of the Social Security Act, Trust fund balances may be invested only in interest-bearing obligations of the U. S. or in obligations guaranteed as to both principal and interest by the U.S. These investments consist of U.S. Treasury special issues and bonds. Special issues are special public debt obligations for purchase exclusively by the trust funds and for which interest is computed semi-annually (June and December). Net position of Trust fund is currently available assets held in the Trust fund for Social Security benefits. As of September 30, 2002, OASDI Trust fund held \$1,354 billion of assets for benefit payments. During the fiscal year 2002, SSA paid out \$453 billion of benefit payments to OASDI program beneficiaries.⁹ While the Trust fund currently holds sufficient assets to pay benefits now, however, the Trust fund is projected to become exhausted by 2041. The balance sheet of the OASDI Trust fund shows the current status of assets, liabilities and net position of the fund only, but provides no information for the future financial status of the program.

2). Required Supplementary Stewardship Information (RSSI): The entity responsible for the social insurance program should include in its financial report, as required supplementary stewardship information (RSSI), a clear and concise description of the program, how it is financed, how benefits are calculated, and its financial and actuarial status. The description should include a discussion of the long-term sustainability and financial condition of the program. A display should illustrate and the discussion should explain the trend revealed in the data. The entity should consider both narrative and graphic presentations. The projections and estimates used should be based on the entity's best estimates of demographic and economic assumptions, taking each factor individually and incorporating future changes mandated by current law. Significant assumptions should be disclosed. RSSI should include the following measures and data:

(1) Cashflow Projections – Projections of cashflow for those persons who are participating or eventually will participate in the program as contributors (“total cash inflow”) or beneficiaries (“total cash outflow”) during a projection period sufficient to illustrate long-term sustainability. For example, traditionally the Social Security program has used a projection period of 10 years for relatively short-term and 75 years for long-term projections. The narrative accompanying the cashflow data should include identification of any year or years during the projection period when cash outflow exceeds inflow (the “cross-over points”), and an explanation of the significance of the cross-over points. The actuarial estimate should also be provided as a percentage of taxable payroll and Gross Domestic Product (GDP).

Social Security Administration's FY 2002 Performance and Accountability Report (“SSA's 2002 Report”) provides actuarial estimates of OASDI annual income, income excluding interest, and expenditures for 2002–2041 in nominal dollars. These estimates are only reported through 2041, the year that the OASDI trust funds are projected to become exhausted.¹⁰ The estimates are for the open group population, all persons projected to participate in the OASDI program as covered workers or beneficiaries, or both, during that period. Thus, the estimates include payments from, and on behalf of, workers who will enter covered employment during the period as well as those already in covered employment at the beginning of that period. They also include expenditures made to, and on behalf of, such workers during that period.

and Accountability Report. SSA, however, prepares balance sheets of OASI Trust Fund and DI Trust Fund separately.

⁹ Consolidated Statement of Net Cost for the year ended September 30, 2002.

¹⁰ SSA's FY 2002 Performance and Accountability Report, p. 80.

SSA's 2002 Report shows that estimated expenditures start to exceed income (including interest) in 2027. This occurs because of a variety of factors including the retirement of the "baby boom" generation, the relatively small number of people born during the subsequent period of low birth rates, and the projected increases in life expectancy, which increase the average number of years of receiving benefits relative to the average number of years of paying taxes. Estimated expenditures start to exceed income excluding interest even earlier, in 2017. At that time, to meet all OASDI expenditures on a timely basis, the trust funds would begin to redeem assets (Treasury securities). To finance this redemption, the government would have to increase its borrowing from the public, raise taxes (other than OASDI payroll taxes), and/or reduce expenditures (other than OASDI expenditures). The government, of course, could avert this redemption by changing the law to increase OASDI taxes and/or reduce OASDI benefits.

(2) Ratio of Contributors to Beneficiaries – With respect to the OASDI and HI programs, the ratio of the number of contributors to the number of beneficiaries (commonly called the "dependency ratio") during the same projection period as for cashflow projections (e.g., 75 years), using the program managers' best estimate.

SSA's 2002 Report provides the estimated number of covered workers per OASDI beneficiary using the Trustees' intermediate assumptions. As defined by the Trustees, covered workers are persons having earnings creditable for OASDI purposes on the basis of services for wages in covered employment and/or on the basis of receipts from covered self-employment. The estimated number of workers per beneficiary will decline from 3.4 in 2001 to 2.1 in 2037 and 1.8 in 2076.

(3) Actuarial Present Values (APV) – The actuarial present value of future contributions and tax income during the projection period should be subtracted from the actuarial present value of future expenditures for the projection period related to benefit payments to derive a total excess of future benefit payments over future contributions and tax income. These actuarial present values should be reported in the *Statement of Social Insurance* of the entity.

Table 3 shows the Statement of Social Insurance of OASDI for the 75-year projection period beginning January 1, 2002. The actuarial present value of future income was \$25.3 trillion and the actuarial present value of future expenditures was \$29.9 trillion, respectively. While the 75-year projected deficit of the Social Security Trust Fund was \$4.6 trillion, but the Trust Fund only needs additional \$3.4 trillion in order to pay the current OASDI benefits until 2076, because the Trust Fund had \$1.2 trillion of assets¹¹ in the fair market value, as of January 1, 2002.

Table 3 Statement of Social Insurance Old-Age, Survivors and Disability Insurance 75-Year Projection as of January 1, 2002

(In billions)

	<u>Estimates from Prior Years</u>		
	<u>2002</u>	<u>2001</u>	<u>2000</u>
Actuarial present value¹ for the 75-year projection period of estimated future income (excluding interest)² received from or on behalf of:			

Current participants³ who, at the start of projection period:

¹¹ Total assets for OASDI at the end of the fiscal year 2002 as of September 30, 2002 were \$1.35 trillion, according to the Consolidated Balance Sheet in the SSA's 2002 Report.

Have not yet attained retirement eligibility age (Ages 15-61)	\$13,048	\$12,349	\$11,335
Have attained retirement eligibility age (Age 62 and over)	348	309	266
Those expected to become participants (Under Age 15) ⁴	<u>11,893</u>	<u>11,035</u>	<u>10,088</u>
All participants	<u>25,289</u>	<u>23,693</u>	<u>21,688</u>

Actuarial present value¹ for the 75-year projection period of estimated future expenditures⁵ paid to or on behalf of:

Current participants³ who, at the start of projection period:

Have not yet attained retirement eligibility age (Ages 15-61)	20,210	18,944	17,217
Have attained retirement eligibility age (Age 62 and over)	4,402	4,255	4,020
Those expected to become participants (Under Age 15) ⁴	<u>5,240</u>	<u>4,700</u>	<u>4,297</u>
All participants	<u>29,851</u>	<u>27,899</u>	<u>25,534</u>

Actuarial present value¹ for the 75-year projection period of estimated future excess of income (excluding interest) over expenditures

-\$4,562 -\$4,207 -\$3,845

Trust Fund Assets⁶ at Start of Period

1,213 1,049 896

Actuarial Present Value¹ for the 75-year Projection Period of Estimated Future Excess⁷ of Income (excluding interest) and Trust Fund

-\$3,350 -\$3,157 -\$2,949

Assets at Start of Period Over Expenditures

(Source: SSA's FY 2002 Performance and Accountability Report)

Footnotes to the Statement of Social Insurance

¹ Present values are computed on the basis of the intermediate economic and demographic assumptions specified in the Report of the Board of Trustees for the year shown and over the 75-year projection period beginning January 1 of that year. Totals do not necessarily equal the sum of the rounded components.

² Income (excluding interest) consists of payroll taxes from employers, employees, and self-employed persons; revenue from Federal income-taxation of OASDI benefits; and miscellaneous reimbursements from the General Fund of the Treasury.

³ Current participants are the "closed group" of individuals age 15 and over at the start of the period. To calculate the actuarial present value of the excess of future income (excluding interest) from or on behalf of these individuals over future expenditures for them or on their behalf, subtract the actuarial present value of future expenditures for them or on their behalf from the actuarial present value of future income (excluding interest) from them or on their behalf. The projection period for the closed group would theoretically include all future working and retirement years, a period which may exceed 75 years in some instances. While the estimates are limited to the 75-year projection period, the present value of future income and expenditures for the closed group participants beyond 75 years is not material.

⁴ Includes births during the period.

⁵ Expenditures include benefit payments, administrative expenses, net transfers with the Railroad Retirement program, and vocational rehabilitation expenses for disabled beneficiaries.

⁶ Trust fund assets represent the accumulated excess of all past income, including interest on trust fund assets, over all past expenditures for the social insurance program. The assets are invested only in securities backed by the full faith and credit of the Federal Government.

⁷ If this excess is positive, it represents the estimated trust fund assets (expressed in present value dollars) at the end of the 75-year projection period; if negative, the absolute value of the excess represents the magnitude of the unfunded obligation of the program over the 75-year projection period. The calculation of the actuarial balance used for analysis by the Social Security trustees differs from the calculation of the amount presented on this line. The trustees' actuarial balance is expressed as a percentage of the taxable payroll and includes the cost of attaining a target fund balance equal to the estimated next year's expenditures at the end of the period.

(4) Sensitivity Analysis – All programs except Unemployment Insurance (UI) illustrate the sensitivity of the projections and present values to changes in the most significant economic and demographic assumptions, including GDP, labor force, unemployment, average wages and self-employment earnings, interest rates on Treasury securities, productivity, inflation, fertility, mortality, net immigration, marriage, divorce, retirement patterns and disability incidence and termination. Because perfect long-range projections of these factors are impossible, the OASDI and Medicare programs are required to report the sensitivity of the long-range projections to changes in assumptions by analyzing, at a minimum, the following six key variables: total fertility rate, death rate, net immigration, real-wage differential, consumer price index, and real interest rate.¹² The Medicare program is required to analyze the health care cost factors and their trend, in addition to above key factors. In this section, we describe the sensitivity of the long-range projections to changes in assumptions of two factors: the fertility rate and the death rate.

Table 4 shows the present value of the estimated excess of OASDI income over expenditures for the 75-year period, using various assumptions about the ultimate total fertility rate. The total fertility rate for any year is the average number of children who would be born to a woman in her lifetime if she were to experience the birth rate by age observed in, or assumed for, the selected year, and if she were to survive the entire childbearing period. These assumptions are 1.7, 1.95 and 2.2 children per woman, where 1.95 is the intermediate assumption in the 2002 Trustees Report. The total fertility rate is assumed to change gradually from its current level and to reach the selected ultimate value in 2026.

Table 4. Present Value of Estimated Excess of OASDI Income over Expenditures with Various Ultimate Total Fertility Rate Assumptions Valuation Period: 2002 – 2076

	<u>Low</u>	<u>Intermediate</u>	<u>High</u>
Ultimate Total Fertility Rate (%)	1.7	1.95	2.2
Present Value of Estimated Excess (In billions)	-\$5,041	-\$4,562	-\$4,102

(Source: SSA's FY 2002 Performance and Accountability Report)

Table 4 demonstrates that, if the ultimate total fertility rate is changed from 1.95 children per woman to 1.7, the shortfall for the period of estimated OASDI income relative to expenditures would increase to \$5,041 billion from \$4,562 billion; if the ultimate rate were changed to 2.2, the shortfall would decrease to \$4,102 billion.

Similarly, Table 5 shows the present values of the estimated excess of OASDI income over expenditures for the 75-year period, using various assumptions about future reductions in death rates. The analysis was developed by varying the percentage decrease assumed to occur during 2001 - 2076 in death rates by age, sex, and cause of death. The decreases assumed for this period, summarized as changes in the age-sex-adjusted death rate, are 0.32, 0.75 and 1.33 percent per year¹³, where 0.75 percent is the intermediate assumption in the 2002 Trustees Report. These assumptions, however, do not apply uniformly to all ages. Some variation by age was assumed in recognition of historical patterns and to ensure that, in terms of the financial status of the OASDI program, estimates based on the summarized 0.32-percent and 1.33-percent reduction assumptions would be more optimistic and more pessimistic, respectively, than those based on the intermediate assumption.

Table 5 demonstrates that, if the reduction in death rates is changed from 0.75 percent per year, the Trustees' intermediate assumption, to 0.32 percent, meaning that people die younger, the shortfall for the period of estimated OASDI income relative to expenditures would decrease to \$3,300 billion, from \$4,562 billion; if the reduction were changed to 1.33 percent per year, meaning that people live longer, the shortfall would increase to \$6,092 billion.

Table 5. Present Value of Estimated Excess of OASDI Income over Expenditures with Various Death Rate Assumptions Valuation Period: 2002 - 2076

	<u>Low</u>	<u>Intermediate</u>	<u>High</u>
Average Annual Reduction in Death Rates (from 2002 to 2076)	0.32%	0.75%	1.33%
Present Value of Estimated Excess (In billions)	-\$3,300	-\$4,562	-\$6,092

(Source: SSA's FY 2002 Performance and Accountability Report)

(5) Social Security Assumptions -The estimates used in the RSSI are based on the assumption that the programs will continue as presently constructed. They are also based on various economic and demographic assumptions. Table 6 shows Social Security assumptions and the other values on which these displays are based reflect the intermediate assumptions of the 2002 Trustees Report. Estimates made in certain prior years have changed substantially because of revisions to the assumptions based on changed conditions or experience, and to changes in actuarial methodology. It is reasonable to expect more changes for similar reasons in future reports.

¹² SFFAS No. 17, par. 27 (4) (a).

¹³ The resulting cumulative decreases in the age-sex-adjusted death rate during same period are 21, 43 and 63 percent, respectively.

Table 6. Social Security Assumptions

	Total Fertility Rate ¹	Age-Sex-Adjusted Death Rate ² (per 100,000)	Period Life Expectancy at Birth		Net Annual Immigration (persons per year)	Real-Wage Differential ⁴ (percentage points)
			Male	Female		
2002	2.12	804.3	73.9	79.5	900,000	1.8
2005	2.10	789.6	74.3	79.7	900,000	1.2
2010	2.07	759.8	74.9	80.1	900,000	1.0
2020	1.99	698.1	76.0	81.0	900,000	1.1
2030	1.95	642.2	77.1	81.9	900,000	1.1
2040	1.95	593.2	78.0	82.8	900,000	1.1
2050	1.95	550.0	79.0	83.5	900,000	1.1
2060	1.95	511.9	79.8	84.3	900,000	1.1
2070	1.95	478.1	80.7	85.0	900,000	1.1

	Average Annual Percentage Change In:			Average Annual Interest Rate ⁷ (%)
	Average Annual Wage in Covered Employment	CPI ⁵	Real GDP ⁶	
2002	3.1	1.3	0.7	4.9
2005	4.1	2.9	3.2	6.4
2010	4.1	3.0	2.2	6.0
2020	4.1	3.0	1.8	6.0
2030	4.1	3.0	1.8	6.0
2040	4.1	3.0	1.8	6.0
2050	4.1	3.0	1.7	6.0
2060	4.1	3.0	1.7	6.0
2070	4.1	3.0	1.7	6.0

(Source: SSA's FY 2002 Performance and Accountability Report)

1. The total fertility rate for any year is the average number of children who would be born to a woman in her lifetime if she were to experience the birth rates by age observed in, or assumed for, the selected year, and if she were to survive the entire childbearing period. The ultimate total fertility rate is assumed to be reached in 2026.
2. The age-sex-adjusted death rate is the crude rate that would occur in the enumerated total population as of April 1, 1990, if that population were to experience the death rates by age and sex observed in, or assumed for, the selected year. It is a summary measure and not a basic assumption; it summarizes the basic assumptions from which it is derived.
3. The period life expectancy for a group of persons born in a given year is the average that would be attained by such persons if the group were to experience in succeeding years the death rates by age observed in, or assumed for, the given year. It is a summary measure and not a basic assumption; it summarizes the effects of the basic assumptions from which it is derived.
4. The real-wage differential is the difference between the percentage increases, before rounding, in the average annual wage in covered employment, and the average annual Consumer Price Index.

5. The Consumer Price Index (CPI) is the annual average value for the calendar year of the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W).
6. The real Gross Domestic Product (GDP) is the value of total output of goods and services, expressed in 1996 dollars. It is a summary measure and not a basic assumption; it summarizes the effects of the basic assumptions from which it is derived.
7. The average annual interest rate is the average of the nominal interest rates, which, in practice, are compounded semiannually, for special public-debt obligations issuable to the trust funds in each of the 12 months of the year.

IV. Summary and Suggestions

In this paper, we have introduced the new accounting standards for social insurance (SFFAS No. 17) in the United States for the National Pension Fund of Korea. We have further discussed important actuarial measures and data that are included in the financial report as supplementary stewardship required information (RSSI), such as cashflow projections, ratio of contributors to beneficiaries, actuarial present values (APV) and sensitivity analysis. A statement of specific social insurance program presents the actuarial present value of all future expenditures, contributions and tax income and the net present value of cashflow during the projection period. The net present value represents the required amount in order to sustain the program during the projection period, for example, 75-years for the U. S. Social Security.

Long-range actuarial estimations typically do not show the actuarial present values, but only shows how long a program sustains. Long-range actuarial estimates are sensitive to economic and demographic variables. For example, in early 1990's there were several reports that the Social Security Trust fund may become exhausted in around 2030 or even earlier. There have been various proposals how to fix or "save" Social Security.¹⁴ However, the SSA's 2002 Report has projected that the Trust fund may sustain until 2041.

Current annual reports of the National Pension Fund do not provide actuarial estimates that are important in assessing the long-term sustainability of the National Pension Scheme. We suggest the National Pension Corporation to adopt social insurance accounting standards and provide both long-range actuarial estimates and actuarial present values of the National Pension Fund in order to enhance public trust toward the NPF. We support Yun and Kang's (2002) proposal of the 50-year long-range estimation period. We, however, suggest the National Pension Corporation issue both 50-year long-range estimates and actuarial present values of the NPF every year, rather than every five years.

¹⁴ Baker and Weisbrot (1999) insisted that, since funding problems of Social Security have been attributed to changes in demographic factors, no single reform proposal would be able to save Social Security. Only further changes in demographic factors would eventually save Social Security.

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Aging Society and Management of Public Pension Funds in Korea

by
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I. Introduction

A significant aging transformation is putting pressure on the financing of public pension systems in many OECD member countries. This aging transformation will decelerate economic growth and further increase the government's fiscal burden. Projections of an aging population have shifted focus to implementing policy approaches that place the future of public finances on a sustainable path, and a number of reform measures have been initiated or are being considered in many OECD countries. Reducing benefits and pay-outs from public pension systems will help ease the burden on public finances; however, reduced benefits and pay-outs may raise questions of political sustainability.

The National Pension Scheme (NPS), which provides coverage to workers in firms with 10 or more employees, was introduced in 1988. The National Pension Scheme has been acclaimed as having the capacity to accommodate an aging population. Korea has adopted a partial pre-funding public, defined benefit scheme; in that the sustainability of public pension systems for many pensioners depends, to some extent, on how these funds are managed. Debate continues to grow over policy reform of Korea's public pension system. The focus of attention centers around identifying policy provisions that will effectively increase the pre-funding levels of public pensions. The implicit public pension debt will impose an intertemporal fiscal constraint. If the government does not appropriately manage the implicit public pension debt, then future generations will bear the intergenerational transfer of public pension liabilities. In the past, public pension funds have been subject to political interference and mismanagement. To enhance the management of public funds, five OECD countries – Canada, Ireland, Japan, New Zealand and Sweden – recently introduced new management models¹. This paper attempts to present ways on how to improve the management of public pension funds in Korea, in particular, the National Pension Fund.

¹ Palacios, Robert, "Managing Public Pension Reserves Part II: Lessons from Five Recent OECD Initiatives," World Bank, July 2002.

II. Aging Society

A large proportion of the population in OECD member countries are expected to experience a significant aging transformation over the next half-century. On average, old-age dependency rates will nearly double between now and 2050². These demographic shifts can be attributed to the combination of several factors including, aging of the post-war "baby-boom" generation, increased longevity, and low birth rates. This aging transformation will decelerate economic growth and further increase the government's fiscal burden. The ratio of elderly non-active to the working age population is rising, presenting serious challenges for many public sector pension schemes. Realizing that the financial burdens of public pensions could weigh heavily on public finances if benefits and pensions remain unchanged, several governments, including Korea, have been seeking ways to reform their pension systems.

It is expected that the demographic transformation in Korea will be more rapid compared to other countries. In other developed economies, the length of time for the proportion of the elderly population (aged 65 and over) to increase from 7 percent to 14 percent was more than 40 years, but Korea will experience the same growth rate in only 19 years. According to the forecast of the Ministry of Health and Welfare (2002), Korea has already entered the stage of an "aging" society as of 2000 and will become an "aged" society by 2019. A society is defined as "aging" if the proportion of the population aged 65 and above is greater than 7 percent and "aged" if the proportion is greater than 14 percent. This aging transformation is expected to accelerate after 2030, and by 2050 the proportion of elderly people will reach almost 25 percent, a proportion similar to that of more advanced economies.

Table 1. International Comparison of the Aging Process

Percentage	Year	Number of Years					
	7%	14%	20%	7%	14%	14%	20%
Korea	2000	2019	2026	19		7	
Japan	1970	1994	2006	24		12	
France	1864	1979	2020	115		41	
Germany	1932	1972	2012	40		40	
UK	1929	1976	2021	47		45	
Italy	1927	1988	2007	61		19	
US	1942	2013	2028	71		15	
Sweden	1887	1972	2012	85		40	

Source: UN, "The Sex and Age Distribution of World Population." Korea – Korea National Statistical Office, 2003.

² OECD (2002), "Responding to Aging Through Later Retirement," ECO/CPE (2002)10, Economic Policy Committee, OECD.

Consequently, the old age dependency ratio (the number of elderly people per 100 working-age persons) will rise from 10 in 2000 to 30 in 2030 and 45 in 2050. As a result of this aging population, the real GDP growth rate is expected to decline from 6.5 percent in 2000 to 1.2 percent in 2050³. Given the current state of the public pension and social welfare system, the combination of a rapidly aging population and a decline in the GDP growth rate will weigh heavily on public finances and will trigger substantial increases in age-related spending over the coming half century.

III. Current Management of Public Pension Funds

1. Four Major Public Pension Funds

There are four major public pension funds in Korea— National Pension Fund, Government Employees Pension Fund, Teachers' Pension Fund and Military Pension Fund. The combined assets of these four public pension funds totaled 88.37 trillion won or about 16.2 percent of GDP at the end of 2001. The majority of the assets are managed under the National Pension Fund. As of 2002, the National Pension Fund has accumulated assets totaling 92.8 trillion won or about 15.6 percent of GDP.

Table 2. Total Funds Raised and Assets of Four Major Public Pension Funds

(Units: In hundred million Won)

<i>Fund Name</i>	<i>Funds Raised</i>		<i>Assets</i>		<i>Gov't Subsidies</i>
	<i>Accumulated</i>	<i>Percent of GDP</i>	<i>Accumulated</i>	<i>Percent of GDP</i>	
<i>National Pension Fund</i>	<i>756,412</i>	<i>13.88%</i>	<i>781,855</i>	<i>14.35%</i>	<i>0</i>
<i>Gov't Employees Pension Fund</i>	<i>45,522</i>	<i>0.84%</i>	<i>52,253</i>	<i>0.96%</i>	<i>0</i>
<i>Teachers' Pension Fund</i>	<i>43,844</i>	<i>0.80%</i>	<i>46,048</i>	<i>0.84%</i>	<i>0</i>
<i>Military Pension Fund</i>	<i>3,590</i>	<i>0.07%</i>	<i>3,590</i>	<i>0.07%</i>	<i>2</i>
<i>Total</i>	<i>849,368</i>	<i>15.58%</i>	<i>883,746</i>	<i>16.22%</i>	<i>2</i>

Note: As of Year Ending 2001.

Source: Status of Pension Fund, 2002, <http://www.mpb.go.kr/>, Ministry of Planning & Budget, Budget Coordination Division, 2002.8.22.

Most of the assets under management by the four major public pension funds rely heavily on bonds and asset allocations in other funds. In particular, the National Pension Fund allocates about 37.7% of its assets in other funds.

³ Lee, Hyehoon and Kiseok Hong (2002), "The Structure of the Economy in an Aging Society," Korea Development Institute.

Table 3. Current Status of Asset Allocation of Four Major Public Pension Funds

(Units: In hundred million Won)

<i>Asset Allocation</i>		<i>National Pension Fund</i>	<i>Government Employees Pension Fund</i>	<i>Teachers' Pension Fund</i>	<i>Military Pension Fund</i>
<i>Financial Investments</i>	<i>Deposit in BOK</i>	-	-	-	-
	<i>Deposit in Deposit Money Banks</i>	-	1,228	3,217	285
	<i>Non-Bank Financial Intermediaries (Non Bond & Stock)</i>	217	-	9,555	686
	<i>Bonds</i>	404,625	36,607	13,692	-
	<i>Stocks</i>	48,359	1,611	745	-
	<i>Other Commercial Loans</i>	22,351	4,578	9,735	29
<i>Inter Gov't Transactions</i>	<i>Allocations to Other Accounts</i>	-	-	-	-
	<i>Allocations to Other Funds</i>	294,441	-	6,900	1,500
<i>Real Estate</i>		3,453	5,716	2,187	1,090
<i>Others (Intangible Property et al.)</i>		8,409	2,513	17	-
<i>Total</i>		781,855	52,253	46,048	3,590

Note: As of Year Ending 2001

Source: Status of pension Fund, 2002, <http://www.mpb.go.kr/>; Ministry of Planning & Budget, Budget Coordination Division, 2002.8.22.

However, inconsistent objectives set by government officials, responsible for overseeing the allocation of assets for the National Pension Fund, have led to a relatively low and long-run rate of returns on investments. In addition, reserve assets in public pension systems have been tapped to finance various types of government-sponsored economic and social projects. These management decisions reflect the low level of public accountability and transparency.

2. National Pension Scheme and National Pension Fund

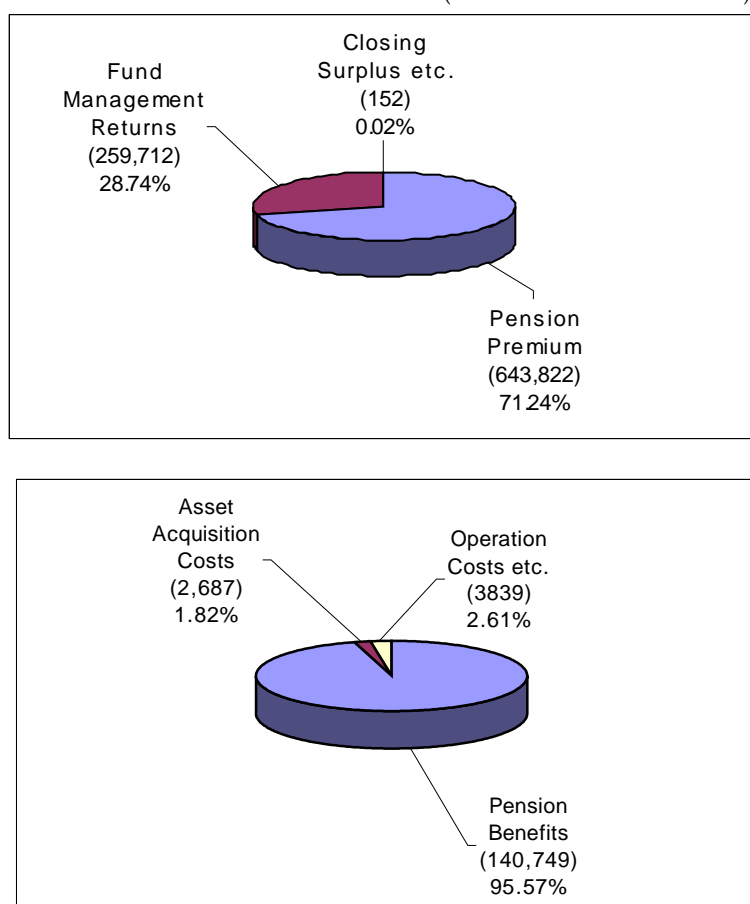
The National Pension Scheme (NPS), which provides coverage to workers in firms with 10 or more employees, was introduced in 1988. In 1992, the compulsory coverage was expanded to include firms with 5 or more employees. Under the current organization structure, the Minister of Health and Welfare has fiduciary responsibility over the fund's management and operation. The management of the fund is strictly regulated by the National Pension Act, and allows only those transactions that are expressly and explicitly

permitted by the relevant regulations. Given the long-term investment objectives and relative short life span of the National Pension Fund, the size of the fund is expected to grow, which as of year ending 2001 had accumulated a total of KRW 75.6 trillion in its reserves. The provision which requires public funds to allocate a portion of their assets to the Public Fund of the Ministry of Budget & Planning was repealed in 1998. Hence, the deregulation of this act is expected to increase the proportion of assets allocated in funds managed by professional fund managers.

The National Pension Fund strictly follows the "National Pension Fund Management Guidelines". The investment of the fund is classified into three different types: public sector, financial sector, and welfare sector. The fund's average return on investment was 11.23% over the period between 1988 to 2000, under-performing the average market rate of return of 14.63% which is based on returns of 3-year maturity corporate bonds. The fund's under-performance is believed to be attributed to inefficiencies caused by the fund's mandatory asset allocation requirements.

Figure 1. National Pension Fund Reserves (903,686 hundred Million Won) and Expenditures (147,275 hundred Million Won)

(Units: In hundred Million Won)



Note: As of Year Ending 2001

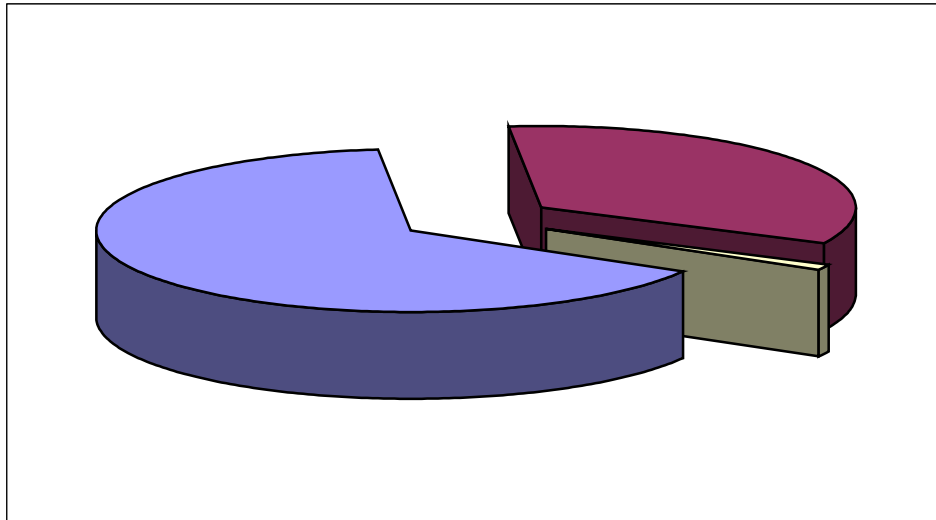
Source: National Pension Corporation, National Pension Statistical Yearbook 2002

Table 4. Investment Breakdown of the National Pension Fund by Sector

	(Units: %)										
	1988	1992	1993	1994	1995	1996	1997	1998	1999	2000	Ave.
Market Rate of Returns	14.45	16.30	12.62	12.92	13.82	11.87	13.40	15.10	8.86	9.34	14.63
Total	11.98	12.68	11.99	12.10	12.11	10.75	8.84	14.41	12.80	4.69	11.23
Public Sector	11.00	11.00	9.67	10.25	11.64	10.30	10.33	13.02	8.45	8.57	10.42
Welfare Sector	-	11.00	11.00	10.94	10.68	9.69	8.67	8.93	8.01	8.05	9.66
Financial Sector	12.95	14.07	13.87	13.91	13.11	11.86	5.56	18.37	24.49	-1.83	12.64

Source: National Pension Corporation, Internal data; Won, Jong Wook (2002)

Figure 2. Investment Breakdown of National Pension Fund



The Korean National Pension Scheme has been acclaimed as having the capacity to accommodate an aging population. Substantial funds have been accumulated in the National Pension Fund as shown in Table 2. The National Pension Fund plays a critical role in the economy. The pension system not only offers good income prospects for present and future generations, it also allows for a collective sharing of intergenerational risks by spreading out both economic windfalls and setbacks with younger working generations. The consolidation of risks among generations contributes to making the economy more resilient to financial shocks. A true assessment of the NPS's long-run financial stability should be based on the net volume of implicit pension debt, that is, the difference between the amount of reserves required for meeting all future pension pay-outs and the actual reserves of the National Pension Fund. The net implicit pension debt was estimated to exceed 120 trillion won as of 1998⁴.

⁴ Hyngpyo Moon, "The Korean Pension System: Current State and Tasks Ahead," mimeograph, Korea Development Institute, 2002.

The financial vulnerability of the National Pension Scheme originates from its structural imbalance stemming from the low pension contributions and high pension benefits given to pensioners. To deal with the NPS's structural problems, the National Pension Reform Committee was formed in 1997, followed by an amendment to the National Pension Act in 1998. The revisions lowered the average income replacement rate from 70 percent to 60 percent and implemented steps to gradually raise the minimum qualifying age from 60 to 65. In addition, the contribution rate (currently 9 percent) was modified to include periods of readjustment every 5 years beginning in 2010 to narrow the gap between contributions and pay-outs. The National Pension Fund is projected to grow to approximately 600 ~ 800 trillion won (in 2000 constant prices) by 2020 ~ 2030 if the current rate of pension contributions and pension benefits continue to be applied to the current pension scheme. However, the National Pension Fund will incur deficits in the budget as early as 2036 and will run out of funds by 2047. Table 5 illustrates the financial projections of the National Pension Scheme up to 2080.

Table 5. Financial Projections of the National Pension Scheme

(Units: In billion won, in 1999 Constant Prices)

Year	Revenues			Expenditures			Cash Balance	Accum- ulated <i>Reserves</i>
	Total	Pension Contribu- tions	Invest- ment Returns	Total	Pension Benefits	Admin. Expenses		
2000	18,660	12,706	5,954	813	559	254	17,847	75,379
2010	47,434	28,166	19,268	4,454	3,891	563	42,980	330,959
2020	72,184	34,606	37,577	24,789	24,097	692	47,395	659,256
2030	90,425	45,445	44,979	68,743	67,834	909	21,682	821,103
2040	94,963	59,391	35,572	137,137	135,949	1,188	-42,174	606,174
2050	77,855	77,855	-	213,152	211,595	1,557	-135,297	-
2060	102,605	102,605	-	293,735	291,683	2,052	-191,130	-
2070	135,604	135,604	-	390,178	387,465	2,712	-254,574	-
2080	181,151	181,151	-	496,271	492,648	3,623	-315,120	-

Source: National Pension Corporation

There are several ways to increase the funding ratio that is defined as the size of reserve assets, which is relative to the pension liability. Increasing a pension fund's funding ratio can be achieved by reducing benefits, increasing pension contributions or achieving a higher return on investments. Among the three methods, increasing the return on investment would be the preferred option. The National Pension Fund Operation Committee should implement a new investment policy to ensure the long-term fiscal sustainability of the National Pension Fund; in that the fund's investment policy should coincide with the interests of the pension members to maximize returns without taking on undue risk of loss.

3. Aging Population and the National Pension Fund

Several emerging trends could raise the risks for pensioners and those saving for a pension, and have an impact on inter-generational risk sharing including the aging

population, individualization and increasing international labor mobility. An aging population means that the ratio of pensioners to those in the labor force increases, eroding the basis for a collective sharing of inter-generational risk. The higher the pension assets and liabilities in relation to the number of people in employment, the smaller the pension contribution base becomes. Subsequently, financial shocks in investment returns or liabilities will then have to be absorbed by fewer people, so the extent in which these shocks affect individual contributions is magnified⁵. Currently ten workers are supporting one retiree; however, projections estimate that four workers will have to support three retirees after 2060.

The loss in capital by the National Pension Fund will have a significant impact on the Korean economy. The rise in the volatility of pension contributions increases the risk level for future generations. The question is whether future generations will be able and willing to absorb the financial shocks to the system. In addition, the growing international labor mobility will provide more opportunities for evading the burden of pension contributions. For instance, suppose that the fund's pension contributions with a disproportionate percentage of aging pensioners have to be substantially raised due to disappointing investment returns, then new pension participants would face a capital loss.

The National Pension Fund can initiate three different measures to prevent the risk of macroeconomic spillovers: implementing a more conservative investment strategy, spreading out the risk among pension members, and lowering the National Pension Scheme's level of ambition. The Committee on the National Pension Scheme Development is currently conducting a study on various ways to increase the funding ratio of the National Pension Fund. If the government adopts the Committee's preferred option, then National Pension contributions are expected to rise gradually from 9 percent of total wages to 15.85 percent in the coming years starting in 2011. And the average income replacement rate will be reduced from 60 percent to 50 percent. The higher pension contributions would not only affect the purchasing power of people in employment, but they would also affect the labor market and public sector finances (through the deductibility of pension contributions). Consequently, higher pension contributions attribute to a rise in labor costs and contraction in employment.

4. Current Management Structure of the National Pension Fund

The National Pension Fund is operated under the oversight of the Fund Operation Committee, whose objective is to maximize investment returns and safeguard the long-term stability of the fund. The management principles of the National Pension Fund are as follows: First, considering that the pension fund is comprised of the participants' contributions, meeting the legal reserves for future pension payments is a critical factor, and thus investments must be conducted in a way that ensures the long-term stability of the fund. Second, the National Pension Fund's objective is to maximize the rate of return on investment. Third, the National Pension Fund is a public fund composed of contributions by the majority of the nation's citizens. The size of the fund as of 2001 was 13.9% of Korea's GDP, and is by far the largest domestic fund. Therefore, the fund's investment policies must serve to positively affect the national economy while carefully assessing the interests of the participants during the investment process.

Currently, the National Pension Fund Operation Committee and the National Pension Fund Assessment Committee determine the investment ratios and size for each sector (public, finance, and welfare sector). It is the National Pension Corporation's

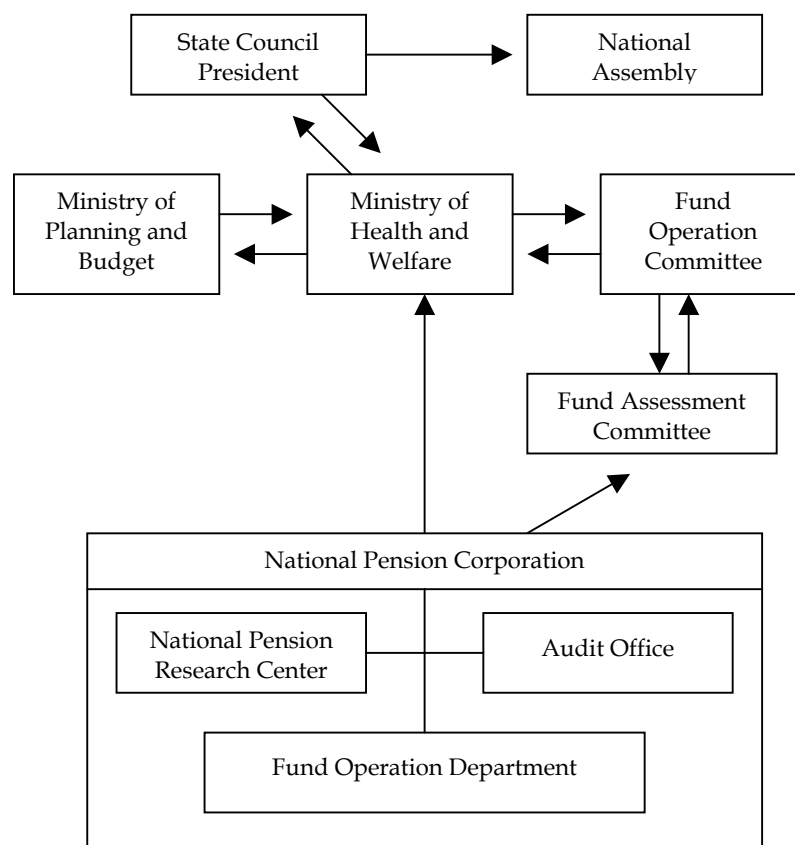
⁵ Casper van Ewijk and Martijn van de Ven (2003).

responsibility to set the annual fund management plan and to determine the size of investment for each financial market and product in accordance with the Pension Fund Management Plan. In addition, the fund's management and performance is internally evaluated by the National Pension Fund Research Center.

The National Pension Fund Operation Committee is comprised of twenty-one members; the Committee chairman and six *ex officio* members, twelve members representing pension participants, and two professional experts. The Chairman is the Minister of Health and Welfare and the six *ex officio* members are comprised of five deputy ministers from related ministries and the chief executive of the National Pension Corporation. The pension participants are represented by six members recommended by business and labor organizations each having three representatives, and six members representing regional pension participants. Term limits on the committee members allow them to serve two years but *ex officio* members can be reappointed accordingly.

The Fund Operation Committee has the authority to act as a decision making body on the pension fund's management. The Committee deliberates and establishes the fund's investment policy in the areas of management guideline, negotiation of interest rates on deposits, annual management plan, evaluation of management performance, and making required adjustments to the investment strategy. The Committee is required to meet four times annually.

Figure 3. National Pension Fund Operation Structure



Source: National Pension Corporation, National Pension Statistical Yearbook 2002

Figure 4. Organization of National Pension Fund Operation Committee

<i>Classification</i>	
<i>Ex officio members (7)</i>	
<i>Delegated Committee members</i>	<i>Representatives of Employers(3)</i>
	<i>Representatives of Employees(3)</i>
	<i>Representatives of regional pension members (6)</i>
	<i>Experts(2)</i>

Source: National Pension Corporation, <http://www.npc.or.kr>

Additionally, the National Pension Fund Assessment Committee was established to provide greater professional expertise to the Fund Operation Committee, and is the organizational body that is responsible for monitoring the overall management process. The committee examines and evaluates fund asset management/accounting procedures and operational activities, and makes necessary assessments and improvements in management and operations, as well as areas raised before the Fund Operation Committee and recognized by the chairman of the Assessment Committee as requiring examination. The structure of the Fund Assessment Committee is comprised of the Vice Minister of Health and Welfare as the Committee Chair, seven officers, and seven other members consisting of pensioner representatives and others. The actual management of the fund is conducted internally by the Fund Operation Department.

IV. International Comparison in Managing Public Pension Reserves

In the past, public pension funds in Korea have been subject to political interference and mismanagement. Five OECD countries – Canada, Ireland, Japan, New Zealand and Sweden – recently introduced new models of public pension fund management⁶. We attempt to highlight the well-devised practices from the five OECD initiatives and to apply them in Korea's public pension system, in particular, the National Pension Fund.

Table 6 gives a brief background on the six OECD countries - Canada, Ireland, Japan, New Zealand, Sweden and Korea – where, except Korea, recent years. Korea has the youngest

Table 6. Statistical Comparison of Six OECD Countries

<i>Country (Year Enacted)</i>	<i>Population of Age 65+¹⁾</i>	<i>Public Pension Per GDP²⁾</i>	<i>Public Pension Fund Asset Per GDP²⁾</i>	<i>Private Pension Fund Asset Per GDP²⁾</i>
<i>Canada(1998)</i>	<i>16.5%</i>	<i>5.4%</i>	<i>10%</i>	<i>48%</i>
<i>Japan(2001)</i>	<i>23.1%</i>	<i>6.9%</i>	<i>34%</i>	<i>19%</i>
<i>Ireland(2000)</i>	<i>15.5%</i>	<i>4.6%</i>	<i>None</i>	<i>45%</i>
<i>New Zealand (2001)</i>	<i>15.5%</i>	<i>6.5%</i>	<i>None</i>	<i>n. a.</i>
<i>Sweden(2001)</i>	<i>22.1%</i>	<i>11.1%</i>	<i>33%</i>	<i>3%</i>
<i>Korea (2001)</i>	<i>12.2%²⁾</i>	<i>15.6%</i>	<i>16.2%</i>	<i>4⁶⁾</i>

Notes: 1. World Bank (2000)

2. The National Statistical Office (Over Age 60 + Age unknown)/Total Population, Census Population (2000).

⁶ Palacios, Robert, "Managing Public Pension Reserves Part II: Lessons from Five Recent OECD Initiatives," World Bank, July 2002.

3. OECD Social Expenditure database (1997).

4. Accumulate amount of only four major public pension funds in 2001.

5. Data on 1998 from OECD Institutional Investors Yearbook (2000).

6. Individual pension plans in 2002.

Source: Palacios (2002); OECD(1996); OECD(2000); World Bank population database; Financial Supervisory Service, Korea.

demographic structure whereas, Japan and Sweden have an older population. As the table shows, Japan and Sweden have amassed large public pension reserves, while Korea and Canada have also accumulated a significant amount compared to Ireland and New Zealand which have none.

Table 7 summarizes key features of public pension funds in six OECD member countries – Canada, Ireland, Japan, New Zealand, Sweden and Korea with respect to governance, revealing some key fundamental similarities and differences. With the exception of Korea and Japan, several countries attempted to create some distance between government officials or ministries and the pension fund⁷.

Table 7. Comparison of Governance and Transparency

	Canada	Ireland	Japan	New Zealand	Sweden	Korea
Fiduciary Authority	Professional Board	Professional Board	Minister	Professional Board	Hybrid Board	Representative Board
Appointing Body	Finance Minister ¹)	Finance Minister	Minister of Health and Labor ²	Governor-General ³)	Government ⁴)	Minister of Health and Welfare ⁵)
Annual External Audits	Yes	Yes	Yes	Yes	Yes	Yes
Percentage of Portfolio Managed Externally	All	85%	Approx. 1/3	All	At least 10%	8.8% ⁶)
Explicit & Objective Selection & Monitoring Criteria	Yes	Yes	Yes	Yes	Yes	Yes

Notes: 1. Selects from list of nominees.

2. Designated by law.

3. Selects from list of nominees.

4. Appoints 5 and selects 2 each from employer/ee nominees.

5. Designated by law.

6. (2000)

Source: Palacios (2000), Author's elaboration.

Table 8 summarizes key features of public pension funds in six OECD member countries – Canada, Ireland, Japan, New Zealand, Sweden and Korea - with respect to investment policy. The investment policy options available to each Board are subject to quantitative restrictions in each country except for New Zealand. Public pension funds in six OECD countries except for Korea avoided mandates for targeted investments and adhered to a commercial investment policy in principle. The risk that the public pension

⁷ Robert Palacios, "Managing Public Pension Reserves Part II: Lessons from Five Recent OECD Initiatives," World Bank, 2002.

funds will be utilized in a way that distorts the capital markets is mitigated in Ireland and New Zealand through large allocations of foreign investments.

Table 8. Comparison of Public Pension Fund Investment Policies

	<i>Canada</i>	Ireland	Japan	New Zealand	Sweden	Korea
Commercial Investment Mandate	Yes	Yes	Ambiguous	Yes	Yes	No
Statutory Asset Class Restrictions	Yes ¹⁾	Yes ²⁾	³⁾	No	Yes ⁴⁾	Yes ⁵⁾
Statutory Mandates (Social/ETIs)	No	No	No	No	No	Yes ⁶⁾
Minimum for Government Treasuries	No	No	Yes, de facto	No	Yes, 30%	No
Shareholder Voice Policy	Yes	Yes ⁷⁾	⁸⁾	Yes ⁷⁾	Yes ⁹⁾	No

Notes: 1. 30% Limit on foreign securities.

2. Prohibits holdings of domestic govt. treasuries.

3. Established by Minister, not by Law.

4. 40% Limit on nonhedged foreign securities.

5. In Law.

6. Social/ETIs

7. Limited by foreign investment.

8. Delegated to manager with conditions.

9. Limits on individual firm Shares.

Source: Palacios (2000), Author's own elaboration.

In all of six OECD countries except for Korea and Japan, the arms' length Board arrangement combined with the commercial investment mandate acts as a safeguard against governments seeking to shore up domestic financial markets or direct investment to favored instruments. In Korea, the size of the National Pension Fund and direct government oversight, have raised concerns that some of the funds may be used for intervention in domestic financial markets.

Table 9 shows a qualitative assessment of how well each of the six countries manages the challenges in insulating against specific political interference. The last column provides some measures designed to minimize these risks⁸. It seems fair to say that Korea has not implemented these safeguards – commercial investment mandate, a buffer zone between the board – for the National Pension Fund.

⁸ Palacios (2000).

Table 9. Qualitative Assessment of Safeguard Mechanisms Against Conflicts of Interest

	Canada	Ireland	Japan	New Zealand	Sweden	Korea	Mitigation Procedures
Safeguard Mechanisms against:							
Increased Government Borrowing	High	High	Low	High	Moderate	High	CIM, P-A L-B, Prohibits Public Bonds
Social Mandates And ETIs	High	High	Moderate	High	High	High	CIM, P-A L-B, Prohibits ETIs
Capital Market Distortions	Moderate	High	Low	High	Moderate	Moderate	CIM, P-A L-B, Foreign Investments
Corporate Governance Conflicts	Moderate	High	Moderate	High	Moderate	Moderate	CIM, P-A L-B, Foreign Investments

Notes: CIM = Commercial Investment Mandate.

P-AL-B = Professional, Arms-Length Board.

Source: Palacios (2000), Author's own elaboration.

V. Reform of the National Pension Fund Management System

1. Governance

Four major public pension funds in Korea use representative committees. The current National Pension Fund Operation Committee is comprised of government, labor, employer and self-employed representatives; however, there are few committee members with expertise in finance, investment, and pension management. We have to reorganize the current composition of the committee and its selection process to establish a more independent and professionally knowledgeable Board. For reference, we could gain valuable lessons in reform from the Canada Pension Plan Investment Board and New Zealand Superannuation Fund. In order to improve efficiencies and the long-term financial standing of the National Pension Fund, we have to establish a buffer zone between the professional committee and the government ministries and bureaucrats to ensure optimum management of pension funds and to insulate the Board from political influence.

First, the current National Pension Fund Operation Committee, which currently meets four times a year, should be reorganized into a permanent Board responsible for formulating the overall investment policy and developing a plan for managing assets and

monitoring investment results. The Board should include members with expertise in finance, investment, and pension management. The selection process of the Board members should be revised as follows: First, the 12 - 15 member Board should be first nominated by a ten member nominating committee established by the Minister of Health and Welfare and comprised of members with relevant work experience that would enable them to identify qualified candidates for appointment. Then, the Minister would appoint the Board members among the pool of nominated candidates. In addition, the Chairman of the National Pension Fund Management Board would be appointed by the President from the group of Board members with the Minister's recommendation. Finally, the term of each Board member would be no more than 3 years with a possibility for reappointed for another three-years with a maximum limit of three terms. This system of selecting Board members would create a buffer by widening the distance between the government ministries and the Board. Board members would have to abide by strict codes of conduct and be required to uphold both honest and ethical values during the term of service. In addition, Board members would be obligated to immediately report any conflicts of interest to the board.

2. National Pension Fund Management Board

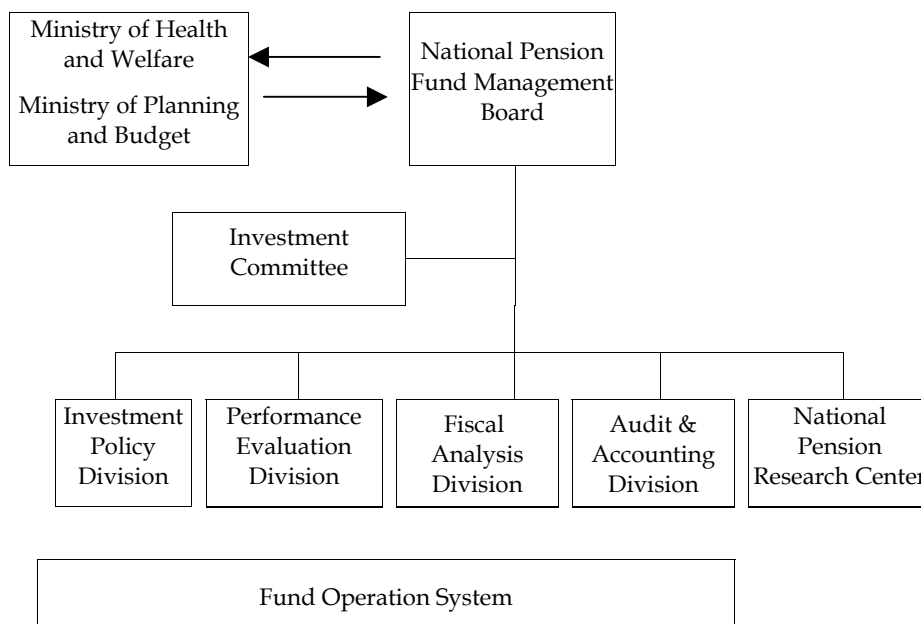
The Board should invest the fund by adopting a prudent, and commercially driven investment policy that seeks to maximize returns at an acceptable level of risk. The fund should be managed solely for the purpose of maximizing returns; hence, socially driven and economically targeted investments should be gradually phased out all together.

The Board would have investment policymaking authority for overall medium- and long-term investments, as well as determining the annual strategic asset allocation policy. In addition, the Board would also be responsible for tracking and evaluating investment performance. In doing so, the Board would be assisted by the executive office, consisting of four divisions including, Investment Policy Division, Performance Evaluation Division, Fiscal Analysis, and Audit and Compliance Division. In the following organization structure, both the National Pension Corporation Investment Management (NPCIM) and the National Pension Research Center of the National Pension Corporation would be placed under the Board's management.

Once reorganization has been completed, the current National Pension Fund Assessment Committee would be phased out. The National Pension Corporation Investment Management (NPCIM) would oversee the preparation of the strategic asset allocation policy, the quarterly investment policy as well as the implementation guidelines. The NPCIM would have direct management over some of the funds with the capacity to outsource private asset managers and commission contracts; however, external managers would manage most of the fund's total assets.

The Ministry of Health and Welfare would be responsible for submitting the Fund Investment Plan to the Ministry of Planning and Budget (MPB) and would consult with the MPB about the Plan on behalf of the Board. The Ministry would also supervise the fund and oversee the legislative activities and regulation of the National Pension Fund. The Board must present a detailed independently audited report on the fund's performance to the Minister of Health and Welfare who in turn must disclose the reported results to the National Assembly and general public. In addition, management of the fund in terms of administrative and internal costs and investment performance should be regularly reported to the public through an independently audited report, annual report, and quarterly financial statements.

Figure 5. Proposed Reorganization of Fund Operation Management System



3. Efficient Management of Assets

External Management

The advantage in the internal management of assets is that investment returns can be achieved at a lower cost and with greater autonomy. However, in public sector enterprises such as the National Pension Corporation, asset managers who demonstrate an exceptional investment performance are often recruited by the private sector. In addition, drawing upon the expertise of external asset managers has its benefits such as utilizing them as benchmarks for internal managers and leveraging their research capacities in the areas of asset allocation and risk management. The government began to commission contracts to private asset managers in 2001. The proportion of total National Pension reserves managed by external managers reached 8.8 percent in 2002. In contrast, all assets under the Canada Pension Plan (CPP) and the New Zealand's Superannuation Fund are managed externally, while roughly one-third of Japan's National Pension Fund is managed externally.

Thus, the Board should seek to commission more contracts to external asset managers and the Pension Fund Investment Pool under the Ministry of Planning and Budget (MPB). This would give the MPB direct oversight and responsibility of the private asset managers contracted under the Pension Fund Investment Pool. Under the new structure, the Board would be responsible for selecting external asset managers and evaluating their investment performance against a predefined set of benchmark indices. In addition, the

Board would have to monitor the risk management and the internal control system, and review the investment performance of external asset managers.

Foreign Investment

The National Pension Fund is expected to expand considerably relative to domestic capital markets. As of December 2001, 73 percent of the Korea Stock Exchange's total market capitalization was concentrated in ten stocks, which is far higher compared to other countries including, England, Japan and the United States⁹. Funds invested in a heavily concentrated stock market coupled with a strong preference for investing in domestic companies will lead to lower and highly volatile returns over the long-term. Hence, the retirement incomes of National Pension participants will be tied to the performance of a few domestic companies.

The danger resulting from the mismanagement of funds in a way that distorts the capital markets could be eased through large foreign investments. By increasing overseas investments, the fund's asset allocation would be greatly diversified, lowering the volatility of returns, increasing risk-adjusted returns and opening more opportunities for better performance. Pension funds in OECD countries have begun to implement an asset allocation policy of diversifying across borders; however, by the mid-1990s, only a relatively small portion of a funds' assets were invested in foreign markets. Among G-10 countries with significant pension fund holdings, the proportion of foreign asset allocations increased from 12 percent in 1990 to 17 percent in 1996¹⁰.

Presently, the National Pension Fund has yet to accumulate sufficient experience and expertise necessary to make overseas investments. With long-term objectives in mind, the fund should seek to develop expertise internally and draw on external money managers with specialized expertise in international markets. The approach of combining domestic and international fund management is critical in enhancing competition and diversification among asset managers.

Diversification of Assets

During 1990s, the pension fund market experienced a significant shift towards foreign investments. In general, the investment trends of pension funds have largely targeted U.S. and European equity markets, as the Netherlands and Japan have followed similar international investment trends. There has been a sharp rise in the proportion of equity investments in the asset allocation of many pension funds compared to bonds, which produce a lower rate of return. For example, pension funds in OECD countries showed a significant increase in the proportion of equity holdings in the period between 1990-1996. In contrast, Asian-Pacific pension funds, which include those in Japan, Korea and Australia, recorded the lowest increase in equity holdings¹¹.

Initially, risk-bearing pension funds benefited considerably from strong returns in equity investments due to the dramatic rise in share prices in U.S. and European countries. By the same token, equity heavy portfolios have made pension funds equally

⁹ Shaw B. Wagner, "Governance Structures and Investment Policies for Public Pension Funds," International Symposium on National Pension Fund Management, National Pension Corporation, March 2002, pp. 79-99.

¹⁰ OECD (1998), "International Financial Market Implications of Aging Populations," Financial Market Trends, No. 71, November 1998.

¹¹ OECD (1998), "International Financial Market Implications of Aging Populations," Financial Market Trends, No. 71, November 1998.

sensitive to declining share prices, which has become more evident in recent years¹². To achieve higher returns on investments, funds may have to target illiquid investments such as non-listed stocks and private equity and real estate investments. The U.S. in 1979 through the Employee Retirement Income Security Act (ERISA) allowed pension funds to allocate assets in venture capital funds. This gave venture capital funds access to an enormous resource of capital, and by 2000 the percentage of venture capital investments increased substantially capturing 55 percent of the private equity market in the U.S. Pension funds have become by far the main source of capital for venture funds, accounting for 59 percent of total assets under management in 1999¹³. Similarly, in the United Kingdom, pension funds have also become the principal source of capital for venture funds, accounting for 51 percent of total funds in 1996¹⁴. The approach in asset allocation taken by U.S. and U.K. pension funds of investing in venture funds may also be worth examining.

VI. Concluding Remark

The rapid demographic shift towards an aging society over the coming decades presents Korea with a complex and formidable set of inter-related challenges. Overcoming the challenge of an aging population will demand comprehensive reform initiatives that address the limits of Korea's pension and health system, as well as the fiscal, financial and labor market implications. Korea has adopted a partial pre-funding public, defined benefit scheme. A sustained move toward a more fully funded pension system would have an enormous affect on the size and nature of the capital markets. One implication of an aging population in Korea as well as other OECD countries and the associated growth of pension funds, is the increased demand for professional fund management services. With continued efforts to liberalize cross-border capital flows and to strengthen capital markets, pension funds will continue to pursue strategic asset allocation policies to achieve greater diversification of portfolios. In addition to assisting in diversifying fund portfolios, these initiatives will serve to increase the breadth and depth of the financial markets. Thus, fund managers will be able to improve the return-to-risk ratio of the portfolios, further adding to ensure that there are sufficient reserves for benefits and pension pay-outs¹⁵.

This paper has attempted to present policy recommendations for reforming the governance structure of the National Pension Fund and improving the fund's development of investment policies. The recommendations could be applied to other public pension funds in Korea as well. The improvement in the management of public pension funds will contribute to enhancing their performance, thus increasing the long-term fiscal sustainability of the pension funds and removing distortions caused by current policies. Without proper accountability and governance, no public pension system can survive in the long-term.

The government can initiate a broad range of policies to strengthen the public pension system, but all the approaches will certainly include difficult political choices. The burden of having fewer workers supporting each retiree over time will require a board overhaul of the public pension system including, raising pension contributions, reducing

¹² Casper van Ewijk and Martijn van de Ven, "Pension Funds at Risk," cpb Report 2003/1, cpb, 2003.

¹³ NVCA, 2000 National Venture Capital Association Yearbook, 2000.

¹⁴ British Venture Capital Association (1997), Report on Investment Activity.

¹⁵ OECD (1998), "International Financial Market Implications of Aging Populations," Financial Market Trends, No.71, November 1998, pp. 53-66.

benefits, diverting other tax revenues to finance pensions, or raising the investment returns of pension funds. The degree of suffering involved in realizing the first three choices will depend on future economic growth¹⁶. Although rapid economic growth may ease the pressures placed on the government and workers, it will not solve all the difficulties brought about by an aging population.

¹⁶ Erica L. Groshen and Thomas Klitgaard (2002), "Live Long and Prosper: Challenges Ahead for an Aging Population," *Current Issues*, Volume 8 Number 2, Federal Reserve Bank of New York.

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Impact of China's Globalization on Korea's Exports to the U.S. & Chinese Markets

by
*Semoon Chang**

I. Introduction

Developments in international trade witnessed in East Asia since the 1997 financial crisis are so fast-paced that, unless prepared, the future of Korea's exports can easily be swept aside by these unfolding global events. These developments include China's accession to WTO in 2001, China's agreement in 2002 with ASEAN nations to organize ASEAN-China free trade area, the bilateral investment treaty that Japan and Korea signed in early 2002, and several mechanisms put into place for regional policy dialogue, which include the ASEAN+3 Economic Review and Policy Dialogue, the Manila Framework, and the Executive's Meeting of East Asia-Pacific Central Banks. Recent developments also include (a) the Chiang Mai Initiative that allowed member nations requesting liquidity support to immediately obtain short-term financial assistance; (b) the failed attempt to establish an Asian Monetary Fund; (c) Japan's outreach programs, which include a proposal to establish closer economic relationships with ASEAN countries, bilateral FTA with Singapore, and discussion of organizing similar arrangements with Korea and Mexico; and (d) Korea's attempt to establish itself as a Northeast Asia's business hub.

Most important of all may well be the emergence of China as a global trade power. Korea is directly affected by China's surging globalization ever since the relations between the two countries were normalized in August 1992. According to the Korea International Trade Association, China is now Korea's second largest export destination and third largest source of imports.¹ Although Korea has not experienced a trade deficit with China since 1992, Korea's concerns over future competition from China as a global exporter have increased in recent years especially in such sectors as machinery, electronics, home appliances, textiles, and some information technology products.

Explored in this paper is the hypothesis that the growing competitiveness of China's exports and trade liberalization on imports to China through its accession to WTO will cause Korea's exports of certain products to be squeezed out of the U.S. as well as the Chinese markets. The source of the trade data employed in this paper is the Comtrade Database Level 2 as collected annually by the United Nations Department of Economic and Social Affairs, Statistics Division.

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¹ Cooper 2002, p. 1.

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II. China's Accession to WTO

In 1947, the GATT was created pursuant to an agreement among 23 nations to reduce barriers to international trade practiced during the 1930s and the first half of the 1940s. In order to achieve this goal, membership in the GATT was predicated upon each country extending to all other signatory nations most favored nation (MFN) status. In effect, each country would impose the lowest tariffs on goods being imported from its "most favored" trading partner to identical items imported from all GATT members. This commitment to MFN status would result in tariffs being reduced to their lowest level among the GATT countries. Membership also required each nation to extend "national treatment" to all imports. For example, the same percentage excise or value-added tax would be imposed on both imported and domestically produced goods.[Merkel and Lovik 2002, p. 2] By the mid 1980s, more than 100 nations joined the GATT with average global tariffs on industrial and consumer goods dropping from approximately 44% to about 8%.²

In 1995, the GATT evolved into the WTO. Added to the list of membership requirements was the stipulation that all members would settle trade disagreements through the WTO's Trade Dispute Settlement Procedure rather than on a bilateral basis as was formerly the case. Also, three new areas of trade policy that had generated numerous disputes among GATT countries during the 1980s and early 1990s were included in the new WTO agreement: international investment flows, trade in services such as computer software, and the universal protection of intellectual property rights (IPRs) for patents and copyrights.³

China's economic policy has undergone a radical transformation since Deng Xiaoping and his allies took control of the government in 1978. The transformation included the use of market mechanisms, flexible prices, and private incentives over a wide range of economic decision-making.⁴ As Deng's economic reforms were implemented, the annual increase in real GDP averaged 9.5% during the 1980s, the highest average yearly increase in the world during the decade. This phenomenal rate of growth continued throughout the 1990s, ranging between the high 14.2% in 1992 to the low 8.8% in 1997.⁵

China's full accession into the WTO began with a formal petition to join the then GATT in July 1986 from the Chinese government. This was accompanied by a listing of the nation's laws, regulations, and policies that affected trade and foreign investment which the government proposed to change to satisfy WTO requirements. The then GATT General Council appointed a Working Party in March of 1987 to examine China's application and negotiate terms for China's accession. Following the formation of the WTO on January 1, 1995, a successor WTO Working Party took over the negotiations with each interested WTO member negotiating bilaterally with China regarding market access concessions and commitments in the goods and services areas. The most liberalizing concessions and commitments obtained through these bilateral negotiations were consolidated into China's Goods and Services Schedules applicable to all WTO members. Overlapping in time with these bilateral negotiations, China engaged in

² U. S. CBO 1987.

³ Merkel and Lovik, p.3.

⁴ U.S. ITC 1999, p. F-2.

⁵ Merkel and Lovik 2002, p.3.

multilateral negotiations with Working Party members on the rules that would govern trade with China. These commitments are set forth in China's Protocol of Accession and an accompanying Report of the Working Party. China's admission was unanimously approved on November 10, 2001, at the WTO Ministerial Conference in Doha, Qatar. China became the 143rd member of the WTO on December 11, 2001. China's Protocol of Accession, accompanying Working Party Report and Goods and Services Schedules are available on the WTO's website (www.wto.org). Even the downing of the US EP-3 spy plane during April 2001 by the Chinese military did not derail these negotiations. Both President Bush and Premier Jiang Zemin agreed to exempt all trade activities and agreements from any ensuing diplomatic measures.⁶ Taiwan's accession to WTO was approved 24 hours after that of China.⁷

1. What China Received

As a result of China's WTO accession, the United States has granted China the permanent most-favored-nation status, which until then was subject to annual renewal by the U.S. congress. Several of China's trading partners have lifted most of their quantitative restrictions on a range of products. Quotas on textiles and clothing are phased out in accordance with the Agreement on Textiles and Clothing; other quotas are phased out in accordance with negotiated schedules. China can now resort to the WTO for settling trade disputes, as well as participate in multilateral negotiations on trade rules and future trade liberalization.⁸

China's market access gains could be eroded by three provisions that some describe as being discriminatory against China. First, under the so-called transitional product-specific safeguard mechanism which will be in effect for 12 years, China's trading partners may impose restrictions on Chinese imports based on "market disruption or the threat of market disruption," whereas, under the normal WTO standard, restrictions can be imposed on imports only if there is "serious injury" or a "threat of serious injury." In addition, if one country invokes the safeguard mechanism against China, other countries may also take action to prevent diversion of Chinese exports to their countries without establishing evidence of market disruption.⁹ Second, although all quotas on China's textile and clothing exports are to be phased out by January 1, 2005, a special safeguard mechanism will be in place until the end of 2008. This mechanism allows importing countries to restrict imports from China when they result in market disruption.¹⁰ Third, Chinese exporters can be hit with dumping charges on the basis of price or cost comparisons of similar products in third countries, instead of China prices, to determine whether Chinese firms are dumping their products. Similar methodologies can also be used to determine whether Chinese exporters are being subsidized.¹¹

2. China's Commitments

A real interest of China's trading partners such as Korea relates to China's commitments. In agriculture, China pledged to reduce all tariffs from an average level of 31.5 percent to 17.4 percent. It will eliminate export subsidies and rapidly increase the

⁶ Time, April 23, 2001, p.43.

⁷ Hong Kong Trader <http://www.hktrader.net/200111/200101/200101s5.htm>.

⁸ Adhikari and Yang 2002, p. 23.

⁹ Adhikari and Yang 2002, p. 23.

¹⁰ Adhikari and Yang 2002, p. 23.

¹¹ Adhikari and Yang 2002, p. 23.

volumes of tariff-rate quotas (TRQ) on most imports. In-quota tariff rates will be minimal (1-3 percent); above-quota tariffs for sensitive products (mostly grain) will be reduced from 80 percent to 65 percent, a level comparable to those in the European Union and some Northeast Asian economies.¹² Under the TRQ system, a set quantity of imports is allowed at low tariff rates, while imports above that level are subject to higher tariff rates.¹³ For industrial products, China has pledged to phase out quantitative restrictions, cut the average tariff from 24.6 percent to 9.4 percent by 2005, and sign the Information Technology Agreement, which will result in the elimination of all tariffs on telecommunications equipment, semiconductors, computers & computer equipment, and other information technology products.¹⁴ To China's credit, China implemented the required tariff changes on agricultural and industrial goods for 2002 on January 1, 2002.¹⁵

The most far-reaching opening may take place in the services sector, which had largely been closed to competition. The restrictions facing foreign service providers in the areas of licensing, equity participation, geographic location, business scope, and operations will be relaxed or removed over time. China has promised to open its telecommunications, financial services, distribution, and many other industries to foreign service providers.¹⁶

Besides market access, China has made other commitments that will increase the transparency of its trade and investment regimes. It has pledged to apply its trade policy uniformly across the country and to enforce only those laws, regulations, and other measures that have been published beforehand. China has also agreed to eliminate all prohibited subsidies including those to state-owned enterprises, liberalize trading rights, and require state trading companies to conduct their operations in a commercial manner.¹⁷ China's Ministry of Foreign Trade and Economic Cooperation announced in May 2002 that more than 2,300 laws and regulations had been amended to comply with WTO rules and 830 abolished since the country joined WTO on December 11, 2001.¹⁸ China agreed in its accession protocol to undergo a special transitional review mechanism, under which the WTO's 16 subsidiary bodies and committees will review the country's progress on implementation each year for eight years, with a final review 10 years after accession.¹⁹

One of the more significant highlights among industrial tariffs was China's agreement to participate in the Information Technology Agreement (ITA), which requires the elimination of tariffs on computers, semiconductors and other information technology products. China agreed to eliminate these tariffs by January 1, 2005. One problem arose in 2002 from China's treatment of 15 ITA tariff lines, covering certain semiconductor and telecommunications equipment inputs. China conditioned the reduced or zero tariffs for these tariff lines on the importer's completion of an end-use certificate, to be approved by the Ministry of Information Industry (MII), guaranteeing that the products being imported would be used as inputs into the production of finished information technology

¹² Adhikari and Yang 2002, p. 22.

¹³ U.S. Trade Representative, p. 13.

¹⁴ Adhikari and Yang 2002, p. 22.

¹⁵ U.S. Trade Representative, p. 30.

¹⁶ Adhikari and Yang 2002, p. 23.

¹⁷ Adhikari and Yang 2002, p. 23.

¹⁸ US-China Business Council staff. "China's WTO Implementation Efforts," *The China Business Review*, V. 29, N4, July-August 2002, p. 1 from <http://www.chinabusinessreview.com/0207/tni.html>.

¹⁹ US-China Business Council staff. "China's WTO Implementation Efforts," *The China Business Review*, V. 29, N4, July-August 2002, p. 1 from <http://www.chinabusinessreview.com/0207/tni.html>.

products in China. The use of this condition is not authorized by the Goods Schedule negotiated as part of China's accession to the WTO.²⁰

In its accession agreement, China also agreed to eliminate numerous non-tariff measures (NTMs), which included quotas, licenses and import tendering requirements covering hundreds of products including machinery and electronic products.²¹ Most of these NTMs covering such products as chemicals, agricultural equipment, medical and scientific equipment and civil aircraft had to be eliminated by the time that China acceded to the WTO. China was allowed to phase out other NTMs, listed in an annex to the accession agreement, over a transition period ending on January 1, 2005.²² China has agreed to remove, mostly by 2005 but no later than 2010, all subsidies to SOEs and others as specified in the Agreement on Subsidies and Countervailing Measures (SCM), effectively eliminating dual prices.²³

III. The Model

The diplomatic and economic relations between China and Korea were normalized on August 24, 1992. The trade agreement between the governments of China and Korea was signed on September 30, 1992 and came into force on October 30, 1992. On August 25, 2002, the Incheon International Airport announced that China surpassed Japan as the destination with the most flights from Korea during the peak summer season. Korea began to feel post-normalization competitive pressure from China that turned to concerns after China became a member of the WTO late in 2001.²⁴ Korea's concerns over China's rapid globalization are more conspicuous in Korea's export markets in the U.S. and China itself.

A model is developed in this section to test the hypothesis that the growing competitiveness of China's exports and trade liberalization on imports to China will cause Korea's exports of certain products to be squeezed out of the U.S. as well as the Chinese markets. The source of the trade data employed in this paper is the Comtrade Database Level 2 as collected annually by the United Nations Department of Economic and Social Affairs, Statistics Division.²⁵

²⁰. U.S. Trade Representative, p. 8.

²¹. Bajona and Chu 2002, p. 7.

²². U.S. Trade Representative, p. 12.

²³. Bajona and Chu 2002, p. 7.

²⁴. For instance, Korea agreed in July 2000 to buy large amounts of garlic at fixed rates to protect Korean garlic producers from being outpriced by their Chinese competitors in exchange for the lifting of a Chinese retaliatory tariff on South Korean mobile phone and chemical exports to China. In July 2002, it was revealed that such import controls could not be extended beyond 2002 under a secret clause in the July 2000 agreement, subjecting Korean garlic growers to new international competition beginning in 2003. On July 19, 2002, Senior Presidential Secretary for Economic Affairs Han Duck-soo and Vice Agriculture and Forestry Minister So Kyu-ryung resigned to take responsibility for the government's alleged concealment of an agreement with China to open the Korean market to Chinese garlic imports from Jan. 1, 2003. On July 25, 2002, the Korea's Ministry of Agriculture and Forestry announced that it would invest 1.8 trillion won into the local garlic farming sector over the next five years following a firestorm of criticism that the Korean government failed to act transparently during the garlic negotiations with China, under which Korea would be open to Chinese garlic imports from Jan. 1, 2003. On July 30, 2002, Korean Trade Commission Chairman Junn Sung-chull resigned to take responsibility for South Korean failures in negotiations over garlic imports.]

²⁵. <http://unstats.un.org/unsd/comtrade>.

We first define variables:

i = individual export products

X_{K-U}^i = exports from Korea to U.S., i.e., U.S. imports from Korea

X_{C-U}^i = exports from China to U.S., i.e., U.S. imports from China

X_{K-C}^i = exports from Korea to China, i.e., China's imports from Korea

X_{W-C}^i = exports from world (no Korea) to China, i.e., China's imports from the world

Y_U = GDP of the U.S.

P_K = prices of export products from Korea to the U.S.

P_C = prices of export products from China to the U.S.

P_W = prices of export products from the world to China

T_C = tariffs in China including non-tariff barriers

F_K = dummy for 1997 financial crisis in Korea with 1 for 1997 & 1998

D_K = dummy for post-1997 devaluation of Korea's won with 1 from 1997 to 2001

D_C = dummy for 1994 devaluation of China's yuan with 1 from 1994 to 2001

R_K = research & development in Korea

$\tilde{\alpha}_{(K-U)(C-U)}^i$ = regression coefficients indicating the correlation between X_{K-U}^i & X_{C-U}^i

$\tilde{\alpha}_{(K-C)(W-C)}^i$ = regression coefficients indicating the correlation between X_{K-C}^i & X_{W-C}^i

One approach to testing the competitiveness of Korea's exports to the U.S. in relation

to China's exports to the U.S. would be to estimate the following export models:

$$X_{K-U}^i = X_{K-U}(Y_U, P_K, T_C, F_K, D_K, D_C, R_K)$$

$$X_{C-U}^i = X_{C-U}(Y_U, P_C, T_C, F_K, D_C, R_K)$$

The following two criteria may then be compared to test the hypothesis that the recent globalization of China's trade through lowered tariffs and non-tariff barriers had a negative impact on Korea's exports to the U.S. but a positive impact on China's exports to the U.S.:

$$d(X_{K-U}^i) / dT_C < 0$$

$$d(X_{C-U}^i) / dT_C > 0$$

The impact of lower tariffs in China from its 2001 accession to WTO, however, cannot be estimated through regression because the process of lowering tariffs just started and will continue over the next several years until 2010. Further, the U.S. market had remained open to China's exports during the study period, including the MFN treatment that had been renewed on an annual basis since 1980. This means that the competition between China and Korea began long before China's WTO accession, although the competition may have become more intense with the accession. As an alternative, therefore, the following model is estimated for individual product groups to identify Korea's exports that may have been declining in comparison to China's exports to the U.S. market:

$$X_{K-U}^i = X_{K-U}(F_K, D_K, D_C, X_{C-U}^i) \quad (1)$$

Upon estimation, $\tilde{\alpha}_{(K-U)(C-U)}^i$, $\tilde{\alpha}_{DK}^i$ (coefficient for D_K) and $\tilde{\alpha}_{DC}^i$ (coefficient for D_C) are reviewed for each product group to determine a significant inverse correlation against the dependent variable X_{K-U}^i .

Similarly, one approach of testing the competitiveness of Korea's exports to China in relation to the world exports to China would be to estimate the following export models:

$$\begin{aligned} X_{K-C}^i &= X_{K-C}(Y_U, P_K, T_C, F_K, D_K, D_C, R_K) \\ X_{W-C}^i &= X_{W-C}(Y_U, P_W, T_C, F_K, D_C, R_K) \end{aligned}$$

The following two criteria may then be compared to test the hypothesis that the recent globalization of China's trade through lowered tariffs and non-tariff barriers had a negative impact on Korea's exports to China but a positive impact on the world's (excluding Korea's) exports to China:

$$d(X_{K-C})/dT_C < 0$$

$$d(X_{W-C})/dT_C > 0$$

Again, the impact of lower import tariffs in China from its 2001 accession to WTO cannot be estimated through regression because the process of lowering tariffs just started and will continue over the next several years until 2010. As an alternative, therefore, the following model is estimated for individual product groups to identify Korea's exports that may have been declining in comparison to the world exports to the Chinese market:

$$X_{K-C} = X_{K-C}(F_K, D_K, D_C, X_{W-C}) \quad (2)$$

Upon estimation $\gamma_{(K-C)(W-C)}$, γ_{DK} and γ_{DC} are reviewed for each product group to determine a significant inverse correlation against the dependent variable X_{K-U} .

The annual data range 1992 through 2001. The findings of this approach are expected to be important since any small advantage during this period may lead to external economies of scale, i.e., agglomeration benefits, and later internal economies of scale that may widen the gap in comparative advantages between competing nations.

IV. Competition in the U.S. Market

The competition between China and Korea in the U.S. market is measured in equation (1). Estimates of equation (1) are summarized in Table 1.

Estimates in Table 1 on Korea's exports to the U.S. market in competition of China's exports to the U.S. market are condensed in Table 2 by deleting all coefficients as well as their t-values that are statistically insignificant. Coefficients that are statistically significant at 10 percent level are marked with one star (*); 5 percent level with two stars (**); and 1 percent level with three stars (***) in Table 2. It may be noted that the ratio of won per dollar divided by yuan per dollar was included as an independent variable in equations summarized in Table 2 as an alternative estimation. The ratio of exchange rates variable, however, turned out statistically insignificant in all product groups of Table 2 and thus was deleted. *Findings of Table 2 are the following.*

First of all, Korea's exports to the U.S. of SITC 85 footwear and SITC 87 scientific equipment nes, which includes instruments, appliances, measuring & analyzing apparatus, and components of industrial plants, have been falling, while China's exports of the same items to the U.S. market have been rising sharply. These are indicated by the negative sign of the X_{C-U} coefficient for the two product groups. These are only two of 58 SITC product groups that both Korea and China have been exporting to the U.S. market. The amount of Korea's exports to the U.S. of SITC 85 footwear was \$1,448,917,888 in 1992 (8.0% of total exports to the U.S. in 1992) and \$96,377,192 in 2001 (0.3% of total exports to the U.S. in 2001). The amount of Korea's exports to the U.S. of SITC 87 scientific equipment nes was \$167,080,656 in 1992 (0.9% of total exports to the U.S. in 1992) and \$184,331,328 in 2001 (0.6% of total exports to the U.S. in 2001). The amount of exports of SITC 87 peaked in 1996 at \$400,301,440.

Secondly, there are exports to the U.S. market of certain products that have not necessarily been falling in competition against China's exports to the U.S. market, but were likely affected adversely either directly by the 1994 devaluation of the Chinese currency or by the post-1994 growth of the Chinese economy, or both. These products include SITC 03 fish, crustacean & molluscs; SITC 05 vegetables and fruits; SITC 76

telecommunication and sound equipment; and SITC 84 clothing and accessories. Note that the estimated coefficient of D_C is negative for these four product groups. Note also that China's exports of these products to the U.S. have increased sharply during the study period.

For SITC 03 fish, crustacean & molluscs, the amount of Korea's exports to U.S. in 1992 was \$108,333,352 (0.6% of total exports to the U.S. in 1992) and \$67,329,336 in 2001 (0.2% of total exports to the U.S. in 2001). For SITC 05 vegetables and fruits, the amount of Korea's exports to the U.S. in 1992 was \$12,512,208 (0.1% of total exports to the U.S. in 1992) and \$25,151,264 in 2001 (0.1% of total exports to the U.S. in 2001). For SITC 76 telecommunication and sound equipment, the amount of Korea's exports to U.S. in 1992 was \$1,916,681,088 (10.6% of total exports to the U.S. in 1992) and \$4,998,446,592 in 2001 (15.9% of total exports to the U.S. in 2001). For SITC 84 clothing and accessories, the amount of Korea's exports to U.S. was \$2,776,940,872 in 1992 (15.3% of total exports to the U.S. in 1992) and \$2,208,032,096 in 2001 (7.0% of total exports to the U.S. in 2001).

In the third place, three product groups experienced a significant decrease in exports from Korea to the U.S. market since 1997. China's exports of these products to the U.S. during the same period rose. These are SITC 03 fish, crustacean & molluscs, SITC 26 textile fibres, and SITC 83 travel goods, handbags and related items. This is indicated by the negative sign of the D_K coefficient for the three product groups. Our estimates indicate that Korea's exports of textile to the U.S. market decreased while China's exports increased even before China's accession to WTO. For SITC 03 fish, crustacean & molluscs, the amount of Korea's exports to the U.S. in 1992 was \$108,333,352 (0.6% of total exports to the U.S. in 1992) and \$67,329,336 in 2001 (0.2% of total exports to the U.S. in 2001). For SITC 26 textile fibres, the amount of exports to U.S. in 1992 was \$68,876,912 (0.4% of total exports to the U.S. in 1992) and \$83,451,960 in 2001 (0.3% of total exports to the U.S. in 2001). For SITC 83 travel goods, handbags and related items, the amount of Korea's exports to U.S. in 1992 was \$313,229,952 (1.7% of total exports to the U.S. in 1992) and \$104,781,600 in 2001 (0.3% of total exports to the U.S. in 2001).

Finally, the total amount of the eight SITC export groups identified as having been affected either directly or indirectly represents 38.2 percent of Korea's total exports to the U.S. (\$18,153,042,774) in 1992 and 24.9 percent of Korea's total exports to the U.S. (\$31,357,324,325) in 2001, if SITC 26 and SITC 83 were included; and 36.1 percent in 1992 and 24.3 percent in 2001 if SITC 26 and SITC 83 were excluded. Note that the declining exports to the U.S. of SITC 26 and SITC 83 since 1997 may or may not have been caused by competition from China. Either way, the amount of Korea's exports to the U.S. that are affected by the China's emerging global power appears significant.

According to the Korea Trade-Investment Promotion Agency (KOTRA), China has long surpassed Korea in terms of the share of the U.S. import market. Between 1993 and 2001, for instance, Korea's share of the U.S. import market had remained stagnant at 3 to 3.1 percent; Japan suffered a gradual decline from 18.5 percent to 11.1 percent; but China increased its market share from 5.4 percent to 9 percent in the same period. Put differently, during the period, "Korea posted an average annual growth rate of 9.6 percent in its exports to the United States, which is higher than Japan's corresponding rate of 3.3 percent, yet sharply lower than China's 16.8 percent."²⁶ Although estimates in Table 2 indicate some replacement of Korea's exports to the U.S. by China's exports, it is not clear how much of the China's rapid increase in its export share to the U.S. market is at the expense of Korea's exports. It may suffice to say that "Korea is engaged in fiercer competition with China than with Japan in the U.S. market."²⁷

²⁶. "China overtakes Korea in U.S. market," from <http://english.korcham.net>.

²⁷. "China overtakes Korea in U.S. market," from <http://english.korcham.net>.

Finally, the U.S.-China Business Council,²⁸ established in 1973, publishes the leading magazine on U.S.-China trade and economic relations, called *The China Business Review*.²⁹ Also, Section 421 of the U.S.-China Relations Act of 2000 (P.L.106-286), 22 U.S.C. § 6951, requires the United States Trade Representative (USTR) to report annually to Congress on compliance by China with commitments made in connection with its accession to the WTO, including both multilateral commitments and any bilateral commitments made to the United States. USTR chairs the Trade Policy Staff Committee (TPSC) subcommittee on China WTO Compliance, a newly created, inter-agency TPSC subcommittee whose mandate is devoted to China and the extent to which it is complying with its WTO commitments.³⁰

V. Competition in the Chinese Market

The competition between Korea and the rest of the world in the Chinese market is measured in equation (2). Estimates of equation (2) are summarized in Table 3. Estimates in Table 3 on Korea's exports to the Chinese market in competition of the world's exports to the Chinese market are condensed in Table 4 by deleting all coefficients as well as their t-values that are statistically insignificant. Coefficients that are statistically significant at 10 percent level are marked with one star (*); 5 percent level with two stars (**); and 1 percent level with three stars (***). It may be noted that as an alternative estimation the ratio of won per dollar divided by yuan per dollar was included as an independent variable in equations summarized in Table 4. The ratio of exchange rates variable turned out statistically insignificant except in one product group (#84). The inclusion of the exchange rate variable, however, led to statistical insignificance of the D_K coefficient suggesting possible multicollinearity between the two variables. The exchange rate variable was thus deleted from estimation.

1. Interpretation of the Estimates

Probably because of the advanced nature of the Korean economy in relation to other countries that also export to China, and also because China's economy is still in its early stages of development, Korea's exports to China in competition of the world exports to China have not been disadvantaged much for the study period, 1992 to 2001. Whether Korea's success in the short run will continue in the long run remains to be seen.

First of all, only two product items of Korea's exports to China declined while the world exports of the same items increased (sharply) during the study period: SITC 02 dairy products and bird eggs, and SITC 32 coal, coke and briquettes. Note that $X_{W.C}$ is negative for the two product groups. China's comparative advantage is claimed to lie in the agricultural sector.³¹ Further, given China's large cost advantages in the production of fruit, flowers, and vegetables, its exports may be expected to make major inroads into regional markets.³² Our estimates already indicate a declining export of SITC 02 dairy products to China in comparison to the world's export to China. For SITC 02 dairy products and bird eggs, the amount of Korea's exports to China was \$60,287 in 1992 (0.0% of total exports to China in 1992) and \$37,274 in 2001 (0.0% of total exports to China in

²⁸. www.uschina.org.

²⁹. www.chinabusinessreview.com.

³⁰. U.S. Trade Representative, p. 1.

³¹. Poon 2001, p. 7.

³². Bhattasali and Kawai 2001, p. 16.

2001). For SITC 32 coal, coke and briquettes, the amount of Korea's exports to China was \$63,819,096 in 1992 (2.4% of total exports to China in 1992) and \$631 in 2001 (0.0% of total exports to China in 2001).

Secondly, Korea's exports of SITC 23 crude rubber to China in comparison to the world exports to China decreased since 1994. It may be cautioned, however, that the estimated coefficient of D_C is statistically insignificant, making the interpretation tentative. The decrease is not caused by production of substitutes in China because the amount of the world exports to China of the item has increased through 2001. It may indicate a loss of comparative advantages to Korea's exporters of the product. The amount of Korea's exports of SITC 23 crude rubber to China was \$5,157,235 in 1992 (0.2% of total exports to China in 1992) and \$127,517,528 in 2001 (0.5% of total exports to China in 2001).

Thirdly, four product items of Korea's exports to China in comparison to the world exports to China decreased since 1997: SITC 21 hides, skins, furskins, raw; SITC 56 fertilizer; SITC 84 clothing and accessories; and SITC 87 scientific equipment. This is indicated by the negative sign of D_K for the four product groups. It may be pointed out that the decrease may not have been caused by production of substitutes in China at least for SITC 21, 84 and 87 because the amount of the world exports to China of these three items have increased through 2001. It may indicate a loss of comparative advantages to Korea's exporters of the three product groups. In case of SITC 56, both Korea's and the world's exports to China fell during the study period, indicating increased production of fertilizer in China. It is widely believed that China's shares of world export markets for apparel and textiles as well as electronics and other manufacturers are projected to rise dramatically due to WTO accession.³³ It is less known, however, that China's imports of textiles are also projected to increase due to an expansion in China's wearing apparel sector.³⁴

For SITC 21 hides, skins, furskins, raw, the amount of Korea's exports to China was \$1,928,929 in 1992 (0.1% of total exports to China in 1992) and \$4,601,616 in 2001 (0.0% of total exports to China in 2001). For SITC 56 fertilizer, the amount of Korea's exports to China was \$1,884,714 in 1992 (0.1% of total exports to China in 1992) and \$1,820,607 in 2001 (0.0% of total exports to China in 2001). For SITC 84 clothing and accessories, the amount of Korea's exports to China was \$9,989,819 in 1992 (0.4% of total exports to China in 1992) and \$74,408,424 in 2001 (0.3% of total exports to China in 2001). For SITC 87 scientific equipment, the amount of Korea's exports to China was \$5,683,456 in 1992 (0.2% of total exports to China in 1992) and \$312,348,480 in 2001 (1.3% of total exports to China in 2001).

Finally, the total amount of the six SITC export groups (excluding SITC 23 which is statistically insignificant) to China identified as having been affected either directly or indirectly by world competition represents no more than 3.2 percent of total exports to China (\$2,622,744,567) in 1992 and 1.6 percent of total exports to China (\$23,376,903,021) in 2001. It appears that at least during the study period, Korea has not lost its competitive edge so far as its exports to China are concerned.

Some argue that "In the short run, China's reduction of tariffs and non-tariff trade barriers following its WTO entry will boost Korea's exports to China and thus its China trade surplus."³⁵ The benefits for Korea described above that will follow from China's WTO membership arise allegedly from the complementary nature of the Chinese and Korean economies.³⁶ In the long run, however, keener competition is expected in both

³³. Bhattasali and Kawai 2001, p. 16.

³⁴. Chirathivat and Mallikamas 2002, p. 8.

³⁵. Poon 2001, p. 5.

³⁶. Poon 2001, p. 9.

Chinese and third country markets and Chinese companies will become fierce competitors. Further, Korea has to compete with other countries within China. Companies from various countries will set up their production bases in China, capturing both the cheap labor costs and more importantly the huge domestic market. Korea is going to compete with the best companies from all over the world.³⁷ There is also the threat from fast-learning Chinese companies. These Chinese companies will compete with their Korean counterparts in China as well as in third-country markets. Korea's higher cost structure when compared to China can only be justified if Korea can produce more effectively.³⁸

2. Opportunities for Service Industries

China enacted new patent law on July 1, 2001; new trademark law on December 1, 2001; and new copyright law on October 27, 2001. These new laws and regulations are designed to bring China into compliance with minimum Trade Related Aspects of Intellectual Property Rights Agreement (TRIPs) requirements.³⁹ The biggest problem is still a lack of effective IPR enforcement. Among the reasons cited are: lack of coordination between central and local governments, local protectionism and corruption, lack of criminal enforcement, and weak punishments. China has taken steps to protect IPR by giving more power to IPR enforcement authorities. The 2002 anti-counterfeit and anti-piracy campaigns seized 16 million in illegal publications and 39 million in pirated disc.⁴⁰ Although China has revised its IPR laws and regulations to strengthen administrative enforcement, civil remedies and criminal penalties, IPR violations are believed still rampant.⁴¹

In 1998, one American visitor in China bought a video CD of *Saving Private Ryan* for \$2.00 in a music store in Kunming while the movie was still running in western theaters. In fact, he was given a list of movies that were still running in early 2003 and not yet on video in the United States: *Chicago*, *Catch Me If You Can*, *Gods and Generals*, *Dare Devil*, *Lord of the Rings - The Two Towers*, *Harry Potter and The Chamber of Secrets*, *Final Destination II*, *Jungle Book II*, and *How to Lose a Guy in Ten Days*. The American visitor found all of these movies available for purchase in China.

China is believed slow in accepting service businesses from foreign firms. For instance, China through the Ministry of Information Industry threatened to restrict the business of international express delivery companies in China by proposing a domestic monopoly for delivery of mail under 500 grams and by requiring foreign express services firms to register with China Post for carrying packages over 500 grams. For another example, China's Administrative Regulations on Foreign Insurance Companies called for extremely high capital requirements, which foreign companies viewed as being restrictive if not prohibitive.⁴²

³⁷. Poon 2001, p. 10.

³⁸. Poon 2001, p. 10.

³⁹. U.S. Trade Representative, pp. 35-37.

⁴⁰. Testimony of Robert A Knapp, "Effects and Consequences of an Emerging China," US-China Business Council, 2002, posted March 19, 2003. <http://www.uschina.org/public/testimony/testimony14.html>.

⁴¹. U.S. Trade Representative, p. 34.

⁴². US-China Business Council staff. "China's WTO Implementation Efforts," *The China Business Review*, V. 29, N4, July-August 2002, p. 2 from <http://www.chinabusinessreview.com/0207/tni.html>.

VI. Summary & Conclusions

One of the most important determinants of the future global status of the Korean economy is the rapidly globalizing China aided by its accession to WTO in 2001. Although the long-term impact of China's globalization on Korea's exports requires continuing research, this study finds the following trends in Korea's exports to the U.S. and China on the basis of trade data from 1992 to 2001.

Korea's exports to the U.S. of SITC 85 footwear and SITC 87 scientific equipment nes, which includes instruments, appliances, measuring & analyzing apparatus, and components of industrial plants, have been falling, while China's exports of the same items to the U.S. have been rising. Secondly, Korea's exports to the U.S. of certain products have not necessarily been falling in competition against China's exports to the U.S., but appear affected adversely in recent years. These product groups include SITC 03 fish, crustacean & molluscs; SITC 05 vegetables and fruits; SITC 26 textile fibres; SITC 76 telecommunication and sound equipment; SITC 26 textile fibres; and SITC 84 clothing and accessories. Overall, the total amount of the Korea's eight SITC export groups identified as having been affected either directly or indirectly by China represents 38.2 percent of Korea's total exports to the U.S. in 1992 and 24.9 percent of Korea's total exports to the U.S. in 2001, if SITC 26 and SITC 83 were included; and 36.1 percent in 1992 and 24.3 percent in 2001 if SITC 26 and SITC 83 were excluded. Either way, the amount of Korea's exports to the U.S. that are affected by the China's emerging global power appears significant.

Regarding the competition within China, only two product items of Korea's exports to China declined while the world exports of the same items increased: SITC 02 dairy products and bird eggs, and SITC 32 coal, coke and briquettes. Korea's exports to China of SITC 21 hides, skins, furskins, raw; SITC 23 crude rubber; SITC 56 fertilizer; SITC 84 clothing and accessories; and SITC 87 scientific equipment have declined in recent years. This decrease is not caused by production of substitutes in China because the amount of the world exports to China of the same items had increased through 2001. The total amount of the six SITC export groups, excluding SITC 23 which is insignificant statistically, to China identified as having been affected either directly or indirectly by world competition represents no more than 3.2 percent of Korea's total exports to China in 1992 and 1.6 percent of Korea's total exports to China in 2001. At least during the study period, Korea does not appear to have lost its competitive edge so far as its exports to China are concerned.

Undoubtedly, global China is a mixed blessing for the Korean economy. Global China provides many new export and investment opportunities for Korean firms, but at the same time poses a big threat in international markets, including Korea's domestic market. Whether or not global China is more a blessing than a curse may well depend on how well Korea prepares for future competition from China. It is safe to stress the importance of continuing reform of the Korea's economy, and developing a new China strategy through research on identification and promotion of comparative advantages. Estimates presented in this paper clearly indicate that competition between China and Korea has just begun.

In closing, when China launched its ambitious modernization program around 1980, the Chinese leadership headed by Deng Xiaoping was quick to adopt an export-oriented growth model, which had dominated China's economic development since then.⁴³ A

⁴³. Abeyasinghe and Lu 2002, p. 5.

recent article by Feldman and Xie (2001) suggests signs that China may be shifting away from an export-oriented growth model toward a trade deficit-based, internal demand driven growth model.⁴⁴ Similarly, Abeyasinghe and Lu argue that since the second half of the 1990s, domestic demand has increasingly become the major engine of China's economic growth, and that "a further developed China with greater market openness will become an increasingly powerful growth engine in the region."⁴⁵

⁴⁴. Abeyasinghe and Lu 2002, p. 7.

⁴⁵. Abeyasinghe and Lu 2002, p. 17

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Table 1. Estimates of Korea's Exports to the U.S.: X_{K-U}

Code	Description	C	F _K	D _K	D _C	X _{C-U}	R ²	D-W
41	ANIMAL OILS AND FATS	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
42	FIXED VEG. FATS AND OILS	-171798.2	-266674.4 (-0.804199)	-407827.9 (-0.664927)	-123.0849 (-0.000822)	0.190276 (1.111686)	0.713	3.143
43	ANIMAL,VEGFATS OILS,NES	53515.67	-298135.1 (-0.660532)	446922.9 (1.069854)	260793.4 (0.425784)	-0.181212 (-0.623708)	0.586	1.934
51	ORGANIC CHEMICALS	54760668	33599963 (0.791141)	32973330 (0.469863)	-27044061 (-0.727968)	0.425383 (1.544186)	0.931	2.419
52	INORGANIC CHEMICALS	-5101454	-18202063* (-2.098827)	23357405 (1.957477)	119865.1 (0.012448)	0.067956 (0.846629)	0.823	0.067
53	DYES,COLOURIN G MATERIALS	17319957	4329902 (1.216266)	5617955 (0.517693)	2336232 (0.343923)	0.243949 (1.227789)	0.958	2.479
54	MEDICINAL,PHA RM.PRODUCTS	-6260151	-6171455 (0.568602)	-297596.2 (-0.016558)	4463855 (0.454047)	0.071800 (0.857143)	0.725	0.071
55	ESSENTL.OILS, PERFUME,ETC	8966394	-1074809 (-0.356220)	4755303 (1.538579)	-1164259 (-0.514104)	0.140054* (2.52874)	0.901	2.912
56	FERTILIZER,EXC EPT GRP272	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
57	PLASTICS IN PRIMARY FORM	25326112	-77987117** (-4.401994)	1.05E+08** (5.305454)	34253664* (2.351745)	0.124369 (0.276804)	0.958	3.397
58	PLASTIC,NON-PRIMARY FORM	85540781	20978068 (0.545529)	-61118802 (-0.728905)	17800291 (0.653145)	2.045517 (1.201550)	0.804	1.623
59	CHEMICAL MATERIALS NES	-7967154	-6204700 (-0.217229)	13700256 (0.436552)	29139091 (1.305813)	0.391265 (1.370958)	0.785	1.938
61	LEATHER, LEATHER GOODS	10334311	-1237478 (-0.687678)	1490995 (0.828465)	363366 (0.257821)	-0.027604 (-1.781754)	0.458	2.899
62	RUBBER MANUFACTRES, NES	2.6E+08	-14303763 (-0.323943)	11927087 (0.170427)	-12281732 (-0.391858)	0.416215 (1.514504)	0.930	2.500
63	CORK, WOOD MANUFACTURES	5240007	-2500780 (-0.787028)	-938034.5 (-0.234679)	2581499 (1.471426)	0.000819 (0.059797)	0.552	2.424
64	PAPER, PAPERBOARD,ETC.	4792204	-69791000 (-1.057816)	1.39E+08 (1.566088)	-16541835 (-0.321604)	0.530711 (0.880015)	0.896	3.035
65	TEXTILE YARN, FABRIC,ETC.	4.20E+08	-10775607 (-0.121139)	2.04E+08 (1.823531)	73912590 (1.257725)	0.218349 (0.758178)	0.942	2.363
66	NON-METAL. MINERAL MANFCT	84665959	-52621122** (-4.659897)	61935830** (2.860428)	-15578775 (-0.924843)	-0.021018 (-0.429613)	0.927	2.761
67	IRON AND STEEL	4.45E+08	1.02E+08 (0.553152)	1.90E+08 (0.845174)	-28167705 (0.139228)	0.849401 (1.137342)	0.740	2.476
68	NON-FERROUS METALS	-21781792	-8017713 (-0.387279)	8638402 (0.219584)	373584.5 (0.018847)	0.590891** (2.828814)	0.937	3.179
72	SPECIAL.INDUST . MACHINERY	1.12E+08	38947607 (0.438135)	95414814 (0.819551)	1.48E+08* (2.528009)	0.293858 (0.416202)	0.905	2.637
73	METALWORKIN G MACHINERY	11508030	47088258 (0.730806)	-30109639 (-0.341089)	46927941 (0.697233)	0.878153 (0.536020)	0.619	2.199
74	GENERALINDUSIL MACHINES	2.61E+08	-2.49E+08* (-2.457264)	2.66E+08 (1.947650)	-60458867 (-0.805698)	0.258494 (1.647691)	0.953	3.038

Code	Description	C	F _K	D _K	D _C	X _{C-U}	R ²	D-W
75	OFFICEMACHINES, ADPMACH	1.38E+09	-1.92E+09 (-1.085067)	8.28E+08 (0.263455)	-2.00E+08 (-0.156065)	0.666807 (0.821613)	0.784	2.865
76	TELECOMM.SOU ND EQUIP ETC	1.38E+09	-1.00E+09 (-1.580332)	2.24E+08 (0.296508)	-1.38E+09* (-2.553811)	0.832180** (3.162213)	0.935	2.511
77	ELEC MCH APPAR,PARTS,NES	3.85E+09	-7.84E+08 (-0.285256)	5.10E+08 (0.129088)	4.85E+09** (2.596350)	-0.731173 (-0.578584)	0.646	2.718
78	ROAD VEHICLES	7.30E+08	-1.47E+09 (-1.358552)	1.19E+09 (0.971494)	-7618968 (-0.010128)	2.492565 (1.791225)	0.924	1.699
79	OTHR.TRANSPO RT EQUIPMENT	3.16E+08	-1.55E+08 (-1.006118)	3.70E+08* (2.051829)	-47761780 (-0.275850)	-1.021491 (-0.943998)	0.536	2.120
81	PREFAB BUILDGS, FITNG ETC	38983903	-4897219 (-0.812849)	108199.3 (0.014304)	8971515 (1.844945)	-0.024250 (-1.691626)	0.796	2.122
82	FURNITURE, BEDDING,ETC.	17963440	1591285 (0.186584)	-3950816 (-0.335526)	5453447 (1.237847)	0.018418* (2.439967)	0.949	2.742
83	TRAVEL GOODS, HANDBGS ETC	3.28E+08	30076796 (1.060584)	-89822233** (-3.540792)	-19560091 (-0.416641)	-0.125779 (-1.061861)	0.868	2.354
84	CLOTHING AND ACCESSORIES	2.71E+09	-4.51E+08 (-1.411759)	4.71E+08 (1.243517)	-7.31E+08* (-2.364875)	-0.033260 (-0.152184)	0.693	2.195
85	FOOTWEAR	1.90E+09	-77790334 (-0.815599)	1.10E+08 (0.751137)	-3.40E+08* (-2.546723)	-0.323279** (-3.751837)	0.973	2.200
87	SCIENTIFIC EQUIPMENT NES	2.99E+08	-3.05E+08** (-2.702882)	5.16E+08** (2.926118)	1.72E+08* (2.357844)	-1.218264** (-2.642658)	0.689	2.664
88	PHOTO.APPARA T. NES;CLOCKS	2.01E+08	48010566 (1.86594)	-26712403 (-0.748924)	42243089 (1.268169)	-0.007056 (-0.090793)	0.613	2.693
89	MISC MANUFCTRD GOODS NES	1.41E+09	-2.15E+08** (-3.242082)	2.11E+08 (1.851264)	-43331398 (0.472169)	-0.046586 (-1.623386)	0.851	2.966
91	MAIL NOT CLASSED BY KIND	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
93	SPEC. TRANSACT . NOT CLASSD	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
96	COIN NON GOLD NON CURRENT	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
97	GOLD, NON MONIRY EXCLOS	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: United Nations Statistics Division, Comtrade Database - Express Selection,
<http://unstats.un.org/unsd/comtrade/dqQuickQuery.aspx>, based on Standard International
 Trade Classification, Revision 3 (SITC Rev.3).

Table 2. Statistically Significant Estimates of Korea's Exports to the U.S.: X_{K-U}

Code	Description	F_K	D_K	D_C	X_{C-U}
00	live animals		34760.84**	39440.70*	
03	fish, crustacean, mollusc		-23277256**	-22092161**	
04	cereals, cereal preprtns.		7103863**	4795762	
05	vegetables & fruit	-7982637**	7452331**	-6251630*	
08	animal feed stuff		5749434**	163241.8	
26	textile fibres		-1964721**	35072308**	
27	crude fertilizer, mineral			4789699**	
33	petroleum, petrol.product	-5.12e+08**	4.86e+08**		0.794042*
52	inorganic chemicals	-18202063*			
55	essentl.oils,perfume,etc				0.140054*
57	plastics in primary form	-77987117**	1.05e+08**	34253664*	
66	non-metal.mineral manfct	-52621122**	61935830**		
68	non-ferrous metals				0.590891**
72	special.indust.machinery			1.48e+08*	
74	general industl.mach.nes	-2.49e+08*			
76	telecomm.sound equip etc			-1.38e+09*	0.832180**
77	elec mch appar,parts, nes			4.85e+09**	
79	othr. transport equipment		3.70e+08*		
82	furniture,bedding,etc				0.018418*
83	travel goods, handbags etc		-89822233**		
84	clothing and accessories			-7.31e+08*	
85	footwear			-3.40e+08*	-0.323279**
87	scientific equipment nes	-3.05e+08**	5.16e+08**	1.72e+08*	-1.218264**
89	misc manufactrd goods nes	-2.15e+08**			

Table 3. Estimates of Korea's Exports to China: X_{K-C}

Code	Description	C	F_K	D_K	D_C	X_{W-C}	R ²	D-W
00	LIVE ANIMALS	88061.67	-52671.08 (-0.393159)	122280.6 (1.121079)	52336.18 (0.357963)	-0.003853 (-0.800913)	0.624	2.949
01	MEAT, MEAT PREPARATIONS	-84259.69	-1442854 (-0.307624)	2956326 (0.589447)	63011.66 (0.051100)	0.002943 (0.282817)	0.833	2.155
02	DAIRY PRODUCTS, BIRD EGGS	482316.4	-561029.4 (-1.545434)	725582.0 (1.879634)	439288.9** (3.280816)	-0.00732** (-2.677897)	0.819	2.399
03	FISH,CRUSTACEA N, MOLLUSC	-13183620	8703548 (0.441614)	-783681.9 (-0.040148)	10934563 (0.887832)	0.044941 (1.312856)	0.823	2.822
04	CEREALS,CEREA L PREPRtns.	-700690.6	-2015134** (-3.797180)	3111001** (3.909174)	1407547* (2.165430)	0.000694* (2.067448)	0.925	2.295

Code	Description	C	F _K	D _K	D _C	X _{W-C}	R ²	D-W
06	SUGAR,SUGR.	1462488	-3313136	10740666*	4428931	0.023711**	0.865	1.857
	PREPTNS,HONEY		(-0.976423)	(2.513759)	(0.945097)	(2.825540)		
07	COFFEE,TEA,	-408725.4	252198.1	46984.49	368581.9	0.010435	0.798	2.880
	COCOA,SPICES		(1.137549)	(0.204731)	(1.480694)	(1.309237)		
08	ANIMAL FEED	-281571.6	334584.9	2431544*	946000.0	0.001722	0.833	2.230
	STUFF		(0.179809)	(2.222255)	(0.719232)	(1.072299)		
09	MISC.EDIBLE	756838.0	-217957.6	2163109	-264410.4	0.013577	0.915	2.234
	PRODUCTS ETC		(-0.132349)	(1.298198)	(-0.322925)	(1.616739)		
11	BEVERAGES	-197057.9	468617.3	-562529.5	222721.4	0.014260	0.664	2.077
			(0.398776)	(-0.341568)	(0.530623)	(0.924942)		
12	TOBACCO,TOBA	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	CCO MANUFACT							
21	HIDES,SKINS,	1215827	1772329	-13122303**	9234970**	0.010322	0.816	3.077
	FURSKINS,RAW		(0.464975)	(-3.269924)	(2.664115)	(1.024970)		
22	OILSEED,	-531.5346	430172.1	-216826.6	55213.35	7.56E-05	0.569	2.535
	OLEAGINUSFRUIT		(1.630023)	(-0.574434)	(0.309472)	(0.548109)		
23	CRUDERUBBER	-19983494	-18279266**	63186262***	-2029479	0.066046***	0.994	1.950
			(-3.865709)	(14.51608)	(-0.397137)	(7.836014)		
24	CORKANDWOOD	-175436.8	2568857	-3210628	-284004.1	0.002344	0.594	2.599
			(1.341904)	(-1.393201)	(-0.417228)	(1.935693)		
25	PULP AND	104240.9	-111652.6	-827205.9	1606050	-1.44E-05	0.496	2.539
	WASTE PAPER		(-0.080767)	(-0.541505)	(1.954605)	(-0.016594)		
26	TEXTILE FIBRES	34956283	1.02E+08	39977276	1.01E+08	0.088736	0.800	2.324
			(1.257914)	(0.444146)	(0.882523)	(1.580231)		
27	CRUDE	60738.82	878035.3	5590651	4381902**	0.004920	0.969	2.528
	FERTILIZER,		(0.377795)	(1.983412)	(3.654852)	(0.971198)		
	MINERAL							
28	METALLIFEROUS	4147317	1960708	-5030095	-7906278	0.003919*	0.630	2.872
	ORE,SCRAP		(0.328496)	(-0.785629)	(-1.675817)	(2.216791)		
29	CRUDE ANIMAL,	-10931144	7460532	-12475314	85931252*	0.087444	0.741	2.430
	VEG.MATERL.		(1.393274)	(-1.525415)	(2.333299)	(1.636497)		
32	COAL, COKE,	32238828	16529834	-267230.1	21761223	-0.734675*	0.932	2.070
	BRIQUETTES		(1.250430)	(-0.021332)	(1.142483)	(-3.911443)		
33	PEIROLEUM,	24728230	-3.35E+08*	8.30E+08**	39404392	0.058267**	0.980	2.656
	PEIROLPRODUCT		(-2.337850)	(5.245081)	(0.274872)	(3.899405)		
34	GAS,NATURAL,	16586181	-78697215	1.53E+08	30672076	-0.035415	0.774	1.768
	MANUFACTURED		(-1.268896)	(1.868754)	(0.545885)	(-0.353044)		
35	ELECTRIC	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	CURRENT							
41	ANIMAL OILS	-17800.48	-100002.9	128966.6*	-48389.64	0.000974	0.676	1.986
	AND FATS		(-1.372408)	(2.104263)	(-0.524318)	(1.091991)		
42	FIXED VEG. FATS	305406.9	1411301	-371290.4	739060.3	-0.000351	0.453	2.504
	AND OILS		(1.449266)	(-0.292174)	(0.451216)	(-0.345812)		
43	ANIMAL,VEG.FATS,	-366852.5	997093.2	-187597.5	193972.5	0.045870**	0.984	2.571
	OILS,NES		(1.673758)	(-0.288387)	(1.058084)	(3.833678)		
51	ORGANIC	-3.00E+08	1.40E+08	102227.6	1.51E+08	0.339694**	0.984	2.858
	CHEMICALS		(0.655959)	(0.000460)	(1.331162)	(6.057612)		
52	INORGANIC	-14501935	-9369283	10343896	3275938	0.094841**	0.985	2.136
	CHEMICALS		(-1.593778)	(1.353020)	(0.710339)	(5.822179)		

Code	Description	C	F _K	D _K	D _C	X _{W-C}	R ²	D-W
54	MEDICINAL,PHA RM.PRODUCTS	-11847978	3728856 (0.296688)	2815212 (0.216811)	3005448 (0.505832)	0.041285* (2.023575)	0.884	2.853
55	ESSENTL.OILS, PERFUME,ETC	-3470890	6864543 (1.908760)	3984618 (0.896209)	5297609** (2.623526)	0.041628 (1.662628)	0.974	2.953
56	FERTILIZER,EXC EPT GRP272	-6597497	2371619 (1.336885)	-10062691** (-5.619467)	14847541*** (8.539561)	0.003386** (3.677142)	0.971	2.725
57	PLASTICS IN PRIMARY FORM	-2.01E+08	4.04E+08 (1.718797)	1.38E+08 (0.443700)	4.28E+08* (2.385796)	0.201362** (2.971150)	0.972	2.825
58	PLASTIC,NON- PRIMARY FORM	-81986187	74429702 (1.298867)	43088556 (0.566996)	46112628 (0.935629)	0.155382 (1.178291)	0.929	2.850
59	CHEMICAL MATERIALS NES	-97200722	62981350** (6.013033)	57772104** (-3.913447)	-3211518 (-0.561068)	0.133860*** (13.12543)	0.997	2.920
61	LEATHER,LEATHER GOODS	-3.09E+08	99459657 (0.906007)	16934819 (0.167173)	3.01E+08** (2.784083)	0.495015 (1.678157)	0.906	2.183
62	RUBBER MANUFACIRES,NES	9970269	-32723900 (-1.283398)	44590589 (1.423608)	16721468 (1.428404)	-0.021079 (-0.230458)	0.865	2.614
63	CORK, WOOD MANUFACTURES	-2214927	-13018792 (-1.095550)	2745487 (0.264790)	42133335** (3.554268)	0.036611 (0.741131)	0.804	2.019
64	PAPER, PAPERBOARD,ETC.	-2.94E+08	47532782 (0.897932)	74066649 (0.723649)	62535601 (0.929661)	0.286601** (3.079096)	0.978	2.885
65	TEXTILE YARN, FABRIC,ETC.	-2.85E+09	83969314 (0.389490)	1.82E+08 (0.823145)	4.50E+08 (1.358983)	0.479921** (3.401170)	0.955	2.628
66	NON-METAL. MINERAL MANFCT	-47941459	-30289328 (-0.876865)	59322063 (1.468343)	-7844777 (-0.323532)	0.082629* (2.203882)	0.946	2.841
67	IRON AND STEEL	3.64E+08	-4.38E+08** (-3.039833)	8.62E+08*** (7.120411)	-24432324 (-0.180892)	0.068033** (2.796419)	0.937	3.575
68	NON-FERROUS METALS	-13086390	-1.70E+08 (-1.908841)	4.07E+08** (3.924827)	80340936 (1.543006)	0.030945 (0.976361)	0.973	2.673
69	METALS MANUFACIRES,NES	-83442151	-13785903 (-0.580734)	38468845 (1.419057)	46357504 (1.404299)	0.130892** (2.614393)	0.955	2.189
71	POWER GENERATNG MACHINES	-5.80E+08	62921759 (0.717370)	-1.84E+08 (-1.299760)	-1.45E+08 (-2.012396)	0.244933** (2.888510)	0.927	2.213
72	SPECIAL.INDUST . MACHINERY	-5.74E+08	22556762 (0.169044)	2.13E+08 (1.496637)	1.92E+08 (1.329110)	0.078111* (2.526189)	0.774	1.549
73	METALWORKIN G MACHINERY	-1.14E+08	46504408 (1.358014)	28974581 (0.949053)	-13345689 (-0.255710)	0.069176* (2.192363)	0.745	2.162
74	GENERAL INDUSTL. MACH.NES	-3.08E+08	74923538 (1.085474)	66890093 (1.246159)	-37821926 (-0.431304)	0.096899** (3.948250)	0.937	2.036
75	OFFICE MACHINES, ADP MACH	-31949443	-88779278 (-0.779373)	54702209 (0.363907)	32808681 (0.481804)	0.043216* (2.256328)	0.934	2.756
76	TELECOMM.SOU ND EQUIP ETC	-1.40E+08	-1.03E+08 (-0.438392)	1.61E+08 (0.702810)	1.58E+08 (0.969092)	0.057611 (1.344986)	0.854	1.517
77	ELEC MCH APPAR,PARTS,NES	-2.83E+08	-3.96E+08 (-1.401026)	7.13E+08* (2.091469)	36889678 (0.226827)	0.106661*** (7.031346)	0.992	2.941

Code	Description	C	F _K	D _K	D _C	X _{W-C}	R ²	D-W
79	OTHR.TRANSPOR T EQUIPMENT	-15498796	64760962 (1.769458)	-29098386 (-0.882651)	19958131 (0.533276)	0.008362 (0.544818)	0.433	2.972
81	PREFAB BUILDGS, FTING ETC	2536158	-3115990 (-1.444731)	4975419 (1.376549)	5520836* (2.291209)	-0.003311 (-0.071627)	0.842	2.362
82	FURNITURE, BEDDING, ETC.	-621016.9	1420554 (1.199556)	-962422.0 (-0.857305)	1258680 (1.441275)	0.026412** (2.670706)	0.759	2.950
83	TRAVEL GOODS, HANDBGS ETC	1621475	1200985 (0.613760)	-178184.4 (-0.127187)	-1492703 (-0.935118)	0.024452 (0.310311)	0.303	2.441
84	CLOTHING AND ACCESSORIES	-57750299	45456186* (2.513974)	-81799095** (-3.229709)	17708915 (0.691356)	0.178528** (2.848089)	0.863	2.774
85	FOOTWEAR	1.87E+08	8770208 (0.415537)	5914874 (0.163075)	19715491 (0.280881)	-0.462215 (-0.747661)	0.858	1.918
87	SCIENTIFIC EQUIPMENT NES	-1.07E+08	67505783* (2.515298)	-66080758* (-2.412332)	-6648899 (-0.357417)	0.084833*** (8.803867)	0.974	2.705
88	PHOTO.APPARA T. NES;CLOCKS	-16306769	-13373576 (-1.298214)	32840611** (3.022295)	14150123 (1.950740)	0.015196 (1.654677)	0.958	2.297
89	MISC MANUFCTRD GOODS NES	-1.74E+08	46881529 (0.818804)	43891223 (0.717190)	1.12E+08* (2.412243)	0.144171* (2.323202)	0.942	2.412
91	MAIL NOT CLASSED BY KIND	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
93	SPEC.TRANSACTION . NOT CLASSD	-8251254	4241508 (1.014539)	-3921276 (-0.821515)	-1020747 (-0.601616)	0.013410* (2.350703)	0.908	2.638
96	COIN NONGOLD NONCURRENT	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
97	GOLD, NONMONETARY EXCL ORES	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: United Nations Statistics Division, Comtrade Database - Express Selection,
<http://unstats.un.org/unsd/comtrade/dqQuickQuery.aspx>, based on Standard International
 Trade Classification, Revision 3 (SITC Rev.3).

Table 4. Statistically Significant Estimates of Korea's Exports to China: X_{K-C}

Code	Description	F _K	D _K	D _C	X _{W-U}
02	dairy products ,bird eggs			439288.9**	-0.00732**
04	cereals, cereal preprtns.	-2015134**	3111001**	1407547*	0.000694*
05	vegetables & fruit			1461759*	
06	sugar, sugr. preprtns, honey		10740666*		0.023711**
08	animal feed stuff		2431544*		
21	hides, skins, furskins, raw		-13122303**	9234970**	
23	crude rubber	-18279266**	63186262***	-2029479	0.066046***
27	crude fertilizer, mineral			4381902**	
28	metalliferousore, scrap				0.003919*
29	crude animal, veg. materl.			85931252*	

Table 4. continued

Code	Description	F _K	D _K	D _C	X _{W-U}
32	coal, coke, briquettes				-0.734675*
33	petroleum, petrol. product	-3.35e+08*	8.30e+08**		0.058267**
41	animal oils and fats		128966.6*		
43	animal, veg. fats, oils, nes				0.045870**
51	organic chemicals				0.339694**
52	inorganic chemicals				0.094841**
53	dyes, colouring materials			36097491**	0.171916**
54	medicinal, pharm. products				0.041285*
55	essentl .oils, perfume, etc			5297609**	
56	fertilizer, except grp272		-10062691**	14847541***	0.003386**
57	plastics in primary form			4.28e+08*	0.201362**
59	chemical materials nes	62981350**	57772104**		0.133860***
61	leather, leather goods			3.01e+08**	
63	cork, wood manufactures			42133335**	
64	paper, paperboard, etc.				0.286601**
65	textile yarn, fabric, etc.				0.479921**
66	non-metal .mineral manfct				0.082629*
67	iron and steel	-4.38e+08**	8.62e+08***		0.068033**
68	non-ferrous metals		4.07e+08**		
69	metals manufactres, nes				0.130892**
71	power generating machines				0.244933**
72	special .indust. machinery				0.078111*
73	metalworking machinery				0.069176*
74	general industl. mach. nes				0.096899**
75	office machines, adp mach				0.043216*
77	elec mch appar, parts, nes		7.13e+08*		0.106661***
78	road vehicles			1.16e+08**	
81	prefab buildgs, fttng etc			5520836*	
82	furniture, bedding, etc.				0.026412**
84	clothing and accessories	45456186*	-81799095**		0.178528**
87	scientific equipment nes	67505783*	-66080758*		0.084833***
88	photo. apparat. nes, clocks		32840611**		
89	misc manufctrd goods nes			1.12e+08*	0.144171*
93	spec. transact. not classd				0.013410*

Comments on "Impact of China's Globalization on Korea's Exports to the US and Chinese Market"

Yong-Seok Choi
Fellow, KDI

Professor Chang's paper nicely summarized the process of China's globalization, especially focusing on China's accession to World Trade Organization in December 2001. And then the paper empirically tests two separate hypotheses about Korea's competition in two largest export market of Korea: the first one is the competition between Korea and China in the US market and the other one is the competition between Korea and all other countries in the Chinese market. Testing on the competition of Korea in these two markets would be very interesting and informative because many commentators are saying that the globalization of China would be a big challenge to Korea in the US market while that could be a great opportunity to Korea in the Chinese market.

Having said that, I would like to discuss several points of the paper that need to be sophisticated in my opinion. First, as the author pointed out, China's accession to WTO in 2001 was too recent event to be included in the empirical investigation. Thus, the author proposed alternative model to test the hypotheses which are equation (1) and (2). In equation (1), Korea's export to US is determined by three dummy variables and China's export to US market. However, this equation is exposed to the simultaneity problem because China's export to US market is also an endogenous variable. And the same issue emerges with equation (2) as well. In this sense, the simultaneous equation technique could be employed to test the hypotheses.

Second, I was not fully convinced with the usage of dummy variables in the estimation models. In the model, three dummy variables are used. F_K is the dummy for Korea's financial crisis, putting 1 for 1997 and 1998, D_K is the dummy for post-1997 devaluation of Korea putting 1 from 1997 to 2001 and D_C is the dummy for 1994 devaluation of China putting 1 from 1994 to 2001. These dummies, especially D_K and D_C , may just capture the increasing volume of trade over time, not the price competition of the Korean exports. Instead of these dummy variables, the Real Effective Exchange Rates could be more appropriate to measure the price competition in the export market, although I am not so sure if one can calculate the REER for China.

Third, the author puts the estimation results of China's reduction of trade barriers by product in the appendix for the period of 2000 to 2010. I think these estimates could be used for simulation study to analyze the Chinese import market. That is, after estimating the import demand function of China, we can use these estimates to analyze how the Chinese import market will grow after China's accession to WTO. This could be the fruitful research area for appropriate policy suggestions in taking up the challenge of the globalizing Chinese economy.

CHAPTER 3-2

Korea's Direct Investment in China and Its Implications for Economic Integration in Northeast Asia

by
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Abstract

This paper investigates Korea's direct investment in China and its implications for economic integration in Northeast Asia by examining its effect on bilateral trade between the two countries. The empirical part of the research is based on two recent surveys on Korea's overseas direct investment (ODI), one carried out by the Korea Institute for Industrial Economics and Trade and the other by the Korean Export-Import Bank. The paper concludes that although the motives for investing in China are diverse Korea's ODI in China as a whole has had a positive effect on bilateral trade and thus on the economic integration of the two economies.

Economic relations between the Republic of Korea (henceforth Korea) and the People's Republic of China (henceforth China) have been expanding ever since China undertook the Four Modernization reforms in the late 1970s. Ever since then, bilateral trade between the two countries has been growing steadily in terms of both the volume and the variety of goods traded. Capital flows between the two likewise have been increasing although the flows have been mostly from Korea to China and in the form of direct investment. Between 1989 and 2000, for instance, Korea's merchandise exports to China grew from \$213 million to \$18.4 billion while China's merchandise exports to Korea grew from \$3.9 million to \$11.3 billion (ICSEAD 2002). In fact, China has now emerged as Korea's third largest trading partner. Also, by the end of 1999 Korea had invested \$4.3 billion in China where it had virtually no investment before the late 1970s, and in the year of 2000 alone Korea invested

* Corresponding author. Comments from seminar participants at Texas A&M University-College Station, University of Central Florida, University of New Hampshire, California State University-Fullerton, and Western Economic Association International (2002) conference are greatly appreciated.

\$307 million in China (China Statistical Press 1999, and Lee 2001). These increases in both trade and investment are signs of growing economic interdependence and integration of the two economies, which, we expect, will further economic growth in both countries.¹

China and Korea are two key players in Northeast Asia, a region that stretches from Japan on its eastern edge to the Mongolian People's Republic in the west and the Russian Federation's Far Eastern provinces in the north. It is one of the most dynamic regions in the world although it has yet to develop into a well-integrated economic entity with formal regional machinery similar to the European Union and the NAFTA.

The European experience has clearly demonstrated that the establishment of formal regional institutions such as a free trade area and supranational or intergovernmental institutions can pave the way toward greater regional economic integration. Such institutions are, however, unlikely to emerge unless the region develops its own identity through economic interdependence and creates political support for them (Seliger 2002). Trade and investment are what brings national economies together into close economic interdependence and will thus contribute to the process of regional economic integration.²

In this paper we investigate Korea's direct investment in China and its implications for economic integration in Northeast Asia by investigating its effect on bilateral trade between Korea and China and other possible effects on economic integration. These two countries are key players in Northeast Asia and increasing interdependence between the two through trade and investment will significantly contribute to region-wide economic integration, as their increasing interdependence will lead to a greater division of labor, greater scale economies, and a higher rate of growth in their economies and thus create further incentives for other countries to join in.

In the following section we lay out various possible linkages between outward direct investment (ODI) and bilateral trade between home and host countries. In section II we discuss the motives for Korea's ODI in China with the purpose of shedding light on the investment-trade linkages between the two economies, and in section III we investigate the geographical distribution of Korea's ODI within China and its determinants. We offer some concluding remarks in Section IV.

I. Overseas Direct Investment, Trade, and Economic Integration

ODI makes a direct contribution to economic integration of home and host economies by leading to the establishment of an affiliate or a subsidiary in a foreign country and thus transforming a national enterprise into a transnational one. Within this enterprise, as within any internal organizations, there is a hierarchical relationship between home office and affiliates and an up-and-down flow of information and personnel. Such exchange between home office and affiliates is not readily quantifiable as it bypasses the market, but being an

¹ There are disputes regarding the effect of membership in economic union on the member countries' long-term economic growth, but a recent empirical study points out that membership in European Union has had a positive effect on the long-term growth of the member countries (Crespo-Cuaresma et al. 2002).

² Economic integration is usually defined as "a state of affairs or a process involving attempts to combine separate national economies into larger economic regions" and takes place through the establishment of formal regional machinery such as a free trade area, a customs union, a common market, or a complete economic union (Bende-Nabende 2002, p.11). In this paper we take it also to mean increasing economic connectedness between national economies through trade, investment, and labor movement. Thus economic integration can be brought about either through deliberate attempts to create formal regional machinery or by policy changes toward freer trade and investment or technological changes that facilitate trade/investment expansion between national economies.

intra-firm relationship it is a closer and more intimate person-to-person relationship than the typical arm's-length relationship between independent agents across the market and thus has a greater integrative effect on the two economies.

What effect ODI has on the trade relationship between home and host economies is less clear as it can either increase or decrease bilateral trade or may even have no effect at all. It will have no effect on bilateral trade if it simply creates in the host country an "export platform" for third-country markets and replaces the home-country exports to those markets with the exports from the affiliate. This kind of ODI is most likely to occur when a firm is seeking to minimize the labor cost by relocating its production site from home to a low labor-cost country. Even in that case, however, ODI will have a positive effect on bilateral trade if the affiliate imports intermediate goods from the home country.

ODI will have a positive effect on bilateral trade if it leads to "reverse importing" – the home country importing the affiliate's output and replacing what has been produced for home market with the goods from the affiliate. This will happen when the home country is losing its comparative advantage in labor-intensive industries and transfers them through ODI to another country that has a latent comparative advantage in the same industries. In this case, seeking to minimize the labor cost is obviously the main motive for ODI. This kind of ODI took place in Japan in the 1970s (Kojima 1996, Lee 1994) and also in Korea since the mid-1980s, as will be shown below.

ODI will also have a positive effect on bilateral trade if it is for exploiting natural resources that the home country lacks. Its imports of natural resources from the host country may displace its imports of the same from a third country, but this "trade diversion" is likely to be welfare-improving for both countries since for the home country it is from a more costly to a less costly supplier of natural resources and for the host country it expands the market for its natural resources.

ODI will have a negative effect on bilateral trade if it leads to a partial or full displacement of home country's exports to the host country with locally produced goods. This will occur if the motive for ODI is to serve the host-country market regardless of whether it is to jump a tariff wall or to reduce the cost of serving the market such as the cost of transportation. But even in this case ODI will not completely displace bilateral trade if the affiliates import intermediate products from their parent companies or home-country suppliers, which appears to generally happen.

It is clear from the above discussion on the relationship between ODI and bilateral trade that we can infer the effect of ODI on bilateral trade from its motive. If the motive for ODI is to take advantage of low-cost labor in the host country or exploit its natural resources it is likely to have a positive effect on bilateral trade whereas if the motive is to exploit the host-country market it is likely to have a negative effect (although negligible or even positive if intermediate inputs are supplied from home country).

The discussion so far of the effect of ODI on bilateral trade is based on the assumption that in the economic relationship between two countries trade precedes ODI. It is quite possible, however, as happened in China after the Four Modernizations that foreign investment comes in first to manufacture products in the host country, which then are exported. Such investment will have a positive effect on bilateral trade as it generally leads to importing intermediate products from the home country and possibly to exporting final products to the home country.

These investment-trade linkages are a direct effect of ODI on bilateral trade between home and host countries and do not take into account any indirect effect that ODI may have on bilateral trade through its effect on economic growth. As is well documented in the literature (e.g., Bende-Nabende 2002, Graham and Wada 2001, Henley, Kirkpatrick, and Wilde 2002, OECD 2000, Tseng and Zebregs 2002), ODI generally has a positive effect on the economic growth of the host country, and definitely in the case of China, as it brings in

capital, advanced technology, and managerial know-how and expands employment while increasing competitive pressure on local enterprises and thus enhancing their efficiency. It is also likely to have a long-run positive effect on the home-country economy by transferring abroad the industries in which it is losing its comparative advantage and thus facilitating structural adjustment in accordance with changing comparative advantage. These changes in both home and host countries will have a positive effect on bilateral trade, provided that it is positively related to economic growth.

If this indirect positive effect of ODI is taken into account, ODI motivated by low-cost labor will have a positive effect on bilateral trade whereas the effect of ODI motivated by host-country market will remain ambiguous, its sign depending on the relative magnitude of direct and indirect effects.³

In addition to the ODI-trade linkages there is another reason why ODI will have a positive effect on regional economic integration, and that is the backward linkages created by ODI in the host country. To the extent that the affiliates purchase locally produced intermediate goods the local suppliers participate in the production network that runs across national boundaries and become indirectly linked with the affiliates' parent companies. This inclusion into parent companies' production network will have as strong an effect on regional economic integration as bilateral trade, as demonstrated in the case of Southeast Asia and the coastal areas of China where foreign direct investment has been instrumental in promoting economic growth. As will be shown below, Korea's ODI in China has led to extensive local procurement and thus to the inclusion of local Chinese firms into Korean firms' production networks.

II. Motives for Korea's ODI in China and Its Effect on Bilateral Trade

In investigating the effect of Korea's ODI in China on the two countries' bilateral trade we rely on the results of two recent surveys on Korea's ODI, one carried out by the Korea Institute for Industrial Economics and Trade (KIET) and the other by the Korean Export-Import Bank (KEXIM). The KIET survey, conducted by two KIET researchers, Ha and Hong (1998), was based on a sample of 615 Korean companies (216 large firms and 399 small and medium-sized enterprises) and their 952 offshore affiliates. It contains information on the motives for overseas investment, the patterns of sales and procurement, and other activities of offshore affiliates, as reported by their parent companies registered officially as overseas investors in 1996.

The KEXIM survey was based on a smaller sample of 290 large offshore affiliates with an outstanding investment of at least US\$10 million at the end of 1998. Of these affiliates, 191 (66 percent) were the affiliates of the top 5 *chaebols* and 29 (10 percent) the affiliates of the next 25 largest *chaebols*. Given that small and medium-sized enterprises (SMEs) are not included in the KEXIM survey, we hope to draw some inference about ODI by Korea's SMEs and its effect on economic integration by comparing the results of this survey with those of the KIET survey.

1. Motives for Investing in China

Table 1 reports the results of the KIET survey on the motives for Korea's ODI in general. The survey asked the firms to pick the two most important from a number of motives for investing overseas— natural resource or raw materials, low-cost labor, market access, high

³ If ODI is tariff-hopping and goes into an import-substitute sector it may have a negative effect on economic growth and thus a negative indirect effect on bilateral trade.

technology, and "others." Out of 305 firms with investment in China, 179 firms (58.7 percent) reported low-cost labor and 66 firms (21.6 percent) market access as the most important motive for investing in China. These motives are quite different from those for investing in North America and Europe, which, according to the survey, are market access, "others" and high technology in a descending order of importance (Table 1).⁴

Table 2, based on the KEXIM survey on the motives for Korea's ODI, shows that export expansion from Korea was chosen by 34.3 percent of the respondents as the most important reason for investing in China whereas low-cost labor was chosen by only 16.4 percent. This is significantly less than the 58.7 percent of the respondents in the KIET survey that reported low-cost labor as the most important motive for investing in China. Given that the KEXIM survey covers only the affiliates of large firms whereas the KIET survey covers the affiliates of large firms as well as SMEs, we take the difference in the reported percentage as an indication that the motives for investing in China differ between large firms and SMEs. That is, for large firms the access to markets in China is the most important reason for investing in China whereas for SMEs China's low-cost labor is the most important one.⁵

The two surveys also report the motives for ODI by industry, which are summarized in Tables 3 and 4. It is clear that, as to be expected, low-cost labor was the most important motive for Korea's ODI in labor-intensive industries.⁶ According to the KIET survey (Table 3), for a majority of firms in the textiles and apparel and the footwear and leather industries, which are all labor-intensive, low-cost labor was the most important motive for investing overseas (72.8 percent and 66.7 percent of the respondents, respectively). According to the KEXIM survey (Table 4), which breaks down the responses by region/country as well, 46.2 percent of the respondents in the textiles and apparel industry and 100 percent of the respondents in the footwear and leather industry that had invested in Asia regard low-cost labor as the most important motive for ODI. The corresponding figures for China are 100 percent for the two groups of industries.

The textiles and apparel and the leather and footwear industries had been two of Korea's major export industries until it began losing its comparative advantage in labor-intensive industries in the mid-1980s, owing in part to rapid wage increases. Korean firms in those industries had already established highly developed international marketing networks and thus could continue to utilize them in marketing the products of their affiliates in China and other low-cost labor countries. In the case of those two industries it is reasonable to conclude that the exports from the Korean affiliates in China were displacing the export of the same goods from Korea. Whether it has led to bilateral trade in intermediate goods and "reverse imports" will be addressed later in the paper.

⁴ This difference in motives between ODI in China and that in North America and Europe may to a certain extent be due to the fact that China has SEZs and others do not. Some of the Korean ODI in China is likely to be in SEZs but with no access to China's internal markets. Due to lack of data we are unable to verify this possibility.

⁵ According to Tseng and Zebregs (2002), the market size is more important as a determinant of European and U.S. FDI in China than for FDI from Hong Kong and Taiwan. That is, the motive for investing in China by European and U.S. investors is similar to that of large Korean investors whereas the motive of Hong Kong and Taiwanese investors is similar to that of Korea's SME investors. See also Graham and Wada (2001).

⁶ This survey results are consistent with the result of an econometric study that shows that investments from Hong Kong and Taiwan tend to use China to manufacture goods for export to industrialized countries and also tend to be concentrated in labor-intensive industries that only require low-skill labor (Fung, Iizaka, and Parker 2002).

Table 1. KIET Survey on Motives for Korea's ODI by Region (As of 1996)

(Unit: %)

	Natural resource or Raw materials	Low-cost labour	Market Access	High technology	Others	Total (number of sample)
Asia	10.1	52.5	27.7	0.8	8.9	100 (651)
China	12.8	58.7	21.6	0.0	6.9	100 (305)
North America	6.5	8.7	58.7	9.4	16.7	100 (138)
Europe	3.2	4.8	73.0	7.9	11.1	100 (63)
Latin America	29.5	23.0	34.4	0.0	13.1	100 (61)
All regions	11.3	39.6	36.3	2.5	10.3	100 (938)

Note: The figures are the shares of the firms indicating the most important motive for investing abroad in total number of surveyed firms.

Source: Ha and Hong (1998)

Table 2. KEXIM Survey on Motives for Korea's ODI by Region (As of 1998)

(Unit: %)

	Natural resource or Raw materials	Low-cost labour	Export Expansion	High technology	Others	Total (number of sample)
Asia	12.4	11.7	37.2	0.7	37.9	100 (145)
China	1.5	16.4	34.3	0.0	47.7	100 (67)
North America	29.8	1.8	42.1	0.0	26.4	100 (57)
Europe	20.0	1.7	51.7	0.0	26.7	100 (60)
Latin America	26.6	0.0	53.3	0.0	20.0	100 (15)
All regions	19.3	6.6	41.7	0.3	32.1	100 (290)

Note: The figures are the shares of the firms indicating the most important motive for investing abroad in total number of surveyed firms.

Data Source: KEXIM

Tables 3 and 4 also show that low-cost labor in the host country was an important factor in the decision to invest overseas for firms in capital-intensive heavy industries such as machinery and equipment, electronics and telecommunications equipment, and motors and freight. This is particularly evident in the case of Korea's ODI in China (Table 4). This apparent contradiction with the theory of comparative advantage (i.e., investment in capital-intensive industries in labor-abundant China) can be easily explained, however, once we recognize the increasingly widespread practice of intra-firm inter-process production arrangements or "international fragmentation" in production process (Jones 2001).¹

Production processes in heavy industries involve, relative to light manufacturing industries, a large number of separable sub-processes with different requirements for technology and factor intensity – some sub-processes requiring high-tech materials and component parts and others requiring an intensive use of low-cost labor. A firm in such an industry can minimize the unit cost of producing the final output by locating some processes in countries well endowed in physical and human capital and others in countries where low-cost labor is in abundant supply. For example, it may produce high-tech components in the home country where there is a high technological capability while the assembling of components is done in China where there is an ample supply of low-cost labor. Indeed, many Korean firms in heavy industries have made such production arrangements since the late 1980s by establishing assembly plants in China. International fragmentation thus makes it possible for a developing country to become a site for producing some parts of a previously wholly integrated process and to acquire new skills and knowledge by producing them.

The Korean affiliates in heavy industries in China may be serving as an export platform for their parent companies. Even though in that case the affiliates' exports from China are displacing exports from Korea, the international fragmentation of production processes has a positive effect on bilateral trade if parts and components are shipped from parent to affiliate firms.

2. Trade Patterns of Korean Affiliates in China

As discussed in the preceding section, we are able to make some informed guesses about the effect on bilateral trade of Korea's ODI in China from the knowledge of its motives. In this section we try to find additional information on the ODI-trade nexus by looking into the procurement and sales patterns of affiliates as reported in the KIET and KEXIM surveys. This examination will provide us, however, only with a first approximation of the ODI-trade nexus since it does not take into account the indirect linkage effect of ODI that may take place in other sectors in the economy.

2-a. Procurement and Import Patterns

Table 5 reports the sources of procurement made by Korean offshore affiliates, as reported in the two surveys. According to the KIET survey (the top panel of the table), 60.5 percent of the total procurement of intermediate goods and materials by Korean affiliates in China came from Korea, 31.3 percent from local suppliers, and 8.2 percent from third countries. It is interesting to note that Korean affiliates outside of Asia (including China) imported a larger share of their intermediate goods and materials from Korea and procured

¹ Jones (2001) defines international fragmentation in the production process as a phenomenon that allows previously integrated production processes at one location to be separated into various component parts, some of them being "outsourced" to other countries. He adds that international fragmentation does not necessarily occur within a multinational corporation and can take place as arm's-length transactions whereby the market is utilized between firms.

Table 3. KIET Survey on Motives for Korea's ODI in Manufacturing (As of 1996)

	(Unit: %)					
	Natural resource or Raw materials	Low-cost labour	Market Access	High technology	Others	Total (number of sample)
Manufacturing	10.8	55.5	22.8	1.5	9.4	100 (618)
Food and Beverage	26.8	31.7	36.6	0.0	4.9	100 (41)
Textiles and Apparel	8.6	72.8	11.3	0.0	7.3	100 (151)
Footwear and Leather	2.6	66.7	15.4	0.0	15.3	100 (39)
Wood	31.0	48.3	20.7	0.0	0.0	100 (29)
Paper and Printing	14.3	57.1	7.1	0.0	21.4	100 (14)
Petroleum and Chemical	14.7	35.3	38.2	4.4	7.4	100 (68)
Non-metallic metals	11.5	73.1	0.0	0.0	15.4	100 (26)
Basic metals	14.7	41.2	41.2	0.0	2.9	100 (34)
Fabricated metals	0.0	55.6	38.9	5.6	0.0	100 (18)
Machine and equipment	14.8	44.4	18.5	11.1	11.1	100 (27)
Electrical Machinery	0.0	69.0	27.6	0.0	3.4	100 (29)
Electronics and telecomm equipment	5.4	49.5	21.5	2.2	21.4	100 (93)
Motors and Freight	6.9	41.3	44.8	0.0	7.0	100 (29)

Note: The figures are the shares of the firms indicating the most important motive for investing abroad in total number of surveyed firms.

Source: Ha and Hong (1998), P124-125.

Table 4. KEXIM Survey on Motives for Korea's ODI in Manufacturing by Industry and Region (As of 1998)

(Unit: %)

		Natural resource or Raw materials	Low-cost labour	Export Expansion	High technology	Others	Total (number of sample)
Asia [China]	Manufacturing	8.9 [0.0]	18.9 [26.2]	46.7 [50.0]	0.0 [0.0]	15.6 [9.5]	100 (90) [42]
	Food and Beverage	33.3 [0.0]	0.0 [0.0]	16.7 [0.0]	0.0 [0.0]	50.0 [100]	100 (6) [3]
	Textiles and Apparel	15.4 [0.0]	46.2 [100]	15.4 [0.0]	0.0 [0.0]	15.4 [0.0]	100 (13) [2]
	Footwear and Leather	0.0 [0.0]	100 [100]	0.0 [0.0]	0.0 [0.0]	0.0 [0.0]	100 (3) [2]
	Petroleum and Chemicals	33.3 [0.0]	11.1 [25.0]	22.2 [50.0]	0.0 [0.0]	33.3 [25.0]	100 (9) [4]
	Basic Metals	0.0 [0.0]	0.0 [0.0]	75.0 [80.0]	0.0 [0.0]	0.0 [20.0]	100 (8) [5]
	Machine and Equipment	0.0 [0.0]	28.6 [33.3]	57.1 [66.7]	0.0 [0.0]	14.3 [0.0]	100 (7) [6]
	Electronics and Telecomm equipment	0.0 [0.0]	12.5 [18.8]	68.8 [62.5]	0.0 [0.0]	6.3 [18.8]	100 (32) [16]
	Motors and Freight	0.0 [0.0]	16.7 [33.3]	16.7 [66.7]	0.0 [0.0]	33.3 [0.0]	100 (6) [3]
United States	Manufacturing	9.1	0.0	63.6	0.0	18.2	100 (11)
	Machine and Equipment	0.0	0.0	100	0.0	0.0	100 (2)
	Electronics and Telecomm equipment	0.0	0.0	80.0	0.0	20.0	100 (5)
Europe	Manufacturing	15.4	3.8	50.0	0.0	19.2	100 (26)
	Electronics and Telecomm equipment	21.4	0.0	57.1	0.0	7.1	100 (14)
	Motors and Freight	0.0	14.3	57.1	0.0	14.3	100 (7)
Latin America and Africa	Manufacturing	14.3	0.0	50.0	0.0	7.1	100 (14)
	Textiles and Apparel	0.0	0.0	100	0.0	0.0	100 (2)
	Basic metals	0.0	0.0	0.0	0.0	0.0	100 (2)
	Electronics and Telecomm equipment	12.5	0.0	62.5	0.0	0.0	100 (8)
All region	Manufacturing	10.6	12.8	48.9	0.0	15.6	100 (141)

Note: 1) The figures are the shares of the firms indicating the most important motive for investing abroad in total number of surveyed firms.

2) The figures in [] are the share of the firms indicating the most important motive for investing in China in total number of surveyed firms.

Data Source: KEXIM

less from local suppliers (with the exception of the affiliates in North America) in comparison with their counterparts in Asia.

Tables 3 and 4 also show that low-cost labor in the host country was an important factor in the decision to invest overseas for firms in capital-intensive heavy industries such as machinery and equipment, electronics and telecommunications equipment, and motors and freight. This is particularly evident in the case of Korea's ODI in China (Table 4). This apparent contradiction with the theory of comparative advantage (i.e., investment in capital-intensive industries in labor-abundant China) can be easily explained, however, once we recognize the increasingly widespread practice of intra-firm inter-process production arrangements or "international fragmentation" in production process (Jones 2001).¹

Production processes in heavy industries involve, relative to light manufacturing industries, a large number of separable sub-processes with different requirements for technology and factor intensity – some sub-processes requiring high-tech materials and component parts and others requiring an intensive use of low-cost labor. A firm in such an industry can minimize the unit cost of producing the final output by locating some processes in countries well endowed in physical and human capital and others in countries where low-cost labor is in abundant supply. For example, it may produce high-tech components in the home country where there is a high technological capability while the assembling of components is done in China where there is an ample supply of low-cost labor. Indeed, many Korean firms in heavy industries have made such production arrangements since the late 1980s by establishing assembly plants in China. International fragmentation thus makes it possible for a developing country to become a site for producing some parts of a previously wholly integrated process and to acquire new skills and knowledge by producing them.

The Korean affiliates in heavy industries in China may be serving as an export platform for their parent companies. Even though in that case the affiliates' exports from China are displacing exports from Korea, the international fragmentation of production processes has a positive effect on bilateral trade if parts and components are shipped from parent to affiliate firms.

2. Trade Patterns of Korean Affiliates in China

As discussed in the preceding section, we are able to make some informed guesses about the effect on bilateral trade of Korea's ODI in China from the knowledge of its motives. In this section we try to find additional information on the ODI-trade nexus by looking into the procurement and sales patterns of affiliates as reported in the KIET and KEXIM surveys. This examination will provide us, however, only with a first approximation of the ODI-trade nexus since it does not take into account the indirect linkage effect of ODI that may take place in other sectors in the economy.

2-a. Procurement and Import Patterns

Table 5 reports the sources of procurement made by Korean offshore affiliates, as reported in the two surveys. According to the KIET survey (the top panel of the table), 60.5 percent of the total procurement of intermediate goods and materials by Korean affiliates in China came from Korea, 31.3 percent from local suppliers, and 8.2 percent from third

¹ Jones (2001) defines international fragmentation in the production process as a phenomenon that allows previously integrated production processes at one location to be separated into various component parts, some of them being "outsourced" to other countries. He adds that international fragmentation does not necessarily occur within a multinational corporation and can take place as arm's-length transactions whereby the market is utilized between firms.

countries. It is interesting to note that Korean affiliates outside of Asia (including China) imported a larger share of their intermediate goods and materials from Korea and procured less from local suppliers (with the exception of the affiliates in North America) in comparison with their counterparts in Asia.

According to the KEIXM survey (the bottom panel of Table 5), the procurement pattern of large-firm affiliates differs from that of all affiliates: The former imported 44.7 percent of intermediate goods and materials from Korea (78 percent of this share came directly from their parent companies or related affiliates). Local suppliers in China accounted for 39.2 percent of total procurement while third countries accounted for 16.1 percent. In other words, Korea's large-firm affiliates in China imported less from Korea, procured more locally and from third countries, implying that Korea's SME-affiliates in China relied more heavily than their large-firm counterparts on imports from Korea and less from local and third-country sources. This difference may be due to the networks of SMEs being more localized in Korea than those of large firms, which we expect to be more global in reach. Another reason might be that, relative to SMEs, large firms are concentrated in capital-intensive industries, which are internationally more fragmented in production processes than labor-intensive industries in which ODI from SMEs is concentrated.

The results of the KEXIM survey are consistent with the information obtained from the KIET survey. That is, Korean affiliates in China imported a large share of their intermediate goods and materials from Korea, albeit not as much as that by those outside of Asia (including China). They generally procured more from local suppliers, creating substantial backward linkages within China. These results lead the conclusion that as far as procurement by affiliates is concerned Korea's ODI in China has had a positive effect on bilateral trade and has created extensive backward linkages, thus contributing to the economic integration of the two countries.

Table 6 shows the procurement pattern of offshore affiliates by manufacturing industry, as reported in the KIET survey. For affiliates in food and beverages—natural-resource-based industries in which the motive for ODI is to obtain natural resources in the host country—the share of imports from Korea was, as to be expected, small, 7.2 and 0.9 percent, respectively. Their share of local procurement was quite large, 91.4 and 98.9 percent, respectively, indicating a strong backward linkage effect of ODI.

In a number of labor-intensive industries and in some heavy industries the share of imports from Korea was very large. In the former group are the textile and the footwear and leather industries, where the share of inputs imported from Korea was 74.8 percent and 90.8 percent, respectively. In the latter group are the fabricated metals, electrical machinery, motors and freight, and electronics and telecommunication equipment industries, where the share was 96.0, 74.5, 68.9 and 64.7 percent, respectively. For affiliates in those industries local procurement accounted for a small share of intermediate goods and materials, indicating that they are basically assemblers of imported parts utilizing low-cost labor in the host country.

Table 7 reports the procurement pattern of Korea's large-firm affiliates in China. In footwear and leather, basic metals, and machinery and equipment at least one half of intermediate goods and materials was imported from Korea. In food and beverage, apparel, non-metallic minerals, and motors and freight a significant portion of inputs was supplied locally, a sign of strong backward linkages of ODI in China by large-firm affiliates. In textiles and basic metals at least a third of inputs was imported from third countries.

For manufacturing as a whole the share of inputs imported from Korea was 45.2 percent while the share of local procurement was 38.5 percent. These high figures suggest that ODI in China by Korea's large-firm affiliates has had a positive effect on economic integration of the two countries.²

² Doner (1997) argues that foreign affiliates in developing countries initially tend to rely heavily on

Table 5. Sources of Procurement by Offshore Affiliates of Korean Firms by Region

(Unit: % of total procurement)

KIET Survey (As of 1996)				
	Local Procurement	Import		Total
		Korea	Third Countries	
Asia	37.4	52.3	10.3	100
China	31.3	60.5	8.2	100
North America	34.6	64.8	0.5	100
Europe	19.6	80.1	0.3	100
Latin America	12.6	85.9	1.5	100
KEXIM Survey (As of 2000)				
	Local Procurement	Import		Total
		Korea	Third Countries	
Asia	45.4 (3.8)	33.4 (30.2)	21.3 (9.3)	100
China	39.2 (3.1)	44.7 (34.8)	16.1 (8.1)	100
North America	20.1 (8.4)	58.7 (56.9)	21.2 (14.7)	100
Europe	23.0 (7.9)	48.9 (45.4)	28.1 (14.4)	100
Latin America	31.0 (14.8)	51.6 (46.4)	17.5 (8.6)	100

Note: Figures in parenthesis of KEXIM survey are the share of the related affiliates out of total procurement.

Source: Ha and Hong (1998), KEXIM.

Table 6. KIET Survey on Sources of Procurement by Offshore Affiliates of Korean Firms in Manufacturing by Industry (As of 1996)

(Unit: % of total procurement)

	Local Procurement	Import		Total
		Korea	Third Countries	
Manufacturing	47.3	46.0	6.7	100
Food and Beverage	91.4	7.2	1.3	100
Textiles	21.8	74.8	3.4	100
Apparel	49.1	49.1	1.8	100
Footwear and Leather	7.0	90.8	2.2	100
Wood	32.8	51.5	15.7	100
Paper and Printing	62.0	32.6	5.4	100
Petroleum and Chemicals	30.9	33.0	36.1	100
Non-metallic metals	48.8	39.5	11.6	100
Basic metals	98.9	0.9	0.2	100
Fabricated metals	0.9	96.0	3.1	100
Machinery and equipment	68.1	27.4	4.5	100
Electrical Machinery	25.0	74.5	0.4	100
Electronics and telecomm equipment	16.7	64.7	18.6	100
Motors and Freight	31.1	68.9	0.0	100

Source: Ha and Hong (1998), P66-67.

Table 7. KEXIM Survey on Sources of Procurement by Korea's Large-Firm Affiliates in China in Manufacturing by Industry (As of 2000)
(Unit: % of total procurement)

	Local Procurement	China	
		Korea	Import Third Countries
Manufacturing	38.5 (3.1)	45.2 (35.1)	16.2 (8.1)
Food and Beverage	80.0 (0.0)	20.0 (0.0)	0.0 (0.0)
Textiles	29.5 (0.0)	32.2 (32.2)	38.3 (22.0)
Apparel	72.1 (0.0)	24.8 (24.8)	3.1 (0.0)
Footwear and Leather	29.9 (0.0)	68.5 (68.5)	1.5 (0.0)
Petroleum and Chemicals	44.2 (0.0)	27.9 (13.3)	27.8 (0.0)
Non-metallic Minerals	100.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Basic Metals	17.0 (0.3)	49.8 (21.5)	33.1 (26.4)
Machinery and Equipment	10.0 (0.0)	67.4 (67.4)	22.6 (0.0)
Electronics and Telecommunication Equipment	41.8 (4.8)	45.1 (37.7)	13.1 (6.8)
Motors and Freight	55.6 (0.0)	44.4 (44.4)	0.0 (0.0)

Note: 1) Figures in parenthesis are the share of related affiliates out of total procurement.

Data Source: KEXIM

2-b. Sales and Export Patterns

Table 8 reports the sales and exports of Korean affiliates as reported in the two surveys. Korean affiliates in China exported 69.9 percent of their output to the rest of the world—27.9 percent to Korea and 42.0 percent to third countries (the top panel of the table). In comparison, its large-firm affiliates exported 53.3 percent of their output to the rest of the world—24.5 percent to Korea and 28.8 percent to third countries (the bottom panel of the table), indicating that Korea's SME affiliates in China exported a much larger share of their output. The share of local sales by the affiliates outside of China was much larger than that by the affiliates operating in China, suggesting that the latter performed largely as an export platform for Korean companies, especially for its SMEs.

Table 9 shows that the Korean manufacturing affiliates as a whole sold 66.1 percent of their output in the host countries and exported 9.4 percent to Korea and 24.5 percent to third countries. It also shows a wide industry variation in the shares of local sales and exports. In food and beverage, petroleum and chemicals, non-metallic minerals, basic metals, fabricated metals, machinery and equipment, and motors and freight more than a half of the affiliate output was sold locally. In contrast, in textiles, apparel, footwear and leather, wood, paper and printing, electrical machinery, and electronics and telecommunication equipment more than a half of the output was exported. Reverse imports—exports back to Korea—accounted for 9.4 percent of the entire manufacturing sector output and was especially large in wood (41.9 percent) and electrical machinery (44.4 percent).

The large reverse imports in wood reflect a strategy of Korean firms for developing and importing resource-based products, which are in short supply in Korea. In contrast, the large share of reverse imports of electrical machinery in total sales reflects Korea's changing comparative advantage and the displacement of home production with imports in some of the consumer durable goods markets in Korea.

Table 10 reports the sales and exports of large-firm affiliates in China, as reported in the KEXIM survey. For the entire manufacturing sector, local sales in China accounted for 45.8 percent of total sales, reverse imports 24.9 percent, and exports to third countries 29.3 percent. Reverse imports were especially large in non-metallic minerals (89.1 percent) followed by apparel (41.1 percent), textiles (38.3 percent), and electronics and telecommunication equipment (32.4 percent). As noted earlier (see Table 7), offshore affiliates in most of those industries procured much of their intermediate products from their parent companies; i.e., apparel 24.8 percent, textiles 32.2 percent, electronics and telecommunication equipment 45.1 percent. This pattern of procurement, combined with heavy reliance on reverse imports, suggests the importance of intra-firm trade for large-firm affiliates in those industries.

For large-firm affiliates in China in the footwear and leather industry, third-country markets accounted for 79.5 percent of their total sales; for those in apparel 41.8 percent; and for those in electronics and telecommunication equipment 34.7 percent.

Reverse imports resulting from ODI clearly add to bilateral trade between home and host countries and reflect a changing comparative advantage between the two countries.

What motivated Korean firms to invest in China was the rapidly increasing labor cost at home and an abundant supply of low-cost labor in China. An increasing gap in the labor cost between the two countries would have caused a contraction in labor-intensive industries in Korea and an expansion in the same in China even without the transplantation of those industries to China through ODI and would have led to Korea's importing labor-intensive products from China. What ODI has done is to bring about a more rapid response of the international division of labor to changing comparative advantage and a greater expansion of bilateral trade between Korea and China than would have been otherwise (Ogawa and Lee 1996).

Table 8. Sales Destination of Offshore Affiliates of Korean Firms by Region

(Unit: % of total sales)

KIET Survey (As of 1996)				
	Local Sales	Export		Total
		Korea	Third Countries	
Asia	64.5	14.2	21.3	100
China	30.2	27.9	42.0	100
North America	93.9	3.6	2.5	100
Europe	69.9	1.4	28.7	100
Latin America	58.0	10.9	31.1	100
KEXIM Survey (As of 2000)				
	Local Sales	Export		Total
		Korea	Third Countries	
Asia	49.1 (2.5)	30.0 (25.5)	20.9 (9.4)	100
China	46.7 (7.1)	24.5 (23.8)	28.8 (13.9)	100
North America	83.5 (2.2)	5.5 (3.6)	11.0 (4.2)	100
Europe	50.1 (6.2)	7.2 (4.4)	42.7 (9.8)	100
Latin America	68.5 (13.2)	20.1 (20.1)	11.4 (4.2)	100

Note: Figures in parenthesis of KEXIM survey are the share of the related affiliates out of total sales.

Source: Ha and Hong (1998), KEXIM.

Table 9. KIET Survey on Sales Destination of Offshore Affiliates of Korean Firms in Manufacturing by Industry (As of 1996)

(Unit: % of total sales)

	Local Sales	Export		Total
		Korea	Third Countries	
Manufacturing	66.1	9.4	24.5	100
Food and Beverage	77.2	10.2	12.6	100
Textiles	31.7	21.0	47.3	100
Apparel	24.5	19.8	55.7	100
Footwear and Leather	26.7	21.6	51.7	100
Wood	41.8	41.9	16.3	100
Paper and Printing	2.9	23.4	73.7	100
Petroleum and Chemicals	64.3	13.5	22.1	100
Non-metallic metals	67.3	20.5	12.2	100
Basic metals	95.4	2.3	2.3	100
Fabricated metals	56.8	3.8	39.5	100
Machinery and equipment	97.5	2.4	0.1	100
Electrical Machinery	19.4	44.4	36.1	100
Electronics and telecommunication equipment	27.4	7.6	65.1	100
Motors and Freight	86.7	0.9	12.3	100

Source: Ha and Hong (1998), P56-57.

Table 10. KEXIM Survey on Sales Destination of Korea's Large-Firm Affiliates in China in Manufacturing by Industry (As of 2000)
(Unit: % of total procurement)

	China		
	Local Sales	Export	
		Korea	Third Countries
Manufacturing	45.8 (7.2)	24.9 (24.2)	29.3 (14.1)
Food and Beverage	76.2 (0.0)	0.0 (0.0)	23.8 (0.0)
Textiles	36.0 (6.1)	38.3 (38.3)	25.7 (0.0)
Apparel	17.0 (0.0)	41.1 (41.1)	41.8 (0.0)
Footwear and Leather	0.2 (0.0)	20.3 (20.3)	79.5 (0.0)
Petroleum and Chemicals	75.1 (12.9)	11.4 (11.4)	13.6 (11.5)
Non-metallic Minerals	10.9 (0.0)	89.1 (89.1)	0.0 (0.0)
Basic Metals	97.8 (18.9)	0.0 (0.0)	2.2 (0.2)
Machinery and Equipment	100.0 (12.2)	0.0 (0.0)	0.0 (0.0)
Electronics and Telecommunication Equipment	33.0 (5.1)	32.4 (31.2)	34.7 (21.2)
Motors and Freight	79.6 (0.0)	20.4 (20.4)	0.0 (0.0)

Note: 1) Figures in parenthesis are the share of related affiliates of total sales

Data Source: KEXIM

III. Sectoral and Geographical Distribution of Korea's ODI in China and Its Determinants

FDI in China is not evenly distributed throughout the country, being highly concentrated in the coastal areas (Broadman and Sun 1997, OECD 2000). Such geographical concentration implies that the effect of FDI on economic growth and integration into the world economy is not evenly distributed throughout China. If Korea's ODI follows the same pattern its effect on bilateral economic integration will be also unevenly distributed, some areas in China being more integrated with Korea than others. In this section we investigate the geographical distribution of Korea's ODI in China to find out the spatial distribution of its integrative effect in China.

As is clear on Table 11, Korea's ODI in China is, like FDI in China in general, concentrated in the coastal areas, which received 88.9 percent (\$2,896 million) of total FDI from Korea in 1993-97. The inland areas and the autonomous regions received only 9.3 percent and 1.8 percent, respectively, during the same period.

Among the coastal areas the Shandong province is the most favored destination for Korean investment (28.5 percent of Korea's ODI in China), followed by the Liaoning province (11.6 percent), the Jiangsu province (11.3 percent), the city of Shanghai (11.3 percent), the city of Tianjin (10.7 percent) and the city of Beijing (7.6 percent). It is noteworthy to point out that Korea's ODI is concentrated, relative to FDI from the world, in Shandong, Liaoning, Shanghai, Tianjin and Beijing—areas that are along the Yellow Sea and nearest to Korea.

Another noteworthy point is that three provinces in China's northeastern region (Liaoning, Jilin and Heilongjiang) have received significant amounts of FDI from Korea, particularly from its SMEs, when the same provinces have received relatively negligible amounts from other countries. We explain this difference as due to the fact that those three provinces have the highest concentration of ethnic Koreans in China:¹ The common language and some commonality in culture would have the effect of reducing the transactions cost in investing overseas, such cost reduction being more important for SMEs than large-firm affiliates.

Table 12 reports the distribution of Korea's ODI in China by province and by sector. In 1993-97 Korea's ODI in manufacturing in China amounted to \$2,649 million, about 81 percent of Korea's total ODI in China. Within the manufacturing sector, electronics and telecommunication equipment registered the largest share (18.8 percent), followed by textiles and apparel (17.2 percent), machinery and equipment (10.4 percent), and petroleum and chemicals (9.4 percent). Investment by SMEs was concentrated in light industries such as textile and apparel, footwear and leather, and wood and furniture, whereas investment by large firms was concentrated in heavy and chemical industries such as electronics and telecommunication equipment, motors and freight, non-metallic minerals, and basic metals.

The city of Tianjin was the largest recipient of Korean investment in electronics and telecommunication equipment whereas the provinces of Shandong, Liaoning and Jiangsu were the largest recipients of investment in textiles and apparel, machinery and equipment, and basic metal, respectively.

¹ According to the 1990 China Census Data, ethnic Koreans in China numbered 1.92 million with 97 percent (1.86 million) residing in the three provinces in northeastern region (1.18 million in Jilin, 0.45 million in Heilongjiang, and 0.23 million in Liaoning).

Table 11. Geographical Distribution of FDI in China by Region (Cumulative, US\$ Million)

	From Korea (1993-1997)			From the World (1994-1997)
	Total	Large Firm	SMEs	
Coastal areas	2,896.3 (88.9%)	1,777.0 (90.7%)	1,119.3 (86.2%)	135,609.7 (85.4%)
Shandong	927.2 (28.5%)	434.4 (22.2%)	492.8 (38.0%)	10,650.5 (6.7%)
Jiangsu	369.1 (11.3%)	293.7 (15.0%)	75.4 (5.8%)	19,599.2 (12.3%)
Liaoning	377.0 (11.6%)	188.1 (9.6%)	188.9 (14.6%)	6,968.9 (4.4%)
Tianjin	348.1 (10.7%)	209.1 (10.7%)	139.0 (10.7%)	7,200.0 (4.5%)
Shanghai	367.4 (11.3%)	304.7 (15.6%)	62.7 (4.8%)	13,532.0 (8.5%)
Beijing	248.7 (7.6%)	181.0 (9.2%)	67.7 (5.2%)	5,597.3 (3.5%)
Guangdong	106.0 (3.3%)	71.9 (3.7%)	34.1 (2.6%)	44,112.6 (27.8%)
Hebei	51.9 (1.6%)	26.2 (1.3%)	25.8 (2.0%)	3,003.4 (1.9%)
Zhejiang	72.1 (2.2%)	55.8 (2.8%)	16.3 (1.3%)	5,432.3 (3.4%)
Fujian	19.7 (0.6%)	5.6 (0.3%)	14.1 (1.1%)	16,038.7 (10.1%)
Hainan	9.1 (0.3%)	6.5 (0.3%)	2.6 (0.2%)	3,474.8 (2.2%)
Inland areas	301.8 (9.3%)	128.3 (6.5%)	173.5 (13.4%)	19,611.4 (12.4%)
Jilin	125.8 (3.9%)	51.0 (2.6%)	74.8 (5.8%)	1,503.8 (0.9%)
Heilongjiang	108.6 (3.3%)	24.7 (1.3%)	83.9 (6.5%)	2,166.2 (1.4%)
Hunan	29.8 (0.9%)	28.6 (1.5%)	1.2 (0.1%)	2,501.2 (1.6%)
Hubei	14.0 (0.4%)	12.3 (0.6%)	1.7 (0.1%)	2,756.4 (1.7%)
Anhui	4.4 (0.1%)	2.0 (0.1%)	2.4 (0.2%)	1,793.6 (1.1%)
Henan	3.0 (0.1%)	0.0 (0.0%)	3.0 (0.2%)	2,080.9 (1.3%)
Shanxi	2.4 (0.1%)	0.3 (0.02%)	2.2 (0.2%)	502.5 (0.3%)
Sichuan	7.4 (0.2%)	6.4 (0.3%)	1.1 (0.1%)	2,570.7 (1.6%)
Shaanxi	3.9 (0.1%)	2.6 (0.1%)	1.3 (0.1%)	1,517.1 (1.0%)
Jiangxi	0.9 (0.03%)	0.0 (0.0%)	0.9 (0.1%)	1,332.9 (0.8%)
Guizhou	0.4 (0.01%)	0.4 (0.02%)	0.0 (0.0%)	201.8 (0.1%)
Yunnan	1.1 (0.03%)	0.0 (0.0%)	1.1 (0.1%)	393.7 (0.2%)
Gansu	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	283.1 (0.2%)
Qinghai	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	7.5 (0.004%)
Autonomous Regions	59.3 (1.8%)	54.0 (2.8%)	5.3 (0.4%)	3,516.1 (2.2%)
Total	3,257.4 (100%)	1,959.3 (100%)	1,298.1 (100%)	158,737.2 (100%)

Data Source: KEXIM, www.koreaexim.go.kr/oeis/index.html, National Bureau of Statistics of China, www.stats.gov.cn

Table 12. Korea's Net Outward Manufacturing Investment in China (Cumulative, 1993-97): By Sector and Region

(Unit: US\$ thousand, %)

	(1) FB	(2) TA	(3) FL	(4) WF	(5) PP	(6) PC	(7) NM	(8) BM	(9) FM	(10) ME	(11) ET	(12) MF	(13) OT	Total
Shandong	43,296	219,325	80,888	9,242	9,568	48,536	123,016	8,187	20,511	58,437	85,949	119,975	66,699	893,629 [33.7]
Jiangsu	11,798	65,824	6,824	1,556	580	72,128	8,710	87,067	1,196	25,816	70,377	1,680	4,949	358,505 [13.5]
Liaoning	9,281	39,926	27,692	14,290	11,076	16,089	28,907	17,818	9,143	73,104	26,710	19,478	11,391	304,905 [11.5]
Tianjin	4,423	38,997	9,860	1,016	1,214	33,818	3,210	6,102	14,154	11,975	146,740	3,722	59,462	334,693 [12.6]
Shanghai	8,366	17,846	1,214	2,151	21,678	1,608	6,487	300	5,795	8,171	42,506	14,610	8,695	139,427 [5.3]
Beijing	22,709	7,259	2,204	309	680	14,116	18,059	1,190	5,013	18,443	39,092	4,743	5,273	139,090 [5.3]
Guangdong	3,500	3,094	1,760	3,508	308	9,298	150	12,387	2,984	7,657	47,541	8,500	3,986	104,673 [4.0]
Hebei	17,321	8,389	1,204	1,108	86	1,119	2,014	2,824	1,469	8,440	100	141	2,767	46,982 [1.8]
Zhejiang	3,498	8,675	825	797	1,361	28,120	730	521	84	591	220	150	2,169	47,741 [1.8]
Fujian	0	1,256	0	0	0	3,780	280	2,191	52	1,220	888	7,131	2,811	19,609 [0.7]
Hainan	0	0	0	20	0	200	1,800	6,456	0	0	0	0	0	8,476 [0.3]
Jilin	11,906	34,158	643	8,320	2,571	10,663	4,713	3,302	2,890	4,387	6,200	1,894	1,912	93,559 [3.5]
Hilongjiang	6,257	4,725	951	3,090	1,773	2,880	1,167	2,031	898	54,873	1,840	1,048	-2,073	79,460 [3.0]
Hunan	0	100	0	0	0	0	0	0	0	0	28,618	0	1,100	29,818 [1.1]
Hubei	391	5,480	0	70	0	300	0	0	0	50	0	6,900	0	13,191 [0.5]
Anhui	1,000	0	0	0	0	1,254	0	0	0	0	2,000	25	70	4,349 [0.2]
Henan	906	0	0	0	0	902	64	0	0	526	80	0	50	2,528 [0.1]
Shanxi	0	0	0	0	0	0	1,120	0	0	0	0	0	0	1,120 [0.04]
Sichuan	0	781	0	0	0	0	0	0	0	0	156	0	0	937 [0.04]
Shaanxi	315	0	0	0	0	12	0	0	0	0	200	0	211	738 [0.03]
Jiangxi	0	146	0	0	22	0	0	0	0	139	0	0	0	307 [0.01]
Guizhou	0	0	0	0	0	0	0	0	0	0	0	414	0	414 [0.02]
Yunnan	0	0	0	0	0	0	0	0	0	0	0	0	0	0 [0.0]
Gansu	0	0	0	0	0	0	0	0	0	0	0	0	0	0 [0.0]
Qinghai	0	0	0	0	0	0	0	0	0	0	0	0	0	0 [0.0]
Total	145,636 (5.5)	456,191 (17.2)	134,065 (5.1)	45,477 (1.7)	50,942 (1.9)	249,050 (9.4)	201,837 (7.6)	150,376 (5.7)	64,189 (2.4)	276,076 (10.4)	499,217 (18.8)	205,926 (7.8)	169,544 (6.4)	2,648,526 [100] (100)
Large	80,282 <55.1>	185,955 <40.8>	29,850 <22.3>	7,973 <17.5>	22,893 <44.9>	131,212 <52.7>	149,353 <74.0>	125,341 <83.4>	14,393 <22.4>	136,074 <49.3>	376,661 <75.5>	149,078 <72.4>	57,510 <33.9>	1,466,575 <55.4>
SMEs	65,354 <44.9>	270,236 <59.2>	104,215 <77.7>	37,504 <82.5>	28,049 <55.1>	117,838 <47.3>	52,484 <26.0>	25,035 <16.6>	49,796 <77.6>	140,002 <50.3>	122,556 <24.5>	56,848 <27.6>	112,034 <66.1>	1,181,951 <44.6>

Note: (1) Food and Beverage (FB), (2) Textiles and Apparel (TA), (3) Footwear and Leather (FL), (4) Wood and Furniture (WF), (5) Paper and Printing (PP), (6) Petroleum and Chemicals (PC), (7) Non-Metallic Minerals (NM), (8) Basic Metals (BM), (9) Fabricated Metals (FM), (10) Machinery and Equipment (ME), (11) Electronics and Telecommunication Equipment (ET), (12) Motors and Freight (MF), (13) Others (OT)

Data Source: KEXIM, www.koreaexim.go.kr/oeis/index.html

In order to find out the factors that determine the geographical distribution of Korea's ODI in China we carry out a regression analysis of the following location choice model of FDI that includes variables representing the level of economic development and foreign investment policies of different regions. The model is applied to two different sets of FDI data, one for large-firms and the other for SMEs.

$$ODI_i = \beta_1 + \beta_2 Y_i + \beta_3 W_i + \beta_4 E_i + \beta_5 I_i + \beta_6 DP_i + \beta_7 DK_i + \varepsilon_i$$

where

ODI_i = log of Korea's net cumulative direct investment in a manufacturing industry in region i in 1993-97,

Y_i = log of nominal GDP of region i in 1995,

W_i = log of nominal annual average wage for staff and workers in region i in 1995,

E_i = ratio of the number of students enrolled in higher education to population in region i in 1995,

I_i = total length of road in region i per square kilometer of land in 1995,

DP_i = dummy variable for Special Economic Zones and Open Coastal Cities,

DK_i = dummy variable for provinces where ethnic Koreans constitute a major minority group,

ε = stochastic disturbance term

Y , GDP, represents the market size of a region and is expected to have a positive coefficient and the variable W , with a negative expected coefficient, is to capture low-cost labor as a motive for Korea's ODI in China. The variable E is to capture the importance of the availability of skilled labor as a motive for ODI and is expected to have a positive coefficient. It is well recognized in the literature that the availability of infrastructure is an important factor in the decision on where to locate FDI and various indicators have been used as a measure of infrastructure availability. In our regression we use the total length of road within a region (I), normalized by its geographical size, as a measure of infrastructure availability.

The regression model also includes a dummy variable for preferential policies for FDI inflows. As is well known, China has a number of open economic zones such as Special Economic Zones (SEZs) and Open Coastal Cities (OCCs), which offer special tax incentives and maintain a liberal trade and investment regime but are separated from China's internal markets. The policy dummy variable (DP) is assigned value 1 for Guangdong, Fujian, Hainan, Liaoning, Hebei, Tianjin, Shandong, Jiangsu, Zhejiang, areas designated as either SEZ or OCC, and value 0 for other areas. The expected sign for DP is positive. Another dummy variable (DK) is included in the model to find out whether common culture/language mattered in locational decisions of Korean investors. It is assigned value 1 for the three provinces of Jilin, Heilongjiang, and Liaoning where ethnic Koreans constitute a major minority group and value 0 for other provinces.

The dependent variable employed in the model is the net cumulative manufacturing investment for 1993-97. For estimation we apply the canonical censored regression model, given that the dependent variable is left censored at zero. All the data for the independent variables are for 1995, a midpoint in the 1993-97 period.¹

We have shown in the preceding sections that there is a significant difference in the motives for ODI as well as in the sales and procurement patterns between large firms and SMEs. Those differences imply that the large-firm affiliates would be much more sensitive to the size of local market and less sensitive to labor cost and would produce more of their

¹ Data for the variables used in the regression analysis are from the following sources: ODI from KEXIM (www.koreaexim.go.kr/oeis/index.html), variables Y , W , E , and I from National Bureau of Statistics of China (NBS) (www.stats.gov.cn).

output for local markets than SMEs. They also imply a larger regression coefficient of the local market size (Y) for large-firm affiliates than for SMEs and a smaller absolute value of the negative coefficient of labor cost (W) for large-firm affiliates than for SMEs.

Two sets of regression results are reported on Table 13. The first set (Model I), which includes all the independent variables discussed above, shows that in the case of SMEs all the explanatory variables are statistically significant and have the correct signs whereas in the case of the large-firm affiliates only the market size (Y) and the policy dummy variable (DP) are significant and have the correct signs. Model I, however, suffers from multicollinearity as the infrastructure variable (I) is highly correlated with wage (W) and education (E).²

The second set of regression results (Model II), which excludes infrastructure as an independent variable, shows that the estimate of the market size (Y) is positive and statistically significant for both large-firm affiliates and SMEs and is larger for the former than the latter, a result consistent with the survey results discussed in a preceding section.

The estimate of the wage-rate coefficient is negative for both large firms and SMEs, as expected, but is statistically significant only in the case of SMEs. This result is consistent with the survey result that low-cost labor is the most important motive for SMEs but not for large-firm affiliates. There is also a notable difference between large-firm affiliates and SMEs with respect to the effect of labor quality (E) on Korea's ODI in China. The coefficient of this variable is much larger for large-firm affiliates than for SMEs.

These results are consistent with the observation made earlier that investments in China by SMEs are concentrated in low-skilled labor-intensive industries such as textiles and apparel, footwear and leather, and wood and furniture whereas investments by large firms are concentrated in capital- and technology-intensive industries such as electronics and telecommunication equipment, and motors and freight that require more skilled labor. For the first group of investments, low-cost labor is a more important factor in determining where to locate than the quality of labor and conversely for the second.

The dummy variable for preferential policies has a positive and statistically significant coefficient for both large-firm affiliates and SMEs with the effect being stronger on investments from large-firms than those from SMEs. Finally, the estimate of the coefficient of the dummy variable for common culture/language is positive and statistically significant for SMEs but not significant for large-firm affiliates, as expected.

IV. Concluding Remarks

No single motive drives a country's ODI and Korea's case is no exception: Some firms have invested in China to take advantage of its cheap labor and others have invested in China for market access or to secure its natural resources. In spite of such diverse motives the data presented in this paper suggest that Korea's ODI in China as a whole has had a

² <Correlation Matrix for the Explanatory Variables>

	Y	W	E	I	DP	DK
Y	1.00					
W	0.14	1.00				
E	0.04	0.63	1.00			
I	0.34	0.73	0.70	1.00		
DP	0.35	0.33	-0.08	0.35	1.00	
DK	0.05	-0.30	0.06	-0.23	-0.02	1.00

positive effect on the two countries' bilateral trade. We also have found out that Korea's ODI in China is not evenly distributed throughout China, being limited mostly to the coastal areas and the areas with a high concentration of ethnic Koreans.

If by economic integration we mean that capital, labor, and goods and services can move between countries more freely than otherwise, Korea's ODI in China certainly has had and will continue to have a positive effect on the economic integration of the two countries. It will further the integrative process by promoting information and personnel exchange between the two countries and by inducing them to abide by contracts and accept property rights and the rule of law and to realize the importance of cross-border harmonization of rules and regulations on trade and investment. These are the effects of ODI that are rarely quantified and seldom discussed in the literature but perhaps are more important for regional integration in the long run.

Recently, at a meeting in Beijing a group of Korean business leaders proposed that China, Japan and Korea establish a joint policy coordination body with the aim of creating a Northeast Asian free trade area (*Digital Korea Herald*, Friday June 7, 2002).³ Creating such an area would be a difficult task in the short run because there are a number of economic, historical and political factors unique to the region that many argue hinder its immediate establishment (Lee, forthcoming; Schott and Goodrich 2001, Seliger 2002). Those factors should not be, however, a barrier to the establishment of a joint policy coordination body, which can carry out the task of promoting trade and investment among them and contributing to the creation of a strong regional identity. That way it will pave the way toward building formal regional machinery in Northeast Asia.

³ A similar proposal for establishing a regional economic cooperation body, the Council for Northeast Asian Economic Cooperation, was made by Lee (2001) in August 2001. His rationale for the proposal is that although establishing a free trade area of China, Japan, and Korea in the near future is unlikely a cooperation body can perform some useful functions such as strengthening the voice of the three countries in the international arena and pave the way to future formal economic integration in the region.

Table 13. Locational Determinants of Korean Firms' Manufacturing Investment in China (1993-97)

	<i>Model I</i>		<i>Model II</i>	
	Large firms	SMEs	Large firms	SMEs
GDP	1.94 * (1.9)	1.88 *** (4.5)	2.13 ** (2.0)	2.08 *** (3.8)
Wage	-4.83 (-0.8)	-7.03 *** (-2.73)	-2.12 (-0.4)	-5.01 * (-1.9)
Labour Quality	6.45 (1.6)	4.02 ** (2.0)	9.4 *** (2.9)	6.89 *** (4.1)
Infrastructure	11.62 (1.1)	11.02 ** (2.5)	-	-
Dummy: Government policy	5.70 *** (3.0)	3.15 *** (3.6)	6.6 *** (3.6)	3.87 *** (4.2)
Dummy: Korean People	3.92 (1.5)	3.96 *** (3.3)	3.02 (1.2)	2.67 ** (2.2)
Constant	30.20 (0.6)	52.76 ** (2.5)	8.1 (0.2)	36.5 * (1.7)
Adjusted R ²	0.55	0.77	0.56	0.73

Note: 1) t-values are in parenthesis. ***, ** and * indicate that the coefficient is significantly different from zero at 1, 5 and 10 percent levels respectively.

Appendix. Summary Statistics for Explanatory Variables (1995)

	GDP (billion yuan)	Average Wage (yuan)	Education (%)	Infrastructure	SEZs/OCCs
Beijing	139	8,144	1.46	0.69	-
Tianjin	92	6,501	0.72	0.38	OCC
Hebei	285	4,839	0.20	0.27	OCC
Shanxi	109	4,721	0.22	0.22	-
Liaoning	279	4,911	0.44	0.30	OCC
Jilin	113	4,430	0.39	0.17	-
Heilongjiang	201	4,145	0.31	0.11	-
Shanghai	246	9,279	1.02	0.60	-
Jiangsu	516	5,943	0.30	0.25	OCC
Zhejiang	352	6,619	0.21	0.33	OCC
Anhui	200	4,609	0.14	0.25	-
Fujian	216	5,857	0.22	0.38	SEZ, OCC
Jiangxi	121	4,211	0.20	0.21	-
Shandong	500	5,145	0.18	0.35	OCC
Henan	300	4,344	0.13	0.30	-
Hubei	239	4,685	0.32	0.26	-
Hunan	220	4,797	0.20	0.28	-
Guangdong	538	8,250	0.22	0.48	SEZ, OCC
Hainan	36	5,340	0.17	0.44	SEZ
Sichuan	353	4,645	0.18	0.18	-
Guizhou	63	4,475	0.10	0.18	-
Yunnan	121	5,149	0.13	0.17	-
Shaanxi	100	4,396	0.37	0.19	-
Gansu	55	5,493	0.19	0.08	-
Qinghai	17	5,753	0.15	0.02	-
Average	217	5,467	0.33	0.28	NA

Note: 1. Education: ratio of the number of students enrolled in higher education to population in 1995

2. Infrastructure: total length of road in 1995 per square kilometer of land

Data source: National Bureau of Statistics of China, www.stats.gov.cn

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Comments on “Korea’s Direct Investment in China and Its Implications for Economic Integration in Northeast Asia”

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This paper contributes to the study on the analysis of ODI behavior and motives of Korean firms' primarily by examining offshore affiliates' activities. The behavior of offshore affiliates and locational determinants of ODI, investigated and argued based upon the results of surveys, are proved through empirical studies using a simple and clear model. This paper also illustrates how two countries, Korea and China, can be integrated through international direct investment.

However, I would like to point out some aspects.

Initially, in explaining the direct trade effects of ODI, the export of machinery and equipment may be one of the major effects that could be expected by the investing country. A portion of machinery and equipment for the affiliates were likely exported from Korea since Korea's ODI to China began in the early 90s and most of it was a greenfield investment.

Second, the advertisement or demonstration effect may be more significant as an indirect trade effect than the growth effect with respect to ODI. The parent companies' export generally increases as the presence of offshore affiliates in the local market promotes the brand of the parent company. The increase in export comprises not only of parts and intermediate goods but finished goods as well. This effect, that cannot be quantified, works to offset the export substitution of offshore affiliates, as explained by Lipsey and Weiss (1984).

Third, it can be assumed that during the different years the surveys were taken, 1996 by KIET and 2000 by KEXIM, the statistics may have been influenced since the financial crisis in 1997 had brought about a change in the relationship between the parent companies and their affiliates. This time period may have had some impact on the indicators used. Furthermore, the number of firms that replied to the survey is so small in certain industries especially the chemical industry that it is possible the indicators may have been distorted.

Finally, it is recommended that the cases of ODI as a dependent variable should be regressed.

Measurements of the Effects of Socio-Economic Reforms

by
Hae-shin Hwang

Abstract

Korea has experienced tremendous changes in economic structure and regulatory statutes in the past half century. In particular, at the behest of the IMF after the financial crisis in 1997, numerous economic reform measures have been proposed and implemented. Past studies on the effectiveness of these reform measures have focused on the change in mean and volatility of the rate of equity returns. Many reform measures, however, seem to be designed to reduce low-end risk to avoid another financial crisis. In this paper we propose to use the ratios of low quantiles (Value-at-Risk) or mean excess losses (Conditional Value-at-Risk) of the distributions of equity returns as a summary statistics for the effectiveness of risk-reducing reform measures. Their usefulness is demonstrated by using Korean equity return data.

1. Introduction

There exists a voluminous literature on the East Asian financial crisis, which addresses the causes of the crisis, institutional and legal reforms and restructuring efforts taken by each country, and the assessment of the various reforms. One of the recurring theme in this literature is the institutional weakness of the financial sector before the crisis in credit and risk assessment capabilities, prudential supervision and governance, inadequate capital ratios, and preparation in capital market opening.

The restructuring and reform programs after the crisis focused on the improvement of such institutional weakness and improving the quality of bank loan portfolios that has been deteriorated since the onset of the financial crisis. In Korea, the National Assembly passed financial reform bills in December, 1997 which granted independence to the central bank with price stability as its main objective, established a unified financial regulatory agency (the Financial Supervisory Commission and the Financial Supervisory Board), and enhanced prudential regulations over financial institutions for safe and sound operations.

Financial reform bills are followed by massive restructuring of the financial sector, forced closures and mergers, and massive infusion of public funds for recapitalization and disposal of non-performing loans. In particular, enhanced prudential regulations involved the improvement of the BIS capital adequacy ratio, strengthening prudential rules in risk assessment and management, and the improvement of transparency and accountability to the level of the international standard.

Implementation of these reforms is expected to help the competitiveness of the financial industry, and to ensure its safety, soundness and stability. Though the financial

reforms will help the profitability of the financial industry and promote the efficiency of resource allocation, their main function seems to be a reduction in the downside risk and prevention of another big surprise. In this paper, we are interested in constructing a statistical index that measures the relative success of the downside-risk reducing function of the financial reforms¹.

Our choice of the statistical index is based on the premise that, in a country with well developed financial markets, asset prices incorporate all information about the current and expected future effects of various reforms which are deemed important to domestic as well as international investors. Financial reforms are expected to affect not only the location and scale of the distribution, but also the shape of the distribution. Furthermore, they will also affect the joint distribution of asset prices across different industries or countries. Statistics that are widely used to represent the location, scale and shape properties of the distribution are the mean, variance, correlation, skewness and kurtosis coefficients. These statistics play important roles in the analysis of financial data for the optimum portfolio or for the test of contagion hypothesis of financial crisis. However, individually, they are not sufficient to describe the changes in the distributions. The statistical index we wish to construct is to capture the changes in the distribution, in particular, changes in the low tails of the distribution of asset prices or asset returns.

There are several statistics that can serve our purpose. The first candidate is the Value-at-Risk (VaR), which is a low-end percentile of a distribution and is expected to capture the changes in location, scale, skewness and kurtosis of the asset return distributions. Since the introduction of JP Morgan's RiskMetrics system in 1995, the VaR has become a standard tool for risk management partly because it is an easily interpretable summary measure of risk and also has an appealing rationale. We offer another interpretation of the VaR as a measure of aggregate effects of reforms that are designed to reduce the downside risk². This interpretation is also in line with the event studies which are used frequently in finance literature. A typical event study examines the presence of abnormal returns around the time of certain events. Thus, it is interested in finding the changes in the tail probability for a given critical value and association of such changes with certain regulatory changes, while the VaR analysis is interested in finding the critical value for a given tail probability. In addition to the VaR based index, we may also consider an index based on a related concept, the conditional Value-at-Risk (CVaR) or mean excess loss. While the VaR focuses only on the probability of loss, it does not indicate the extent of the losses that might be suffered beyond the threshold amount indicated by VaR. The CVaR quantifies such losses, which is the conditional expectation when the losses exceed the level of VaR.

Another candidate we may consider is from the viewpoint of investors. Assuming that investors are risk-averse expected utility maximizers, we may use the changes in the stochastic dominance of the distributions in the second or third degree. If the distribution after the financial reform dominates the previous distribution in the second degree, the expected utility of all risk averse investors will be higher, and the reform can be considered as a success. Though it is an attractive alternative, we suspect that the

¹ The downside risk of financial industry must be affected not only by the reforms specifically targeted to the industry, but also by other social, political and educational reforms. However, since our index is based on the relative performance of the financial industry against the performance of a benchmark industry or economy, the effects of other changes will be removed as long as they affect both sectors equally.

² The VaR risk management rules are similar in spirit to the 'safety-first rule' which is affected by the changes in the shape of the distribution. In this sense, our index based on the VaR may be considered as an index from the view point of the investors who follow the safety-first rule or an extreme case of prospect theory. Since the VaR is affected by many common risk factors other than the reform measures we need a benchmark VaR to isolate the effects of the reform measures on the distribution.

complete stochastic dominance relationship will hold rarely over time. To implement this alternative we need to develop preference ordering on the basis of incomplete or partial stochastic dominance. And thus, we have not tried this approach in this paper.

In the next section, we present brief descriptions of the VaR based index of the assessment of the changes, and discuss the estimation strategies. Importance of the choice of flexible distribution function in the estimation of VaR and CVaR is also discussed. In section 3, we applied the procedure to the Korean financial market daily return data. The results are encouraging: the index seems to reflect the events in regulatory changes well. The likelihood of excessively large losses of the finance and banking sectors relative to the entire equity market have stabilized since mid 2000. However, the level of excess loss risks are not lower than the pre-financial crisis levels. The paper concludes in section 4 with a summary of the findings and suggestions for future studies.

2. Methodology

The Value-at-Risk is the low-end percentile (usually 1% or 5%) of the distribution of asset returns, and is taken as a measure of the market risk of a portfolio. Though the concept of the VaR is simple and attractive, its estimation is not unique. There is a wide variety of estimation models and methods, and there are substantial evidences that different methodologies lead to significantly different estimates of VaR for the same portfolio. The quality of inference we can derive from the VaR estimates thus depend critically on the quality and accuracy of the model.

Since we wish to interpret the changes in the VaR as an indicator of the effects of various socio-economic reforms and restructuring, we need to identify the data series of an economic sector which is the target of the reforms and hence affected the most by the reforms. An examination of the changes in the VaR of a target data series over time may reveal the effects of reforms, and one may design a formal test of the stability of the VaR. However, the distribution of asset returns are subject to many shocks other than the reform measures, and we need to control the effects of such shocks.

A reasonable approach to accomplish this is through a comparison of the target series VaR and the VaR of a benchmark data series. It will be ideal to have a benchmark data which is subject to the same set of shocks as the target series VaR, while it is not affected or affected the least by the reforms under study. For example, when we are interested in the effects of reform measures in, say, the financial sector, we may take the VaR of the composite return index of the entire market excluding the financial sector as the benchmark VaR. The differences or ratios of the target and benchmark VaR's will show the effects of the reforms aimed at the target series.

Identification of the target and benchmark data series becomes less important when one is interested in the international comparison. A comparison of the VaR's of the same economic (say, financial) sector in two countries is expected to show the relative successes of the sector specific policies. It is conceivable that a comparison of the VaR's of the composite return indices of two countries can reveal the relative effects of all socio-economic changes between the two countries.

Another important issue to consider is the choice of the distribution function for the estimation of the VaR. JP Morgan's RiskMetrics system assumes a joint normal distribution of asset returns. However, it is well known that financial asset returns are in general leptokurtic and skewed, and VaR estimates based on the normality assumption can lead to significantly biased estimates. There exist a large number of skewed leptokurtic parametric distributions functions in the literature that have been employed in the analysis of individual financial data. The first set of parametric distribution functions are introduced to

capture the excess kurtosis, and includes the central Student's t distribution, the *generalized error distribution* (GED) and the *generalized t* (GT) distribution. The GED has one shape parameter and the GT distribution has two shape parameters. Both distributions can be leptokurtic as well as platykurtic, while the central t can only be leptokurtic³.

Though these distributions can capture the leptokurtic nature of the financial data, they cannot accommodate the skewness. This motivated Hansen (1994) to generalize the central t distribution by introducing a skewness parameter. Since Hansen's method can be applied to any symmetric distribution, the GED and GT distributions are subsequently generalized to take asymmetric distributional forms by Theodossiou (1998, 2000). In earlier literature, Tauchen and Pitts (1983) and Hsieh (1989) employed the normal-lognormal mixture distribution and McDonald (1991) introduced the exponential generalized beta of the second kind (EGB2) distribution, which has two shape parameters. More recently, a noncentral t distribution is used in Harvey and Siddique (1999) in their study of the stochastic process of the skewness, and Nagahara (1999) and Bera and Premaratne (2001) introduced the Pearson Type IV distribution, which has two shape parameters⁴. Figure 1 shows the density curves of skewed t (ST), skewed GED (SGED), skewed GT (SGT), Pearson Type IV (P4), and EGB2 distributions, along with a normal density curve for a comparison. All densities shown in Figure 1 have the same mean and same variance.

Our study requires VaR estimates of at least two series of asset returns including the benchmark asset returns. An efficient estimation thus requires a multivariate distribution function which is flexible enough to be able to generate the empirical values of skewness and kurtosis of financial data. Unlike in the case of univariate models, however, there have been little efforts to introduce more flexible distribution functions beyond the multivariate Student's t distribution. The common form of multivariate t distribution is characterized by a symmetric positive definite covariance matrix and a degree of freedom parameter. Since the marginal distributions of the multivariate t are scalar multiples of univariate t , this distribution can account for the thick tails of individual distribution. However, it requires all variables to share the same parameter for the degree of freedom, and hence all variables are restricted to have equally thick tails. Furthermore, it is a symmetric distribution and hence, cannot accommodate the skewness in the data⁵. This can be a serious drawback particularly when the major interest is in the comparison of the estimates of tail probabilities of different data series. In this paper, we will estimate

³ The central t -distribution is used in Bollerslev (1987), Hsieh (1989), Baillie and DeGannaro (1990) and De Jong, Kemna and Kloeck (1990) among others, the GT distribution is introduced by McDonald and Newey (1988), and the GED is used in Baillie and Bollerslev (1989) and Nelson (1991). The GED is also called Power Exponential distribution, or Subbotin distribution, or Box-Tiao distribution, and it nests several distribution functions such as normal, and Laplace distributions. The GT distribution nests the GED, central t and normal distributions.

⁴ In addition to these distributions, the Gram-Charlier, Edgeworth and Edgeworth-Sargan asymptotic expansions have been used in finance literature, particularly in option pricing. See for example Jarrow and Rudd (1982), Lee and Tse (1991), Mauleón and Perote (1999, 2000), Clews, Panigirtzoglou and Proudman (2000), Dinenis, Flamouris and Hatgioannides (2000), Giamouridis and Tamvakis (2002), among others. See also Mitnik and Paolella (2003) for the use of a family of α -stable distributions.

⁵ See Mauleón and Perote (1999) for a bivariate t distribution model, and Fiorentini, Sentana and Calzolari (2000) for the analytical score functions and the test of normality under multivariate t distribution. Mauleón and Perote (1999) also introduced a Edgeworth-Sargan distribution model, which is a multivariate version of Gram-Charlier expansion. Recently, skewed multivariate Student's t (Azzalini and Capitanio (2003)) and skewed multivariate Laplace (Kotz, Kozubowski and Orski (2003)) distributions have been introduced in the statistics literature, but, to our best knowledge, they have not been used in the analysis of financial data. Wang (2001) used multivariate normal mixture distribution in the analysis of financial data.

the unconditional distribution functions of the target series and benchmark series individually by using one of the flexible distribution functions discussed above.

The choice of the distribution function depends on the degree of their flexibility. It was shown in Choi and Hwang (2003) that the SGED is one of the most flexible distribution functions among the distribution functions mentioned above in the sense that it can cover the widest range of skewness and kurtosis. In particular, it can be platykurtic as well as leptokurtic. In the empirical application to the rates of returns of Korean stocks, we found that many subsamples exhibit platykurtic sample moments. Consequently, we use the SGED in the empirical application.

The density function of a Hansen-type skewed GED with a zero location parameter and unit scale parameter is given by⁶

$$f(y; k, \lambda) = \begin{cases} Ce^{-|y|^k/b_1}, & b_1 = 2(1-\lambda)^k \quad \text{if } y < 0 \\ Ce^{-|y|^k/b_2}, & b_2 = 2(1+\lambda)^k \quad \text{if } y \geq 0 \end{cases} \quad (1)$$

where k is a positive shape parameter, λ is a skewness parameter in an interval $(-1, 1)$, and

$$C = \frac{k}{2^{(1+1/k)} \Gamma(1/k)}$$

where Γ is a gamma function. The density function of a SGED with a location parameter α and scale parameter θ can be derived from a linear transformation $X = \alpha + \theta Y$. The VaR and the CVaR of X are derived in Appendix.

3. Empirical Application

Parameters of a distribution function are typically estimated by maximizing the likelihood function of unconditional distribution or the conditional distribution in the form of a GARCH model. Since we are interested in finding the change in a distribution relative to another distribution over time, the simplest method for our purpose is to use the rolling window. This approach requires a choice of window width and the size of increments, which can be critical in detecting any changes. A wide window width or a large increment may miss detecting relatively short-lived changes. On the other hand, a narrow window width or a small increment can lead to inefficient estimates of parameters and may not smooth out pure random shocks⁷. To avoid over-smoothing, we used a rolling window of size 125 days (6 months) with 10 day (two week) increments in our empirical analysis.

⁶ See Choi and Hwang (2003) for more details of the distribution function.

⁷ In the earlier version of this paper, we reported the results of numerical experiments that examined how well the VaR and CVaR ratios between two series of data computed from the rolling window estimates capture the changes in one distribution when parameters are estimated by the maximum likelihood from subsamples of rolling window. The results showed that these ratios detect the changes of distribution shape parameters quite well.

We used the data set of daily percentage rates of return in Korean stock market⁸. This data set has 1771 observations that cover the sample period of 1995/1/4 - 2001/7/2, and includes data on KOSPI index (excluding finance sector), finance sector (excluding banking sector) and banking sector. As mentioned earlier, there are many subsamples of each data series which show platykurtic sample moments, i.e., sample kurtosis coefficients less than 3. Among the distribution functions described above, the only distribution functions that allow such properties are the SGED and SGT distributions. Since the SGT distribution has one more parameter than the SGED and the maximum likelihood estimation of its parameters often does not converge, we use the SGED. Parameters of the unconditional SGED distribution are estimated by the maximum likelihood method and ratios of VaR and CVaR between a pair of data series are computed by using the sample in each window.

The left hand side panels of Figure 2 show the ratios of VaR and CVaR (dashed line) between finance sector and KOSPI, between banking sector and KOSPI, and between banking and finance sectors. The right hand side panels show the ratios which are estimated from the standardized sample in each window. This is to isolate the effects of changes in skewness and kurtosis⁹.

Both VaR and CVaR ratios stay close to each other except for a few short periods. The ratios of the finance and banking sectors against KOSPI are greater than one for most periods of the series. This indicates that the two sectors have a greater risk of large losses, which is an expected result as the KOSPI is a broad market index and is diversified more than the finance or the banking sector alone. The ratios of the banking sector to the finance sector are also greater than one for most part of 1997 through 1999, indicating a greater risk in the banking sector than the finance sector around the financial crisis and two years after the crisis¹⁰.

Since late 1995, the risk of excess losses in the finance and banking sectors relative to the overall KOSPI index was improving till June, 1997 for the finance sector and till September, 1996 for the banking sector. As the financial crisis loomed up, the risk of excess losses in both sectors rose sharply, peaking off in August 1997, and then declined sharply perhaps in anticipation of the IMF funding agreement on December 3, 1997. It is interesting to notice that, compared to the financial sector, the banking sector seems to respond more quickly to the factors that cause a decline in excess loss risk and more slowly to the factors that cause an increase in the excess loss risk.

Overall increases in the risk of excess losses in both sectors followed the earlier sharp declines, reaching the peak in June, 1999 for the financial sector and in September, 1999 for the banking sector despite of a flurry of reform activities such as the change in the selection procedure of bank president (03/02/98), establishment of financial Supervisory Commission (04/01/98), Bank Act Revision hearings (10/21/98) and draft of the revision (12/15/98) and management reforms of a major bank (04/13/99)¹¹. Perhaps in anticipation of certain passage of the Bank Act Revision in December 1999, the excess loss risks started decline early in the financial sector and two months before the passage of the new law in the banking sector. After further reform activities from mid April to early June, 2000, the completion of work-outs earlier than expected in particular, the excess loss risks of these two sectors relative to the KOSPI index have stabilized.

⁸ Bong Soo Lee generously provided the data that he used in his paper with Heungsik Choe, "Korean bank governance reform after the Asian financial crisis," Working paper, April 2003.

⁹ Since the results and interpretations of the two panels are similar, we will concentrate our discussion on the left panel.

¹⁰ Choe and Lee (2003) define the pre-crisis period as the period till September 30, 1997. The windows of the samples that include this date are between two vertical lines in Figure 2.

¹¹ The dates of special events are borrowed from Choe and Lee (2003).

The excess loss risks after various reform measures during 1998 through mid 2000 seem to have settled at a level a little higher than the low levels of excess loss risks before the effects of financial crisis set in. It appears that various reform measures aggravated the excess loss risks at their introduction and implementation stages.

To see the benefit of using a flexible distribution function SGED, we also estimated the ratios of VaR and CVaR by using the maximum likelihood estimates of normal distribution parameters and by using the RiskMetrics method¹². Figure 3 presents these results. Note that the ratios of VaR and CVaR are almost identical for both cases. The RiskMetrics method produces more volatile ratios, which is expected because of the fast decaying weights. Comparisons of the VaR ratios between the SGED and normal, and between the SGED and RiskMetrics are presented in Figure 4. In general, the ratios based on the normal distribution show less variations than the estimates from the SGED. Consequently, the normal distribution underestimates the risk of excess losses when the risk is relatively high, and overestimates it when the risk is relatively low.

4. Conclusion

We proposed in this paper to use the ratios of VaR and/or CVaR to detect the effects of financial reform measures on the premise that the current and expected effects of such measures are best summarized in the movements of prices and rates of returns of financial assets. They are particularly useful when one wishes to analyze the effects of financial reform measures which are designed to reduce an excessive loss or financial crisis. We proposed to use the ratios of VaR's or CVaR's between the target series and benchmark series to control the effects of the events which affect both data series.

It is important for a proper analysis to use a flexible distribution function that can be leptokurtic/platykurtic and skewed in the estimation of the distribution function of the rates of returns. We proposed to use the skewed generalized error distribution (SGED). This distribution can be leptokurtic as well as platykurtic, and it covers all skewness and kurtosis of the sample that we used in this paper.

The VaR and CVaR of the daily rates of returns of the KOSPI, the financial and banking sectors in Korean stock market are estimated using the SGED distribution. Both estimates show the variation of the ratios which can be matched with several events of regulatory changes. The estimates also show that the likelihood of excessively large losses of the finance and banking sectors relative to the entire equity market have stabilized since mid 2000. However, the level of excess loss risks are not lower than the pre-financial crisis levels. To illustrate the importance of using a sufficiently flexible distribution function we also presented the estimates of VaR and CVaR by using the maximum likelihood estimates and RiskMetrics estimates of a normal distribution. The RiskMetrics estimates generate much more volatile estimates and it is difficult to draw any conclusion about the effects of financial reforms from them. The normal distribution tends to underestimate the risk of excess losses when the risk is relatively high, and overestimates it when the risk is relatively low.

Though the concept of the VaR and CVaR is simple and attractive, its focus on the gloomy situation may not fit the objectives of all research. One may be interested in the effects of policy changes on the stability of the distribution, i.e., not only on the low tails, but also on the upper tails. The typical measure of the stability, or lack of stability, is the variance (volatility) of the return. The variance cannot capture the changes in the shape of

¹² The RiskMetrics assumes a normal distribution, but computes the variance by a exponentially declining weighted sum of the squared deviation of the return rate from the mean. The decay rate of 0.94 is commonly used.

the distribution in a satisfactory way. As an alternative, one may examine the changes in the inter-quantile ranges.

Figure 1. Probability Densities

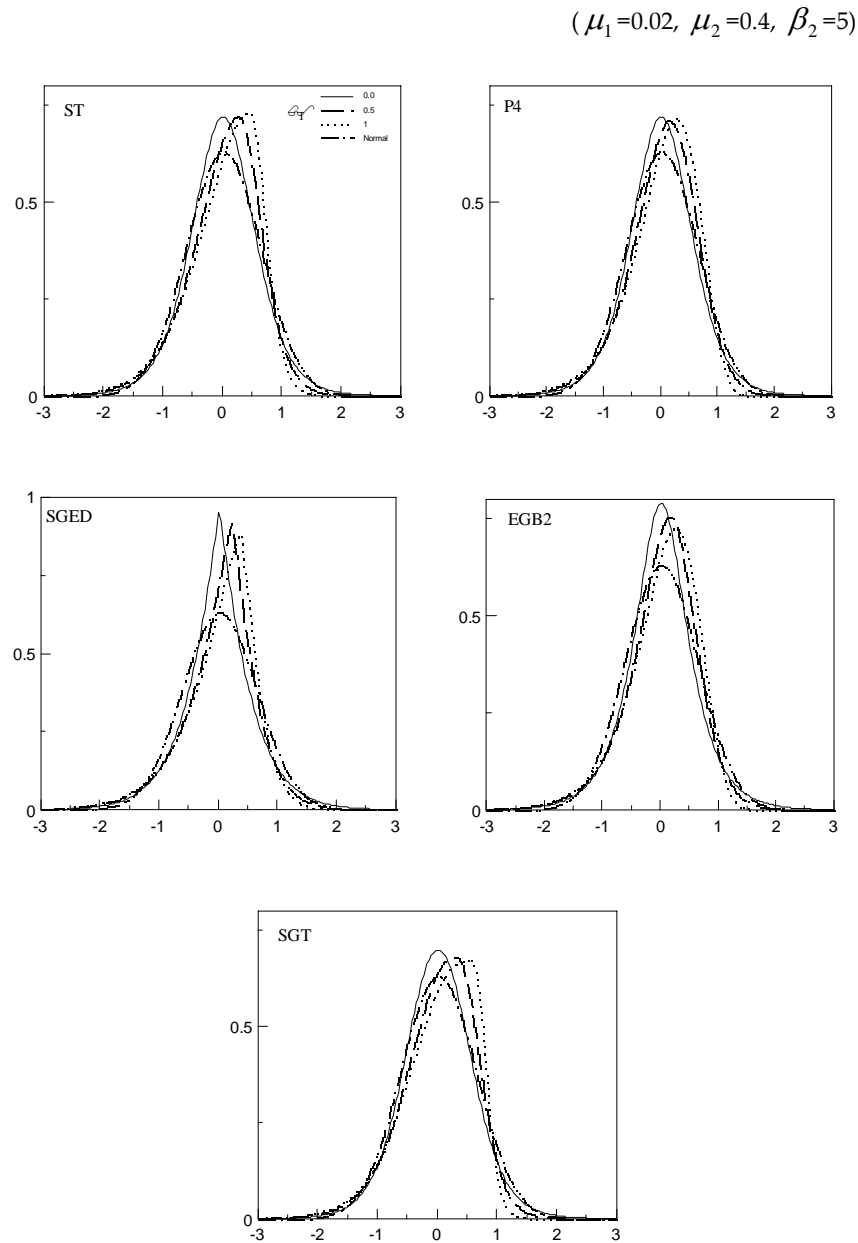


Figure 2. Ratios of VaR and CVaR - SGED Distribution

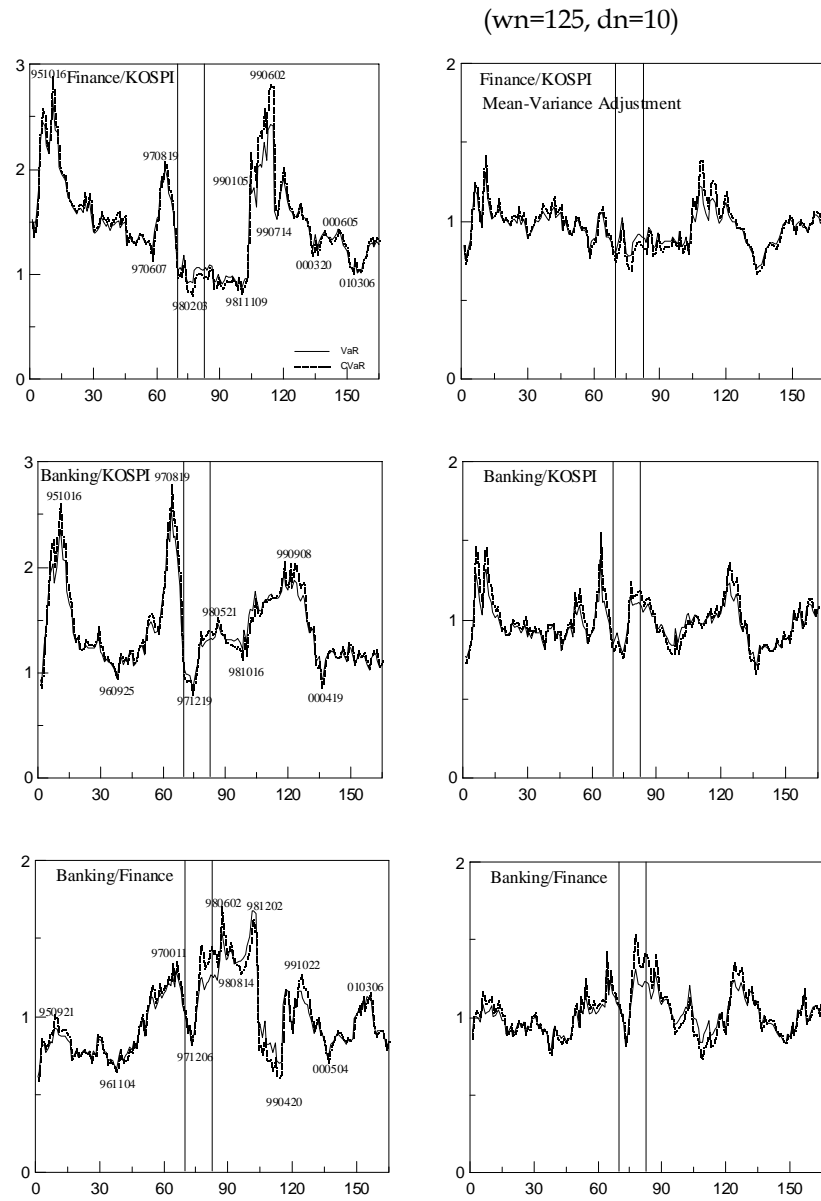


Figure 3. Ratios of VaR and CVaR under Normal and RiskMetrics

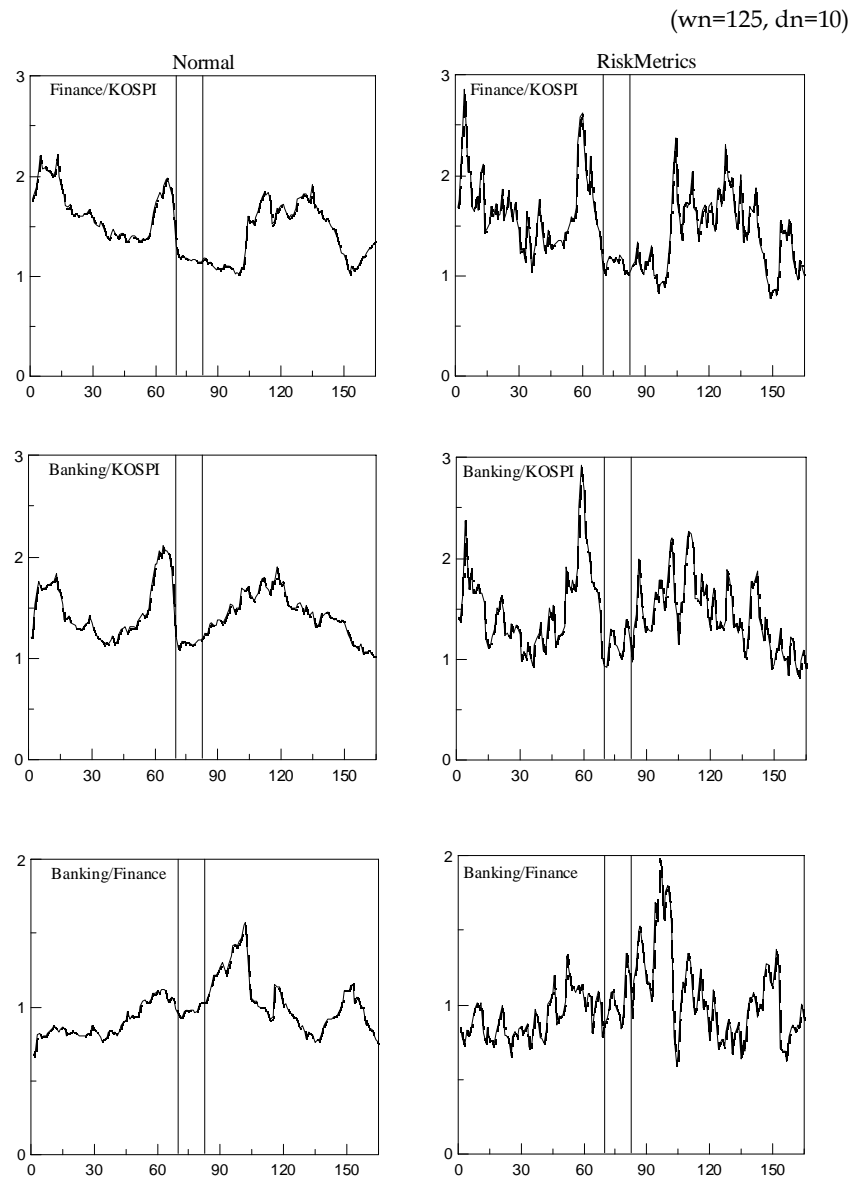
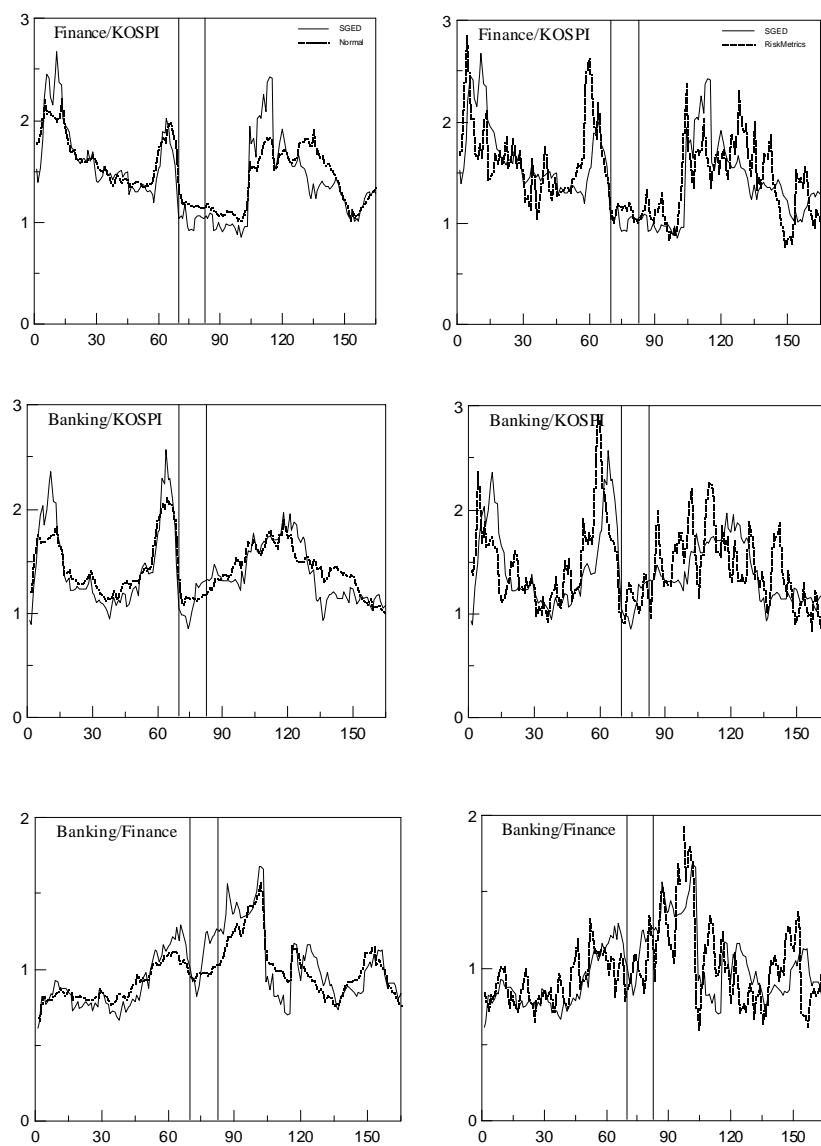


Figure 4. Comparison of VaR Ratios under GED, Normal and RiskMetrics

(wn=125, dn=10)



Appendix

Derivation of VaR and CVaR of Skewed GED

The density function of a Hansen-type skewed GED with a zero location parameter and unitary scale parameter is

$$f(y; k, \lambda) = \begin{cases} C e^{-|y|^k / b_1}, & b_1 = 2(1 - \lambda)^k \quad \text{if } y < 0 \\ C e^{-|y|^k / b_2}, & b_2 = 2(1 + \lambda)^k \quad \text{if } y \geq 0 \end{cases} \quad (\text{A. 1})$$

where

$$C = \frac{k}{2^{(1+1/k)} \Gamma(1/k)}$$

and its cdf is

$$F(y; k, \lambda) = \begin{cases} \frac{1}{2} (1 - \lambda) [1 - G(1/k, y_1^*)] & \text{if } y < 0 \\ \frac{1}{2} [(1 - \lambda) + (1 + \lambda) G(1/k, y_2^*)] & \text{if } y \geq 0 \end{cases} \quad (\text{A. 2})$$

where $y_1^* = \frac{|y|^k}{2(1 - \lambda)^k}$ and $y_2^* = \frac{|y|^k}{2(1 + \lambda)^k}$, and

$$G(a, z) = \frac{1}{\Gamma(a)} \int_0^z e^{-t} t^{a-1} dt$$

is the incomplete gamma function with a shape parameter a . This can be computed by using `proc cdfgam(a, z)` in GAUSS software.

Note that $F(0) = (1 - \lambda)/2$. Hence, the condition $y < 0$ in the cdf is equivalent to $p \equiv F(y) < (1 - \lambda)/2$. Using this, we can write the inverse cdf for a given p and λ as

$$G(1/k, y_p^*)$$

$$= \begin{cases} 1 - 2p/(1 - \lambda) & \text{if } 0 < p \leq (1 - \lambda)/2 \text{ (i.e., } y \leq 0) \\ [2p - (1 - \lambda)]/(1 + \lambda) & \text{if } (1 - \lambda)/2 < p \leq 1 \text{ (i.e., } y > 0) \end{cases} \quad (\text{A. 3})$$

Once y_p^* is found from the inverse incomplete gamma function, the p -th quantile y_p of the skewed GED random variates can be computed from

$$y_p = \begin{cases} -(1 - \lambda)[2y_p^*]^{1/k} & \text{if } 0 < p \leq (1 - \lambda)/2 \\ (1 + \lambda)[2y_p^*]^{1/k} & \text{if } (1 - \lambda)/2 < p \leq 1 \end{cases} \quad (\text{A. 4})$$

To find the mean of the truncated distribution

$$E(Y | Y < y_p) = \frac{1}{F(y_p)} \int_{-\infty}^{y_p} y f(y; k, \lambda) dy \quad (\text{A. 5})$$

The moments of this truncated distribution can be derived by using the following integrals for $b > 0$

$$\int_{a_0}^{a_1} y^r e^{-|y|^k/b} dy = \frac{1}{k} b^{(r+1)/k} \int_{a_0^k/b}^{a_1^k/b} t^{[(r+1)/k]-1} e^{-t} dt$$

$$\text{if } a_1 > a_0 \geq 0 \quad (\text{A. 6a})$$

which is derived by a change in variables ($t = y^k/b$). Similarly, for negative values of y we can write

$$\int_{a_0}^{a_1} y^r e^{-|y|^k/b} dy = (-1)^r \frac{1}{k} b^{(r+1)/k} \int_{(-a_1)^k/b}^{(-a_0)^k/b} t^{[(r+1)/k]-1} e^{-t} dt$$

$$\text{if } a_0 < a_1 \leq 0 \quad (\text{A. 6b})$$

Applying these integral relationships we can write (A. 5) in the case of $y_p \leq 0$ as

$$E(Y | Y < y_p) = \frac{1}{F(y_p)} \int_{-\infty}^{y_p} y f(y; k, \lambda) dy$$

$$\begin{aligned}
&= -\frac{1}{F(y_p)} \frac{C}{k} b_1^{2/k} \Gamma(2/k) \int_{(-y_p)^k/b_1}^{\infty} \frac{e^{-t} t^{2/k-1}}{\Gamma(2/k)} dt \quad (\text{A. 7a}) \\
&= -\frac{b_1^{2/k} C \Gamma(2/k)}{k F(y_p)} \left[1 - G\left(\frac{2}{k}, \frac{(-y_p)^k}{b_1}\right) \right], \quad y_p \leq 0
\end{aligned}$$

When $y_p \geq 0$, we have

$$\begin{aligned}
E(Y | Y \leq y_p) &= \frac{1}{F(y_p)} \left(\int_{-\infty}^0 y f(y; k, \lambda) dy + \int_0^{y_p} y f(y; k, \lambda) dy \right) \\
&= \frac{1}{F(y_p)} \left(-C \frac{b_1^{2/k} \Gamma(2/k)}{k} + \frac{b_2^{2/k} C \Gamma(2/k)}{k} G\left(\frac{2}{k}, \frac{y_p^k}{b_2}\right) \right) \\
&= \frac{C \Gamma(2/k)}{k F(y_p)} \left(-b_1^{2/k} + b_2^{2/k} G\left(\frac{2}{k}, \frac{y_p^k}{b_2}\right) \right), \quad y_p \geq 0
\end{aligned} \quad (\text{A. 7b})$$

Now, we introduce the location and scale parameters through a linear transformation

$$X = \alpha + \theta Y$$

The VaR and the CVaR of X can be computed from the relationship

$$p = P(X \leq \nu) = P(Y \leq (\nu - \alpha)/\theta) \quad (\text{A. 8a})$$

$$E(X | X \leq \nu) = \alpha + \theta E(Y | Y \leq (\nu - \alpha)/\theta) \quad (\text{A. 8b})$$

Once y_p is found from (A. 4) and the truncated mean from (A. 7), the VaR of X can be computed from (A. 8a) by $\nu = \alpha + \theta y_p$, and the CVaR of X can be computed from (A. 8b).

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Comments on "Measurements of the Effects of Socio-Economic Reforms"

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This is a very interesting paper. The title of the paper is intriguing enough to draw anyone's attention and the contents do not betray the anticipation. In the paper, Prof. Hwang asks how we can measure the effects of reforms. Surely, the question itself is too abstract to answer and needs more refinement. Hence, he concentrates on financial reforms and confines his interest to measuring "the relative success of the downside-risk reducing function of the reforms". For the specified task, his strategy is to construct a statistical index that captures the changes in the low tails of the distribution. With the strategy, his choice of methodology is the VaR. In particular, after reviewing various techniques to estimate VaR's and implementing Monte Carlo experiments, he observes that the VaR ratios between two series of data computed from the rolling window estimates of SuN distribution parameters seem to capture the changes in distribution quite well. Given the justification, he applies the procedure to the Korean stock market data consisting of three series: banking sector, finance sector excluding the banking sector, and the rest. Based on the variation of the ratios between the sectors, the paper draws a conclusion on the effects of the financial reforms in Korea as follows. First, the likelihood of excessively large losses of the finance and banking sectors relative to the rest of the economy have stabilized since mid 2000. Second, however, the level of excess loss risks is not lower than the pre-crisis levels.

While admiring the novelty of the paper, there are a few parts that I could not fully follow. First, regarding the conclusion of the paper, I am not sure if the estimation results in Figure 3.1 fully support it. The benchmark estimates seem to indicate that the ratios of VaR's have stabilized since mid 2000. However, once the ratios are re-estimated with the mean-variance adjusted samples, it is not clear if there has been any remarkable changes during the sample period. It suggests that most of variations found in the benchmark estimation results is due to the changes in mean and variance rather than those in skewness or kurtosis. Of course, we are left to figure out what factors were responsible for the changes in mean and variance, and more importantly if they are related to the financial reforms. But, whatever the factors may be, the fact remains that the low tail properties of the banking and the finance sector stock returns has not much changed between before and after the crisis.

Secondly, it seems to me the paper is exposed to an inherent identification problem. The paper is to identify the effects of the financial reforms in risk reduction. Given the purpose, it should be noted that Korea has adopted various liberalization measures since the crisis of 1997, as well as the reform measures aimed at increasing the soundness of the financial sector. And there is no guarantee that all the liberalization measures took impacts on the financial sector in the same direction with the reform measures. The adoption of the floating exchange rate system and the full opening of the capital market is the case in point among others. These measures are likely to increase short-term volatility of the asset returns rather than reduce. In the presence of the liberalization measures, the ratios of VaR's may reflect composite effects of the reform and the liberalization measures while the net effect of the reforms is yet to be isolated.

Nonetheless, I enjoyed reading the paper and would like to urge others to read it once.

Public Investment in Transport and Communication and Growth: A dynamic panel approach*

by
M. Emranul and Dong Heon Kim

Abstract

This paper re-examines the relationship between public investment in transportation and communication and economic growth in a dynamic panel framework using traditional instrumental estimation approach and the mixed fixed and random coefficient approach. We find that there is a dynamic effect of public investment in transportation and communication on economic growth and its impact is positive. In contrast to earlier studies, our estimated coefficients are reasonably lower. However, for the reverse causal relationship proposed by acceleration investment hypothesis, we find that there is significant heterogeneity across countries and our empirical study does not support the reverse causality.

Key Words: Causality, Dynamic panel, Public Investment in Transport and Communication, Economic Growth

JEL Classification: E62, C23, O11

1. Introduction

The recent explosion of work on externality based growth models has generated a number of models linking government spending with the economy's long run growth rate; see Barro (1990) and Barro and Sala-i-Martin (1995, 1999). Such view has sparked a number of empirical studies on the relationship between the size of government (both at aggregate and disaggregate levels) and economic growth. Examples include Barro (1990, 1991), Barro and Sala-i-Martin (1995, 1999), Easterly and Rebelo (1993), Cashin (1995), Deverajan, Swaroop and Zou (1996), Kocherlakota and Yi (1996, 1997), Agell, Lindh and Ohlsson (1997), Mendoza, Milesi-Ferretti, and Aseaet (1997), Miller and Ressek (1997), Kneller, Bleany and Gemmell (1999), and Gupta, Clements, Baldacci, and Mulas-Granados (2002), among others.

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There is, however, conflicting evidence in the literature regarding the question as to how the composition of government expenditure affects economic growth. In particular, on the relationship between public investment in transportation and communication (infrastructure) and economic growth, there has been a mixed picture. Aschauer (1989) finds that core infrastructure — streets, highways, airports, mass transit, and other public capital — has the most explanatory power for private-sector productivity in the United States over the period 1949 - 1985. In a cross-country study, Easterly and Rebelo (1993) find, using the instrumental estimation technique, that only public investment in transportation and communication (hereafter T&C) among the sectorial components of government investment, is consistently positively correlated with growth with a very high coefficient (between 0.59 and 0.66). On the other hand, Deverajan et al. (1996) find from the study of 43 developing countries over 20 years that economic infrastructure expenditures have a negative correlation with per-capita real GDP growth. Miller and Russek (1997) report that the estimated coefficient on transportation and communication expenditure to GDP is positive but not statistically significant for 23 developing countries.

Why does previous literature provide conflicting results? Recent econometric literature on panel data analysis for developing countries has raised significant issues on these studies. First of all, in practice, it is often difficult to find good instruments in the traditional instrumental approach. Kiviet (1995) shows that panel data models that use instrumental variable estimation often lead to poor finite sample efficiency and bias. Secondly, as pointed out in Weinhold (1999), and Nair-Reichert and Weinhold (2001), the instrumental approach imposes the assumption widespread in the panel causality literature in that the coefficients on the explanatory variables are equal across units in the panel and thus it might be the potential bias induced by heterogeneity of the cross section units. Thirdly, in terms of theoretical point, it takes time for public investment in T&C to affect growth and thus a dynamic model might be more desirable for the investigation of the relationship. In these points of view, ones feel that more careful investigation is necessary for addressing the relationship.

The purpose of this paper is to revisit and examine the causal relationship between public investment in T&C and economic growth with bearing those econometric issues in mind. In exploring this end, our study is different from previous literature on the several grounds. First of all, we consider a dynamic panel model with a much richer data set for a panel of 15 developing countries from 1970 to 1987. Secondly, we not only employ an instrumental approach but also apply the mixed fixed and random coefficients model (hereafter MFR) of Weinhold (1999) and Nair-Reichert and Weinhold (2001) to avoid biased parameter estimates resulting from the cross-sectional heterogeneity. Thirdly, following the accelerating effect of output on investment as in Clark (1979) and Wagner's law (the tendency for government expenditure to be higher at higher level of per capita GDP), we examine reverse causality in which public investments in T&C follow growth and thus rapid growth leads to higher investments in this sector.¹

¹ Musgrave (1969, p.74) mentions that the most plausible formulation of Wagner's hypothesis appears to be in terms of a positive correlation between share of government expenditure in GDP and income per capita. Also, there is a large body of literature on Wagner's law, which includes Gandhi (1971), Abizadeh and Gray (1985) and Ram (1987), among others.

Our results confirm and extend the conclusion of earlier study that public investment in T&C Granger causes economic growth. The estimated coefficients in our study are reasonably lower while the size of the coefficients is disturbingly high in Easterly and Rebelo (1993). Furthermore, although we allow heterogeneity of dynamics to the developing country panel, the estimation results of the MFR model still support causal relation from public investment in T&C to growth. However, from both approaches, instrumental estimation and MFR model, we do not find evidence on the reverse causality. In particular, the estimation results of MFR model indicate that there is a great deal of heterogeneity across countries in the reverse causal relationship. The plan of the paper is as follows. Section 2 discusses a methodology used in this panel study and Section 3 reports empirical results. Concluding remarks are offered in Section 4.

2 Methodology

In the study on the effect of public investment in T&C on growth, Easterly and Rebelo (1993) use instrumental variable estimation to avoid the joint endogeneity of the two variables and the possibility of reverse causality. However, since the size of the coefficient is disturbingly high (a coefficient of 2) and their analysis on the decade averages indicate only two data points per country, their results on causality from infrastructure to growth casts doubt on the validity of the procedure. On the other hand, Devarajan *et al.* (1996) use pooled regressions with the choice of a five-year forward lag moving average of percapita real GDP growth to reflect the fact that public expenditures often take time before their effects on output growth registered, to eliminate short-term fluctuations induced by shifts in public expenditure, and to increase the number of time series observation in the panel data. However, their analysis does not consider potential bias resulting from the heterogeneity in cross-country panel for developing countries. Furthermore, as public investment in T&C takes time before its effect on output growth can be registered, an appropriate model should consider dynamic adjustment over time and ignoring the dynamic aspect of the data is not only a loss of potentially important information but can lead to serious misspecification biases in the estimation.

Our study tries to avoid these potential weaknesses and considers a dynamic panel framework in which we reflect the dynamic effect of public investment in T&C on growth over time and incorporate heterogeneous behaviour of cross-units into model estimation. In a dynamic panel data model, we can not use the pooling regression or the Least Squares Dummy Variable (LSDV) estimation method due to the bias resulting from the correlation between the lagged dependent variables and the error term as shown in the Nickell (1981), Andersen and Hsiao (1981, 1982), Hsiao (1986) and Kiviet (1995), among others.² The usual approach for dealing with this problem is to take first-difference the data to remove the fixed effects and estimate it by using instruments. Holtz-Eakin *et al.* (1988) adopt the approach to panel VAR's in a framework for testing Granger causality in panels and suggest using a time-varying set of instruments that includes both differences and levels. Following Holtz-Eakin *et al.* (1988), we consider a bivariate dynamic panel model:

$$y_{it} = \alpha_0 + \sum_{j=1}^m \alpha_j y_{it-j} + \sum_{j=1}^m \beta_j x_{it-j} + f_i + \varepsilon_{it}, i = 1, 2, \dots, N, \quad (1)$$

where y_{it} and x_{it} are the dependent variable and the causal variable at time t for country i respectively, f_i is the fixed effects, the lag length m is sufficiently large to ensure that it is a white noise error term and the α 's and β 's are the coefficients of the linear projection of y_{it} on a constant, past value of y_{it} and x_{it} and the individual effect f_i . Taking the 2 See Baltagi (2001) for a useful overview of this issue.

difference in the equation (1) to eliminate the fixed effects leads to the model:

$$\Delta y_{it} = \sum_{j=1}^m \alpha_j \Delta y_{it-j} + \sum_{j=1}^m \beta_j \Delta x_{it-j} + u_{it}, i = 1, 2, \dots, N, \quad (2)$$

where. $\Delta y_{it-j} = y_{it-j} - y_{it-j-1}$ for $j = 0, 1, \dots, m$, $\Delta x_{it-j} = x_{it-j} - x_{it-j-1}$ for $j = 1, 2, \dots, m$ and $u_{it} = \varepsilon_{it} - \varepsilon_{it-1}$. Because Δy_{it-1} is correlated with the first difference error term, $u_{it} (= \varepsilon_{it} - \varepsilon_{it-1})$, it is necessary to use instrumental variables procedures. Following Holtz-Eakin et al. (1988, 1989), we can estimate the equation (2) by using 2SLS instrumental variables procedure with a time-varying set of instruments. Holtz-Eakin *et al.* suggest that the vector of instrumental variables, Z_{it} , that is available to identify the parameters of equation (2), is

$$Z_{it} = [1, y_{it-2}, y_{it-3}, \dots, y_{i1}, x_{it-2}, \dots, x_{i1}]$$

The authors address the question of whether x Granger causes y or not by testing the joint hypothesis:

$$\beta_1 = \beta_2 = \dots = \beta_m = 0. \quad (3)$$

In our study, we start with this procedure to address the question of whether the public investment in T&C Granger causes economic growth.

However, there might be some potential problems for this instrumental approach. First of all, in practice it is often difficult to find good instruments for the first-differenced lagged dependent variable, which can itself create problems for the estimation. Kiviet (1995) shows that panel data models that use instrumental variable estimation often lead to poor finite sample efficiency and bias. Secondly, this approach imposes the assumption widespread in the panel causality literature in that the coefficients on the explanatory variables are equal across units in the panel. Weinhold (1999) and Nair-Reichert and Weinhold (2001) point out that this restriction of a single coefficient on the causal variable for all the units saves the most degrees of freedom but at the cost of the unlikely assumption that either causality

occurs everywhere or it occurs nowhere in the panel and thus it might be the potential bias induced by heterogeneity of the cross section units.

To avoid biased parameter estimates resulting from the cross-sectional heterogeneity present in many panel data sets, they propose a mixed fixed and random coefficients model (MFR) in which the intercepts and the coefficients on the lagged dependent variables are specific to the cross section units, while the coefficients on the exogenous variables are assumed to be normally distributed across the cross section. Thus, the MFR model allows for greater heterogeneity in the parameters than do the traditional models. This model is originally developed by Hsiao et al. (1989) in a non-dynamic, non-fixed-effects panel data model of regional electricity demand and adapted in Weinhold (1996, 1999) as an alternative specification for panel data causality testing and of estimating panel data models with heterogeneous dynamics. Weinhold (1999) shows that the MFR model performs very well compared to the instrumental variables approaches and her Monte Carlo experiments show the bias on the exogenous variable's parameter estimate when T is between 10 and 25 and N is between 20 and 40 is relatively small³. Following Weinhold (1999) and Nair-Reichert and Weinhold (2001), we consider an alternative specification for dynamic panel data model:

$$y_{it} = \alpha_i + \sum_{j=1}^m \gamma_{ij} y_{it-j} + \sum_{j=1}^m \beta_{ij} x_{it-j} + \varepsilon_{it}, \quad (4)$$

where the coefficients on the lagged dependent variables, γ_{ij} , are country-specific, the coefficient on the exogenous explanatory variable x , β_{ij} , is drawn from a random distribution with mean $\beta_j + v_i$ and v_i is a random disturbance. In essence, this approach uses information on the distribution of the estimates on the lagged exogenous variable to extract the required information and address the question of the direction of causality or possible joint determination between economic variables in a panel data set. Weinhold (1999) suggests that the estimated variance of the random coefficients can be used as a diagnostic tool to determine the extent of heterogeneity in the relationship in question and thus, if the estimated variance is quite large relative to the coefficient estimates, this is a signal of significant heterogeneity in the panel. In our study, we employ this approach for further investigation of the causality.

3 Estimation results

3.1 Data

Existing studies aiming at evaluating growth effects of public investment at a disaggregated level largely suffer from 'sparseness of data' problem.²⁴ For us, however, this problem poses a greater challenge due to the fact that a formal test for causality requires usage of lags and leads of the variables in question and such analysis needs to be based on

² Due to shortage of data, Easterly and Rebelo (1993) have based their analysis on the decade averages implying only two data points per country.

data sets containing relatively large number of observations per country. To overcome these shortcomings, we aimed at collecting a large and balanced data set on central government investment expenditure in the T&C sector for developing countries by consulting a large collection of World Bank Country Economic Reports and Public Expenditure Reviews.³ 5 But we ended up with a data set for a panel of 15 developing countries from 1970 to 1987 without any missing data in between. Our data for growth rate of GDP per capita is taken from World Bank CDROM.⁴ Our study use the bivariate estimation and thus can avoid any implausible results from using various control variables in the growth study.

Even though the time period is only 18 years, the ADF test (Augmented Dickey-Fuller test) for unit root in public investment in T&C indicates that all countries have a unit. To avoid that a specification with the explanatory variables in non-stationary levels could lead to spurious results in a panel, we take the growth rate of our variables as adopted in Nair-Reichert and Weinhold (2001). Thus, we ask whether an increase in growth rate of public investment in T&C helps forecast an increase in the economic growth. In other words, we try to address the question that if the growth rate in public investment in T&C is relatively high compared to other countries, will GDP growth rate also be relatively high.

3.2 Causality from public investment in T&C to economic growth

As outlined in section 2, we start with a traditional panel causality test proposed by Holtz-Eakin et al. (1988) for the dynamic panel models. From the equation (1) and (2), we have:

$$\Delta GY_{it} = \sum_{j=1}^m \alpha_j \Delta GY_{it-j} + \sum_{j=1}^m \beta_j \Delta GTCI_{it-j} + u_{it}, i = 1, 2, \dots, N, \quad (5)$$

where ΔGY_{it} and $\Delta GTCI_{it}$ are the first differences of the growth rate of GDP and public investment in T&C for the country i at time t . How can we choose the correct lag length, m ? Holtz-Eakin et al. (1988, 1989) discuss how to find the "best" value of m . First of all, we choose a relatively large value of m to be sure to avoid truncating the lag structure inappropriately. Denote by \tilde{m} the relatively large value of m used for initial estimation of the model. Re-estimate the system (5) with $m = \tilde{m} - 1$. If the increase in the sum of squared residuals is "large", then $m = \tilde{m}$ is accepted. If the increase is "small", then try $m = \tilde{m} - 2$. Continue testing successively smaller lag lengths until one is rejected by the data, or $m = 0$. Following this procedure, we estimate equation (5) with $m = 3$ and different instrument sets and the procedure is summarized in the Table 1. The procedure indicates that we cannot reject the null of $m = 2$ at the 5% and 10% level for different instrument sets, while we can reject the null of $m = 3$ at the 5% level. Thus, the procedure for the choice of lag length suggests that the lag length, $m = 2$ is appropriate.

³ 5Our data set is available upon request. We wish to thank World Bank for allowing us to use their archive at Washington D.C.

⁴ 6The panel data on the transportation and communication investment is very limited and we try to use as many available data as possible. Countries are Bahamas, Congo, Ethiopia, Guatemala, Indonesia, Kenya, Malaysia, Morocco, Nepal, Pakistan, Rwanda, Sierra Leone, Sri Lanka, Tanzania, Thailand, and Zambia.

Table 2 presents the results from 2SLS estimation of equation (5). While the estimated coefficient on $\Delta GTCI_{it-1}$ is statistically significant at the 10% level, that on $\Delta GTCI_{it-2}$ is not statistically significant. In contrast to Easterly and Rebelo (1993) in which the effect of public investment in T&C on growth is robustly significant with instrumental variables but the size of the coefficients is disturbingly high, the values of the estimated coefficients in our estimate are ranged between -0.004 and 0.004 and thus reasonably low. The p -value in the Wald test of the null hypothesis that $\beta_1 = \beta_2 = 0$ is 0.025, implying that we reject the null at the 5% level. Thus, the Holtz-Eakin et al. dynamic panel causality test indicates that the growth in public investment in T&C Granger causes GDP growth.

However, while the value of the estimated coefficient on $\Delta GTCI_{it-2}$ is positive, that of $\Delta GTCI_{it-1}$ is negative. As previous literature has reported contradicted results, our result based on the dynamic panel instrumental variable estimation might not indicate clearly that infrastructure has a positive impact on economic growth. One possible reason might be attributed to heterogeneity in the relationship between two variables. The econometric analysis presented in table 2 is based on underlying assumptions about the homogeneity of the relationships in question across countries in the panel. However, it is reasonable to expect quite a bit of heterogeneity both in the dynamic structure as well as the relationship between economic growth and public investment in T&C, especially, in a panel of developing countries. Pesaran and Smith (1995) and Weinhold (1999) point out that the presence of such heterogeneity can result in serious mis-specification biases in the subsequent estimation that imposes homogenous parameter values.

To investigate whether this result is attributed to heterogeneity on the cross-country units, we employ the MFR model described in Section 2. Following Nair-Reichert and Weinhold (2001), we use orthogonalization which is necessary to ensure that the coefficients are independent which in turn allows their estimated variances to be appropriately interpreted. That is, we have:

$$GY_{it} = \alpha_i + \sum_{j=1}^m \gamma_{ij} GY_{it-j} + \sum_{j=1}^m \beta_{ij} GTCI_{it-j}^0 + \varepsilon_{it}, \quad (6)$$

where $GTCI_{it-j}^0$ denotes the orthogonalized growth rate of public investment in T&C after the linear influences of the other right-hand side variables have been removed (including any other lags of this variable if multiple lag lengths are used). As in the 2SLS estimation, we chose the lag length, $m = 2$. The estimated mean and variance of the indicated causal variables are reported in table 3, as are the standard error of the estimated means.

As pointed out in the Weinhold (1999) and Nair-Reichert and Weinhold (2001), if the estimated variance of the coefficients on $GTCI_{it-j}^0$ is quite large relative to the mean of estimated coefficients, this is a signal of significant heterogeneity in the panel. The estimated variances of the random coefficients are not large, implying that there might not be a great deal of the heterogeneity across this panel. In contrast to 2SLS estimation, the estimated means of the coefficients on $GTCI_{it-1}$ and $GTCI_{it-2}$ are positive but the value of the estimated coefficient on $GTCI_{it-1}$ is not statistically significant. The positive value and the statistical significance on $GTCI_{it-2}$ imply that public investment in T&C has a positive impact on economic growth and seem to support that there is a dynamic effect of public

investment in T&C on growth and thus our dynamic panel model is appropriate for considering dynamic adjustment over time in this study.

For the further investigation of the degree and shape of the heterogeneity in the relationship between GY_{it} and $GTCI_{it-2}$, Figure 1 plots the distribution of the estimated individual coefficients on $GTCI_{it-2}$. Even though the distribution is a little skewed to the right, it would seem that the distribution is approximately bell-shaped, implying that the coefficients are not completely idiosyncratic across countries. Overall, heterogeneity is not a great deal in this relationship but the MFR model seems to be appropriate methodology for explaining previous controversial results and taking heterogeneous behaviour in developing countries into account. In addition, the magnitudes of the values on the estimated coefficients on both estimations, Holtz-Eakin *et al.*'s instrumental estimation and the MFR model, are quite similar.

In sum, Holtz-Eakin *et al.*'s instrumental estimation and the MFR model for the dynamic panel suggest that public investment in T&C Granger causes economic growth. In particular, the values of the estimated coefficients on public investment in T&C are considerably lower in contrast to previous literature as in Aschauer (1989), and Easterly and Rebelo (1993). Our results support that infrastructure such as transportation and communication matters for economic growth in developing countries.

3.3 Reverse causality

In terms of the accelerating effect of output on investment as in Clark (1979) and Wagner's law as in Abizadeh and Gray (1985) and Ram (1987), there might be reverse causality, which means that public investments in T&C follow growth and thus rapid growth leads to higher investments in this sector. To investigate this issue, we employ same methodology. First of all, we consider Holtz-Eakin *et al.*'s (1988) instrumental variable estimation for the dynamic panel as follows:

$$\Delta GTCI_{it} = \sum_{j=1}^m \alpha_j \Delta GTCI_{it-j} + \sum_{j=1}^m \beta_j \Delta GY_{it-j} + u_{it}, i = 1, 2, \dots, N. \quad (7)$$

Table 4 shows the 2SLS estimation results of equation (7). As in the causality test of equation (5), we choose the lag length at $m = 2$. The estimated coefficients on ΔGY_{it-1} and ΔGY_{it-2} are positive but not statistically significant and disturbingly high, suggesting that there might be a great deal of heterogeneity in the reverse relationship. The Wald test for the null hypothesis that $\beta_1 = \beta_2 = 0$, indicates that we can not reject the null at the conventional level. This result implies that the reverse causality does not work and thus economic growth does not Granger cause public investment in transportation and communication.

To examine this reverse causality with taking heterogeneity in cross-country units into account, following Weinhold (1999) and Nair-Reichert and Weinhold (2001), we also estimate the MFR model:

$$GTCI_{it} = \alpha_i + \sum_{j=1}^m \gamma_{ij} GTCI_{it-j} + \sum_{j=1}^m \beta_{ij} GY_{it-j}^0 + \varepsilon_{it}, \quad (8)$$

where we choose $m = 2$. The estimated mean and variance of the indicated causal variables are reported in table 5 as are the standard error of the estimated means. The estimated means of estimated coefficients on GY_{it-1} and GY_{it-2} are positive and pretty much lower than in Holtz-Eakin *et. al.*'s (1988) instrumental variable estimation.

However, none of the estimated coefficients is statistically significant. In particular, the variances of the estimated mean on the random coefficients are much larger relative to the mean, implying that there are a great deal of heterogeneity across this panel in the reverse causal relationship. Overall, the estimation results in the MFR model are similar with Holtz-Eakin *et. al.*'s instrumental variable estimation for the dynamic panel causality test. Thus, we do not find significant evidence that there is a reverse causal relationship between growth and public investment in T&C and our empirical study does not support that the acceleration investment hypothesis works in the case of public investment in transportation and communication and economic growth for developing countries.

4. Concluding remark

Empirical literature on the relationship between public investment in transportation and communication and economic growth has reported a mixed picture; sometimes significant and positive, sometimes significant and negative, and sometimes not significant. In addition, the size of the estimated coefficient on public investment in T&C is disturbingly high, implying a result which naturally casts doubt on the validity of the procedure.

This paper re-examined this issue with considering the dynamic effect of public investment in T&C on growth over time and heterogeneity in developing countries. For this end, we started with Holtz-Eakin *et. al.*'s (1988) instrumental estimation which is a benchmark model for a dynamic panel causality test. Our results in the instrumental variable estimation show that public investment in T&C matters for economic growth and the values of the estimated coefficients on lagged public investments in T&C are reasonably lower than in previous literature. However, these values are mixed of negative and positive ones as reported in previous literature, indicating that it is not clear for ones to decide that public investment in T&C has an positive impact on economic growth.

To investigate further whether these results are attributed to heterogeneity in developing countries, we employ the mixed fixed and random coefficient model (MFR) of Weinhold (1999) and Nair-Reichert and Weinhold (2001). The estimation results indicate that there is not a great deal of heterogeneity but the MFR model is more appropriate one to examine the relationship. From the MFR estimation, we confirm earlier findings that public investment in T&C has a positive impact on economic growth. Overall, both estimations suggest that public investment in T&C takes time to affect growth and thus a dynamic panel model is more desirable for studying the relationship between infrastructure such as transportation and communication and economic growth.

However, from both approaches, we do not find an evidence on the reverse causality which is suggested by the acceleration effect of output on investment and Wagner's law. In

particular, the MFR model estimation suggests that there is a great deal of heterogeneity across developing countries in the reverse causal relationship. Hence, we feel that the effect of public investment in transportation and communication on economic growth is generally significant and considerable, while the other way around might be questionable for developing countries.

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Table 1. The choice of lag length, m

H_0	X^2	p - value	Instruments
$m = 2$	2.226	0.329	Constant, $GY_{it-j}, GTCI_{it-j}, j = 2,3,4,5$
$m = 2$	5.260	0.072	Constant, $\Delta GY_{it-j}, \Delta GTCI_{it-j}, j = 2,3,4$
$m = 1$	8.014	0.091	Constant, $GY_{it-j}, GTCI_{it-j}, j = 2,3,4,5$
$m = 1$	16.375	0.003	Constant, $\Delta GY_{it-j}, \Delta GTCI_{it-j}, j = 2,3,4$

Table 2. Holtz-Eakin et al.(1988) dynamic panel data Causality test

$$\Delta GY_{it} = \alpha_1 \Delta GY_{it-1} + \alpha_2 \Delta GY_{it-2} + \beta_1 \Delta GTCI_{it-1} + \beta_2 \Delta GTCI_{it-2} + u_{it}$$

coefficient	$\hat{\alpha}_1$	$\hat{\alpha}_2$	$\hat{\beta}_1$	$\hat{\beta}_2$	instruments
	-0.232*** (0.084)	-0.142* (0.073)	-0.0044* (0.0024)	0.0042 (0.0031)	constant, $GY_{it-j}, GTCI_{it-j}, j = 2, \dots, 5$

$$H_0 : \beta_1 = \beta_2 = 0, X^2 = 7.35, p - value = 0.025$$

Note: *** and * denote the statistical significance at the 1% level and 10% level in a two-tail test respectively.

Table 3. MFR model causality test

$$GY_{it} = \alpha_i + \gamma_{i1} GY_{it-1} + \gamma_{i2} GY_{it-2} + \beta_{i1} GTCI_{it-1} + \beta_{i2} GTCI_{it-2} + \varepsilon_{it}$$

Variable	Est. coeff.	Std. error	Coeff. Variance
$GTCI_{t-1}$	0.0015	0.0033	0.0007
$GTCI_{t-2}$	0.0047***	0.0004	0.0008

Note: a. *** denote a statistical significance at the 1% level.

b. est. coeff., Std. Error, and Coeff. variance denote the estimated mean of random coefficient, the standard error of the estimated mean and the estimated variance of the random coefficients respectively.

Table 4. Holtz-Eakin *et al.* (1988) Reverse causality test

$$\Delta GTCI_{it} = \alpha_1 \Delta GTCI_{it-1} + \alpha_2 \Delta GTCI_{it-2} + \beta_1 \Delta GY_{it-1} + \beta_2 \Delta GY_{it-2} + u_{it}$$

coefficient	$\hat{\alpha}_1$	$\hat{\alpha}_2$	$\hat{\beta}_1$	$\hat{\beta}_2$	instruments
	-0.701*** (0.102)	-0.315** (0.134)	3.283 (3.663)	4.057 (3.196)	constant, $GY_{it-j}, GTCI_{it-j}, j = 2, \dots, 5$

$$H_0 : \beta_1 = \beta_2 = 0, X^2 = 1.836, p\text{-value} = 0.399$$

Note: *** and ** denote the statistical significance at the 1% level and 5% level respectively.

Table 5. MFR Reverse causality test

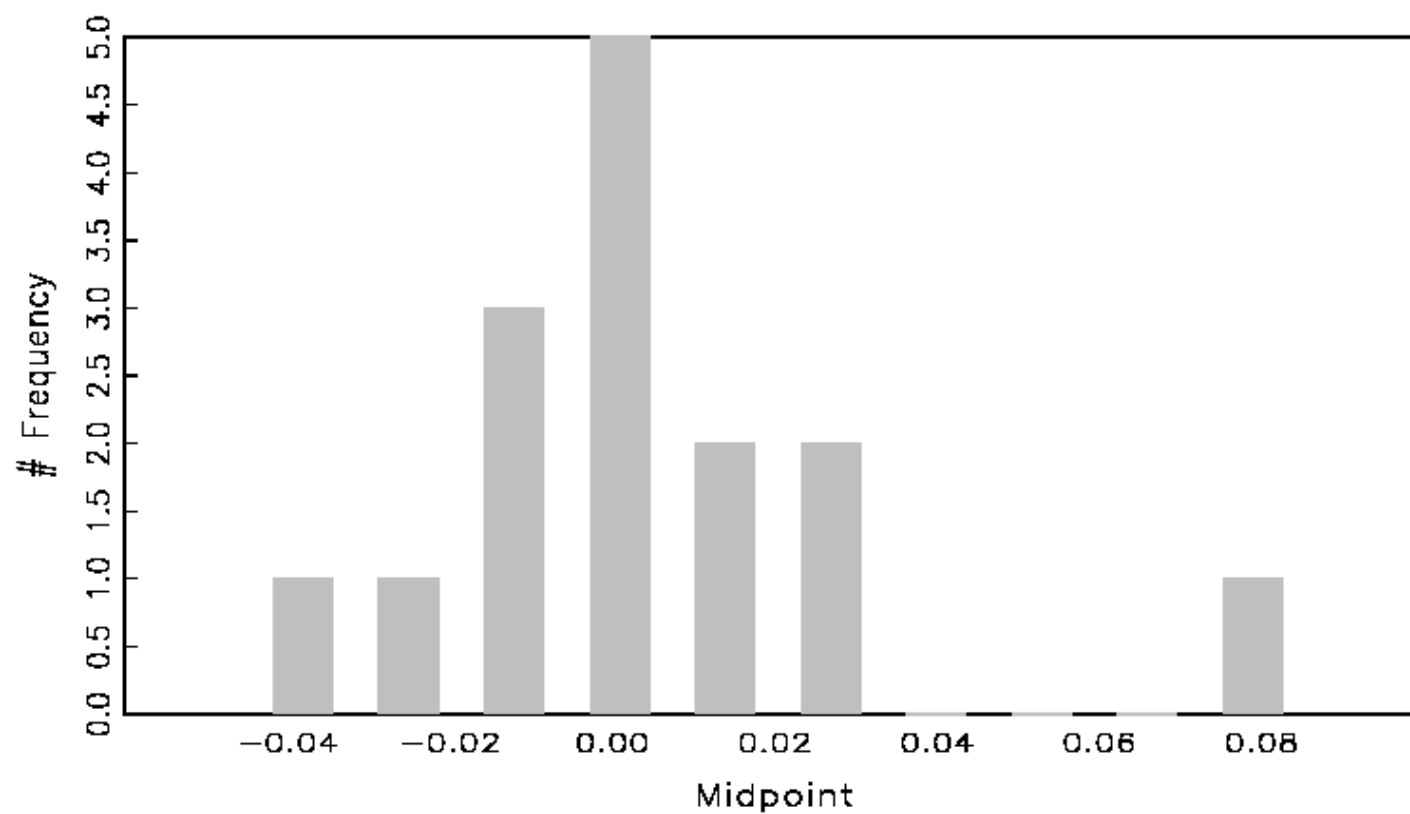
$$GTCI_{it} = \alpha_i + \gamma_{i1} GTCI_{it-1} + \gamma_{i2} GTCI_{it-2} + \beta_{i1} GY_{it-1} + \beta_{i2} GY_{it-2} + \varepsilon_{it}$$

Variable	Est. coeff.	Std. error	Coeff. Variance
GY_{t-1}	0.886	2.892	80.802
GY_{t-2}	1.367	3.278	63.021

Note: Est. coeff., Std. error, and Coeff. variance denote the estimated mean of random coefficient, the standard error of the estimated mean and the estimated variance of the random coefficients respectively.

Figure 1. Distribution of Country-specific coefficients on GTCI: the second lagged random coefficient

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Figure 1. Distribution of Country-specific coefficients on GTCI:
the second lagged random coefficient

Comments on Public Investment in Transport and Communication and Growth: A dynamic panel approach

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Overall Review

The paper deals with the effect of public investment on growth rate, and would receive great amount of attention in Korea. Korea wasted six years at the threshold of US\$10,000 per capita GDP, and these days, Korean society is discussing the strategies to leap from US\$10,000 to \$20,000 per capita GDP, which makes the paper quite timely.

As pointed out in the paper, the role of the government in heightening the growth rate is one of the hottest issues in many countries. This is almost the same in Korea. The era of rapid economic growth rate for over three decades is ending and the Korean economy is entering the phase of slower growth, and much attention is given to the future growth forecasts and to the role of government in future growth strategy.

Specifically, this paper tries, successfully, to measure the effect of public investment in transportation and communication(T&C) on growth rate, and is impressive in many ways. First, the paper delivers a compact and informative survey of the literature in the field, and the structure of the paper is extremely clear and well-organized. Also, it should be said that the way the author treats the data and the empirical results is quite careful, all of which makes the paper informative and easy to understand.

The overall synopsis of the paper is as follows: the purpose of the paper is to measure the effect of the growth rate of public investment in T&C on economic growth, and to test the existence of reverse causality, called the Wagner's law. The author employed the dynamic panel data method in order to take into account the time lag that is usual in the effect of investment in T&C on economic growth. Also, the author adopted the MFR(mixed fixed and random) coefficient model in order to avoid the bias resulting from cross-country heterogeneity. By using the panel data of 15 developing countries for 18 years(1970~1987), the author reports that the effect of public investment in T&C on growth is positive and statistically significant, that the reverse causality cannot be confirmed, and that the degree of cross-country heterogeneity was considerable in the reverse causality.

Comments

The following are a few comments on this paper. First, the paper starts with the Holtz-Eakin's model(Eq. 5), and proceeds to the MFR model(Eq. 6) in order to avoid the bias resulting from cross-country heterogeneity. However, it turns out that the degree of heterogeneity is not significant in the case of the empirical study of this paper. This makes the argument of the paper slightly less impressive, and makes it a little uncomfortable to claim that 'MFR is more appropriate.' In other words, the paper would have been more persuasive if it turned out that the empirical result of the MFR model was better in terms of

statistical significance and fitting, and, at the same time, the degree of heterogeneity was considerable.

Second, the coefficients of the lagged causal variables are estimated 0.0015(lag 1) and 0.0047(lag 2). This implies that 1% increase in the growth rate of public investment in T&C will increase the economic growth rate by 0.0015%(lead 1) and 0.0047%(lead 2). These figures appear to be quite small not only compared to previous studies but also considering the policy implication. This result could have been due to the choice of the dataset, and it would be desirable to use the data of other countries.

Third, it is conjectured that the empirical part of the paper could be improved by choosing other countries, for additional reason. Per capita GDP of 15 countries dealt with in the paper are US\$13,928, \$4,797, \$2,805, \$1,558, \$1,370, \$500 ~ 1,000(4 countries), and \$100 ~ 400(6 countries)*. One could argue the low reliability of GDP and its growth rate data for countries with extremely low per capita GDP.

Finally, a brief description of the mechanism in which the public investment in T&C affects the economic growth, would make the paper friendly to wider audience. In most growth accounting literature, economic growth rate is decomposed into the contribution of increased factor inputs and the rest, called total factor productivity(TFP), and it can be said that increased public investment in T&C is a constituent of TFP. A brief discussion on this point will make the paper more readable.

* 1995 constant US dollar.

Evaluation of the Effectiveness and Appropriateness of Korean Tax Incentive Policy on Foreign Investments and Straight Line Depreciation*

by
Sang-Hoon Kim

Abstract

In order to induce foreign investment, many countries often offer multinational firms various investment incentives such as low tax rates and accelerated depreciation. In Korea, where only straight line (SL) depreciation is allowed, the central and local governments provide low tax rates to certain types of foreign corporate investments. To evaluate the effectiveness of this investment incentive policy, the paper examines how different levels of tax rates and an accelerated depreciation affect the profit and risk aspects of a typical foreign investment. The examination provides several important implications which are useful in evaluating the current tax incentive policy and straight line depreciation.

I. Introduction

Many countries often provide various investment incentives such as low tax rates and accelerated depreciation methods to induce foreign corporate investments. Such incentives affect both the profit and risk aspects of investment projects. In general, however, when assessing a risky project, the profit and risk aspects are combined. For example, under the NPV (net present value) method, the expected NPV (the profit aspect) is adjusted using a risk-adjusted discount rate, which accommodates the overall risk of the project.

Since the $E(NPV)$ so computed does not provide any information about the risk aspect of the project such as the probability that the project will be profitable, it is possible to accept a highly risky project without properly evaluating its risk aspect. Consequently, in order to evaluate properly the effectiveness of an investment incentive policy, it is necessary to examine how it affects both the profit and risk aspects of investment projects.

It should be noted that a complete probability distribution of all possible NPVs can be derived if the $E(NPV)$ and $Var(NPV)$, the variance of the NPV, are available. This is because once the first two moments are known, even when the underlying probability distribution of the NPVs is unknown, the probability distribution still can be derived using Tchebycheff's inequality.

* A good portion of this paper was prepared with the support of Fulbright Senior Scholar's Grant while staying at the KDI School as a Fulbright visiting scholar.

The objective of this paper is to evaluate the effectiveness and appropriateness of various levels of tax incentives and an accelerated depreciation which Korean government can provide as an incentive to induce foreign investments.

For the evaluation, it is necessary to derive the first two moments of the NPV - $E(NPV)$ and $Var(NPV)$ - based on cash flow components of each periodic cash flow. The paper examines how different levels of tax rates and an accelerated depreciation can affect the profit and risk aspects of a typical investment project using the first two moments which were derived by Kim et al.[8].

The next section reviews the probability distribution method which evaluates risky investment projects based on probability distributions of possible NPVs. Section III reviews the tax incentives offered by Korean central and local governments to foreign investments. Section IV shows how different levels of tax incentives and an accelerated depreciation can affect the profit and risk aspects of a typical foreign investment project. Section V covers conclusion.

II. Probability Distribution Method

Once the first two moments are known, a complete probability distribution of all possible values of the random variable can be derived if the random variable is normally distributed. The distribution of the NPV of a typical risky investment project which has a relatively lengthy useful life is very close to a normal distribution due to the central limit theorem. This is because the NPV is composed of random periodic cash flows which are somewhat identically distributed due to the fact that the nature of periodic cash flows are not likely to vary period to period. In addition, the periodic cash flows are composed of random component cash flows such as sales and royalty revenues, material and labor costs, and marketing costs. These component cash flows are also somewhat identically distributed in that all component cash flows are affected by the unpredictable periodic sales revenue. Obviously, these component cash flows are not perfectly independent, but they are also not perfectly correlated.

When the the distribution of random variable NPV is unknown, it is still possible to derive a certain boundary probability information based on the two moments and Tchebycheff's inequality:

$$P[E(NPV) + h\sigma_{NPV} \leq NPV \leq E(NPV) - h\sigma_{NPV}] \leq \frac{1}{h^2} \quad (1)$$

where h represents any real number. The probability that the project is profitable ($P(NPV \geq 0)$) is very useful information in evaluating the risk aspect of investment projects. By replacing h with $E(NPV)/\sigma_{NPV}$, the following probability information can be derived:

$$P[2E(NPV) \geq NPV \geq 0] \geq 1 - \left(\frac{\sigma_{NPV}}{E(NPV)}\right)^2 \quad (2)$$

Equation (2) does not provide the probability information that $P(NPV \geq 0)$ but it still provides the probability information that the project is profitable up to a certain amount of the NPV. However, it should be noted that an observant reader can see that equation (2) implies that

$$P(NPV \geq 0) > 1 - \left(\frac{\sigma_{NPV}}{E(NPV)} \right)^2 \quad (3)$$

In summary, for the probability distribution method and also for the examination of the impact of tax incentives and accelerated depreciation, the first two moments of the NPV need to be estimated based on cash flow components.

Under the NPV method, the Expected NPV is found such that

$$E(NPV) = \sum_{t=1}^n \frac{E(C_t)}{(1 + r_f)^t} - C_o \quad (4)$$

where $E(C_t)$ = the expected periodic cash flow at period t , C_o = the initial investment, r_f = the risk-free discount rate, n = the project's useful life. To make a separate assessment of both the profit and risk aspects of investment projects, the expected cash flows need to be discounted by a risk-free interest rate rather than a risk-adjusted discount rate because the main concern is to find the expected NPV without considering the risk aspect.

As shown by Hillier [5], the variance of the NPV can be written as

$$\text{Var}(NPV) = \sum_{p=1}^n \sum_{q=1}^n \frac{1}{(1 + r_f)^{p+q}} r_{pq} \sigma_p \sigma_q \quad (5)$$

where r_{pq} = the inter-temporal correlation coefficient between cash flows of p^{th} and q^{th} periods, and σ_p (σ_q) = the standard deviation of the periodic cash flow for period p (q). Compared to other project evaluation methods, the additional variables which need to be estimated for the probability distribution method are the periodic standard deviations (σ_p) and the inter-temporal correlation coefficients (r_{pq}). The inter-temporal correlation coefficients are considered the most difficult parameters to be estimated, especially in the case of lengthy multi-period investment projects due to the large number of r_{pq} that must be estimated.

Many authors [1][2][3][4][5][9][10] proposed various methods for the estimation of the inter-temporal correlation coefficients. All these methods, however, have deficiencies because the underlying assumptions are not realistic or the information required is not easily available.

According to equation (4), $\text{Var}(NPV)$ is a function of the four variables: n , r_f , σ_p , and r_{pq} . Since σ_p and r_{pq} are affected by cash flow components, in order to measure the impact of tax and depreciation on $\text{Var}(NPV)$, it is necessary to derive models for σ_p and r_{pq} based on cash flow components. Kim et al [8] showed how to derive the first two moments of the NPV based on cash flow components.

The periodic cash flows (C_t), which are composed of cash flow components, can be expressed as:

$$C_t = A_t \left(\sum_{i=1}^k C_{ti} - \sum_{i=k+1}^m C_{ti} \right) + D_t T_t \quad \text{for } t=0,1,\dots,n \quad (6)$$

where the subscript t represents t^{th} period, $A_t = (1 - T_t)$ = the corporate after-tax earnings rate, C_{ti} = i^{th} component cash flow which represents cash inflow when $i \leq k$ and cash outflow when $i > k$, m = total number of component cash flows, k = total number of component cash inflows, and D_t = depreciation. The component cash flows (C_{ti}) include items such as sales revenue, any cash saving, service revenue, royalties, material cost, wages, advertising costs, and so forth.

Then, it can be shown that

$$E(C_t) = A_t \left[\sum_{i=1}^k E(C_{ti}) - \sum_{i=k+1}^m E(C_{ti}) \right] + D_t T_t \quad \text{for } t = 1, \dots, n \quad (7)$$

$$\text{Var}(C_t) = A_t^2 \left(\sum_{i=1}^m \sigma_{ti}^2 + 2 \sum_{i=1}^k \sum_{j=i+1}^k \tau_{ij} \sigma_{ti} \sigma_{tj} - 2 \sum_{i=1}^k \sum_{j=k+1}^m \tau_{ij} \sigma_{ti} \sigma_{tj} + 2 \sum_{i=k+1}^m \sum_{j=i+1}^m \tau_{ij} \sigma_{ti} \sigma_{tj} \right) \quad \text{for } t = 1, \dots, n \quad (8)$$

where $E(C_{ti})$ = the expected i^{th} component cash flow of the t^{th} period, τ_{ij} = the correlation coefficient between the i^{th} and the j^{th} component cash flows, $\sigma_{ti}(\sigma_{tj})$ = the standard deviation of the $i^{\text{th}}(j^{\text{th}})$ component cash flow for period t , and the other notations are the same as defined before.

Then, the inter-temporal correlation coefficient between p^{th} and q^{th} periods can be derived as:

$$r_{pq} = \frac{1}{\sigma_p \sigma_q} \{ A_p A_q \left[\sum_{i=1}^m \sum_{j=1}^m E_{ij} - 2 \sum_{i=1}^k \sum_{j=k+1}^m (E_{ij} + E_{ji}) \right] + A_p D_q T_q \left[\sum_{i=1}^k E(C_{pi}) - \sum_{i=k+1}^m E(C_{pi}) \right] + E(C_q) [D_p T_p - E(C_p)] \} \quad (9)$$

where $E_{ij} = \tau_{piqj} \sigma_{pi} \sigma_{qj} + E(C_{pi}) E(C_{qj})$, and τ_{piqj} = the inter-temporal correlation coefficient between i^{th} cash flow component of p^{th} period and j^{th} cash flow component of q^{th} period. The other notations are the same as defined before, except that the subscripts p and q are used for periods p and q .

According to equations (8) and (9), the variance of the cash flows and the inter-temporal correlation coefficients are a function of six of the following variables: A_t , D_t , $E(C_{ti})$, σ_{ti} , r_{ij} , and τ_{piqj} .

The first three variables are the information required for the expected periodic cash flows, which are essential for the E(NPV). Without these variables, project evaluation itself is not possible. Regarding the fourth and fifth variables (σ_{ti} , r_{ij}), Hillier [5,6] showed how to estimate these variables by extending the PERT (Program Evaluation and Review Technique), which was originally developed by Malcolm et al. [11]. Also, Kim and Elsaid [7] extended Hillier's estimation method. Since Hillier [5,6] and Kim and Elsaid [7] already showed how these two variables can be derived, the only additional variables which needs to be estimated is τ_{piqj} .

Depending on the project, the total number of τ_{piqj} can be large. However, it should be noted that the two variables, r_{ij} and τ_{piqj} are closely related. The former represents the correlation coefficient between two cash flow components and the latter represents the inter-temporal correlation coefficient between two cash flow components of two different periods.

The correlation coefficients that represent the relationship between two cash flow components are expected to remain relatively the same during the project life. On the other hand, the inter-temporal correlation coefficients, τ_{piqj} , decay away as the time lag (the

difference between p and q) increases. For example, consider the impact of an advertisement in a certain period on sales of later periods.

Therefore, a practically feasible approach is to estimate τ_{piqj} based on a constant annual decay rate just as a constant annual dividend growth rate is assumed for the valuation of common stock. It is practically impossible to estimate all possible future dividends without making a certain assumption regarding the dividend growth rate. Just as the constant dividend growth model is modified depending on the nature of the growth rate of different stocks, the estimation model based on a constant decay rate can also be adjusted depending on the nature of the decay rate of different projects.

Let δ = the constant annual decay rate for τ_{ij} . Then, one possible way in which the inter-temporal correlation coefficient between two components of two different periods can decay away is:

$$\tau_{piqj} = \delta^{q-p} \tau_{ij} \quad (10)$$

where $q \geq p$.

The decay rate, which can be in the range: $0 \leq \delta \leq 1$, may not be constant and is impossible to be accurately estimated. However, it should be noted that equation (9) makes it possible to perform a sensitivity analysis to observe the impact of a possible range of the decay rate on the r_{pq} , $\text{Var}(\text{NPV})$, and probability distribution of the project's NPV.

Since the main concern of this paper is to examine the tax impact, it will be assumed that the first five variables and a reasonable decay rate are provided.

III. Korea Tax Incentives

In Korea, foreigners are allowed, without restraint, to make various investments except for the following:

- a. those that threaten the maintenance of national safety and public order,
- b. those which have harmful effect on public hygiene or the environmental preservation of Korea, or are against Korean morals and customs, and
- c. those which violate the laws of Korea.

In general, the corporate income tax rate in Korea is 16% if net profit is less than or equal to 100 million won; if net profit is over 100 million won, the rate is 28% for the exceeding amount. However, in addition to the corporate income tax, there are various other taxes that affect both domestic and foreign investments such as corporate tax, acquisition tax, registration tax, property tax, aggregate land tax, value-added tax, and special consumption tax. Of these, corporate tax, income tax, value-added tax, and special consumption tax are national taxes, while the acquisition tax, registration tax, property tax, and aggregate land tax are local government taxes.

Foreign investment in Korea is primarily regulated by the "Foreign Investment Promotion Act" and the "Enforcement Decree of the Foreign Investment Promotion Act". However, foreign investments are also regulated by many other laws and regulations in trade, finance, intellectual property rights, tax, labor relations, etc. [14]. Tax incentives on foreign investments are provided primarily by the following acts:

- a. "Foreign Investment Promotion Act" (Act No. 5559, Sep. 16, 1998),
- b. "Enforcement Decree of the Foreign Investment Promotion Act" (Presidential Decree No. 16720, Feb 23, 2000),
- c. Korea Trade and Investment Promotion Agency Act,
- d. The Custom Duties Act,
- e. Act on Designation and Management of Customs-Free Zones for Fostering

International Logistics Centers (Act No. 6054, Dec. 28, 1999), and
 f. Act on the Designation, etc., of Free Trade Zone (Act No. 6142, Jan 12, 2000).

In general, the tax incentives allowed to foreign capital invested companies are a reduction of or an exemption from corporate taxes or income taxes for the first seven year period and thereafter a 50% reduction for the next three year period. If the foreign investment is less than 100%, the exemption or reduction is accordingly reduced depending on the percentage of the foreign investment. In addition, if corporate taxes and income taxes are exempted and reduced, acquisition taxes, registration taxes, property taxes, and aggregate land taxes are also usually exempted or reduced, regardless of the percentage foreign ownership, by the full amount for the first five year period from the starting date of business and thereafter by 50% for the next three year period.

The foreign investments that receive tax incentives such as a reduction or exemption from corporate tax, income tax, acquisition tax, registration tax, property tax, and aggregate land tax include:

- a. Industry-supporting service business vital to the improvement of international competitiveness in domestic industry and business involving highly developed technology,
- b. Business carried out by a foreign-invested enterprise that operates in a foreign investment zone and provides a certain number of newly hired full time employees with a certain amount of capital investment,
- c. Business for which tax reduction and exemption is unavoidable in order to attract foreign investment, as determined by Presidential Decree, and
- d. Manufacturing business or distribution business operating in a free trade zone.

In addition to tax incentives, various other incentives are provided to induce foreign investments that will contribute to the development of the nation's economy. For example:

- a. A local government, with funds fully or partially provided by the central government, may form a foreign investment zone (for example, as a site for factories) and sell lots in the zone at a price lower than the land formation fee, or rent the land in lots to foreign-capital invested companies at a reduced or exempted rental fee,
- b. State owned or public properties may be leased or sold to foreign capital invested companies, and in the case of a lease, the term of the lease can be for up to fifty years,
- c. When a foreign capital invested company purchases a state owned property and certain conditions are met, the purchase price may be paid in installments for up to twenty years or the time period for payment of the purchase price may be extended for up to one year, and
- d. With funds supplied by the central government, a local government may provide various subsidies such as education and training subsidies.

Furthermore, reduction of or exemption from various taxes is provided for both domestic and foreign investments by the Restriction of Preferential Taxation Act (Act No. 16194, Jan 21, 2000), if the investments satisfy certain conditions.

IV. Example and Evaluation of Investment Incentives

Multi-national firms make foreign investments for many different reasons. However, the single most important reason is the profit aspect of foreign investments. Multi-national firms would not make foreign investments unless the investments provide high profit prospects. Investment incentives are offered to improve the profit prospect. Tax incentives and accelerated depreciation methods are provided to induce a typical foreign investment whose project's useful life is not limited to one or two year period like construction projects.

Therefore, to evaluate the effectiveness of tax incentives and an accelerated depreciation, a typical investment project for which the investment incentives are designed should be used. Tax and other incentives are provided to enhance the profit prospect of typical investment projects which have at least a ten year useful life so that the maximum tax benefit offered by Korean central and local governments can be applied. It should be noted that in Korea tax incentives are not provided to cash flows that occur after the first 10 year period.

The typical investment project prepared for the evaluation is as follows. Suppose that a multi-national firm (Associated Automobile Company (AAC)) is considering the production of a new energy saving auto part containing computer chips developed by the company. The device can be installed in new as well as used cars. The company is considering producing the devices in Korea. To produce this device, equipment worth \$4.5 million will be needed. Technological advances will limit the project's life to ten years. Since only straight line depreciation is allowed in Korea, the equipment will be depreciated on a straight-line basis over the ten year life of the project.

If the investment qualifies for the full tax incentives, AAC is entitled to a tax exemption for the first seven profit-making years followed by 50% reductions for the subsequent three-year period. This amounts to zero tax in the first seven years and only 14% (28% x 50%) in the next three years.

These tax rates, which amount to an average annual tax rate of 4.2% over the ten year project life, are the most favorable tax rates which can be offered to foreign investment in Korea. The possible impacts of an increase or decrease in the average tax rate on both the profit and risk aspects of the project will be very useful information for both the multi-national firm and the central and local governments. It is especially important information for governments agencies in re-evaluating the appropriateness of the various tax incentives offered to foreign investments in Korea.

Suppose that AAC's management has made three estimates (optimistic, most likely, and pessimistic estimates) for each cash-flow component for the next ten years, as shown in Table 1.

Please insert Table 1 around here.

There are three cash inflow components and six outflow components: X_1 (new car market sales), X_2 (used car market sales), X_3 (royalties from licensing agreements with foreign car manufacturers), X_4 (labor cost of X_1), X_5 (labor cost of X_2), X_6 (material cost of X_1), X_7 (material cost of X_2), X_8 (advertising and sales promotion), X_9 (other selling and delivery expenses), and X_{10} (general and administrative expenses).

Given the estimates of the cash flow components, the project's $E(C_t)$, $Var(C_t)$ and r_{pq} can be measured as follows:

- a. For the estimation of the expected values and standard deviations for the random cash flow components ($X_1 - X_{10}$), the method suggested by Wagle [12] and Hillier [6], can be used. According to the method, the two parameters can be estimated as follows:

$$E(X) = \frac{1}{6} [X_{pes} + 4X_{most} + X_{opt}] \quad (11)$$

and

$$Var(X) = \left[\frac{1}{6} (X_{opt} - X_{pes}) \right]^2 \quad (12)$$

where X_{pes} = pessimistic estimate, X_{most} = most likely estimate, and X_{opt} = optimistic estimate. The expected values and standard deviations of the cash flow components which are shown in Table 2 were computed using the three estimates in Table 1 and equations (11) and (12).

Please insert Table 2 around here.

- b. The original PERT method proposed by Malcolm et al. [11] does not provide any estimation procedure for the correlation coefficients (τ_{ij}). Hillier [5,6] and Kim and Elsaid [7] showed how to derive the correlation coefficients between an investment project's cash flow components for the PERT technique based on the regression slope parameter. Therefore, rather than repeating the lengthy estimation method proposed by Kim and Elsaid [7], this paper assumes that τ_{ij} are already estimated. Table 3 depicts the assigned τ_{ij} .

Please insert Table 3 around here.

- c. The expected values ($E(C_t)$) and variances ($\text{Var}(C_t)$) of each periodic cash flow were computed using the data in Tables 2 and 3, equations (4) and (5), and ten different average tax rates (0 to 45% in 5% increments) under two different depreciation methods (straight line and the sum of year's digits depreciation methods). Table 4 shows the computed values of the expected values and standard deviations of each periodic cash flow.

Please insert Tables 4.

- d. Then the inter-temporal correlation coefficients, r_{pq} were computed using equation (9) and the different tax rates. Tables showing all computed r_{pq} were not prepared because of the huge number of correlation coefficients. For the computations of r_{pq} , a decay rate of .6 was used for ρ_{pq} such that: $\rho_{pq} = (0.6)^{q-p}$ where $q > p$.
- e. The first two moments, $E(\text{NPV})$ and $\text{Var}(\text{NPV})$ were computed based on the estimated values of $E(C_t)$, σ_t , r_{pq} , and equations (4) and (5). For the computation of $E(\text{NPV})$ and $\text{Var}(\text{NPV})$, 12% was used for the discount rate. Table 4 shows the computed $E(\text{NPV})$ s and the standard deviations of the NPV under ten different average tax rates which range from 0 to 45%. The same table shows $P(\text{NPV} \geq 0)$, the probability that the project's NPV is greater than zero -- the possibility that the project can be profitable. For the computation of the probability, Tchebycheff's inequality was used, assuming that the underlying probability distribution of the NPV is unknown. Figures 1 and 2 are graphical representation of the table. A careful observation of the two figures shows that as the tax rate increases, the $E(\text{NPV})$ decreases at a constant rate. But the probability that $P(\text{NPV} > 0)$ decreases at an increasing rate. To examine the impact of accelerated depreciation, the sum of year's digits method was used.

Please insert Figures 1 and 2 around here.

The analysis provides several important implications:

First, the expected profit (the net present value) alone is not enough information for making a sound investment decision. For example, under straight line depreciation, even when the average tax rate is as high as 45%, the expected profit (NPV) from the project is \$1,360,000. However, at the 45% tax rate, the $P(\text{NPV} > 0)$ is only 9.2%, implying that it is

highly probable that the NPV can be less than zero. Traditionally, both the profit and risk aspects are combined by using the risk-adjusted discount rate. The risk-adjusted NPV alone provides incomplete information, which can lead to the acceptance of highly risky projects. Consideration of both the profit and risk aspects separately is very important in evaluating risky investment projects.

Second, at very low tax rates, the $P(NPV > 0)$ is not sensitive to changes in the tax rate, implying that unnecessarily low tax rates are not needed to induce foreign investment. Table 4 and Figure 1 show that up to the tax rate of 25%, the $P(NPV > 0)$ is greater than 50%. Consequently, if there are no other taxes, the policy that the corporate tax rate is, in general, around 28% does not appear to be excessive.

Third, the $P(NPV \geq 0)$ is very sensitive at higher tax rates. Thus, the Korea central and local governments should not raise the current 28% tax rates. Additional increases in tax rates significantly deteriorate corporate profit prospects and investments.

Fourth, as can be seen from the two figures, the accelerated depreciation method improves both the profit and risk aspects of the project. The improvement gradually increases as the average tax rate rises. It is much higher at higher tax rates than at lower tax rates. In addition, the improvement of the risk aspect is much larger than the improvement of the profit. Consequently, the extent of the benefit of accelerated depreciation depends on the average level of tax incentives. For example, under a very low average tax rate, an additional investment incentive in the form of accelerated depreciation is not a good incentive policy because of its insignificant improvement of a project's profit and risk. However, to those domestic companies that pay the maximum 28% corporate tax, an accelerated depreciation can significantly improve both the profit and risk aspects of these firms. It implies that if accelerated depreciation is allowed a small amount of additional tax can be assessed above the 28% tax rate without adversely affecting the overall company's profit and risk.

V. Conclusion

Traditionally, in evaluating a risky investment project based on the risk-adjusted NPV method, only the project's profit aspect is considered by using a risk-adjusted discount rate. The $E(NPV)$ so computed, however, does not properly take into account the risk aspect of the project. As a result, a highly risky project may be accepted. Therefore, the separate assessment of both the profit and risk aspects is very useful in the evaluation of risky investment projects.

Various tax incentives are offered in Korea to induce foreign investments. Such incentives obviously affect both the profit and risk aspects of foreign investments. Therefore, to evaluate properly the effectiveness and appropriateness of the tax incentive policy, the two aspects should be examined. For the evaluation, a numerical example of a typical manufacturing investment project for which investment incentives are provided was used.

The analysis revealed that at very low tax rates, the $P(NPV > 0)$ is not sensitive, implying that unnecessarily low tax rates are not needed to induce investment. However, the $P(NPV > 0)$ is very sensitive at higher tax rates. Thus, a very small amount of tax increase above the current 28% maximum corporate tax rate can significantly deteriorate corporate profit and risk.

In addition, at low average tax rates, both the $E(NPV)$ and $P(NPV > 0)$ are not sensitive to the accelerated depreciation method, implying that an accelerated depreciation (the sum of year's digit method) is not needed to induce foreign investment. An accelerated depreciation does not appear to be a good additional investment incentive to those multi-

national firms which get maximum tax incentives. However, to those domestic companies that pay the maximum 28% corporate tax on their profits an accelerated depreciation method can significantly improve both the profit and risk aspects of these firms. It also implies that if accelerated depreciation is allowed, a small amount of additional tax can be assessed above the 28% rate without adversely affecting the overall companies' profit and risk.

Other variables, such as the duration of a project, can also affect the profit and risk aspects of an investment. Therefore, it is possible that the results derived can be somewhat different depending on the size of other variables. However, it should be noted that it is always possible to conduct a sensitivity analysis based on the mathematical models of the first two moments. Furthermore, the sensitivity analysis is very useful not only for the evaluation of the appropriateness of a change in the government's investment incentive policy, but also for the company's accept/reject decision of a project.

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Table 1. Optimistic, Most Likely, and Pessimistic Estimates of Cash Flow Components (000's)

Variable	Year ⇒	1	2	3	4	5	6	7	8	9	10
X ₁	Optimistic	5,000	7,000	10,000	12,500	12,500	10,000	7,000	7,000	5,000	2,500
	Most likely	4,165	5,831	8,330	10,413	10,413	8,330	5,831	5,831	4,165	2,083
	Pessimistic	2,533	2,786	3,040	3,546	3,546	3,293	2,786	2,533	1,520	760
X ₂	Optimistic	1,000	3,000	5,000	7,500	10,000	10,000	7,500	7,500	5,000	2,500
	Most likely	835	2,499	4,165	6,248	8,330	8,330	6,248	6,248	4,165	2,083
	Pessimistic	507	507	760	1,013	1,267	1,267	1,013	507	507	253
X ₃	Optimistic	120	200	200	400	450	400	290	290	200	100
	Most likely	100	167	250	333	375	333	242	242	167	83
	Pessimistic	61	66	76	91	96	91	76	61	41	20
X ₄	Optimistic	1,075	1,582	2,370	3,025	3,088	2,420	1,659	1,659		538
	Most likely	895	1,318	1,974	2,572	2,572	2,016	1,382	1,382	1,130	448
	Pessimistic	545	599	654	762	763	708	599	545	942	164
X ₅	Optimistic	215	678	1,185	1,815	2,470	2,420	1,778	1,778	1,130	537
	Most likely	180	565	987	1,543	2,058	2,016	1,481	1,481	941	448
	Pessimistic	109	109	163	218	272	272	218	109	109	54
X ₆	Optimistic	2,150	3,080	4,500	5,625	5,750	4,500	3,150	3,150	2,200	1,075
	Most likely	1,791	2,566	3,749	4,686	4,790	3,749	2,624	2,624	1,833	896
	Pessimistic	1,089	1,198	1,307	1,524	1,525	1,416	1,198	1,098	654	327
X ₇	Optimistic	430	1,320	2,250	3,375	4,600	4,500	3,375	3,375	2,200	1,075
	Most likely	359	1,100	1,874	2,811	3,832	3,748	2,812	2,812	1,832	895
	Pessimistic	218	218	327	436	545	545	436	218	218	109
X ₈	Optimistic	288	480	500	500	500	480	500	500	240	120
	Most likely	240	400	450	500	450	400	500	500	200	100
	Pessimistic	146	158	137	164	116	109	182	146	80	80
X ₉	Optimistic	410	613	868	1,122	1,249	1,122	842	842	613	35
	Most likely	350	513	717	921	1,023	921	697	697	513	9
	Pessimistic	185	192	205	225	232	225	205	185	158	309
X ₁₀	Optimistic	780	1,000	1,275	1,550	1,688	1,550	1,247	1,247	1,000	725
	Most likely	750	950	1,200	1,450	1,575	1,450	1,175	1,175	950	700
	Pessimistic	530	537	550	570	577	570	550	530	503	477

Key: optimistic (most likely, pessimistic) = optimistic (most likely, pessimistic) estimate, X₁ = new car market sales,

X₂ = used car market sales, X₃ = royalties, X₄ = labor costs of X₁, X₅ = labor cost of X₂, X₆ = material cost of X₁, X₇ material cost of X₂, X₈ = advertising and sales promotion, X₉ = other selling and delivery expenses, and X₁₀ = general and administrative expenses.

Table 2. Expected Values and Standard Deviations of Cash Flow Components (000's)

Year ⇒ Variabl	1	2	3	4	5	6	7	8	9	10
E(X ₁)	4,032	5,518	7,727	9,616	9,616	7,769	5,518	5,476	3,863	1,932
σ ₁	411	702	1,160	1,492	1,492	1,118	702	745	580	290
E(X ₂)	808	2,251	3,737	5,584	7,431	7,431	5,584	5,500	3,695	1,848
σ ₂	82	416	707	1,081	1,456	1,456	1,081	1,166	749	375
E(X ₃)	97	156	229	304	340	304	222	220	151	75
σ ₃	10	22	37	52	59	52	36	38	27	13
E(X ₄)	867	1,242	1,820	2,346	2,357	1,865	1,298	1,289	871	416
σ ₄	88	164	286	377	388	285	177	186	134	62
E(X ₅)	174	508	883	1,368	1,829	1,793	1,320	1,302	834	397
σ ₅	18	95	170	266	366	358	260	278	170	81
E(X ₆)	1,734	2,424	3,467	4,316	4,406	3,485	2,474	2,456	1,698	831
σ ₆	177	314	532	684	704	514	325	344	258	125
E(X ₇)	347	990	1,579	2,509	3,412	3,340	2,510	2,474	1,624	794
σ ₇	35	184	321	490	676	659	490	526	330	161
E(X ₈)	232	373	406	444	403	365	447	441	18	100
σ ₈	24	54	61	56	64	62	53	59	27	7
E(X ₉)	333	476	657	839	929	839	639	636	471	288
σ ₉	38	70	111	150	170	150	106	110	76	38
E(X ₁₀)	718	890	1,104	1,320	1,428	1,320	1,083	1,080	88	667
σ ₁₀	42	77	121	163	185	163	116	120	83	41

Key: E(X_i) = expected value of the *i*th cash flow component, X₁ = new car market sales, X₂ = used car market sales, X₃ = royalties, X₄ = labor costs of X₁, X₅ = labor cost of X₂, X₆ = material cost of X₁, X₇ = material cost of X₂, X₈ = advertising and sales promotion, X₉ = other selling and delivery expenses, and X₁₀ = general and administrative expenses.

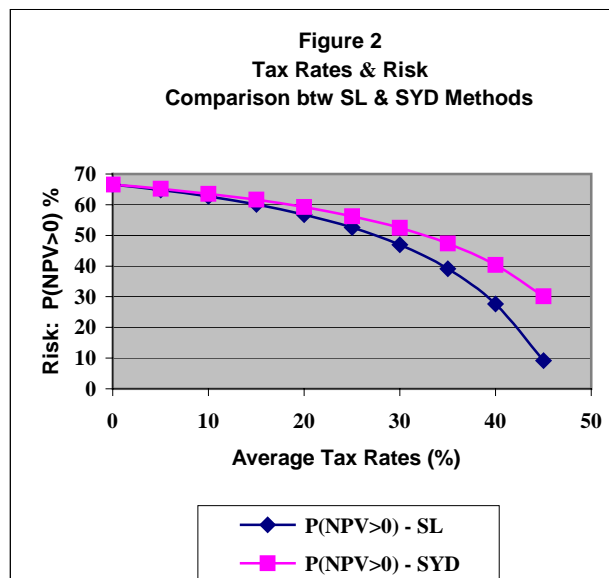
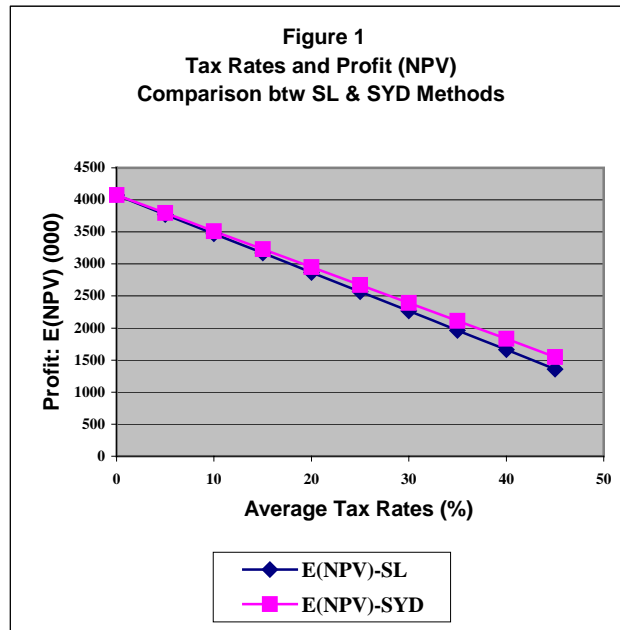
Table 3. Correlation Coefficient Matrix for Component Cash Flow

	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀
X ₁	1.00									
X ₂	.60	1.00								
X ₃	.40	.30	1.00							
X ₄	.94	.20	.10	1.00						
X ₅	.20	.94	.10	.20	1.00					
X ₆	.98	.30	.20	.95	.10	1.00				
X ₇	.30	.98	.20	.10	.95	.20	1.00			
X ₈	.50	.70	.30	.20	.30	.20	.30	1.00		
X ₉	.40	.50	.05	.10	.12	.10	.12	.05	1.00	
X ₁₀	.20	.20	.10	.10	.10	.10	.10	.05	.05	1.00

Key: X₁ = new car market sales, X₂ = used car market sales, X₃ = royalties, X₄ = labor costs of X₁, X₅ = labor cost of X₂, X₆ = material cost of X₁, X₇ = material cost of X₂, X₈ = advertising and sales promotion, X₉ = other selling and delivery expenses, and X₁₀ = general and administrative expenses.

Table 4. Periodic Cash Flow, Expected NPV, Standard Deviation, and P(NPV>0)
Under Different Tax Rates and Depreciation Methods (000's)

Tax Rates	Depreciation		Yearly Expected Cash Flows & Standard Deviations										E(NPV) σ_{NPV}	P(NPV>0) (%)
			1	2	3	4	5	6	7	8	9	10		
0%	SL	E(C _t) σ_t	532 171	1022 422	1660 706	2364 1021	2626 1150	2498 1009	1554 681	1518 735	1142 550	362 290	4074 2356	66.56%
	SYD	E(C _t) σ_t	532 171	1022 422	1660 706	2364 1021	2626 1150	2498 1009	1554 681	1518 735	1142 550	362 290	4074 2356	66.56%
5%	SL	E(C _t) σ_t	528 162	994 401	1600 671	2268 970	2517 1093	2395 959	1499 647	1465 698	1107 522	367 276	3772 2238	64.80%
	SYD	E(C _t) σ_t	546 162	1008 401	1610 671	2274 970	2519 1093	2393 959	1493 647	1455 698	1093 522	3482 76	3794 2238	65.19%
10%	SL	E(C _t) σ_t	524 154	965 380	1539 636	2172 919	2408 1035	2293 908	1445 613	1411 661	1073 495	371 261	3471 2120	62.68%
	SYD	E(C _t) σ_t	560 154	994 380	1560 636	2185 919	2413 1035	2889 908	1432 613	1391 661	1044 495	3342 61	3513 2120	63.57%
15%	SL	E(C _t) σ_t	520 145	937 359	1479 600	2077 868	2300 978	2191 858	1389 579	1358 624	1038 467	375 247	3169 2003	60.07%
	SYD	E(C _t) σ_t	575 145	980 359	1509 600	2095 868	2306 978	2184 858	1370 579	1327 624	995 467	320 247	3233 2003	61.62%
20%	SL	E(C _t) σ_t	515 137	908 337	1418 565	1981 817	2191 920	2088 807	1333 545	1305 588	1003 440	380 232	2868 1885	56.80%
	SYD	E(C _t) σ_t	589 137	965 337	1459 565	2006 817	2199 920	2080 807	1309 545	1264 588	964 440	3062 32	2952 1885	59.24%
25%	SL	E(C _t) σ_t	511 128	879 316	1358 530	1885 766	2082 863	1986 757	1278 511	1251 551	969 412	384 218	2566 1767	52.58%
	SYD	E(C _t) σ_t	603 128	951 316	1409 530	1916 766	2092 863	1976 757	1248 511	1200 551	897 412	2922 18	2672 1767	56.26%
30%	SL	E(C _t) σ_t	507 120	851 295	1297 494	1790 715	1973 805	1883 707	1223 477	1198 514	934 385	389 203	2265 1649	46.96%
	SYD	E(C _t) σ_t	618 120	937 295	1358 494	1827 715	1985 805	1871 707	1186 477	1136 514	848 385	2782 03	2391 1649	52.44%
35%	SL	E(C _t) σ_t	503 111	822 274	1237 459	1694 664	1864 748	1781 656	1168 443	1144 477	900 357	393 189	1963 1531	39.14%
	SYD	E(C _t) σ_t	632 111	922 274	1308 459	1737 664	1879 748	1767 656	1125 443	1073 477	799 357	264 189	2111 1531	47.38%
40%	SL	E(C _t) σ_t	499 103	794 253	1176 424	1598 613	1756 690	1679 606	1113 409	1091 441	865 330	397 174	1661 1414	27.60%
	SYD	E(C _t) σ_t	646 103	908 253	1258 424	1647 613	1772 690	1662 606	1064 409	1009 441	750 330	2501 74	1831 1414	40.37%
45%	SL	E(C _t) σ_t	495 94	765 232	1116 388	1503 562	1647 633	1576 555	1057 375	1037 404	830 302	402 160	1360 1296	9.19%
	SYD	E(C _t) σ_t	661 94	894 232	1208 388	1558 562	1665 633	1558 555	1002 375	945 404	702 302	2361 60	1550 1296	30.13%



Comments on "Evaluation of the Effectiveness and Appropriateness of Korean Tax Incentive Policy on Foreign Investments and Straight Line Depreciation"

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The paper tries to evaluate the effectiveness/appropriateness of incentive structure offered to foreign director investments in Korean corporate income tax system. The author reports four main findings. First, one must consider risk characteristics as well as expected profit of a project to make a sound investment decision. Second, it is unnecessary to set corporate income tax rate at very low rates to induce foreign direct investments since the probability of negative NPV is not sensitive to changes in tax rate when it is already low. Third, the risk of a investment project expressed as the probability of NPV being positive is a decreasing concave function of (average) tax rate. Fourth, allowing for accelerated depreciation helps an investment project become more attractive in terms of both expected profit and risk profile.

Unfortunately, it seems that the author put too much confidence on the claims that are very difficult to accept considering the limited generality and depth of the arguments presented in the paper.

First of all, every single conclusion the author draws in the paper is totally based on an example carefully but arbitrarily constructed to illustrate the usefulness of an estimator for inter-temporal correlation coefficient of stochastic cash flows published in 1999 by the author and co-authors in *Engineering Economist*. He surely was successful in showing the plausibility of the claims above through AN EXAMPLE presented as a mere "thought experiment". The conclusions are not applicable to other numerous cases with different structure of expected cash flows and correlations among them. The author emphasizes the word "typical" in the presentation to avoid the criticism on the specificity of argument. I do not know how typical his typical example is. Even though I accept the "typicality" of the example, it is still just an example. I am pretty sure that the result cannot survive a series of robustness check, if properly designed and done. The author did not prove any claim in the paper. It is next to impossible to generalize the results in the paper into cases with different structures. Moreover, it is definitely not a recommendable practice to draw a conclusion on the effectiveness of an economic policy or to make policy recommendations based on somewhat arbitrary and anecdotal evidences.

As for theoretical or practical significance of four findings, the first and the fourth findings are trivial. The author cautioned us not to be over-confident on the NPV alone whether it be discounted by simple risk free interest rate or risk-adjusted interest rate. Except for pedagogical examples in introductory finance textbook, it is very difficult to find the cases where NPV alone is taken too seriously as THE INDICATOR for investment decision. Moreover, the author does not offer any criterion on which we base investment decision when one investment project displays higher expected profit but riskier cash flow profile than another investment project. He also claims that he is able to pin down the whole distribution of cash flow through Tchebycheff's inequality. It is simply not true since

what Tchebycheff's inequality can do is not to describe the whole distribution but to pick up the upper bound of probability. Therefore, knowing the first and the second moments is not enough to pick up the complete probability distribution except for some special distributions such as normal or t distribution.

Next, it is well-known in public finance literature that accelerated depreciation allowance promotes investment activities. If we cannot put much economic significance on numerical values, the paper does not add much to our understanding of economic phenomenon.

Third, I still have enormous difficulty in connecting what is done in the paper with the title of the paper. The results in the paper can be compared with any corporate income tax scheme. Simply putting the average tax rate in Korea into the context does not justify the title. In addition, analyzing the investment decision with average tax rate may have distorted the whole picture without pay due consideration to the existing progressive structure of corporate income tax in Korea. For example, the investment decision of a firm that already maintains an investment project in Korea will depends not on the average but on the marginal tax rate. The example may represent the process of investment decision by a new entrant into Korea but cannot be used to explain an incremental investment decision by a firm that already has operating projects in Korea.

In sum, the author basically recycles the example from his 1999 paper in *Engineering Economist* and tries to apply to different context without proper modifications. It is quite hard to find the innovation achieved by the paper other than a small thought experiment whose results are too case dependent to be claimed as general results. Another example with a more sophisticated and careful scheme - preferably, an example based on real data - would have done much better job in persuading the audience.

Hierarchy and Market Competition in South Korea's Higher Education Sector

by
Sunwoong Kim and Ju-Ho Lee

1. Introduction

During the last few decades, the expansion of higher education in South Korea (Korea hereafter) has been quite spectacular. In 1960, the number of students enrolled in higher educational institutions in Korea was only about 100,000. Forty-two years later in 2002, the enrollment has increased to more than 3.5 million.¹ More than 70% of the high school graduates advance to some sort of higher education institution. As of April 2002, there are 159 2-year technical colleges (colleges hereafter) and 163 4-year colleges and universities (universities hereafter) in Korea. In addition, there are 11 4-year national teachers' universities,² and 19 4-year technical universities.

In contrast to the government's commitment to public education in primary and secondary schools, Korea's higher education is predominantly private.³ Out of 159 colleges, 143 institutions are private, and out of 163 regular universities, 137 are private. 11 of the 19 technical universities are also private. Excluding more than 300,000 students in the Korea National Open University, there are 2 million students are enrolled in 4-year universities, and about three quarters of them are in private schools. At the same time, about one million students are enrolled in colleges, and more than 95% of them are in private institutions. In terms of expenditure, Korea spends about 2.51% of GDP in higher education in 1998, and the figure is one of the highest in the OECD countries. However, the government's share is only 16.7%, and it is the lowest among them (OECD, 2002). Most of

¹ Since the establishment of the nation state in 1948, South Korea has adopted a 6-3-3-4 educational system. Education over grade 12 is considered higher education in this paper. In 1950, there were 11,358 students in higher education institutions. The number has increased to 101,014 in 1960, to 201,436 in 1970, to 647,505 in 1980, to 1,691,681 in 1990, and 3,383,293 in 2000. Currently, Korea's enrollment rate in higher education is among the highest in the world, and given the high enrollment rate, it would be safe to say that Korea's higher education is saturated, and it is unlikely that the rate would continuously increase in the future.

² All teachers' colleges had been 2-year institutions until they were converted to 4-year since early 1980s.

³ In 2003, primary schools (grades 1-6) and middle schools (grades 7-9) are free and compulsory. Though high schools (grades 9-12) require modest tuition payment, the government subsidizes all private middle schools and high schools since she implemented the "equalization policy" that prohibits the schools to select students. As a result, the enrollment rates for middle and high schools are close to 100%. See Kim and Lee (2002b) for more detail regarding the "equalization policy."

government expenditure in higher education in Korea is disbursed as a subsidy to the public universities, and there are virtually no direct financial aids to students. Most of public universities are national universities that are directly governed by the Ministry of Education and Human Resources Development (MOEHRD, formerly Ministry of Education). Some non-national public universities include universities run by local or provincial governments, other central ministries, or independent government agencies.

Despite the fact that private sector has been the major provider of higher education, the extent of market competition among universities and colleges has been strongly controlled by the government. Up until 1995, MOEHRD not only maintained strict guidelines regarding how to establish and operate the institution, it also controlled number of students for each department for each school as well as student selection methods and the amount of tuition. Despite the fierce competition among students to enter better school, competition among universities to recruit better students was limited because it is difficult for each institution to become different from others due to the heavy regulations applied across the board. The government has not allowed for-profit institutions in higher education. However, some of the private institutions may have been established and operated mainly by profit motives.⁴

Recognizing various problems resulting from the heavy regulation in the education sector, the Presidential Commission on Education strongly recommended market-based approaches to education policy in 1995. Following the Commission's recommendations, the government started to loosen up the regulations. Private institutions outside of Seoul metropolitan area are free to choose the number of incoming class as well as the distribution of students within the institution.⁵ Establishment of new schools was liberalized to enable any institutions above minimum standards to establish schools. Also, the government started to implement discriminatory subsidy policy based on comprehensive evaluation of universities. In short, the government tried to introduce market competition both by making higher educational institutions more autonomous and by requiring them more competitive. The shift in the paradigm of the government's policy creates both opportunities and challenges in higher education in Korea.

In this paper we examine the market structure of higher education sector in Korea. In particular, we recognize the fact that higher education is provided private sector as well as by the government. Depending on the political and economic environment, the supply and finance of higher education vary a lot across countries. In Switzerland, Germany and Austria, higher education is mostly financed and provided by the government, and students pay very little for attending universities. In the U.K., higher education is supplied by the government, but the level of tuition is considerable and the households as well as the government pay some portion of the expense. In the U.S., Japan and France, both government and private sector provides higher education with mixed financing between households and government. Korea resembles the last group, though the government's share in expenditure is lower than the other countries.

The paper is organized as follows. The next section briefly describes our theoretical framework. In particular, we adopt the hierarchical education market model proposed by Epple and Romano (1996), and modify it to suit the economic and regulatory environment of the Korean higher education sector. In Section 3, we consider the ramifications of one of

⁴ However, there are more than 15,000 for-profit educational institutions (*hakwons*) in Korea. Though the majority of *hakwons* specialize in the preparation of college entrance examination, many compete with technical colleges in the area of professional and occupational training. See Kim and Lee (2002a) for more detail.

⁵ However, the institutions in the Seoul metropolitan area still have to get explicit permission from the MOEHRD as a part of the government's decentralization policy that attempts to disperse economic activities to outside of the area.

our modifications by allowing different types of governance structure (for-profit private, non-profit private, and public) for the supply of higher education. The discussions in these sections would be applicable to higher education sector in many countries in which there exists substantial number of private institutions. In the next section, we analyze the assets and strategies for market competition by each type of institution in the Korean environment. The remainder of the paper is focused on the empirical analyses. The empirical evidence strongly support our characterization of the Korean higher education market structure, in which ranking plays a key role in matching institutions of different quality and students of various ability. Conclusions and policy implications of the study are offered at the end.

2. The Basic Theoretical Framework

In this section, we propose a theoretical framework to evaluate the competition among students and institutions in higher education market. Our starting point is the theoretical set up by Epple and Romano (1998). They (referred to as ER hereafter) developed a hierarchical model in the education market in order to examine the effects of voucher system in secondary education system in the U.S. However ER model provides a useful starting point for the characterization of higher education system that is dominated by the private sector such as in Korea. After briefly reviewing the model, we propose several modifications to the ER model in order to make the model more suitable for the analysis of higher education in Korea.

The ER model can be briefly summarized as follows. Households (or students) vary according to income (y) and ability (b), and the probability density function of the households is represented by $f(y, b)$. The support for income and ability is $(0, y_{\max}] \times (0, b_{\max}]$. Each household has the utility function $U(x, e)$ on x (the Hicksian composite good) and educational achievement (e). The educational achievement is determined by the quality of the institution and the student's ability b , in the form $e = e(\cdot, b)$. The price of the composite good is normalized to one. All schools have the same cost structure that includes a large fixed cost. Public schools charge no tuition, but private schools determine profit maximizing tuition schedules according to each student's income and ability. The equilibrium is characterized by the tuition schedules of private schools and resulting allocation of students of different income and different ability to different quality schools. In equilibrium, all private schools maximize profits and all students maximize utilities. In the long run, the maximum profits of private schools are zero because of the free entry and exit in the market.

Under these assumptions, ER proved the following statements hold in equilibrium:

1. A strict hierarchy of quality of schools would emerge with the public school at the bottom, and the higher the quality of the school, the higher the tuition for a given student;
2. Schools would be stratified by income, i.e., a higher quality school would have a higher average student income;
3. Schools would be stratified by ability, i.e., a higher quality school would have a higher average student ability provided that higher income students have higher marginal rate of substitution of education with respect to the composite good;
4. Each institution charges effective marginal cost to each of its students, which is the sum of out-of-pocket marginal cost of running the school plus peer group externality cost.
5. The resulting outcome is efficient.

In order to analyze higher education sector in Korea, we modify the ER model as follows. First, we assume that the provision of high quality education costs more (both in fixed cost and variable cost) than low quality education. In ER model, school quality is solely determined by the student characteristics. Although, the quality of students is an important input for the quality of education service provided by the school, certainly it is not the only input. The quality of teaching staff and school facilities such as laboratory and library are also important inputs for the education process, and it would be safe to assume that the education costs are higher for higher quality institutions. Later in the empirical section, we will provide the evidence that quality is indeed associated with operating expenditure.

Second, we incorporate a competitive student selection process by institutions. In ER model, student allocation is done through a price mechanism, in which each institution is allowed to discriminate students according to their ability and income. Therefore, in equilibrium a higher ability student pays a lower tuition than a lower ability student if both attend the same school and their incomes are identical. Also, if two students with identical ability attend the same school, the student with higher income would pay higher tuition. The ability to price discriminate in ER model is the key assumption for the efficiency result. Without the price discrimination assumption, the equilibrium will not be efficient, because both schools and students may be better off if high quality institutions lower tuitions to lower-income-high-ability students. However, as both the income and ability are not readily observable, the assumption of perfect information seems unrealistic. Furthermore, price discrimination may be politically and socially unacceptable. For example, there has been a great deal of debate on whether the government should allow the "admission for donation" scheme that some high-ranked private institutions favor. Also, historically higher learning institutions traditionally have very little need-based scholarships in Korea.

Thirdly, we envision three different types of ownership structure and consider explicitly incentives and behavior of the different types. Typically in the provision of higher education services, there exist non-profit private institutions as well as for-profit institutions and public institutions, all of which compete in the same education market by providing comparable education services. It would be fair to assume all institutions, no matter what their types are, are concerned about financial security (or profit), to provide quality educational services to the students, and to generate knowledge to the whole society. However, depending on the type of institution, the institutions would have different incentives, and consequently may behave differently in the same environment. In the next section we shall examine the incentives of the three different types in more detail.

Lastly, we incorporate an element of reputation and prestige in the ER model in order to examine competitive strategies that institutions of different type may take in Korea. Being a static model, ER model does not specify the process in which how students congregate around different peer group. We view that the essential mechanism is the prestige and reputation of institutions by which students sort themselves. We recognize the fact that quality of the institution is built through a long time period, and any change in reputation can only occur slowly with substantial investment by the institution.⁶ We shall follow the framework by Brewer et al. (2002) that provide a comprehensive and qualitative study on the nature of the competition among higher education institutions in the U.S. They argued the pursuit of prestige is the most important planning objective for many high quality institutions whereas reputation (meeting student's expectation) is the most important objective for lower quality education. Another reason for our specific concern for the competitive strategy is that it will enable us to analyze how changing market situation affect the entry and exit of institutions. For example, if the number of potential students

⁶ For a study of stable hierarchy in US higher education market, see Mayer-Foulkes (2002).

increases, what do existing institutions will behave in order to take advantage of the growing market? Furthermore, it will help us to examine what types of institutions are likely to enter the market. We shall analyze assets and strategies of higher education institutions for market competition in Section 5.

3. Incentives and Behavior of Different Types of Institutions

In this section, we shall discuss the implications of having different types of institutions in the provision of higher education. We shall discuss private institutions first and public institutions later. Although for-profit private institutions are not allowed in higher education sector by law in Korea, many institutions are de facto for-profit, and the illegal transfer of resources to the owner from the institutions has been one of the most important perennial issues of campus dispute in many private institutions and government regulations. Therefore, we include for-profit institutions in our analysis. For-profit institutions exist in order to make profit. Either it is a corporation or a sole proprietorship, for-profit institution would be expected to be sensitive to the profit motive. There are certain social benefits of having for-profit supplier in higher education. Since student satisfaction is very important to them, they would be more flexible and more responsive to the changes in the student preference or economic environment in which they operate. For example, the quickness in setting up a new program or eliminating an existing program in order to meet the new market demand would be their strength. Also, for-profit institutions would have strong incentives for cost cutting in order to increase production efficiency. However, they would be less concerned about the activities that do not yield direct financial benefits. For example, research activities of the institutions would be minimal, and faculty members would not be encouraged to perform research activities or community services. As far as the revenue structure is concerned, it is unlikely to expect for-profit institutions would generate substantial public donations or government subsidy, as the potential donors would suspect that the owner rather than the students would ultimately benefit by such donations. Therefore, it is likely that they would offer education programs that are popular and inexpensive to provide. They would minimize the size of teaching staff that specialize in teaching, as the instructional personnel is the major component in the cost structure of higher education. Their entry and exit would be flexible and would be driven by profits and losses.

Non-profit private institutions commonly exist in higher education market. The suppliers of higher education cannot effectively communicate the information regarding the quality of service they provide beforehand. Students need to attend schools in order to fully evaluate the quality of the education they receive. Ridding the residual claim of the institution, the institution can send more effective signal to potential students that the institutions is more concerned about stated mission rather than the resulting profits of the activities. Furthermore, without the residual claimant of earnings, the stakeholders in non-profit institutions would have stronger incentive to seek prestige than for-profit institutions, which depends on the quality of faculty, facility, and students.

The status of non-profit organization gives clear advantage in raising donations, as potential donors would consider the non-profit status of the institution as assuring signal that the donations would ultimately benefit students (Hansmann, 1980, 1990). Furthermore, the Korean government tax codes stipulate that donations to non-profit higher education institution can be deducted from income taxes. Since non-profit institutions do not distribute residual claim for every fiscal year, they can retain the operational earnings. Over a long time period, non-profit institutions may generate large sums of endowment. The possibility of private donation and accumulation of endowment gives non-profit

institutions distinctive advantages over non-profit institutions in providing students with more financial aid. In order to attract more donations and sponsored research funds, these institutions would seek to hire more renowned faculty and encourage them to engage in research activities. However, these activities are costly and the strategy to seek prestige would be constrained by the financial stability of the individual institutions. On the contrary, by lowering the admission standards, they would be able to increase the size of incoming class and consequently tuition revenue. They have to balance the two somewhat conflicting objectives of "the pursuit of prestige" and "securing financial stability".

Based on the arguments above, we can conclude two things. First, we would expect that the non-profit institutions dominate the upper layer of the quality spectrum and for-profit institutions dominate the lower layer among private institutions. Second, the higher quality institutions would attract more donations, possess higher endowments, attracts higher quality faculty and students.⁷

In ER model, public schools charge no tuition, and occupy the lowest end of the quality spectrum. In secondary education in the U.S., this may be a reasonable assumption, particularly in the large urban areas where voucher program is debated. However, in Korea, as in many other countries, there are several reasons why public higher education institutions occupy high quality spectrum. First, unlike U.S. high schools, public universities in Korea have student choice. If the public institutions are allowed to select students, there is no reason that public institutions would be the lowest quality. In fact, quite the opposite would be true, as they would be able to offer lower tuition than private institutions because of the public subsidy. When the size of the subsidy is substantial, public institutions may have distinctive financial advantage over private institutions, particularly compared to private institutions with weak endowments. Second, in many countries where the history of high education is relatively short, public institutions may have longer history than private institutions. In fact, to a large degree, Korea followed Japanese model of higher education in which the government recruits and educates highest quality students so that they can be the ruling elite of the later generation. In order to accomplish this objective, the government maintained low tuitions along with competitive entrance examinations. The long history and extensive network of successful graduates in addition to lower tuition contributed higher standing of public institutions.

As public institutions rely substantial portion of their revenue on government, they would be more sensitive to the political as well as educational needs, which include accessibility, community service, and/or research activities. Although the degree in which these different objectives imposed on each institution may vary according to the individual charter, the diversity among public institutions would be smaller than that within private institutions. Also, the bureaucratic rent-seeking among public institutions, and the political nature of the decision making process within and between public institutions would restrict their autonomy. However we would expect that the bureaucratic rent-seeking would tend to create an incentive for control and size over to satisfying market demand. Therefore, while public institutions may be the slowest in adjusting the changing market environment, they tend to exploit the change in promoting the institutions position for more control and bigger size.

For some high rank public institutions, the extensive network of graduates and high quality faculty may generate substantial donations and extramural research fund as well. However, since these institutions are fundamentally public, the control of the extra revenue

⁷ However, the size of endowments in Korean private higher education institutions is relatively small compared to, say, the U.S. There are several reasons for it. First, the history of higher education institutions is relatively short. Second, the country's average income has been quite low until recently. Third, the government has been actively controlling the tuition level in order to make high education more accessible.

would be restricted. Therefore, it would be difficult to imagine they can develop endowments as large as high quality private institutions. Table 1 lists other aspects of institutional objectives and behavior in addition to the ones discussed above.

Table 1. Objectives and Behavior by Types of Higher Education Institutions

	For-Profit Private	Non-Profit Private	Public
Objectives			
Financial security	Very important	Very important	Not important
To provide quality education	Important	Very Important	Important
To meet student demand	Very important	Important	Not important
To provide research product	Not important	Important	Important
To seek prestige	Not important	Very important	Important
To provide community service	Not important	Important	Not Important
To increase the institutional size	Not important	Not important	Very important
Behavior			
Response to change	Very important	Important	Not important
Non-educational income generation	Very important	Very important	Not important
Response to student teaching	Very important	Important	Not important
Rent seeking through government	Not important	Important	Very important
Recruit top quality professors	Not important	Very Important	Important
Facility management	Not important	Very important	Important
Alum maintenance	Important	Very important	Not important
Seeking publicity	Very important	Very important	Not important
Operational transparency	Very important	Important	Important
Accountability	Very important	Important	Not important
Internal governance	Owner controlled	Board controlled	Public agency

Our modifications will not change the conclusion of the ER model that the hierarchy of schools will emerge in equilibrium. However, the characteristic of the hierarchy would be different. First, public institutions would not be at the bottom of the quality spectrum, but will at the top. Also, non-profit private institutions will be in the higher hierarchy than for-profit institutions. The competition between the public and non-profit private institutions would depend on the size of public subsidy, and the operational autonomy of public institutions. Second, the stratification by income in the modified model is expected to be more extreme compared to the original ER model. The average income for high quality institutions would be higher in our model compared to the ER model, as high-income-low-ability (low-income-high-ability) students are now faced with lower (higher) tuitions from high quality institutions, as they are not allowed to price discriminate. Similarly, stratification by ability would be less extreme, as high-ability-lower-income students would settle for lower quality schools in the absence of reduced tuition from the high quality institutions. However, the higher quality schools would still charge higher tuitions than lower quality schools, not only because high income students have higher marginal rate of

substitution of education but also because it is more costly to provide high quality education.

4. Resources and Strategies for Competition in Hierarchical Market

How higher education institutions of different types would compete in the hierarchical market structure? If the number of potential students increases like in Korea, what do existing institutions will behave in order to take advantage of the growing market? How would changing market situation affect entry of new institutions and exit of existing institutions? In this section, we shall discuss the ramification of our model in the context of Korea in order to answer the questions raised above.

The expansion of higher education demand creates opportunities for all existing institutions, but the incentive would vary among different types of institutions. As previously discussed, higher learning institutions have multiple objectives, and those objectives are sometimes conflicting to one another. In order to simplify the analysis, we focus on key objectives of each institutional type, that is to say, we assume that for-profit private institutions seek higher profit, non-profit private institutions seek higher quality, and public institutions seek more expenditure. Regardless of the institutional types, as the prestige and reputation of an institution can only be built through a substantial time period, the institution that has been around longer would have natural advantage in higher quality spectrum. Students would recognize the name of the institution with longer history better than a start-up. Also, older institutions have produced more graduates, and these graduates would provide some support for the school individually or collectively. In particular, the more influential figures in the society the institution produces, the higher the reputation will be.

Existing for-profit universities would increase enrollment in order to increase tuition revenue and profit. Since the marginal cost per student is relatively small, existing low-ranking for-profit institutions would have particularly strong incentive to increase enrollment. The high-ranking non-profit universities would also like to increase enrollment, but their incentives for increased enrollment would be smaller. First, profit and earning is less important for them. Second, they rely less on tuition revenue. Third, they may want to increase its prestige by being more selective in admission process rather than to increase the enrollment. The public institution would also like to increase enrollment, but its incentive would be smaller than private universities. Although higher enrollment may generate more tuition revenue, government subsidy may not increase as much the increase of enrollment. Consequently, the workload for faculty and administration may worsen by admitting more students. Instead, they may try to use the opportunity to improve their administrative standing in the bureaucracy, such as the conversion from 2-year to 4-year institution.

As the capacity constraints of the existing institutions become more binding, one would expect entry into higher education sector. For-profit institutions would be most responsive in meeting the increased demand, and public institutions would be the least responsive. Also, the entry would be heavily focused on the lowest quality spectrum, not only because providing lower quality education is cheaper but because the new startups would not have a good reputation to attract high quality students.

Improving the ranking in the hierarchy would require substantial efforts and resources. In order to increase the institutional prestige or reputation, it needs to do the following: 1) to increase the quality of students; 2) to increase the quality of teaching and research staff; 3) to improve the facility; 4) to increase the visibility of the institution by investing in more sports, arts or entertainment; and 5) to increase the quality of student service including the

quality of teaching and better job placement. The first three strategies would increase prestige, while the last two would increase reputation.

Attracting high quality students into a low quality institution would not be an easy task. Merit scholarship would be the most relevant tool, and even with the merit scholarship it would be more and more difficult to dip into the higher quality student, particularly if the tuition for high ranked public institutions are already low. It will be difficult as well as expensive to recruit high quality faculty. High quality professors may not be willing to come to low ranked institutions because of the fear that they may not get professionally productive interactions with the existing faculty and students. Also, salary for higher quality faculty is likely to be higher. Improving the physical facility may be the most straightforward, and can be done in a reasonably short time period.

All these strategies to improve prestige are risky as well as expensive. Furthermore, they may not yield a tangible effect unless the amount of financial resource committed is quite large. Such large commitments will be unlikely to come from yearly operating budgets. Therefore, if the institution relies heavily on tuition for its revenue, any significant improvement in ranking in the upper spectrum is unlikely. Large influx of financial resources to non-profit private and public institutions may be a great asset for an attempt to increase prestige.⁸

The institution may want to focus on the strategy to increase its reputation by satisfying the education demand of the students more effectively. This strategy involves more flexibility regarding the declaration of the major, international exposure such as study abroad program, better teaching and student services, better job placement assistance, and so on. Increasing the institution's visibility through more active marketing and sponsorship for arts, sports, and entertainment activities may also be useful. These strategies would be cheaper and less risky to implement than the strategies seeking higher prestige. Therefore, they would be more popular to the institutions ranked lower in the hierarchy. Effective administration and internal governance structure would be an asset in pursuing such objectives.

Although public institutions have substantial advantage regarding the cost of tuition, their autonomy for competition is quite restricted. As was mentioned above, most public higher education institutions are national universities that are governed directly by the MOEHRD, and much of their operations are to a large extent regulated. Although the key administrative posts (presidents, deans, and so on) are occupied by faculty, most of the staffs in national universities are civil servants so that the president of the university cannot hire or fire his subordinates not to mention deciding their salaries. Due to historical reasons, national universities are distributed throughout the nation in provincial capitals. Often they are the oldest and the most prestigious institution in the province. Since most of the nationally ranked private universities are located in Seoul metropolitan area, most public universities have strong monopoly of good students. The local monopoly is accentuated by the fact that the public universities have substantially lower tuition than private universities.

Since the deregulation, the government rely more on selective support based on evaluation outcome. Though the nominal amount of the support may be relatively small

⁸ The large endowment to Pohang Institute of Technology (PIT) by Pohang Steel Corporation (POSCO) made PIT a top ranking research school in science and technology. The KAIST, established by the Ministry of Science and Technology also made into top rank school quickly. Both schools are relatively small, and have virtually no tuition. An improvement in ranking among large comprehensive universities would be more difficult, and it is unlikely that many institutions would try unless there is a substantial influx of resources such as the recent acquisition of Sungkyunkwan University by Samsung Foundation. Also, when Daewoo Foundation took control of Ajou University, it tried successfully improve its ranking by hiring high quality faculty and providing full merit-based scholarships for a quarter of incoming students.

compared to the total budgets of the institutions, institutions would be quite keen to the evaluation outcomes because there are substantial promotional effects of these evaluations. Recently, there are also private evaluations on departments, schools, and institutions. Most notably, Joong-Ang Daily Newspaper provides annual ranking for major disciplines among universities, similar to the US News and World Report's ranking on US universities.

5. Empirical Analyses on Hierarchy in Korean Higher Education Sector

Data

We set out to collect a variety of institutional characteristics for all colleges and universities in Korea for the academic year of 1999-2000. There were 158 colleges and 161 universities at that time. Out of this universe, we managed to collect information on 132 colleges and 124 universities. Unfortunately, some key variables on financial information and/or school quality were not available for some institutions.⁹

Korean government has conducted annual mandatory joint entrance examinations for all applicants for colleges and universities for more than a decade. Each institutions are required to use the test score along with other information about the student, such as high school transcripts, recommendations, personal interviews, and so on. However, traditionally the test score has been regarded the most important determinant of the admission decision for most institutions. The information regarding minimum acceptable test scores and average scores for admitted students for each institution are well publicized, and students use them quite extensively in their application decision making process. In some cases, departments (or schools) within an institution are allowed to have different minimum scores depending on their popularity. For this study, we obtained the average scores for successful admissions from Jinhaksa, a private information service company specializing in entrance examinations for higher education institutions. The scores were then standardized from 0 to 100, 100 being the highest.

Information regarding the finance and facilities is obtained from Sul (1999, 2000, 2001). Financial information includes total operating cost, tuition revenue, government subsidy, private donation, and net transfer from/to the mother institutions (when applicable) for the fiscal year of 1999. These figures are standardized per student. Unfortunately, we were not able to obtain important financial stock information, such as net wealth or endowments. School facility information is based on the MOEHRD's guidelines for required number of teaching staff, floor space of building, and land area per student.¹⁰ The facility information also includes the number of books in the library and value of laboratory facilities per student.

One of the issues in collecting the information is how to treat the branch campuses. Since MOEHRD has not permitted the expansion of private universities in Seoul metropolitan area, many large private universities in Seoul set out branch campuses outside of the area. Since these branch campuses have separate faculty and admission criteria as well as different physical facility, it seems natural to treat them separate institutions. Unfortunately, these campuses do not have separate financial statements, even though there are substantial quality differences between the main campuses and branch

⁹ All 11 teachers' universities and 18 open universities (8 national and 10 private) are excluded. Other special purpose institutions such as The Korea Advanced Institute of Science and Technology (KAIST), The Korea National University of Arts (KNUA), police and military academies are excluded in the sample.

¹⁰ The guidelines stipulate higher requirements for medical and engineering students than humanities or social sciences. We calculated the facility information by taking the weighted average over different majors.

campuses. Therefore, we drop the branch campuses in the regression analyses later. 13 of these branch campuses are included in the university sample.

The location and the year of establishment of institutions, and whether it is private are obtained by visiting each institution's home pages. For universities that have converted into 4-year institutions from 2-year, the year of establishment is when the institutions made the formal transition. The number of graduates listed in the Who's Who databases for four major daily newspapers (Chosun, Joong-Ang, Donga, and Moonwha) are enumerated. The following is the abbreviations of the variables and their exact definitions.

SCORE: The average standardized test score (0 to 100) of the admitted students in the government administered college entrance examination for the entering class of 2000.

EXP: Annual operating expenditure per student that includes costs for personnel, administration, laboratory, research, student service, acquisition of books and laboratory instruments.

COST: Net tuition per student, i.e., tuition – scholarship.

SUBSIDY: Education subsidy per student, calculated as $EXP - COST$.

STUDENT: Total number of students in the institution (including graduate students).

HIST: The age of the institution, calculated by $1999 - \text{the year of establishment}$. When the institution was converted from a 2-year to a 4-year, the year of the change was used for the year of establishment.

SSI: The number of journal articles listed in Social Science Index per full time faculty.

R_BLDG: Ratio of the floor area of all school buildings to the MOEHRD guidelines.

R_TEACH: Ratio of the number of full time faculty to the MOEHRD guidelines.

WHOS: logarithm of the number of people listed in the Who's Who databases in 4 major daily newspapers.

TWO_YEAR: 1 if the institution is a two-year college, 0 otherwise.

SEOUL: 1 if it is located in the City of Seoul, 0 otherwise.

METRO: 1 if it is located in the Seoul metropolitan area, which includes the City of Seoul and the surrounding Kyunggi Province, 0 otherwise.

The Table 2 describes some descriptive statistics of the variables listed above. Two outliers in the sample, Pohang Institute of Technology (PIT) and Agricultural Cooperative College spent exceptional amount of money per student, because these two institutions are unusually well endowed whereas the number of students are extremely small. Therefore, in the Table, we provide some statistics excluding these two institutions in the parentheses. Notice the maximum values in EXP and SUBSDY drastically lowers when the two institutions are dropped. The regression analyses in the next sub-section are conducted without these two outliers.

Numbers in the parentheses are for the sub-sample excluding two outliers: Pohang Institute of Technology and Agricultural Cooperative College.

In order to show the hierarchical nature of the higher education market, we arrange the data in 10 categories of deciles in SCORE, the single most important indicator for the hierarchy. Overall, public universities specialize in higher quality spectrum, and private colleges specialize in lower quality spectrum. Private universities distributed from the 1st decile to the 10th decile, though they are more in the upper quality level. Therefore, it seems that public institutions and private universities compete in the higher rank spectrum, all three types of institutions compete in the middle rank, and the private universities and private colleges compete in the lower rank.

Table 2. Major Descriptive Statistics of the Data

	Number of observation	Mean	Standard Deviation	Minimum	Maximum
SCORE	256(254)	54.71(54.40)	22.68(22.50)	6.55(6.55)	99.57(99.57)
EXP	253(251)	3152(2969)	2359(1215)	820(820)	25893(8577)
SUBSIDY	253(251)	138(-52)	2454(1229)	-2046(-2046)	23926(5575)
COST	253(251)	3013(3020)	673(673)	940(940)	4446(4446)
WHOS	111(110)	5.50(5.51)	2.83(2.84)	0(0)	11.54(11.54)
STUDENT	256(254)	6870(6912)	5222(5220)	200(360)	29341(29341)
HIST	256(254)	25.0(25.0)	15.5(155.5)	0(0)	60(60)
SCI	111(110)	.128(.111)	.220(.133)	0(0)	1.972(.917)
R_BLDG	256(254)	70.32(68.49)	30.42(18.52)	29.23(29.23)	444.6(132.83)
R_TEACH	256(254)	48.28(47.87)	17.53(16.95)	20.83(20.83)	189.5(189.5)
TWO_YEAR	256(254)	.516(.516)			
BRANCH	256(254)	.058(.051)			
SEOUL	256(254)	.172(.173)			
METRO	256(254)	.375(.374)			

Table 3. Hierarchical Nature of Korean Higher Education Market

	Score	Number of Schools			Average Number of Students			Per Student Operating Expenditure			Per Student Subsidy		
		Pub. U	Pri. U	Pri. C	Pub. U	Pri. U	Pri. C	Pub. U	Pri. U	Pri. C	Pub. U	Pri. U	Pri. C
1 st Decile	94.3	3	17	0	25,187	12,977	-	4,719	5,414	-	2,734	1,641	-
2 nd Decile	83.5	7	17	1	14,470	8,582	200	3,779	4,219	25,893	2,618	550	23,909
3 rd Decile	75.9	5	18	3	11,970	9,773	1,107	3,543	3,883	3,830	1,948	320	734
4 th Decile	65.7	2	16	10	7,613	8,852	2,876	3,161	3,026	3,048	1,856	-370	-224
5 th Decile	59.3	2	11	9	7,512	10,877	4,819	3,413	2,978	2,657	1,826	-322	-675
6 th Decile	52.9	1	11	14	4,022	5,810	4,993	4,224	2,701	2,698	2,740	-439	-848
7 th Decile	44.3	0	7	20	-	6,717	4,094	-	2,549	2,295	-	-456	-767
8 th Decile	37.6	0	4	21	-	8,580	4,035	-	2,089	2,339	-	-749	-655
9 th Decile	29.8	0	2	26	-	3,520	3,982	-	1,468	2,185	-	-694	-632
10 th Decile	20.1	0	1	28	-	3,130	4,409	-	1,545	2,089	-	-269	-509
Seoul Metro	70.9	1	51	44	29,341	9,071	4,029	6,105	4,299	2,593	3,843	596	-696
Other Regions	46.7	19	53	88	12,681	9,368	3,998	3,678	3,400	2,271	2,056	124	-585
Whole Nation	54.5	20	104	132	12,514	9,222	4,008	3,942	3,834	2,379	2,250	352	-622

Pub. U: 4-year public university

Pri. U: 4-year private university

Pri. C: 2-year private technical college

Seoul Metro: City of Seoul and the surrounding Kyunggi Province

In general, public institutions, particularly the ones in higher ranks, are larger than private institutions. Also, higher ranked institutions are generally larger than the lower ranked institutions except for private colleges, which size and rank seems independent to each other. It seems quite clear that per student operating expenditure is higher as the rank is higher in private universities. The difference in operating expenditure across ranks is relatively small for public universities and private colleges. Based on the theoretical consideration, we suspect the lack of difference is mainly due to the rent seeking activities among public institutions, and profit motivations among private colleges. Students in public institutions enjoy substantial amount of subsidy (in the form of lower tuition), but top ranked private universities also have substantial amount of subsidy (financed by donation and endowment revenue). However, the level of subsidy in private institutions is relatively smaller than those to public universities suggesting that public universities still have substantial advantage in term of finance.

The subsidies become negative for private institutions below the 4th decile. This contrasts sharply to the similar table in Winston (1999), which shows that subsidy for all levels of hierarchy in higher education institution in the U.S. is positive and quite substantial. The fact that most private institutions spend less to students than their tuition revenue clearly suggests that financial situation for most private institutions are much worse than public institutions. As our operating expenditure does not include capital cost, the negative subsidy does not necessarily mean that the institutions make money. However, it suggests that many of such institutions are de facto for-profit institutions.

Figure 1 shows the relationship between the annual operating expenditure per student for three different types of institutions: public university, private university and private college. As expected, the scatter diagram shows a quite strong positive relationship between the academic strength of entering class and the teaching expenditure per student among institutions. Overall, it seems that the three types of institutions compete one another in the homogenous environment. Although private colleges are more heavily concentrated in the region with low student expenditure and low student quality, there are substantial overlap between low-end private universities and high-end private universities. It is observed that public universities do not serve lower half of student quality. This phenomenon seems to be mainly due to the fact that public universities offer lower tuition because of the government subsidy so that they are able to attract high quality students.

Figure 1. Student Admission Score and Per Student Expenditure in Korean Higher Education Institutions

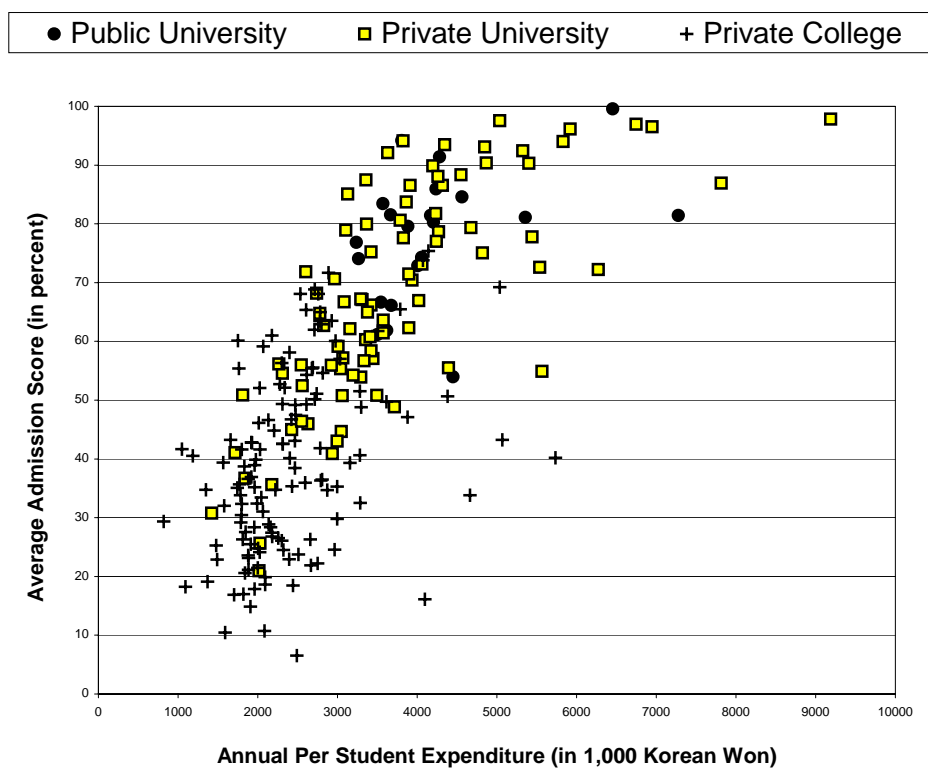
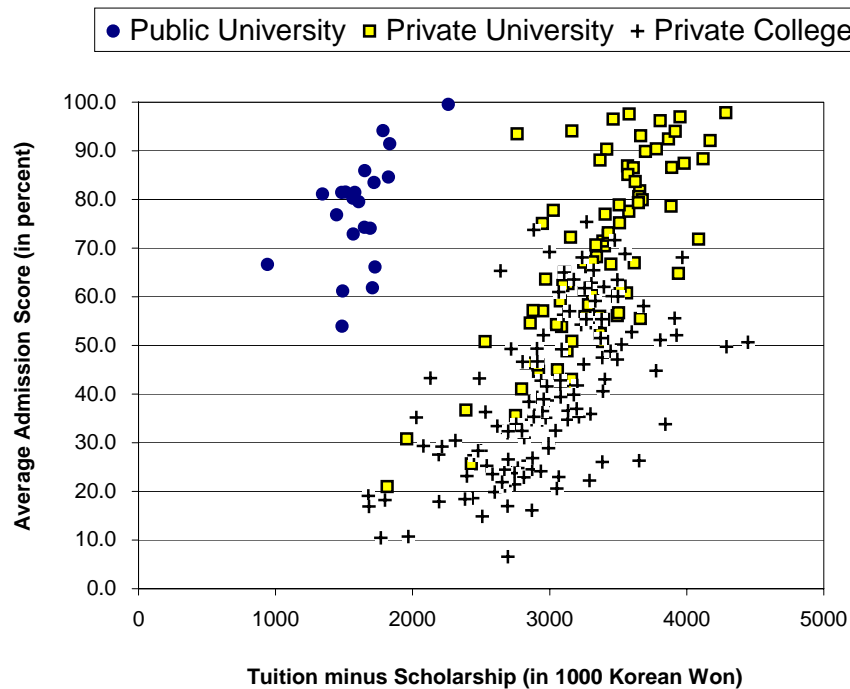


Figure 2 depicts the relationship between the student admission score and net tuition per student, which is the average of tuition revenue minus scholarship distributed to students. Notice that there is a clear distinction between the public institutions and private institutions, whereas the universities and colleges seem to be in one group.

Figure 2. Student Admission Score and Per Student Expenditure in Korean Higher Education Institutions



Regression analyses

In this subsection, we report the results of the regression analysis using the data described previously. There are two main concerns regarding the specification of the regression model. First, although we suspect that many private institutions, particularly in the lower rank in the hierarchy, are for-profit institutions, we cannot distinguish them from non-profit institutions. Therefore, we did not distinguish for-profit and non-profit a priori. Rather, we include SUBSIDY variable so that it reflects the amount of educational subsidy provided by the institution. The second problem is that the student's admission score, education expenditure of the institution, and the subsidy to the student may be endogenous so that single equation regression may create a simultaneity bias. Therefore, we specified a system of three simultaneous equations, and estimate the system with three stage least square (3SLS) estimation.

Based on the theoretical discussion and the incentives and behavior of the three types of higher education institutions, we specify the following system.

- (1) $EXP = f(SCORE, PUBLIC, SCI, TWO_YEAR, R_TEACH, R_BLDG, LAB, LIB)$
- (2) $COST = f(SCORE, SUBSIDY, TWO_YEAR, WHOS, HIST, SEOUL, METRO)$
- (3) $SUBSIDY = f(SCORE, PUBLIC, TWO_YEAR)$
- (4) $EXP = COST + SUBSIDY$

The first equation reflects the supply of the hierarchy of education services. More specifically, we envision that per student expenditure of an institution is a function of quantity and quality of inputs for education services. The quality of education service here is measured by the average test score of the incoming students reflecting peer-group effect and research productivity of the faculty measured by the per faculty number of articles per year listed in Science Citation Index. Also, quantity and quality of teaching is measured in the number of teachers, the size of floor space, the amount of laboratory equipments and the number of library books. We also include dummy variables for public university and private college in order to control for any technological differences between the types of institutions.

The second equation reflects the students' demand for the hierarchy of higher education service. Here we assume that the net tuition (tuition minus scholarship) is a function of average test score, the amount of institutional subsidy per student, log of number of graduates listed in Who's Who in Korea, dummy variables for whether the institution is a public or private college, whether it is located in Seoul or in the Seoul metropolitan area. Since there has been a restriction on the number of students in for the institutions in Seoul metropolitan area even since the deregulation started, we expect the excess demand in the area would drive up the admission scores for the institutions located there.

The third equation is a representation of how institutions obtain non-tuition revenue. The public institutions receive the large subsidy from the government. Although private institutions receive some direct subsidy from the government through various government initiatives, they are relatively small portion of the budget. For non-profit institution received revenue from donation by the alums and general public. In order to simplify the estimation, we aggregate all types of non-tuition revenue into a single category of subsidy. The fourth equation is just the identify stating that the total expenditure must sum to the tuition revenue and non-tuition revenue.

We estimated the system of three equations by using three different estimation techniques for comparison. First, we used 3SLS estimation. Here, we estimate the whole system simultaneously by using full information estimation method. We take EXP, SCORE, and SUBSIDY endogenous, and all other variables exogenous. Also, we take into the cross

equation identity constraint between EXP, COST, and SUBSIDY. Second, we provide estimates by ordinary least square (OLS). OLS estimates each equation separately without considering the simultaneity bias and the cross equation restriction. Third, we estimate the three equation system with seemingly unrelated regression estimation (SURE) in order to take advantage of potential correlation among the error terms. But, SURE does not take into account the cross equation restriction.

We ran the three estimations on two separate samples. The first sample contains the whole sample, and the second sample contains only the 4-year universities. The reason for the two sets of estimations is two-fold. First, we have some additional information for universities regarding the research performance of faculty and (SCI) and the quality and extent of the graduates (WHOS), which are not available for colleges. Second, we would like to examine whether there are substantial differences in the 4-year sub-market and the whole higher education market. Tables 4 shows the results of the estimation with the whole sample, and Table 5 shows the results with the university sample only. Because of the lack of separate financial information, branch campuses are excluded. Also, two institutions, PIT and ACC, are excluded, because these two institutions have much higher expenditure per student than the rest. The usable number of observations is 190 for the first sample, and 100 for the second sample.

Table 4. Estimation Results with University and College Sample

	3 stage least square		Ordinary least square		Seemingly unrelated	
Operating Expenditure equation						
Constant	245.6	223.1	-478.29*	259.5	248.64	223.3
SCORE	29.98***	2.72	25.46***	2.87	30.15***	2.72
PUBLIC	480.37***	138.78	-163.67*	159.4	426.08***	142.1
TWO_YEAR	316.57**	141.57	460.18***	165.4	310.97**	141.5
R_TEACH	11.13***	2.19	28.14***	3.22	10.77***	2.19
R_BLDG	.604	1.78	-.336	2.65	.665	1.80
LAB	.072***	.020	.137***	.029	.075***	.020
LIB	6.11**	2.64	10.48***	3.94	6.30**	2.67
	N = 190, R ² = .655		N = 190, R ² = .729		N = 190, R ² = .657	
Net Tuition equation						
Constant	1596**	193	2084***	196.3	1665***	184.5
SCORE	20.43***	.045	10.17**	3.67	19.14***	3.32
SUBSIDY	-.562***	.045	-.344***	.038	-.535***	.033
TWO_YEAR	73.37	106	29.55	109	68.22***	105.5
HIST	4.83**	2.33	5.56*	2.30	4.62**	2.58
SEOUL	15.99	107.7	218.8	137.9	74.62	119
METRO	192.06***	100.2	312.2***	123.4	193.7***	106.5
	N = 190, R ² = .407		N = 190, R ² = .504		N = 190, R ² = .431	
Subsidy equation						
Constant	-1117***	302.4	-1222***	259.7	-1217***	257.0
SCORE	16.43***	4.26	17.97***	3.59	16.65***	3.54
PUBLIC	2212***	202.84	2197***	203.7	2618***	190.4
TWO_YEAR	-58.33	176.01	-11.64	163.81	35.44	161.9
	N = 190, R ² = .549		N = 190, R ² = .567		N = 190, R ² = .555	

Note: Endogenous variables in 3SLS estimation are EXP, SCORE, and SUBSIDY.

*, **, and *** represent p-values of less than .10, .05, and .01 respectively.

Tables 5. Estimation Results with University Sample Only

	3 stage least square		Ordinary least square		Seemingly unrelated	
Operating Expenditure equation						
Constant	-209.20	299.23	-531.48	350.0	-219.00	299.55
SCORE	31.54***	3.87	24.23***	5.54	31.70***	3.87
PUBLIC	186.22	145.95	-282.43*	166.47	150.75	148.68
SCI	1260***	437.1	1928***	588.3	1252***	437.8
R_TEACH	16.19***	2.72	29.46***	3.67	16.23***	2.73
R_BLDG	1.031	3.38	.584	4.56	1.008	3.39
LAB	.0803***	.035	.1314***	.0467	.0814**	.0347
LIB	4.560	3.18	5.894	4.29	4.678	3.19
	N = 100, R ² = .720		N = 100, R ² = .778		N = 100, R ² = .722	
Net tuition equation						
Constant	1651***	266.4	2412***	286.48	1780***	257.8
SCORE	14.12***	5.07	-1.64	5.84	11.41**	5.02
SUBSIDY	-.529***	.047	-.317***	.047	-.496***	.040
WHOS	110.8***	32.2	154.1***	42.9	119.1***	35.39
HIST	-6.26	4.90	-10.76	6.58	-7.185	5.42
SEOUL	86.48	146.7	230.4	197.0	116.27	162.23
METRO	348.2***	135.7	579.3***	178.6	393.6***	147.6
	N = 100, R ² = .553		N = 100, R ² = .633		N = 100, R ² = .576	
Subsidy equation						
Constant	-1907***	368.4	-1994***	376.3	-1920***	368.5
SCORE	26.42***	5.21	29.39***	5.34	26.86***	5.21
PUBLIC	2657***	206.6	2082***	236.2	2573***	214.6
	N = 100, R ² = .563		N = 100, R ² = .588		N = 100, R ² = .570	

Note: Endogenous variables in 3SLS estimation are EXP, SCORE, and SUBSIDY.

*, **, and *** represent p-values of less than .10, .05, and .01 respectively.

Overall, the models fit data very well. Most of the variables identified in the theoretical discussion turned out to be statistically significant at 1% level or 5% level. In all three estimations for the two samples, the goodness-for-fit measures, r-squared, are generally quite high. The sizes of the estimates differ substantially among the three estimations indicating that the simultaneity bias may be significant. For example, in Table 4, the estimate for SCORE in the net tuition equation is 20.43 in 3SLS, but only 10.17 in OLS. However, it seems that there is no clear directions of the bias. In the following, we shall examine the results of the 3SLS in more detail.

For the whole sample, the estimated results of the expenditure function clearly shows that providing quality education is costly. Attracting more able students, providing more professors, producing more research activities, providing more laboratory facilities and library books are expensive. However, per student floor space turns out to be not significant. Controlling for other variables, public universities seem to spend more than private universities. The difference is 480,000 won, and it is a substantial amount compared to the sample mean of 3,010,000 won. This may be due to the lax financial control in public universities. Two-year private colleges also have substantial additional expenditure than four-year private universities.

At the same time students are willing to pay higher net tuitions for higher rank institutions. Holding other things constant, one percentage point increase in test score is associated with additional net tuition of 24,300. On the other hand, one-dollar increase in student subsidy is associated with 56 cents decrease in net tuition. This suggests that students are sensitive to the subsidy given by the institution, but not to the fullest amount. There is a significant location premium. Students are willing to pay 192,000 more for a comparable institution located in Seoul metropolitan area. The additional premium for the City of Seoul is only 15,000, and it is not statistically significant. The location premium would reflect the desirability of Seoul as the place for the student's higher education as well as the government's enrollment restriction for the institutions in the region. There is no significant premium for four-year university over two-year college holding other things constant.

The result of the subsidy equation estimation shows that non-tuition revenue of public institutions is substantial. Also, it shows higher quality of students is an import determinant for non-tuition revenue. However, there is no premium or penalty for two-year institution in raising the non-tuition revenue. Another interesting finding is that the quality premium for non-tuition revenue does not depend on whether the institution is public or private.

6. Conclusions and Policy Implications.

The supply of higher education in Korea is predominantly provided by private sector. However, because of the public subsidy and the tradition of government financed elite higher education with competitive entrance examinations, public universities have advantages of attracting high ability students. Since the public institutions would not have any organization incentives to cater for low-ability students, they specialize in higher quality spectrum. Although no for-profit institutions are legally allowed, many private institutions in higher education in Korea are de facto for-profit. Our theoretical consideration suggests that the newer private institutions created to meet the expanding demand for higher education tend to be for-profit, and these institutions are likely to specialize in low quality spectrum, whereas older, more established, non-profit institutions specialize in high quality spectrum.

The empirical analysis reported in this paper confirms that Korean higher education sector is highly hierarchical in which public and private institutions compete. In general, 4-year institutions (universities) specialize in higher quality spectrum, whereas 2-year institutions (colleges) specialize in lower quality spectrum. However, there is a substantial overlap of the two types institutions in the middle spectrum achievement. This indicates that these students can be attracted to either universities geared to general education or colleges specializing in professional training.

The institutions located in Seoul or surrounding Kyunggi Province are able to attract better students. This is in part due to the government's regulation that restricts the increase of enrollment in the institutions located near Seoul as an attempt to decentralize population. There is a substantial premium for public universities even after controlling for net tuition and non-tuition subsidy. This may be due to the fact that most of the high ranked private institutions are located in Seoul, and the public institutions located outside of Kyunggi Province do not have any effective competitors.

Since 1995 education reform, a great deal of regulations on the establishment and operation on higher education institutions has been relaxed. However, under the current situation, the room for competition both by public and private institutions is still quite restricted. For public institutions, the central control by the MOEHRD is the most limiting

restrictions. For private institutions, lack of financial resources is the key restriction, as most of them rely heavily on tuition revenue.

With the proliferation of higher education and the rising education costs, the Korean government is likely to be faced with a large political pressure to increase the government funding to higher education sector. This political pressure will be both a challenge and an opportunity. The increase in public support would inevitably create competitive rent seeking activities among higher education institutions. Public institutions would ask for larger supports in order to serve more students. Private institutions would like to institute direct support mechanism similar to the Japanese model established in the seventies and eighties.

At this point, the government's role in higher education should be redefined and clarified. In the current situation, there is no longer a compelling reason for supporting elite public universities. Private institutions can provide quality education as competitive as public institutions. The ability to draw quality students by public universities is largely due to their cheaper tuitions. The price subsidy via lower tuition in public universities is likely to be inequitable, as they tend to be attended by higher income students. In the current situation in which the large private tutoring expenses are required in order to gain an admission to a high rank university, high incomes students are more likely to succeed in the admission game.

Research and graduate education has not been the major responsibility for the majority of professors in Korea. Throughout the period of rapid economic development, Korea relied her graduate educations on foreign research universities, particularly in the U.S. It may have been an optimal policy given the fact that graduate education is expensive and the social return to graduate education in Korea was low. However, as the Korean economy transforms more to a knowledge based economy, and the domestic production of research and development output increases, the demand for research and graduate education will increase. Therefore, funding mechanism for top ranked universities that specialize in those activities has to be considered. Donation for admission, which has been quite controversial, needs to be examined more carefully. Efficient allocation mechanisms for research funds, government or private, need to be examined as well.

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- Literature in Korean

Comments on “Hierarchy and Market Competition in South Korea’s Higher Education Sector”

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The paper theoretically and empirically examines the tertiary education system of Korea based on a hierarchical model in the education *market* developed by Epple and Romano (1998). The paper expands the model of Epple and Romano (1998, ER hereafter) by differential cost condition, student selection process, various types of universities with different ownership structure, and reputation effect. This expanded model predicts public institutions would be at the top of the quality spectrum unlike Epple and Romano (1998). The model also predicts less stratification by income and ability simply because price discrimination exists to a much less extent. In the empirical part of the paper, using unique school-level data of Korea colleges and universities, the paper shows that tertiary education sector of Korea is highly hierarchical where public and private institutions compete. The evidence provided, figures and regression results, are quite intriguing. The paper also discusses policy implications of their model and empirical findings.

The paper is insightful and creative in that it expands “hierarchical model” to situation of Korea and finds supporting evidence using a unique data and solid methodology. As a commentator, I would like to make several comments.

First, the model part of the paper is not a formal model, but a careful discussion. Developing a model with the various factors reflecting the real situation in the paper may be worth pursuing. Especially, differential cost structure of university and reputation effect are critical modification of the ER model.

Second, the argument that public university will be at the top of the hierarchy in the expanded model is not clear to me. Is this due to reputation effect of public universities? A more detailed discussion about derivation of key propositions would help readers how assumptions and positions are connected.

Third, the paper might need to discuss the demand side of tertiary education as well as the supply side. Currently, the paper seems to focus on the supply side of higher education. Is it possible that specific type of demand for higher education increases as a society develops? Discussion on the demand side would enrich the paper.

Fourth, the paper indicates that students in public institutions enjoy substantial amount of subsidy in the form of lower tuition. Do the tuition variable include extra payment called *Gisunghyebi*? It is argued that *Gisunghyebi* of public universities is as large as that of private universities, and in the total there are only 20-30% difference in the total tuition between public and private universities. I think that there has been a large amount of public fund from various government ministries flowing into public universities.

Fifth, specification used in the regression seems somewhat arbitrary. If I am not mistaken, “Subsidy”, treated as an endogenous variable, is identified by “Public” dummy. Why does “History” affect the cost, but not subsidy? Which variable is used as IV for “Score”? More discussion about the specification would help readers.

Sixth, I am interested in regression results with log of current dependent variables. It is common to use log value of amount of cost, subsidy, and etc. Taking log may makes two outliers excluded in the current sample be more comparable to other observations.

Seventh, the paper reports that two-year private colleges have substantial additional expenditure than four-year private universities. This is quite contrary to what I assume. The coefficients of dummy of two-year private colleges across three equations, expenditure, subsidy, and cost, seem inconsistent. Data and model specification need to be checked.

Lastly, one important policy implication of "hierarchical model", which is not discussed in the paper, is that the government should provide subsidy to well-performing poor students. Hierarchical model predicts sorting of student and universities, which result in an inefficient allocation when there exist well-performing poor student who cannot afford high tuition of better universities. As pointed out in the paper, government subsidy to public universities might be inequitable. The equity goal can be more directly and effectively by need-based direct subsidy to students.

Private Tutoring As Rent Seeking and Effects of Some Measures to Curb It

by
Yoon-Ha Yoo

Abstract

Tuition control in the education market necessarily creates excess demand. The educational goods then must be rationed out through non-price competition. One non-price selection device commonly adopted is the admission test. Parents and students pour their resources in competition to win the prize, the admission ticket. In this paper, we build a simple choice-theoretic model to analyze how much would be spent for this kind of rent-seeking activity and how the aggregate amount would respond to various measures to discourage it. We show that many seemingly plausible measures will not generate the desired effects.

JEL classification: I2, D72

Key words: private tutoring, rent-seeking, rationing, contest

Private Tutoring as Rent Seeking and Effects of Some Measures to Curb It.

1. Introduction

For various reasons, tuition controls are practiced in many higher educational markets, both in advanced as well as underdeveloped countries, with one conspicuous reason being making the opportunity for higher education available to as many students as possible, especially those from poor families. Whatever the reasons might be, however, the economic effects of the tuition control are similar almost everywhere and every time.

First, a large part of the actual benefit does not accrue to poor families but to middle or high income families because a larger portion of college students are in fact coming from relatively rich families. Second, it almost always creates an excess demand in those markets. The number of students who are seeking opportunities for advanced study is in excess of the supply where prices are regulated below the market clearing level. The school authority, constrained not to raise the tuition to clear the market, therefore, has to adopt a certain kind of rationing device in allocating the limited slots to a large number of contending students. Administering various

forms of admission tests is the most conventional way of selecting the students.¹ Students then compete to get higher marks in the tests, and thereby increase their chances of getting admitted.

Obtaining an admission in the situation is just like winning a prize in a contest. If one student succeeds in getting in, he can enjoy a windfall gain and so he becomes a prize winner. If he fails, he is just a loser in the contest. The prize, the gap between his demand price and the controlled price, therefore, drives students and their parents to compete in various ways; they may study or practice harder at home, attend private educational institutions, hire private tutors. Some may even attempt illegal activities such as forging application documents, bribing the person in charge to get tips on test questions or fabricate the results. In short, they will do whatever will help to raise the chances of their being admitted.

In a way, self-study and/or private tutoring are complementary to school education, and are sometimes needed for their own. But in many countries, the highly selective admission procedure induced by the tuition control and resulting competitive frenzy are creating various social problems with them; financial burdens for the families are substantial and the stress imposed on the students are by no means trivial. In Korea, the issue of "excessive" private tutoring has been chronic social headache since early 1960s, and the government has tried various policy measures to abate the pressures.² Japan, with its exceptionally tight educational system and fierce competition among students has also been known to have grappled with similar problems for many years. France has its own long history in this matters, and modern China is not an exception.³ According to a recent report (Bray, 1999), private tutoring is prevalent in many more countries, such as Sri Lanka, Malta, Egypt, Thailand, Mauritius, Hong Kong, Morocco, Tanzania, Zimbabwe and Taiwan.

The main purpose of this paper is to build a simple model in which the above mentioned private tutoring activities in educational markets can be examined. The private tutoring is seen in this paper as one of the rent seeking activities in the educational market under tuition control. Parents and students compete for grabbing the rent artificially created by the tuition control.

Existing literature abounds which deals with rent seeking activities of this kind; contest models in a public choice theory and tournament models in labor economics are only a few among many.⁴ What is newly attempted in the paper is to develop a model with a continuum of players in the hope that it may generate richer implications and a handy tool for comparative statics analysis. With few exceptions, most existing literatures in this area limit themselves to the cases where there are only two contestants. And because of this modelling rigidity, some interesting issues are not fully developed.

In a pair-wise competition model, if one wins, the other necessarily loses. In a model of continuum of players, the number of winners and losers can be freely controlled. This fits more

¹ Even in the absence of excess demand, schools may still administer tests to sort out different student abilities. Because of the peer effects, securing a relatively homogeneous group as a single educating unit is more effective and less costly. Rothschild and White (1995) and Stiglitz and Weiss(1981).

² See Adams and Gottlieb(1993), Park(2000), and Korean Ministry of Education(1998).

³ For some illustrative stories of these countries, see Little and Wolf(1996), Dore(1997).

⁴ For contest and tournament models, see Lazear and Rosen(1981), Nalebuff and Stiglitz(1983), McLaughlin(1988), and Nitzan(1994). In many cases, the tournament models are not directly concerned with rent seeking activities. They are more concerned with the problem of eliciting optimum amount of productive efforts by setting up an incentive payment system. A slight modification and reinterpretation, however, will allow it to be transformed into a contest model most of which directly aims to explain rent seeking activities.

squarely with the situation described above where a large number of contestants compete to get the coveted items and multiple winners are selected.⁵

Selecting a small number of winners out of a large number of contestants requires a kind of formal or informal criterion according to which the selection is made. Selection criterion can be either a standard or a quota. In a standard system, the ones whose qualification are determined to lie above the pre-set value will be chosen, whereas in a quota system, those whose relative ranks are equal to or higher than the pre-set number will be chosen. Depending on which system is used, the incentives faced by the contestants become different. Continuous agent model allows us to develop a model which can consistently handle these two distinctive selection criteria in a coherent way.

Since private tutoring as a rent seeking is inherently unproductive and wasteful from social standpoint, governments in many countries have implemented various policy measures to stem or reduce it, ranging from an outright ban of private tutoring (in China and Korea) to designing a new, more elaborate test format that will help select qualified students while allaying the cost of tutoring. We examine the effectiveness of some of those anti-private-tutoring measures.

One noble finding is that the effectiveness of policy measures to suppress the rent seeking is in many cases indeterminate, and crucially depends on the current degree of competitiveness in the market. For example, if the current competition to get in college is highly competitive, making it easier to get admission either by lowering the cut-off score or increasing the quota does *not* reduce the aggregate amount of private tutoring. Instead, one should make it even harder to discourage private tutoring. In short, under quite general and plausible environments, there is no simple linear relationship between the degree of competitiveness and the aggregate amount of rent seeking, which is somewhat counter-intuitive on first impression.

Devising a test procedure which will render the private tutoring to be less reliable means to improve the score is not a good way to curb the private tutoring, either. Increasing the random elements in the test will have differential impact on students' chances of winning, depending on where their expected scores are located. As a result, the average quality of students admitted under this system will deteriorate. Furthermore, the total amount of private tutoring aggregated over the whole population varies differently, depending again on the current state of competitiveness in the college admission.

Under the quota system, things get further complicated because a fixed quota necessarily introduces negative externalities among students. At the margin, one student's admission necessitates one other student's rejection. When there is a policy shift, therefore, some students will gain, and others will get hurt. In certain cases, schools may end up with undesirable outcomes, in the sense that students with stronger aspiration for study, and thus, higher value on education may suffer from diminished odds for admission, while students with lower value enjoy increased chances.

Although the paper is mainly concerned with the private tutoring problem in the educational market, the model developed here can be applied, with little change, to a great variety of markets under price control. The divergence between the demand price and the regulated price is unavoidable consequence of the price control of any type. Thus, we face

⁵ A tournament model with multiple contestants has been developed formally in Green and Strockey(1983) and touched briefly in Nalebuff and Stiglitz(1983) and O'keeffe, Viscusi and Zeckhauser(1984). All are, however, mainly concerned with the optimum payment scheme rather than rent seeking.

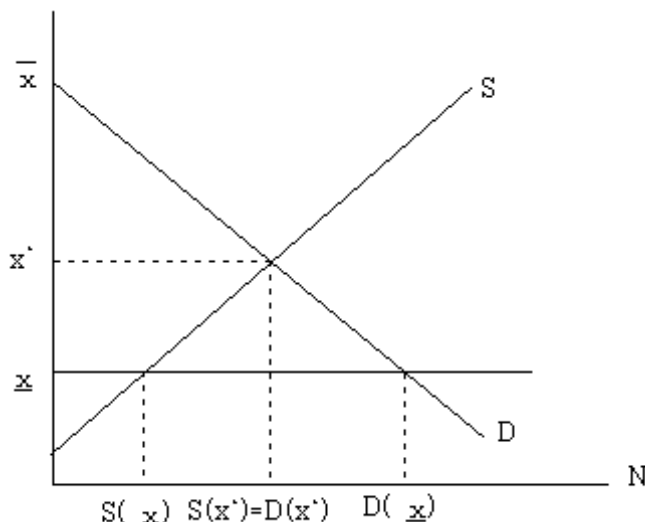
exploitable rents in these markets. Competition to get the goods in question is then just a rent seeking. The selection process may not be as formal as in education market, but there still exist various forms of selection criterion, implicit or explicit, and people will make investment in those activities which they conceive will enhance their chances of meeting the criterion. And various anti-rent-seeking measures may be introduced in those markets.

The organization of the paper is as follows. In the next section, I set up a basic model in which a private tutoring as a rent seeking is analyzed in a setting of a pre-set quality standard. The effects of various policy measures to suppress the private tutoring are discussed. In Section 3, the model is expanded to cover the cases where admission quota is fixed. The effects of policy measures are again taken up in this expanded setting. Conclusions are in Section 5.

2. Basic Model

Let's consider a college education market. The demand is given as $D(X)$, and the supply as $S(X)$, where X stands for the tuition that a student has to pay. As usual, the demand schedule is assumed to be downward sloping and the supply schedule upward sloping, $D'(X) < 0$ and $S'(X) > 0$. The maximum value of x , the intercept of demand curve with the vertical axis, is assumed to be \bar{x} .

Figure 1. Tuition Control



If there is no regulation on tuition in the college education market, the equilibrium tuition will be determined at x^* , and the market will be cleared. If the government imposes a ceiling on the level of tuition below x^* , the market will be in disequilibrium. Let's assume the tuition ceiling is set at x ($x < x^*$). Students whose personal valuation on education is greater than x will

want to get in the college and are willing to spend on something which can help increase his chance for getting admitted to college. Once he is admitted to school, the surplus he can enjoy is, therefore, given by $X - \underline{x}$. The total number of students who is willing to participate this selection contest is given $D(\underline{x})$ which is obviously greater than $D(x^*)$. Under the regulated scheme, the supply of educational service is constrained to be $S(\underline{x})$ ($< S(x^*)$). Then, the admission rate, which is the inverse of the competition rate, is given by $\phi(\underline{x}) = S(\underline{x}) / D(\underline{x})$.

I start with a simplest model, and then will try to zero in step by step by adding more constraints until it would appear to fit the general picture described above.⁶ Let's start with a simple contest model in which the contestants have varying valuations for the objects that they are competing for.⁷ It is assumed that the valuations of the prize, X , ($X \geq 0$) which is distributed in the range of $[\underline{x}, \bar{x}]$, has the density function, $H(x)$, and cumulative distribution function,

$H(X)$. Therefore, $D(X) = \int_{\underline{x}}^x h(s)ds = H(x)$.

There will be an admission test to select the qualified students. Students will put forth effort, denoted as e , to obtain high scores in the test. The effort can be anything which can improve his odds of winning the prize, so it will depend on the characteristics of the test adopted. More specifically, the effort in this paper is interpreted to represent the amount of private tutoring a student purchases outside of regular schools. It is assumed that the tutoring has no intrinsic value or productivity in itself other than improving his score in the admission test. In this regard, the student can be said to be engaged in rent seeking, the rent associated with the college admission. The student will spend valuable resources to grab the rent as much as he deem worthwhile.

The test score will be distributed as

$$T = e + \epsilon, \quad \epsilon > 0. \quad (1)$$

The noise term, ϵ , has a mean 0, and variance σ^2 , and has density function f , and cumulative distribution function F . It is assumed that f is symmetric around 0, and $f' > 0$ when $\epsilon < 0$ and $f' < 0$ when $\epsilon > 0$. Given e , an individual student's expected test score is e , i.e., $E(T) = e$.

Taking effort or purchasing private tutoring is costly, and the cost function is given by $c(e)$, $c'(e) > 0$, where c' is a parameter affecting the marginal cost of private tutoring. About the general shape of the cost function, it is assumed that

$$c' > 0, \quad c'' > 0, \quad c'(0) = 0. \quad (2)$$

⁶ The model developed below is quite similar to Kim(2000) although there are several differences. Kim considers the problem of optimum test design assuming that students have different intrinsic ability. His main concern was to design a test structure which can select the most able people to assign to two different tasks so that total social welfare is maximized. He doesn't relate his model with the issue of tuition control. In this paper, in contrast, the contestants differ not in their ability but in their valuations of the prize they will get when they become winners. And the individual gains are directly affected by tuition control. Furthermore, the tuition control has also an effect on the number of people who are willing to participate in the selection contest, and on the number of people who will be selected for the prize.

⁷ According to O'keeffe, Viscusi and Zeckhauser(1984)'s terminology, the model described here is an "uneven" but "fair" contest.

Students whose score is greater than the cut-off level, t^* , will be admitted. Later, this cut-off score will be determined endogenously in such a way that it would be compatible with a given number of students who will be admitted. In the meantime, the cut-off score is assumed to be fixed. It should be noted at this juncture, however, that the fixity of the cut-off score is just a matter of degree. Even when the total number of admissions is strictly controlled by the relevant authority, schools occasionally apply a kind of implicit quality standard to maintain the overall quality of the students, sometimes even risking the possibility of having unoccupied slots in the school, especially when the overall quality of the applicants turns out to be poor. In this sense, the assumption of fixed cut-off score has still some practical relevance.

Given the cut-off level of score, t^* , the probability of being admitted is given as

$$\begin{aligned}
 \Pr ob(T > t^*) &= \Pr ob(\alpha e + \varepsilon > t^*) \\
 &= \Pr ob(\varepsilon > t^* - \alpha e) \\
 &= 1 - F(t^* - \alpha e) \\
 &= F(\alpha e - t^*)
 \end{aligned} \tag{3}$$

The last equality comes from the assumption of symmetry of F which assures the relationship, $1-F(z)=F(-z)$. This transformation allows us more intuitive and straightforward interpretation of some of the results below. Under this transformation, F has the meaning of probability of success which is increasing in effort level, e , and f the marginal probability of success.

The student's optimization problem is then

$$Max_e X F(\alpha e - t^*) - \beta c(e). \tag{4}$$

The FOC is

$$\begin{aligned}
 Xf(\alpha e - t^*) \alpha - \beta c'(e) &= 0 \text{ for } e > 0, \\
 Xf(\alpha e - t^*) \alpha - \beta c'(e) &\leq 0 \text{ for } e = 0.
 \end{aligned} \tag{5}$$

The FOC simply says that the marginal gain from an additional tutoring must be equated with its marginal cost for interior solution. Otherwise, the equilibrium effort will be set at 0.

The corresponding SOC is

$$Xf'(\alpha e - t^*) \alpha^2 - \beta c''(e) = \mu < 0 \tag{6}$$

Since $f' > 0$ when $x < 0$, the SOC may not hold with an arbitrary density function, especially when the distribution is highly concentrated and/or the marginal cost function is quite flat. In the following, it is assumed that the variance of the distribution, σ^2 , is sufficiently large, and/or the marginal cost function is sufficiently steep so that the SOC is always satisfied.⁸

From the FOC, we can solve for the optimum amount of private efforts as a function of parameters of the model,

$$e^* = e^*(X, t^*, \alpha, \beta, \sigma), \quad (7)$$

and perform the comparative statics with respect to each parameter. Since we are assuming that private tutoring is a unproductive rent seeking activity, we will use the following social welfare function which should be maximized as much as possible in evaluating the efficacy of various policy measures to curb the private tutoring.

$$W(t^*, \alpha, \beta, \sigma) = \int_{\underline{x}}^{\bar{x}} \beta \quad c[e^*(t^*, \alpha, \beta, \sigma)] dH(X) \quad (8)$$

The Effects of Varying Valuations Among Individuals

Differentiating the FOC with respect to X and rearranging the terms yields,

$$\frac{\partial e^*}{\partial X} = \frac{-f\alpha}{\mu} > 0 \quad (9)$$

The denominator is negative from the SOC, and since $f > 0$ everywhere, the whole expression is positive. In other words, a student who puts a higher value on education will purchase more tutoring to improve the test score⁹. If $c'(0) > 0$, some students who are located near the lower end of the distribution, x , may choose 0 effort and thus drop out of the contest. In order to ensure that every student with a positive surplus value participate in the game and exert a certain positive amount of effort, I have imposed the constraint, $c'(0) = 0$, in (2) above.

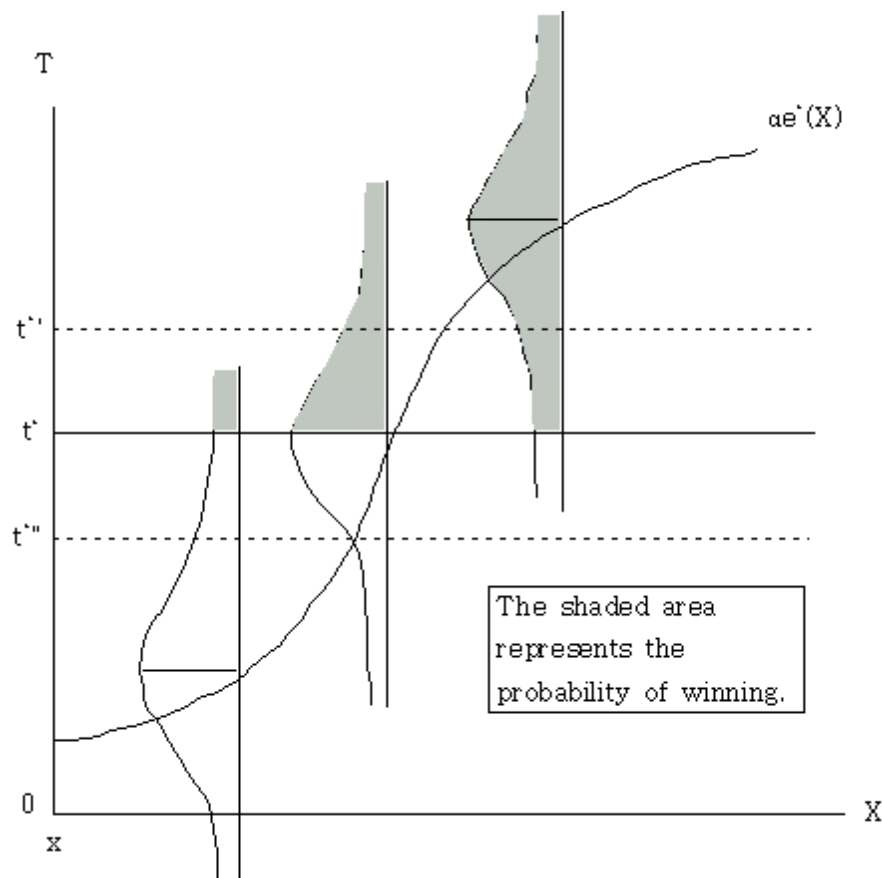
One interesting thing is that for a student with a given X , his equilibrium effort level is at its highest when he is near the cut-off score. This comes from the fact that f is symmetric around 0 and has the largest value at $x = 0$. The student whose expected score is far below the cut-off point does not work hard because his marginal gain from the incremental effort is expected to be small. By the similar logic, the student whose expected score is way above the cut-off point

⁸ The possibility that the SOC condition may not be met appears in most of the tournament models. See Lazear and Rosen(1981), Nalebuff and Stiglitz(1983) and McLaughlin(1988).

⁹ This accords with the general results in tournament models that the equilibrium effort is increasing in the prize spread between the winning and losing prize. In the current model, the loser gets 0 payoff.

does not work hard, either, because his chance of being admitted is not affected that much by his additional effort.

Figure 2. The Relationship Between Test Scores and Values



A diagram is helpful for understanding the relationship explained above. Note that $f' > 0$ when $ae^*(X) < t^*$, and $f' < 0$ when $ae^*(X) > t^*$. Consequently, the value of $f(ae^*(X) - t^*)$ increases monotonically when $ae^*(X) < t^*$, and reaches peak at $ae^*(X) = t^*$, and then decreases when $ae^*(X) > t^*$. The slope of the function $e^* = e^*(X)$ should, therefore, increase up until ae^* reaches t^* and then decrease beyond that point, yielding a S shaped curve like in <Figure 2>. Note also that as t^* moves upward (to t^{*1} in the <Figure 2>), more students fall into the range in which each student's f at his $ae^* - t^*$ takes a positive value. If t^* moves downward (to t^{*2} in the <Figure 2>), the opposite result occurs.

With the result, it is easy to show that the student with a higher value on education will have a higher probability of being selected. By differentiating $F(ae^* - t^*)$, the winning odds, with respect to X , we obtain the following.

$$\begin{aligned}\frac{\partial F}{\partial X} &= fa \frac{\partial e^*}{\partial X} \\ &= -\frac{f^2 \alpha^2}{\mu} > 0\end{aligned}\tag{10}$$

The fact that the student who has a higher value on college education will exert more effort guarantees the whole expression above to be positive, implying students with greater values on education will have higher probability of getting admitted. The selection process is, therefore, conducive to social efficiency in the sense that the opportunities for higher education are allocated to those who attach relatively higher values on education.

Changing the Cut-Off Score of the Test

The effect of changing the cut-off level of the test score on the effort level can be obtained in a similar way. By differentiating the FOC with respect to t^* , we have

$$\frac{\partial e^*}{\partial t^*} = \frac{Xf'\alpha}{\mu}\tag{11}$$

The direction of change in the above expression depends on the sign of f' . It is positive when $f' < 0$, that is, when $\alpha e^*(X) > t^*$. The students whose expected scores are higher than the cut-off point will work harder because their stakes are now threatened by the increased cut-off point, and their marginal returns to efforts are made higher. The direction of change is negative when $f' > 0$, in other words, when $\alpha e^*(X) < t^*$. It implies that the students whose expected test scores are below the cut-off point will decrease their effort level in response to the increased cut-off point. They will take more relaxed attitude because their chances of being admitted have gone farther away by the upward movement of the cut-off point. For them, additional efforts are no longer worth as much as they used to be. (see <Figure 2>.)

Even though each student is making adjustment in different directions depending on his own relative location in the distribution, the odds of success will invariably decrease for every student by the hike of cut-off point. Differentiation of $F(\alpha e^* - t^*)$ with respect to t^* yields¹⁰,

¹⁰ We use the notation dF/dt^* to distinguish it from the direct effect, $\partial F / \partial t^*$, which is just $-f$, even though there are still some other parameters held constant. In the following the same rule about the notation on derivatives will be applied; whenever the effect of a parameter change is evaluated in such a way that it contains not only the direct effect but also the indirect effect via the endogenous variables of the model, it is denoted as total derivatives, despite the fact there remain some fixed parameters. Needless to say it is a bit confusing. But there appears to be no other good alternatives since we do not have yet a good notation for partial total derivatives.

$$\begin{aligned} \frac{dF(\alpha e^* - t^*)}{dt^*} &= f(\alpha \frac{\partial e^*}{\partial t^*} - 1) \\ &= \frac{f\beta c''}{\mu} < 0 \end{aligned} \quad (12)$$

For an obvious reason, the student who has chosen to work less in response to the increased cut-off point will have a smaller chance of being admitted. The student who has chosen to work harder will not be able to improve his/her odds, either, because he/she cannot fully recover the loss of odds due to the cut-off increase by working harder. Surely, as he/she works harder, his/her score will improve, but not as much as the whole amount of the change in the cut-off point. As a result, part of the gap between his/her expected score and the cut-off point, $\alpha e^* - t^*$, will remain shrunk. This will lower his/her winning probability, F , too. The reason why he/she cannot fully recover the gap between his/her expected score and the cut-off point is that he/she has already taken large enough effort (Note that he/she is the one whose expected score exceeds the cut-off score.) and increasing his/her effort further entails a cumulative cost increase.

One important implication of the above result is that the total number of students who will be admitted will invariably decrease when the cut-off point is raised, and will increase when the cut-off score is lowered, regardless whether students work harder or not following the hike or cut.

There is one more implication which is equally important. In aggregate, if the test is highly competitive in the sense that the cut-off score is set at so high a level that only those students with very high X 's can pass, most students will fall in the range of $f' > 0$ ¹¹. In this case, making the examination more difficult by raising the cut-off score will have an effect of discouraging a larger number of students and making all of them work less. (see <Figure 2>). On the other hand, making an easy test a bit more difficult-- easy in the sense that the cut-off point is set at a low level so that a large number of student can pass the exam -- will make a large number of students, who used to be above the cut-off line, become alert and push them to work harder.

In short, making a hard test harder will make many students discouraged and work less. Whereas, making an easy test harder will induce many students to work more. This implies that if the policy objective is to minimize the rent seeking activities, it would be desirable to make a hard test harder, or an easy test easier because it can thereby reduce the aggregate amount of rent seeking activity of the whole population. Making a hard test easier or an easy test harder will aggravate the situation by increasing the aggregate volume of rent seeking expenditures.

Still in other words, an effective way of reducing the aggregate expenditures on rent seeking is to push the cut-off point toward either the upper or lower extreme end. It will make most of the students either discouraged or relaxed, and thereby the additional efforts unworthy. On the other hand, moving the cut-off score toward the mid-point will make most of the people either newly alerted or revived, and the additional rent seeking will appear more attractive.

More formally, differentiating the social objective function (8) with respect to t^* gives,

¹¹ In the extreme, if we set the cut-off score at a very high level, say at $\alpha e^*(\bar{X})$ so that the student with the highest value, \bar{X} , can have 50% chance of winning, then everybody else will have $f' > 0$.

$$\frac{dW}{dt^*} = \int_{\underline{x}}^{\bar{x}} \beta^c \frac{\partial e^*}{\partial t^*} dH(X) \quad (13)$$

Therefore, the sign depends on the sign of $\partial e^* / \partial t^*$, which in turn depends on the location of t^* . If it is located near the upper end of the score distribution, then in a wide of range of X , the partial derivative inside of the integral will take negative value, rendering the sign of the whole expression to be negative. If the cut-off point is located near the lower end, the opposite conclusion would ensue¹².

Reducing the Effectiveness of the Private Tutoring on Test Scores

Another measure that may be contemplated by the public authority which intends to discourage the private tutoring is to design the test format in such a way that private tutoring becomes less effective in raising the test scores¹³. The effect can be analyzed simply making the size of μ smaller in our model.

Differentiating the FOC with respect to a and rearranging gives,

$$\frac{\partial e^*}{\partial a} = \frac{-Xf}{\mu} + \frac{-Xf'ae^*}{\mu} \quad (14)$$

The first term is positive and the sign of the second term depends on the sign of f' . The first term captures the pure effect of increasing the marginal product to effort, μ , on the marginal revenue, holding the marginal probability of winning constant. One unit increase in a pushes up the marginal revenue by Xf . This enhanced marginal returns to effort then induces everybody to increase his effort.

The second term captures the effects of an increase in a that works through the change in marginal probability of winning. As the expected score gets higher due to an increase in a , the marginal probability of winning is affected differently depending on where he is located. For a student whose expected score is below the cut-off line, $ae^*(X) < t^*$, a higher score moves him closer to the cut-off line, and it raises his marginal probability of winning. Consequently, the student works harder. In the above expression, it means $f' > 0$, which makes the second term positive, thereby rendering the whole expression to be positive. In short, those students whose

¹² For example, in Korea, the college entrance examination has been highly competitive, with the competition ratio standing somewhere around 3:1 to 4:1. In this situation, making the exam easy is likely to bring forth the opposite effects to what the Korean government is intending for. That is, it will further encourage the private tutoring activities among students, especially those who otherwise would have given up in some sense. With a given number of college applicants, making the test easier by lowering the cut-off score necessarily results in an increase in the total number of college admissions. In this regard, the above result implies that increasing the college admissions will not have an effect of reducing the private tutoring as long as the current competition rate remains higher than 2:1.

¹³ A high ranking Korean government official was reported to have made the remark that, in the coming years, the test will be designed in such a way that having private tutoring will turn out to be totally worthless.

expected scores fall short of the cut-off point (who put relatively lower value on college education) will study harder as the returns to study get higher.

Those students whose expected scores are already higher than the cut-off line, $ae^*(X) > t^*$, however, work less as far as the effect of the second term is concerned when the marginal returns to effort gets higher. For them, a higher expected score moves their whole test score distribution upward, pushing further away from the cut-off point and this makes the marginal gain in their success probability smaller, that is, $f' < 0$. As a consequence, the second term becomes negative for them.

The overall effect is then the sum of these two effects. Since it is impossible to proceed further with an arbitrary density function, I will assume a normal distribution and show that those who have extremely high expected score will in fact reduce their effort. With a normal density and letting $y = ae^* - t^*$, we have

$$\begin{aligned} f'(y) &= \frac{1}{\sqrt{2\pi}\sigma} \exp\left[-\frac{y^2}{2\sigma^2}\right] \left(-\frac{y}{\sigma^2}\right) \\ &= \left(-\frac{y}{\sigma^2}\right)f \end{aligned} \quad (15)$$

The combined effect will be negative only when $-Xf - Xf'ae^* = -X[f + f'ae^*] > 0$, alternatively, when $f + f'ae^* < 0$. Substituting and solving gives

$$f + f'ae^* = f\left[1 - \frac{yae^*}{\sigma^2}\right] < 0 \quad (16)$$

Solving this for ae^* , we obtain,

$$ae^* > \frac{t^*}{2} + \frac{\sqrt{t^{*2} + \sigma^2}}{2} \quad (17)$$

Those students whose expected scores are higher than the value in the right hand side of the above inequality, therefore, work less when the returns to private tutoring get's higher.

Although some students with high enough scores choose to reduce their effort level, their odds to win the prize do not decrease. In fact, every student's odds, regardless of his/her initial score, will improve as a result of this increased returns to efforts. Differentiating $F(ae^* - t^*)$ with respect to μ , we have

$$\begin{aligned} \frac{dF}{d\alpha} &= f(e^* + \alpha \frac{\partial e^*}{\partial \alpha}) \\ &= \frac{-f\beta(c''e^* + c')}{\mu} > 0 \end{aligned} \quad (18)$$

Thus the odds improves for every student. The reason why the odds improves even for those students whose effort levels were lowered is that the increased marginal returns to per unit of effort. The above results imply that an examination test which would cripple the marginal returns to private tutoring would be in general effective in reducing the expenditures on private tutoring.

Increasing the Noise of the Test

Still another conceivable measure to abate the incentive for the private tutoring might be to construct a test such that the test score should be relatively unpredictable. If private tutoring is unreliable means to improve the test scores, people will, on first impression, make less investment in tutoring. But this intuition does not bear scrutiny.

Upon differentiation of the FOC with respect to σ , we obtain the following equation,

$$\frac{\partial e^*}{\partial \sigma} = \frac{-\alpha X f_{\sigma}}{\mu}, \quad \text{where} \quad f_{\sigma} = \frac{\partial f}{\partial \sigma} \quad (19)$$

Therefore, the overall sign depends on the sign of f_{σ} . Again by resorting to the assumption of normality, we have,

$$f_{\sigma}(y) = \frac{y^2 - \sigma^2}{\sigma^3} f(y) \quad (20)$$

Plugging it into (19) yields,

$$\frac{\partial e^*}{\partial \sigma} = \frac{-\alpha X f}{\mu} \left(\frac{y^2 - \sigma^2}{\sigma^3} \right), \quad (21)$$

implying that the sign of the change depends on the relative size of y^2 and σ^2 ; it is negative in the range of $t^- < \alpha e^* < t^+$, and positive outside of the range. This suggests that the students whose expected scores are in the middle range around the cut-off point will decrease their efforts whereas the students who are located near the both tails of the distribution will increase their efforts.

This result is quite intuitive if we look at the changes made in the shape of the density function by the increased dispersion. Augmenting the variance decreases the density in the middle range and makes the tails of both ends fatter. Or, to put the same story in a slightly different way, the students in the upper tail work harder to guard against the possibility that their chances will be marred by the increased randomness of the test outcomes. The students in the lower tail also work harder but for a slightly different reason. They get into the bet in an anticipation that they may get admitted, this time just by sheer chance.

The winning odds for each student moves in a bit complicated way. For some students, the odds improve as a result of the increased dispersion, and for some others, they deteriorate. And

still for some others, the signs of changes are indeterminate. To see this, let us take a differentiation of F with respect to σ . The result is,

$$\left. \frac{dF}{d\sigma} \right|_{t^*=exog} = F_{\sigma} + f\alpha \frac{\partial e^*}{\partial \sigma} \quad (22)$$

where $F_{\sigma} = \partial F / \partial \sigma$. The first term captures the pure effect of the σ change on winning odds, holding the effort level constant, and the second term the effect of the effort level change due to the increased noises in the test.

Let's take the second term first. It is easy to interpret because it contains the expression, $\partial e^* / \partial \sigma$, whose sign is indeterminate as seen above. The sign of the first term also depends on the location of student's expected score, but this time relative to the cut-off point itself, t^* . For any density function which has a unimodal and symmetric around the zero mean, as assumed at the outset, when $t^* < 0$, and when $t^* > 0$, and $F_{\sigma} < 0$ when $\varepsilon > 0$. In the current setting, therefore, the first term is positive for those students whose expected score is below the cut-off score, and negative for those students whose score is above the cut-off score.

Combining these two effects to get the overall picture about the effects on the winning odds of increased noises gives the following diagram, <Figure 3> below. The dark colored range represents where the winning odd effects are negative, and the white positive. As shown in the diagram, the odds improves for those students who are located near both the lower and higher ends of the distribution, and those in the middle range suffer. Since the demarcation lines are skewed to the right of t^* , the average quality of the student body will deteriorate as a result of the increased variance of the test.

Figure 3. Overall Effect of Variance Change on Winning Odds



Increasing the Cost of Private Tutoring

Finally, still another measure that can be employed for the purpose of reducing the private tutoring is to make private tutoring more costly to take¹⁴. In the present model, increasing the cost means to raise the value of c .

Differentiation of the FOC with respect to c renders the following expression.

¹⁴ Legally banning the private tutoring altogether is certainly one option, which can be interpreted as making the cost prohibitively high.

$$\frac{\partial e^*}{\partial \beta} = \frac{c'}{\mu} < 0, \quad (23)$$

which invariably insures that the efforts will decrease in response to the increased cost. Whether this will reduce the aggregate social cost of private tutoring, however, is uncertain because the per-unit marginal cost of tutoring has been increased even though the total amount of private tutoring is clearly decreased. Differentiating the social objective function, (8) with respect to β , gives,

$$\frac{dW}{d\beta} = \int_{\underline{x}}^{\bar{x}} \left[c + \beta c' \frac{\partial e^*}{\partial \beta} \right] dH(X) \quad (24)$$

The second term inside the integral is negative from the above, but the first term is positive, and therefore, the net result is indeterminate¹⁵.

As every student cuts down his/her effort level in response to the increased cost, the winning odds decreases for every student, for a trivial reason.

$$\frac{dF}{d\beta} = f\alpha \frac{\partial e^*}{\partial \beta} = \frac{f\alpha c'}{\mu} < 0 \quad (25)$$

3. Rent Seeking Under Quota System

So far, I have assumed that the cut-off score, t^* , is exogenously given. So the model described above pertains to the cases where there are some kinds of pre-set standards for passing. There is a variety of tests which fit this category; most certificates or licenses are issued only those who pass the minimum quality standard, and some government administrative and judiciary officials are selected in this way.

There are, however, other tests where the total number of winners, not the cut-off score, is pre-set. In this system, therefore, whatever the distribution of scores may be, the selection criterion is not the absolute individual score but his relative ranking, and those people whose rank is above the pre-set number will be selected. We can call the former as the "Quality Standard System" and the latter as the "Quota System". In most cases, student selection for admission is administered by the quota system described above, the more so in the case that the total number of admission tickets is controlled by education authority, as is done in many underdeveloped countries. In the following I try to incorporate this new mode of selection method into the model and analyze its implications.

¹⁵ Apparently, it depends on the elasticity of the total cost with respect to β . Rewriting the inside of the integral of equation(25) gives $c[1 + (\beta/c)(dc/d\beta)] = c[1 + \eta_{c\beta}]$ where $\eta_{c\beta}$ is the elasticity of the cost with respect to β .

Basically, the model is the same as before except that we need one additional constraint that assures that the cut-off score now has to be set at the level that would be compatible with the pre-set quota. The system works like the following. Initially, ex ante, students form expectations about the cut-off score that will be chosen by the test authority given the fixed number restriction, n . And, on the basis of this expected cut-off score, they choose their optimum level of efforts, i.e. the amount of their tutoring purchase. Then the ex post cut-off score will be determined by the school authority at the level of the n^{th} highest score. In the final equilibrium, students' expectations are realized in the sense that the ex ante expected cut-off score is equal to the ex post cut-off level chosen by the school authority.

More formally, from the FOC and equation (7), we can see that for a student with value X , the probability that his score falls short of an arbitrary level of score, t , is given as

$$\begin{aligned} \text{Prob} [\alpha e^*(t^*, X, \dots) + \varepsilon < t] &= \text{Prob} [\varepsilon < t - \alpha e^*(t^*, X, \dots)] \\ &= F[(t - \alpha e^*(t^*, X, \dots))] \\ &= 1 - F[\alpha e^*(t^*, X, \dots) - t] \end{aligned} \quad (26)$$

By taking the weighted average of this individual distribution of test score over X , we can get ex ante population distribution of test score, $G(t)$.

$$G(t) = 1 - \int_{\underline{x}}^{\bar{x}} F[\alpha e^*(t^*, X, \dots) - t] dH(X) \quad (27)$$

In equilibrium, the fraction with t greater than t^* in $G(t)$ must be equal to the admission rate, ϕ , where $\phi = n/N$, with N denoting the total number of applicants¹⁶. Alternatively, $1 - G(t^*) = \phi$ or simply, $\phi = \int F dH(X)$ must hold.

Under this reformulation, the whole system is now represented by the following two equations with two endogenous variables, e^* and t^* .

$$\begin{aligned} 1) \quad & X f[\alpha e^* - t^*] \alpha - \beta_c(e^*) = 0, \\ 2) \quad & \phi = \int_{\underline{x}}^{\bar{x}} F[\alpha e^* - t^*] dH(X) \end{aligned} \quad (28)$$

¹⁶ In a strict sense, fixed number system is different from fixed ratio system, especially when the total number of applicants varies every time. In this section, I am assuming the total number of applicants is fixed. Therefore, both are the same.

The equation 1) is just the replication of the FOC given in (5) in the previous section¹⁷. The equation 2) is the rational expectation perfect foresight condition.

Now that we have set the stage for this expanded model, we can proceed to examine some of the effects of policy changes as we have done in the previous section.

Increasing the Admission Ratio

First, let's take a look at the effects of changing ϕ , the new parameter which represents the admission rate, on t^* and e^* . Differentiating equations 1) and 2) in (29) with respect to ϕ generates the following.

$$X f' \alpha \left(\alpha \frac{de^*}{d\phi} - \frac{dt^*}{d\phi} \right) - \beta c'' \frac{de^*}{d\phi} = 0 \quad (29)$$

$$\int_{\underline{x}}^{\bar{x}} f \left(\alpha \frac{de^*}{d\phi} - \frac{dt^*}{d\phi} \right) dH(X) = 1 \quad (30)$$

Solving (29) for generates,

$$\frac{de^*}{d\phi} = \frac{X f' \alpha}{\mu} \frac{dt^*}{d\phi} \quad (31)$$

Note that the coefficient of $dt^* / d\phi$ above is just the same as $\partial e^* / \partial t^*$ given in (11). Therefore, the following result holds,

$$\frac{de^*}{d\phi} = \frac{\partial e^*}{\partial t^*} \frac{dt^*}{d\phi}, \quad (32)$$

which is self-explanatory. That is, the question of how students will respond to an increase in admission rate hinges on how much of the cut-off point will be adjusted in response to the admission rate change, and how students will react to that cut-off point change.

¹⁷ This is not innocuous, though. In a strict sense, the environment, and thus incentives faced by the students under the quota system are different from those under quality standard system. Under fixed quota system, how other students will behave has a direct impact on the probability of my being selected. For example, at the margin, if I get admitted, then another student must be dropped out to keep the fixed quota. Partly because I have here a continuum of students and for the sake of simplicity, I rule out such strategic considerations and use the same FOC as is used in the earlier section. In other words, I am assuming that every student plays "against the field." For a model which attempts to explicitly consider the strategic aspects, see Dixit(1981).

Of course, the required change in t^* to make the new hold, in turn, depends on how students will behave in response to the ϕ change. So, the logics are circular, and we have to solve them simultaneously.

Inserting (31) into (30), and solving for $dt^*/d\phi$ yields,

$$\frac{dt^*}{d\phi} = \frac{1}{\int \frac{f\beta c'' dH(X)}{\mu}} < 0 \quad (33)$$

Thus, the cut-off score must be cut down. This is, in a sense, a trivial result because in order to increase the number of students admitted, you have to lower the cut-off score with other things fixed.

By definition, an integral of individual student's winning odds over the whole population gives the fraction of students who are admitted, the admission rate, ϕ . Therefore, the whole expression in the denominator of equation (33) is simply $dt^*/d\phi$, the resulting change in admission rate when t^* is one unit increased. This can be again easily checked by directly differentiating equation 2) in (28) with respect to t^* . Since the sign of this expression is negative, it gives simply how many students will additionally fail if you increase the cut-off score by one point.

Plugging (33) back into (31) gives the effects of change in ϕ on individual student's effort level. Since the coefficient of $dt^*/d\phi$ is the same as the one given in (11), and is $dt^*/d\phi$ negative, it implies that those students whose expected scores are in excess of the cut-off score will work less, and students with low scores will work more as the admission rate increases. As it gets easier to gain an entry into the college due to the admission rate increase, those students with relatively high scores now work less hard, because it is no longer necessary to put that much effort to get in. Whereas, those students with lower scores work harder because their chance of being admitted has now been improved.

The fact that students will show different responses to the change in admission rate depending on his/her relative position to the cut-off score gives rise to the similar implications on the aggregate tutoring, discussed earlier. That is, the aggregate volume of private tutoring will crucially depend on the current state of competitiveness of college admission. If it is already highly competitive, relaxing it by increasing the admission quota a little bit will not help reduce the private tutoring, but aggravate the situation further.

Increasing the Cost of Private Tutoring

The effect of increasing the cost of private tutoring can be analyzed in a similar way. Differentiating equations 1) and 2) in (28) with respect to c gives,

$$X f' \alpha \left(\alpha \frac{de^*}{d\beta} - \frac{dt^*}{d\beta} \right) - \beta c'' \frac{de^*}{d\beta} - c' = 0 \quad (34)$$

$$\int_{\underline{x}}^{\bar{x}} f \left(\alpha \frac{de^*}{d\beta} - \frac{dt^*}{d\beta} \right) dH(X) = 0 \quad (35)$$

Solving (34) for $de^* / d\beta$ yields,

$$\frac{de^*}{d\beta} = \frac{X f' \alpha}{\mu} \frac{dt^*}{d\beta} + \frac{c'}{\mu} \quad (36)$$

Note that the second term in (36) is exactly the same as that in (23) above. So this is the direct effect of raising the cost of private tutoring on students' effort level, the sign of which is negative. The first term then takes into account the effect of cost increase on t^* and each student's subsequent adjustment in effort level due to the change in t^* . Simply put, the equation (36) can be rephrased as,

$$\frac{de^*}{d\beta} = \frac{\partial e^*}{\partial t^*} \frac{dt^*}{d\beta} + \frac{\partial e^*}{\partial \beta} \quad (37)$$

Inserting (36) into (35) and solving for renders,

$$\frac{de^*}{d\beta} = - \frac{\int \frac{\alpha f c'}{\mu} dH(X)}{\int \frac{f \beta c''}{\mu} dH(X)} < 0 \quad (38)$$

The denominator is what we have already seen in (33) and is negative. In overall, an increase in tutoring cost will put a downward pressure on the cut-off score. The intuitive reason behind this result is straightforward. An increase in tutoring cost induces every student to take less tutoring, and this lowers the overall distribution of test scores. Under the situation, the school authority has to lower the cut-off point of the test in order to continue to secure a given fraction of students.

It is interesting to note that the numerator in (38) is just $d\phi / d\beta$ evaluated under the assumption of fixed t^* . That is, differentiating the equation 2) in (28) with respect to β , holding t^* constant, yields,

$$\left. \frac{d\phi}{d\beta} \right|_{dt^*=0} = \int \frac{\alpha f c'}{\mu} dH(X) < 0 \quad (39)$$

So it captures the effect of changing β on the admission rate under the fixed t^* , and the sign is negative. As mentioned earlier, an increase in tutoring cost causes every student to take less tutoring. This lowers the expected score of every student. Consequently, if the school keeps the cut-off point at the old level ($dt^*=0$), the fraction of students who are admitted will be curtailed.

Cancelling this negative effect on the admission rate of increased cost and restoring the original admission rate requires a corresponding adjustment in the cut-off score in an opposite direction. The size of the latter adjustment necessary is obtained by dividing this expression by the denominator in (38) which happens to be equal to $d\phi/dt^*$. In short, the following relationship holds.

$$\frac{dt^*}{d\beta} = - \frac{\left. \frac{d\phi}{d\beta} \right|_{t^*=exog}}{\left. \frac{d\phi}{dt^*} \right|_{t^*=exog}} \quad (40)$$

Note that this is the very relationship between t^* and β (or any other parameters for that matter) that should hold when you want to keep ϕ constant in equation 2) in (28).

Generalizing the above result, we obtain the following "fundamental relationship" between the cut-off score and every exogenous parameter of the model for maintaining a fixed admission rate. Denoting the representative exogenous parameter as z , we have,

$$\begin{aligned} \frac{dt^*}{dz} &= - \frac{\frac{d\phi}{dz}}{\frac{d\phi}{dt^*}} = - \frac{\int \left. \frac{dF}{dz} \right|_{t^*=exog} dH(X)}{\int \left. \frac{dF}{dt^*} \right|_{t^*=exog} dH(X)} \\ &= - \frac{\int \left[\frac{\partial F}{\partial e^*} \frac{\partial e^*}{\partial z} + \frac{\partial F}{\partial z} \right] dH(X)}{\int \left[\frac{\partial F}{\partial e^*} \frac{\partial e^*}{\partial t^*} + \frac{\partial F}{\partial t^*} \right] dH(X)}, \end{aligned} \quad (41)$$

with an understanding that both numerator and denominator are to be evaluated at equilibrium point treating t^* as if exogenous¹⁸. Note that the denominator contains no expressions related to exogenous parameters. Consequently the denominator is not associated with any particular parameter, but is common to every exogenous parametric change.

The effect of cost change on each student's equilibrium effort level is now obtained by plugging (38) into (36). The overall effects on individual efforts are likely to be negative for those students whose expected scores are greater than the cut-off score since both the last term and $dt^*/d\beta$ in the first term in equation (36) are negative, and the coefficient of $dt^*/d\beta$ is positive for them. For those students whose expected scores are below the cut-off point, however, the sign is indeterminate because the whole first term is positive but the second term is negative.

In the final equilibrium after the adjustments both in students' effort levels and the school's cut-off score have been made, the change in individual student's final winning probability depends crucially on his/her position relative to the whole distribution. Some students' odds will improve, and others' not, depending on the criterion to be discussed shortly. This is one of the most important differences between the quality standard system and the quota system. In the earlier section where the cut-off point is exogenously set, the directions of changes in individual student's odds have been in most cases uniform across the board, as are given in (17), (18) and (25)¹⁹.

Under the current quota system, however, if some students get extra benefits due to a policy change, in terms of their winning odds, then some others must get hurt. This is simply because of the definition of the quota system. If someone gains, others must lose to keep the level flat²⁰. The new cut-off score will be set exactly at the point that will accomplish this leveling task, somewhere in the middle that will balance off the opposing forces. And the resulting changes in individual student's odds should occur in such a way that the aggregate admission rate will not be affected. This is, of course, trivial in the sense we have already imposed such a condition from the beginning, but worthwhile to check whether it really holds and how.

Since the above claim applies to every parametric change, I will use the generalized version given in (41) in deriving the proof. Let the inside of the integral sign in the denominator be denoted as ξ . And then, by dividing and multiplying the inside of the integral of the numerator by ξ , we have the following relationship,

¹⁸ This explains why the expression, $\partial e^*/\partial z$, in the numerator has the partial derivative sign, and the expression, $\partial e^*/\partial t^*$, can be defined and have any meaning.

¹⁹ One exception has been the case in which the dispersion of the test scores has been increased. There some students get hurt while others benefit in terms of winning odds.

²⁰ Although I have introduced the assumption that every student is playing against the field, some remaining negative externalities are unavoidable, because they are inherent in the quota system.

$$\frac{dt^*}{dz} = \frac{\int -\frac{dF}{dz} \Big|_{t^* = exog} \xi dH(X)}{\int \xi dH(X)} \quad (42)$$

Let the first term inside of the integral of the numerator be denoted by still another term K , so that we have,

$$\frac{dt^*}{dz} = \frac{\int K \xi dH(X)}{\int \xi dH(X)} = \bar{K} \quad (43)$$

Under this new representation, , the change in equilibrium cut-off point due to a parametric change, can be interpreted as a weighted average of K , with the weights being given by ξ . Correspondingly, the generalized version of the equation (36), which represents the change in equilibrium effort due to a parametric variation, becomes,

$$\begin{aligned} \frac{de^*}{dz} &= \frac{\partial e^*}{\partial t^*} \frac{dt^*}{dz} + \frac{\partial e^*}{\partial z} \\ &= \frac{\partial e^*}{\partial t^*} \bar{K} + \frac{\partial e^*}{\partial z} \end{aligned} \quad (44)$$

Now, differentiating the winning odds function, F , with respect to z , and substituting (44) for dt^*/dz . yields²¹,

$$\begin{aligned} \frac{dF}{dz} &= \frac{\partial F}{\partial e^*} \frac{de^*}{dz} + \frac{\partial F}{\partial t^*} \frac{dt^*}{dz} + \frac{\partial F}{\partial z} \\ &= \frac{\partial F}{\partial e^*} \left[\frac{\partial e^*}{\partial t^*} \bar{K} + \frac{\partial e^*}{\partial z} \right] + \frac{\partial F}{\partial t^*} \bar{K} + \frac{\partial F}{\partial z} \end{aligned} \quad (45)$$

²¹ Note that in this paper we have the following three different but related expressions; dF/dz , $dF/dz \Big|_{t^* = exog}$, and $\partial F/\partial z$.

Collecting terms and further simplifying generates,

$$\begin{aligned} \frac{dF}{dz} &= \left(\frac{\partial F}{\partial e^*} \frac{de^*}{dt^*} + \frac{\partial F}{\partial t^*} \right) \left[\frac{\frac{dF}{\partial e^*} \frac{\partial e^*}{\partial e} + \frac{dF}{dz}}{\frac{dF}{de^*} \frac{\partial e^*}{\partial t^*} + \frac{dF}{dt^*}} \right] \\ &= \xi \left[\bar{K} - K \right] \end{aligned} \quad (46)$$

Equation (46) says that change in individual student's winning odds in the final equilibrium in the wake of a parametric change solely depends on his/her position relative to the population mean of K . Since ξ is negative, if his/her K is greater than the whole population mean, his chance of winning will improve, whereas if his/her K is smaller than the mean, his chance will deteriorate.

As mentioned earlier, it is redundant to check whether these improvements and deteriorations of individual student's winning odds will indeed average out among students, and, thus, consequently result in an unchanged admission rate, because we have solved everything so far under that condition. But it is still illuminating to confirm the result because it reassures us that all the necessary adjustments should be made in such a way that in the final equilibrium the admission rate should not be affected at all.

Differentiating with respect to z gives,

$$\begin{aligned} \frac{d\phi}{dz} &= \int \frac{dF}{dz} dH(X) \\ &= \int \xi \left[\bar{K} - K \right] dH(X) \\ &= \bar{K} \int \xi dH(X) - \int \xi K dH(X) \\ &= 0, \end{aligned} \quad (47)$$

where the last equality follows from the very definition of \bar{K} , given in (43). This proves the claim asserted in the above.

Now, we have to explicate what the K above really stands for. Looking back the expression in the second equality of equation (41) is helpful in this regard. The inside of the denominator given there is simply ξ . Therefore, K is just a ratio of the following two derivatives,

$$K = - \frac{\left. \frac{dF}{dz} \right|_{t^* = exog}}{\left. \frac{dF}{dt^*} \right|_{t^* = exog}} \quad (48)$$

Given this, K is simply the Marginal Rate of Substitution (MRS) between z and t^* , holding F constant. Thus, it gives the rate of change in t^* that is necessary to keep the winning odds of each student constant when there is a change in a parameter. If a student works harder in response to a particular parameter change, his/her odds will probably increase. To keep his/her odds at the old level, the school authority has to adjust the cut-off point a bit upward. If another student works less, then the school authority has to lower the cut-off point correspondingly for him/her.

Note that the adjustments of cut-off point in this hypothetical experiment are all individualized, targeted for each specific student. The school, however, cannot have multiple cut-off points, custom-tailored for each student. It has to set just one cut-off point applicable to every student somewhere in the middle considering the whole distribution of the required adjustments. So it must take a weighted average of those necessary adjustments. This is exactly what drives the results we have had in (43) and (46) above. This also explains why we should take t^* exogenous while evaluating every term in (41) and (48).

The weights used to compute the average, is $\xi \, dF / dt^* =$, the sensitivity of F to the changes in t^* . Thus, \bar{K} is the weighted average of the individual student's MRS between an exogenous parameter, z , and the cut-off point, t^* , with the weights being the sensitivity of F with respect to the cut-off point, t^* .

Lowering the Marginal Returns to Private Tutoring

It is now straightforward to analyze the effect of a change in α . All we need is just to follow the path that has been cleared in the above. Differentiating equation 1) in (28) with respect to α , and simplifying gives,

$$\frac{de^*}{d\alpha} = \frac{\alpha Xf' \, dt^*}{\mu \, d\alpha} + \frac{-Xf - \alpha Xf' e^*}{\mu} \quad (49)$$

Again, the second term in the right hand side is the direct effect of an increase in α on the effort level which has appeared in equation (14). As explained there, most students, except those with very high expected scores, will increase their efforts in response to the raised marginal returns to private tutoring. The first term is the indirect effects induced by the change in cut-off score the direction of which will be determined shortly.

Utilizing the results obtained in the above, and taking partial total derivatives of ϕ in equation 2) in (28) with respect to t^* and α , respectively, treating t^* exogenous, and lastly taking the negative ratio between the two gives,

$$\frac{dt^*}{d\alpha} = \frac{\int \frac{f\beta(c'+c''e^*)}{\mu} dH(X)}{\int \frac{f\beta c''}{\mu} dH(X)} > 0 \quad (50)$$

Enhanced marginal returns to private tutoring thus causes the cut-off score to move upward. The intuition behind this results is again fairly simple. An improvement in marginal returns to tutoring raises the expected score, e^* , of every student, given e^* . Furthermore, almost every student chooses to take more effort, e^* , in response to the increase. The combined effect of this two upward pressures causes the cut-off score to rise.

Plugging this result back into (49) will give the final equilibrium solution for $de^* / d\alpha$.

Increasing the Noise of the Test

Differentiating the equation 1) in (28) with respect to σ yields,

$$\frac{de^*}{d\sigma} = \frac{\alpha X f'}{\mu} \frac{dt^*}{d\sigma} + \frac{\partial e^*}{\partial \sigma} \quad (51)$$

With every term in the RHS of (51), we are familiar now. The second term is the direct effect of change on the effort level, which we have had in (19). The first term is the indirect effect that comes through its effect on t^* which we will examine below.

In the previous section, we examined the effects of the increased noise of the distribution on the winning odds of each student at some length. There we have seen that the students can be grouped into four different categories; one group has improved winning odds with enhanced efforts, the second group has indeterminate odds with higher efforts. The third group has deteriorated odds with lowered efforts and the last group indeterminate odds with decreased efforts. Taking an integral of these changes, which are represented as $dF / d\sigma$ in (22) but now has to be interpreted as $dF / d\sigma \Big|_{t^*=exog}$, over the whole population gives the change in admission rate due to the change in the variance of the density. This will work as a numerator in (41).

$$\frac{d\phi}{d\sigma} \Big|_{t^*=exog} = \int \frac{dF}{d\sigma} \Big|_{t^*=exog} dH(X) \quad (52)$$

$$= \int \left[F_{\sigma} - \frac{\alpha^2 f_{\sigma} X f}{\mu} \right] dH(X)$$

Taking the negative of this, and dividing it by $d\phi / dt^*$, which is just the integral of (12) or, equivalently, the denominator of (41) itself, renders our desired solution for $dt^* / d\sigma$, the size

of the required adjustment in t^* that would keep the admission rate constant in the wake of the increased dispersion,

$$\frac{dt^*}{d\sigma} = \frac{\int \left[-F_{\sigma} + \frac{\alpha^2 f_{\sigma} X f}{\mu} \right] dH(X)}{\int \frac{f \beta c''}{\mu} dH(X)} \quad (53)$$

For the reasons explained already in the previous section, its sign is indeterminate. Depending on the location of the cut-off point, or, alternatively, the degree of competition in college admission, the sign of the whole expression may be positive or negative.

4. Conclusion

Rent seeking is pervasive in many controlled markets. In the education market, where tuition control is routinely practiced, this rent seeking is more serious than in other market. The divergence between the value a student is willing to pay and the price he has to pay to get one unit of education creates an exploitable rent, and thus incentives for every potential students to fiercely compete for admission ticket.

The form and volume of rent seeking will crucially depends on the selection criterion adopted, its effectiveness and precision in the measurement and policy measures to cope with them. Two general forms of selection criteria are considered in the paper; a quality standard system under which those with higher test scores than a preset cut-off value are admitted and a quota system under which those with higher rank are admitted.

Under the quality standard system, the overall effectiveness of policy measures aimed to reduce rent seeking, say, reducing the marginal efficacy of private tutoring, increasing the cost of tutoring, or increasing noise elements in assessment will critically hinge on the current degree of competitiveness of the market. If it is highly competitive, a reduction of the cut-off score will not reduce the rent seeking, but will encourage the rent seeking further. Any measures to increase the dispersion of test score, thus making it less reliable means to improve his/her test scores will not contribute to the reduction of rent seeking activity, either. Rather, making the market more competitive by raising the cut-off standard or by reducing the quota may sometimes be generate better results as far as a reduction of private tutoring is concerned.

Under the quota system, almost the same conclusions would hold, with regard to competition rate in the market. However, in addition to this, quota system inevitably creates negative externalities among students in the sense that an improvement in one contender's winning odds must be purchase at the cost of another contender's loss of his/her odds. And because of this, some one's gain should be matched by some other's loss. Depending on who becomes the new winner and who becomes a induced loser, in the wake of policy shift, allocative efficiency can be improved or deteriorated.

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Korean Bank Governance Reform after the Asian Financial Crisis

by
Heungsik Choe and Bong-Soo Lee

Abstract

We discuss corporate governance reforms in the Korean banking sector, which include reforms in board composition and executive compensation, implemented after the Asian financial crisis in 1997 and examine the stock market's response to the reforms. We find that the banking returns and volatilities became more Granger-causally prior to both KOSPI and finance sector returns after 1998. The announcements of banking governance reforms are generally associated with significant increases in banking sector stock returns. The KIF survey finds that board governance is considered essential in assessing the value of the firm. The participants in the McKinsey survey indicate that they are willing to pay a premium of 24% on average for firms with outstanding corporate governance systems.

JEL Classification: G15, G3

Keywords: bank governance, Asian financial crisis, Korean bank

1. Introduction

Korea and several Asian countries have experienced a severe financial crisis that was accompanied by large exchange rate depreciations and stock market declines since mid-1997. In the end, the financial crisis forced the IMF to orchestrate a record \$57 billion rescue bailout package for Korea in early December 1997 to help shore up its foreign reserves and bolster its currency. Various explanations have been offered as to the cause of the Asian financial crisis.

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We would like to thank Dr. Woojin Kim for providing us with the KIF survey results, and Jaeuk Khil for helping us find corporate governance related events from various Korean newspapers. We also would like to thank the Korea Stock Exchange for providing us with various indices, and participants at the PACAP conference in Seoul and KAFA-KIF joint conference for their useful comments.

Some argue that the crisis reflects permanent, structural (or fundamental) problems in the Korean economy, while others argue that it is mainly due to a non-fundamental liquidity shortage.¹ For example, Radelet and Sachs (1998a, b) and Wade and Veneroso (1998) attribute the East Asian economic crisis to financial panic that was made serious by IMF pressure to increase interest rates and to close down banks. Another view is based on international bank behavior and argues that the Asian panics had their origins in implicit guarantees offered by governments and believed by investors [e.g., Krugman (1998)]. These explanations tend to emphasize macroeconomic and banking issues but tend to agree that there was a loss of confidence by domestic and foreign investors in these markets. This led to a fall in capital inflows and an increase in capital outflows that triggered, in some cases, a very large nominal depreciation and a stock market crash.

The important role of corporate governance during the Asian financial crisis is well documented by Johnson, Boone, Breach, and Friedman (2000). They present evidence that measures of corporate governance, particularly the effectiveness of protection for minority shareholders, explain the extent of exchange rate depreciation and stock market decline better than do standard macroeconomic measures. A possible explanation is that in countries with weak corporate governance, worse economic prospects result in more expropriation by managers and thus a larger fall in asset prices.² In the case of the Asian crisis, they find that corporate governance provides at least as convincing an explanation for the extent of exchange rate depreciation and stock market decline as any or all of the usual macroeconomic arguments.

Since the outbreak of the financial crisis and the subsequent introduction of the IMF stabilization package in December 1997, a number of important steps have been taken to restructure the banking sector in Korea. A wide range of restructuring, which includes reforms in banking governance structure and cleaning up of non-performing loans of financial institutions, has built a foundation upon which financial institutions operate with profitability and stability. These restructuring efforts are deemed to have helped normalize the financial system earlier than expected and ease the credit crunch situation significantly. As a result, the Korean economy rebounded from the crisis, and the sovereign credit rating, which plunged into the below-investment grade, soon recovered to the investment grade.

A major component of the banking sector reform was to improve board governance, which seems consistent with the argument of Johnson, Boone, Breach, and Friedman (2000). New board governance of the Korean banking sector was hastily assembled and launched after the financial crisis in response to pressing concerns over the viability of the major Korean banks. Under the supervision of the Financial Supervisory Commission, Korean banks have established a board governance system satisfying the global standard with outside-majority boards and a committee structure. The proportion of outside directors in the new boards has reached 60 to 80%. The Korean banking sector has adopted the functions of various committees

¹ Ha, Khil, and Lee (2001) find that the sudden decline in Korea's stock market prices during the 1997 financial crisis was primarily due to fundamental components rather than non-fundamental factors, although they find evidence of substantial non-fundamental components in Korea's stock market prices. Some argue that the Asian crisis was mainly due to inappropriate macroeconomic policy during the 1990s [e.g., Greenspan (1998) and Corsetti, Pesenti, Roubini (1998)].

² By 'corporate governance' they mean the effectiveness of mechanisms that minimize agency conflicts involving managers, with particular emphasis on the legal mechanisms that prevent the expropriation of minority shareholders.

including the governance committee, the management development and compensation committee, the audit committee, and the risk management committee, which are under the board of directors. It has also reformed the system of decision making. The regulations concerning the roles, the authorities, and the obligations of the board have all been stipulated.

Given the importance of the banking governance reforms in Korea, in this paper we explore the stock market's response to various board governance reforms in the banking sector, in particular, reforms in board composition and executive compensation, and provide some appraisal of the banking reforms based on a survey result. As we will review below, previous studies tend to focus on cross-sectional comparisons and obtain mixed results on the relation between board composition and firm performance. In this paper, we approach the relation from three different perspectives. First, we examine how the banking sector fares relative to the rest of the economy based on a time-series analysis of banking sector returns, the Korean stock market index (KOSPI) returns, and financial sector returns. Economists tend to hold different views on the importance of the banking sector in affecting the rest of the economy. There has been some debate in Korea regarding the order of the various sectors—banking sector or non-banking sector—corporate governance reforms. We find that the banking sector has become more Granger-causally prior to both the Korean stock market (KOSPI returns) and finance sector after the banking governance reforms. This seems consistent with the view that banking sector reforms implemented after the financial crisis may have helped lead the rest of the economy.

Second, we examine the stock market's (or investors') response to announcements of various stages of banking sector reforms using a variation of event study method. An alternative approach would be to use a regression analysis before and after the reform. Given the rapidly changing economic environment in Korea with ongoing reforms, a simple regression approach may not provide strong power to identify the market's response to various reforms compared with the event study. The conventional event study method may not fully identify important events with the market's significant reactions because the corporate governance reforms involve a series of events (announcements) and ongoing reform legislations. As such, we employ a variation of the event study. We identify 12 out of 18 events (67%) of unusual high/low abnormal returns of the banking sector during 1997-2001 to be associated with some banking reform related announcements that are related to board composition, committee structure, and executive compensation. This implies that banking reforms have been strongly, positively received by the market.

Third, we examine bank managers' perceptions about the banking reform based on the survey results conducted by the Korea Institute of Finance (KIF) and McKinsey, respectively, which are regarded as the first serious attempt to evaluate the effects of the reform. A major finding is that the participants in the KIF survey show that board governance is essential in assessing the value of the firm. The participants in the McKinsey survey indicate that they are willing to pay a premium of 24% on average for firms with outstanding corporate governance systems.

The rest of the paper is organized as follows. In Section 2, we briefly review related literature. Section 3 describes the data and the dynamic relation between the banking sector and the rest of the economy. Section 4 discusses the announcement effects of banking sector corporate governance reforms. Section 5 briefly summarizes the KIF survey results on banking reforms delegating a more detailed discussion to appendix , and Section 6 concludes the paper.

2. Related Literature

2.1. Board composition and firm performance

Since the board composition and increased responsibility of board members are a major component of the board governance reform in the Korean banking sector, we briefly review previous studies on this issue.³ It has long been recognized that board composition is very important with respect to the ability to monitor and is related to the reduction of agency costs, which occur when managers pursue their own interests at the shareholders' expense [e.g., Fama and Jensen (1983)]. Inside directors have valuable knowledge of the firm's operating policies and day-to-day activities, while outsiders may contribute fresh ideas, independence, objectivity and expertise gained from their own fields. However, many researchers question the ability of outside directors to exercise effective oversight [e.g., Byrd and Hickman (1992)]. Some argue that outsiders often provide little more than a source of outside contacts and advice for top management [e.g., Mace (1986), see also John and Senbet (1998)].⁴

Some studies focus on the relation between board composition and the incidence of particular events (e.g., hostile takeovers, CEO turnovers) with implications for corporate performance [e.g., Shivdasani (1993) and Weisbach (1988)]. Other studies concern a direct relation between board composition and firm performance. Prior studies tend to focus on the cross-sectional relation between board composition and performance and find, at best, mixed evidence.

Baysinger and Butler (1985) find weak evidence that firms with more outside directors in 1970 had higher industry-adjusted returns on equity in 1980. Rosenstein and Wyatt (1990), using the standard event study methodology, find that announcements of appointment of an outside directors are associated with increases in shareholder wealth.⁵ Hermalin and Weisbach (1991) examine differences in firm performance caused by board composition and ownership structure and find little relation between board composition and performance. Agrawal and Knoeber (1996) find that more outsiders on the board of directors negatively affect performance. Bhagat and Black (1998) also find that the proportion of outside directors on the board is negatively related to firm performance as measured by Tobin's *q*, returns on assets, and several other accounting measures. Lawrence and Stapledon (1999) fail to find consistent evidence of a direct positive relation in a sample of listed Australian firms. In a recent study, Hossain, Prevost, and Rao (2001) explore the efficacy of monitoring by the board of directors, and especially independent outside directors, in New Zealand. They find that the effects of the Companies Act and related legislation in 1993, which are directly designed to enhance monitoring and firm performance, are relatively benign in so far as influencing the relation between firm performance and outside board representation is concerned.

³ For an extensive review of board composition and other corporate governance related issues, see John and Senbet (1998).

⁴ An optimal board composition --an optimal percentage of outside directors-- still remains an open question.

⁵ Brickley et al. (1994) find a significant positive relation between the stock market reaction to the adoption of poison pills and the fraction of outside directors.

2.2. Management compensation and firm performance

Much theoretical and empirical literature has investigated executive compensation, often using an agency framework.⁶ Agency theory predicts that compensation policy that ties the CEO's welfare to shareholder wealth helps align the private and social costs and benefits of alternative actions and thus provides incentives for CEOs to take appropriate actions. There are many mechanisms through which compensation policy can provide value-increasing incentives, including performance-based bonuses and salary revisions, stock options, and performance-based dismissal decisions. Numerous studies support the presence of a positive relation between management compensation and firm performance but find that the sensitivity of pay to stock returns is fairly low [See Jensen and Murphy (1990)]. A stronger relation is commonly found between top executive pay and firm size.⁷

Concerning the relation between CEO pay and performance in the *banking* sector, Barro and Barro (1990) find that, for newly hired CEOs, the elasticity of pay with respect to bank assets (i.e., bank size) is about one-third.⁸ For continuing CEOs, the change in compensation depends on performance, as measured by stock and accounting returns. However, the sensitivity of pay to performance diminishes with experience.⁹

Regarding the pay-performance relation (including pay, options, stockholdings, and dismissal), Jensen and Murphy (1990) find that while the relation between pay and firm performance is positive and statistically positive, it is small for an occupation in which incentive pay is expected to play an important role.¹⁰ They also find that dismissals are not an important source of managerial incentives. Although the incentives generated by stock ownership are large relative to pay and dismissal incentives, most CEOs hold trivial fractions of their firms' stock, and ownership levels have declined over the past 50 years. They acknowledge that these findings are inconsistent with the implications of formal agency models of optimal contracting.

Instead, they provide an interesting alternative hypothesis for the findings: the implicit regulation hypothesis. According to this hypothesis, political forces may play a role in the contracting process by implicitly regulating executive compensation by constraining the type of

⁶ See, for example, Tosi and Gomez-Mejia (1984), Rosen (1992), Gomez-Mejia (1994), and Abowd and Bognanno (1995). For the study of Japan, see Kato and Rocke (1992), Kaplan (1994), Kaplan and Minton (1994), and Kato (1997).

⁷ The Rosen (1992) survey reports the puzzling finding of a relative uniformity in the elasticity of executive pay with respect to firm size across firms, industries, countries, and time periods. See, for example, Leonard (1990) and Gibbons and Murphy (1992) for a discussion of these issues.

⁸ They use a data set that covers chief executive officers (CEOs) of large commercial banks over the period 1982-87.

⁹ Collins, Blackwell, and Sinkey (1995) find that total compensation and the ratio of incentive compensation-to-total compensation increased substantially at regional bank holding companies but remained stable at money-center bank holding companies for the sample period of 1979 to 1985. Chakraborty, Kazarosian, and Trahan (1999) investigate whether uncertainty in CEO compensation influences the firm's investment decisions and find that CEOs with high earnings uncertainty invest less.

¹⁰ They use *Forbes* survey data that include 2,213 CEOs from 1974 to 1986 and find that CEO wealth changes \$3.25 for every \$1,000 change in shareholder wealth.

contracts that can be written between management and shareholders. These political forces, operating both in the political sector and within organizations, appear to be important but are difficult to document because they operate in informal and indirect ways. Public disapproval of high rewards seems to have truncated the upper tail of the earnings distribution of corporate executives. Equilibrium in the managerial labor market then prohibits large penalties for poor performance, and as a result the dependence of pay on performance is decreased. They maintain that their findings that pay-performance relation, the raw variability of pay changes, and inflation-adjusted pay levels have declined substantially since the 1930s are consistent with such implicit regulation. This implicit regulation hypothesis may help explain why compensation in Korea has not been effectively used as an incentive for top executives in the past.

In a recent study for Italy, Brunello, Graziano, and Parigi (2001) find that managerial pay is positively affected by firm performance, measured by real accounting profits per head; the semi-elasticity that relates pay to profits, however, is small, which is consistent with Jensen and Murphy's (1990) findings. Importantly, they find that the sensitivity of pay to performance is higher when the firm belongs to a multinational group, is owned by foreign capital and is listed in a stock exchange. Since firms owned by foreign capital and/or affiliated to a multinational group are less likely to be affected by the main features of Italian capitalism, they interpret this finding as supportive of the view that the specific Italian economic environment leads to a lower sensitivity of managerial pay to firm performance. A similar situation can be found in Korea.

3. Empirical results

3.1. Data and simple statistics

We use daily returns and compare banking sector returns with the broad market index (KOSPI) returns and finance sector returns. The finance sector includes insurance companies and security companies. Since the KOSPI includes both the banking and finance sectors, and the finance sector includes the banking sector, we obtained the three separate indices without any overlapping firms. For our statistical analyses, we use these non-overlapping indices, all of which are value-weighted indices.¹¹ Our sample period covers from 1995/1/3 to 2001/7/2. We split the sample into two sub-periods, pre-crisis period (1995/1/3-1997/9/30) and post-crisis period (1997/10/1-2001/7/2), to see whether various banking reforms after the financial crisis have made a significant difference between the two sub-periods.

Table 1 shows that all (daily) mean returns (of KOSPI, banking, and finance sectors) are negative for the sample period. All three returns show a substantially higher volatility in the post-crisis period, implying a more uncertain nature of the post-crisis period. The premium of banking sector returns over KOSPI returns (i.e., the spread) is negative for the sample period and became more negative in the post-crisis period. Table 2 reports cross correlations between banking returns and KOSPI returns and between banking return volatility and KOSPI return volatility for the whole sample period and the two sub-periods. Not surprisingly, the

¹¹ We obtained the three separate indices without any overlapping firms from the Korea Stock Exchange.

contemporaneous correlation is high with about 0.6 for returns and about 0.4 for return volatilities. Among other things, it is noted that return volatility spillover seems to flow from banking sector (e.g., X_t) to KOSPI return (e.g., Y_{t-k} for $k = -1$, and -2) in the post-crisis period.

3.2. Unit root and cointegration tests

In anticipation of Granger-causality tests that use stationary variables, we test for a unit root (or the difference stationary process) employing both the augmented Dickey-Fuller (D-F) test (1979) and the Phillips-Perron (P-P) test (1988):

$$(a) \text{ Augmented Dickey-Fuller regression: } \Delta x_t = \rho_0 + \rho x_{t-1} + \sum_{i=1}^n \delta_i \Delta x_{t-i}$$

$$(b) \text{ Phillips-Perron regression: } x_t = \alpha_0 + \alpha x_{t-1} + u_t$$

The difference between the two unit root tests lies in their treatment of any 'nuisance' serial correlation. The P-P test tends to be more robust to a wide range of serial correlation and time-dependent heteroskedasticity. In these tests, the null hypothesis is that a series is nonstationary (i.e., difference stationary): $\rho = 0$ and $\alpha = 1$. We use two and four lags (i.e., $n=2$ and 4) in the test.

Table 3 reports unit root and cointegration tests. All three index prices (i.e., KOSPI, finance, and banking index prices) are non-stationary but not cointegrated so that we use returns (i.e., log differences). I.e., the spread S1 (= a linear combination of banking prices and KOSPI prices), S2 (= a linear combination of banking prices and finance prices), and S3 (= a linear combination of finance prices and KOSPI prices) are all non-stationary.

3.3. Causality tests

Economists tend to hold different views on the importance of the banking sector in affecting the rest of the economy. However, it is widely recognized that financial intermediaries provide important services in pooling risks, gathering information, meeting uncertain liquidity needs and monitoring borrowers. Therefore, the health of the banking sector matters. When Korean government considered reforms in the economy, one of the questions was where to begin the reform: banking sector or non-banking sector. There was a heated debate on this issue. Eventually, the government decided to implement the reform in the banking sector prior to the non-banking sector.

We may expect to find that banking returns and volatilities Granger-cause KOSPI returns more strongly in the post-crisis period than in the pre-crisis period if the banking reforms lead the rest of the economy [see Granger (1969)].¹² We use the following trivariate autoregression to test for causality between the banking sector return and two other returns (KOSPI return and finance sector return):

¹² The notion behind causality testing in Granger (1969) is based on the premise that the future cannot cause the present or the past. If an event x occurs before an event y , then we can say that x causes y . Formally, if the prediction of y using past x is more accurate than the prediction without using past x in the mean square error sense [i.e., if $\sigma^2(y_t | I_{t-1}) < \sigma^2(y_t | I_{t-1} - x_t)$, where I_t is the information set], x Granger-causes y .

$$\begin{aligned}
Y_t &= c_1 + \sum_{i=1}^m \alpha_{1i} Y_{t-i} + \sum_{i=1}^m \beta_{1i} X1_{t-i} + \sum_{i=1}^m \gamma_{1i} X2_{t-i}, \\
X1_t &= c_2 + \sum_{i=1}^m \alpha_{2i} Y_{t-i} + \sum_{i=1}^m \beta_{2i} X1_{t-i} + \sum_{i=1}^m \gamma_{2i} X2_{t-i}, \\
X2_t &= c_3 + \sum_{i=1}^m \alpha_{3i} Y_{t-i} + \sum_{i=1}^m \beta_{3i} X1_{t-i} + \sum_{i=1}^m \gamma_{3i} X2_{t-i},
\end{aligned}$$

Suppose that Y_t , $X1_t$, and $X2_t$ are KOSPI, finance, and banking returns, respectively. If the γ_{1i} coefficients are statistically significant, inclusion of past values of banking return ($X2$), in addition to past history of KOSPI return (Y) and finance return ($X1$), yields a better forecast of KOSPI return, and we say banking returns Granger-cause KOSPI returns. If a standard F -test does not reject the hypothesis that $\gamma_{1i} = 0$ for all i , then banking returns do not Granger-cause KOSPI return. Similarly, in the second equation, if the γ_{2i} coefficients are statistically significant, inclusion of past values of banking return ($X2$), in addition to past history of KOSPI return (Y) and finance return ($X1$), yields a better forecast of finance return, and we say banking returns Granger-cause finance returns. In the third equation, if the α_{3i} coefficients are statistically significant, inclusion of past values of KOSPI return (Y), in addition to past history of finance return ($X1$) and banking return ($X2$), yields a better forecast of finance return, and we say banking returns Granger-cause finance returns.

The results of the Granger-causality tests based on the trivariate model are presented in Table 4.

First, the banking sector has become Granger-causally prior after the crisis. That is, in the pre-crisis period, banking returns used to be Granger-caused by both KOSPI returns and finance returns, but in the post-crisis period, neither Granger-causes banking returns. As a result, the banking sector is Granger-causally prior for the whole sample period. Second, there was a feedback relation between banking returns and KOSPI returns before the financial crisis, but the relation disappeared after the crisis so that there remained no causal relation between the two returns. Third, finance sector returns have no causal relation with either KOSPI returns or banking returns. The absence of the causal relation holds in both pre-and post-crisis periods. In short, banking returns have become significantly more Granger-prior to both KOSPI and finance returns in the post-crisis period.

We now examine causal relations among stock return volatilities of the three sectors. We include the volatility in our analysis in part because return volatility tends to be associated with information flow and in part because volatility is a key ingredient of the risk-return tradeoff that permeates modern financial theories.¹³ The results are reported in Table 5. We find that, first, as in the case of return causality, banking return volatility has become Granger-causally prior after the crisis. In the pre-crisis period, banking return volatility used to be Granger-

¹³ A thorough understanding of the determinants of the volatility process is critical for issues related to the functioning of markets and the implementation and evaluation of both asset pricing theories and option pricing theories. Regarding the volatility of stock returns, Hamao, Masulis, and Ng (1990) find spillover effects from the U.S. and the U.K. stock markets to the Japanese market. Although they suspect that such volatility spillovers could represent a causal relation across markets, they do not further pursue the causal relations. For a recent study of the information content in return volatility, see also Lee and Rui (2002)

caused by both KOSPI and finance return volatilities, but in the post-crisis period, neither volatility Granger-causes banking return volatility. Second, after the crisis, banking return volatility has become more Granger-causally prior to KOSPI return volatility, whereas finance return volatility has not become Granger-causally prior to KOSPI return volatility. Third, finance return volatility remains Granger-caused by banking return volatility.

Overall, banking return and volatility have become more Granger-causally prior to the rest of the economy, losing its feedback relation with KOSPI returns after the crisis. In addition, banking sector return volatility has become more strongly Granger-causally prior to KOSPI return volatility after the crisis.

4. Announcement effects of banking sector corporate governance reforms

Event studies have been used in the field of law and economics as well as in finance and accounting to measure the impact on the value of a firm during a change in the regulatory environment. Given ongoing board governance related reforms in Korea's banking sector comprised of a series of announcements of changes in regulations and laws, it would be appealing to employ a variation of event study method to identify the stock market's response to various announcements of banking reforms.

In an attempt to identify the board governance related reforms and the stock market's response, we use, as a measure of abnormal return, a three-day window cumulative abnormal return (CAR) of the banking sector in excess of the KOSPI index return. The daily *Abnormal Return* (AR) for the banking sector on day t is defined as the difference between the banking return and the KOSPI return:

$$AR_t = R_{bt} - R_{mt},$$

where R_{bt} is the banking sector return on day t , and R_{mt} is the KOSPI market index (value-weighted) return on day t . The three-day (-2, -1, 0) window Cumulative Abnormal Return of the banking sector (CAR) is given by :

$$CAR_t = \sum_{i=-2}^0 AR_{t+i}.$$

Event studies usually identify announcement dates on the basis of exogenous data and then examine the market's responses around the dates [see Rosenstein and Wyatt (1990)].¹⁴ Given numerous board governance related reforms in Korea's banking sector comprised of a series of announcements of changes in regulations and laws, we take a somewhat different approach, focusing on the dates (and events) with significant stock market responses. First, we identify dates with the CAR being either greater than 5% or less than -5%. We find 19 dates. Figure 1 shows abnormal returns of the banking sector for the sample period of 1995/1/3 – 2001/7/2. Then, we search various newspapers to determine whether there were any banking reform related announcements (or events) around the date. Although our sample begins in January 1995, the first event with more than 5% CAR occurs on November 29, 1997.¹⁵ However, since

¹⁴ Rosenstein and Wyatt (1990) find significant positive excess returns around the days of the announcements of outside board appointments by using the standard event methodology.

¹⁵ On November 27, 1997, the government announced the implementation of plans for financial market stability, which include a provision of up to 4 trillion won (about \$3.08 billion) of public money for the troubled bank

the Korean government and the IMF agreed to an emergency funding package on December 3, 1997, and the banking reforms began after the IMF agreement, we focus our attention on the sample period after December 1, 1997. Therefore, we have 18 dates of unusual abnormal returns. Among 18 dates, we can relate 12 dates (e.g., 67%) to board governance related banking reforms (or events). For the remaining six dates, we attempt to provide in footnotes related events that may not be directly associated with board governance related banking reforms. There are 12 positive CARs and 6 negative CARs. Five negative CARs are related to banking cash flows either by capital requirement or additional funding. These events are briefly summarized below.

(1) *December 4, 1997: CAR = +6.50%*

The Korean government and the IMF agreed to an emergency funding package on December 3, 1997, and three major political parties announced on December 4 that they agreed to pass the Financial Reform Act, which requires structural reforms for the banking sector and the opening of the Korean capital market. It also allows foreign banks' M&A of Korean banks and their entry into domestic banking and requires adoption of an international accounting system and audits by internationally certified accounting firms.

(2) *March 3, 1998: CAR = +6.28%*

Change in the selection procedure of a bank president: To strengthen domestic banks' international competitiveness, the government realized that the current system of the selection of bank presidents is outdated and announced on March 2, 1998, that foreign bankers and banking experts can be presidents or directors of domestic banks, and the Bank Act will be revised accordingly.

On April 1, 1998, the Financial Supervisory Commission (FSC) was established in order to strengthen the supervision of financial institutions. With the establishment of the FSC, the four supervisory authorities for banks, security houses, insurance companies, and other financial institutions were placed under one umbrella, and the FSC was given the authority to engineer the restructuring of the financial sector.

(3) *September 15, 1998: CAR = -5.99%*

No significant event of board governance related banking reform is found.¹⁶

(4) *September 29, 1998: CAR = +5.06%*

and investment securities sector. Government officials hoped that this could help to stabilize the capital market. On the same day, one of the troubled banks, Korea First Bank, announced the new issue of 800 billion won (about \$615 million). As a result, the amount of capital in Korea First Bank became 1.62 trillion won (about \$1.25 billion).

¹⁶ On September 14, 1998, the Financial Supervisory Commission ordered the capital reduction of 90% to two troubled banks, Commercial Bank of Korea and Hanil Bank. Seoul Bank and Korea First Bank have already reduced their capital. Several other banks that experienced troubles are expected to follow suit. This news was perceived as a strongly negative one for the banking industry.

The Ministry of Finance and Economy (MOFE) announced on October 1 that it began review of bank ownership structure reform and the change in the bank president selection procedure. The MOFE will repeal the current 4% of maximum individual ownership restriction and consider the selection of president of a bank by majority shareholders, not by the government.

(5) October 21, 1998: CAR = +5.36%

Hearing of the Bank Act Revision was held. Major items include:

1. Relaxation of the very restrictive ownership restriction,
2. Bank management structure reform including the selection procedure of bank presidents, and
3. Increasing management's responsibility and strengthening of small shareholders' monitoring function. In addition, in late October 1998, unified disclosure standards for financial institutions were introduced. As a result, all financial institutions are now subject to the new disclosure system. This new system stipulates that a regular disclosure is to be made twice a year and strengthens the penalty for false or dishonest disclosures.

(6) November 11, 1998: CAR = -5.58%

No significant event of board governance related banking reform is found.¹⁷

(7) December 16, 1998: CAR = -7.04%

On December 15, 1998, the Financial Development Committee came up with the draft of Bank Act Revision. On December 17, the MOFE announced that the government intends to revise the Bank Act in such a way that the government (or deposit insurance corporation) can appoint directors of the banks to which the government contributed at least 4% of their capital. This was considered as a setback from the bank governance perspective.

(8) January 14, 1999: CAR = +7.53%

On January 14, Hanvit Bank announced board governance reforms that ensure the independence of the board from management. On January 18, 1999, Housing & Commercial Bank of Korea announced changes in personnel structure and governance structure. The bank will introduce a stock option system for top managers and make them more responsible (liable) for the management. The bank will also change the governance structure by introducing outside directors and allow one of them to be elected as chair of the board. Housing & Commercial Bank of Korea's stock price rises significantly on that day.

(9) April 12, 1999: CAR = +5.01%

On April 13, 1999, the president and directors of Chohung Bank agreed to implement various management reforms. The bank disclosed on April 9 that the bank presidential

¹⁷ Chohung Bank announced that it would have a substantial capital reduction. It is rumored that the Moody will lower the credit rating of Chohung Bank soon.

candidate and six directors agreed to a set of management goals and promised to hire outside experts. On April 14, at the shareholders meeting, they strengthened stock options for top managers, linking them to the profitability (or performance) of the bank. Regarding the governance structure, they decided to reduce the number of directors from 25 to 15 and executive (or standing) directors from 50% to 40%.¹⁸ They also made it clear that those who have a vested interest in the bank are not allowed to be elected as non-executive directors. In addition, they strengthened the requirement for the non-executive directors. The president agreed to a certain set of management goals. The bank stock price increased substantially on the day of the announcement.

(10) August 27, 1999: CAR = -6.05%

No significant event of board governance related banking reform is found.¹⁹

(11) December 14, 1999: CAR = +5.40%

On December 16, 1999, the 'Corporate Structure Reform Advisory Committee' at the Ministry of Justice announced a recommendation draft. On the same day, the Parliament passed the Revised Bank Law, Securities Law, Insurance Law, and other related laws. These laws include, among other things,

1. To promote healthy management of financial institutions, the ratio of outside directors are determined by the law, and
2. The audit committee of the bank should be established as part of the board, and two thirds of the committee members should be outsiders.

(12) January 5, 2000: CAR = +6.48%

The Minister of MOFE, Mr. Bong Gyun Kang, announced on January 4, 2000, that he is considering the establishment of the Financial Holding Company to meet the needs of the global scale of financial institutions and diversification of their operations. This was the first announcement regarding the holding company. In this case, the share holding restriction will be relaxed. On January 5, 2000, the government announced that it strongly encourages banks to adopt an executive stock option system through a special resolution at shareholder meetings in February because it is desirable to reform bank management.

(13) April 14, 2000: CAR = +10.88%

¹⁸ This seems consistent with the finding of Yermack (1996) that there is an inverse relation between firm's market valuation and the size of board of directors.

¹⁹ On August 26, 1999, a group of creditors announced the workout plan for Daewoo Group. Given Daewoo Group's heavy reliance on bank loans, it was a strong negative event for the banking industry. On the same day, a committee announced the first formal draft on 'The Standard for the Corporate Governance Structure', and the Ministry of Justice announced a draft of the Commercial Law Revision. Although these might have been a positive development from the corporate governance perspective, the announcement of Daewoo group's workout was a dominant, negative event.

On April 10, 2000, the Financial Supervisory Commission announced that listed companies should include clauses on the corporate governance structure when they submit required public documents such as operations reports or securities reports. On April 14, 2000, the Financial Supervisory Commission announced that Deutsche Bank is allowed to participate in the management of Seoul Bank and provide advice on board governance.

(14) May 17, 2000: CAR = -8.25%

No significant event of board governance related banking reform is found.²⁰

(15) May 25, 2000: CAR = +11.28%

On May 24, 2000, it was announced that 14 companies completed their work-out procedure earlier than expected. On May 25, 2000, Shinhan Bank and Hana Bank decided that their ex-CEOs would be converted from executive (standing) directors to non-executive (non-standing) directors after the FSC raised the question about the arrangement. This was motivated to prevent the banks from the dual governance system.

(16) June 1, 2000: CAR = -5.72%

No significant event of board governance related banking reform is found.²¹

(17) June 8, 2000: CAR = +7.09%

On June 8, 2000, the meeting of deputy ministers passed the Revised Bank Law draft that includes changes in the governance structure sponsored by the MOFE. It is expected to pass the cabinet meeting next week. The draft strengthens small shareholders' monitoring function and requires that half of the board members be outside directors and an audit committee be established.

(18) September 26, 2000: CAR = +5.32%

No significant event of board governance related banking reform is found.²²

²⁰ On May 17, 2000, it was revealed that the size of bad loans and losses in the banking sector were significantly larger than expected. The Financial Supervisory Commission announced its plan to induce the M&A between good quality banks and troubled banks, which was perceived as bad news because a good quality bank cannot merge with another good quality bank. Commentators expressed their concern and predicted the need for additional infusion of public money.

On May 14, 2000, the Financial Supervisory Commission (FSC) announced that banks should include items on the corporate governance structure (e.g., composition of the board, the audit committee, small shareholders' exercise of rights) in their quarterly report. We believe the negative news of large bad loans and losses on May 17 was strong enough to offset the positive announcement effect of the FSC on May 14.

²¹ On June 1, 2000, the troubled Hyundai Group announced its restructuring plan. It may have not been good enough news to the banking sector that lends enormous amount of loans to the group. There have been rumors about various M&A among banks. The Financial Supervisory Commission asked to refrain from spreading the unfounded rumors.

5. KIF survey results on banking reforms

A survey was undertaken in 2000 to assess the progress and current status of board governance in the banking sector. The survey was conducted by the Korea Institute of Finance in cooperation with the FSS (Financial Supervisory Service) and McKinsey. Seventy-two outside directors and 56 executive directors from 15 commercial banks took part in the survey. The numeral ratings are based on a scale of 1 (low) to 5 (high).²³

Overall, the survey finds substantial improvement in the board governance of the Korean banking sector. The directors who participated in the survey replied that the board acquired a significant amount of independence, and the authority of the board has been strengthened. The survey finds that board governance is considered essential in assessing the value of the firm. This is especially apparent in the response of foreign institutional investors. Another survey conducted by Professor Sang-Yong Park (1999) in collaboration with McKinsey, in which 64 institutional investors participated, find that the participants are willing to pay a premium of 24% on average for firms with outstanding corporate governance systems [see also Coombes and Watson (2000)]. This is a significant finding about the value of corporate governance. The banks with the best practice of governance proudly display their governance system in their website, and they use their governance system as an important instrument for investor relations. The directors who participated in the survey believe that the competitive advantage of the banks in the future will be decided not only by the hardware side, such as quality of the assets and capital adequacy, but also by intangible assets such as the governance system.

A brief summary of the survey results is provided in Table 6 [see also Appendix].

5.1. The survey results on board activities

5.1.1. *The Composition of the Board*

After the reform, outside directors became the majority of the board. The average number of directors on the board was 12, and 73.4% of directors were outside directors. The majority (80%) of the directors replied that the current number of directors on the board is adequate for supervising management. The desirable occupations for the outside directors were suggested in the order of bank executives, accountants, professors, and attorneys.

5.1.2. *The authority of the board*

The directors responded that the authority of the board has been enhanced after the outside directors became the majority of the board (3.7 out of 5 rating). This is an indication that the directors perceived the change in board composition positively. The directors of the major banks rated the authority of the board higher (4.0) than the directors of the local banks (3.4).

²² On September 26, 2000, the government made it clear that it intends to implement the second structural reform in the banking sector and plans to raise 40 trillion won (about 30.8 billion) of public funds to finance the reform.

²³ See also Kim and Chung (2000) for the discussion of governance structure of Korean banks.

The executive directors of the major banks (4.3) rated the authority of the board higher than the outside directors (3.7).

The board members answered that the board generally maintained independence (3.7 out of 5 rating). The major banks (3.9) were considered to maintain more independence than the local banks (3.4). The executive directors of the major banks (4.2) and the local banks (3.2) showed difference in opinion on the board independence.

The board members answered that their banks did not have major problems with the conflict of interests. The directors of the major banks (1.5) and the local banks (1.7) showed similar responses. The cases of personal loans or loans to related companies, or the cases of a friend or a relative of the director being employed are not frequent. There was not much difference in answers between the executive directors (1.6) and the outside directors (1.7).

The board members point out that the requirements for the board directors need to be specifically documented for board independence. Only 59% of major banks have documentation of director's qualifications, while 77% of local banks have the documentation.

5.1.3. Satisfaction with the role of the board

Directors' satisfaction level is above average and no severe dissatisfaction has been noted (3.3 out of 5 rating). The executive directors of the major banks (3.6) were generally more satisfied with activities of the outside directors than those of the local banks (2.7). The outside directors of the major banks (3.3) and the local banks (3.5) were generally satisfied with their own roles.

The performance of the chairman of the board was generally considered effective. The executive directors (3.7) of the major banks rated the chairman's performance higher than the outside directors (3.4) did. The outside directors (3.3) and the executive directors (3.3) of the local banks showed a similar opinion on the chairman's performance.

Unclear role division and lack of leadership hinder chairmen's performance and depress board performance. About 80% of the board members (88% of the outside directors) felt the need for specific documentation of the roles and the responsibilities of the board. Only 50% of banks have a basic description of board/committee duties. Even when they do, their effectiveness is deemed low (2.8). The majority (80%) of the banks do not have a job description for CEO or chairman. Even when they do, its effectiveness is considered low (2.3 average).

5.1.4. The chairman of the board/CEO

About two thirds (66%) of the board members were in favor of combining the bank CEO position and the chairman of the board. Seventy-three percent of the executive directors and 59% of the outside directors were in support of the combination.

5.1.5. Activities of the board and committees

The board members rated the board's activities to supervise and advise management to be higher than average. The executive directors of the major banks (3.9) rated substantially more highly the board activities than those of the local banks (2.6). However, there was not much difference between the outside directors of the local banks (2.9) and the major banks (3.1). The

reasons for the lack of board performance mentioned by the board members were that the outside directors lack professional knowledge and that the banks do not supply the board with sufficient and adequate information.

Regarding the measures to improve board activities, the majority of respondents (82%) agreed that they need to appoint a business-oriented person as a board member. On appointing a risk management specialist as a board member, 82% responded yes. On changing the director's term to one year, only 29% said yes. On replacing directors with low performance, 69% responded yes.

The overall committee activities under the board were rated average, although those of the local banks (2.7) were considered below average. The reason for inefficient committee activities was that the committees were not provided with sufficient information and that the committees lack legal authority over management. The plan to replace the current statutory audit system with the audit committee system was supported by 49% of the directors. Sixty-one percent of the outside directors felt the need for the audit committee. However, only 33% of the executive directors were in support of the committee.

5.2. The survey results on management compensation

5.2.1. The evaluation of the board and the directors

Overall, the board members rated the current performance evaluation criteria as average, whereas the executive directors of the local banks (2.7) rated it below average. About half (53%) of the board members were considered to have a higher level of competence and make a positive contribution to the board activities. A third (33%) of the board members were considered to have a fair level of competence and contribution and were in need of training. About 14% of the board members were considered to be incompetent. More than half (60%) of the outside directors were considered to be either in need of training or were considered incompetent. The executive directors and the outside directors showed similar responses.

The specific reasons for the lack of contribution were the lack of professional knowledge and participation in the board meetings. The board members suggested several ways to motivate the board activities. These include appointing risk management specialists (82%), or personnel with commercial business backgrounds (69%), or replacing the directors of low contribution (9%). The executive directors and the outside directors showed similar responses. The methods suggested for replacing incompetent outside directors were across-the-board resignation, persuading them to resign, and a shareholders' resolution. Changing the directors' term to one year did not receive much support.

The executive directors, including the bank CEO, were reluctant to be individually evaluated by the board. The executive directors of the major banks (3.2) seemed more receptive to the idea of individual performance evaluation relative to those of the local banks (2.4). The outside directors of the major banks (3.8) showed higher support than the outside directors of the local banks (3.4).

The idea of the board evaluating the management as a whole and delegating the individual evaluation of the executive directors to the bank CEO was very much supported by the executive directors. The executive directors (85%) showed more support than the outside directors (65%). The executive directors of the major banks (90%) showed the highest support.

The outside directors of the local banks (77%) showed more support than those of the major banks (56%).

5.2.2. The board and the management compensation

The board members responded that the current level of compensation did not reflect performance. The board members of the major (local) banks suggested that the performance-based incentives should be 41% (31%) of overall payments. The board members of the local banks (4.0) and the major banks (4.7) both showed strong support for the plan to give stock options to the executive directors. The executive directors (4.9) and outside directors (4.5) of the major banks showed stronger support than those of local banks. The executive directors (4.1) and the outside directors (3.9) of local banks did not show much difference in opinion.

There was a significant difference on the plan to give stock options to the outside directors. The executive directors of the major banks (3.6) support the plan, while those of the local banks (2.2) were against it. The executive directors (3.6) and the outside directors (3.8) of the major banks did not show much difference in opinion. There was a significant difference between the executive directors (2.2) and the outside directors (3.1) of the local banks. Obligating the outside directors to hold the bank's stocks received more support from the outside directors of the major banks (3.2) than those of the local banks (2.6).

The directors generally felt that the level of compensation needs to be raised. The adequate level of payment suggested for the CEO by the board members of the major banks was much higher than that suggested by those of the local banks. The adequate level of payment suggested for the major bank CEOs was 400 million won (about \$308,000) plus stock options, whereas 200 million won (about \$154,000) plus stock options was suggested for the local bank CEOs. This is much higher than the current level of payment for bank CEOs, which is 130 million won (about \$100,000) for the major banks and 88 million won (about \$67,700) for the local banks.

6. Summary and concluding remarks

We have investigated the stock market's response to various banking reforms in Korea after the Asian financial crisis, focusing on the reforms in board composition and executive compensation and provided some appraisal of the banking reform. Economists tend to hold different views on the importance of the banking sector in affecting the rest of the economy. There has been some debate in Korea regarding the order of the various sector reforms in Korea. Employing a time-series analysis, we find that the banking sector has become more Granger-causally prior to both the Korean stock market (KOSPI returns) and the finance sector after banking reforms. In addition, banking return volatility has become more strongly Granger-causally prior to KOSPI return volatility after the crisis. These findings lend support for the view that banking sector reform after the financial crisis may have helped lead the rest of the economy.

The empirical evidence on the relation between board composition and firm performance has been mixed, using mostly cross-sectional comparisons. Using a variation of the event study method due to ongoing nature of reforms, we have investigated the stock market's (or investors') response to announcements of various stages of banking sector reforms. We find

that 12 out of 18 (67%) dates of unusual high/low abnormal returns of the banking sector are associated with banking sector board governance related reforms for the sample period. This finding implies that the banking reforms were strongly and positively received by the market. In particular, we find that six dates of unusual high abnormal returns (e.g., 3/3/1998, 1/14/1999, 4/12/1999, 12/14/1999, 5/25/2000, and 6/8/2000) are related to events associated with outside directors, which suggests a significant relation between board composition and the market-based measure of corporate performance. This finding seems consistent with Rosenstein and Wyatt (1990). We also find that three dates of unusual high abnormal returns (e.g., 1/14/1999, 4/12/1999, and 1/5/2000) are related to the introduction (or strengthening) of executive stock options or other compensation, and at least one date (e.g., 12/14/99) is related to the committee structure (i.e., audit committee). Among 18 dates of unusual abnormal returns, there are 12 positive CARs and 6 negative CARs. Five negative CARs are related to banking cash flows either by capital requirement or additional funding.

We have also examined bank managers' perceptions about the banking reform based on the survey results conducted by the Korea Institute of Finance and McKinsey, respectively. The participants in the KIF survey indicate that, among other things, board governance is essential in assessing the value of the firm. The participants in the McKinsey survey indicate that they are willing to pay a premium of 24% on average for firms with outstanding corporate governance systems.

Despite the remarkable recovery from the financial crisis, the Korean economy still remains fragile. This is in part due to the fact that the financial reform that includes corporate governance reform has not been fully completed, and further improvements are required to strengthen the financial system. The government-driven reform may have been quite effective in building a public consensus on the need for financial reform, but the private sector has yet to show a more positive attitude towards the reform. In order to sustain the initial spirit of the reform, the market needs to lead the reform, motivating the private sector with profitable incentives. Given the market's positive response to banking reforms, this will help increase the shareholders' value and contribute to enhancing the competitiveness of the Korean economy.

Appendix: More on the Survey results

1. The problems of board management

(1) *Ambiguous roles of the board and the management:* The survey shows that a major problem with the board management is that the roles of the board and management are ambiguous. The duties of the board and the committees are also unclear and not explicitly specified. Currently, the majority (80%) of the banks do not have a job description of the board. Even when the roles and duties are stated, they often disagree on interpreting their roles and on specific issues.²⁴ Management and the board even have different opinions on who should chair the shareholders' meeting.

(2) *Inadequate board resolution item:* A problem that is often mentioned regarding the lack of board authority is that most items in the agenda are report items, whereas very few are resolution items. This makes it difficult for the board to carry out its roles. Presently, the board resolution items are restricted to those that are stipulated only in the board regulation. Thus, it is difficult for the board to participate in important issues that are not specifically stated in the board regulation.

(3) *Inactive committee functions:* Because most of the items in the agenda are discussed and decided in board meetings and the authorities of the board are not being delegated enough to committees, the functions of the various committees under the board are very weak. This makes it difficult for the committees to carry out their functions to discuss and decide the agendas. Most of the committees only review the agendas that are scheduled to be placed before the board. This forces the board to hold unnecessary meetings to make resolutions for every agenda, thus rendering board management inefficient.

(4) *Lack of professional knowledge and transparency of board members:* Another reason for the board being inactive is that it does not consist of business experts. There are board members who have little understanding of the agenda and the issues. Some of the outside directors show little interest and low participation in the board activities. The process of appointing the directors is still not transparent. The government still has direct and indirect influences over the major banks in appointing the bank's directors. The survey shows that the bank CEO does not have authority in appointing the board members.

2. The problems of performance evaluation and compensation

(1) *Performance evaluation:* According to the survey, the item 'Performance Evaluation and Compensation' that is considered one of the most important functions of the board of the banks in the advanced countries, is not considered serious by Korean banks. Seventy percent of the banks do not have an official procedure to evaluate the bank CEO's performance, and 80% of the banks do not have a standard for performance evaluation of management. Even

²⁴ For example, on the issue of moving or closing a branch office, the management believes that this should be their decision because it is in the ordinary course of business matters. On the other hand, the board believes that this should be decided by the board, because it is stipulated as a board resolution item.

when they do have a standard, it is not specific. This makes it difficult for the CEOs to be compensated for their performance.

One of the fundamental problems is the lack of a well-specified profit index, which is the most important criterion for management performance evaluation, to be used for performance assessment. Instead of the profit index, the growth rate of deposit has long been used as the bank's short-term objective, although it is not an adequate standard for performance criteria. However, the bank's short-term objective along with the performance criteria is changing recently to profitability. Still, an accurate cost accounting system needs to be established as a prerequisite for an effective profit assessment system.

(2) *Performance-based compensation and stock options:* In the past, compensation was not linked to performance in Korean banks. The level of base pay needs to be enhanced for top management, and difference of salary among the positions needs to be more distinguished. Compared to the foreign banks, the compensation system of the domestic banks is very fragile. For example, in 1998, the compensation of a typical CEO of a bank in Korea consists of 77% base salary and 23% annual incentive, whereas that of a typical CEO of the top 20 banks in the U.S. consists of 15% base salary, 34% annual incentive, 28% stock options, 14% restricted stock, and other compensations.

The performance-based incentive should be given on the basis of a short-term goal or budget. All of the means of hidden compensation in the past scheme need to be reflected in the base salary for a transparent compensation scheme. The proportion of performance-based compensation should be higher in the higher levels of bank hierarchy. Obligating all directors and executive officers to own the bank's stock in order to relate their interest with that of the stockholder's equity should be considered.

Stock options can be given to the CEO and the board members as a long-term incentive scheme to maximize the shareholder's wealth. The merits of stock options do not interfere with business efficiency, and they can solve the problems of conflicts of interests. Stock options also monitor the moral hazard of management.

As pointed out by Brunello, Graziano, and Parigi (2001), an important element for a successful and effective stock option plan is the establishment of a performance-oriented corporate culture. As the implicit regulation hypothesis by Jensen and Murphy (1990) suggests, compensation in Korea has not been effectively used as an incentive for top executives in the past. In addition, for a successful stock option plan, the activities of the compensation committee need to be enhanced, and the stock option plan needs to be consulted with an outside expert.

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Table 1. Simple statistics: Daily data, 1995:1:3 - 2001:7:2 (1772 observations)

Index	sample period	observations	mean(%)	std. dev
Panel A: Index returns:				
KOSPI	95:1:4 -01:7:2	1771	-0.03034	2.23338
KOSPI	95:1:4 -97:9:30	794	-0.04402	1.16203
KOSPI	97:10:1 -01:7:2	977	-0.01929	2.81929
Finance	95:1:4 -01:7:2	1771	-0.03691	3.11347
Finance	95:1:4 -97:9:30	794	-0.10248	1.88435
Finance	97:10:1 -01:7:2	977	0.01638	3.83255
Banking	95:1:4 -01:7:2	1771	-0.08845	3.04428
Banking	95:1:4 -97:9:30	794	-0.08724	1.66180
Banking	97:10:1 -01:7:2	977	-0.08942	3.81619
Spread	95:1:4 -01:7:2	1771	-0.05807	2.50463
Spread	95:1:4 -97:9:30	794	-0.04323	1.45143
Spread	97:10:1 -01:7:2	977	-0.07013	3.10879
Panel B: Index prices:				
KOSPI	95:1:4 -01:7:2	1771	783.8426	225.7158
Finance	95:1:4 -01:7:2	1771	551.1599	223.8344
Banking	95:1:4 -01:7:2	1771	310.2723	184.4996

notes: 1. $\text{Spread}_t = \text{banking return}_t - \text{kospi return}_t$

2. KOSPI excludes Finance sector, and Finance excludes Banking sector.

Table 2. Cross-correlations between returns and between return volatility

X(t) Y(t-k)											
K =	-5	-4	-3	-2	-1	0	1	2	3	4	5
banking KOSPI 95:1:4 -01:7:2											
	-0.027	0.022	0.009	-0.039	0.067	0.587	0.046	-0.022	0.004	-0.010	-0.061
banking KOSPI 95:1:4 -97:9:30, pre-crisis period											
	0.033	-0.005	0.076	0.083	0.147	0.519	-0.020	-0.111	-0.022	0.004	0.040
banking KOSPI 97:10:1 -01:7:2, post-crisis period											
	-0.035	0.026	-0.002	-0.057	0.055	0.597	0.056	-0.008	0.006	-0.011	-0.075
bankingv KOSPIv 95:1:4 -01:7:2											
	0.154	0.171	0.181	0.258	0.231	0.423	0.128	0.137	0.191	0.179	0.161
bankingv KOSPIv 95:1:4 -97:9:30, pre-crisis period											
	0.110	0.042	0.115	0.076	0.071	0.276	0.080	0.055	0.058	0.103	0.077
bankingv KOSPIv 97:10:1 -01:7:2, post-crisis period											
	0.062	0.085	0.094	0.184	0.154	0.365	0.035	0.046	0.107	0.092	0.072

notes: 1. bankingv and KOSPIv denote return volatilities in banking sector and KOSPI index.

2. KOSPI excludes Finance sector, and Finance excludes Banking sector.

Table 3. Unit root and cointegration tests

Panel A. Unit root tests of index price

(a) Augmented Dickey-Fuller regression: $\Delta x_t = \rho_0 + \rho x_{t-1} + \sum_{i=1}^n \delta_i \Delta x_{t-i}$

(b) Phillips-Perron regression: $x_t = \alpha_0 + \alpha x_{t-1} + u_t$

Variables(x_t)	Dickey-Fuller Test		Phillips-Perron Test	
	n = 2	n = 4	k = 2	k = 4
KOSPI	-1.659	-1.691	-1.702	-1.704
finance	-2.181	-2.269	-2.273	-2.292
banking	-1.170	-1.246	-1.370	-1.368
Spread	-23.280*	-20.040*	-36.161*	-36.100*

Panel B. Cointegration test

Regressions:

(1) $\text{banking}_t = \alpha_1 + \beta_1 \text{KOSPI}_t + S_{1t}$

(2) $\text{banking}_t = \alpha_2 + \beta_2 \text{finance}_t + S_{2t}$

(3) $\text{finance}_t = \alpha_3 + \beta_3 \text{KOSPI}_t + S_{3t}$

Variables(x_t)	Dickey-Fuller Test		Phillips-Perron Test	
	n = 2	n = 4	k = 2	k = 4
S1t	-1.142	-1.243	-1.152	-1.151
S2t	-1.145	-1.192	-1.137	-2.224
S3t	-2.259	-2.358	-2.203	-2.224

notes: 1. KOSPI, finance, and banking are index prices. KOSPI excludes Finance sector, and Finance excludes Banking sector.

2. $\text{Spread}_t = \text{banking return}_t - \text{KOSPI return}_t$

3. For the cointegration tests of the spreads S_i for $i = 1, 2, 3$, and 4, critical values with 100 (200) observations are 10%, -3.03 (-3.02); 5%, -3.37(-3.37); and 1%, -4.07(-4.00), respectively. [see Engle and Yoo (1987, Table) p.157]

The spreads S_i for $i = 1, 2$, and 3 denote the residuals from the above regressions (1) to (3); n, k = the number of lags in tests; Significant at the 10% level.

Table 4 Granger-causality tests using returns: Trivariate model

$$Y_t = b_0 + \sum_{i=1}^5 \phi_i Y_{t-i} + \sum_{i=1}^5 \lambda_{1i} X1_{t-i} + \sum_{i=1}^5 \lambda_{2i} X2_{t-i}$$

Y	period	X1 X2	F-stat F-stat	p-value p-value	
Banking	95:1:4 -01:7:2	KOSPI Finance	F(5,1745) = F(5, 1745) =	0.64609 0.46603	0.66453 0.80176
Banking	95:1:4 -97:9:30	KOSPI Finance	F(5,773) = F(5,773) =	4.25210 2.12348	0.00080 0.06070
Banking	97:10:1 -01:7:2	KOSPI Finance	F(5,972) = F(5,972) =	0.37222 0.36932	0.86786 0.86979
KOSPI	95:1:4 -01:7:2	Banking Finance	F(5,1745) = F(5,1745) =	0.66147 1.35338	0.65276 0.23914
KOSPI	95:1:4 -97:9:30	Banking Finance	F(5,773) = F(5,773) =	3.02226 1.74896	0.01038 0.12109
KOSPI	97:10:1 -01:7:2	Banking Finance	F(5,972) = F(5,972) =	0.75644 1.12747	0.58140 0.34392
Finance	95:1:4 -01:7:2	KOSPI Banking	F(5,1745) = F(5,1745) =	1.35914 1.02280	0.23686 0.40249
Finance	95:1:4 -97:9:30	KOSPI Banking	F(5,773) = F(5,773) =	1.19423 1.35850	0.31015 0.23784
Finance	97:10:1 -01:7:2	KOSPI Banking	F(5,972) = F(5,972) =	0.99825 0.55444	0.41757 0.73500

Notes: 1. Y, X1, X2 are returns of the KOSPI, finance sector, and banking sector, respectively, depending on the model as indicated in the table. KOSPI excludes Finance sector, and Finance excludes Banking sector.

Table 5. Granger-causality tests using return volatility: Trivariate model

$Y_t = b_0 + \sum_{i=1}^5 \phi_i Y_{t-i} + \sum_{i=1}^5 \lambda_{1i} X1_{t-i} + \sum_{i=1}^5 \lambda_{2i} X2_{t-i}$					
Y	period	X1 X2	F-stat F-stat	p-value p-value	
Banking	95:1:4 -01:7:2	KOSPI Finance	F(5,1745) = F(5,1745) =	4.60275 0.46272	0.00035 0.80420
Banking	95:1:4 -97:9:30	KOSPI Finance	F(5,773) = F(5,773) =	3.05315 3.31943	0.00975 0.00566
Banking	97:10:1 -01:7:2	KOSPI Finance	F(5,972) = F(5,972) =	1.68127 0.36727	0.13635 0.87114
KOSPI	95:1:4 -01:7:2	Banking Finance	F(5,1745) = F(5,1745) =	15.21075 2.27152	0.00000 0.04520
KOSPI	95:1:4 -97:9:30	Banking Finance	F(5,773) = F(5,773) =	4.53918 8.37387	0.00043 0.00000
KOSPI	97:10:1 -01:7:2	Banking Finance	F(5,972) = F(5,972) =	7.17512 1.67812	0.00000 0.13711
Finance	95:1:4 -01:7:2	KOSPI Banking	F(5,1745) = F(5,1745) =	1.59628 3.87000	0.15789 0.00171
Finance	95:1:4 -97:9:30	KOSPI Banking	F(5,773) = F(5,773) =	2.00953 6.11655	0.07517 0.00001
Finance	97:10:1 -01:7:2	KOSPI Banking	F(5,972) = F(5,972) =	1.10441 2.05513	0.35631 0.06877

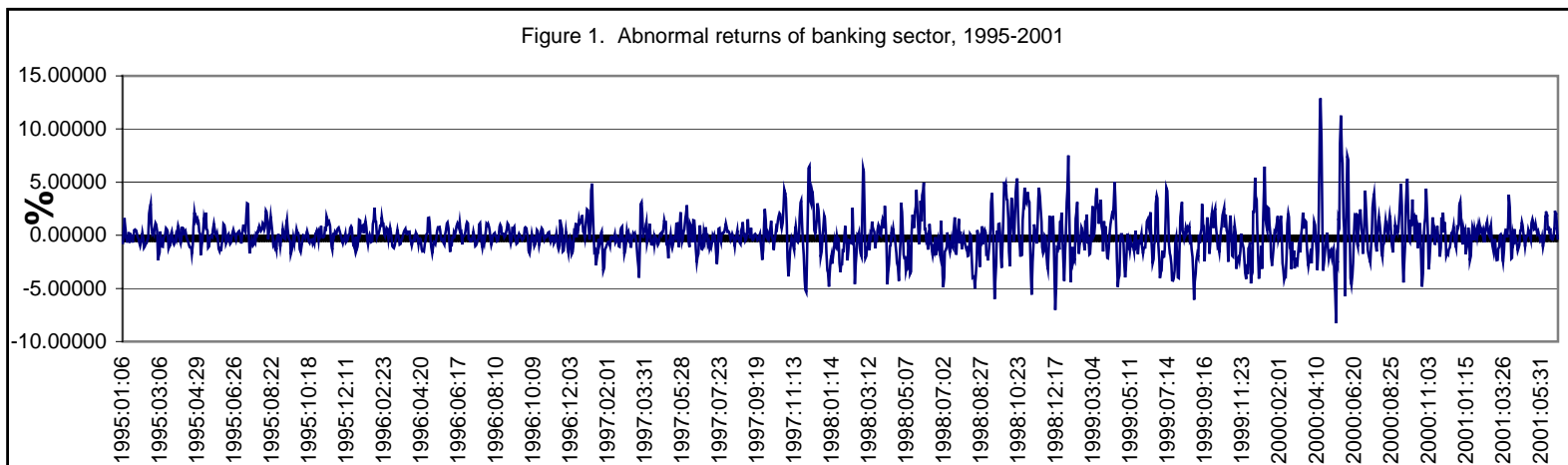
Notes: 1. Y, X1, X2 are return volatilities of the KOSPI, finance sector, and banking sector, respectively, depending on the model as indicated in the table. KOSPI excludes Finance sector, and Finance excludes Banking sector.

Table 6. Summary of survey results

Item	Results
the composition of the board	the average number of directors on the board: 12 outside directors: 73.4% of directors the current number of directors on the board is adequate for supervising management: 80%
the authority of the board	the authority of the board has been enhanced after the outside directors became the majority of the board: 3.7 out of 5 rating MB = 4.0, LB = 3.4; ED of MB = 4.3, NED of MB = 3.7 the board generally maintained independence: 3.7 out of 5 rating MB = 3.9, LB = 3.4; ED of MB = 4.2, NED of MB = 3.2 their banks did not have major problems with the conflict of interests MB = 1.5, LB = 1.7; ED of MB = 1.6, NED of MB = 1.7
satisfaction with the role of the board	directors' satisfaction level: 3.3 out of 5 rating ED of MB = 3.6, ED of LB = 2.7, NED of MB = 3.3, NED of LB = 3.5 The performance of the chairman of the board ED of MB = 3.7, ED of LB = 3.3, NED of MB = 3.4, NED of LB = 3.3
activities of the board and committees	the board's activities to supervise and advise management ED of MB = 3.9, ED of LB = 2.6, NED of MB = 3.1, NED of LB = 2.9
the evaluation of the board and the directors	the idea of individual performance evaluation ED of MB = 3.2, ED of LB = 2.4, NED of MB = 3.8, NED of LB = 3.4
the board and the management compensation	the plan to give stock options to the executive directors ED of MB = 4.9, ED of LB = 4.1, NED of MB = 4.5, NED of LB = 3.9 the plan to give stock options to the outside directors ED of MB = 3.6, ED of LB = 2.2, NED of MB = 3.8, NED of LB = 3.1

Note: ED = Executive director; NED = Non-executive director; MB = major bank; LB = local bank

Figure 1. Abnormal returns of Banking Sector, 1995-2001



Comments on “Korean bank governance reform after the Asian financial crisis”

Dongsoo Kang
Fellow, KDI

This paper attracts attentions from both policy makers and academic researchers in that the authors attempt to quantify the effects of bank restructuring policies after the Korean financial crisis, to identify them with chronological events, and then to support the causes by providing relevant survey results on corporate governance. The paper sounds very compatible with the intentions of the policy makers and the initial guesses of the researchers. In this aspect, this paper brings comforts and complacency to many people that have been deeply involved in the restructuring policies.

The main theme of the paper is that the restructuring policies prioritized to and concentrated on the banking sector has led the recovery not only of the other financial sector but also of the real sectors. This argument is addressed by the Granger-causality tests based on the stock market data. The time-series data on the stock market is deemed to be the best available statistics in the rigorous and objective analysis concerning the measurement of the policy effects, but they have limited implications in the sense that they carry the market participants' expectations and evaluations rather than the actual effects. Another limitation should be taken into account in inferring the policy implications from the stock market data that a few, but significant banks have been de-listed and re-listed during the sample period under scrutiny so that the bank stock index may not represent the entire banking sector properly. To answer to these types of criticism, it may be advisable for the paper to provide empirical evidence at the micro level of individual banks by distinguishing sound banks from unsound ones.

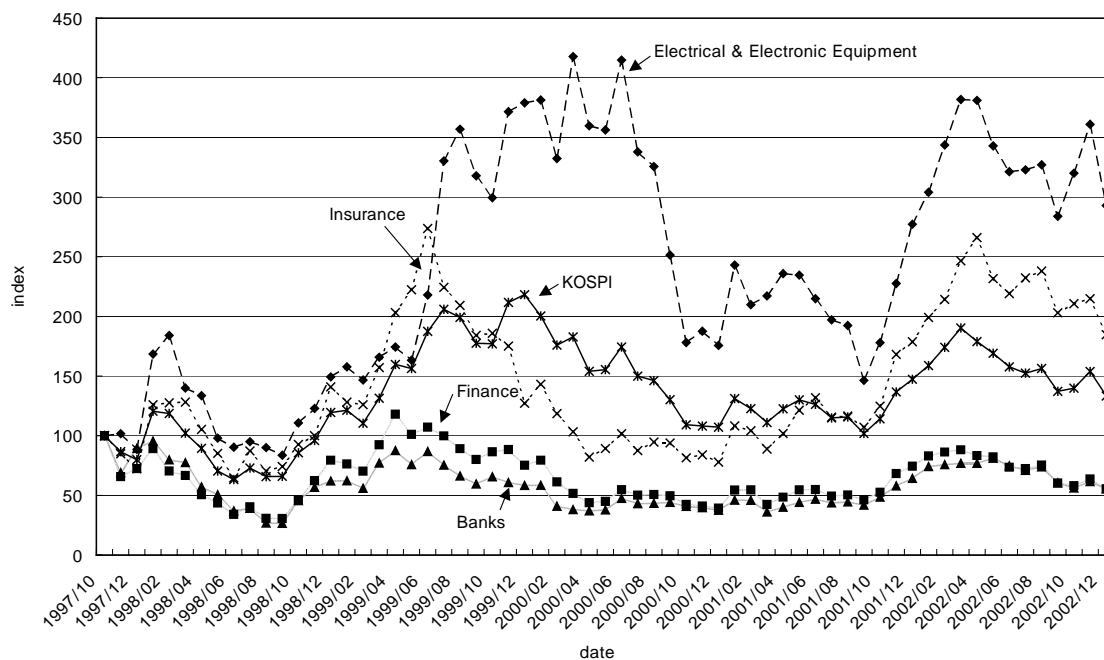
Despite the partial deficiency including the aforementioned limitations, the main arguments still survive. Lower frequency data set like monthly indices or returns rather than daily ones used in the paper seem to reinforce the effects of the banking sector restructuring on the others that this paper argued. The following graph shows the phenomenon that the banks' performance has been ahead of the others'. The upward slopes of the bank index during the booms lead the others' slope in a month or two and the same to the downward slopes, too. Furthermore, banks' returns are quite highly correlated (about 25%) with the lag of the other sectors' in the monthly data than the daily ones. This may imply that the banking sector reform has had persistent effects on the entire economy.

It is pointed out in this paper that corporate governance is most important, though not the most important, factor that has driven the stock market relative performances among various sectors. Namely, improvement in the governance structure and regulation in the banking sector

helps the price of the bank shares immediately and then boosts others' prices with some intervals. These arguments sound highly probable, but quite a natural conclusion unless more evidence is added. For example, an observationally equivalent result may be obtained if there exist certain macro events such as monetary easiness that affect the bank performances more positively than the other sectors. The paper would have become more persuasive by suggesting empirical facts and findings about the bank share price patterns, say alpha and beta of the banking in the CAPM.

Finally, the authors contain three different kinds of topics in a single paper with just vague cause-and-effect relationship. More editorial efforts are needed for the ideas, motivations and messages to sound univocal.

<Graph> Stock Market indices after the Financial Crisis in Korea



Expiration Day Effects in Korean Stock Market: Wag the Dog?

by
Chang-Gyun Park and Kyung-Mook Lim

Abstract

Despite great success of derivative market, regulators express concerns regarding the additional volatility due to expiration of derivative securities. The expiration day effect around the world varies depending on the structure of settlement procedure. This paper examines the impact of the expiration of KOSPI 200 derivatives on the underlying cash market in Korea Stock Exchange (KSE). The KOSPI 200 derivative market has a unique settlement price determination process since the closing price of stock market is determined by call auction during the last 10 minutes. We analyze typical maturity effects such as volume, volatility, and price effects on the expiration days. In addition, we explore the influence of the unique settlement procedure of KSE on the underlying cash market during the last 10 minutes.

I. Introduction

Stock index futures and options have been a great success story in Korea. After stock index futures and index options were introduced in 1997 and 1998 respectively, the trading volume and value of these financial derivatives have grown enormously and Korean derivative market has become one of the biggest derivative exchange markets in the world. Although there are other derivative markets, which have shown successful growth, the success of derivative market in Korea is rather extraordinary. As of 2002, the trading volume of index option in KSE is more than 16 times that of the second place market, EURONEXT (France).¹

The success of index derivative market is mainly due to its convenience in managing market risk exposure and leverage effects. In general, derivative trading is more convenient and less expensive than stock trading.

Despite this success, there have been some concerns regarding the effects of the introductions of these financial derivatives. Especially, the popular program trading is considered by market participants and popular media as a possible main force to generate additional volatility in the market. Since the U.S. stock market crash of October 1987,

¹ It is an intriguing research topic to investigate sources of the extraordinary volume of the KSE option market.

researchers have studied the adverse effects of derivative expiration on the underlying stock market.²

1. Related Literature

The most widely cited work on the maturity effect is a series of researches by Stoll and Whaley (1987, 1990, 1991). Stoll and Whaley (1987) have investigated the effects of large transactions on prices, and they found significant volatility on expiration days. As the response to the criticism on the effects of derivative expiration, the Chicago Mercantile Exchange (CME) imposed a new procedure on the future expiration. Beginning with the June 1987 S&P 500 futures contract, the last trading day was moved from Friday to Thursday with final settlement based on a "special"³ Friday opening for the underlying index. After this change in the market structure, Stoll and Whaley (1991) and others try to answer the following question. Has this change reduced expiration day effects? Stoll and Whaley and most other studies argue that this change has only moved the expiration effects to the Friday opening. That is, although the triple witching hour effects has been reduced or removed, the Friday opening preceding the expiration day is associated with greater price volatility than before this change.

After the derivative market became popular in other international markets, quite a few studies have analyzed the expiration day effects in each market. (Chamberlain, Cheung, and Kwan (1989) – TSE 300 Index on the Toronto Stock Exchange, Pope and Yadav (1992) – United Kingdom case, Schlag (1996) – DAX derivatives in Germany, Karolyi (1996) – Nikkei 225 index in Japan, and Stoll and Whaley (1997) AOI futures of the Sydney Futures Exchange) Most of these studies find similar expiration day effects in each market as in the case of the United States.

A recent notable paper by Chow, Yung, and Zhang (2002) explores the expiration day effects in Hong Kong. The Hang Seng Index derivatives traded in the Hong Kong Futures Exchange use a unique procedure for determining the settlement price of both index future and index option contracts. The final settlement price is determined by taking the average every 5-minute interval of the Hang Seng Index quotation on the expiration day. Their analyses show that there are almost no expiration day effects in Hong Kong derivative market. With some reservation, they argue this is due to the unique settlement price determination scheme in Hong Kong.

The concern regarding expiration day effects is no different in Korea. Popular media and financial analysts show interest on the expiration day whenever either options or futures expire. Despite these concerns, there are not many studies, which tackle these expiration day effects in the KSE directly.⁴ A few exceptions are Min (2000), and Che (2001). Previous studies using daily data have not found typical expiration day effects in the KSE.

In this paper, we analyze the expiration day effects in the KSE using minute-by-minute price and trading data. As other studies on expiration day effects, we explore the following four issues; i) volatility of underlying cash market on expiration day, ii) volume changes on

² It is called as triple witching hour effect since there are expirations of index future, index option, and individual options every three months.

³ See Table xx.

⁴ There are some studies regarding volatility and trading volume of futures over the maturity such as Seo, Um, Kang (1999) or regarding changes of volatility in the cash market after the introduction of derivatives such as .

expiration day, iii) price effect on the underlying index components, and iv) price reversal of underlying individual stocks after the expiration. As others have shown previously, there is no strong evidence of expiration day effects in the KSE using daily data. But if we concentrate our analyses on the later part of trading time on expiration day, there are significant expiration day effects. We try to interpret our result with the market microstructure of settlement determination procedure.⁵

This paper is organized as follows. Chapter 2 describes the market structure of derivatives in the Korean Stock Exchange. Chapter 3 analyzes the maturity day effect in the KSE and Chapter 4 concludes.

II. The Market Structure of Derivatives in the KSE

The maturity day effect depends on the market structure of derivative such as trading time, and settlement price determination process. So it is essential to understand the market microstructure of both derivative and cash markets.

1. Description of Cash Market

Orders submitted by investors are executed according to price and time priority, by means of periodic call auction⁶ and continuous auction. During regular trading hours (from 9:00 am to 2:50 PM), all orders are matched using continuous auction. Periodic call auction is utilized to determine a price after a period of trade suspension or in case where detailed information on securities market is lacking or unavailable. This method brings together all bids and offers submitted during a certain period of time and matches a single price. This price is determined at a level which all bids with prices higher than the price and all offers with prices lower than the prices are filled. This periodic call auction is regularly utilized to determine the opening price (from 8:00 am to 9:00 am) and the closing price (from 2:50 PM to 3:00 PM).

2. Description of Derivative Market

The underlying asset of stock index futures and options in the Korean Stock Exchange (KSE) is the KOSPI 200. It is a market capitalization weighted index composed of 200 major stocks listed on the KSE. Contract months of index futures are March, June, September, and December. As for the index option contract months are three consecutive near months plus one nearest from quarterly cycle.

The KSE also provides seven individual stock options on the blue chip stocks such as Samsung Electronics, SK Telecom, etc, since 2002. Considering the short period of existence and minute trading volume of these individual stock options, the introduction of these individual stock options would be negligible.

The unique part of derivative structure in the KSE is the settlement price determination process. On the last trading day of derivatives, the trading of matured derivative contracts ends

⁵ The importance of the market microstructure in derivative market has been emphasized several times by Stoll (1988), Stoll and Whaley (1997), and Chow, Yung, and Zhang (2002).

⁶ Sometimes it is called as batch auction.

at 2:50 PM. Then, the settlement price is set to the closing price of cash market, which is determined by the 10-minute call auction.

3. Possible Sources of the Maturity Effect

Most studies argue that the primary source of expiration day effect is from the cash settlement feature of index derivative contracts. Index arbitrage represents a trading activity that exploits mis-pricing between a derivative asset and its underlying cash market price.

Index arbitrage links the price of future or option contract to the level of the underlying index. In the absence of transaction costs, the equilibrium requires,

$$F = S(1 + r - d)$$

where F , S , r , and d represent index futures price, index cash price, riskless (risk free) interest rate, and dividend yield of the stock index over the remaining maturity. If this equality does not hold by some reason, arbitrageurs buy and sell the component of index and exploit this mis-pricing. At maturity, the derivatives contract self-liquidate since index futures and options call for cash settlement, while stock position should be liquidated through trade in the market place. Arbitrageur's trading activity could cause abnormal volume and return in underlying cash market.⁷

This can be easily observed by analyzing the program trading activity in the KSE. The following table shows the proportion of program trading in the KSE between March 2002 and June 2003. The trading volume in the KSE is larger during non-expiration day than during expiration day. However, the proportion of program is much bigger during expiration day than non-expiration day. This reflects the degree of program trading on expiration day.⁸

In Chapter 3, we analyze expiration day effects in the KSE and explore effects of unique settlement procedure described in this section.

Table 1. The Proportion of Program Trading in the KSE

	Arbitrage Trading	Non Arbitrage Trading	Total Program Trading	Total Trading Volume
Non-Expiration Day	1.20%	0.70%	1.90%	804,982
Expiration Day	3.90%	2.30%	6.20%	690,854

Note: From March 2002 to June 2003.

⁷ For more detailed description on the mechanism of expiration day effects, see Stoll (1988).

⁸ The proportion of program trading in the KSE is much smaller than that in the NYSE, which is over 20%.

Table 2. Specifications of the Derivatives Traded on the KSE

	Index Futures	Index Options	Equity Options
Underlying Asset	KOSPI 200		7 listed stocks (Hyundai Motor, KEPCO, Kookmin Bank, KT, POSCO, Samsung Electronics, SK Telecom)
Contract Months	March, June, September, December	Three consecutive near months plus one nearest from quarterly cycle (March, June, September, and December)	
Exercise Style	-	European	
Multiplier	KRW 500,000	KRW 100,000	10 shares
Last Trading Day	Second Thursday of the contract month		
First Trading Day	The day following the last trading day		
Trading Hours	09:00~15:15 (09:00~14:50 on the last trading day)		09:00~15:15
Trading Unit	One contract		
Tick Size & Value	0.05 point	- 0.05 point for 3 point or more of premium - 0.01 point for less than 3 point of premium	KRW 10~200
Type of Order	Limit order, Market order, Limit-or-market on close order, Best order		
Price Limit	10% of the previous day's closing price	-	-
Position Limit	Net position of 5,000 contracts	-	Net position of 50,000~200,000 contracts depending on the number of listed shares and trading volume of the underlying stock.

III. Empirical Analyses

1. Abnormal Return and Volatility: Daily Data Analysis

As discussed above, the expiration of derivative securities such as futures or options written on the KOSPI 200 Index is expected to accompany a high trading volume and significant fluctuation in prices of the underlying asset since program traders try to unwind their positions before the expiration of derivatives to avoid the cumbersome settlement procedure.

As the first step to investigate the price effects of derivative expiration in Korean stock market, we compare the average return of the Index for derivative-expiring Thursdays with the

average return for non-expiring Thursday. We construct the sample by collecting only Thursdays' observations to control for the possible presence of calendar effect in stock market.⁹

The institutional arrangement in the Korean Stock Exchange (KSE) in which all stocks included in the KOSPI 200 Index are traded allows us to split all Thursdays in the sample into three different groups; non-expiration (NE) Thursdays when neither futures nor options expire, Option-expiration Thursdays (OE) when options expire but no futures do, and Twin-expiration (TE) Thursdays¹⁰ when both futures and options expire. Our sample covers about five and half years' span from June 19, 1997 to December 26, 2002. The starting week was chosen simply because it was the first week just after the expiration of the last futures contracts issued before the first option contract was introduced. Except for national holidays and irregular closing days for various reasons, there are 269 Thursdays in the sample of which 42 are NE Thursdays and 21 are TE Thursdays.¹¹

One can expect to observe significantly different patterns of price movements between non-expiring Thursdays and expiring Thursdays if expiration-day effects indeed exist. Efforts to unwind positions taken by program traders to avoid settlement procedure make trading more active and present themselves in the form of abnormal daily returns, whether higher or lower, or higher volatilities on expiring Thursdays than ordinary Thursdays.

We calculate two different daily log-returns and their standard deviations for each Thursday; intra-day and inter-day. Intra-day return is the log difference between opening price and closing price on each Thursday and inter-day return is the log difference of closing prices between each Thursday and the immediately preceding trading day.¹²

Table 3. Daily Return and Volatility

		NE ¹⁾	OE ²⁾	TE ³⁾
Intra-day ⁴⁾	Mean	-0.0764	-0.3604	0.7537
	S.D.	2.3273	2.1170	2.9694
Inter-day ⁵⁾	Mean	0.0019	-0.1461	0.8545
	S.D.	2.6619	2.6243	3.3620
No. of Obs.		206	42	21

Note: 1) Non-expiration Thursdays when neither a future nor an option contract expires.

2) Option-expiration Thursday when an option contract expires.

3) Twin-expiration Thursdays when both a future and an option contracts expire.

4) Log-return between opening and closing prices on the corresponding Thursday.

5) Log-return between Thursday's closing price and Wednesday's closing price.

⁹ For a comprehensive and critical review of calendar effect in U.S. stock markets, see Schwert (2002).

¹⁰ They are often called as "double-witching" days.

¹¹ Options expired on April 12, 2000 and May 10, 2000 instead of April 13, 2000 and May 11, 2000 when they were supposed to expire, respectively. Moreover, June 2002 option and futures expired on Wednesday rather than Thursday since market was closed on Thursday. We drop the three observations from the subsequent analyses to maintain the uniformity of the sample.

¹² In most cases, it was Wednesday.

Table 3 shows mean returns and standard deviations of three groups. Mean return is highest in TE followed by NE and OE. The volatilities in terms of standard deviation are ranked in the same order. A casual inspection shows that there is no material difference in average return and standard deviation across three groups of Thursdays considering the magnitudes of standard deviations. To confirm the conjecture, we perform a series of formal statistical tests in Table 4. Table 4 reports the results of tests for equality of means and variances of different groups.

Assuming that daily returns, r_i 's are independently and identically distributed, one can show that the distribution of test statistic given in (1) is t-distribution with the degrees of freedom $(N_{NE} + N_j - 1)$ under the null hypothesis that there is no difference in means of the two groups under consideration.

$$t = \frac{\bar{r}^{NE} - \bar{r}^j}{s_p} \quad (1)$$

where $\bar{r}^{NE} = \frac{1}{N_{NE}} \sum_{i=1}^{N_{NE}} r_i^{NE}$, $\bar{r}^j = \frac{1}{N_j} \sum_{i=1}^{N_j} r_i^j$ along with $j = OE$ or TE and s_p is the standard deviation of the pooled sample defined as

$$s_p = \sqrt{\frac{(N_{NE} - 1)s_{NE}^2 + (N_j - 1)s_j^2}{(N_{NE} + N_j - 2)}}$$

with $s_j^2 = \frac{1}{(N_j - 1)} \sum_{i=1}^{N_j} (r_i^j - \bar{r}^j)^2$, $j = NE, OE, TE$.

On the other hand, it is also easy to show that the distribution of test statistic given in (2) is F-distribution with the degrees of freedom $((N_{NE} - 1), (N_j - 1))$ under the null hypothesis that there is no difference in variances of the two groups.

$$F = \frac{s_{NE}^2}{s_j^2} \text{ when } s_{NE}^2 > s_j^2 \text{ or } = \frac{s_j^2}{s_{NE}^2} \text{ when } s_j^2 > s_{NE}^2 \quad (2)$$

Table 4. Tests of Differences in Means and Variances of Daily Returns

	Difference in Means		Variance Ratios	
	Intra-day	Inter-day	Intra-day	Inter-day
NE vs. OE	0.2841 ¹⁾ (0.4652)	0.1480 (0.7423)	1.2086 ²⁾ (0.3947)	1.0288 (0.8639)
NE vs. TE	-0.8301 (0.1311)	-0.8526 (0.1743)	1.6279 (0.2004)	1.5953 (0.2199)

Note: 1) The number is the difference in means between NE and OE and the number in parenthesis is p-value of t-statistic to test the equality of means.

2) The number is variance ratio of NE and OE and the number in parenthesis is p-value of F-test to test the equality of variances.

In no case presented in Table 4 do we reject the null hypothesis of no difference in means. Moreover, we find no evidence for different patterns of volatility across three groups. The findings are in agreement with the results reported by Chen and Williams (1994) in that using observations on the inter-day returns of the NYSE Composite Index and the S&P 500 Index on triple-witching Fridays and non-triple-witching Fridays, they conclude that the differences of mean returns and standard deviations are statistically insignificant. The findings are, however, at odds with the prediction based on position unwinding on expiration days offered originally by Stoll and Whaley (1987).

2. Abnormal Return and Volatility: High Frequency Data Analysis

As discussed in Stoll and Whaley (1987) or Stoll and Whaley (1991), we expect to detect activities associated with position clearing on expiration days at the later stage of trading day since program traders, in general, have the tendency to postpone position unwinding as long as possible. Therefore, it is highly likely that we will not observe the predicted pattern of return structure, that is, unusual level of return and higher volatility simply because the unit interval is too lengthy to pick up characteristic pattern of returns for expiration days. One way to solve the identification problem is to use high frequency data. In other words, minute-by-minute price data for the KOSPI 200 Index are used to analyze each group separately. We examine means and their standard deviations of the Index's returns realized on Thursdays at 10-minute, 30-minute, and 60-minute intervals.

A slight change in notation facilitates subsequent analyses with high frequency data. First of all, define the rate of return on the KOSPI 200 Index at 10-minute¹³ intervals during one Thursday as

$$r_{i,t}^j = \frac{P_{i,t+1}^j - P_{i,t}^j}{P_{i,t}^j}$$

where $P_{i,t}^j$ is the Index level at the beginning of interval t on Thursday i with $j=NE, OE, TE$.

The mean return for an expiration day and a non-expiration day is then defined as

$$\bar{r}_i^{-j} = \frac{1}{N_{j,i}} \sum_{t=1}^{N_{j,i}} r_{i,t}^j$$

where $N_{j,i}$ is the number of 10-minute intervals on Thursday i of type j . Finally, the mean return of type j Thursdays over the sample period is defined as

$$\bar{r}^{-j} = \frac{1}{N_j} \sum_{i=1}^{N_j} \bar{r}_i^{-j}$$

The t-statistic given in (1) along with the standard deviation of the pooled sample can be used to examine the equality of the mean returns between NE and OE or between NE and TE. In addition, we use the variance ratio test described in (2) to compare the return volatilities between non-expiration and expiration Thursdays.

The first column of Table 5 reports the difference in mean returns and variance ratio between NE and OE Thursdays at 10-minute, 30-minute, and 60-minute intervals. We cannot find any evidence of abnormal returns, higher or lower, on option-expiring Thursdays compared to

¹³ Returns at 30-minute and 60-minute intervals are defined and analyzed analogously.

non-expiring Thursdays, which is in accord with the case of daily returns. The variances of returns at 30-minute and 60-minute intervals do not show statistically different magnitudes between NE and OE Thursdays, which also coincides with the result with daily returns. However, the return fluctuations on option-expiration Thursday seem to be much more volatile than those on non-expiration Thursdays.

As for the comparison between NE and TE Thursdays illustrated in the second column of Table 5, one can find somewhat marginal evidences for difference in mean returns. The test statistics for mean differences are significantly different from zero at 10% significance level in the case of 30-minute and 60-minute returns. Although the finding can be used as an argument to support the existence of abnormally high returns¹⁴ when options and futures expire on the same

Table 5. Test of Differences in Means and Variances of High Frequency Returns

		NE vs. OE	NE vs. TE
Mean Difference	10 minutes	0.0150 ¹⁾ (0.3131)	-0.0175 (0.3934)
	30 minutes	0.0175 (0.6389)	-0.0864* (0.0914)
	60 minutes	0.0291 (0.7294)	-0.1751* (0.0788)
Variance Ratio	10 minutes	1.2512 ^{2), 3)} (0.0000)	1.7439*** (0.0000)
	30 minutes	1.0936 (0.2403)	1.4838*** (0.0002)
	60 minutes	1.1567 (0.1814)	1.6943*** (0.0006)

Note: 1) The number is the difference in means between NE and OE and the number in parenthesis below is p-value of t-statistic to test the equality of means.

2) The number is variance ratio of NE and OE and the number in parenthesis below is p-value of F-test to test the equality of variances.

3) ^{*)} : The null hypothesis is rejected at 10(1)% significance level.

day, the evidence is not overwhelming but marginal in the sense that, if we were indeed able to identify the presence of abnormally high returns on twin-expiration Thursdays by increasing the sampling frequencies for a given time span, the test statistic for mean differences at 10-minute intervals should have been statistically significant. On the other hand, we can conclude that returns on TE Thursdays are much more volatile than those on NE Thursdays. The conclusion is supported by all cases we considered in Table 5 and the evidence is overwhelmingly contrary to the cases of mean differences.

¹⁴ Since the test statistic is negative with a statistical significance, it implies abnormally high mean returns on TE Thursdays.

In sum, analyses up to this point reveal the fact that by employing daily instead of high frequency sample, we must have missed a different pattern of return volatility among three groups of Thursdays and may have failed to pick up abnormally high mean return on TE Thursdays compared to NE Thursdays. In addition, the choice of observational scheme concerning the sampling frequency brings no material difference into the conclusion when we make comparison of return structures on NE and OE Thursdays.

As an additional check for abnormal return and volatility on expiration days, we also investigate the last 10-minute, 30-minute, and 60-minute returns before the market closes on each Thursday. Aside from being another test for the existence of expiration-day effects, there are two more reasons we examine the behavior of returns just before the market closes. First, the literature on stock market microstructure has suggested that intra-day trading volume and return variance tend to follow a U-shaped pattern during a trading day. Second, as Stoll and Whaley (1987) argue, the efforts to unwind the positions by program traders are likely to center around closing time since they have every incentive to postpone taking the offsetting positions. Therefore, it is of interest to examine whether there is any distinguishable behavior in returns of the Index just before the market closes. Table 6 presents the results of last 10-minute, 30-minute, and 60-minute returns of NE and OE Thursdays (first column) and of NE and TE Thursdays (second column). It can be seen from the first column of the table that there is a strong evidence of price effects, abnormal return and high volatility on OE Thursdays, for all cases. Evident from the level of p-values, it is also true that the evidence of price effects become stronger as we shorten the comparison window from 60 minutes to 10 minutes. The last 60-minute mean return on OE Thursdays is lower by about 10 times in magnitude (-0.4362 versus -0.0438) and its variance is about 1.7 times larger (1.9119 versus 1.1226) than on NE Thursdays. On the other hand, the last 10-minute mean return on OE Thursdays is lower by about 37 times in magnitude (-0.4644 versus -0.0125) and its variance is about 7 times larger (1.0519 versus 0.1487) than on NE Thursdays. Turning to the comparison between NE and TE Thursdays, the differences in means and variances are much bigger. The last 60-minute mean return on TE Thursdays is higher by about 20 times in magnitude (0.8307 versus -0.0438) and its variance is about 3 times larger (3.4662 versus 1.1226) than on NE Thursdays. The last 10-minute mean return on TE Thursdays is higher by about 35 times in magnitude (0.4378 versus -0.0125) and its variance is about 10 times larger (1.5373 versus 0.1487) than on NE Thursdays. In general, the above results suggest that we do have strong evidence that the last 60 minutes, 30 minutes, and 10 minutes on expiration days are associated with considerable abnormal returns and very volatile movements of the Index. We also find that there exists a downward price pressure on the underlying stock index during Thursdays when only options expire.¹⁵ Strangely enough, expirations of both options and futures on the same Thursday apply an upward instead of downward pressure to prices on the stock market. It is very difficult to figure out the reason why pressures on stock price movements work in opposite directions on two groups of expiration Thursdays.¹⁶

¹⁵ The finding agrees with the results of Pope and Yadev (1992) in UK case and Stoll and Whaley (1991) in US case.

¹⁶ For a reasonable account of the puzzling discovery, we may need to scrutinize transactions and quotes (TAQ) data tapes provided by the KSE. By doing so, we can identify who placed buy or sell order in stock market during the time we are interested in and what positions they take in derivatives.

Table 6. Test of Differences in Means and Variances of Returns

		NE vs. OE	NE vs. TE
Mean Difference	Last 10 minutes	0.4520*** ¹⁾ (0.0000)	-0.4503*** (0.0002)
	Last 30 minutes	0.3119** (0.0455)	-0.7336*** (0.0009)
	Last 60 minutes	0.3924** (0.0396)	-0.8744*** (0.0011)
Variance Ratio	Last 10 minutes	7.0742*** ^{2), 3)} (0.0000)	10.3374*** (0.0000)
	Last 30 minutes	2.0988*** (0.0058)	4.1766*** (0.0005)
	Last 60 minutes	1.7031** (0.0441)	3.0875*** (0.0047)

Note: 1) The number is the difference in means between NE and OE and the number in parenthesis below is p-value of t-statistic to test the equality of means.

2) The number is variance ratio of NE and OE and the number in parenthesis below is p-value of F-test to test the equality of variances.

3) **(***) : The null hypothesis is rejected at 5(1)% significance level.

The way in which the KSE determines the closing price probably is accountable for the pattern of volatility we found in Table 6. Two trading methods are used by the electronic order matching system in the KSE: a periodic auction and a continuous, discriminating auction. The periodic auction is used twice a day to generate opening and closing prices. All orders are submitted during the morning pre-trade session for the opening price and between 2:50 PM to 3:00 PM for the closing price. All orders submitted are batched for execution at a single equilibrium price. Therefore, information flow is blocked for 10 minutes before the market closes since trade through continuous, discriminating auctions are not allowed while orders are submitted and processed to determine a single price for closing price. If a program trader still possesses considerable open interests in derivative markets, whether it is in options or futures markets, on an expiring day, she may wait until 2:50 PM in unwinding the positions by taking offsetting positions in the underlying stock market. If she takes actions before 2:50 PM and cannot conceal the source of unusual order flow she initiates, that would invite strategic trading activities from other traders and be likely to bring in unintended or unfavorable

outcome. The story thus far offers a partial explanation for abnormal return and high volatility during the last 10 minutes in expiring Thursdays.

Another explanation can be found in the way the KSE determines the settlement price of a derivative security when it matures. On an expiring day, all trades are halted at 2:50 PM and buy and sell orders are submitted to determine the closing price that will be also used for the settlement price of the expiring derivative. If a trader takes significant positions on one side of the market and thinks that he has the least market power to make differences, he has an incentive to use the window of 10 minutes before closing when all information flow on trading activities are blocked so that he can effectively conceal his intention to make difference in the equilibrium price. One way to check the possible presence of the above-mentioned motive is to compare abnormal returns and volatilities of the last 10 trading minutes on each day of a week. Table 7 presents the results. The first and the third column report mean returns and standard deviations of each day in a week, respectively. For comparison's sake, we split Thursdays into two groups: non-expiring (NE) Thursdays and expiring Thursdays (OE and TE). The second column summarizes the differences in mean returns between NE Thursdays and other dates along with the p-value of the t-statistic of the null hypothesis that the two means are equal. Except for the case of Wednesdays versus NE Thursdays, we cannot find any statistically significant difference in mean returns between NE Thursdays and other dates. One unfortunate result in Table 7 is that we can find any evidence for the mean difference between NE and expiring Thursdays, which, at first glance, seems to be irreconcilable with the results in Table 6.¹⁷ A careful inspection of Table 6 helps us understand the seemingly contradictory results. The difference in mean returns between NE and OE Thursdays is significantly positive and between NE and TE Thursdays significantly negative. Moreover, the differences are very close to each other in magnitude. If we pool the two samples of OE and TE Thursdays, it is predictable to obtain the result in Table 7. Excluding expiring days, we cannot find any evidence for abnormal returns on Thursdays compared to other dates if we focus on the return of the last 10 trading minutes. That is, we can identify nothing special in Thursdays' return were not it for expirations of derivative securities.

The last column in Table 7 reports the variance ratio between NE Thursdays and other dates along with the p-value of the F-statistic of the null hypothesis that the two variances are equal. First, all dates other than Fridays show different levels of volatility from NE Thursdays. Second, it is not possible to locate a regular pattern from the distribution of standard deviations across dates in a week. Third, although all other pairs except for one display statistically significant differences in volatilities, the magnitudes of F-statistic and p-value implies that the difference is bigger between expiring and NE Thursdays than between NE Thursdays and other dates.

¹⁷ In Table 6, we argue that there exists a significant difference in means between NE and OE as well as between NE and TE.

Table 7. Return and Volatility of the Last 10 Minutes¹⁾

	Mean	Mean Difference	S.D.	Variance Ratio
Monday	-0.0028	-0.0097 ¹⁾ (0.7578)	0.2996	1.6572*** ^{2), 3)} (0.0002)
Tuesday	0.0401	-0.0526 (0.1072)	0.3217	1.4370*** (0.0065)
Wednesday	0.0437	-0.0562* (0.0747)	0.2972	1.6838*** (0.0001)
Friday	0.0009	-0.0134 (0.7153)	0.4065	1.1114 (0.4149)
Thursday ⁴⁾ (OE and TE)	-0.1637	0.1512 (0.1119)	1.1728	9.2489*** (0.0000)
Thursday (NE)	-0.0125	N.A.	0.3856	N.A.

Note: 1) The number is the difference in means between Monday and NE Thursday and the number in parenthesis below is p-value of t-statistic to test the equality of means.

2) The number is variance ratio of Monday and NE Thursday and the number in parenthesis below is p-value of F-test to test the equality of variances.

3) ***(*) : The null hypothesis of equality is rejected at 1(10)% significance level.

4) The pooled sample of OE and TE Thursdays.

We can conclude from the discussion thus far that the stock returns show a much more volatile behavior for the last 10 trading minutes on expiring Thursdays and a plausible explanation can be found from possible activities of program traders during the time.

3. Price Reversals

Additional measure of the price effects is the degree of price reversal on the morning of the trading day after the expiration day suggested by Stoll and Whaley (1987, 1991). The unwinding of index arbitrage stock positions by program traders at an expiration day, especially close to the closing time, would drive the stock index temporarily out of equilibrium. If such a price pressure indeed exists on the expiration day, then stock index should on average reverse to the opposite direction after the derivative contract have expire since it is not unreasonable to expect that the price pressure will be absorbed or dissipated and the stock index will start to move back toward the previous equilibrium as time passes.

Following Stoll and Whaley (1987), we define three types of price reversal as

$$REV_{1t} = \begin{cases} r_{t+1} & \text{if } r_t < 0 \\ -r_{t+1} & \text{if } r_t \geq 0 \end{cases} \quad (3)$$

$$REV_{2t} = \begin{cases} |r_{t+1}| & \text{if } \text{sign}(r_t) \neq \text{sign}(r_{t+1}) \\ 0 & \text{otherwise} \end{cases} \quad (4)$$

$$REV_{3t} = \begin{cases} |r_t| & \text{if } \text{sign}(r_t) \neq \text{sign}(r_{t+1}) \\ 0 & \text{otherwise} \end{cases} \quad (5)$$

where $r_t = 100(\ln(P_{close,t}) - \ln(P_{close-10,t}))$, the return for 10 minutes just before the market closes on an expiration day and $r_{t+1} = 100(\ln(P_{open+10,t+1}) - \ln(P_{open,t+1}))$, the return for 10 minutes just after the market opens the next day.

A positive value for REV_{0t} indicates a reversal, a negative value a continuation. The second measure REV_{1t} is assigned the value zero if there is no reversal and the absolute return for the 10 minutes of the Friday following expiration if there is a reversal. REV_{1t} overstates the price effect somewhat because price reversals due to new information unrelated to the activities accompanying expiration are fully reflected, whereas the failure of price reversals due to new information is not reflected. As for the type 3 price reversal, the measure uses the first-period (Thursday) price change rather than the second-period (Friday) price change used for the type 2 reversal. It has the same kinds of drawbacks as the type 2 reversal. If the price change on the first day conveys new information, the measure tends to overstate the amount of pressure on price as distinguished from information effect. But it does convey new information about the price change on the expiration day.¹⁸

Table 8 reports three different measures of price reversals discussed above for three different time intervals. The last row requires some explanation. A pair of returns is calculated to measure over-night reversals. Returns from 2:50 PM to 3:00 PM on an expiring Thursday are compared to the returns from Thursday's closing price and Friday's opening price. The reason we pay close attention to the comparison of two returns is that the returns in those intervals are determined by periodic auctions instead of continuous, discriminating auctions to determine the closing, therefore the settlement price. One may infer, as discussed above, that program traders possess considerable incentive to conceal their strategic trading patterns by amassing orders while the periodic auctions are conducted when they trade to satisfy the needs of positions taken in derivatives and spot markets. If it is indeed the case, it is highly likely that over-night price reversal can serve as an excellent indicator for price reversals. We can find stronger evidence for the existence of price reversals as window for return observations become shorter. The 10-minute window shows more frequent and bigger price reversals in almost all cases than the 60-minute one. Although the over-night window shows more frequent price reversals than 10-minute window, the degree of price reversals is lower when we use the over-

¹⁸ Further information on various measures of price reversals can be found in Stoll and Whaley (1987).

night window rather than the 10-minute one. We are able to find evidence for price reversals on neither OE nor TE Thursdays, which is to be confirmed by the negative value for REV1.

Table 8. Price Reversals: 10-minute, 60-minute, over-night returns

		OE Thursday			TE Thursday		
		No. of Days ¹⁾	No. of Rev. ²⁾	Ave. Rev. ³⁾	No. of Days	No. of Rev.	Ave. Rev.
10 minutes	REV ₁	42	25	0.3275	21	13	0.4402
	REV ₂	42	25	0.4848	21	13	0.5886
	REV ₃	42	25	0.4523	21	12	0.4579
60 minutes	REV ₁	42	16	-0.0969	21	8	-0.0637
	REV ₂	42	16	0.4307	21	8	0.3806
	REV ₃	42	16	0.4647	21	9	0.6002
Over-night	REV ₁	42	32	0.0088	21	18	0.0111
	REV ₂	42	31	0.0105	21	18	0.0123
	REV ₃	42	32	0.5819	21	17	0.7000

Note: 1) The number of all OE Thursdays

2) The number of OE Thursdays with price reversal

3) Average price reversals (%)

In sum, we can find some evidence for price reversals if we take shorter intervals. Especially, the finding that the price reversals between two subsequent periods of periodic auctions are significant has a great importance if we recall the result from the previous sections that price effects on the expiration day seem to be clustered around the closing time.

4. Volume Effect

An additional arena in which we can possibly detect unusual patterns in stock trading activities associated with expirations of derivative securities is the total volume of stocks traded during a given period of time surrounding expirations of derivatives. The efforts mainly by program traders to unwind the position before expiration may result in higher trading volume than usual to reflect more frequent trading activities around the expiration time.

We compare trading volumes in three different groups of Thursdays: NE, OE, and TE Thursdays. In order to detect the possibility that unusual pattern of trading volumes becomes more conspicuous as the closing time nears, we also compare the volumes of the Index traded for 60 minutes, 30 minutes, and 10 minutes before the market closes in addition to daily trading volumes on three groups of Thursdays from June 19, 1997 to December 26, 2002. As easily recognized from a casual plot of trading volumes in each category¹⁹, it is almost certain that all series contain exponential trend. One can explain the existence of exponential trend in the series by arguing that the growth of the economy and the progress of depth in capital market are generally accompanied with increases in stock market activities. We model the feature by specifying the following equation for the growth of stock trading volume.²⁰

$$\ln y_t = \alpha + \beta t + \varepsilon_t \quad (6)$$

where y_t is the volume of stock traded during period t . The log of a variable with an exponential growth pattern can be well described by a linear time trend model. Therefore, we run the regression (6) and keep the residuals for later use.

$$\hat{\varepsilon}_t = \ln y_t - \hat{\alpha} - \hat{\beta}t \quad (7)$$

The residual series²¹ obtained from (7) are subjected to further analyses to find the evidence for higher trading volumes than usual due to expiration of derivatives.

Table 9 summarizes the results of the tests for mean-differences of (residual) trading volumes in three groups of Thursdays. We confront with the same pattern as in Table 4 and Table 6. Employing daily data, we find no evidence for unusually high trading volumes in OE or TE Thursdays compared to NE Thursdays. However, if we turn our attention to high frequency data set, we uncover strong evidence for bigger trading volumes both in OE and TE Thursdays. Moreover, as we shorten the interval of observations from 60 minutes to 30 minutes and finally to 10 minutes before the market closes, the evidence for volume effect becomes stronger. The effect becomes more striking on Thursdays when both futures and options expire rather than when only option contracts expire.

¹⁹ They are daily, 60-minute, 30-minute, and 10-minute trading volumes.

²⁰ We would have specified the model with both time trend and a unit root. Augmented Dickey-Fuller test rejects the null of one unit root in all cases.

²¹ Actually, we analyze the residual series after taking anti-log to convert into the natural scale.

Table 9. Tests of Differences in Means: Trading Volumes

		NE vs. OE	NE vs. TE
Mean Difference	Daily	-0.0320 (0.7252)	0.1678 (0.1739)
	60 minutes	0.0984 ¹⁾ (0.2828)	0.3119** (0.0123)
	30 minutes	0.2350** (0.0188)	0.4736*** (0.0005)
	10 minutes	0.4549*** (0.0000)	1.2398*** (0.0000)

Note: 1) The number is the difference in means between NE and OE and the number in parenthesis below is p-value of t-statistic to test the equality of means.

2) **(***) : The null hypothesis of equality is rejected at 5(1)% significance level.

. Conclusion

As we have shown in Chapter 3, empirical analysis strongly suggests that there are expiration day effects in the KSE. These effects are relatively unrevealed in the previous research using daily data set. There are, however, significant abnormal price and volatility around the last 10 minutes of trading time. We guess that these results are due to the settlement procedure of the KSE. After the trading of derivative at maturity ends at 2:50 PM, the price determination process for the settlement price begins. During these 10 minutes of call auction, program traders, who have already finalized their derivative position could optimize their cash index position by selling and buying index components.

To reduce or remove this expiration day effects, regulators around the world have made various efforts on modifications to the procedure of derivative expiration. Table 9 summarizes the main features of expiration procedure in international derivative markets. Some markets such as the CME and the Osaka Exchange use the special quotation as the settlement price is based on the total opening prices of each component issue in the index on the business day following the last trading day. Some markets use the average value of the index calculations performed during later part of the trading period on the last trading day.

Some of these changes have turned out not to be very useful in reducing the expiration day effects such as the current scheme of the CME and the Osaka Exchange. On the other hand, the recent paper by Chow, Yung, and Zhang shows that the expiration day effects does not appear in Hong Kong derivative market.

Various merits of derivative products could be well appreciated with minimal impact on the underlying cash market by derivatives. Given that there are very big expiration day effects in the KSE, further research on this issue is necessary. Although derivative market in the KSE has grown as one of the biggest exchange in the world, our understating is far behind to this quantitative growth. Only proper market microstructure based on rigorous research can guarantee sound growth for both cash market and derivative market in Korea.

Table 10. Specifications of the Derivatives Traded in other Exchanges

Country	USA	Hong Kong	Germany
Name	S&P500 Index Future (e-Mini S&P500)	Han Seng Index	DAX Index
Market	CME	Hong Kong Future Exchange	EUREX
Contract Months	March, June, September, December	March, June, September, December	March, June, September, December
Last Trading Day	The trading day preceding the second Friday of each contract month	The business day immediately preceding the last business day of the contract month	Third Friday
Settlement Price	Special Quotation (Special Quotation is based on the total opening prices of each component issue in the S&P 500 on the business day following the last trading day)	The average of quotations of the HIS taken at 5-minute intervals during the last trading day	The average value of the DAX calculations performed between 1:21 PM and 1:30 PM on the last trading day
Country	France	England	Japan
Underlying Asset	CAC40 Index	FTSE100 Index	NIKKEI225 Index
Market	MONEP	LIFFE	Osaka Exchange
Contract Months	March, June, September, December	March, June, September, December	March, June, September, December
Last Trading Day	Last trading day of each contract month	Third Friday of each contract month	The trading day preceding the second Friday of each contract month
Settlement Price	The settlement price is the average values calculated and disseminated between 3:40 and 4:00 PM on the last trading day.	The settlement price is based on the average values of the FTSE100 index every 15 seconds between 10:10 and 10:30 on the last trading day	Same as S&P 500

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Comments on "Expiration Day Effects in Korean Stock Market: Wag the Dog?"

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- Overall, I think that this is a nicely written paper. The intention of the authors is clearly put. The methodology is straightforward. The results are summarized nicely.
- The paper examines the link between cash and derivatives contracts in the Korean stock market. Specifically, it evaluates whether the price and return behavior of the KOSPI200 cash index is different around expirations of the KOSPI200 index futures and options contracts.

The merit of this study lies in the use of high-frequency price and volume data, rather than low-frequency daily data used in the previous research on the same issue for the Korean stock market.

Using high-frequency data, the paper finds:

1. The return volatilities of the KOSPI200 cash index on expiration- Thursdays are high relative to those on other Thursdays.
 2. The level of the KOSPI200 cash index tends to reverse its course on the morning of the next trading day immediately following expiration of futures/options contract.
 3. The trade volume of KOSPI200 stocks on expiration-Thursdays is high relative to that on other Thursdays.
- The paper has potential for becoming a very good one. The authors put a great deal of efforts into the research. I hope my suggestions below can help polish the paper further.

First, I find that the introduction of the paper is weak in describing the motivation of the study. Readers may wish to know why they have to care about the issue. For this purpose, the paper can argue that high volatilities of cash stock returns and deviations of cash stock prices from the equilibrium around expirations of futures/options contracts can bring about welfare loss for market participants. The paper also can provide some historical background of the research on this topic. That is, in the wake of the Crash in 1987, the role of the program trading received a lot of attention as a source for market disruption. ...

Second, my impression is that the paper does not adequately discuss the implications of the findings. Yes, in the statistical sense, the above findings are significant and thus expiration-date effects may be there. Nonetheless, some readers will be compelled to ask whether the magnitude of these expiration-date effects is large enough to raise

concern for market participants and call for a change in the settlement system. A later version of the paper needs to discuss the economic significance of the findings.

Though it won't be easy to gauge the economic significance of the findings, my gut feeling is that the extent of the abnormal volatilities and price changes of cash market around futures/options expirations might not be too large to call for any concern. Note that Stoll and Whaley (1991) arrive at the same conclusion.

Third, the paper says in the introduction that it will try to interpret the findings on the basis of the nature and structure of the settlement system in the Korean stock and futures/options markets. This is definitely a good direction to take and I was very expectant. Unfortunately, however, I don't find much discussion in the latter part of the paper that relates the findings to the workings of settlement system. (For example, what elements of the settlement system might cause the erratic price and return behavior around expiration dates?)

Fourth, the authors might be able to benefit from examining the behavior of non-KOSP200 stocks around expirations of futures and options contracts. It will be interesting to see whether there are spillover effects (contagion effects) on non-KOSPI200 stocks from KOSP200 stocks.

Fifth, when the paper looks into the price reversal of the KOSPI200 cash index around expirations of futures and options contracts, it examines only price reversals around expiration-Thursdays. The paper reports that price reversals are observed around these days. However, there is an open possibility that price reversals occur around other Thursdays (i.e., non-expiration Thursdays) as well. I believe that the paper needs to present price-reversal patterns for other Thursdays and compare them against those for expiration-Thursdays.

- To facilitate a better understanding for readers, Table 1 needs an extra column that presents the number of occurrences for non-expiration days and expiration days, respectively. Also, the table needs to cite the source of the data.

In Table 9, 60 minutes, 30 minutes, and 10 minutes need to be changed to last 60 minutes, last 30 minutes, and last 10 minutes, in order to be consistent with the entries in earlier tables.

The Impact of Internet Banking on the Performance of the Korean Banking Industry: An Empirical Analysis

by
Hyeon-Wook Kim and Chang-Gyun Park

Abstract

This paper aims to verify the hypothesis that Internet banking, rapidly expanding in the Korean banking industry, allows banks to reduce cost and ultimately contributes to higher profitability. Our analysis, based on the quarterly financial statements of 20 Korean banks from 2000 to 2002, suggests that Internet banking, especially when it expands, contributes to reduction of banks' cost, while it does not affect their profitability. It implies that the primary objective of introducing Internet banking, which was to reduce the operating cost such as branch maintenance expenses, has been accomplished, but this cost-reduction effect has not reached the stage in which beneficial effects of Internet banking overcome the negative effect of initial investment on the profitability of banks. Considering that the growth potential of Internet banking consists in its cost efficiency, this also indicates that Korean banks' strategies of expanding Internet banking would ultimately bring positive outcomes.

The findings of this paper offer an important implication that Internet banking has increased social welfare by making banks distribute the benefit of cost reduction to customers in various forms such as preferential interest rates and fee exemption, rather than internalize the benefits to the banks' profits. This paper also finds an indirect evidence that benefits to the Internet banking customers has been primarily provided through the interest rate channel rather than non-interest service channel. In addition, we found that the people's preference for face-to-face transaction may be very low in Korea, which supports the hypothesis that the cost for securing customer base will be much reduced. From the results of empirical analyses, it can be also anticipated that the profit-enhancing effect of Internet banking will become more significant in the near future since the cost-reduction effect of Internet banking will be stronger with the technology development that reduces the cost of maintaining Internet banking system.

I. Introduction

Internet banking can be defined as using the Internet as a delivery channel for banking services such as opening a deposit account, transferring funds, or lending. In various finance literatures, a common hypothesis is that Internet banking is clearly different from other delivery channels of banks such as branch offices, ATMs, and other remote routes, in terms of either benefits to customers of banking services or impact on competition structures of banking

industry. Literally, the core difference comes from that the Internet banking services are channeled through the Internet, a globally open network. Customers, in addition to merely having another service channel apart from banks, benefit from being able to execute their banking business whenever and wherever they have access to the Internet. For banks, the scope of competition is not limited by the region or by country and it is more difficult to retain their customer base since switching cost, an opportunity cost paid by a customer when he/she changes his/her main financial institution, is lowered by Internet banking. Therefore, Internet banking is expected to introduce competitive pressure that may bring significant changes in banks' financial performance and the structure of banking industry.

Among various attributes of the Internet, such as low cost, time-saving promptness, and interactiveness, etc., the most important is the 'low cost' and this exerts a first-order influence on the performance of banks. For instance, banks can substantially reduce overhead expenses by jettisoning physical branch offices, which could be substituted by Internet banking system, and enhance their profitability.¹ Banks can use the resulting savings to reduce their loan interest rates or increase their deposit interest rates, retaining most profitable customers and attracting new customers without sacrificing earnings.

Looking for this cost-reduction effect, Internet banking has been actively and widely introduced by banks across the globe. In Korea, the introduction of Internet banking was somewhat late compared to other countries, but it expanding with one of the fastest speed in the world. And, based on the rapid increase in Internet banking population, the worldwide attention has been paid to the growth potential of Internet banking in Korea. The major factor that makes Korean banks endeavor to expand in the Internet banking market is the assumption that, having been exposed to fierce competition after the financial crisis, they can reduce operational costs to a great extent.²

However, many research on the banking industries of other countries report that the performance of Internet banking is not satisfactory thus far. Moreover, even Internet-only banks, which were expected to flourish and enjoy the cost reducing effects to the fullest, are adjusting their business strategies or being absorbed by incumbent traditional banks.³

This paper is interested in the effects of introduction and expansion of Internet banking on the profitability structure of the Korean banking industry, and tries to evaluate whether the

¹ For example, according to DeYoung (2001a) based on a survey by Booz, Allen & Hamilton, it has been estimated that branch banking costs about \$1.07 per transaction, telephone banking costs about \$0.55 per transaction, ATM banking costs about \$0.27 per transaction, and Internet banking costs about \$0.01 per transaction. Table 2 of Sato and Hawkins (2001) also presented similar figures.

² Since it was introduced when the use of Internet was already widespread for commercial purposes, Koreans might be relatively more comfortable with Internet banking. This can be another factor that makes the rapid expansion of Internet banking in Korea.

³ Banks offer Internet banking in two main ways. First, an existing bank with physical offices can establish a Web site and offer its customers Internet banking in addition to its traditional delivery channels of 'brick and mortar' branches. At present, all the Korean banks, like most banks in foreign countries, offer Internet banking using this 'click and mortar' business strategy. Second, a bank may be established as a "virtual," or "branchless" bank, with a computer server that is housed in an office that serves as the bank's legal address or at some other location. Virtual banks may offer customers the ability to make deposits and withdraw funds at automated teller machines (ATMs) or other remote delivery channels owned by other institutions. These are also called as "Internet-only banks" or "pure play Internet banks."

performance of Internet banking in Korea is also poor. Thus, the paper aims to analyze financial statements of individual Korean banks for the past 3 years, and to find evidence of the cost reducing effect that is expected to be the most important merits of Internet banking.

Considering that only three years have passed since Korean banks introduced Internet banking and that its market continues to grow rapidly, it is certainly possible that the conclusions may be premature, and that predicting future development of Internet banking only based on the result of empirical analyses may be dangerous. However, it is still meaningful to offer a current picture of changes in the banking industry due to the introduction and expansion of Internet banking. Such a picture can provide an important initial step for analysis of financial market policies and strategies of individual banks as well as the likely future impact of Internet banking on the financial services industry.

The remainder of the paper proceeds as follows. Chapter 2 provides a brief description of Internet banking in the Korean banking industry and reviews some of the previous literature on topics related to this study. In Chapter 3, after describing the data, we test various hypotheses regarding the impact of Internet banking on the profitability and cost-efficiency of Korean banks, and interpret the results of our empirical analysis. Chapter 4, the final chapter, summarizes the major findings and concludes the paper.

II. Internet Banking in Korea and Related Literature

1. Overview of Internet Banking in Korea

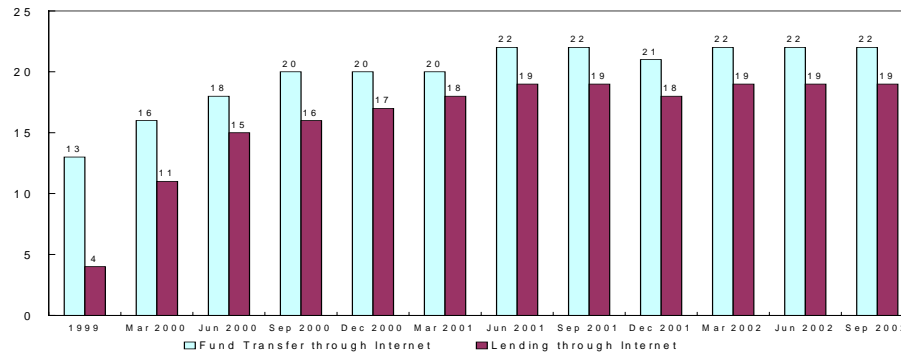
Though Korean banks had provided information such as branch locations and product descriptions through their Web sites from the mid 1990s, it was only after the second-half of 1999 that they began offering 'transactional' Internet banking with which customers can transact business such as opening a deposit account or transferring funds. While the Internet banking system in Korea had a late start compared to other countries, the rate of its expansion was remarkable.

After Shinhan Bank first introduced its Internet banking services in July 1999, about half of the other Korean banks followed providing the service during the second half of the same year, and by the end of the year 2000, all Korean banks were providing Internet banking service. Thus, the number of Internet banks in Korea increased from 13 at the end of 1999 to 22 at the end of June 2002, including Korea Post Bank, Korea Development Bank, and 2 foreign bank branches, Citibank and HSBC.

Most Internet banks in Korea also provide their customers with lending services through their Web sites. At the end of 1999, only 4 among 13 Internet banks provided Internet lending service, and at the end of June 2002, the number increased to 19.

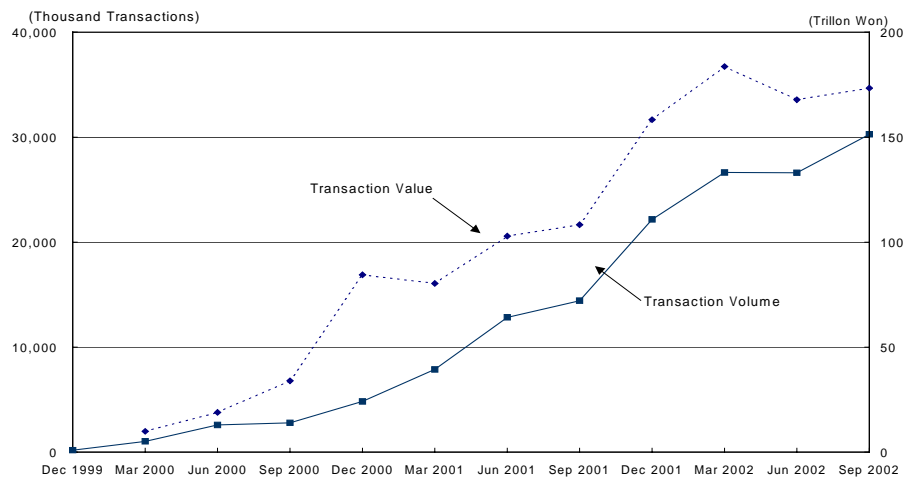
The number of registered Internet banking customers also continued to grow rapidly and within approximately 3 years of its introduction, that is, by the end of September 2002, over 30% of the Korean population were using the service. The monthly transaction volume through the Internet banking service also rapidly increased from about 5 millions in 2000 to more than 30 millions amounting to 173 trillion won in September 2001, after recording the average quarterly growth rate of higher than 50% in 2001.

Figure 1. Numbers of Banks Providing Internet Banking Service in Korea



Source: The Bank of Korea, Press Releases.

Figure 2. Monthly Transaction Volume and Value through Internet Banking in Korea



Source: The Bank of Korea, Press Releases.

Table 1. Average Share of Internet Banking Transactions in Korean Banking Industry

	June 2001	Dec. 2001	Mar. 2002	June 2002	Sep. 2002
Total Banks	5.9	8.8	10.5	11.7	14.1
Commercial Banks	8.5	14.2	14.5	17.9	22.1
Local and Specialized Banks	2.7	4.3	6.6	8.4	9.2

Source: The Bank of Korea, Press Releases.

The share of Internet banking transaction among all transactions including the representative 4 distribution channels, which are branch banking, phone banking, ATM banking as well as Internet banking, rapidly increased in Korea. The average Internet banking share of 22 Internet banks exceeded over 10 percent level in March 2002 and, due to the impact from implementing five-day workweek by Korean banks from July 2002, the share rose to 14.1 percent for all banks and 22.1% for commercial banks in September 2002.

2. Previous Literature Regarding the Impact of Internet Banking

While there exist many theoretical industry analyses outlining the potential impact of Internet banking on cost savings, revenue growth, and increased customer convenience based on anecdotal evidence and conjecture,⁴ little empirical analyses or systematic information exist. To the authors' knowledge, there is no empirical analysis in Korea on the impact of Internet banking prior to the present paper. This may stem from the lack of availability of appropriate data for empirical studies since Internet banking has only 3-year history in Korea.

Even in developed countries such as the U.S., it is only very recent that banks started to periodically report their Internet banking related business transaction trends to the supervisory authority,⁵ and there are no regularly compiled data on this feature of banking industry. Therefore, assembling comprehensive information on the Internet banking activities of commercial banks has been quite difficult, and this may be a reason why there exist only a small number of empirical studies regarding Internet banking in these countries. However, their result should be interpreted with caution since even these rarely existing studies had been processed with data of the banks in specifically characterized categories.

⁴ See Beck (2001), Claessens et al. (2000, 2001, 2002), DeYoung and Hunter (2001), Herbst (2001), and Lin et al. (2001).

⁵ The Office of Thrift Supervision (OTS) has not required prior notice for federally chartered thrifts until beginning in 1999, and in the third quarter of 1999 a line was added to the 'Report of Condition and Income' (the 'call report') for all banks and thrifts to report their uniform resource locator (URL). See Furst et al. (2002).

Among the empirical studies on the impact of Internet banking, Furst et al. (2000, 2002) used the most comprehensive data set. They investigated whether offering Internet banking effects a bank's financial performance by examining about 2,500 national banks covered by the third quarter of 1999 'Report of Condition and Income' (the "call report") of the U.S. Office of the Comptroller of the Currency (OCC). In terms of the cost-efficiency, ratios of non-interest expenses of small banks with Internet banking were higher than non-Internet ones, while, for the larger banks, the ratio was not significantly different between Internet banks and non-Internet banks. Small and large banks showed different degrees of the impact of Internet banking on the profitability. For example, the ROEs of large banks with Internet banking were higher than those of non-Internet ones, while small Internet banks were less profitable than non-Internet small banks. The authors argued that the poor financial performance of small Internet banks may be the result of short-run costs incurred in making an investment in Internet banking, which could be significant for the smaller banks, while not prohibitive.

Sullivan (2000) provided another empirical research that compared Internet banks and non-Internet banks in terms of cost-efficiency and profitability by examining financial statements of the banks in the Tenth Federal Reserve District of U.S.⁶ Most results were not very different to those of Furst et al. (2000, 2002), while expenses tended to be higher at Internet banks compared to the non-Internet banks. He concluded that banks have been neither helped nor harmed by their commitment to the Internet as a delivery channel, and explained that the increase in non-interest operating expenses due to the start-up costs had been offset by the increase in non-interest revenues due to the adoption of Internet banking.

DeYoung (2001a, 2001b) provided empirical analyses on the profitability and cost-efficiency of Internet-only banks to examine whether the Internet-only bank is viable business model. Contrast to the findings in Furst et al. (2002) and Sullivan (2000), he found that the average Internet-only bank earned significantly lower profits than the average traditional bank, due primary to low business volumes and high non-interest expenses. And he found that non-interest revenues of Internet-only banks is relatively lower, interpreting this to suggest that it is difficult to cross-sell fee-based financial products to loan and deposit customers over a distribution channel that minimizes person-to-person contact, because a large portion of Internet banking customers do not view the Internet-only bank as their main financial institution.

However, DeYoung (2001b) argued that relatively lower profitability of Internet-only banks in the U.S. could be attributed to that the learning process of these newly established banks was still underway. Thus, he concluded that as Internet-only banks age, they accumulate experience which may allow them to operate more efficiently, and as they grow larger they may generate scale-based savings not available to traditional banks that use less capital-intensive production and distribution technologies. Finally he predicted that, if the experience-based technology effects and the scale-based technology effects are large enough, the performance gap between Internet-only banks and traditional banks could narrow in the future, and thus, suggested that the Internet-only banking model may well be viable when executed efficiently.

⁶ The Tenth Federal Reserve District consists of Oklahoma, Kansas, Nebraska, Wyoming, Colorado, western Missouri, and northern New Mexico.

III. Empirical Analysis on the Impact of Internet Banking

1. Scope of Analysis

In what follows, using various econometric analyses, we try to verify the hypothesis that introduction and expansion of Internet banking allow banks to reduce cost and ultimately contribute to the financial performance of banks by enhancing their profitability. The primary interest of this paper is whether the Internet banking can enhance the bank profitability. However, analyzing only profit enhancement effect is not enough since the Internet banking is generally expected to not only benefit the bank profitability but also consumers' welfare by improving cost-efficiency. For example, when a bank, aiming to secure its market base for new business, provides preferential interest rates or service fee exemptions to its Internet banking customers, it is possible that the cost-reduction effect of Internet banking does not clearly contribute to enhancing profitability.

Thus, to more precisely analyze and to clearly understand the role of Internet banking, it is necessary to investigate its impact on the non-interest expenses and revenues, as well as the profitability of banks. The analysis on non-interest expenses provides important information on the cost efficiency due to Internet banking. And the analysis on the non-interest revenues provides a yardstick for judgement whether banks share the benefits of Internet banking with their customers⁷ and, if so, which channel are the benefits to customers being delivered through.⁸

2. Data and Results

Previous empirical analyses of the economic effects of Internet banking have been performed using cross-section data. In countries like the U.S., where many banks compete with each other and show different patterns on the adoption of Internet banking, it is possible for the banking industry to provide enough number of observations and a variety of samples with which the cross section analysis could draw statistically meaningful results.

However, in the Korean banking industry, where Internet banking system was introduced just 3 years ago, only 20 banks from all the commercial banks, regional banks, and specialized banks combined which have retail banking divisions were available for analysis. Thus, the data are too limited to proceed to cross-section analysis and, because we have about 10 quarterly data in the last 3 years, the time-series analysis is not an alternative, either. In addition, it is not

⁷ It is difficult to measure the value of Internet banking or its share for banks and customers. However, we may judge that, like Sullivan (2000), when Internet banking does not have any influence on the profitability because the non-interest revenues of banks is big enough to cancel out the initial investment expenses for system building, data imply that average customer do not sufficiently benefit from Internet banking.

⁸ If the benefits to customers were delivered primarily through the preferential interest rates such as higher deposit rates and lower lending rates, the data would tell us that Internet banking does not influence on the non-interest expenses or revenues. If the benefits delivered primarily through the fee exemptions and other non-interest advantages, the data shows negative impact on non-interest revenues.

easy to construct sample data that consist of various observations because, for example, half the banks in our sample started Internet banking services almost simultaneously in the second half of 1999.

To overcome such data limitations, the authors constructed a panel data of 20 banks, observed on a quarterly basis, from the first quarter of 2000 to the second quarter of 2002. This strategy accounts for at least 200 observations. So we can solve data problem, which arise when we use only cross section data or time series data and, since the sample data consist of each unit traced by time series, there are merits that we can include such as dynamic path of economic variables into the analysis.

A. Data

The sample period of our empirical analysis is 10 quarters from the first quarter of 2000 to the second quarter of 2002. Though Korean banks already offered Internet banking services in July 1999, the data available for our analysis were those after 2000 because the Bank of Korea first collected data to publicize the 'Domestic Use of Internet Banking Services' during the first quarter of 2000. And it was not until the first quarter of 2000 when quarterly financial statements of Korean banks were publicly open, as the amended 'Regulation on Supervision of Banking Business' required Korean banks to do so. Thus, the quarterly financial performance information of banks is available only from the first quarter of 2000.

Twenty banks were analyzed. Two foreign-bank branches, Citibank and HSBC, and two government-managed banks, but Korea Development Bank and Korea Post Bank, are excluded from the sample, taking into consideration that they have quite different business strategies compared to other banks. For the last quarter of 2001 to the second quarter of 2002, the data from Korea Housing & Commercial Bank and Peace Bank do not exist because they were merged with Kookmin Bank and Woori Bank, respectively. We include these two banks in the analysis, however, since the timing for adopting Internet banking is different for these merging banks and the information on the effect of introducing Internet banking might be unique for each bank before the mergers.

Though most variables used in our analysis have 200 observations, on average, however, considering that we do not have data for the last three-quarters of two merged banks, some variables have only 194 observations. Some other variables, whose series start from the last quarter of 1999, consist of 214 observations.

a. Data from Financial Statements of Banks

Data for financial conditions and performance of individual banks were mostly derived from financial statements published in 'Data Analysis, Retrieval and Transfer System' (DART, <http://dart.fss.or.kr>) of Financial Supervisory Service. Since each account in income statement are accumulated from the beginning of the year to the relevant quarter to analyze performance of a bank in a quarter, that is flow variable, we had to rewrite those income statements. Since stock variables related to the balance sheets are not needed for such an adjustment, we used same data that are publicized. In the case of National Agricultural Cooperative Federation and National Federation of Fisheries Cooperatives, we used quarterly financial statements publicized at their respective Web site because the 'DART Regulation' dose not apply to them.

Variables used in our analysis are as follows. From the balance sheets of each bank, we calculate ratios of total stockholders' equity, the ratio of interest-bearing assets,⁹ the ratio of loan, and the ratio of won-denominated deposits, respectively to total assets of each bank. The market share based on deposit balance and market share based on loan balance of each bank are also respectively calculated. For the variables related to managerial characteristics of each bank such as number of employees, number of branches, and BIS capital adequacy ratios, which are not shown in balance sheets, are obtained from the 'Banking Statistics' of Financial Supervisory Service and 'Statistics Database' of the Bank of Korea. The number of employees and the number of branches are divided by the total assets of each bank to control the size effect. In addition, to control the differences of performance due to the restrictions on business area, we used a dummy variable sorting out nation-wide banks from local banks. Another dummy variable sorting out banks that received the restructuring-related public funds also used to consider the change of performance after the injection of the public fund.

From income statements, we used operating expenses, operating revenues, and their sub-items¹⁰ and calculated their linear combinations, including non-interest operating expenses, non-interest operating revenues, net operating revenues,¹¹ interest income,¹² 'income before income tax' and 'net income before income tax and allowance for credit losses'. To measure profitability or cost efficiency of each bank, we calculated return on equity (ROE), return on assets (ROA), and some ratios related to relative expenses and revenues. The ratios related to expenses include the ratio of non-interest operating expense to total assets, the ratio of interest expenses to interest-bearing assets, the overhead ratio,¹³ 'salaries & employee benefits per employee', and 'occupancy, furniture & equipment expenses per branch'. The ratios related to revenues include the ratio of non-interest operating revenue to total assets, the share of non-interest operating revenues,¹⁴ the ratio of non-interest revenues,¹⁵ and net interest margin.¹⁶

Most of data related to expenses or revenues to yield such variables and ratios keep their original name as in income statements publicized from banks, but some items are adjusted by different grouping of sub-items. These adjustments were needed to minimize possible distortion in quarterly flows of expenses or revenues, since operating expenses can be significantly affected by the regulatory changes in required loss-provision ratios. So, adjusted items are mostly related with allowance for credit losses and fees & commissions from trust account. Also, 'The Criterion of Bank Accounting Method' was enacted in 1998 to change some

⁹ Interest-bearing assets are sum of cash & checks, due from banks, traded securities, investment securities, and loans & discounts in the balance sheet of banks.

¹⁰ Operating expenses consist of interest expenses, commission expenses, salaries & employee benefits, occupancy, furniture & equipment expenses, and other operating expenses. Operating revenues consist of interest revenues, commission revenues, net fees and commissions from trust account, and other operating revenues.

¹¹ Net operating revenues can be calculated from subtracting interest expenses from total operating revenues.

¹² Interest income is interest revenues less interest expenses.

¹³ Overhead ratio is a ratio of non-interest operating expenses to net operating revenues.

¹⁴ The share of non-interest operating revenues is a ratio of non-interest operating revenues to total operating revenues.

¹⁵ The ratio of non-interest revenues is a ratio of non-interest operating revenues to net operating revenues.

¹⁶ Net interest margin is a ratio of interest income to interest-bearing assets.

account names and classification standards.¹⁷ However, for some variables we use account names of old accounting standard to deliver the implications of analysis more clearly.

b. Internet banking data

Data regarding introduction and expansion of Internet banking are collected for 20 banks just as financial statement data. Most of these data are acquired from various press releases of the Bank of Korea. It was not easy, however, to secure consistent time series data of the present condition of bank's Internet banking. Among these data, we utilize starting dates of various Internet banking services and completion dates of related system building, amounts of funds transferred through Internet banking system, and shares of Internet banking transactions of individual banks in our analysis.

As an index of opening Internet banking service or not, we use a quarterly dummy variable obtained from the starting date of Internet banking in each bank. The starting dates of Internet banking can be traced from the third quarter of 1999, but, considering that all 20 banks could provide Internet banking service from the third quarter of 2000, the practical time span is short. There can be three different data series of starting dates, first, dates of allowing interaccount fund transfer through Internet banking system, second, dates of lending service, and third, dates of starting each bank's own Internet banking system.¹⁸

Most previous empirical analyses on Internet banking in other countries recognize a bank as the Internet bank only if the bank offers 'transactional' Internet banking system, which allows the customer, at minimum, to initiate interaccount transfers. This might be based on considerations that a simple Web site providing branch and product information or even on-line balance inquiry has only minor impact on the bank's financial performance and that this simple Internet service system does not require greater commitment of a bank's resources to the Internet banking.

We follow the custom to identify Internet banks. However, if we choose data of starting dates of allowing interaccount fund transfer through Internet banking system, the observations are concentrated in the second half of 1999.¹⁹ So it is difficult to analyze the effect of the Internet banking differentiated by the time of adoption. We also have similar difficulties when we choose data of starting dates of Internet lending service. Thus, we choose the third series of starting dates of Internet banking based on dates of starting each bank's own Internet banking system. Since the decision of a bank to build its own Internet banking system is closely related to the bank's judgement on the market demand for Internet banking and necessity of IT investment to secure market share and customer base, these data of starting dates can better reflect business strategies of individual banks. In addition, the difficulties that stems from concentration of observation can be alleviated when we use the completion date of building banks' own Internet banking system.

¹⁷ For example, expenses classified as salaries & employee benefits are now classified into three sub-items including salaries, retirement allowance, and other employee benefits.

¹⁸ Starting dates of interaccount fund transfer and lending service is collected based on press releases of the Bank of Korea and completion date of building banks' own Internet banking system is grasped from personnel of Financial Supervisory Service, Banktown, and relevant banks.

¹⁹ Total of 14 banks excluding Chohung, Woori, Seoul, Kookmin, Daegu, Pusan Bank started Internet banking service including interaccount transfer through Banktown in the second half of 1999.

To measure the degree of expansion of Internet banking, we use a proxy variable that is a ratio of amount of interaccount transfer through Internet banking system to the total won-denominated deposit balance. The Bank of Korea provides average share of Internet banking transactions out of total transactions through four representative distribution channels, including branch, phone, ATM, and Internet. Though these shares could reflect the degree of Internet banking expansion better, it is impossible for us to use these data since the data exist biannually and only from June 2001. Nevertheless, the proxy used in our analysis is rational enough, considering that the value of funds transacted through Internet banking is proportionally increasing with its transaction volume, and the number of transactions through various channels is increasing proportionally to the deposit balance. Also, total Internet banking activities of banks could be represented by the volume and value of fund transferred since, as shown at the press releases of the Bank of Korea, the shares of Internet banking lending service is still immaterial.

B. Empirical Results

a. Internet banking and profitability

First of all, we investigate the impact of both introduction and diffusion of Internet banking on the profitability of the banking industry in Korea. Examining the simple correlation between the indexes representing activities related to Internet banking and bank's profitability, we proceed to embed the indexes into typical regressions used in many empirical studies and gauge the degree of comovement between the indexes and profitability after controlling for the variables that traditionally thought to be relevant to bank's profitability.

The empirical model we specify possesses the following panel structure with the two-way fixed effect.

$$y_{it} = \alpha + \beta z_{it} + \gamma' x_{it} + \mu_i + \eta_t + \varepsilon_{it} \quad (1)$$

where y_{it} is the performance measure of bank i at time t , z_{it} is an index for Internet banking activities, and x_{it} is the vector of variables related to performance of the bank. As for the design of fixed effect, while μ_i represents an individual-specific time-invariant intercept, term η_t captures individual-invariant time effect. ε_{it} s are identically and independently distributed error terms with the mean 0 and variance σ^2 .

Two popular measures for banks' performance have been used in many empirical studies; return on assets (ROA) and return on equity (ROE). We take ROE to represent the performance of banks in this paper²⁰. Net income is used in the numerator when ROE is calculated in most of the cases but it shows a significant fluctuation during the time span covered in the paper. The Korean banking industry had gone through a turbulent restructuring process during the time so that the main portion of fluctuation in net income may mirror technical changes stemming from frequent changes in tax code and accounting practices rather than represent the performance of individual bank. Instead, we use 'net income before income tax and allowance

²⁰ We performed the same analysis with ROA but could not find any substantial differences in the results to change the course of argument in the main text. The results of analysis with ROA can be obtained from the authors upon request.

for credit losses' to calculate ROE to minimize the influence of aforementioned institutional realignments unrelated to ordinary activities of banks.

We take two different indexes for measures of Internet banking related activities. One is the dummy for the quarter when a bank established its own Internet banking system (D1), which is intended to gauge the impact of introducing Internet banking on profitability. The other is the ratio of amount of interaccount transfer through Internet banking system to the total won-denominated deposit balance (D2) to represent the expansion in Internet banking. The rationale behind the distinction is that there may be two different forces working here. Internet banking may cause bank's profitability to be shifted down permanently when it is introduced or to be improved gradually as higher proportion of bank's fundamental task such as interaccount transfer is performed through on-line facilities. It seems that the main motive for banks to introduce Internet banking and to extend its role lies in lower cost and ultimately higher profitability. It is, however, very difficult to predict the signs of estimated coefficients on D1 or D2 in our analysis. It was not until the second half of 1999 that banks started to establish their own Internet banking system to serve the customers though a group of banks including Shinhan Bank, Hanmi Bank, and now non-existing Korean Housing & Commercial Bank offered limited range of Internet banking services by contracting out to an independent service provider called "Banktown" system. Considering the fact that investment generally requires a certain amount of digestive period to realize its return and investment on information technology to extend the depth and the scope of Internet banking related services is still under progress, the time span we cover in the analysis, at most up to three years after the initial investment, is probably too short to produce a convincing answer to the question we raised.

As for the control variables other than measures for Internet banking related activities, we include total assets (ASSET), lagged ratio of equity to assets (E/A), dummy for injection of public fund (DF) to rescue banks on the verge of default due to the currency crisis in 1997, and subsequent economic downturn. Total assets is expected to have a positive effect on ROE since large banks are generally regarded as having commanding advantages such as better accessibility through a network of many branches, higher consumer confidence on soundness of bank's operation, and economy of scale in providing services. Equity-to-assets ratio is also selected to be included in the regression to control for the influence of bank's trustworthiness on ROE. Increase in the ratio seems to contribute to enhancing the trustworthiness of a bank that it would eventually help its profitability to be improved. We, therefore, expect the sign of the estimated coefficient on the variable to be positive. Income and equity, however, are determined simultaneously by an accounting relationship at a given point of time that the ratio is not qualified for an explanatory variable in equation (1). To avoid the well-known econometric problem resulting from an endogenous explanatory variable, we take the lagged equity-to-assets ratio as an instrument for the current ratio. The dummy variable for the injection of public fund is included to capture possible beneficial effects of investment on stocks of banks in hardship and purchase of non-performing liabilities with public fund financed by issuing government-guaranteed bonds.

Loan-to-assets ratio (L/A), ratio of non-interest operating expenses to assets (NIE/A), overhead ratio (OR), and market share (MS) are also included in the regression as explanatory variables. Loan-to-assets ratio and ratio of non-interest operating expenses to assets are meant to explain the systematic effect on ROE of revenues and expenditure, respectively. Overhead ratio defined by ratio of non-interest operating expenses to net operating revenues is an indicator for managerial inefficiency so that one can predict the estimated coefficient to have a

negative sign. Market share²¹ would have a positive sign should large-sized banks possess enough market power to command excess profit.

As ROE's are very sensitive to fluctuations in macroeconomic environments with a noticeable seasonality, we specify the two-way fixed model as in (1) to allow for both individual specific and time specific effect on ROE²².

Our sample consists of quarterly observations from 20 deposit banks in Korea, ranging from the first quarter of 2000 to the second quarter of 2002²³. The summary statistics for the variables in the paper is given in the <appendix>.

Table 2 reports the regression results. Model I and Model II measures the effect of introducing Internet banking on ROE. On the other hand, Model III and Model IV investigate the effect of diffusion. First of all, both Model II and Model IV show reasonable fit. Except for lagged equity-to-assets ratio (E/A)²⁴, all explanatory variables possess the predicted signs for estimated coefficients. The improvement in R^2 indicates the joint significance of explanatory variables added in Model II or Model IV. Second, though we are able to obtain the predicted signs in most of the cases, the estimation result is in no way satisfactory in that only two explanatory variables, DF and L/A , have estimated coefficients significantly different from zero. Third, simple correlation analysis hints that neither introduction ($D1$ in model I) nor expansion ($D2$ in Model III) of Internet banking brings banks higher profitability. The conclusion holds even after we control the influence of other variables in Model II and Model IV. One can interpret the results in Table 2 stating that Internet banking would do harm rather than good to bank profitability, if really desired. It is, however, a very immature conclusion considering the fact that neither $D1$ nor $D2$ is statistically significant²⁵. Betting on the safe side, we conclude that we cannot find a convincing evidence for a systematic relationship between Internet banking and profitability. As briefly discussed above, one can conjecture that the time span we cover in the analysis, at most, up to three years after the initial investment, is probably too short to give a definite answer. The results coincide with those of Furst et. al. (2002) and Sullivan (2000), both of which studied the relationship between Internet banking and profitability in the U.S. banking industry. Fourth, related to the recent wave of consolidation of banks, we can infer an interesting implication from the findings that neither bigger size nor higher market share can be associated with better performance at least up to now.

²¹ Market share is defined as the simple average of market share based on deposit balance and market share based on loan balance of each bank.

²² Formal statistical tests for individual and time effects also indicate the validity of the specification in (1).

²³ There were two major mergers in the fourth quarter of 2001, resulting in 18 deposit banks that we were able to gather samples only from 18 banks afterward. To avoid several statistical difficulties related to unbalanced panel, we ignore the mergers and construct a balanced panel sample by repeatedly substituting observations from the two remaining banks for missing observations of the two merged banks. We also performed the same analysis only with 196 observations included in the original sample but could only find little difference.

²⁴ We found that it was quite hard to explain away the unexpected estimate in a convincing way.

²⁵ $D1$ in Model II is marginally significant. The p-value is 10.53.

Table 2. Regression Result: ROE and Internet Banking

	Model I	Model II	Model III	Model IV
D1	-12.1075 (17.5776)	-28.8473 (17.7136)		
D2			-4.9246 (15.2329)	-4.4370 (16.2809)
ASSET		0.6213 (1.7331)		0.7229 (1.7464)
E/A		-0.9973 (7.6249)		-0.4598 (8.1487)
DF		95.3190*** (23.8179)		85.4440*** (23.5890)
L/A		3.6993*** (1.5457)		3.4280*** (1.5514)
NIE/A		-13.4898 (14.8906)		-11.7117 (14.9713)
OR		-0.0031 (0.0186)		-0.0047 (0.0188)
MS		-4.0904 (12.1228)		-5.4442 (12.2314)
R ²	0.1529	0.2370	0.1510	0.2250
Num. of obs.	200	200	200	200
F-statistic	1.0578	1.4606*	1.0427	1.4314*

1) dependent variable: ROE

2) *: statistically significant at 10% significance level, ***: statistically significant at 1% significance level.

3) F-statistic is the test statistic for joint significance of variables and all dummies for fixed effect.

b. Internet banking and (non-interest operating) expenses

In previous section, we could not reject the null hypothesis that Internet banking does not contribute to improving performance of a bank. The rejection, however, does not necessarily lead us to the conclusion that Internet banking plays no role in determining profitability of banks. Once we recall the accounting identity that profit (income) is the difference between revenues and expenses, it becomes obvious that one cannot easily predict the effect of Internet banking on ROE. Generally speaking, investments on Internet banking are expected to enhance profit through lower expenses and higher revenues, which results in higher ROE by surpassing the increase in equity, the denominator in ROE formula. One can also offer a totally plausible explanation for the contrary case. That is, the time span covered in the sample is too short to observe the true effects of Internet banking related investment should Internet banking require significant initial investment and beneficial effects of the investment are realized with

considerable time lags. In this section, we pursue the issue further by separately examining non-interest expenses and non-interest revenues.

As Internet banking is introduced and extends its territory, the unit operating expenses would be reduced through various channels such as shorter processing time and less paper work. The increase in cost efficiency is one of the strongest reasons to advocate establishing a widespread network of Internet banking. By analyzing the effect on unit non-interest expenses of introduction and increasing portion of Internet banking in a bank's typical operation²⁶, we try to test the hypothesis that, due to significant initial investment and delayed realization of beneficial effects of investment on Internet banking, it is natural that, with the sample covering too short a period of time, we should not observe improvement in profitability even after Internet banking related activities spread across the banking industry.

We make use of the same model as (1) with different interpretation of variables. The ratio of non-interest operating expenses to total assets (NIE/A) is taken as the dependent variable to represent a bank's cost inefficiency²⁷. Non-interest operating expenses (NIE) is obtained by subtracting interest expenditure from total operating expenses net of allowance for bad credits and operating expenses of trust assets²⁸. The ratio, therefore, can be interpreted as a bank's unit operating expenses²⁹. A bank with high expenditure other than interest payments on various deposits relative to total assets is generally regarded as inefficient in the sense that the bank spends a big chunk of expenditure on the activities not directly related to earning.

The arguments of cost function include 'salaries & employee benefits per employee' (PL), 'occupancy, furniture & equipment expenses per branch' (PK), and the ratio of interest expenses to total interest-bearing assets (IE/IBA). Assuming that all employees work the same amount of time and there are no economies of scale in expenditure on occupancy, furniture & equipment, 'salaries & employee benefits per employee' (PL) can be regarded as unit price of labor and 'occupancy, furniture & equipment expenses per branch' (PK) as unit price of capital. The 'ratio of interest expenses to total interest-bearing assets' (IE/IBA) in the mean-time characterizes funding structure of a bank and will be utilized for unit price of intermediate goods in producing banking services in our analysis.

²⁶ In our case, it is interaccount transfer.

²⁷ It is needless to say that the pure effect of Internet banking should be obtained after the expenses and revenues related to Internet banking are separated from the expenses and revenues from other activities of a bank. Unfortunately, no balance sheet provides enough information for us to disentangle those different categories of expenses and revenues. For example, though it is highly likely that expenditure on certain items such as software purchase and R&D in information technology, data processing costs, and development and maintenance of the official website are related to Internet banking, according to the generally accepted accounting practice in Korea, they are mingled in the account of other operating expenses with other ordinary operating expenses such as purchasing of office supplies. The accounting practice is not specific to Korea and that is one reason we do not see many studies on the relationship between cost function and Internet banking, in general.

²⁸ We performed the same analysis with overhead ratio, which is a ratio of non-interest operating expenses to net operating revenues as the indicator for cost inefficiency. The result was not significantly different from that of the analysis in the paper. It is available from the authors upon request.

²⁹ In a strict sense, unit operating expenses should be defined as the ratio of non-interest operating expenses and the total value of service flow provided by a bank, for example, sum of total deposit taking and withdrawal as well as total loan and repayment. The difficulties in gathering reliable data forced us to use total asset, instead.

Table 3. Regression Result: Expenses and Internet Banking

dependent variable: $\ln(\text{NIE}/A)$				
D1	-0.1642** (0.0827)	-0.1204 (0.0820)		
$\ln(D2)$			-0.0559** (0.0215)	-0.0428** (0.0214)
$\ln(PL)$		0.3546*** (0.1122)		0.3519*** (0.1113)
$\ln(PK)$		0.1475** (0.1599)		0.1987** (0.1628)
$\ln(IE/IBA)$		0.0359* (0.0190)		0.0070* (0.0043)
R ²		0.6022		0.6269
Num. of obs.	200	200	193	193
F-statistic	7.9858***	7.8986***	8.4603***	8.4011***

1) *: statistically significant at 10% significance level, **: statistically significant at 5% significance level, ***: statistically significant at 1% significance level.

2) F-statistic is the test statistic for joint significance of variables and all dummies for fixed effect.

3) There are 7 observations that report 0's for D2. We drop those observations to take natural log of D2.

The trans-log cost function only with the first order terms are selected as the functional form. After adding a dummy for establishing independent Internet banking system and the proportion of interaccount transfer carried out through Internet banking to represent the extent of diffusion in Internet banking related activities respectively, we estimate the cost function with two-way fixed effect in panel specification.

The estimation results are reported in Table 3. The estimated cost function shows a reasonable fit and all coefficients except for one case are statistically significant and have predicted signs. In other words, a unit non-interest operating expense is positively related to unit prices of all inputs. Note that the dummy variable D1 loses statistical significance³⁰ when other control variables are added. It is difficult to help concluding that the introduction of Internet banking system does not shift down cost function of a bank. On the contrary, higher proportion of interaccount transfer through Internet banking seems to be associated with lower cost reflected in the statistically significant negative estimate on $\ln(D2)$.

Combined with the previous result that Internet banking is not related to better profit prospect, the result in Table 3 implies that the benefits of cost reduction brought by the expansion of Internet banking are dissipated across consumers through competitive pressure on banks. There are two channels through which competition among banks drives excess profit zero; discount or exemption of service fees, higher deposit rates, or lower lending rates. It is not possible to identify which route is taken when the benefits of cost reduction are dispersed across consumers and contribute to welfare gain for the society. We will address this issue later.

³⁰ The non-rejection of the null hypothesis that the estimated coefficient on D1 is not different from 0 is a marginal one. The p-value for the hypothesis is 14.39%.

The finding that investment on Internet banking has already started to provide enhanced cost efficiency implies that we will eventually see improvement in profitability. With the development of information technology along with continuously improved cost efficiency, the beneficial effects of investment on Internet banking will outweigh cost of funding for initial and subsequent investment and ROE will be eventually improved. The finding also supports the premise that we will eventually observe improvement in ROE, thanks to less expenditure when trying to steer more customers to Internet banking.

Our finding in this section agrees with DeYoung's (2001b) argument that emphasized valuable aspects of learning effect in improving profitability as the realm of Internet banking extends.

c. Internet banking and (non-interest operating) revenues

We found that Internet banking did not affect profitability of a bank but contributed to reduction of non-interest operating expenses. In this section, we turn our attention to the revenue side to further investigate the relationship between Internet banking and profitability.

A bank's operating revenues consist of revenues from interest on loans and non-interest operating revenues. It is true that Internet banking indirectly helps increase interest revenues by extending loans. The bank actively involved in investment on Internet banking benefits from lower unit operating expenses as shown in the previous section and may offer lower interest rates for its loan services. It is also true that a bank with high proportion of transactions processed through Internet banking system can take advantage of additional non-interest revenue-basis such as fees on interaccount transfer. Most of the extended revenue sources must have been found in non-traditional business areas rather than traditional ones.

We focus on the relationship between Internet banking and non-interest operating revenues in this section. If Internet banking plays a part in boosting non-interest operating revenues, one can infer that banks with active Internet banking business have the tendency to pursue higher profitability in non-traditional operations. Banks show a great interest in business models such as private banking specifically targeting at affluent customers and increase investments to offer greater range of services in those areas. The strategy is based on the belief that Internet banking will bring sizable service fees as well as revenues generated by traditional interest margin.

We again make use of the model (1) to specify the relationship between Internet banking and non-interest operating revenues per unit of assets. The ratio of non-interest (operating) revenues is taken as the dependent variable in the estimations. Other than Internet banking related variables, D1 and D2, we include, as explanatory variables, total assets (ASSET), ratio of won-denominated deposits to asset (D/A), ratio of loan to assets (L/A), overhead ratio (OR), ratio of employees to assets (EM/A), and ratio of the number of branches to assets (B/A).

ASSET is included to control for possible scale effect in utilizing supplementary services and is not expected to have a specific sign. We would have expected a positive sign for total operating revenues or interest revenues, however, it is impossible to predict the sign *a priori* in case of non-interest revenues. Most supplementary services that customers demand are likely to be accompanied by the main business of banks, deposit and loan. (D/A) and (L/A) are included to allow the possibility and the signs of both estimates are expected to be positive. Overhead ratio, the number of employees per unit of assets, and the number of branches per unit of assets are all included to control for the inputs required to produce the supplementary services that bring a bank non-interest operating revenues. If the production function exhibits monotonicity with respect to each input, all signs on these variables are predicted to be positive.

Table 4. Regression Result: Non-Interest Revenues and Internet Banking

	Model I	Model II	Model III	Model IV
D1	-0.1026 (0.0797)	-0.1622 (0.1804)		
D2			-0.0584 (0.0640)	-0.0530 (0.0707)
ASSET		-1.9292 (2.0347)		-1.6420 (2.0712)
D/A		-1.5385 (6.5144)		-2.0748 (6.7578)
L/A		-0.7180 (3.1243)		-0.9282 (3.1646)
EM/A		-2.6030** (1.4780)		-2.1933* (1.1789)
B/A		0.2237 (0.2823)		0.2514 (0.3068)
R ²	0.5605	0.5965	0.5584	0.5879
Num. of obs.	200	200	200	200
F-statistic	7.4763***	6.9279***	7.4125***	6.6855***

1) dependent variable: non-Interest operating revenues

2) *: statistically significant at 10% significance level, ***: statistically significant at 1% significance level.

3) F-statistic is the test statistic for joint significance of variables and all dummies for fixed effect.

The estimation results appear in Table 4. The overall performance of the empirical model we specify to explain non-interest operating revenues is not satisfactory. Except for (B/A), all of the estimated coefficients have wrong signs, two of which, OR and (EM/A) are statistically significant. One possible account for the disappointing result in Table 4 is that the estimation suffers from the classical symptom of omitted variable bias. Due to difficulties in data availability, we did not include an important price variable, unit price (fee) of supplementary service.³¹ Examining the estimates in Table 3, it is very difficult to support the hypothesis that the introduction and diffusion of Internet banking contribute to increase in non-interest operating revenues.³²

In sum, we find that Internet banking plays a marginal part in reducing non-interest operating expenses but does not contribute to non-interest operating revenues or overall profitability of a bank. We want to attach two reservations in interpreting the findings in the

³¹ Even in the presence of omitted variable bias, the statistically significant negative signs on overhead ratio and the number of employees per unit of asset have an interesting implication that increase in neither share of non-interest operating expenses nor labor input result in higher non-interest revenues.

³² Although D1 seems to have a stronger link to the dependent variable than D2, it is just casual, therefore statistically unjustifiable, observation.

paper. First, the history of Internet banking is short in Korea and it is hard to expect full scale realization of the effects of Internet banking in such a short period of time. Second, since banks started to offer Internet banking in groups, our sample does not have much variation in variables for Internet banking. The results in the paper should not be interpreted as the definite answers to the questions we raised in the paper.

d. Expansion of Internet Banking

In previous section, we uncover that Internet banking has not increased or decreased non-interest revenues. Combined with the findings in sub-section *a* and *b*, it provides us a possible account for the fact that in spite of beneficial effects of Internet banking on cost efficiency, we are not able to link expansion of Internet banking to higher profitability. That is, indirect cost required in inducing more customers and cost to maintain Internet banking system may have been big enough to counterbalance the cost reduction.

In this section, we specify an empirical model to identify determinants of the expansion of Internet banking service. We also try to test the hypothesis that a bank with higher market share takes an aggressive position in Internet banking related investment decision. Sullivan (2000) argues that uncertainty on demand for a new financial product offers a competitive edge to bigger banks when they first launch marketing drive for the new product. Furthermore, if customers retain strong preferences for face-to-face transactions and concern on the stability of banks they transact with in spite of convenience and cost efficiency of Internet banking, we would expect a positive relationship between market share and expansion of Internet banking³³.

For an empirical model to describe the investment decision on Internet banking, we include, as explanatory variables, total assets (ASSET), ratio of non-interest revenues to net operating revenues (NIR/NOR), net interest margin in the previous quarter (NIM(-1)), ratio of won-denominated deposits to asset (D/A), dummy for nationwide or provincial banks (DNP), dummy for injection of public fund (DF), and finally market share (MS).

ASSET will have a positive sign in the sense that a bigger bank would be able to attract cheaper fund for investment on Internet banking. The ratio of non-interest revenues to net operating revenues³⁴ is not only an indicator for aggressiveness of bank's management strategy but a channel through which a bank enhances its profit basis by frequent use of supplementary services such as interaccount transfer. A positive sign on (NIR/NOR) is expected. Lagged net interest margin is included to control profitability indicator for a bank and is not expected to have a specific sign. One can expect a positive sign if a bank with higher profitability in interest related operation attracts fund for initial investment with ease. On the contrary, a bank with a disappointing performance in traditional operation may choose Internet banking as an instrument to improve overall profitability and invest in Internet banking aggressively.

Since a bank less dependent on traditional way of supply and allocation of fund will be more likely to adopt a new way of doing business, higher ratio of deposit to assets would be

³³ This is also related to DeYoung's (2001) argument that since customers are interested in stability as well as cost and convenience in choosing banks with which they maintain deposit and loan accounts, banks with well-established reputation rather than newly licensed Internet-only banks show stronger preference for investment on Internet banking.

³⁴ Note that net operating revenues is obtained by subtracting interest expenses from total operating revenues.

associated with less active transactions related to Internet banking. DNP is defined as 1 if it is for nationwide bank and 0 if otherwise. DF is defined as 1 if public fund is injected into the bank and 0 if otherwise. Market share is calculated as the average of market share based on deposit balance and market share based on loan balance of each bank.

The ratio of amount of interaccount transfer through Internet banking system to the total won-denominated deposit balance (D2) is taken as the dependent variable to measure the expansion of Internet banking.

To allow for the truncation at 0 in the dependent variable, we use two-way fixed effect Tobit model instead of ordinary two-way fixed effect model. The empirical model is given as,

$$y_{it}^* = \alpha + \beta' x_{it} + \mu_i + \eta_t + \varepsilon_{it} \quad (2)$$

$$y_{it} = \begin{cases} 0 & \text{if } y_{it}^* \leq 0 \\ y_{it}^* & \text{if } y_{it}^* > 0 \end{cases} \quad (3)$$

Assuming that $\varepsilon_{it} \sim n.i.d.(0, \sigma^2)$, the log likelihood function is given by,

$$L(\alpha, \beta) = \sum_{i=1}^N \sum_{t=1}^T \left[I_{it} \ln \left[\frac{1}{\sigma} \phi \left(\frac{y_{it} - \alpha - \beta' x_{it} - \mu_i - \eta_t}{\sigma} \right) \right] + (1 - I_{it}) \ln \left[1 - \Phi \left(\frac{\alpha + \beta' x_{it} + \mu_i + \eta_t}{\sigma} \right) \right] \right] \quad (4)$$

where I_{it} is the indicator function defined as $I_{it} = I_{[y_{it} > 0]}$, $\phi(\cdot)$ is density function of a random variable with the standard normal distribution, and $\Phi(\cdot)$ is the cumulative distribution function of a random variable with the standard normal distribution³⁵.

The result of the estimation appears in Table 5.

The estimated model possesses desirable ingredients of a good empirical model; a good fit and statistically significant estimates. First, the faster the expansion of Internet banking is, the higher net interest margin in the previous quarter and the higher deposit-to-assets ratio. Second, nationwide banks and banks with public fund injection for restructuring are much more aggressive in pursuing the business model based on information technology. Third, contrary to theorization popularized by Sullivan (2000) and DeYoung (2001), banks with higher market share are negatively associated with more extensive dependence on Internet banking measured by the proportion of interaccount transfer through Internet banking system out of the total won-denominated deposit balance. The finding indicates that smaller banks confronting with turbulent market environment have been more active in accepting Internet banking as a device to overcome uncertain prospects and enhance profitability. In addition, the result gives indirect evidence that the preferences for face-to-face transaction are not strong in Korea.

³⁵ That is, $\phi(z) = \frac{d\Phi(z)}{dz}$.

Table 5. Regression Result: Expansion of Internet Banking

<i>Explanatory Variables</i>	<i>Estimates</i>	<i>Standard errors</i>
ASSET	0.7570	0.6810
(NIR/NOR)	0.0004	0.0004
(NIM(-1))	0.4659**	0.1999
(D/A)	0.0080*	0.0049
DNP	0.6044***	0.1676
DF	0.1172*	0.0676
MS	-0.0865**	0.0441
Maximized Likelihood	-130.2206	
LR statistics	48.6854***	
Num. of obs.	200	

1) dependent variable: proportion of interaccount transfer through Internet banking system out of total won-denominated deposit balance.

2) *: statistically significant at 10% significance level, ***: statistically significant at 1% significance level.

3) LR statistics is the test statistic for the null hypothesis that all variables in the table are jointly insignificant. The distribution of the test statistic under the null hypothesis is χ^2 with the degrees of freedom 7.

4) The number of censored observations is 193 and uncensored is 7.

IV. Conclusion

This paper is an empirical analysis to verify the hypothesis that the Internet banking, rapidly expanding in the Korean banking industry, allows banks to reduce cost and ultimately contribute to higher profitability. Major findings from the empirical analysis are as follows.

First, from the analysis of relationship between Internet banking and bank performance, we found that introduction and expansion of Internet banking did not influence the financial performance of banks, especially in terms of profitability.

Second, we examined whether the introduction and expansion of Internet banking contributed to reducing non-interest expenses and enhancing management efficiency. While there is no evidence that the introduction of Internet banking have enhanced the cost efficiency of banks, we found that the expansion of Internet banking did contribute to enhancing cost efficiency of banks. That is, although Internet banking could not influence banks' profitability or cost-efficiency when the system was introduced for the first time, it played a role in changing the cost structure of the banks. It implies that the primary objective of introducing Internet banking, which was to reduce the operating cost such as branch maintenance expenses,

has been accomplished, but this cost-reduction effect has not yet reached the stage in which beneficial effects of Internet banking overcome the negative effect of initial investment on the profitability of banks. Considering that the growth potential of Internet banking consists in its cost efficiency, this also indicates that the strategies of the Korean banks to expand Internet banking would ultimately bring positive outcomes.

Third, we could not find any support for the hypothesis stating that introduction and expansion of Internet banking positively affects non-interest operating revenues of Korean banks. This implies that benefits to the Internet banking customers have been primarily provided through the interest rate channel such as higher deposit rate or lower lending rate rather than non-interest service fee channel.

In addition, we found that the people's preference for face-to-face transaction may be very low in Korea, which supports the hypothesis that the cost for securing customer base will be much reduced.

All these findings, lower cost without higher profit, offer an important implication that Internet banking has increased social welfare by making banks to distribute the benefits of cost reduction to customers in various forms such as preferential interest rates and fee exemption, rather than internalize the benefits to the banks' profits. At the same time, it can be also anticipated from our results that profit-enhancing effect of Internet banking will become more significant in the near future since the cost-reduction effect of Internet banking will be stronger with the technology development that reduces the cost of maintaining Internet banking system.

Progress of IT profoundly contributes to the development of banking and financial services industry, and this tendency is expected to continue. Among the contributions, the introduction of Internet banking is one of the most important. Hence, a clear understanding of its pros and cons is critical in the research of the banking industry. Although it should be admitted that the future of Internet banking is uncertain, researchers need to provide a precise analysis on the rapidly growing Internet banking market and its effects on the market structure of the banking industry.

It goes without saying that it may be too early to evaluate the impact of adoption and expansion of Internet banking on the performance of Korean banking industry, whose business behavior and attitude are changing rapidly after the currency crisis followed by the financial restructuring. In addition, since Internet banking in Korea is about only 4 years old, the data presented in this paper may not be sufficient by themselves to support any aforementioned conclusions. Thus, the result of this paper's empirical analysis should be interpreted with some caveats in mind. Regardless of these potential limitations, however, this paper can be evaluated as a rare attempt to offer a picture of the current market for Internet banking in Korea by investigating its impact on the performance of banks, and results of this paper could be utilized as indicative evidence of the related theories and hypotheses.

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Appendix. Summary Statistics for the Variables in the Analysis

Table A. Summary Statistics for the Variables in the Analysis

	Num. Of obs.	Unit	Mean	Median	Standard Deviation	Max	Min
D1	194		0.8608	1.0000	0.3470	1.0000	0.0000
D2	187	%	0.2368	0.0600	0.5304	3.3584	2.43E-05
ASSET	194	10 trillion Won	3.5045	2.6377	3.0510	16.1038	0.1168
E/A	194		0.0387	0.0396	0.0144	0.0720	0.0002
DF	194		0.3711	0.0000	0.4844	1.0000	0.0000
L/A	194		0.5698	0.5688	0.0675	0.7451	0.4245
NIE/A	194		0.0073	0.0064	0.0041	0.0464	0.0034
OR	192		1.1851	0.6436	2.7756	27.9888	0.3114
MS	194	%	5.1546	3.6586	4.6605	24.6197	0.2066
PL	194	Million Won	13.4646	13.2649	3.7423	26.1426	6.2159
PK	194	100 million Won	1.3081	1.2695	0.4752	3.0036	0.4155
IE/IBA	194		0.0138	0.0139	0.0038	0.0414	0.0053
D/A	194		0.6287	0.6361	0.1000	0.8013	0.3641
EM/A	194	Persons/ billion Won	0.1719	0.1587	0.0680	0.4591	0.0744
B/A	194	Branches/ billion Won	0.0122	0.0112	0.0502	0.0291	0.0556
NIR/NOR	194		0.4024	0.4857	0.6247	2.6444	-4.1250
NIM(-1)	194	%	0.5546	0.5476	0.1702	1.1779	-0.0608
DNP	200		0.7000	1.0000	0.4702	1.0000	0.0000

Comments on “Impact of Internet Banking on the Performance of the Korean Banking Industry”

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Kim and Park's recent research on internet banking addresses the following question: Did the introduction and the expansion of internet banking, in Korea, affect bank performances positively? Constructing and carefully investigating a unique data set covering both financial statements and internet banking statistics of 20 banks from 2000, Q1 through 2002, Q2, authors come up with two major conclusions. First, active use of internet banking as the distribution channel of banking services, on average, helps reduce cost. In the authors' cost regression, individual bank's non-interest operating cost divided by its total asset is used as the dependent variable. Variables representing the introduction of the internet banking services and its expansion are used as the explanatory variables of interest. Second, bank profitability in terms of ROE does not show significant sign of improvement as a result of the expanded use of the internet banking.

These results are quite interesting because they may indicate, as the authors claim, that the cost reduction benefits due to internet banking, rather than exclusively appropriated by the stock holders, are substantially shared by the consumers as well. But it, at the same time, is quite puzzling that the authors do not attempt to provide concrete evidences to back up their claim. Simple accounting identity suggests that if profit stays same in spite of cost reduction, one of the following must be the case: Revenue reduction may have happened in parallel with the cost reduction. Or, the reduction of certain, say non interest operating, costs may have been accompanied by an offsetting move of some other, say interest operating, costs. To explain why Korean banks' profitability did not improve much in spite of the enhanced cost effectiveness due to the adoption of the internet banking, authors resort to two different lines of argument: first, internet banking must have been a highly competitive realm of business where players were forced to trade off current profits with the future market share. Therefore, introduction and expansion of the internet banking, as well as reducing overhead costs, must have entailed promotional interest rates and fees. Second, like all other physical investments, it may take up a while to meaningfully materialize the potential business benefit of internet banking while the payment of its cost must be made at present.

The second argument might be true, but it doesn't seem to support the author's empirical results very much. The major business benefit one might expect from adopting internet banking must have to do with cost reduction, but it is already materializing according to the authors. More importantly, major chunk of the startup cost of internet banking is categorized as bank's non-interest operating cost, the dependant variable of the authors' cost regression. The

implication is severe: the cost reduction benefit of internet banking already outweighs its startup cost. On the whole, it is still not very clear why the materialization time argument could help explain the observed fact that internet banking is not enhancing bank profitability yet. I personally agree with the first argument, though. One, through his own daily transactions, can easily observe that Korean banks do offer promotions. Most banks, for example, waive transaction fee when customers perform intra-account fund transfer through the internet. These promotions are likely to generate adverse impact on current business earning. It therefore must have been more clear-cut if the authors were able to show this negative correlation.

Aside from those caveats, the present paper makes nontrivial contributions in the literature of Korean internet banking. First, the data set the authors collected has genuine value. Korean internet banking statistics, in particular, are something that are not easily accessible, which is one of the reason why similar study has not been attempted. Second, the main findings of the paper, in itself, are both interesting and meaningful. Although the authors' explanation of the results is not perfectly convincing, it does not necessarily mean that the results may be untrue. Thus, this paper invites for further investigation of the issue in the future. Third, this paper is an early attempt to diagnose the way internet banking market works in Korea. The future course of the market and its economic consequences are both unknown and unprecedented, and academic attempt to unveil what is actually going on is strongly called for at this early stage of development.

CHAPTER 7

Measuring and Explaining Income Inequality in Korea

by
Kyungsoo Choi

I. Introduction

This paper addresses the issue of measuring and explaining income inequality changes in Korea during the past twenty years. This is a very old issue, but it is currently a very hot issue that draws much public attention since the deterioration of income distribution is very widely felt and much worried by the public. The balance between growth and equality has even emerged as a political issue.

Up to the mid 1990s, Korea has been known as an showcase country where economic growth is accompanied by an improvement in income distribution. Actually from the early 1980s to the mid-1990s, for which period a detailed empirical analysis is possible, income inequality has been improved in all respects. However, in the aftermath of the economic crisis that broke out at the end of 1997, the income distribution suddenly deteriorated. Currently, the income inequality in Korea is almost at the level of the early 1980s, or even worse depending upon how the inequality is measured. If we look at the inequality trends in the past twenty years, it has a literary “U” shape—declining all the way from the early 1980s to the mid 1990s, and ascending back to the level where it used to be in the early 1980s.

As the after-Crisis rise of income inequality is very rapid, one may have interpreted the rise as an evidence of the sufferings during the aftermath of the Crisis, and expect that the rise would disappear as the impacts of the Crisis subsides. But after five years from the Crisis, the inequality is still here, without showing signs of returning to its previous level. This raises another fundamental question. “Was the improvement of income distribution accompanied by efficiency improvements?” The Crisis at the end of 1997 was a foreign currency crisis caused by macroeconomic mismanagement, but at the same time it was a banking crisis caused by enormous non-performing loans that has been accumulated by economic inefficiencies in the past. It may be that the income distribution improvement has been achieved at a cost of efficiency loss, which took its toll on equality after decades.

To address such issues, I perform a detailed empirical analysis of existing data in this paper in the period of 1982 to 2002. Further, I decompose the inequality changes vertically (by income sources) and horizontally (by population sub-groups) to identify sources of the changes.

From the analysis, several trendy long-term changes are identified that may raise inequality in the long run: Family sizes are becoming smaller, female participation rises whose income is positively correlated with husbands’ income, and the shares of household with female and the elderly heads increase. Such changes have existed in the past and expected to persist, raising

the overall inequality in the future. However, although the changes have been accelerated recently, they are not the major factors of the sudden change in inequality.

The analysis shows that most of inequality changes can be attributed to the household heads' labor income distribution. During the 1980s and up to the early 1990s, inequality among the educational groups significantly decreased, while inequality within the educational groups did not change much. Hence, the narrowing of income gaps between different educational groups has been the major factor in reducing income inequality in the late 1980s and early 1990s. However, the effects of between educational group inequality reduction are confined only up to the early 1990s, and since then the between group inequality virtually did not change. The continued inequality reduction until the mid 1990s is attributed to the reduction in within group inequality reduction among the educational groups. It is important that such within groups inequality reduction was realized while real incomes are rising.

The situation is reversed after the Crisis. Within group inequality among educational groups started to rise in the mid 1990s, before the Crisis. Thus, the Crisis is not the direct cause of widening of inequality at least within the educational groups. The most direct cause of after-the-Crisis inequality widening is the rise of inequality among the least educated group. After 1998, household heads' real incomes in the least educated group declined in all income groups especially among the low-income group. And the inequality rise is attributed to loss of job opportunities among them especially in the low-income groups rather than to wage decline. Other educational groups suffered much less working hours reduction and smaller inequality widening among them.

This paper is organized as follows: In the next chapter, I review the past trends of income inequality. In Chapter III, I introduce the data and briefly summarize the inequality trend in the data, followed by some sensitivity check to determine proper measure of inequality. Then I perform vertical decomposition of inequality to see the source of inequality variation, and horizontal decomposition to identify how inequality changed. Chapter IV concludes the paper.

II. Past Inequality Trends

Korea is externally known as a country whose income distribution inequality is relatively 'mild.' Sometimes, Korea is touted as a rare case where rapid economic growth has been achieved with income inequality improvement. Some even pointed out that the initial condition of Korea in income distribution—that is, Korea had near perfect income distribution equality after the Korean War in 1950~1953—motivated the people and contributed to her rapid economic growth. However, internally inequality issue has been very sharply raised in Korea at times. In the late 1980s, when the economy was booming and land and housing prices hiked, concerns over widening inequality in asset holdings were very sharply raised. Recently, as the earnings distribution is deteriorating under an economic restructuring process that is intended to raise the overall efficiency of the economy after the economic Crisis at the end of 1997, the inequality issue is again drawing national attention.

In the past, there has been a gap between the published inequality statistics and the inequality perceived. In the late 1980s, the Gini index continued to fall, while the public generally felt widening inequality. Two factors are usually pointed out to account for the gap: One is that the income survey was incomplete and its resultant statistics is not very reliable before the 1980s, and the other is that while published inequality statistics are on the earnings

inequality, the public is more sensitive to wealth distribution inequalities. (Joung-woo Lee and Seong-hyeon Whang, 1998) The high economic growth in the 1970s and 1980s was accompanied by high inflation and sharp rise of land and housing prices, which must have worsened wealth distribution given that the wealth is more unequally distributed than the earnings. However, data on individuals' asset holdings are not sufficient and unreliable due to the under-reporting practices to evade tax levies, and thus they are not published. The different trends in wealth distribution and income distribution may explain the gap between the published and the 'felt' inequality trends. On the other hand, the current inequality issue is regarding earnings inequality, for which good data sets are available for the period since 1982 and empirical investigation is feasible.

The main data set for measuring income distribution in Korea is the Household Income and Expenditure Survey (HIES), which is a survey over wage/salary worker headed households with two or more members living in the urban area. The survey started in 1963 by the Korea National Statistics Office (NSO). Prior to 1975, the survey was based upon the households' responses to interview questions and less reliable. Since then the surveyed households are asked to record income and expenditure, and the survey is based upon such records. Currently, data sets since 1982 are available for research purposes, and the analysis period of this research is set according to such data conditions.

For the 1960s and 1970s, income distribution inequality statistics are estimated values from combined data sets of various sources. Choo (1979) estimated income distribution inequality in Korea in 1965, 1970, and 1976 based upon the HIES and Farm Household Economy Survey data sets. Incomes of non-wage worker headed households, for which the data do not exist, are projected using their savings records and substituted in his estimates. Table 1 reports his estimates along with the 'official' statistics of the Economic Planning Board from the Social Statistics Survey for the years 1980, 1985, 1988, and 1993.

Table 1. Income Distribution Inequality Trends in Korea: 1965~1993

	1965	1970	1976	1980	1985	1988	1993
Lower 40% (A)	19.34	19.63	16.85	16.06	17.71	19.68	20.42
Upper 20% (B)	41.81	41.62	45.34	45.39	43.71	42.24	39.29
Declie ratio (A/B)	.4626	.4716	.3716	.3538	.4052	.4659	.5197
Gini index	.3439	.3322	.3908	.3891	.3449	.3355	.3097

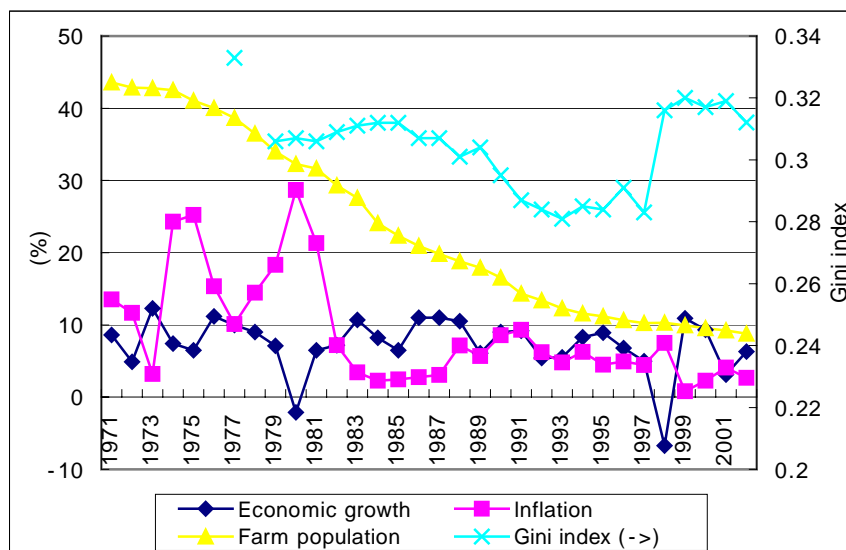
Source: Choo (1979), EPB (1987,1990) cited from Lee and Whang (1998).

The trend of income distribution inequality during the period covered in Table 1 is summarized as follows. The inequality in Korea from the mid 1960s to the 1980s changed in different directions: First, income distribution improved at the initial period of industrialization in the second half of the 1960s. Secondly, during the 1970s income distribution deteriorated. And finally, income distribution improved in the 1980s.

Income distribution improvement in the second half of the 1960s is explained by the onset of industrialization. In the 1960s, government-led and export-oriented economic growth strategy supported labor-intensive industries and resulted growing labor incomes, which contributed to equalizing income distribution as labor incomes are more equally distributed than property incomes. (Lee and Whang, 1998) Leipziger et al. (1992) point out that in the 1960, labor

movement from the rural to urban sector reduced inequality in the rural sector, while the urban sector was still small in size and inequality was not serious there.

Figure 1. Macroeconomic and Gini Index Trends in Korea



During the 1970s, income distribution deteriorated. The 1970s was the decade of rapid economic growth and high inflation in Korea. (See Figure 1.) Inflation rate jumped to 20% in the 1970s from the 1960s' 10% level, accompanied by real estate price hike. In the period, heavy and chemical industries were heavily subsidized as a part of development strategy. Tax levies were reduced and bank loans were assigned at privileged 'policy' interest rates, which were often below the inflation rates, to companies in the industries which were already intrinsically monopolistic. Choo (1982) notes that the Gini index value among the employer and self-employed households jumped to 0.449 in 1976 from 0.353 in 1970, which is significantly higher than the Gini index value of 0.327 in the rural sector and that of 0.355 among the urban wage worker households in 1976. He suggested that urbanization and emergence of high income groups in the urban sector accounts for a significant part of the income inequality widening in the 1970s. Leipziger et al. (1992) explain the rise of income inequality similarly. Their explanation is that as the excess labor depleted in the rural sector, income inequality stopped to fall in the sector, while the urban and industrialized sector with higher income inequality expanded in the 1970s. However, such explanations are not very persuasive because income distribution improved in the 1980s, when the urban and industrialized sector continued to grow. The inequality changes within the urban and industrialized sector need to be explained, if such a description is to be more complete.

In the 1980s, the Gini index continued to fall. It stood at 0.3540 in 1985, at 0.3360 in 1988 and further dropped to 0.3097 in 1993. The deciles ratio, the ratio of the income of lower 40% to that

of upper 20%, continued to rise.¹ Several explanations for the 1980s' income distribution improvement are: First, throughout the 1980s inflation rates were stable. Second, measures were taken to relieve workers' tax burdens, while preferential strategic bank loans to large companies were reduced. Third, demands for the unskilled workers increased while supply of the low educated reduced, resulting the wage gap between educational groups to decline. As we will see later in this paper, empirical evidences show that inequality reduced both between and within educational groups along with real income growth among all decile groups.

However, in the second half of the 1980s, inequality widening became a very pressing social issue and the feeling of relative deprivation was prevalent among the public. The apparent discrepancy between the statistics and the general perception is explained differently by different scholars. Some scholars questioned the reliability of 'official' statistics. Some of them came up with different estimates of Gini indices by applying different estimation methods to the data sets (usually by estimating independently the incomes of those not contained in the data sets) or by using independent surveys. They claimed that income distribution in Korea did not actually improve in the 1980s unlike the trends of the 'official' statistics, and many of them suggested that the Gini index values were in fact significantly higher than the official figures. However, not only the estimates were widely different among themselves, but also results from studies that used the same data sets but applied different methods contradictory among them, which made the results less credible. Other scholars claimed that the generally felt sense of widening inequality was due to the recognition of distributional injustice in the period rather than the actual income change. In the late 1980s, real estate prices hiked and property speculation was prevalent. The high non-labor incomes in the period, which were generated by speculation and tax evasion but which were not reported in official surveys, not only hurt the sense of equality and 'distributional justice,' but also may have deteriorated the actual income distribution. Still others tried to explain the gap between statistics and the general feeling with the uniqueness of the Korean population. The Koreans had a very strong feeling for homogeneity through their long history of being an ethnically homogeneous people. Further, as Korea had been in poverty for a long time and experienced the Korean War in 1950~53, the initial condition of income distribution was nearly perfectly equitable, the entire population suffering from poverty. They claimed that against such background, differences in income growth and widening gaps in living standards might have been felt more strongly than in advanced countries with long history of industrialization, regardless of the actual state of income distribution.

III. Measuring and Explaining Inequality Changes

This paper analyzes income distribution inequality changes in Korea from 1982 to 2002. I begin by introducing the data sets used in the study.

1. Data

In measuring and explaining the inequality, the study relies on two sets of data—the Household Income and Expenditure Survey (HIES) and the National Survey of Household

¹ See Table 1.

Income and Expenditure (NSHIE), both of which collected by the Korea National Statistical Office (KNSO). The two data sets are the most commonly used ones for income distribution analysis in Korea, from which the government statistics are also produced. I describe briefly the data sets in this section.

A. The HIES (Household Income and Expenditure Survey) data

The HIES is the primary survey for income distribution in Korea. The Korea National Statistical Office (KNSO) publishes the survey results every quarter. The survey began in 1963, since then, there have been several major amendments in survey methods and items. Currently, the data set since 1982 is available for research purposes. The data set is the most often used in income and expenditure analysis. Besides being the official data sets from which the published statistics are reproduced, the data sets have the advantage that they contain consistent information on income and expenditure for the longest period of time compared to other data sets.

The HIES data set is a quarterly data set, but the survey itself is conducted monthly by the KNSO over about 5,500 households. Each household observation in the data set has three records corresponding to the number of months in the quarter but information on the survey month is not provided and just the quarter in which the survey is done is known. In the data set, non-responses are not uncommon, and many of the records are filled in with a 'hot-deck procedure'—that is, the missing record is replaced with a replication of some other randomly chosen record in the month from a household with similar characteristics.²

The data set also has some nontrivial defects. One is that since the HIES sample is a subset of a larger sample for employment survey—the Economically Active Population Survey (EAPS), and the latter is changed completely every five years, the HIES series has discontinuities every five years. In Korea, a population census is conducted every five years in the years ending with 0 or 5, and after three years (ending with 3 or 8), the EAPS sample is resampled (from January survey) based upon the census results to improve the representativeness of the sample. The recent re-sampling years after 1982 were 1988, 1993, 1998, and 2003. Although such a sample change is inevitable, the practice impairs the consistency across the years. Incidentally, 1998 was a re-sampling year, which is the first year after the Crisis at the same time. Hence some of the after-the-Crisis changes are mixed with the re-sampling effects, which create some noise in analyzing the former. For example, unemployment rate soared and inequality jumped in 1998 compared to a year ago, and some people claim that part of the change is due to the sample change. On the other hand, an advantage of the HIES sample being a sub-sample of the EAPS sample is that the two data sets can be matched, from which a labor market information can be obtained for the HIES observations. In fact, the information is utilized in section 6 of this chapter when I analyze the working hours by income classes.

Another major weakness of the HIES is its limited coverage. The HIES sample contains households headed by a wage/salary worker and dwelling in the urban area, and among them, single-member households, farmer or fisher headed households, foreigner, and composite households are excluded. The reason for excluding such households is said to prevent possible irregularities caused by households whose incomes are not easily surveyed or regularly reported. Further, the HIES data reports income only for those households whose heads are

² For example, in the 2002 data set, 19.4% of total observations are registered as non-responses and thus filled in by a hot-deck procedure.

wage/salary workers. The reason for such limited coverage is, according to KNSO, that the self-employed' or employers' responses for their incomes are hardly reliable, and hence including their income would make the whole survey less credible. In the NSHIE (2000) data set, which also excludes non-urban households but includes income data for single-member households and households whose heads are self-employed, employers or non-employed, households whose heads are wage/salary workers and which have multiple members are 48.4% of total households. Hence, the HIES data covers less than half of total urban households.³

Lastly, the HIES data set does not contain information on asset holdings. Inferences on capital gains, which may actually affect 'inequality' more seriously than income, are not possible from the data set.

In the HIES data, income is composed of regular and non-regular income. Non-regular income is the part of income that does not occur periodically or repeatedly: typically, they are retirement pay, gifts, congratulatory or condolence money, etc.⁴ Regular income is categorized as (i) labor income, (ii) business income, (iii) asset income, and (iv) transfer income. Labor income is again divided into three sources: the household head's, the spouse's, and other members' income. Hence, individual labor incomes are known only for the head's and the spouse's, and other household members' labor incomes are shown only in their sums. Since many wage/salary workers are household members of wage worker headed households or they belong to non-wage worker headed households whose labor incomes are not reported, the HIES data set is a very poor data set for wages. Transfer income includes private transfers (subsidies) and public transfers. The quarterly HIES data contains only the total of transfer income but the yearly HIES data have separate items for private and public transfers without markings for survey quarters.

B. NSHIE (National Survey of Household Income and Expenditure) data

The NSHIE is a much more extensive survey than HIES, and it can make up for some of the weakness of HIES, the limited coverage. Its sample is comprised of approximately 30,000 households and includes single-member households and farmer/fisher households which are excluded from the HIES sample. It also has more survey items than the HIES.

The NSHIE has been conducted three times (in 1991, 1996, and 2001) with intervals of five years. However, the survey items have not been consistent and survey results in different years are not comparable with one another. For example, the 1991 and 1996, surveys were conducted between October to December, and incomes in the year up to the survey date were recorded, while the 2001 survey was in May and yearly incomes in the previous year (2000) were recorded. As in the case of the HIES, the survey sample is a subsample of the EAPS sample, and re-sampled every five years. Thus, the NSHIE results in different years are from different samples.

The main advantage of using the NSHIE data sets is that not only a wider range of households are included than in the HIES data sets, but also incomes of the self-employed and employer households, which are not reported in the HIES data sets, are recorded in the NSHIE

³ In the NSHIE (2000) data set, single-member households are 15.1% and self-employed, employer, or non-employed headed households are 44.7% of total households.

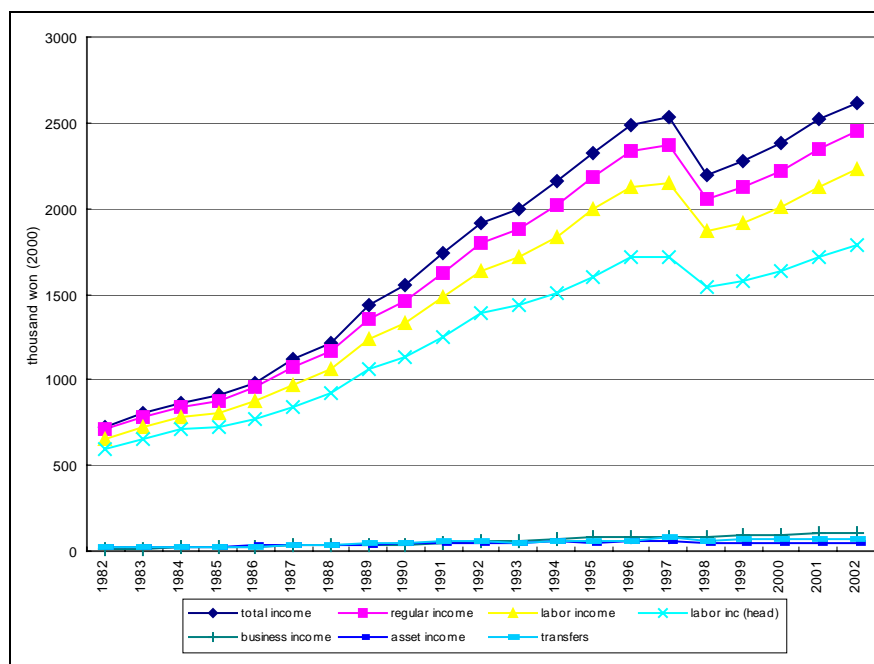
⁴ These items are close to some kinds of 'funds' rather than income. They could be classified as cash asset gains rather than income.

data set.⁵ Thus, the NSHIE data sets are much more useful for cross-section comparisons than for comparison across times. For example, from the NSHIE data, we can measure how far the HIES mean income deviates from the population mean and what the trend of the deviation is across years. For international comparison, data on incomes of the self-employed and employers are required, and the NSHIE data is appropriate. (See Hyun and Lim, 2002)

2. Real Income Trends

I start with a description of the general income trends shown in the HIES data set. Figure 2 reports the general real income growth trends by income sources among the urban worker families (specifically, wage/salary worker headed families). The yearly incomes are averages of the four quarters' real incomes obtained by deflating nominal incomes with the corresponding quarter's CPI index with base year 2000.

Figure 2. General Real Income Trends by Sources among Urban Worker Families



⁵ The 1996 NSHIE data set contains income data for employer and self-employed headed households only for the yearly income category. The 2001 data set has their monthly incomes.

As reported in Figure 2, most of total income is regular income, and labor income is the most important income source of the regular income in urban worker families' income structure.⁶ Regular income takes up on average 95% of the total income, and labor income is about 90% of the regular income.⁷ And the share is fairly constant throughout the period. As a result, the total, regular, and labor incomes have very similar trends. (See Table A.1 for income statistics by sources.) Real incomes of urban worker families have grown steadily, with some acceleration in the late 1980s, until the Crisis at the end of 1997. Urban worker families were particularly hard hit in the aftermath of the crisis and their real incomes declined significantly in 1998, but they are steadily growing again since then. (See Table A.2 for income growth rates by sources.)

The head's labor income has become consistently less important as the major source of household's labor income, while the spouse's and other members' labor incomes have been growing in their shares during the past twenty years. The head's share dropped from 90% in the early 1980s to 80% in 2002, whereas the spouse's share rose from 4% to 11% and other members' share rose from 5% to 9%. (See Figure 3) The trend is very clear and consistent throughout the period. The trend seems to be a direct result of consistently rising female labor participation in the Korean labor market. In 1998, that is immediately after the Crisis, the head's share jumped and the spouse's and other members' shares dropped as the female and young workers suffered more by the recession.

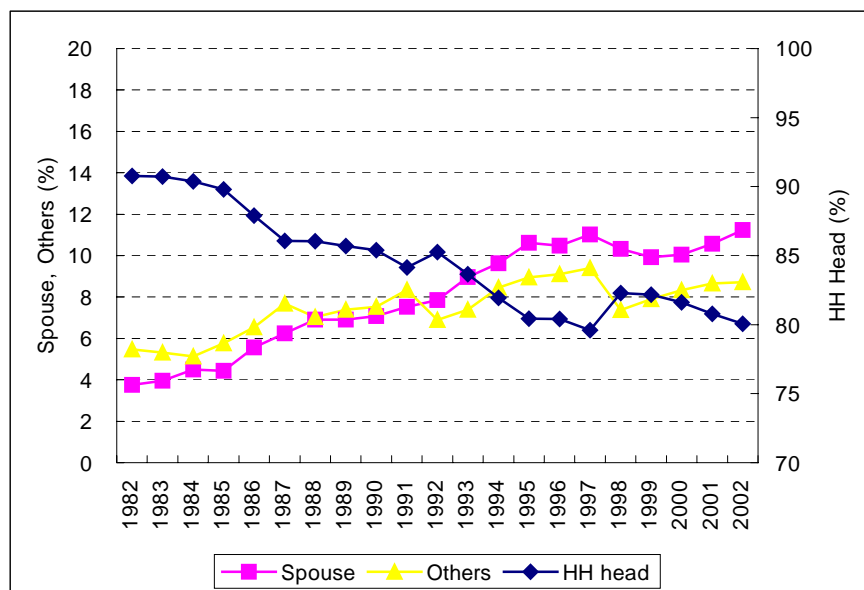
The shares of other income sources also did not vary much during the last 20 years. The share of business income rose from slightly above 2 percent in the early 1980s to about 4% recently and that of non-regular income rose from 2% to 6% in the same period, while the shares of asset income and transfers are roughly constant at around 3% throughout the period. (See Table A.2. in Appendix.)

A more detailed description of income composition by sources is given in Table A.4. The figures are derived from an annual version of the HIES data set of 2001. KNSO provides the HIES data sets in quarterly and annual versions. Annual versions contain full survey items with no markings for survey quarters, whereas quarterly versions have survey quarters but income sources are given only up to the 3 digit classifications—that is, labor income, business income, etc. For example, quarterly versions report only the total transfers, and the shares of public (pensions and other social benefits) and private transfers among them are given only in annual versions. The detailed composition of non-regular income is also given only in annual data sets.

⁶ The importance of labor income as the major source of income is actually greater than this, because labor income is also the most important source of non-regular income. Retirement pay is the major non-regular income, which is in fact part of the labor income.

⁷ See Table A.3.

Figure 3. Shares of Labor Income by Household Members



According to the annual data set for 2001, non-regular income is composed of predominantly (85.8%) 'other non-regular income' which are non-regular lump sum incomes except from gift money and sales of non-assets such as retirement pay and compensations for property loss, accidents, etc. One might conjecture that fluctuations in non-regular income may be due to changes in retirement pay as the compensations have less reasons to fluctuate, but such a conjecture need to be confirmed by a further analysis of the data—the growth rates of non-regular income shows a pro-cyclical pattern. Besides, the annual data suggest that asset income of urban worker families are composed mostly of interest payments and rents, among transfer income the majority is private subsidies (70%) and public transfers takes up only a small portion of the total income.

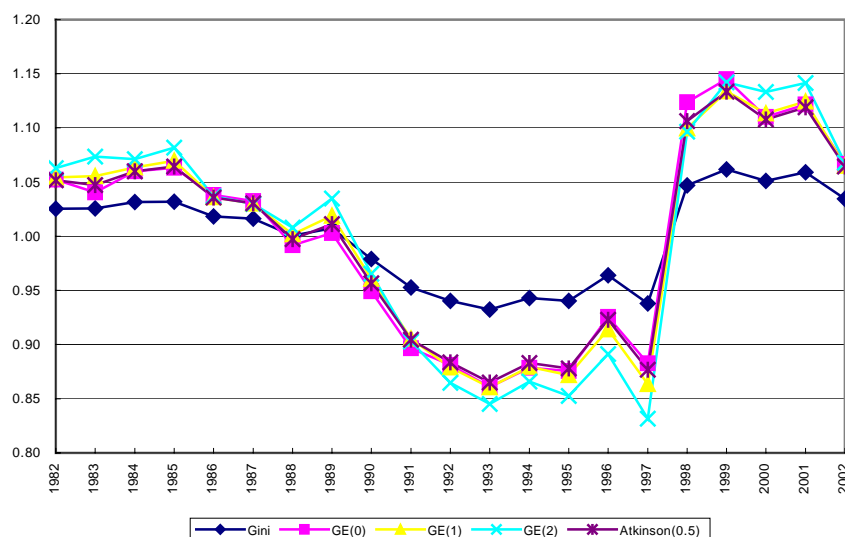
3. Inequality Index Trends

The general inequality changes can be summarized by the trends of major inequality indices. The indices can be simply computed from the income decile group means of households' total income published by KNSO.⁸ Table 2 and Figure 4A reports the trend of six major indices. They show very clear and similar trends: Income inequality did not change much during the mid

⁸ The classification is according to the total income levels of individual records—not individual households. Hence, it is possible that the three records of each household in the quarter can belong to different income classes.

1980; it reduce from the late 1980s to the early 1990; it stayed at the low level during the mid 1990s; and after the Crisis it suddenly increased and stays at the level until recently. As such, this study will primarily focus on the income inequality reduction from the 1980s to the early 1990, and its widening after the economic crisis. Figure 4B provides the index values as a ratio to their period means for an easier comparison among them. The normalization reveals almost identical patterns among the indices. The variation is the largest in GE(2) and the smallest in Gini index.

Figure 4. Trends of Major Inequality Indices: 1982~2002 (Ratios to Period Means)



It is known that $GE(\alpha)$ with larger α is more sensitive at the upper end of distribution.⁹ Since in the Figure 4B, GE(2) varies more than GE(0) except in 1998, one may speculate that most of income inequality variation in Korea is due to changes at the upper end of distribution. But the movement of deciles shows otherwise. Figure 5 plots the income decile ratios of D9/D1,

⁹ General entropy measures (GE) of inequality are defined as follows:

$$GE(0) = (1/n) \sum_{i=1}^n \log(\bar{y} / y_i) \quad , \quad GE(1) = (1/n) \sum_{i=1}^n (y_i / \bar{y}) \log((y_i / \bar{y}))$$

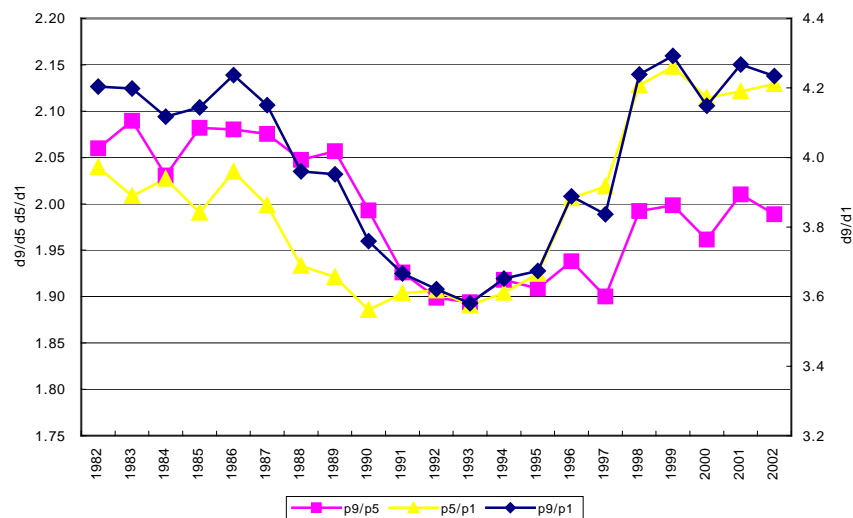
$$GE(2) = (1/2) [1/n \sum (y_i / \bar{y})^2 - 1] = (1/2) (1/n \bar{y}^2) \sum (y_i - \bar{y})^2 = (1/2) SCV$$

GE(0) corresponds to the mean log deviation, GE(1) is Theil index, and GE(2) is 1/2 of the squared coefficient of variation (CV). Atkinson measure is as follows:

$$Atkinson(\varepsilon) = 1 - \left[(1/n) \sum (y_i / \bar{y})^{1-\varepsilon} \right]^{1/\varepsilon}$$

D9/D5, and D5/D1.¹⁰ The deciles show that up to the mid 1990s income inequality reduced from middle to top (D9/D5), whereas inequality widening after the mid 1990s occurred from middle to bottom (D5/D1). This pattern of income decile changes, that is, income inequality in Korea has been improved and deteriorated in different manners will provide an important piece of information later when I try to "explain" the income distribution changes in Korea.

Figure 5. Trends of Total Income Deciles: 1982~2002



¹⁰ The income deciles are derived as means of quarterly income deciles among all the households surveyed in the quarter in the HIES. That is, unlike in the case of income inequality indices, deciles among all the households, not the means of ten income groups, are used.

Table 2. Trends of Major Income Inequality Indices: 1982~2002

	Gini	GE(0)	GE(1)	GE(2)	Atk(0.5)	Atk(1.0)	CV
1982	0.309	0.161	0.068	0.176	0.077	0.147	0.594
1983	0.309	0.159	0.069	0.178	0.076	0.146	0.597
1984	0.311	0.162	0.069	0.178	0.077	0.148	0.596
1985	0.311	0.163	0.069	0.180	0.078	0.149	0.599
1986	0.307	0.159	0.067	0.172	0.076	0.145	0.587
1987	0.307	0.158	0.067	0.171	0.075	0.145	0.585
1988	0.302	0.152	0.065	0.167	0.073	0.139	0.578
1989	0.304	0.153	0.066	0.172	0.074	0.141	0.586
1990	0.295	0.145	0.062	0.160	0.070	0.134	0.566
1991	0.287	0.137	0.059	0.150	0.066	0.127	0.547
1992	0.284	0.135	0.057	0.143	0.065	0.125	0.536
1993	0.281	0.132	0.056	0.140	0.063	0.122	0.530
1994	0.285	0.134	0.057	0.144	0.064	0.125	0.536
1995	0.284	0.134	0.057	0.141	0.064	0.124	0.532
1996	0.291	0.142	0.059	0.148	0.067	0.131	0.544
1997	0.283	0.135	0.056	0.138	0.064	0.125	0.525
1998	0.316	0.172	0.071	0.182	0.081	0.156	0.603
1999	0.320	0.175	0.074	0.190	0.083	0.159	0.616
2000	0.317	0.170	0.072	0.188	0.081	0.155	0.613
2001	0.320	0.172	0.073	0.189	0.082	0.156	0.615
2002	0.312	0.163	0.069	0.177	0.078	0.149	0.595

Note: Each index is the average of quarterly index values computed from means of decile income classes grouped by their total income levels.

4. Sensitivity Analysis

Before vertical and horizontal decomposition of inequality, I do some sensitivity analysis in this section, especially since the index values in section 3 are derived from decile income group means and not from individual household observations.

A. Family size adjustment

Since household incomes are total of all members' incomes, inequality among them is subject to change if household sizes change. The household size in the HIES data continuously decreased during the last twenty years. The average size was 4.39 in 1982, 3.97 in 1990, and 3.46 in 2002. On the other hand, average number of workers in the family steadily increased.

Table 3. Household size and number of workers

	1982	1985	1990	1995	2000	2002
Average family size	4.39	4.18	3.97	3.71	3.54	3.46
Workers per HH	1.27	1.30	1.43	1.54	1.51	1.54

Source: KNSO, from the HIES data sets.

Adjustment for household sizes are commonly done by converting household incomes to individual incomes by dividing them either with the household size or the square root of the household size to take into account 'economies of scale' in consumption.

Figure 6 shows the result of household size adjustment for Gini index for mean incomes of decile groups. The decile income groups are naturally regrouped according to the newly defined individual incomes.¹¹ The size adjustment increases the Gini index in 1982~83 and 1994~45, in which household size reduction was slower, more than in other years. The result is quite surprising. The size adjustment makes inequality change a steady and continuous process, not confined to specific periods. It continuously declined until 1993, and changed direction since then. After size adjustment, it seems that inequality changed in all years except in 1997, in which the change was in opposite direction, rather than inequality changed in exceptional years.

Adjustment with the square root of the household size makes the shift in the same direction but at a less degree (Figure 6). The household size adjustment produced virtually the same result in case of other measures-- GE(0), GE(1), and GE(2), as in the Gini index. The figures are abbreviated.

A. Number of Income Groups

The index values given in previous sections are those calculated from the means of decile income groups. Using the means is computationally simpler and enables one to avoid dealing with zero income cases in computing GE(0) or GE(1) measures. However, grouping may bias the estimates. Inequality among group means is, in fact, equivalent to 'between group' inequality without any 'within group' inequality.

To check the sensitivity of inequality indices to groupings, I compare Gini index values computed from 10, 25, 50, 100, and individual household incomes in Figure 7 (with no adjustment for household sizes). As expected, the Gini index from finer groupings is significantly larger—that from 100 group means is about 2 percent higher than that from 10 group means, but the difference between 25 and 100 groups is relatively small. Further, the difference is very uniform across years. Hence using coarser groups does not seem to distort the trend much.

¹¹ Specifically, the household income is divided by the (square root of) number of household members and the household weight is multiplied by the household size.

Figure 6. Gini index after Family Size Adjustment

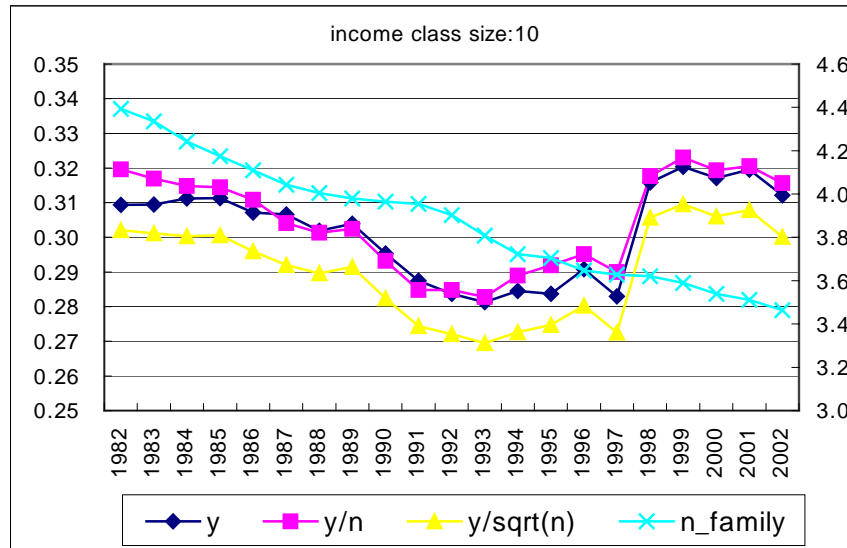
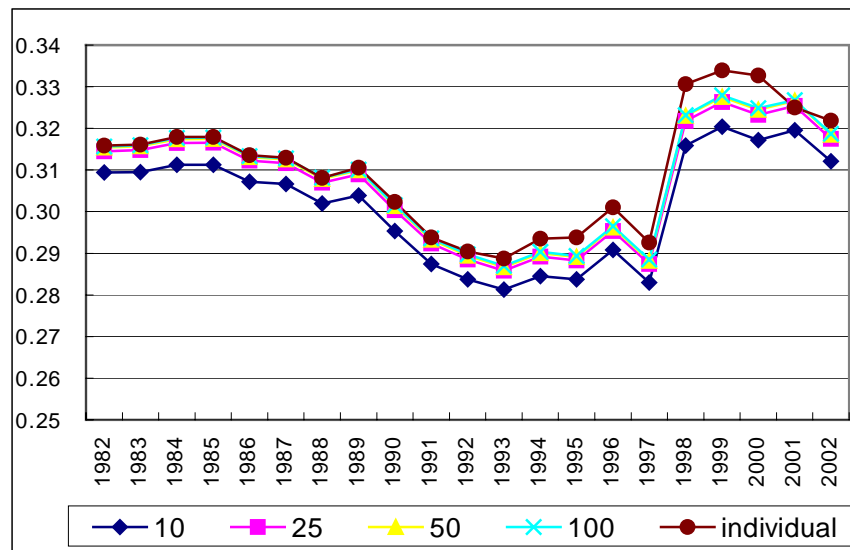


Figure 7. Sensitivity of Gini Index to Number of Income Groups



The Gini index from individual observations is significantly higher than that from 100 group means especially from 1994 to 2000. The difference seems to be due to non-regular income, which does not occur regularly and has very large variation among individuals.

If incomes are adjusted for household sizes, a similar result as in the previous subsection is obtained. The indices show a much more continuous trends. Also, the same results are obtained for other General Entropy measures: Those from finer income groups have larger values, but the difference is small with more than 25 group means. And, with finer groups or individual observations, household size adjustment makes the trends look more continuous.

B. Changes in the Coverage of the HIES

Since the HIES covers only the urban worker families—that is, families whose head is a wage/salary worker and who lives in the urban area, the coverage may have extended during the last twenty years as the share of wage/salary workers has increased and urbanization continued in Korea. As such changes have been continued during the last twenty years, the effects can be considered as trendy—that is, they may have influenced all the index values in the same direction, rather than reversing the direction of inequality changes.

However, such an effect can only be evaluated when a data set that covers the whole population or at least with wider coverage is available. I will discuss this point in the horizontal decomposition section.

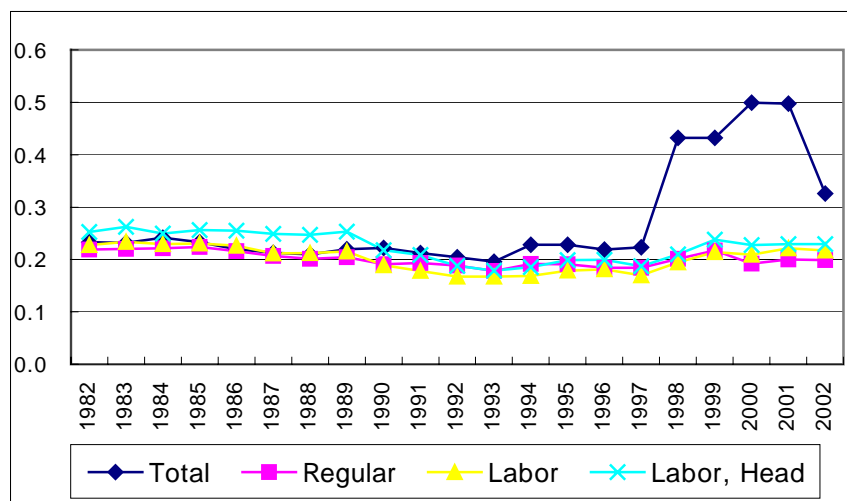
4. Results from Vertical Decomposition

To identify which component of households' income has resulted inequality changes, we can decompose inequality index vertically—that is, by income sources. Since the GE(2) measure allows a simple vertical decomposition, I report the vertical decomposition results for GE(2). In decomposition, individual household observations are used, and all the incomes are adjusted for household sizes.

Figure 8 shows each income source's GE(2) trend. GE(2) of non-regular income and transfer income distribution are very large, and they are not included in the figure. Panel A shows that GE(2) of total income varies much widely than those of regular and labor incomes, suggesting that most of the variation in total income is in non-regular income. GE(2) of asset, business, and labor incomes of spouse and other members are large, and they are given in Panel B in different scales. Noteworthy in Panel B is the difference in the direction of changes: Asset income distribution is becoming more unequal, probably as asset accumulation speeds are different among households. Spouses' labor incomes are more equally distributed as more female are joining the labor market.¹² Non-regular income and transfers show very irregular patterns: Non-regular income inequality was high in 1982~84, low in 1985~97, and jumped in 1998 and remains high. Inequality in transfers was high in the mid 1990s, and low recently.

¹² The share of spouse whose labor income is positive increase from 10% in 1982 to 25% in 2002.

Figure 8A. Trend of GE(2) by Income Sources: Total, Regular, Labor, Head's Labor Income



note: Individual observations, incomes adjusted for household sizes.

Figure 8B. Trend of GE(2) by Income Sources: Asset, Business, Spouse & Other Members' Labor Income

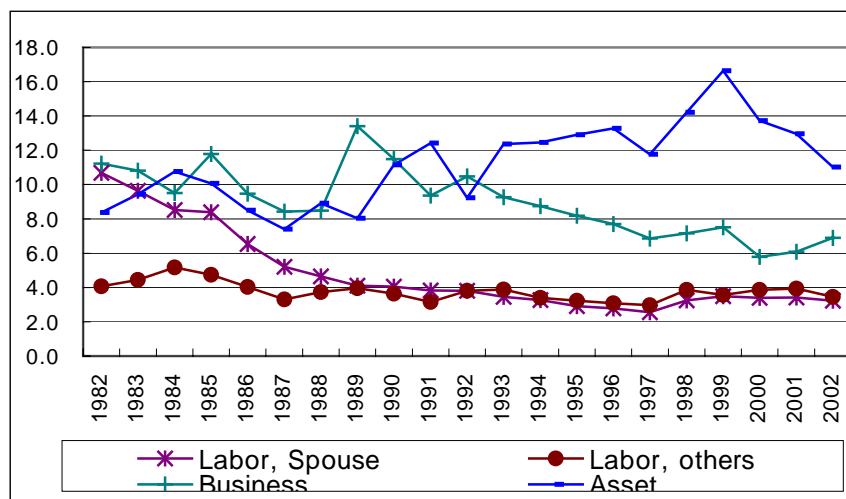


Table 5 reports the results of vertical decomposition. It turns out that the much of the hike in GE(2) of total income distribution is attributed to the rise in non-regular income distribution inequality (Figure 8A). It accounts for more than half of total inequality recently, although its

share is just about 6 to 7 percent. Further, the total of non-regular income did not jump in 1998, only its variation enlarged. Non-regular income is the part of income that is not repeated in its nature—such as retirement pay, celebration or condolence money in weddings or funerals, and other subsidies of non-regular types.¹³ Such money is some type of fund money, and it is questionable that such money should be counted as 'income' and not as 'asset gains.' Anyway, its sudden increase after 1998 is commonly thought of as a result of increased retirement pay which became much more frequent as the economy was under restructuring.

Table 5. Vertical Decomposition of GE(2) Measure: Shares in the Total Inequality

	Regular Income	Labor Income ¹⁾	Head's L Income ²⁾	Spouse's L Income ²⁾	Others' L Income ²⁾	Business Income ¹⁾	Asset Income ¹⁾	Transfer Income ¹⁾	Non- regular
1982	0.927	0.885	0.901	0.081	0.019	0.014	0.039	0.061	0.073
1983	0.917	0.889	0.906	0.076	0.018	0.010	0.040	0.062	0.083
1984	0.890	0.887	0.880	0.091	0.029	0.014	0.045	0.054	0.110
1985	0.926	0.867	0.881	0.083	0.035	0.027	0.042	0.064	0.074
1986	0.933	0.871	0.857	0.106	0.036	0.026	0.052	0.052	0.067
1987	0.908	0.845	0.849	0.108	0.044	0.024	0.053	0.078	0.092
1988	0.898	0.873	0.840	0.118	0.042	0.022	0.045	0.060	0.102
1989	0.867	0.859	0.840	0.091	0.069	0.043	0.036	0.062	0.133
1990	0.788	0.809	0.818	0.108	0.074	0.041	0.055	0.095	0.212
1991	0.814	0.755	0.800	0.125	0.075	0.046	0.046	0.153	0.186
1992	0.840	0.727	0.791	0.154	0.055	0.046	0.040	0.188	0.160
1993	0.838	0.778	0.734	0.188	0.078	0.043	0.049	0.130	0.162
1994	0.760	0.740	0.716	0.202	0.082	0.037	0.057	0.166	0.240
1995	0.787	0.773	0.705	0.208	0.087	0.042	0.050	0.135	0.214
1996	0.773	0.803	0.710	0.201	0.089	0.042	0.053	0.102	0.227
1997	0.782	0.756	0.694	0.210	0.096	0.041	0.054	0.149	0.218
1998	0.480	0.795	0.730	0.212	0.058	0.043	0.041	0.121	0.520
1999	0.533	0.789	0.750	0.199	0.052	0.055	0.050	0.106	0.467
2000	0.398	0.874	0.724	0.204	0.072	0.041	0.034	0.051	0.602
2001	0.444	0.883	0.697	0.225	0.078	0.043	0.032	0.041	0.556
2002	0.570	0.875	0.696	0.244	0.060	0.054	0.030	0.042	0.430

Note: Derived from individual household observations adjusted for HH sizes

- 1) proportion to total regular income inequality
- 2) proportion to total labor income inequality

¹³ According to NSHIE 2000 data, 58.7% of total non-regular income is retirement pay, 13.4% is celebration or condolence money, and 18.0% is 'non-regular' subsidies. Non-regular income moves pro-cyclically, and its ratio to regular income is higher in high income groups.

Figure 9A. Vertical Decomposition of Total Income Inequality between Regular and Non-regular Income

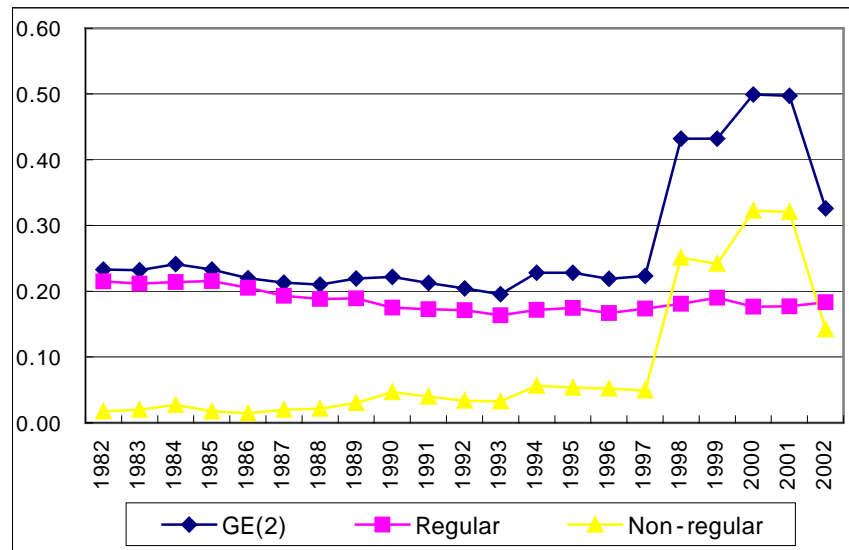


Figure 9B. Vertical Decomposition of Total Regular Income Inequality among Labor, Business, Asset, and Transfer Income Inequality

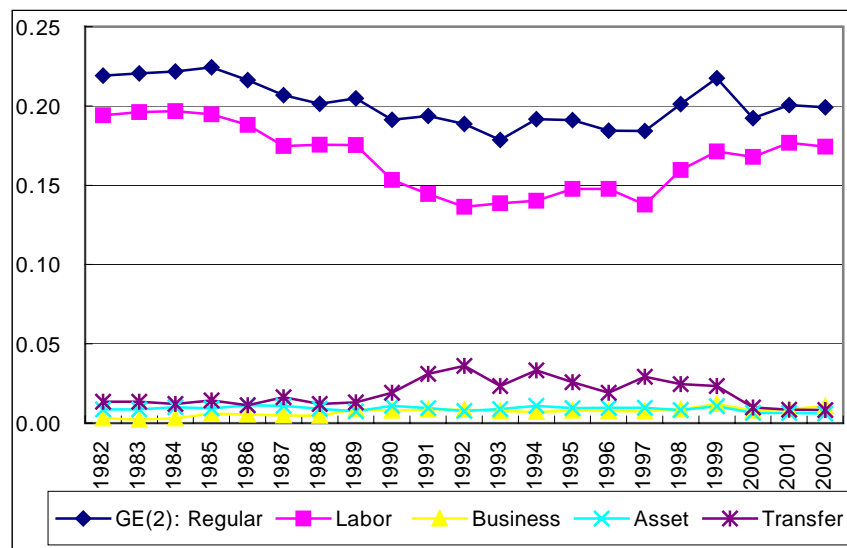
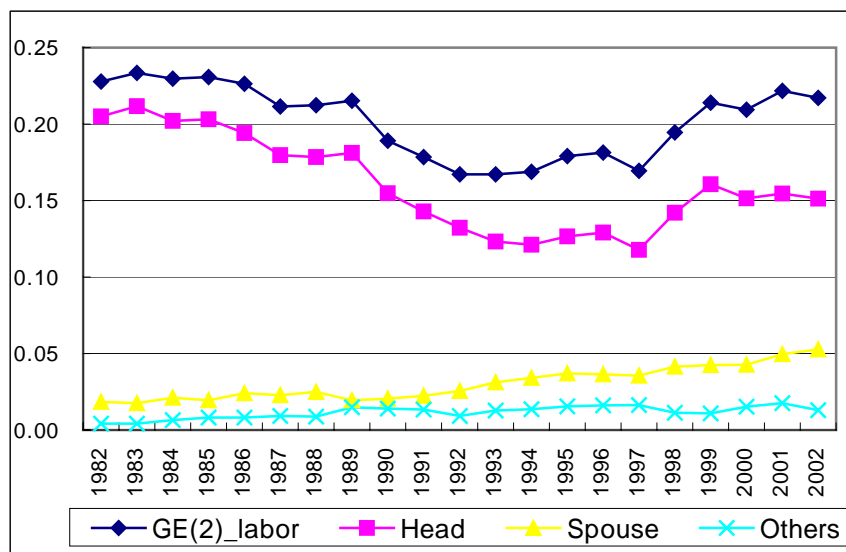


Figure 9C. Vertical Decomposition of Labor Income Inequality among Head, Spouse, and Other Members' Labor Income Inequalities



Labor income is consistently responsible for about 90% of total regular income distribution inequality. In labor income distribution inequality, the share of heads' labor incomes has dropped from about 90% in the 1980s to 70%, recently, while the share of spouses labor incomes rose from 10% to 20%, and other members' share rose from 4% to 10%. While spouses' labor income distribution inequality is dropping, its contribution to total inequality is rising as their incomes are positively correlated with the heads' and female labor participation is increasing. Although the spouses' and other members' labor incomes' contribution to overall inequality is rising, the rise is steady and did not jump after the Crisis.

The contribution of business income in regular income inequality rose from 1% to 7%, and that of asset income declined from 5% to 3%. They show opposite patterns: Business income has become more equally distributed but their contribution to inequality has risen. Asset income is more unequally distributed but its contribution is towards equality.

The contribution of transfer income does not show any trend, fluctuating from 3% to 10% in the period. Social safety nets, such as unemployment benefits and welfare payment, are strengthened significantly after the Crisis. The fall in the contribution of transfers may be a result of such policies—that is, public transfers may be counter balancing private transfers, lowering their contribution to total inequality.

Thus, the major cause for enlarged inequality since 1998 is widening earnings distribution inequality especially among the heads' earnings. Hence, in the next section, I focus on how their distribution has widened by decomposing horizontally.

5. Results from Horizontal Decomposition

In this section, I try to find out how the households' and the heads' labor income distribution has changed by decomposing the change horizontally —i.e., by population sub-groups. Specifically, I address the following question. During the past twenty years, the household structure in Korea has fundamentally changed. Also, during the late 1980s, wage gaps were drastically reduced by labor demand and supply changes and also by union activities. How important are these factors in determining income inequalities? And, as we have seen, the trend of inequality changed direction in the mid 1990s, and it suddenly widened after the Crisis. What are the causes and why they worked in different directions?

The major changes in household structure in the HIES data sets are as follows (Table 7): First, the educational level of heads has remarkably upgraded. In 1985, 20% of household heads had college degrees (including 2-year college), but in 2002, the one-third of household heads are college graduates. Second, there has been general aging of population. The mean age of heads has increased from 36.0 in 1982 to 41.6 in 2002. By age groups, the share of household heads in their twenties was 27% in 1982 but it is 11.6% in 2002. On the other hand, just 8.7% of heads were in their fifties and 1.2% were above 60. But in 2002, the share is 15.8% and 6.5%. Lastly, the share of female heads has increased. It was 11.2% in 1982, but it is 17.6 now. Increasing female heads does not necessarily mean that more households have single parent. According to the KNSO's definition, a household head is one whose income is the major source of household income. If the wife's income is larger than the husband's, then the wife is the head. Increasing female heads may well be a result of increased economic activity of women.

Another objective in reviewing distribution of household characteristics is to check the significance of sample change. The HIES sample has been changed in 1988, 1993, and 1998, and between the years the same households are surveyed. Hence the data set has a panel data nature in the years, and sample change may significantly alter the household distribution. Table 7 shows that distribution of household characteristics does not change much in the same sample. An exception is the 1998 sample change. The share of male household has increased, but as it returned to the 1997 level in 1999 without sample change, its rise in 1998 can be attributed to the economic situation in 1998, in which female employment dropped, rather than to the sample change. However, as the heads' educational composition has changed permanently, we can recognize the significance of the 1998 sample change.

Decomposition by The Head's Educational Level

In Korea, decomposition by the heads' educational level seems to be most important among other groupings. In Korea, different educational groups were affected by the labor market conditions differently at times. If labor incomes are the prime factor in determining inequality, changes of inequality among educational groups should have been different. In Korea, it has been frequently claimed that shrinking wage gap in the late 1980s caused the income distribution improvement in the period. But the distribution of heads' age and educational distribution also improved in the period. More households had college graduate and middle-aged heads. Thus, in this subsection, I will first try to determine whether inequality really decreased in the period by reducing wage gap among the educational groups. Also interesting is the inequality widening process after the Crisis. It is commonly thought that less educated

were hit harder by the Crisis and during the ensuing recession, while the some of the more educated even benefited in the restructuring process.

Table 7. Distribution of Household Head's Personal Characteristics

(unit: %)

	Head's Sex		Head's Mean Age	Head's Education		
	Male	Female		< high school	high school	some college
1982	88.8	11.2	36.0	-	-	-
1983	87.7	12.3	36.1	-	-	-
1984	87.3	12.7	35.8	-	-	-
1985	87.9	12.1	36.0	39.2	40.8	20.0
1986	87.5	12.5	36.3	37.0	41.2	21.8
1987	87.8	12.2	36.2	35.8	43.2	21.0
1988*	89.0	11.0	36.7	35.5	43.0	21.5
1989	88.9	11.1	36.9	30.3	45.8	23.9
1990	89.3	10.7	37.1	30.4	47.9	21.7
1991	89.4	10.6	37.9	31.0	46.8	22.2
1992	89.9	10.1	38.3	27.8	45.5	26.7
1993*	88.8	11.2	38.4	26.2	45.5	28.3
1994	87.2	12.8	38.8	25.4	45.4	29.2
1995	86.6	13.4	39.3	25.4	44.2	30.4
1996	85.9	14.1	40.0	25.1	43.8	31.1
1997	85.4	14.6	40.3	27.0	43.0	29.9
1998*	88.3	11.7	39.9	21.0	45.0	34.0
1999	85.4	14.6	40.4	21.4	45.6	33.0
2000	83.6	16.4	40.9	22.9	44.8	32.3
2001	83.3	16.7	41.4	22.5	44.5	33.0
2002	82.4	17.6	41.6	21.9	43.9	34.2

Note: Asterisk (*) marks the sample change years.

The wage gap reduction in the late 1980s was caused by two factors: One is the advancement of political democracy, which lifted up all the restrictions for union activities. And the other is the change in supply and demand conditions. The supply of the low-educated dropped rapidly in the late 1980s, causing 'labor shortage' among the manual labor.

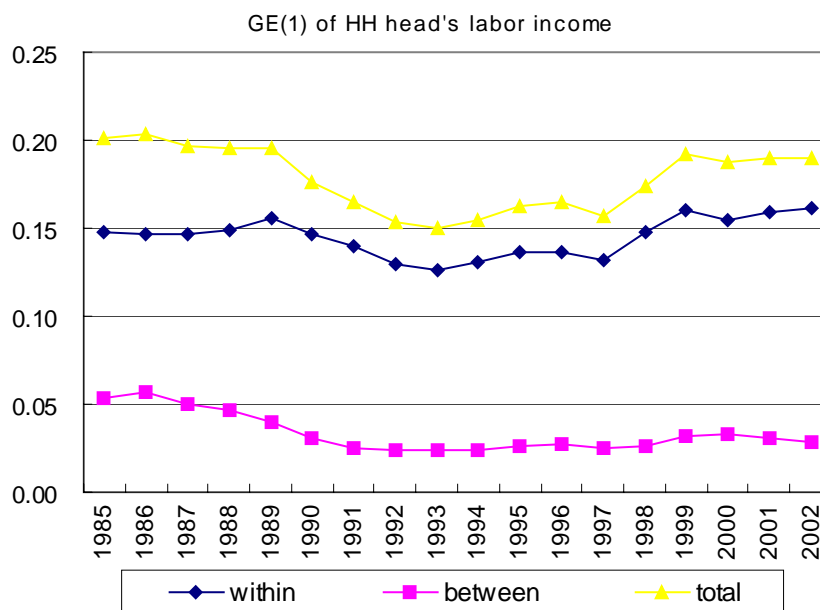
In empirical analysis, I use individual household observations data after adjustment for household sizes, and GE(1) measure for inequality. Since horizontal decomposition is feasible either with GE(1) and GE(2), we can choose between the two. GE(2) measures are very sensitive to outliers, and they rise in the boom period of 1988~1989 deviating from its falling trend, probably as a result of some high incomes at the upper tail. Hence, I choose to use GE(1) for which the rise in 1988~89 is smaller.¹⁴ The HIES data prior to 1985 do not contain information

¹⁴ In computing GE(1) measure, observations with zero or negative income are simply deleted. In the data set, the proportion of such households is very small.

on heads' educational level. Hence the period for horizontal decomposition is confined to 1985~2002. In grouping, I use three groups by the head's educational level: less than high school (primary and junior middle school graduates), high school graduates, and some college (college graduates including 2-year colleges). The results from decomposition of household labor income are very similar to those from the heads' labor income.¹⁵¹⁶ As the latter shows clearer results, I will introduce and explain the latter.

Figure 12 reports the result of horizontal decomposition of head's labor income by head's educational levels. The figure shows that 'between group' inequality, that is, inequality among educational groups, fell significantly in the late 1980s. Since then it is roughly constant, rising a little bit in 1999 and 2000. The within group inequality did not change much since the mid 1980s to 1997—it just decreased somewhat in the 1990s. Since 1998, it started to rise and stays at the higher level. Hence, the decline in inequality in the late 1980s is mostly explained by the reduction in between group inequality—among the total decline of GE(1) of 0.025 during 1985~1990, 0.023 is attributed to between group inequality decline. The result is quite surprising in that usually most of inequality changes are explained by 'within group' inequality changes, and cases in which inequality changes are attributed 'between group' changes are rare. GE(1) of head's labor income declined 0.014 during 1990~95, of which just 0.004 is attributed to between group changes, and it increased 0.025 during 1995~2000, of which just 0.007 is due to between group changes.

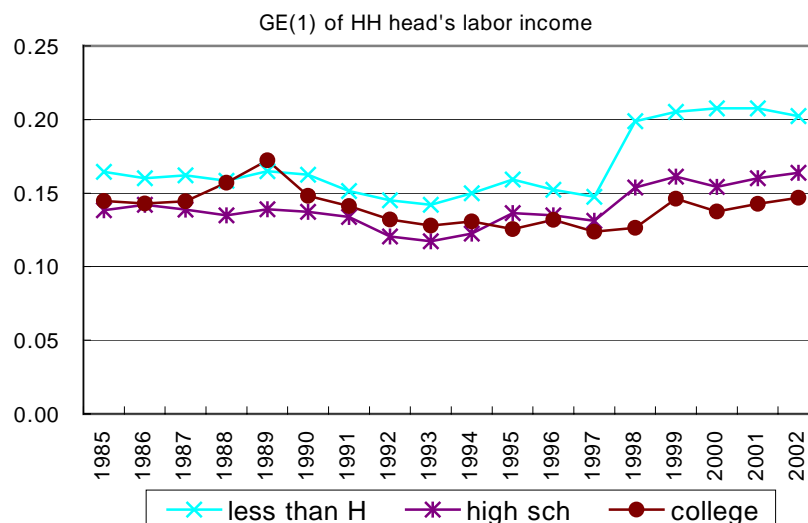
Figure 12. Horizontal Decomposition of GE(1) by Education: Head's Labor Income



¹⁵ The results from using GE(0) is similar to those from GE(1) measures.

¹⁶ Such result is not at all surprising since the head is defined as the major earner for the household.

Figure 13. GE(1) of Head's Labor Income by Educational Classes



In the late 1980s, as the union activities were fully granted, suppressed demands for wage increase among the production workers quickly erupted. Labor disputes were prevalent, but as a result, the wage levels of the less educated—high school graduates and less than high school—increased sharply, narrowing the educational wage gap. The dominant wage payment system in Korea before the 1990s was the seniority system, in which wages are mostly determined by education, age, and experience, and personal differences within companies are small. It seems that under such wage system, shrinking wage differentials among educational groups decreased the overall inequality.

On the other hand, merit-based wage system, which started to be introduced in the mid 1990s, came widely adopted since 1998, as companies tried to save labor cost and better motivate their employees. Such trend is shown in Figure 13, which shows the trend of GE(1) by educational groups. In the figure 'less than H' means 'less than high school' and 'high sch' means high school graduates. The trend shows that inequalities within educational groups generally decreased up to the mid 1990s, and since then they started to rise, accelerating since 1998.¹⁷ The steady rise of inequalities within educational groups seems to be related to the general transition towards an economy in which market principles, efficiency, and individual performance is emphasized, and merit-based system is the dominant payment system. The big jump in inequalities among the least educated after 1998 is also observed when other measures are used. This group's income is likely to be influenced by the shift of payment system. Rather,

¹⁷ The rise of inequality among the college graduates in 1998 and 1999 seems to reflect high incomes among those in large companies in the period when the Korean economy was booming.

they seem to be related to job availabilities--that is, reduction of working hours among the unskilled as we will shortly see.

Within group inequality reduction in the mid 1990s may be related to the age distribution. Before looking into what happened among the least educated after 1998, I survey the effects of changing composition of the heads' age and gender structure on income distribution.

Aging of Household Heads and Growing Share of Female Headed Households

Among the long-term changes of household characteristics, the most conspicuous are the aging of household heads and the growing share of female households. The average age of heads was 36.0 in 1982 but it is 41.6 as of 2002. The share of female-headed households was 11.2% of total households in 1982, but it is 17.6% in 2002. In this section, I check the effects of such changes.

When the population is grouped by the household heads' ages and horizontally decomposed, most of inequality variation is explained by 'between groups' variation and the share of 'within group' variation is very small, implying that income inequality among the age group is far greater than across the age groups.¹⁸ By age groups, within group inequality is the higher, the older the head is. Households whose heads are above 60 or in their fifties have significantly higher inequality among them than the younger groups. Hence, one can deduce that population aging may lead to larger inequality among households. But if we look at the trend of inequality in regular income, which includes other members' income and transfers, the differences in inequalities across heads' age groups are much smaller, suggesting that households whose head is old have other sources of income.

Within group inequalities declined from the late 1980s to the early 1990s in all groups. The period of decline does not exactly coincide with the period of educational between group inequality reduction, which suggests that there should be other factors that contributed to inequality reduction other than the educational wage gap reduction. Noteworthy is the rise in inequality since 1998. Inequality rises in all age groups, but it rises fastest among the elderly group, that is, among the households whose heads are in their fifties. This suggests that the impact of the Crisis was larger for the elderly than the young. It is also important that widening inequalities among the elderly heads' income began in mid 1990s, before the Crisis. As the business profits fell in the second half of the 1990s, the elderly seems to be already losing jobs, the trend of which accelerated in the aftermath of the Crisis.

Thus, one may conclude that population aging produces a secular trend of widening inequality, but it is not the major cause for the increased inequality after the Crisis or since the mid 1990s.¹⁹ Between group inequality among households with heads in different age groups increased but the extent of increase is very small.

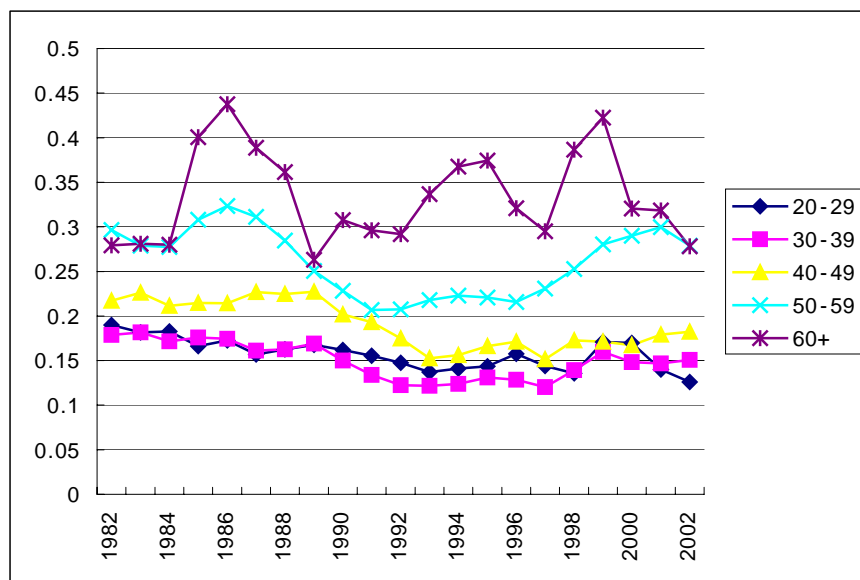
The effect of growing female-headed households is very similar. If we group households by their head's sex, the 'between group' effect is very small. Income variation within male- or female-headed households is far greater than the difference of incomes between the groups.

¹⁸ The grouping by head's age is made in five groups as 20-29, 30-39, 40-49, 50-59, and 60+, where households whose head is under 20 are deleted. The between group inequality accounts for just about 1% of total inequality.

¹⁹ For example, GE(1) among 59-59 is higher by 0.1 than 20-49 average and that of 60+ is higher by 0.17 on average between 1982~2002. In the period, their share (in case of GE(1), its income share) increased from 10% to 18% in total, hence roughly 5% (or 0.01) increase in GE(1) can be attributed to population aging, whereas GE(1) is at least 20% higher by the end of the 1990s compared to its lowest point in the mid 1990s.

Also the 'within group' inequality trend is very similar in the two groups. (See Figure 15.) Inequality among the female-headed households is larger than that among the male-headed households—generally, the difference is about 30% in all major incomes, such as heads' labor income, total labor income, and regular income. As the share of female-headed households is rising steadily, from 11.2% in 1982 to 17.6% in 2002, it raises income inequality, but its effect is not large. If the share rises from 12% to 17% in the 20 years, it would raise the GE(1) value by 1.5%.

Figure 14. Decomposition of Head's Labor Income by Head's Age: GE(1)

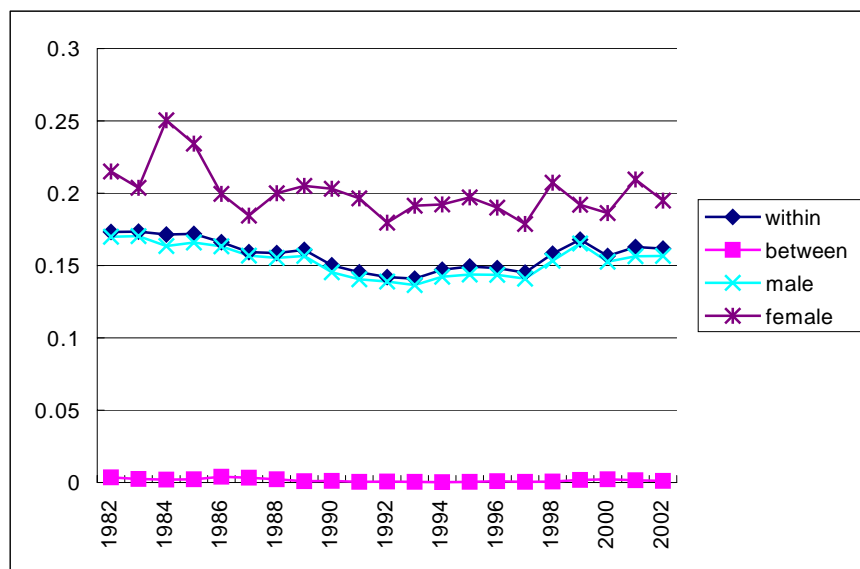


The Effect of 1998 Re-sampling

One of the important potential factors that might change the inequality trends is the effect of re-sampling of the HIES data in 1998. The effect of 1998 re-sampling may be more significant than re-samplings in other years, since it significantly changes the distribution of the household heads' characteristics. For example, the share of female-headed households dropped from 14.6% in 1997 to 11.7% in 1998; the share of households with heads whose educational levels are less than high schools dropped from 27.0% in 1997 to 21.0 in 1998; and those with college educated head increased from 29.9% to 34.0% in 1998.

As the difference in household characteristics in the sample is significant between the two years, one may try to adjust the weights attached to observations such that the 1998 sample have the same distribution in major household characteristics as the 1997 sample. However, the changes in household characteristics between 1997 and 1998 are in the direction of raising the inequality index, with smaller shares of the female-headed households and low-educated households. Thus, I do not try to adjust the weights and re-evaluate the inequality indices. Instead, I use a different data set to compare the inequality index change between the pre- and post-Crisis years.

Figure 15. Decomposition of Head's Labor Income by Head's Sex: GE(1)



What happened to the Income Distribution of Low-educated After the Crisis?

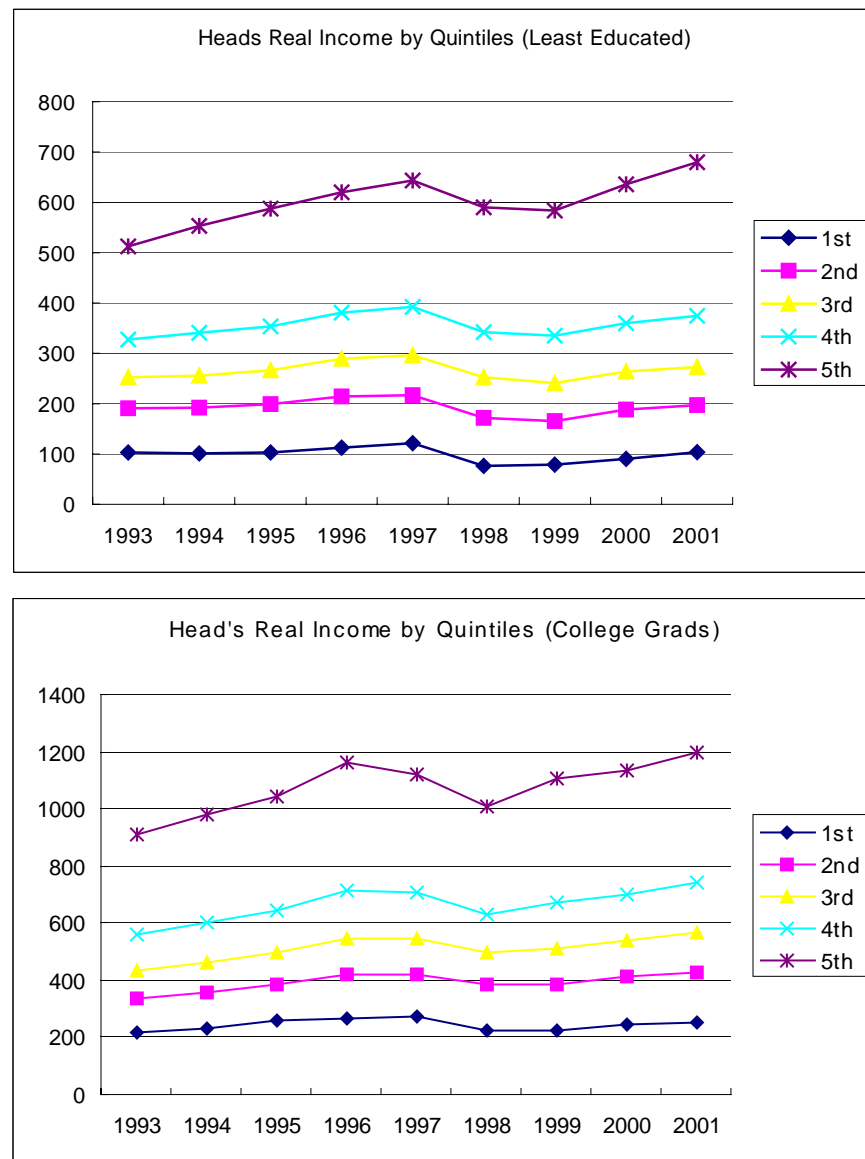
From the horizontal and vertical decomposition results, we can conclude that post Crisis increase of inequality is closely related to widening heads' labor income distribution, especially among the less educated. Population aging and increasing female heads have contributed to widening of income inequality, but they are secular trends and they do not account for the sudden rise in inequality after the Crisis. Thus, I address the critical issue of 'what happened to the income distribution of the low-educated after the Crisis?' in this subsection.

Before looking into the issue, if I introduce briefly the results of horizontal decomposition by both education and age groups, the results are as follows: The between group inequality among the 15 education-age groups (3 educational by 5 age groups) shows a downward trend in the late 1980s to the early 1990s and tilts up slightly after the Crisis, confirming the previous result that although the 'between group' inequality reduction among the educational classes in the late 1980s contributed to the reduction of inequality, its effect is confined to the period. Slight rise of 'between group' inequality after the Crisis is due to the widened mean incomes among the groups, which is mainly caused by real income drop among the less educated and the elderly group. The age/educational group decomposition confirms importance of real income drop among the low educated in explaining the inequality widening after the Crisis.

To see what happened among the low educated since the Crisis, I use the HIES-EAPS combined data set. Since the HIES sample is a subset of the EAPS sample, observations in the two data sets can be matched in principle. The KNSO provided such combined data sets for the periods after 1993. The time span for analysis is determined by the data availability condition for this research, which is from 1993 to 2001. Also, to guard against variability of income rather

than inequality of income, I use yearly sample—that is, inequality index are derived from households' annual incomes rather than as annual averages of quarterly inequality indices.

Figure 16. Head's Real Income Trend by Quintile Groups: The Least Educated and College Graduates Groups



An obvious way to review is to see the changes by income groups. Figure 16 plots heads' real income trend of quintile groups by educational levels. Among the least educated (primary and middle school graduates), heads' real labor income dropped significantly in 1998 in all quintile groups and increased steadily since then. But all groups except the highest income group did not recover the pre-Crisis level in 2001. In contrast, all quintile group means of college graduate heads reached the pre-Crisis level by 2000. As a result, the income gaps among quintile groups are expanded in the low-education group especially between the middle and bottom quintile group, while the income gaps increased but much mildly among the college educated heads. Hence, it can be inferred that widening inequality especially among the low education group and from middle to bottom is mainly responsible for the widening inequality after the Crisis. Next, I look at the labor market conditions that have widened income distribution among the low-educated.

Figure 17. Head's Working Hours and Hourly Wage Rates by Quintile Groups: The Least Educated Group

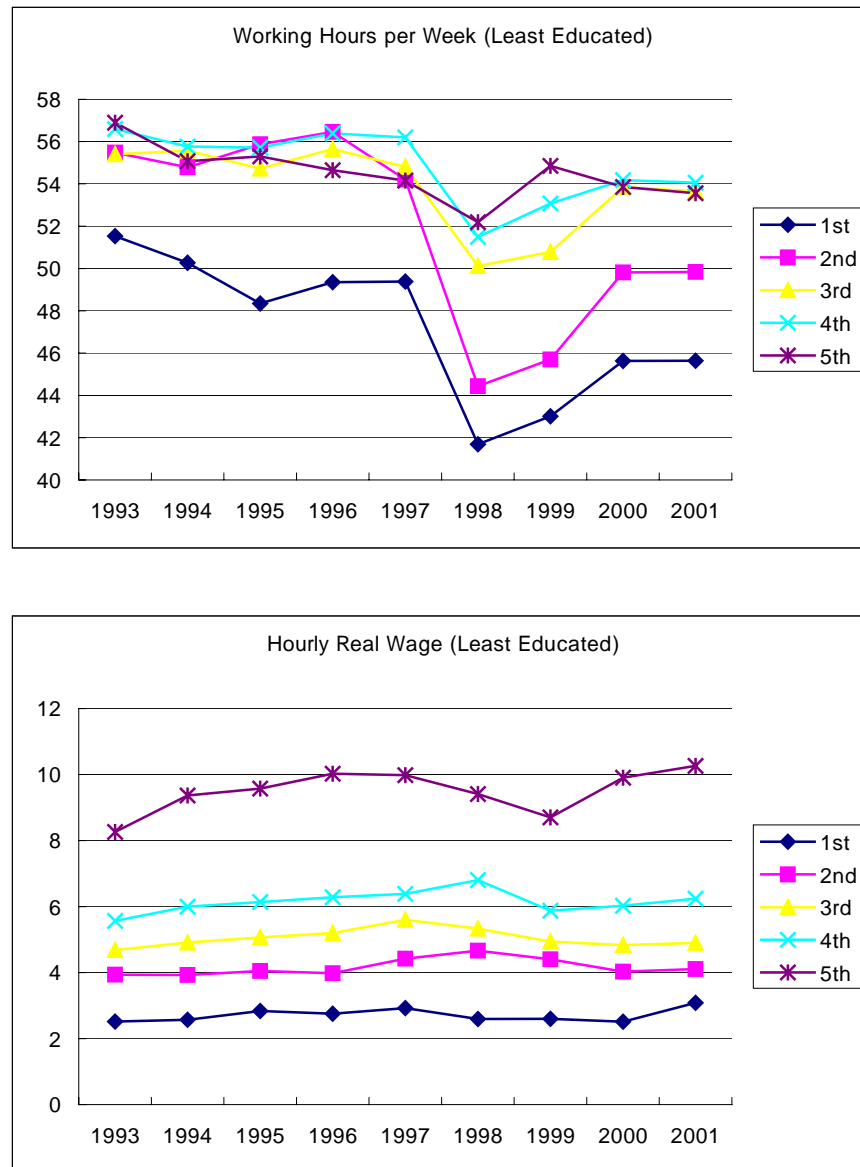


Figure 18. Head's Working Hours and Hourly Wage Rates by Quintile Groups: College Graduates

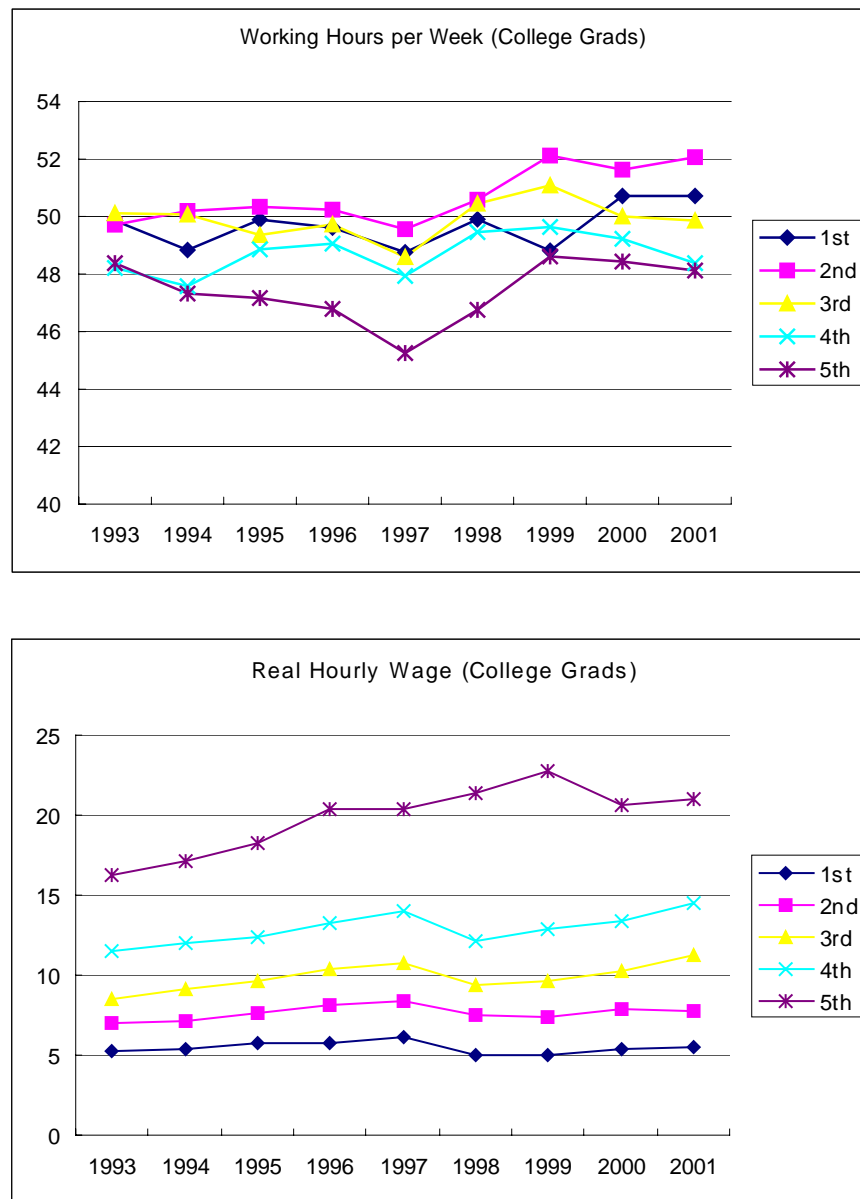


Figure 17 plots working hours and hourly real wage rates by quintile groups among the low-educated, and Figure 18 does the same thing for college educated group for comparison.

Data on weekly working hours are obtained from the EAPS data combined with the HIES data, and hourly real wage rate is derived as monthly income divided by 4.3 times weekly working hours deflated with CPI index of base year 2000. Figure 17 shows that decline of real income among the low quintile groups of the less educated is due to reduction of working time rather than decrease in wage rates. Reduction in working hours was especially severe among the low income quintile groups, whereas reduction in real wage rate is not very significant even among them. On the other hand, among the college graduates, working hours did not decrease in all income quintile groups, and real wages have declined but they reached the pre-Crisis level by 2000 in all quintile groups.

Thus, we can conclude that it is the loss of job opportunities especially among the less educated that has caused the income inequality widening. Downgrading of jobs, that is, job losers get lower hierarchy jobs with lower wages has been suggested as a competing explanation for widening income inequality, but this is not supported by data.

Inequality among All Types of Households: Results from the NSHIE data sets

Previously, we have seen that the loss of job opportunities is the prime cause for widened inequality after the Crisis. If this is the case, it is probable that many households lost jobs and hence dropped out of the sample, reducing the measured inequality. To check how important such sample selection effect may be, I estimate inequality index with a larger data set—the NIES data set and compare the results with those from the HIES data sets.

The following Table 8 compares the composition of households by types contained in the NIES data sets of year 1995 and 2000.²⁰ The NIES classifies households in three types—an employee-headed household, an self-employed (or an employer)-headed household, and those with non-employed heads. As single member households are not surveyed in the HIES, I consider employee-headed households with a single member as another type of households. Table 8 indeed confirms that after the Crisis, the share of households with employee heads has dropped. In terms of members of households, its share dropped from 60.1% to 55.0% in five years excluding single member households.

Table 8. Composition of Household by Types in the NIES Data Sets

HH type	Households		HH members	
	1995	2000	1995	2000
1: employees	54.4	48.4	60.1	55.0
2: self-employed	26.7	25.8	29.9	29.1
3: non-employed	11.4	18.9	7.7	13.7
4: single member employee	7.5	7.0	2.3	2.2

Source: KNSO, the NIES data sets, 1996 and 2001.

However, the effects of such compositional change can not be directly measured, because the 1995 data set contains income information of only employee-headed households. Table 9 shows the values of inequality measure by household types. Households with non-employed

²⁰ The NIES were in 1996 and 2001, but they surveyed 1995 and 2000 incomes. Hence I call them 1995 and 2000 data sets.

heads have of course large inequality among them, but the difference is small if we consider regular income distribution which includes transfers as well as other members' incomes. If I assume very simply that income shares of employed-headed households drop by 5% and those of other type households increased proportionately, the GE(1) index for all household would increase by about 0.01 which is small compared to the increase in GE(1) of heads' labor income among total employee-headed household from 1995 to 2000, which is 0.04.

Thus, we can say that the loss of job opportunities should have increased inequality beyond what is measured by the HIES data, but most of the inequality rise is already measured by the change in income distribution among employee-headed households and the additional effect of the job losers dropping out of the sample is not large.

Table 9. Inequality among Households by Types

	Total GE(1)	HH type 1	HH type 2	HH type 3	HH type 4
total income	0.276	0.183	0.399	0.287	0.168
Regular income	0.266	0.154	0.404	0.268	0.169
labor income	0.263	0.156	0.410	0.354	0.179
head's labor income	0.241	0.180	0.456	0.401	0.179

Source: KNSO, the NIES data sets, 2001.

IV. Conclusion

During the past 21 years, that is, from 1982 to 2002, income distribution inequality declined and then increased in Korea. Income distribution improvement continued until the mid 1990s, and its deterioration started then and accelerated by an external shock—the Crisis at the end of 1997.

The income distribution improvement has accelerated at the end of the 1980s when the country moved from an authoritarian regime to a fully democratized country and when the country was in a big boom and the wages hiked aided by strong union activities which were fully granted then. However, a detailed data analysis reveals that union activities do not solely account for the inequality reduction in the period. Inequality was already declining since the early 1980s, and it continued until the mid 1990s when the reduction in inequality among the educational groups already stopped. With expansion of light, labor intensive industries in the 1970s, wages for low-educated have been growing, and successful transition from the light industries to heavy and chemical industries could support increasing wages and the resultant inequality reduction. It is important to note that the inequality reduction was accompanied by real wage growth in all income groups. The effects of union, in this period, seem to be in realizing the income growth for the production workers, for which the conditions were already ripe. It is also important to note that in Korea, college education has been popularized with widened education opportunities since the early 1980s, and by this time period the supply conditions also worked favorably for the low-educated. Supply and demand condition, and also the payment system, in which wages are determined by seniority without much individual differences contributed to the inequality reduction.

However, the late 1980s was at the same a period of high inflation and asset price hike, which certainly distributed wealth distribution but not captured well by the existing data. Booming economies certainly help to reduce wage gap under the old payment system, but the effects on equality, including the wealth distribution, is still questioned and can not be clearly determined given the data conditions.

Since the 1990s, there are several secular trends that may worsen income distribution steadily: Women's labor participation, whose income is positively correlated with their husbands, is increasing and female household heads are increasing. The family sizes are decreasing, and the population is aging. Such trends are expected to continue in the future but the changes are mild and they do not account for the sudden rise in inequality since the late 1990s. Most of income inequality is still determined by the heads' labor income distribution which is subject to much rapid change depending on the economic conditions.

From the mid-1990s, labor income distribution started to widen within the age and educational classes. Such change seems to be related to the transition of the economy from an industrial oriented to a service economy, but the exact cause is yet to be analyzed. The recession that followed the Crisis hit the low-educated and those whose heads are the elderly particularly severely. And the direct cause was the reduction in job opportunities, shown in the data as working hours reduction, rather than the degrading of job structures, which should appear as real wage decline. The impact would have been severer if there were more low-educated since they are the group that suffered most since the Crisis. The low-educated were not affected temporarily in the aftermath of the Crisis. Their working hours are still shorter compared to the pre-Crisis years. Somehow, the Crisis seems to have accelerated the transition of labor demand from the unskilled to the skilled permanently. Unions did not contribute to income equality in this period. Workers in the unionized sector are in the high income groups among the low-educated, and they did not suffer much from the recession, and quickly recovered their pre-Crisis income levels.

Thus, in the case of Korea, economic growth has certainly contributed to the income distribution improvement in the 1980s, but it did not continue to improve distribution. Or, rigidities in wage distribution and in the economic structure may have hindered economic growth in the second half of the 1990s, resulting widened income inequality at the cost of the low income, low educated group.

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Appendix

A. Vertical and Horizontal Decomposition of Inequality Measures

Horizontal Decomposition: Decomposition by Income Sources

Vertical decomposition of $GE(2)$ measure can be explained very simply as follows: Define the total income by sources as $y = \sum_s y_s$ where y_s is the income from income source s . Let I_s be the decomposition of the total inequality I for income source s , where $I = \sum_s I_s$, and let i_s be the share of income source s in total inequality ($i_s = I_s / I$) the sum of which across s is naturally equal to one ($\sum_s i_s = 1$). In case of $GE(2)$, the share is defined as $i_s = I_s / GE(2) = \rho_s f_s \sqrt{GE(2)_s / GE(2)}$ where $f_s = \bar{y}_s / \bar{y}$ and $GE(2)_s$ is the value of $GE(2)$ measure applied to the distribution of incomes from income source s , y_s .

Horizontal Decomposition: Decomposition by population sub-groups

The horizontal decomposition formula is as follows: Let there be K population sub-groups. Denote the value of $GE(\alpha)$ applied to sub-group j as $GE(\alpha)_j$. The 'within group' inequality can be defined as $GE_w(\alpha) = \sum_{j=1}^K g_j GE(\alpha)_j$ where the sub-group weights g_j are given by $g_j = v_j^\alpha w_j^{1-\alpha}$ where v_j and w_j are the income shares and the population shares, respectively of the sub-groups $j = 1, 2, \dots, K$. The 'between group' inequality, $GE_b(\alpha)$, involves re-estimating total inequality when each member of each sub-group j is given the mean income for that sub-group, \bar{y}_j , and then calculating

$$GE_b(\alpha) = \frac{1}{\alpha(\alpha-1)} \left[\frac{1}{n} \sum_{j=1}^K n_j \left(\frac{\bar{y}_j}{\bar{y}} \right)^\alpha - 1 \right],$$

where \bar{y} is the mean income for the whole population, and n_j is the size of sub-group j where

$\sum_j n_j = n$. That is, $GE_b(\alpha) = (\alpha(\alpha-1))^{-1} \left[\sum_{j=1}^K w_j \left(\bar{y}_j / \bar{y} \right)^\alpha - 1 \right]$. Naturally, the decomposition adds up to the value of the total inequality measure—i.e., $GE(\alpha) = GE_w(\alpha) + GE_b(\alpha)$.

B. Tables

Table A.1. Real Income Trends

(unit: thousand year 2000 constant Won)

	Total Income	Regular Income	Labor Income	Business Income	Asset Income	Transfers	Non-regular
1982	726	712	658	14	20	21	14
1983	804	786	725	14	23	24	18
1984	866	845	783	19	23	21	21
1985	905	879	809	21	24	25	26
1986	985	952	871	26	31	23	33
1987	1,115	1,070	973	30	35	30	46
1988	1,217	1,164	1,067	33	35	30	53
1989	1,433	1,358	1,237	35	40	46	75
1990	1,547	1,456	1,327	40	42	46	91
1991	1,737	1,627	1,479	52	42	55	110
1992	1,916	1,796	1,634	55	49	58	120
1993	1,992	1,877	1,720	59	46	52	115
1994	2,158	2,017	1,838	66	53	60	141
1995	2,321	2,184	1,994	76	52	61	137
1996	2,491	2,334	2,127	85	60	63	157
1997	2,536	2,373	2,149	87	59	77	163
1998	2,199	2,056	1,872	80	45	59	143
1999	2,275	2,124	1,916	91	47	70	151
2000	2,387	2,214	2,008	94	45	66	173
2001	2,523	2,347	2,124	102	48	72	176
2002	2,612	2,456	2,225	110	49	73	155

Table A. 2. Real Income Growth Rates by Sources

(unit: %)

	Total Income	Regular Income	Labor Income	Business Income	Asset Income	Transfers	Non-regular
1983	10.7	10.4	10.2	-0.8	17.0	17.4	29.1
1984	7.7	7.5	7.9	35.2	-0.9	-13.7	18.1
1985	4.5	4.0	3.4	14.0	4.5	17.5	27.0
1986	8.8	8.3	7.7	21.2	31.6	-5.2	25.1
1987	13.3	12.4	11.7	16.4	13.8	30.4	39.2
1988	9.1	8.9	9.6	10.4	-2.7	-3.0	15.2
1989	17.7	16.7	15.9	6.0	16.2	55.5	41.8
1990	8.0	7.2	7.3	13.7	5.4	0.7	21.7
1991	12.3	11.8	11.4	27.8	-1.3	19.3	21.0
1992	10.3	10.4	10.5	7.3	17.5	4.6	8.9
1993	4.0	4.5	5.3	6.6	-7.0	-9.3	-3.7
1994	8.3	7.5	6.9	11.9	16.6	14.2	22.2
1995	7.5	8.3	8.5	15.6	-2.3	1.9	-2.9
1996	7.4	6.9	6.6	10.9	15.0	3.5	14.8
1997	1.8	1.7	1.0	3.5	-0.4	21.8	3.6
1998	-13.3	-13.3	-12.9	-8.2	-24.9	-22.6	-12.2
1999	3.4	3.3	2.3	14.0	5.3	17.1	5.7
2000	4.9	4.2	4.8	3.0	-4.1	-4.7	14.4
2001	5.7	6.0	5.8	8.2	7.3	8.8	1.7
2002	3.5	4.7	4.8	7.4	1.0	0.4	-11.7

Table A.3. Composition of Income by Sources

(unit: %)

	Regular Income	Labor Income*	Business Income*	Asset Income*	Transfers*	Non-regular
1982	98.1	92.4	2.0	2.7	2.9	1.9
1983	97.8	92.2	1.8	2.9	3.1	2.2
1984	97.6	92.6	2.2	2.7	2.5	2.4
1985	97.1	92.1	2.4	2.7	2.8	2.9
1986	96.7	91.5	2.7	3.3	2.5	3.3
1987	95.9	91.0	2.8	3.3	2.8	4.1
1988	95.7	91.6	2.9	3.0	2.5	4.3
1989	94.8	91.1	2.6	3.0	3.4	5.2
1990	94.1	91.2	2.8	2.9	3.2	5.9
1991	93.7	90.9	3.2	2.6	3.4	6.3
1992	93.7	91.0	3.1	2.7	3.2	6.3
1993	94.2	91.6	3.1	2.4	2.8	5.8
1994	93.5	91.1	3.3	2.6	3.0	6.5
1995	94.1	91.3	3.5	2.4	2.8	5.9
1996	93.7	91.1	3.6	2.6	2.7	6.3
1997	93.6	90.6	3.7	2.5	3.2	6.4
1998	93.5	91.0	3.9	2.2	2.9	6.5
1999	93.4	90.2	4.3	2.2	3.3	6.6
2000	92.8	90.7	4.3	2.0	3.0	7.2
2001	93.0	90.5	4.3	2.1	3.1	7.0
2002	94.1	90.6	4.5	2.0	3.0	5.9

Note: * as a share of regular income.

Table A.4. Composition of Households' Income by Sources: 2001

Income Source	Amount (thousand won)	Shares (%)
Total income	2,625	100.0
I. Regular income	2,442	93.0
1. Labor income	2,210	90.5
1.1. Head	1,785	80.8
1.1.1. Wage	1,531	85.8
1.1.2. Bonus	254	14.2
1.2. Spouse	234	10.6
1.2.1. Wage	215	91.9
1.2.2. Bonus	19	8.1
1.3. Other members	191	8.7
1.3.1. Wage	177	92.8
1.3.2. Bonus	14	7.2
2. Business & subsidiary work income	106	4.3
2.1. Business income	86	81.4
2.1.1. Head	6	7.5
2.1.2. Spouse	68	79.3
2.1.3. Other members	11	13.2
2.2. Subsidiary work ¹⁾	20	18.6
3. Asset income	50	2.1
3.1 interest payment	20	40.5
3.2. Dividends	1	2.0
3.3. Rents	29	57.5
3.4. Other asset income	0	0.1
4. Transfers	75	3.1
4.1. Public transfers	23	30.5
4.1.1. Pensions	13	54.7
4.1.2. Other social benefits	10	45.3
4.2. Private transfers	52	69.5
II. Non-regular income	183	7.0
1. Gift money, etc. ²⁾	26	14.1
2. Sales of non-assets ³⁾	0	0.1
3. Other non-regular income ⁴⁾	157	85.8

1) Income from subsidiary work is income of a household member without a regular job. Income of a household member with a job is classified either as a labor income or a business income according to the nature of the income source.

2) Includes gift money in weddings, funerals, etc.

3) Income from sales of goods that are not assets, such as trash papers, etc.

4) Non-regular Income other than from gifts or sales of non-assets. Includes compensations for property loss or accidents and retirement pay. Retirement pay is, in nature, a part of labor income, but it is classified as non-regular income as it is given in lump sum.

Outside Ownership as a Factor Input

by
*Yong KIM**

Abstract

This paper demonstrates how the outside ownership of assets used in production can improve outcomes. If outside ownership improves outcomes, and assets which implement the gains from outside ownership are scarce, then assets can have value conditional on outside ownership. A framework with a continuous creation and destruction of such assets is developed in a model of firm entry and exit. Assets under outside ownership behave like a factor input which earns a periodic return. By mapping a reduced form version of my model to the canonical Hopenhayn (1992) model of firm entry and exit, a micro-foundation for such a model is provided.

Keywords Borrowing constraints; Self employment; Outside ownership: Firm entry and exit
JEL Classification L2, J3, G3.

1. Introduction

In modern economies, the non-human assets of firms are often owned by outsiders who are not directly involved in the production process. Asset values are assumed to be backed by the stream of incomes accruing to such outside owners. What remains unclear is how, asset ownership, which confers residual control rights to assets, translates into a stream of incomes to outside owners.

This paper develops a theory of outside ownership where firm asset values are conditional on an outside ownership structure. I show how outside ownership of assets can be considered a factor input in the production process.

The first innovation of this paper is a theory of how outside ownership arrangements can improve outcomes. At the heart of this theory are borrowing constraints. Outside owners mitigate the borrowing constraint problem faced by agents undertaking production projects. By default, those who cannot exploit the gains from outside ownership are borrowing constrained. More about this mechanism will be discussed in a little while.

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If outside ownership of assets can improve outcomes, and assets which implement the gains from outside ownership are scarce, then assets can have value conditional on outside ownership. The second innovation of this paper considers how such assets are created and when they can be considered scarce inputs. What is required is a dynamic environment where there is a continuous creation and destruction of assets which can implement the gains from outside ownership.

I develop a theory of firm entry and exit where firms undertake specific projects which are repeated over time. In every period, a new set of projects arrives exogenously to the economy. Assets used in new projects cannot exploit the gains from outside ownership. Assets used in repeated projects can exploit the gains from outside ownership, if they use the assets from previously new projects. As a result, the creation of assets which can exploit the gains from outside ownership is costly since agents undertaking new projects are borrowing constrained.

If costly assets are created continuously, there must also be a process of asset destruction. In the model, this happens because the productivity of projects depreciates over time. New and old projects coexist because of the following trade off: although new projects have higher productivity, older projects can exploit the gains from outside ownership. I show how an endogenous number of project vintages will coexist, and the model describes a process of technology diffusion.

The analysis is compared with existing canonical models of firm entry and exit. Such models assume that firms provide an unspecified factor input which delivers profits to the firm net of hired inputs such as labor. A exogenous entry cost of creating this factor input limits the entry of new firms which earn positive profits once this cost is sunk. A exogenous maintenance cost of this factor input ensures that some firms exit if gross profits are sufficiently small.

The last section of the paper sets up a model of firm entry and exit following Hopenhayn (1992), and demonstrates how a reduced form version of my model coincides exactly with this model. What substitutes for the unspecified factor inputs are assets which can implement the gains from outside ownership. The stream of incomes accruing to such assets determines the asset value conditional on outside ownership. A compensating variation which agents opening new firms receive for facing borrowing constraints, substitutes for the exogenous entry cost. The analog to the exogenous maintenance cost will be discussed in the main text.

Under my interpretation of the factor input supplied by firms, both the entry cost and maintenance cost are endogenously determined. By showing how assets under outside ownership are interpreted as a factor input, a key lesson of this paper is that broader measures of parameters determining firm entry and exit should be adopted in empirical work.

Intuitively, how does a theory of outside ownership come together? Consider a two period project where two period lived agents acquire project specific skills in period 1 which they can use in period 2. Production also requires the use of a project specific asset in period 2. Agents are much more productive in period 2, but wish to consumption smooth over their lifetimes so want to borrow against their old period earnings when young. Unfortunately, no-one is willing to lend to them because agents cannot commit to repay loans made against their period 2 labor output. So they are borrowing constrained.

Consider what happens when an outsider owns the asset in period 2. In period 2, the owner holds-up the agent just before production is realized and is able to extract part of the agent's labor output. Asset ownership and ex post hold-up allow outsiders to steal part of the agent's period 2 output. Were this the end of the story, outside ownership is actually worse than the absence of borrowing since the agent has to share output with an outside party. But there is

another protagonist acting in this drama. Ex ante in period 1, the outside owner has to offer the agent a lifetime earning and implied utility level at least what the agent would get under self ownership. Anticipating the stealing of output in period 2, the agent must be offered a bribe to participate in period 1.

The combination of ex post hold up and ex ante competition to attract the agent implements cash flows from the outside owner to agent 4 which resembles borrowing. The existence of assets which agents acquire skills specific to, allows outside ownership arrangements to substitute for borrowing. When assets which implement the gains from outside ownership are scarce, they can have value.

Asset ownership, which confers the residual right to confiscate assets, only has economic meaning in a framework where outcomes cannot be completely specified contractually. The analysis of ex post hold-up problems in this context has been developed in papers by Grossman and Hart (1986) and Hart and Moore (1990). The combination of ex post hold-up and ex ante competition has been explored by Felli and Roberts (2002), and in an environment with search frictions by Acemoglu and Shimer (1999) and Kim (1999), as a mechanism to mitigate inefficiencies associated with hold-up. My theory of outside ownership shows how the combination of these forces can actually improve outcomes.

My theory of outside ownership implies a theory of self employment by default. The self employed cannot exploit the gains from outside ownership, and are borrowing constrained. A robust empirical feature of the self employed is that they are borrowing constrained. In particular, a number of studies including Evans and Jovanovic (1989) and Holtz-Eakin, Joulfaian and Rosen (1994) find agents endowed with greater wealth are more likely to become self employed. A series of related papers by Chiu (1998), de Meza and Lockwood (1998) and Rajan and Zingales (1998) provide an alternative theory of outside ownership. There borrowing constraints are not key, and the self employed are not necessarily borrowing constrained.

Besides Hopenhayn (1992), other industry equilibrium models include Ericson and Pakes (1994) and Hopenhayn and Rogerson (1994). Hopenhayn and Rogerson apply the Hopenhayn model to issues of unemployment benefit and firing costs. This paper also complements existing models of vintage capital including Solow (1960), Boyd and Prescott (1989) and Chari and Hopenhayn (1991).

Sections 2 and 3 describe the model and equilibrium. Section 4 discusses some of the implications, and section 5 shows how a reduced form version of the model coincides with the Hopenhayn (1992) model. The last section concludes.

2. Model

Consider a two period overlapping generations economy with a constant population of agents normalized to 2. Ex ante identical agents have preferences over their young and old period consumption c_y and c_o given by,

$$u = c_y^{\frac{1}{1+\beta}} c_o^{\frac{\beta}{1+\beta}} \quad 0 < \beta < 1 \quad (1)$$

Given their young and old period labor earnings y_1 and y_2 , and the interest factor of the economy R_t , the indirect utility as a function of earnings for a generation born in period t can be expressed as,

$$\begin{aligned} v(y_1, y_2; R) &= \frac{(y_1 + \frac{1}{R_t} y_2)(\beta R_t)^{\frac{\beta}{1+\beta}}}{1 + \beta} \text{ if borrowing constraints do not bind} \\ &= y_1^{\frac{1}{1+\beta}} y_2^{\frac{\beta}{1+\beta}} \text{ if borrowing constraints bind} \end{aligned} \quad (2)$$

2.1 Technology

The technology available has three features: production technology, commitment technology and contractual environment. First consider production technology. In every period a new set of two period projects arrive exogenously to the economy. Projects can be repeated every period so that period 2 of a project and period 1 of its repetition can overlap. Let $\tau \in \{0, 1, \dots\}$ index the age or vintage of a project relative to a frontier project. A vintage $\tau - 1$ project in the current period becomes a vintage τ project in the next period.

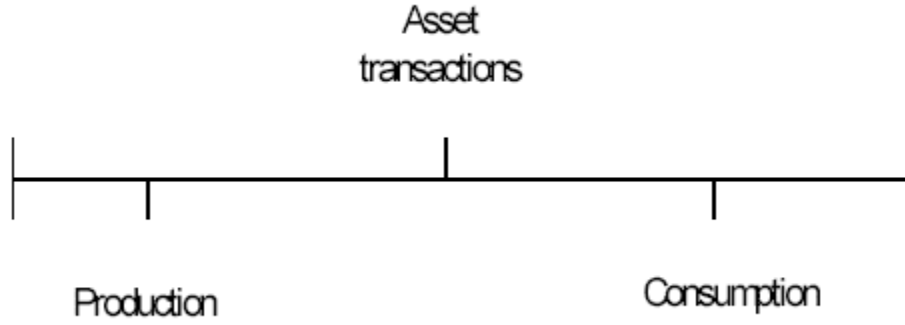
For $\tau \leq 1$, within each vintage there are two types of projects. Non-repeated projects which have never been carried out before and repeated projects which have been carried out at least once. Non-repeated projects use "raw" assets in production, and repeated projects use "seasoned" assets in production. By construction all $\tau = 0$ frontier projects are non-repeated projects.

A vintage $\tau - 1$ non-repeated project starting at time $t - 1$ uses one unit of unskilled labor to produce x units of consumption goods plus one unit of project specific skills. In period 2 of this project, one unit of specifically skilled labor plus one unit of a project specific raw asset plus $n_{\tau,t}$ units of unskilled labor produces $\delta^\tau f(n_{\tau,t})$ units of consumption goods plus one unit of project specific seasoned assets. The project specific raw asset must be available in period 1 for use in period 2 production. Let the unskilled laborers used in period 2 $n_{\tau,t}$, be referred to as "workers" to distinguish them from the unskilled labor used in period 1 of the project. $\delta \in (0, 1)$ means that project productivities decrease over time. Assume $f(0) = 0$, $f'(\cdot) > 0$, $\lim_{n \rightarrow 0} f'(n) = \infty$ and $f''(\cdot) < 0$.

Seasoned assets are raw assets which have been used in projects at least once before. The production technology for a vintage $\tau - 1$ repeated project starting at time $t - 1$ is identical to that of a non-repeated project except in period 2, one unit of a seasoned asset is used instead of a raw asset. Again, the seasoned asset must be available in period 1 for use in period 2 production. The requirement that repeated projects must use seasoned assets embodies an assumption that project specific assets cannot be reproduced.

Assets are assumed not to depreciate. The price of raw assets, reflecting the raw material costs of assets, is assumed zero $V_{\tau,t} = 0 \forall \tau, \forall t$.¹ Let $V_{\tau,t} \geq 0$ denote the price of a vintage seasoned asset at time t . [Figure 1] shows the timing of events in each period. Agents produce, then conduct asset transactions, and finally consume.

¹ This assumption allows the economy to avoid outcomes where new and old projects coexist because the raw material costs of old projects's assets have already been sunk.

Figure 1. Timeline in period t 

The net product of a vintage $\tau - 1$ non-repeated project starting at time $t - 1$ is composed of factor outputs and costs in the following way. In period 1, net product $x - \hat{V}_{\tau-1,t-1} = x$ is composed of labor output x and raw asset value $\hat{V}_{\tau-1,t-1} = 0$. In period 2, net product $\delta^\tau f(n_{\tau,t}) + V_{\tau,t}$ is composed of skilled labor output $\pi_\tau(w_t)$, worker output $n_{\tau,t}w_t$ and the resale value of the seasoned asset $V_{\tau,t}$. w_t is the wage offered to unskilled workers who are homogenous across vintage and are hired from competitive labor markets. $\pi_\tau(w_t)$ is maximized output net of worker wages,

$$\pi_\tau(w_t) \equiv \max_{n_{\tau,t}} \delta^\tau f(n_{\tau,t}) - n_{\tau,t}w_t \quad (3)$$

Since skilled agents are free to provide unskilled labor as workers, we must have $\pi_\tau(w_t) \geq w_t \geq x$, for workers to coexist with agents who acquire project specific skills.

The composition of net product of a vintage $\tau - 1$ repeated project starting at time $t - 1$ is identical to that of a non-repeated project except in period 1, seasoned asset value $V_{\tau-1,t-1}$ replaces $\hat{V}_{\tau-1,t-1} = 0$. Up to this point, the distinction between non-repeated and repeated projects, and raw and seasoned assets, has only been nominal.

The second component of the technology available is commitment technology. Raw and seasoned assets differ in whether a young agent in period 1 of a project can commit to acquire skills specific to that asset. I assume young agents cannot commit to acquire skills specific to a particular raw asset, but young agents can commit to acquire skills specific to a particular seasoned asset. I refer to agents acquiring skills specific to raw assets as "entrepreneurs", and agents acquiring skills specific to seasoned assets as "managers".

Since commitment is an advantage and nothing else differentiates raw assets from seasoned assets, it can be inferred that no non-repeated projects will be undertaken if repeated projects are available within that vintage. This implies that projects undertaken will be non-repeated projects if and only if they are frontier $\tau = 0$. projects. The lifetime of all projects is summarized in [Figure 2].

Figure 2. Lifetime of a project

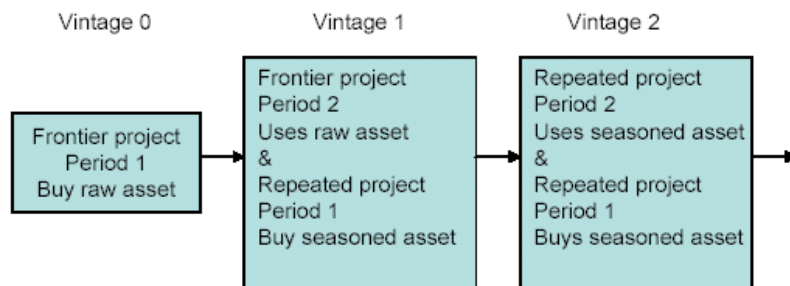


Figure 2: Lifetime of a project

The third component of the technology available is contractual environment. I assume that all borrowing must be collateralized by verifiable values, and assume that period 2 project output and skill levels of entrepreneurs and managers are non-verifiable by courts.² Contracts contingent on these variables are not enforceable and will not be written. This implies that young entrepreneurs and managers cannot borrow against their second period labor output $\pi_\tau(w_t)$. Young entrepreneurs and managers are only able to borrow against the resale value of seasoned assets $V_{\tau,t} \geq 0$, given market trades are verifiable.

To complete the description of the economy, let $\mu_{\tau,t}$ denote the period t measure of skilled agents in vintage τ .

2.2 Self employment versus outside ownership

The commitment and contractual technology imply different asset ownership structures depending on whether agents acquiring skills use raw or seasoned assets. Ownership of an asset confers residual rights of control to assets in contractually unspecified circumstances. This section compares outcomes under self employment and outside ownership of assets. First, under self employment, for all projects the commitment technology and contractual environment are irrelevant since agents acquiring skills work for themselves, and hire workers from competitive labor markets. Agents receive the net product from projects each period, after paying for workers.

Outcomes under outside ownership differ on the type of project. Consider repeated projects using seasoned assets first. Assume that in any bargaining process any outside owner has full

² The simplest justification for this constraint is that agents can always run away with their skills and project output after production. However they cannot run away with the assets.

bargaining power (they make a once and for all take-it-or-leave-it-offer). In project period 2, just before production, the outside owner holds-up the manager by threatening to confiscate the asset, and extracts the full bilateral surplus output of the match between the asset and specifically skilled worker. The match yields output $\pi_\tau(w_t)$. The outside option of the asset is zero since it cannot be used with any other skilled manager. The outside option of the skilled manager is w_t . Income accruing to the outside owner is the surplus $\pi_\tau(w_t) - w_t$. Given this, in period 1 when the outside owner has to attract a young manager to work for her, an employment wage w_{t-1} has to be offered to make the young manager indifferent between becoming a worker or a manager. In effect, the outside owner provides an up-front payment in excess of a young manager's product equal to $w_{t-1} - x$. The combination of ex post hold-up and ex ante competition to attract the manager results in intertemporal transfers which resembles borrowing.³⁴

Consider an outside owner who buys a seasoned asset for $V_{\tau-1,t-1}$, and hires a young manager in period $t-1$ who realizes output x for wage w_{t-1} . In period t , the owner bargains over the output to receive a surplus $\pi_\tau(w_t) - w_t$ and then sells the asset for $w_{\tau,t}$. Assuming competitive markets for outside ownership, and positive asset values, the net discounted earnings of outside owners must be zero,

$$-V_{\tau-1,t-1} + x - w_{t-1} + \frac{1}{R_{t-1}}(\pi_\tau(w_t) - w_t + V_{\tau,t}) = 0 \text{ for } \tau - 1 \geq 1 \quad (4)$$

Rearranging yields an equation for seasoned asset values in terms of the difference between the manager's lifetime product and lifetime employment wages. For $\tau - 1 \geq 1$,

$$V_{\tau-1,t-1} = \max \left\{ 0, \left[\left(x + \frac{1}{R_{t-1}} \pi_\tau(w_t) \right) - \left(w_{t-1} + \frac{1}{R_{t-1}} w_t \right) \right] + \frac{1}{R_{t-1}} V_{\tau,t} \right\} \quad (5)$$

In multi period projects, the correlation between periods when agents have asset specific skills, and agents wish to borrow against product from that period in borrowing constrained economies, implies there are arbitrage opportunities for other agents who can "lend" to such agents. Since outside owners of seasoned assets carry out transfers to managers that resemble borrowing, seasoned assets can have positive value when they are scarce.⁵⁵

³ This coincides with the analysis of firm specific skills in Becker (1964). Outside asset owners appropriate the gains from asset specific skills and "invest" ($w_t \cdot x$) in young managers.

⁴ During their job tenure, managers's product profiles are steeper than their earnings profiles. This analysis is inconsistent with seniority wages: the phenomenon that during job tenure, wage profiles are steeper than product profiles. While empirical studies have shown measured output is consistent with seniority wages, unmeasured components of output (such as the training provided to young by old) may imply that seniority wages do not hold.

⁵ Skills may be general with respect to many assets, but merging such assets can make skills de facto specific. Then, although the technology is constant returns to scale in assets, entrepreneurs/managers and workers, there are increasing returns to merging projects where managers's skills are general. This argument unravels if skills are general throughout all projects in the economy. The single merged asset would implement the ex post hold up of managers, but not the ex ante competition to attract managers. Both the ex post hold up and ex ante competition are essential for

Finally, consider outside ownership of raw assets. Since entrepreneurs cannot commit to acquire asset specific skills, outside owners have no guarantee that entrepreneurs can be held-up in period 2. Thus, the potential gains of outside ownership cannot be realized.

Guess that in an equilibrium, entrepreneurs and managers are borrowing constrained under self employment (which will be verified later).

Then outside ownership of seasoned assets dominates self employment for managers. For raw assets, self employment for entrepreneurs dominates outside ownership. Under outside ownership, entrepreneurs receive no intertemporal transfers that resemble borrowing from outside owners, and they would be giving up the resale value of newly created seasoned assets $V_{1,t}$.

The earnings experiences cross the three occupations can now be summarized. All managers and workers have identical earnings experiences due to the assumption of full bargaining power to outside owners. In particular, managers's earnings are independent of vintage since their outside option (worker wages) is independent of vintage.⁶ Entrepreneurs earn x when young and $\pi_1(w_t) + V_{1,t}$ when old. The only borrowing possibilities are those collateralized by seasoned asset values. This means that young entrepreneurs in period $t - 1$, can only borrow up to $\frac{1}{R_{t-1}} V_{1,t}$.

3. Equilibrium

A competitive equilibrium requires in every period (i) an ownership structure of assets and (ii) agents's choice of occupation, vintage and consumption to maximize lifetime utility subject to the borrowing constraint, earnings across occupations, the interest factor, labor market clearing condition and asset market clearing condition. I restrict the analysis to steady state outcomes where earnings levels, the interest factor, the distribution of labor across occupations and ownership structure of assets are invariant across time: $w_t = \pi_\tau(w_t) = \pi_\tau$

(w) , $V_{\tau,t} = V_\tau$, $R_t = R$, $\mu_{\tau,t} = \mu_\tau$, $e_{\tau,t} = e_\tau$. Time subscripts are dropped.

Ex ante identical agents become entrepreneurs, managers and workers if their lifetime utility across occupations is equalized.

$$v(x, \pi_1(w) + V_1(w, R); R) = v(w, w; R) \quad \forall \tau \text{ where } e_\tau > 0 \quad (6)$$

The terminal vintage $T \geq 1$ is given by the highest such that,

justifying the arbitrage role of outside ownership.

⁶ Managers and workers are distinguished by the tenure of employment for asset owners. Two periods for managers, one period for workers.

$$\begin{aligned} \left(x + \frac{1}{R} \pi_T(w)\right) - \left(w + \frac{1}{R} w\right) &\geq 0 \\ \left(x + \frac{1}{R} \pi_{T+1}(w)\right) - \left(w + \frac{1}{R} w\right) &< 0 \end{aligned} \quad (7)$$

Skilled agents coexist in vintages 1 to T . Since older projects are less productive, T is finite and a decreasing function of w and R .

The value of a vintage $\tau - 1$ seasoned asset conditional on outside ownership, is the discounted value of the stream of managers's product net of their employment wages up to the terminal vintage,

$$\begin{aligned} v_{\tau-1}(w, R) &= \sum_{s=\tau}^T \frac{1}{R^{s-\tau}} \left[\left(x + \frac{1}{R} \pi_s(w)\right) - \left(w + \frac{1}{R} w\right) \right] > 0 \quad \text{for } 1 \leq \tau - 1 \leq T - 1 \\ &= 0 \quad \text{otherwise} \end{aligned} \quad (8)$$

Asset values are strictly falling in vintage τ , the worker wage w , and the interest factor R , and increasing in the age of the terminal vintage T . If entrepreneurs and managers coexist in the economy, $V_1 \geq 0 \Rightarrow x + \frac{1}{R} \pi_1(w) > w + \frac{1}{R} w$. Given the participation constraint, entrepreneurs can only have higher discounted earnings if they are borrowing constrained.

Given $V_1(w, R)$, the indifference condition across occupations allows us to solve for the equilibrium worker wage as a function of the interest factor, $w^* = w(R)$.

Lemma 1 *Worker wages are falling in the interest factor* $\frac{dw^*}{dR} \leq 0$.

Proof. The indifference condition is,

$$\left(x + \frac{1}{R} V_1(w, R)\right)^{\frac{1}{1+\beta}} (\pi_1(w))^{\frac{\beta}{1+\beta}} = \frac{w(1 + \frac{1}{R})(\beta R)^{\frac{\beta}{1+\beta}}}{1 + \beta}$$

Since V_1 is strictly falling in R , entrepreneurs's utility is (weakly) falling in R . Workers's utility is (weakly) rising in R as long as $(\beta - \frac{1}{R}) \geq 0$.

This inequality must hold under asset market clearing in Lemma 2, so the result follows. Since assets cannot be reproduced, and all seasoned assets were previously raw assets, the density of skilled agents across coexisting vintages must be uniform, $\mu_\tau \equiv \mu \forall 1 \leq \tau \leq T$.

The labor market clearing condition for old agents is given by,

$$\frac{\mu}{2} \sum_{\tau=1}^T n_\tau(w) = 1 - \mu T \quad (9)$$

On the left hand side is the demand for workers by entrepreneurs and managers divided by 2 since only half of the workers are old. On the right hand side is the population of old minus the population of entrepreneurs and managers. Since T and n_T are falling in w , μ overall is increasing in w .

Using the steady state measures of μ_τ , the asset market clearing condition is given by,⁷

$$\mu \frac{1}{R} V_1 + \mu(T-1) \left[\frac{\sum_{\tau=2}^T V_{\tau-1}(w, R)}{T-1} + (w-x) \right] = (1-\mu) \frac{(\beta - \frac{1}{R})w}{1+\beta} \quad (10)$$

The left hand side denotes the demand of aggregate savings consisting of the borrowing of entrepreneurs against discounted seasoned asset value V_1 , plus the average seasoned asset values and up-front payment to young managers summed across managers. The right hand side denotes the supply of aggregate savings offered by managers and workers at interest factor R . Note when there are no managers, $T=1 \Rightarrow V_1=0$, then the left hand side is zero and the equilibrium interest factor is $R^* = \frac{1}{\beta}$.

The asset market clearing condition combined with the labor market clearing condition and asset value equations allows the equilibrium interest factor to be expressed as a function of the unskilled wage $R^* = R(w)$.

Lemma 2 Entrepreneurs must be borrowing constrained given any interest factor clearing the asset market. The interest factor lies between $\frac{1}{\beta} \leq R^* < \frac{1}{\beta} \frac{\pi_1(w)}{x}$.

⁷ An alternative formulation of the asset market clearing condition is assets are priced by their discounted future resale price and dividend, $\frac{\mu}{R} V_1 + \frac{\mu}{R} \sum_{\tau=2}^T [V_\tau(w, R) + (\pi_\tau(w) - w)]$. The definition of asset values ensures the equivalence of the two formulations.

Proof. Suppose not so $R^* \geq \frac{1}{\beta} \frac{\pi_1(w)}{x}$ and $(x + \frac{1}{R} \pi_1(w)) - (w + \frac{1}{R} w) = 0 \Rightarrow T = 1 \Rightarrow V_1 = 0$ no assets are traded, and $\mu_{\tau} = 0 \forall \tau \geq 2$ there are no managers. Since there are no asset market transactions the equilibrium interest factor is $R^* = \frac{1}{\beta}$. This is a contradiction. The bounds on the interest factor follow by inspection.

Proposition 1 A steady state equilibrium $\{w^*, R^*, T^*, \mu^*\}$ exists for this economy.

Proof. Consider the bounds on w^* given the bounds on the interest factor from Lemma 2. The upper bound is given by $\bar{w} = w(\frac{1}{\beta})$. The lower bound is given by $\underline{w} \equiv w(\beta \frac{x}{\pi_1(w)})$, and it is known that entrepreneurs are not borrowing constrained, $V_1(w, \beta \frac{x}{\pi_1(w)}) = 0$. So, $w^* \in (\underline{w}, \bar{w})$.

From Lemma 2, we $R^*(\underline{w}) \in [\frac{1}{\beta}, \beta \frac{x}{\pi_1(w)}]$ and $R^*(\bar{w}) \in [\frac{1}{\beta}, \beta \frac{x}{\pi_1(w)}]$. Consider the following two cases. Case 1: $T(\bar{w}, \frac{1}{\beta}) = 1 \Rightarrow R^*(\bar{w}) = \frac{1}{\beta}$. Case 2: $T(\bar{w}, \frac{1}{\beta}) > 1 \Rightarrow R^*(\bar{w}) > \frac{1}{\beta}$ and $R^*(\underline{w}) > \frac{1}{\beta}$. Under case 1, the economy has a solution where $w^* = \bar{w}$, and $R^* = \frac{1}{\beta}$. Under case 2, the economy has a solution where $w^* \in (\underline{w}, \bar{w})$, and $R^* \in (\frac{1}{\beta}, \beta \frac{x}{\pi_1(w)})$.

4. Discussion

4.1 Coexistence of Entrepreneurs and Managers

This subsection highlights three necessary assumptions for seasoned assets to have positive value, which occurs if and only if entrepreneurs and managers coexist. First, if there are no borrowing constraints and young agents can freely borrow against their old period earnings, only frontier projects would be undertaken and there would be no managers, $T^* = 1$. The present discounted value of earnings would be equal for entrepreneurs and workers. The first best outcome is achieved where the credit market clearing condition is given by,

$$\mu'(w' - x) = \frac{(\beta - \frac{1}{R'})w'}{1 + \beta} \quad (11)$$

Substituting in equilibrium μ' μ this equation becomes,

$$\frac{(w' - x)}{\frac{n_1(w')}{2} + 1} = \frac{(\beta - \frac{1}{R})w'}{1 + \beta} \quad (12)$$

Similarly, if there were borrowing constraints, but young entrepreneurs could commit to acquire skills specific to raw assets, only frontier projects would be undertaken and the present discounted value of earnings would be equal for managers and workers. In such an economy the asset market clearing condition would be identical to the credit market clearing condition above since the price of raw assets is zero.

A third necessary condition is that project productivities depreciate, $\delta < 1$. Consider outcomes in the limit as $\delta \rightarrow 1$.⁸ From the definition of T $\delta \rightarrow 1 \Rightarrow (i) T \rightarrow \infty \Rightarrow \mu \rightarrow 0$, (ii) asset values converge to a constant independent of

$$\tau : V_\tau \rightarrow V(\hat{w}, \hat{R}) = \frac{\hat{R}}{\hat{R}-1} \left[\left(x + \frac{1}{\hat{R}} \pi(\hat{w}) \right) - \left(\hat{w} + \frac{1}{\hat{R}} \hat{w} \right) \right],$$

and (iii) input demands for workers are independent of $\tau : n_\tau(\hat{w}) \rightarrow n_1(\hat{w})$. The asset market clearing condition at the limit is,

$$\frac{V(\hat{w}, \hat{R}) + (\hat{w} - x)}{\frac{n_1(\hat{w})}{2} + 1} = \frac{(\beta - \frac{1}{\hat{R}})\hat{w}}{1 + \beta} \quad (13)$$

Agents in equilibrium are indifferent across occupations, but since assets do not depreciate, nobody becomes an entrepreneur.

4.2 Optimal terminal vintage.

The main analysis assumed that outside owners have full bargaining power so that skilled managers's earnings are driven down to their outside option: worker wages w . Suppose when bargaining with outside owners, managers can secure a share $0 \leq \theta \leq 1$ of the surplus between his product and outside option. I interpret θ as an exogenous institutional variable which individual agents cannot affect. Let $\varpi_{\tau-1} \geq x$ denote the earnings offered by outside owners to attract young managers who will become skilled in a vintage τ project when old. The modified terminal vintage rule sets $T \geq 1$ as the oldest vintage such that,

$$\begin{aligned} \left(x + \frac{1}{R} \pi_T(w) \right) - \left(\varpi_{T-1} + \frac{1}{R} [\theta(\pi_T(w) - w) + w] \right) &\geq 0 \\ \left(x + \frac{1}{R} \pi_{T+1}(w) \right) - \left(\varpi_T + \frac{1}{R} [\theta(\pi_{T+1}(w) - w) + w] \right) &< 0 \end{aligned} \quad (14)$$

⁸ In a steady state growth economy, this limit corresponds to the growth rate going to zero.

As long as managers remain borrowing unconstrained, they are willing to work for discounted labor earnings equal to that of workers. If they are borrowing constrained, their discounted labour earnings must be higher for them to remain indifferent across occupations.

$$\begin{aligned}\varpi_{T-1} &= w - \frac{1}{R} [\theta(\pi_T(w) - w)] \text{ if borrowing unconstrained} \\ &> w - \frac{1}{R} [\theta(\pi_T(w) - w)] \text{ if borrowing constrained}\end{aligned}\quad (15)$$

As long as managers are not borrowing constrained (low θ), the terminal vintage rule is optimal. Optimal in the sense that all projects where the product exceeds the opportunity cost of labor are implemented. Once they are borrowing constrained (high θ), the terminal vintage is younger than the optimum. For instance suppose $\theta = 1$, then $T = 1$, no assets are traded and there are no managers. An interpretation of this result is that in economies where outside owners's rights are well protected (low θ), no other stakeholder interests need to be protected. In economies where outside owners's interests are poorly protected (high θ), other stakeholder (e.g. managers's) interests need to be considered in the decision to terminate projects.

High θ economies are characterized by a relative scarcity of employment vacancies opened by outside owners. They are also characterized by a relative abundance of self employed entrepreneurs who undertake relatively short lived projects. [TO BE DONE]

5. Outside ownership as a factor input

This section sets up a canonical model of firm entry and exit, and interprets it as a reduced form version of my model. Consider a discrete time economy composed of a continuum of firms which produce a homogenous good. The output of an individual firm which is $\tau \geq 1$ periods old is,

$$\begin{aligned}\delta^\tau f(m_\tau - 1) &\text{ if } m_\tau \geq 1 \\ 0 &\text{ if } m_\tau < 1\end{aligned}\quad (16)$$

$$\delta^\tau \in (0,1), f(0) = 0, f'(\cdot) > 0, \lim_{n \rightarrow 0} f'(n) = \infty \text{ and } f''(\cdot) < 0$$

m_τ denotes units of homogenous unskilled labor hired from competitive labor markets at wage w .

In each period, a fixed cost c must be incurred to prolong the life of the firm by 1 period. The terminal vintage of a firm is the highest T such that the discounted profit net of the continuation cost is positive,

$$\begin{aligned}-c + \frac{1}{R} [\delta^T f(m_T - 1) - m_T w] &\geq 0 \\ -c + \frac{1}{R} [\delta^{T+1} f(m_{T+1} - 1) - m_{T+1} w] &< 0\end{aligned}\quad (17)$$

The fixed continuation cost is assumed to ensure there is firm exit. If $c = 0$, firm exit would never happen since profits are always non-negative.

The value of a $0 \leq \tau - 1 \leq T - 1$ period old firm (after period τ profits have been distributed) is given by,

$$G_{\tau-1} = \sum_{s=\tau}^T \frac{1}{R^{s-\tau}} \left[-c + \frac{1}{R} \delta^s f(m_s - 1) - m_s w \right] \quad (18)$$

New firms are opened at fixed entry cost F , and yield no output until they are 1 period old. New firms will enter until discounted profits net of the entry cost is zero. The equilibrium entry condition is,

$$F = G_0 \quad (19)$$

The fixed entry cost is assumed to limit the entry of new firms. If $F = 0$, firm entry would be unbounded since profits are positive.

This economy almost exactly describes the industry equilibrium of Hopenhayn (1992). The two differences are that (i) incumbent firms incur fixed costs c , to keep firms open in the following period as opposed to the current period, and (ii) one extra unit of labor must be hired in production.

The concavity of the production function with respect to labor means that firms supply a vintage specific factor input such that production is constant returns to scale in labor and this factor input. The profits of the firm are accruing to this input which costs F to create and costs c to maintain each period.

Recall the original economy with entrepreneurs, managers and workers, and consider the following reduced form modifications. Let (i) $m_\tau = n_\tau + 1$, (ii) $\theta = 0$, (iii) $c = w - x$ the up-front payment to managers, and (iv) $F = (x + \frac{1}{R} [\pi_1(w) + V_1]) - (w + \frac{1}{R} w)$ the difference in discounted earnings which compensates entrepreneurs for facing borrowing constraints. Then, a reduced form version of my original economy has been exactly described above.

Substituting in for c and m_τ and rearranging, firm values and seasoned asset values are equated,

$$G_\tau = V_\tau \text{ for } 1 \leq \tau \leq T \quad (20)$$

The value of a firm is equal to the resale value of seasoned assets. These substitutions also ensure that the terminal vintage condition is identical for both economies.

In light of my theory, the assumptions underlying the canonical Hopenhayn model can be interpreted in the following way. Firms undergo changes in their ownership structure during their life-cycle from self employment to outside ownership. Under self employment, borrowing constrained owners need to be compensated to open new firms, and this compensating variation equals the fixed entry cost F in the Hopenhayn model. Since the role of the self employed is to supply the economy with seasoned assets, their compensation for facing borrowing constraints can be interpreted as the entry cost for seasoned assets. The up-front payment offered by outside owners to attract managers into two period projects translates into the continuation cost c of keeping firms open in the Hopenhayn model. This payment is also

the cost of prolonging the use of assets under outside ownership. Unlike in the Hopenhayn model, both F and c are endogenous to my model.

The outside ownership of seasoned assets behaves just like a factor input which earns a periodic return. The compensating variation entrepreneurs receive for creating seasoned assets and facing borrowing constraints is an entry cost of this factor input. The up-front bribe offered to young managers to continue projects is the periodic maintenance cost of keeping seasoned assets in use. The interpretation of outside ownership as a factor input, emerged endogenously from an economy where agents undertaking multi-period projects faced borrowing constraints.

6. Conclusion

This paper developed a framework in which the outside ownership of assets improves economic outcomes, and can be interpreted as a factor input. The asset value of firms was conditional on an outside ownership structure. By relating the model to an existing canonical model of firm entry and exit, it was possible to interpret assets which can implement the gains from outside ownership as a factor supplied by firms, and which are associated with endogenous creation and maintenance costs. These insights have implications for broadening the parameters determining firm entry and exit in empirical studies.

Several theoretical extensions can be considered. Since agents acquire a fixed level of skills, the model abstracts away from how there may be underinvestment in skills due to the hold-up problem under outside ownership. Such an argument relies on the costs of skills being private to the agent acquiring the skill. Since entrepreneurs unlike managers own the assets they produce with, a richer model could capture the prediction that entrepreneurs accumulate more skills than managers in projects. On the other hand, if investment is costly in output terms, the borrowing constraints facing entrepreneurs could deter skill investment. Different types of skills could be accumulated to different extents depending on whether projects are carried out by entrepreneurs or managers.

Another extension would be to have agents who live for four or more periods, so they can carry out more than one project in their lifetimes. Such a model would predict that entrepreneurs remain entrepreneurs throughout their lifetimes, and always sell assets upon completion of new projects. Entrepreneurs would have the largest stock of accumulated wealth, and are in the best position to overcome borrowing constraints which characterize entrepreneurship in the current model.

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Comments on “Outside Ownership on Factor Input”

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The comment consists of three parts. The first part provides a simplified version of the model. The second part gives major comments and questions, while the last one minor comments.

I. A Simplified Version of the Model.

This part presents a simplified version of the model, assuming the wage and interest rates are given exogenously, to provide the main implication of the model more explicitly. In the model these prices are solved endogenously.

1. The model is an overlapping generations model. Young agents supply one unit of unskilled labor, while old ones become managers with specific skills.
2. Each firm with τ vintage technology of $\delta^\tau f(n) = \delta^\tau A \cdot n$ needs both one manager with the specific skill to run this technology and one unit of unskilled labor.
3. Each young agent supplies one unit of unskilled labor to one specific firm, and obtains the specific skill needed to run the current specific firm through learning by doing. After obtaining this skill she will become a manager one period later. She can also be a self-employed manager of a firm with a new technology, especially when her specific firm exits. Then, the self-employed manager makes the profit of $A - w$, where w is the exogenously given wage rate for one unit of skilled labor. It is additionally assumed that the self-employed manager is borrowing constrained.
4. For simplicity, we additionally assume that self-employed managers cannot sell their assets in the end of the 2nd period.
5. With $\rho = r = 0$, assume that $u(w) + u(A - w) = 2u(\frac{A - k}{2})$, where k represents the value of finance. The fund is inelastically supplied at $r = 0$ only to asset trade.
6. Then the condition for the terminal vintage T is

$$A - (A - k) > 0$$

$$\delta A - (A - k) > 0, \dots,$$

$$\delta^T A - (A - k) \geq 0,$$

$$\delta^{T+1} - (A - k) < 0.$$

II. Major Comments and Questions

1. I think the objective of constructing the specific model that the paper presents had better be explicitly stated, even though the model seems to be general enough to explain many interesting things such as IPO pricing and others. It is because why the model is constructed in a specific way depends on its objective.
2. Is it realistic to assume that the wage rates of the unskilled worker and the manager are equal? If these are equal, then why young agents accumulate specific skills?
3. What is the meaning of the 'seasoned asset'?
4. Considering the implication of some governance literature that concentrated ownership leads to more efficient firms, how can the outside owner avoid the agency problem of the manager?
5. I think it would be better for readers to understand the model more realistically if the author provides empirical facts or studies showing that self-employed managers are borrowing constrained in Introduction.

III. Minor Comments

1. Time line is somewhat confusing with the two period technologies and two period living agents.
 2. What is the meaning of 'young managers' in an economy where only old agents can be managers? Define it more clearly.
 3. Equilibrium conditions are defined loosely.
- What the reason of existence of entrepreneurs besides managers? This question is related to the first question of II.

CHAPTER 8-2

Economic Literacy of Korean High School Students

by
Jungho Yoo

It has long been suspected that the economics education in Korean high schools is not adequate, as the number of hours economics is taught is insufficient and the teachers who majored in economics in college are few. Less than adequate economics education in high schools would produce citizens who do not have a good understanding of how the economy works and are unable to make sensible economic decisions for themselves. In October, 2002 the Center for Economic Information of KDI conducted an economic literacy test on Korean high school students.

This paper reports on the test. Section 1 describes the test. It introduces the test material used, presents for reference the results of the tests that were administered on American students, and it talks about the test itself and the participants in the test. Section 2 discusses the test results and compares them with the American results by content category and by cognitive level. Section 3 tries to discern the common characteristics among questions that test participants found easy and also those that they found difficult. Section 4 attempts to see what the test results say about the effect of economic education. Finally Section 5 concludes.

1. Test of Economic Literacy

The test material used was the third edition of *Test of Economic Literacy* (TEL) developed and published in 2001 by National Council of Economic Education (NCEE), a private organization based in New York to promote economic literacy. It comes in two forms: Form A and Form B, supposedly of the same difficulty. As shall be discussed below, Form B was used to conduct the test on Korean high school students. It is a "standardized test for measuring the achievement of high school students in economics" and "designed primarily to aid the teachers in assessing and improving the quality of high school economics teaching".¹

TEL has 40 questions, and each question has four alternative answers, from which a testee is supposed to pick one correct answer. As shown in Table 1, the questions are distributed among four categories: 14 questions, or 35 percent of the total, are in fundamental economic concepts, 10 in microeconomics (25%), 11 in macroeconomics (27.5%), and five in international economics (12.5%). The questions may also be classified by cognitive level: knowledge, comprehension, and application. The knowledge level tests recognition and recall – ability to remember facts in

¹ Walstad, William B., and Ken Rebeck (2001), *Test of Economic Literacy*, New York: National Council of Economic Education, p.1 and p.9

a form close to the way they were first presented. The comprehension level tests whether one grasps the meaning and intent of information – ability to tell or translate in own words, and the application level, use of information – ability to apply learning to new situations and circumstances.²

Table 1. Distribution of Question items: TEL Form B

Content Categories	Cognitive Level		
	Knowledge	Comprehension	Application
Fundamental Economic Concepts	3	6	5
1. Scarcity	3	1,2	
2. Opportunity cost/trade-offs			4,5
3. Productivity		6	7
4. Economic systems		8,9	
5. Economic institutions & incentives	10,11		12
6. Exchange, money, & interdependence		14	13
Microeconomic Economic Concepts	0	2	8
7. markets & Prices			18
8. Supply & demand			16,17, 19
9. Competition & markets structure			15,20
10. Income distribution		21	
11. Market failures		23	22
12. Role of government			24
Macroeconomic Economic Concepts	3	3	5
13. Gross Domestic Product	25		
14. Aggregate Supply & demand		26, 40	27
15. Unemployment		28	
16. Inflation & deflation	29		30
17. Monetary Policy			31,32
18. Fiscal Policy	33		34
International Economic Concepts	1	0	4
19. Comparative advantage/barriers to trade			35,36, 37
20. Balance of payments & exchange rates	38		39
Total Number of Questions	7	11	22
Percent of Total	17.5	27.5	55.0

Note: Italicized are the identifying numbers of the questions.

In the fall semester, 1999 and spring semester, the next year 7,243 high school students across the U.S. participated in the test. Table 2 reports for later reference on the results of the test where Form B was used and 3,955 students participated. The mean score of the test was 24.5 correct answers on 40 questions, or 61.25 per cent.

Perhaps not surprisingly, as the students' grade went up, so did the test score. It went up

² *ibid*, p.9

a little between freshmen and sophomores, and it jumped between sophomores (correct answers accounted for 55.45 per cent out of total) and seniors (64.88 percent). Female and male students each accounted for about half of the total participants, and the mean test score was substantially higher for the male students, 63.75 vs. 59.30 in percentage terms. Whether or not a student had an economics course (or courses) prior to the test made a big difference in the performance. Those students with economics had on average 64.35 percent correct while those without economics had 47.60 percent correct, a difference of nearly 17 percentage points. As shall be discussed below, this is a very big improvement when compared with Korean test results.

This must account for much of the substantial difference in performance between sophomores and seniors. It turned out that among seniors 95 percent had had economics compared to about 50 percent for the sophomore students.³

Table 2. Results of the Test of US High School Students

		Participants (number)	Test scores
All		3,955	24.50 (61.25)
Gender	Female	1,868	23.72 (59.30)
	Male	1,845	25.50 (63.75)
Grade	Freshman	210	21.92 (54.80)
	Sophomore	1,005	22.18 (55.45)
	Senior	2,354	25.95 (64.88)
Economics	With	3,224	25.74 (64.35)
	Without	731	19.04 (47.60)

Note: (1) Sum of parts does not equal the total. For example, the sum of female and male students is 3,713, falling short of the total of 3,955. This may be due to no answers and "don't know's"

(2) The numbers in the parentheses are the scores in percentage terms.

(3) The standard deviation of the test scores was 8.32

Form B of TEL was used in testing Korean students' economic literacy. It was first translated into Korean with minor changes to suit Korean situation, for example, 'Bank of Korea' for 'Federal Reserve'.

The test was conducted nationally (excluding Jeju Island) in February 2002, and 2,658 high school students from 25 high schools participated in the test, of which three were vocational schools. In each school three classes participated, one class from each grade level.

³ *ibid*, p.31

As shown in Table 3, of all participants 49 percent were female (1,302 in number), and 51 percent were male students (1,356). The students are distributed roughly equally among three grade levels of high school: freshmen accounted for 32.2 percent of total participants, and sophomore and senior students 33.6 percent and 34.2 percent, respectively. Of the test participants 87.0 percent were non-vocational school students, and 13.0 percent were vocational school students; those who had had economics prior to the test accounted for 31.4 percent and the remainder of 68.6 percent had not.

Table 3. Participants and Test Result, Korean High School Students

All		Participants Composition (%)	Test Scores
All		100	22.27 (55.7)
Gender	Female	49.0	22.67 (56.7)
	Male	51.0	21.88 (54.7)
Grade	Freshman	32.2	21.02 (52.55)
	Sophomore	33.6	22.46 (56.15)
	Senior	34.2	23.26 (58.15)
Students Type	Non-vocational	87.0	22.97 (57.43)
	Vocational	13.0	17.57 (43.93)
Economics	With	31.4	23.12 (57.8)
	Without	68.6	21.88 (54.7)

Note : (1) Since Korean high Schools do not offer Economics as a separate for the freshmen, all of them are classified as belonging the group who had not had economics. The group without economics includes five participants who did not answer whether one had or had not economics.

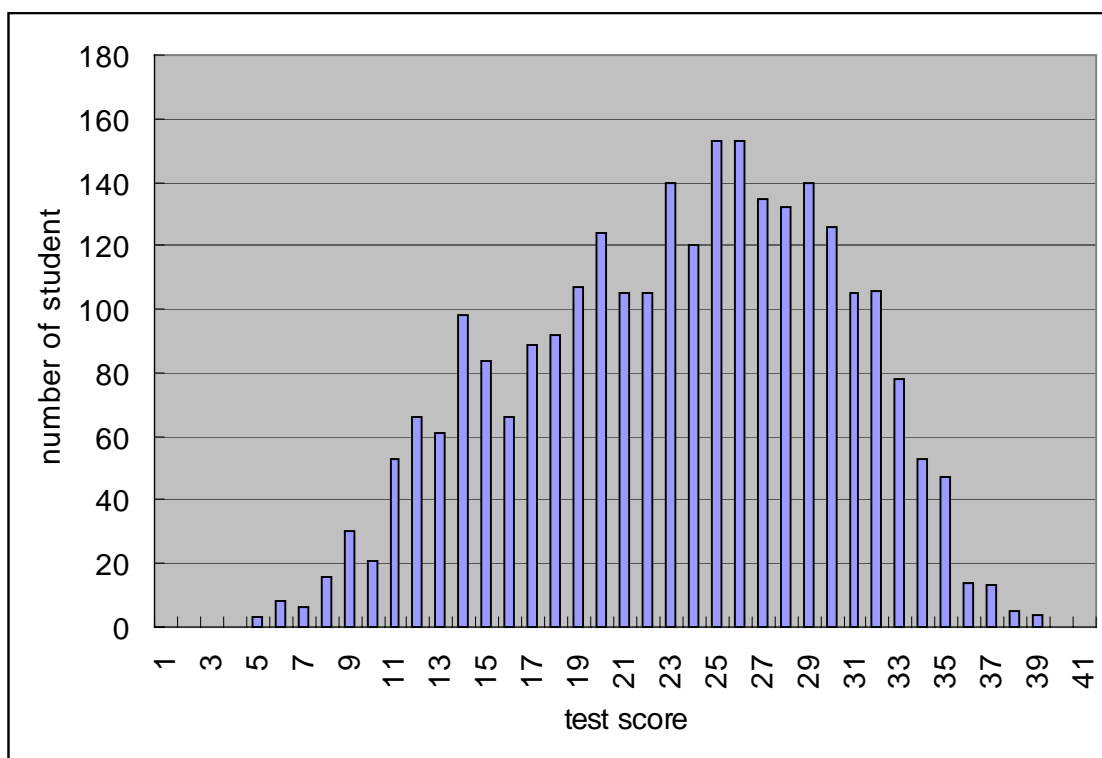
(2) The numbers in the parentheses represent test scores in percentage terms.

2. Test Results

On average Korean high school students had 22.7 correct answers on a total of 40 questions, or 55.7 per cent, and the standard deviation 6.91. The median was 23 correct answers, or 57.5 per cent of the total. On average Korean students had about two fewer correct answers, and the dispersion was smaller for Korean students than American: the standard deviation being 6.91

vs. 8.32. In percentage terms Korean students' mean test score was lower by 5.25 points than that for American students.

Figure 1. Score Distribution of Students



Total number of students: 2,658

Average score: 22.7 (55.7 percent)

Standard deviation: 6.91

Students' grade level tended to make some difference. As the grade went up, the mean test score rose but not by much, about 2 ~ 4 percentage points. Thus, unlike American students, the score gap between senior and lower grade students was small. Again, unlike the American case, Korean female students had higher mean test score (56.7 percent) than male students (54.7 percent). Most contrasting in the test results of the two countries was the difference that an exposure to economics education appeared to make. In Korea it made some difference but not very much. The mean test score for students who had had economics was 57.8 per cent and that for those who had not was 54.7 per cent. Apparently, the effect of taking an economics course was to raise the test score by only 4 percentage points in Korea. In the U.S. the students with economics performed better than those without by nearly 17 percentage points.

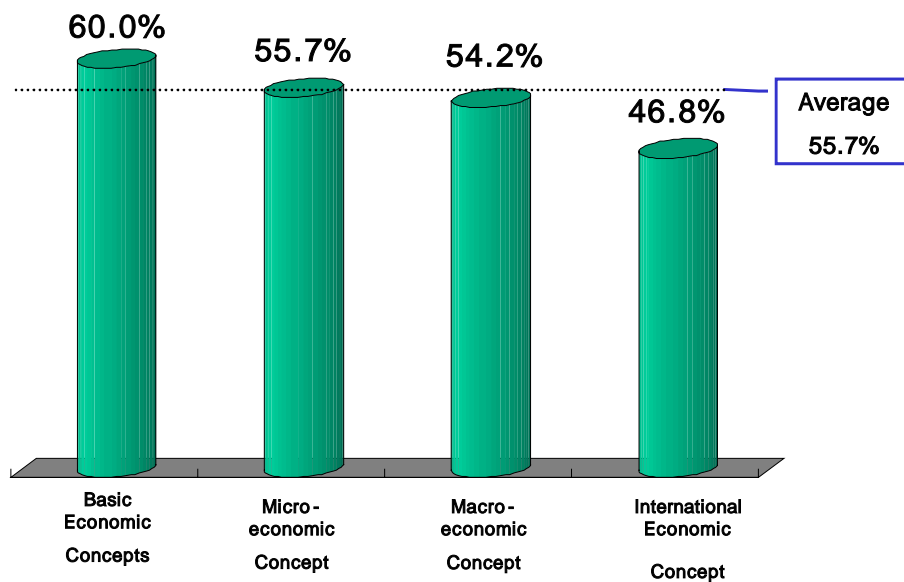
Another interesting thing was that the mean test score of Korean students who had not had economics was higher than that of the American students without economics, 54.7 vs. 47.6

percentage points. (Table 2 and 3) The reason why American students' mean test score was higher than Korean students' was two folds: apparently higher effectiveness of economic education in the U.S. and a higher percentage of those with economics in the sample among American students than among Korean students.

Test scores by content category

Korean students test scores were not the same across four content categories. The mean test score in fundamental economic concepts was 60 percent (8.4 correct answers on 14 questions), the highest among the content categories. It was followed by 55.7 percent in microeconomics concepts (5.57 on ten) and 54.2 percent on macroeconomics concepts (5.96 on eleven). The score was lowest on international economic concepts, 46.8 percent (2.34 correct answers on five questions).

Figure 2. Percentage of correct answers by content category



Among the questions belonging to the "fundamental economic concepts" more than 70% of the students had correct answers on questions dealing with division of labor and specialization (76.0%), entrepreneurs (74.1%), effect of raising interest rates (73.4%), mechanism of the market economy (71.1%), scarcity (70.8%), opportunity cost (70.0%). However, students did poorly on a question on what problem every economic system faces (46.4%) and on a question dealing with money supply (11.1%).

In “microeconomics” students did relatively well on the questions dealing with changes in supply and demand when a monopoly becomes competitors (76.9% of them were correct), the reasons why the government produces public goods (69.7%), and the supply and demand in a competitive market (63.8%). However, students scored poorly on questions dealing with types of income tax (37.1%) and the effect on price of a decrease in supply in a competitive market (36.8%).

In “macroeconomics” most students (85.3% of all) had correct answers on questions dealing with unemployment and recession. They also did well on questions on the concept of gross domestic product (72.8%) and the purpose of government's tax policy (60.5%). However, students exhibited a poor level of understanding of factors limiting maximum output (44.1%), impact of inflation (38.4%), and monetary policy for curbing inflation (21.5%).

On “international economics” students did relatively well on questions regarding the reason for international trade surplus (60.9%), effects of specialization and international division of labor among nations (58.4%), effect of raising tariff rates (56.7%). However, the scores were poor on questions on the effect of depreciation of won against another currency (31.6%), and the principle of comparative advantage (26.2%).

Table 4. Test Results by Content Category: Comparison of Korean and American Students

	Korean High School Students			American High School Students		
	All	With Economics	Without Economics	All	With Economics	Without Economics
Fundamental Concepts	60.0	62.9	58.6	67.3	71.3	50.0
Microeconomics	55.7	57.3	55.0	62.1	64.6	51.0
Macroeconomics	54.2	55.5	53.6	56.1	59.1	43.1
International Economics	46.8	50.0	45.4	53.8	56.0	44.1
Total	55.7	57.8	54.7	61.25	64.34	47.61

Table 4 compares the test results of Korean and American high school students by content category. As mentioned earlier, American students' overall mean score was about 5.5 percentage points higher than Korean students'. “Fundamental economic concepts” was the category where Korean students' mean score was highest, but at the same time it was the content category where they were farthest behind their American counterparts, by 7.3 in

percentage terms. In international economic concepts and microeconomics too Korean students were not much better comparatively. Relatively speaking, Korean students did better in macroeconomics than in other content categories: their mean test score was lower than American students' "only" by 1.9 percentage points.

A similar story emerges, when comparison is made of those Korean and American students who had had economics. In this comparison, too, Korean students were relatively strongest in macroeconomics, relatively weak in microeconomics and international economics, and relatively weakest in fundamental economic concepts. This fact and the fact that those with economics account for more 80 percent of American students in the sample (Table 2) suggest that the performances of American students were heavily influenced by the economics education in the U.S.

However, the relative strength of Korean students looks very different when we compare those students who had not had economics in the two countries, also shown in Table 4. Korean students without economics were relatively strong in macroeconomics and fundamental economic concepts, while they relatively weak in microeconomics and international economics. As mentioned earlier, Korean students without economics had a higher mean test score by 7.1 percentage points than American students without economics. The gap in the test scores between Korean students and American students is largest in macroeconomics (10.5 percentage points), next largest in fundamental economic concepts (8.6), smaller in microeconomics (4.0), and smallest in international economics (1.3).

Thus, Korean students' relative strength compared with American students appears to have changed "after" taking economics, if we attribute all the differences in performances in the two countries' students with economics and without to the effect of taking economics. Korean students' relative strength in macroeconomics "after" taking economics was the same as "before". But in fundamental economic concepts their relative performance that was rather strong turned weakest "after" economics education.

It seems that the difference in overall performance between Korean and American students is mainly the result of the difference in economics education between the two countries. The economics education in the U.S. had a much larger impact than that in Korea. It raised the mean score by 16.7 percentage points in the U.S. whereas it raised it by 3.1 percentage points in Korea. The impact seems to have been particularly strong in fundamental concepts among four content categories.

Test scores by cognitive level

As mentioned earlier, TEL questions may be classified into three different cognitive levels: knowledge, comprehension, and application. There were seven questions at the knowledge level, or 17.5 percent out of the total of 40 questions, 11 questions at comprehension level (27.5 percent), and 22 questions at application level (55 percent). Supposedly, it is easier to pick correct answers at knowledge level than it is at the comprehension level, as it requires a better understanding of economics at the latter level; and it is hardest to pick correct answers to questions at application level.

Table 5 shows that among three cognitive level Korean high school students had highest mean test score at the knowledge level, 61.4 in percentage terms, next highest score of 58.9 percent at the comprehension level, and lowest score of 52.2 percent at the application level. This tendency of falling scores according as the cognitive level becomes progressively harder holds true for both female and male students, except that the mean score was higher for female

students. At the application level the difference between female and male is less than 1.0 percentage points, but it become about two percentage points at the comprehension level and about 5 percentage points at the knowledge level. In contrast, for American students the mean score was almost the same between the knowledge and comprehension levels at 64.3 percent, while it drops nearly 6 percentage points at the application level.

Table 5. Test Results by Cognitive Level: Comparison of Korean and American Students

		Knowledge	Comprehension	Application
Number of questions		7	11	22
Scores of Korean high school Students (%)				
All		61.4	58.9	52.2
Gender	Female	64.0	60.0	52.7
	Male	58.9	57.9	51.8
Economics	With	64.0	61.0	54.3
	Without	60.2	58.0	51.3
Scores of American high school Students (%)				
All		64.3	64.4	58.7
Economics	With	67.4	68.3	61.4
	Without	50.6	47.0	47.0

It has been already mentioned that Korean students who had had economics performed marginally better than those who had not, and the difference in scores between the two groups was three to four percentage points at each cognitive level, remarkably invariant across the three levels. It is interesting to note that economics education in the U.S. seems to have made a big improvement and that the improvement varies across the cognitive levels. It made the biggest difference at the comprehension level by raising the mean score from 47.0 to 68.3 percent, an improvement of 21.3 percentage points, next highest at the knowledge level by nearly 17 percentage points, and about 14 percentage points at the application level.

3. Questions of High Score and Questions of Low Score

Less than perfect test scores obviously mean that students find some questions more difficult than others. It would be instructive to find out which questions students found easy and which ones difficult. Table 6 lists 15 “questions of high score”, that is, the first fifteen

questions when the questions were ranked in a descending order by the percentage of students who made correct answers.

Of the 15 eight questions, more than a half, were related to fundamental economic concepts. Perhaps, it is not surprising that students find them easy, as the questions were "fundamental". Three questions of the 15 were related to microeconomic concepts, another three to macroeconomic concepts, and only one was related to international economic concepts. As mentioned earlier, each content category did not have the same number of questions. For example, fundamental economic concepts had a total of 14 questions, and microeconomics 10, and so on. To neutralize this effect, the number of questions of high score from each content category is expressed in percentage terms of the total number of questions related to the category. Still, it turned out that the fundamental economic concepts had the highest proportion of its total questions belonging to the group of questions of high score. International economics concepts had only one of five questions, or 20 percent, belonging to the group.

Table 6. Fifteen Questions of High Score

Korean High School Students				
	Knowledge	Comprehension	Application	Sum
Fundamental Economic Concepts	<i>3,11</i>	<i>1,6,9</i>	<i>4,5,12</i>	8(57.1)
Microeconomic Concepts	-	<i>23</i>	<i>16,20</i>	3(30.0)
Macroeconomic Concepts	<i>25</i>	<i>28</i>	<i>34</i>	3(27.3)
International Economic Concepts	<i>38</i>	-	-	1(20.0)
Sum	4(57.1)	5(45.5)	6(27.3)	
American High School Students				
Fundamental Economic Concepts	<i>3</i>	<i>1,2,8,9</i>	<i>5,7,12</i>	8(57.1)
Microeconomic Concepts		<i>26</i>	<i>15,16,19,20</i>	5(50.0)
Macroeconomic Concepts		<i>28</i>		1(9.1)
International Economic Concepts			<i>35</i>	1(20.0)
Sum	1(7.1)	6(54.5)	8(36.4)	

Note: Italicized are the identifying numbers of the questions. "Sum" represents either a horizontal or vertical sum. The numbers in the parentheses are the percentage points of total questions in the list. For example, horizontal sum of 8(57.1) corresponding to "Fundamental Economic Concepts" means that eight questions related to the concepts are part of the fifteen questions of high score, and eight represents 57.1 percent of 14 questions related to "Fundamental Economic Concepts".

In terms of the cognitive level, four of the 15 questions of high score were from the knowledge level, five from the comprehension level, and six from the application level. The total number of questions across the three cognitive levels was not the same, either: knowledge has 7 questions; comprehension, 11; and application, 22. Thus, the knowledge level had 57.1 percent of its questions belonging to the group of 15 questions of high score, a highest percentage among the cognitive level. The comprehension level had 45.5 percent of its questions in the group, and the application level, 27.3 percent of its questions. Again, it is not surprising that the students found questions progressively more difficult, as they move from knowledge level to comprehension level and to application level.

Table 6 also shows the same information regarding American high school students' test scores. The distribution of the 15 questions across the four content categories appears not much different except that Korean students found easy more of macroeconomic concepts and less of microeconomic concepts than American counterparts. The distribution looks much different across cognitive levels between Korean and American cases. Interestingly, American students found more questions at the comprehension and application levels easier in the relative sense than the questions at the knowledge level, the lowest cognitive level. For them only one out of seven questions at the knowledge level, 7.1 percent, belongs to the group of 15 questions of high score. This may be related to the fact we noted earlier that economics education in the U.S. improved the performance most at the comprehension level (Table 5).

Table 7 lists 15 "questions of low score", that is, the last fifteen questions when they were ranked in a descending order by the percentage of students who made correct answers. Ten of the 15 questions belong to the application level. Among the content categories macroeconomics and microeconomics both accounted for five questions each, representing roughly a half of all questions in the respective categories, while fundamental economic concepts had three questions belonging to the group and international economic concepts had two. Since the "fundamental" category had 14 related questions and the "international" had just five, relatively speaking, students found the latter category more difficult than the former.

Table 7. Fifteen Questions of Low Score

Korean High School Students				
	Knowledge	Comprehension	Application	Sum
Fundamental Economic Concepts	10	8,14	-	3(21.4)
Microeconomic Concepts	-	-	15,17,18,22,24	5(50.0)
Macroeconomic Concepts	33	26	27,30,32	5(45.5)
International Economic Concepts			36,39	2(40.0)
Sum	2(28.6)	3(27.3)	10(45.5)	
American High School Students				
Fundamental Economic Concepts		14	4,13	3(21.4)
Microeconomic Concepts		21	17,22,24	4(40.0)
Macroeconomic Concepts	25		27,30,31,32	5(45.5)
International Economic Concepts	38		36,39	3(60.0)
Sum	2(28.0)	2(18.2)	11(50.0)	

Note: see the note to Table 6.

In the same table one can see that the distribution of the questions of low scores across content categories and cognitive levels for American students is remarkably similar to that for Korean students. Both Korean and American students found the questions at the application level more difficult than at lower cognitive levels. Also, about two thirds of the questions of low scores were related to micro- and macroeconomic concepts. While it appears in the table that the questions of international economic concepts were more difficult for American

students than Korean counterparts, it may not have been a significant difference, since the difference was made by one question out of a total of five.

4. Effects of Economics Education

Among the student participants in the test some had taken economics, and their test scores were higher than others who had not. The difference in test scores between the two groups must have something to do with the effect of economics education. This suggests that the test results may be analyzed to find out the effect of economics education. Furthermore, since the test results of American students are available, the effect of economics education in Korea and America may be compared. Thus, the test results may even tell us something about the comparative effectiveness of economics education in the two countries.

An obvious thing to do for this purpose is to compare the test scores of the student participants who had had an economics course with the test scores of those who had not. One caution should be taken. Korean high schools do not offer a separate economics course in the freshmen year, and the students elect to take a course in economics in their sophomore and senior years. For this reason it would be better to exclude the freshmen from the group of students who had not taken economics before we get the test scores of the group without economics. For, as mentioned earlier, the test score tends to rise as the grade goes up. The test scores of freshmen may be lower than those of higher grades for reasons other than the exposure to economics.

Appendix Table 1 compares the performances of the Korean sophomore and senior participants with and without economics. The performance is represented by the percentage of student participants who chose correct the answer to a question. As one can see, the mean percentage of correct students in the group *with economics* was 57.8, only 1.2 percentage points higher than that of the group *without economics*, 56.6 percent. Moreover, for 17 questions the percentage difference was negative, that is, a smaller percentage of students in the group *with economics* were correct compared with the group *without economics*.

How surprising this is can be seen by considering the case of American students in Appendix Table 2. As Appendix Table 1, it shows the percentage of American student participants who chose the correct answers to a question. The effect of taking economics course(s) seems highly positive for American students. The percentage of correct students in the group with economics rises substantially over the other group without economics. The rise ranges from 35.5 percentage points for question 2 to 3.7 points for question 38. Not for a single question the student group *without economics* performed better than the group *with economics*.

It seems that the economics education in Korean high schools was not effective. The difference of 1.2 points in the mean percentage of correct students between the groups with and without economics is not significantly different from zero in a statistical sense. In other words, the hypothesis that there was no difference in economic literacy between groups with and without economics cannot be rejected at 5 percent level of significance.⁴ As for the individual questions, while for ten questions the economic education significantly improved the performances of those students with economics, there were six questions for which it significantly worsened. (Appendix Table 2) Put differently, for only 10 out of 40 questions of

⁴ The t-value of the difference in the mean was 1.45 with d.f.= 1,801.

TEL the high school economics education improved students performance. For 30 out of 40 questions either the evidence was not strong that the education improved students' economic literacy or the evidence was strong that students' literacy worsened after economics education.

It would be worthwhile to take a look at the individual questions of "a negative percentage difference", where the group *without economics* had a greater percentage of its students chose correct answers than the group *with economics*. Question 12 of TEL asks the effect of an increase in real interest rates on saving and borrowing. While a high proportion of more than 70 percent of students chose correct answers, there was a negative percentage difference of 4.7 points between the group *without economics* and the group *with economics*. Question 17 is about the cause of a rise in the market price and a simultaneous decline in sales. The answer was a decrease in supply. Simply one has to know this, if one is about to begin to understand how the market works. The responses to the questions were rather alarming. There was a negative percentage difference was 5.2 points. Furthermore, the number of students with wrong understanding was greater than the ones who understood correctly. On this question only 36.8 percent of all participants in the test had the right answer, and 37.8 percent chose "a decrease in demand" as the reason why the market price rises and the sales decline simultaneously.

Question 18 asks why medical doctors generally earn more than farmers. The correct answer is that "medical doctors are more scarce, given the demand for their services." On this question of wage determination and income distribution the negative percentage difference between the groups without and with economics was largest, 7.1 points. Also, a third of the student participants chose as correct the alternative that says, "medical doctors provide a service rather than make a product." Question 20 asks about the effect of a breakup of a monopoly, to which the correct answer was an increase in output and decrease in price. While a rather high proportion of more than three quarters of the students were correct, there was a negative percentage difference of 4.6 points between the groups without and with economics.

Question 22 applies optimization technique to pollution control, the answer being that the most efficient approach is to "reduce pollution as long as the additional benefits are greater than the additional costs." The general level of understanding of the students was low, and the negative percentage difference was substantial at 5.2 points. Question 28 tests whether or not students understand that unemployment tends to rise during a recession. A very high percentage of students had correct answer to this question, but it is hard to see why the group with economics had 4.4 percent more students than the group without economics, who had wrong ideas such as "imports increases" or "the economy grows" during a recession.

5. Summary and Conclusion

Using as the test material Form B of the third edition of *Test of Economic Literacy* (TEL) developed and published in 2001 by National Council of Economic Education (NCEE), Center for Economic Information of KDI conducted a test on Korean high school students. The mean score was 22.7 correct answers on a total of 40 questions, or 55.7 percent. It was lower than the mean score for American high school students by 5.25 percentage points. When students without economics education were compared between the two countries, however, Korean students' mean score of 54.7 percentage points was higher than that of American students by 7.1 percentage points. Economics education in the U.S. was much more effective in improving students' performance. With regard to this point, it should be noted that the economics

education that the sample of American students took included the advanced placement economics, which is a course at the college level.

Korean students' performance was best in the category of fundamental economic concepts, followed by microeconomic concepts, next by macroeconomic concepts, and it was worst in international economic concepts. Korean students' relative strength compared with American students appears to have changed "after" taking economics. Especially, their relative strength in fundamental economic concepts turned weakest "after" economics education.

Among three cognitive levels, not surprisingly, Korean students' performance was best at the knowledge level, followed by comprehension level and then by application level. In contrast, American students did equally well at the knowledge and comprehension levels and much less well at application level. The reason seems to lie in the economics education in the U.S. that boosted by most the score at the comprehension level.

When the questions were ranked by the order of percentage of students with correct answers, 15 questions ranked high and another 15 questions ranked low were examined. Korean students compared with their American counterparts had relatively more questions at the knowledge level and less at the comprehension and application levels in the 15 "questions of high scores". Again, the reason for this difference between Korean and American students seems to lie in the economics education. For the 15 "questions of low scores" their distribution across the cognitive levels and content categories appears to be similar between Korean and American students.

The effect of economics education at Korean high schools, as measured by the difference in the performances of the students who took economics and did not, was almost non-existing. Between the two student groups the difference in the mean score was only 1.2 percentage points, which was not statistically significant. Out of 40 questions, in only 10 questions the evidence was statistically strong that the education improved students' performance. For 30 out of 40 questions either the evidence was not strong that the education improved students' economic literacy or the evidence was strong that students' literacy worsened after economics education.

It appears that economics education fails to improve students' understanding of the workings of a market economy at the most basic level. However, it is not very clear whether the responsibility for the failure should be placed entirely on the high school economics education. One needs to ask if in Korean reality the market works as it is supposed to in the textbook. Students may see enough counter examples where market transactions are determined by something else than demand and supply. Entry barriers, special privileges, government regulations, and so on may distort the way the market works.

While there is no doubt that the economics education was ineffective, it seems highly probable that an effective education in Korea can let students achieve a much higher level of understanding of the economy than that achieved in the U.S. For Korean students without economics appears to be better prepared than their American counterparts. This is another message that one can obtain from the results of the test.

Table 8. Fifteen Questions of Low Score for Students without Economics

Korean High School Students				
	Knowledge	Comprehension	Application	Sum
Fundamental Economic Concepts	10	8, 14	7	4(28.6)
Microeconomic Concepts	-	-	15, 17, 18, 22, 24	5(50.0)
Macroeconomic Concepts	33	26	30, 32	4(36.4)
International Economic Concepts			36, 39	2(40.0)
Sum	2(28.6)	3(27.3)	10(45.5)	
American High School Students				
Fundamental Economic Concepts	-	1, 2, 14	4	4(28.6)
Microeconomic Concepts	-	21	17, 18, 24	5(40.0)
Macroeconomic Concepts	25	-	30, 31, 32	4(36.4)
International Economic Concepts	-	-	36, 39	2(40.0)
Sum	1(14.3)	4(36.4)	9(40.9)	

Note: see the note to Table 6.

Appendix Table 1. Percentage of Participants with Correct Answers: Korean Students

Questions	With Economics	Without Economics	Difference	
1	71.3	72.5	-1.2	
2	62.4	54.9	7.5	*
3	77.1	73.6	3.5	
4	72.8	74.0	-1.2	
5	66.1	67.6	-1.5	
6	76.7	77.2	-0.5	
7	61.3	53.2	8.1	*
8	52.0	45.2	6.8	*
9	75.1	70.4	4.7	*
10	53.0	48.0	5.0	*
11	69.5	64.6	4.9	*
12	72.8	77.5	-4.7	*
13	55.4	59.7	-4.3	
14	14.6	8.2	6.4	*
15	60.4	56.2	4.2	
16	65.0	64.7	0.3	
17	33.7	38.9	-5.2	*
18	50.0	57.1	-7.1	*
19	59.7	61.7	-2.0	
20	76.0	80.6	-4.6	*
21	58.9	59.4	-0.5	
22	50.1	55.3	-5.2	*
23	72.7	69.4	3.3	
24	46.0	41.6	4.4	
25	71.1	73.7	-2.6	
26	45.9	43.5	2.4	
27	54.9	54.8	0.1	
28	82.9	87.3	-4.4	*
29	59.1	56.2	2.9	
30	39.4	32.5	6.9	*
31	57.2	54.5	2.7	
32	27.6	17.6	10.0	*
33	53.4	52.7	0.7	
34	60.4	64.4	-4.0	
35	64.7	55.7	9.0	*
36	27.6	25.6	2.0	
37	59.4	59.6	-0.2	
38	64.7	63.3	1.4	
39	33.5	31.4	2.1	
40	58.0	59.5	-1.5	
Number of Participants	834	967		
Mean Score	57.8	56.6	1.2	
Standard Deviation	19.3	16.3		

Note: * indicates that the difference is statistically significant at 5 percent level.

Appendix Table 2: Percentage of Participants with Correct Answers: American Students

Questions	With Economics	Without Economics	Difference
1	78.5	44.5	34.0
2	75.6	40.1	35.5
3	85.6	59.5	26.1
4	61.5	32.3	29.2
5	76.9	61.3	15.6
6	66.9	44.6	22.3
7	82.7	64.2	18.5
8	77.1	47.2	29.9
9	76.9	57.1	19.8
10	70.7	51.3	19.4
11	69.1	56.2	12.9
12	82.7	70.3	12.4
13	55.1	49.1	6.0
14	38.6	22.6	16.0
15	73.9	63.2	10.7
16	80.3	65.1	15.2
17	47.6	42.3	5.3
18	63.4	40.2	23.2
19	72.3	59.8	12.5
20	71.6	59.0	12.6
21	57.8	41.0	16.8
22	55.2	47.1	8.1
23	63.9	49.9	14.0
24	60.0	42.4	17.6
25	59.1	39.7	19.4
26	72.3	50.1	22.2
27	36.3	25.4	10.9
28	75.1	61.2	13.9
29	67.1	47.3	19.8
30	48.9	38.9	10.0
31	47.6	27.6	20.0
32	41.0	23.1	17.9
33	67.5	51.0	16.5
34	66.4	50.6	15.8
35	70.2	53.9	16.3
36	52.4	33.1	19.3
37	62.7	51.6	11.1
38	53.0	49.3	3.7
39	41.5	32.6	8.9
40	68.7	58.8	9.9
Number of Participants	3224	731	

Comments on “Economic Literacy of Korean High School Students”

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Dr. Yoo's paper has many interesting empirical findings on the economic literacy of Korean high school students. He convincingly argues that economics education in Korea fails to improve students' understanding of the workings of a market economy. I mostly agree with what Dr. Yoo has to say in his paper with a few caveats.

First, I have to point out that the comparison of Korean students with the American counterparts could be misled to some extent. A recent AER article by Hansen, Salemi, Siegfried remarks on the results of a 15 points-Gallup survey which shows college economics course-takers scored 9 points, high-school economics course-takers scored 8 points, and those who took no economics scored 7 points. This appears to be no different from Dr. Yoo's findings on Korean students' economic literacy.

Second, we should be more careful in interpreting the results of the effects of teaching economics at school on economic literacy. There could be several potential problems in the comparison of test scores of economics between two groups of students; those who took economics course and those who did not. There might be a potential self-selection problem. Those who took economics course could have better intrinsic abilities to study economics and that could be one of the reasons why they took economics course. Vice versa for those who did not take economics course. Therefore, we have to control for the other abilities of two groups of students in comparing test scores.

Another potential problem arises because the test of economics that Dr. Yoo's paper utilized are the low-stake tests with very weak incentives for students to do well or out-compete other students. In a highly test-oriented setting like Korean schools, the economic literacy captured by the low-stake tests could be with a large scale of measurement errors.

It should be also noted that the questions for Korean students were simply translated version of those in the tests designed for American students. It should be double checked whether all the questions in the test are relevant to Korean students. Otherwise, the relatively poor performance of Korean students could be attributed to the irrelevance of translated questions which are originally designed for the American students.

I strongly suggest that many other academic investigations on the economic literacy of Koreans should follow Dr Yoo's pioneering paper. How about the research on the effects of teaching economics at universities on economic literacy in Korea? We should not be ignorant about one of the most important outcomes of what we and our colleagues are doing.

“Art and Science” on Nuancing Conflict: Theoretic Approach and Its Application

by
Yun Ho Chung

Abstract

This paper talks about the ‘art and science’ of nuancing conflict situations. The word ‘art’ is used to designate non-scientific factors, and the term ‘art and science’ is employed to introduce the use of non-economic factors, for example diplomatic know-how and negotiation skill, that are intertwined with factors which emanate from a rigorous scientific analysis of a conflict. To do so, this paper discusses a theoretic framework using a diagrammatic analysis of a conflict management procedure, and an application on IMF aid package negotiation process with Indonesia.

The theoretic framework introduces a mechanism in which a small concession from each of conflict involved parties is incorporated, as a third dimension, into main action spaces, and it would result in a more effective negotiation process in the conflict situation. In a more conventional conflict setting, the involved parties do have their own action space where each of the parties would lock themselves in to mobilize their policy action. This strategy only leads the parties to a deadlock situation when possible compromises within the action spaces are exhausted. However, instead of starting the negotiation process from action spaces, specifying the objectives and starting from it would provide both parties more chances to devise a more effective negotiation scheme. This paper proposes this simple idea diagrammatically in a theoretic framework.

Based on the theoretic approach introduced, an application study on the conflict between the IMF and Indonesia is conducted. The nature of conflict is arisen from disagreement on how IMF aid package on Indonesia’s sustainable development is effectively used. Both the IMF and Indonesia would agree on using the aid package for economic program. But the policy action that the IMF proposes would not meet the condition that Indonesia has in mind. Examining the objectives that the IMF and Indonesia perceive on Indonesia’s sustainable development, a proposal on an environmental program can be formulated. The proposal would satisfy the objectives perceived by both the IMF and Indonesia, and possibly break the stalemate that dealing mainly with action spaces would only result in.

This paper concludes with emphasis on dialogue, discussion in a conflict situation that might lead to concessions which possibly bring about realizing mutual improvement in less important policy areas. Once such is realized, more trust, more friendliness and willingness to

discuss other conflictual issues of greater import can be taken up and hopefully more successfully dealt with.

I. Introduction

1. The Problem

In this paper, we would like to talk about the 'art and science' of nuancing conflict situations. In doing so we shall discuss somewhat the conflict between developing and developed nations. In the title of this paper, we use the word 'art', specifically to designate non-scientific factors. But when we employ the term 'art and science', we have in mind the use of non-economic factors, for example diplomatic know-how and negotiation skill, that are intertwined with factors which emanate from a rigorous scientific analysis of a conflict.

As is well known, over sixty years ago there was a work that was expected to solve many significant conflicts: the monumental work of von Neumann and Morgenstern on game theory. Unfortunately, that work and numerous other works by economists, peace scientists and others who have improved and greatly extended game and related theory have had little effective application.¹ Why is this so? The answer lies in the fact that they have given only lip-service to non-economic factors such as politics, social conditions and culture. They have in general failed to integrate effectively the scientific and non-scientific factors. In this paper we will attempt a bit of integration.

In this paper, we shall point up what we consider to be one possible way to do so. In the potential full process, we shall:

(1) Scientifically develop empirical materials based on pairwise comparisons of the objectives and perspectives of actors (decision makers) in a conflict situation. These empirical materials would be on the relative importance of these objectives to the actors. They would be used to establish for each actor levels of satisfaction or index of achievement or relative utility of different joint actions (sets of joint concessions).²

(2) Construct discrete-based 'inferred indifference' curves given the reality of these objectives and perspectives.

(3) Employ 'art' to help nuance a first cooperative joint action (as a first set of small concessions). If necessary, develop a scientific reassessment of the situation.

¹ Typical game-theoretic approaches to conflict studies have been in use of the prisoners' dilemma model and the bargaining model. Political scientists, in general, have been adopting in many cases the prisoners' dilemma model and its extension to understand international conflicts. Brams, for instance, has introduced many applications of prisoners' dilemma model to international conflicts (Brams, 1994). The bargaining model, ever since Nash (1950), has also been an important concept to explain many social conflicts, and its extension (especially with concession concept incorporated, Zeuthen, 1955) has been developed in many forms. However, these game-theoretic approaches to conflict studies mainly focus on 'measurable' factors, and failed to model conflicts when 'non-measurable' factors need to be incorporated. See Chung (2001, Chapter 2) for some critiques on game-theoretic approaches to conflict studies.

² In discussions with diplomats, political figures and those who are responsible for deciding upon policies to be implemented, we would avoid use of the term relative utility which has meaning for economists, but perhaps not so for diplomats and political figures. For them, we suggest the use of such terms as levels of satisfaction, or index of achievement.

(4) Employ 'art' again to nuance a second cooperative joint action (as a second set of small concessions), and so forth, hopefully to achieve a dynamic path for the mediation effort. However, one anticipates that such an effort will be brought to a halt before a rational (or complete, or equilibrium) solution to the conflict situation is achieved.

2. The Motivation

To point up the failure of the scientific approaches in economics, peace science and other scientific areas to resolve most conflicts, let us quote extensively from the brilliant paper of Ravi Kanbur (2001). He defines two broad groups in conflict in the global system. Group A (labelable as Finance Ministry) would include "some who work in finance ministries in the North, and in the South ... also many economic analysts, economic policy managers and operational managers in the International Financial Institutions (IFIs) and the Regional Multilateral Banks" (Kanbur, 2001, p. 1084).³ Group B (labelable as Civil Society) would include "analysts and advocates in the full range of advocacy and operational NGOs ... also people who work in some of the UN specialized agencies, in aid ministries in the North and social sector ministries in the South" (Kanbur, 2001, p. 1084).⁴

As clearly and forcibly witnessed at Seattle and subsequently at Ottawa, and elsewhere there are strongly-held views and sharp differences between Groups A and B on global policy issues. Kanbur observes that perspective and stances taken are so polarized and inflexible on three basic issues that differences on several other issues on which there may be much common interest become exaggerated and consequently less subject to cooperative action.

Between Groups A and B, Kanbur finds three key differences in their perspectives and ways of thinking. These relate to matters of Aggregation, Time Horizon and Market Structure. Succinctly put, the differences associated with aggregation may relate to measurement of welfare based on the presence of poverty (say the fraction of people in a country who fall below a critical level of income (for example the famous \$1 per person per day)).⁵ Group A might tend

³ It would also cover many, though not all, academic economists trained in the Anglo-Saxon tradition.

⁴ Amongst academics, non-economists would tend to be covered in this group. Note that Kanbur states "such classification is bound to be too simple a reflection of reality. Although the terminology of 'Group A' and 'Group B' is easier to deploy, A and B are better thought of as tendencies rather than as defined and specific individuals. There are clearly people who work in the IFIs who are not 'Finance Ministry types', just as there are academic economists trained in the Anglo-Saxon tradition who would, for example, caution strongly on capital account liberalization. The UN specialized agencies and Northern aid agencies are often a battle ground between Finance Ministry and Civil Society tendencies. And, some NGO positions on specific policies would be approved of in Finance Ministries, and vice versa.

This being said, however, the proposed classification offers a sharp enough, and recognizable enough, characterization of divisions to help us understand the nature of disagreements. Group A types are those who tend to believe that the cause of poverty reduction is best served by more rapid adjustment to fiscal imbalances, rapid adjustment to lower inflation and external deficits and the use of high interest rates to achieve these ends, internal and external financial sector liberalization, deregulation of capital controls, deep and rapid privatization of state-owned enterprises and, perhaps the strongest unifying factor in this group—rapid and major opening up of an economy to trade and foreign direct investment. On each of these issues, Group B types tend to lean the other way" (Kanbur, 2001, pp. 1084-1085).

⁵ Per capita income of a nation has often been used as a measure in the past—a measure which is now considered most unsatisfactory.

to consider this measure appropriate and employ it. However, it obviously fails to get at the effects of a policy on the distribution of poverty. For example, for a nation the fraction may fall, but as is often the case this fraction may significantly increase for one or more regions of a nation. Additionally, and more important, this measure fails to capture effects of a policy that are non-measurable, in particular deterioration of the quality and availability of public services, such as those relating to health and education. So to Group B personnel often working in communities with a high fraction of poverty and significant deterioration in non-measurable public services the national fraction is most inappropriate for measurement of the welfare effect a policy has or might have.⁶

A second key difference between Groups A and B in Kanbur's work relates to time horizon. As Kanbur puts it, "medium term is the instinctive time horizon that Group A uses when thinking about the consequences of trade policy, for example. This is implicit in the equilibrium theory which underlies much of the reasoning behind the impact of policy on growth and distribution. It is also implicit in the way empirical analysts interpret their cross-country econometric relationships between growth, equity or poverty on one side and measures of openness on the other" (Kanbur, 2001, p. 1088).

But clearly it is no solace to families at the starvation level, or who have to pull their children out of school to work in 'sweat shops' to sell its assets at fire sales prices, etc., to be told that in five years from now things will be much better for them. Nor is it any solace for other members of group B to be told that degradation of the environment and resource depletion resulting from industrial and consumption practices associated with growth policies (for example, openness of trade) will be offset and adequately controlled through knowledge and technological enhancement.

A third key difference pertains to market structure. Group A invokes the basic theories of trade policy in their spaceless (no dimension) competitive product and factor world where each nation is considered to be a point (or where it is convenient to do so to avoid complications and/or intractability of their 'revered' scientific models). But their statement that openness of trade will increase the price of (and thus benefit) the more abundant factor (for example, which for developing countries is frequently unskilled labor) from the increase in the demand for it is frequently not observed to be the case in reality. Moreover, what is also perceived and observed by Group B is that major non-competitive multinational corporations come to exercise undue influence on, if not control of, economic policy to their benefit and at the expense of the poor. The pure competitive equilibrium doctrine which many in Group A profess to be the result of open trade is in actuality precluded by the presence of physical space. It is a gross lie that many advanced economic theorists continue to perpetuate, to the suffering and misery of many poor.

Despite his brilliant analysis, Kanbur ends up with no effective recommendation other than there is a need for more educated dialogue, more interaction and more real, motivated effort at understanding.^{7,8}

⁶ Another shortcoming, as seen by Group B, is that in nations of high population growth, the fraction might fall, but the absolute number of people at or below the poverty level might significantly increase.

⁷ "This paper has argued that underlying the seemingly intractable differences are key differences of perspective and framework on Aggregation, Time Horizon and Market Structure. Simply recognizing and understanding the underlying nature of the disagreements in these terms would be one step in bridging the gap. But more is needed. More is needed from both sides, but my focus here is on Group A. For those at the more academic end

This is the current situation for basic conflict between Groups A and B (as defined above) in the global system. But there are many differently defined Groups A and B in other major and admittedly exceedingly complex conflicts: e.g., the Arab/Israeli conflict, the Kashmir conflict, the set of conflicts generated by the dissolution of the former Yugoslav nation, the North and South Korea conflict and so forth. More recently, there shows tendency that Kanbur's grouping, Groups A and B, gets more polarized—one end with G7 nations for which the IFIs tend to represent and the other end with the South as a whole.⁹ The conflicts within each of the groups as well as between them become more complex. It gets us even more motivated to put effort at understanding the nature of conflicts, and ultimately at providing a possible procedure toward the first step on conflict resolution.

What we now wish to do is to present one way of going beyond the type of recommendation that Kanbur ends up with. We wish to suggest a way for nibbling at conflict resolution using the word nuancing to cover the achieving of small (building-up trust) concessions by parties to a conflict.

In the next chapter, we will present a theoretic framework within which we will discuss the significance of small concessions on resolving a conflict situation. In the following chapter, we will develop a method which incorporates the theoretic framework to a conflict resolution procedure. In doing so, we shall touch upon the important conflict between the IMF and Indonesia, and suggest a proposal to reach agreement on a financial aid package from the IMF for Indonesia's sustainable development.

II. Theoretic Framework

1. Model Setting

We consider a conflict situation where two parties (participants), L and J, are involved. The situation is currently engaged with a joint action, $a = (a^L, a^J)$, which is initially set up by both

of that spectrum, the message is that explicitly taking into account these complications is more likely to shift the intellectual frontier than falling back yet again on conventional analysis. For those at the more operational and policy end of the spectrum, especially those in policy making and policy implementing institutions, the message is that recognizing and trying to understand legitimate alternative views on economic policy, being open and nuanced in messages rather than being closed and hard, is not only good analytics, it is good politics as well" (Kanbur, 2001, p. 1093).

⁸ Another illustration of a brilliant work of one of the very best minds in the social sciences is that of Amartya Sen (2000) in his paper on "India and the Bomb". His analysis of the failure of deterrence as a policy is the very best, but he ends up with no thought or even a hint how India and Pakistan (or other individuals or institutions) can help temper the escalated conflict situation.

⁹ The traditional sovereign debt problem between two countries becomes an emerging issue within the IMF's policy discussion (Krueger, 2002, Bossone and Sdrilevich, 2002). The IMF proposes a new approach to Sovereign Debt Restructuring Mechanism (SDRM) to intermediate the sovereign debt problem between creditors, mainly G7 countries, and highly indebted poor countries. Although the IMF's proposal is, in general, welcome by the international community, specific details of the proposal are still crucially debatable among both creditors and debtors. For example, the new proposal still does not guarantee to the debtors that the creditors would be bound to commit themselves to the implementation of the proposal, nor provides the creditors with a comprehensive incentive scheme for them to voluntarily participate in the mechanism.

participants (or considered as the status quo), but is evaluated by each participant based on their objectives and some other criteria. Considering the objectives of the participant L, the action a^L is not the best action for him, nor is the action a^J the best for J based on his objectives. But $a = (a^L, a^J)$ is the current agreeable joint action, and they know there would be another joint action from which they mutually increase their satisfaction (utility) based on their own objectives. Then, they have willingness to negotiate for a better joint action, and we try to develop a procedure to help the conflict situation resolved or partially resolved by reaching another joint action at which both participants could be happier.¹⁰

In many situations, we might try to find a compromised joint action based on the initial one, but we fail in most cases. Especially when the joint action, $a = (a^L, a^J)$, is an option which neither participant is willing to step away from, it is hard to convince them of reconsidering it with any compromised joint action. One of the reasons why a compromised joint action based on the initial one, or this kind of approach in general, is not successful is that it is the attempt to cut a pie for two which is assumed to be fixed.¹¹ In this assumption, a bigger piece for the other means a smaller piece for oneself.

The first step toward resolving a conflict is to change the conventional viewpoint to the conflict. Fisher and Ury (1981) suggest the participants start from the objectives supposed to be achieved by each of them rather than the actions per se used only to achieve the objectives. In other words, fully understanding the objectives of each participant will provide a resolution to this situation that might or might not be from the initial joint action. Instead of searching a resolution from the action spaces within which L and J's actions of current joint action are the best options, we try to expand the action space for each participant to see if from the expanded action space we can find a better solution to satisfy the objectives of each participant.^{12 13}

2. Diagrammatic Analysis

Assume that there is another dimension in L's action space in which we can find an action that is not affecting L's utility much at all but could increase the J's utility significantly. We call this additional action for L a concession from L to J. A similar argument applies for J as well. The concessions from L and J are simultaneously taken effect. Then, the net changes in utility for L and J from these actions can be turned out positive. We will present this model graphically in a three dimensional paradigm with two main dimensions of the action for L and J and a third dimension for concessions from L or J, and in a utility-disutility space of L and J.

¹⁰ In other settings, there might a mediator introduced who would have an interest to get involved with the situation and provide a solution to this conflict. But we will hold the mediator off from this framework just to make the model as simple as possible. See Chung (2001) for the case with a mediator involved in a conflict situation.

¹¹ Steven Brams extensively analyzes conflict situations where zero-sum game approach is appropriate to be applied. See Brams (1994, 1996).

¹² We do not, ex ante, presume that there exists a solution to this approach. What we emphasize here is to search a procedure in which the situation could move forward from the stalemate. The stalemate is where there is no other possible joint actions available with the current action planning by both participants. In this case, we would introduce this procedure that possibly provides a solution to the conflict situation.

¹³ If a solution is gained from this approach, it is in fact a Pareto efficient solution. A more detailed description of this solution concept is following in the later chapters.

The actions each with a corresponding concession in the first diagram will be mapped into the second utility-disutility space to understand a progress of a conflict resolving.

Consider first, in Figure 2-1, L and J's action spaces with L's concession space.

Two main dimensions are for L and J's actions, and the third dimension is representing the L's concession space. The initial situation is represented as a point, $a = (a^L, a^J)$. The point, c^L , represents the concession made by L. Then the new joint action with L's concession, c^L , is represented at the point, $a' = (a^L; c^L, a^J)$.¹⁴ Notice that each action in the main dimensions for L and J of the new joint action, a' , is unchanged. Only the L's concession to J, c^L , is reflected in the new joint action. Then, the changes in the utility levels for L and J from the initial joint action, a , to the new joint action, a' , are mapped into the utility-disutility space in Figure 2-2.

The vertical axis is representing J's utility, the right side of the origin on the horizontal axis for L's utility and the left side for L's disutility from the concession. We assume that the initial joint action, a , provides L and J with zero level of utility. Then, the level of utility of the new joint action, a' , reflects the changes in utility from the concession made by L to J. As noted above, the concession is made in the way that it is negligible to the level of L's utility and significant to the level of J's utility. The move from the initial joint action, $a = (a^L, a^J)$, to the new joint action, $a' = (a^L; c^L, a^J)$, with the concession, c^L , in Figure 2-1 is mapped in the utility-disutility space in Figure 2-2.

Now we consider, in Figure 2-3, L and J's action spaces with J's concession space. As we have shown above in Figure 2-1 with the L's concession, likewise in Figure 2-3 we find an action, or we call it concession, of J which is not affecting J's utility much at all but could increase the L's utility significantly. The point, c^J , represents the concession made by J. Then the new joint action with J's concession, c^J , is represented at the point, $a'' = (a^L, a^J; c^J)$. Notice that each action in the main dimension for L and J of the new joint action, a'' , is unchanged. Only the J's concession to L, c^J , is reflected in the new joint action.

Then, the changes in the utility levels for L and J from the initial joint action, a , to the new joint action, a'' , are mapped into the utility-disutility space in Figure 2-4.

The horizontal axis is representing L's utility, the upper side of the origin on the vertical axis for J's utility and the lower side for J's disutility from the concession. The level of utility of the new joint action, a'' , reflects the changes in utility from the concession made by J to L. As noted above, the concession is made in the way that it is negligible to the level of J's utility and significant to the level of L's utility. The move from the initial joint action, $a = (a^L, a^J)$, to the new joint action, $a'' = (a^L, a^J; c^J)$, with the concession, c^J , in Figure 2-3 is mapped in the utility-disutility space in Figure 2-4.

¹⁴ Once the joint action a' is written in the form of $(a^L; c^L, a^J)$, a can be interpreted as $(a^L; c^L, a^J)$ where the value of c^L is 0 (the origin).

Figure 2-1. L-J Joint Action Space with L's Concession on the Third Dimension

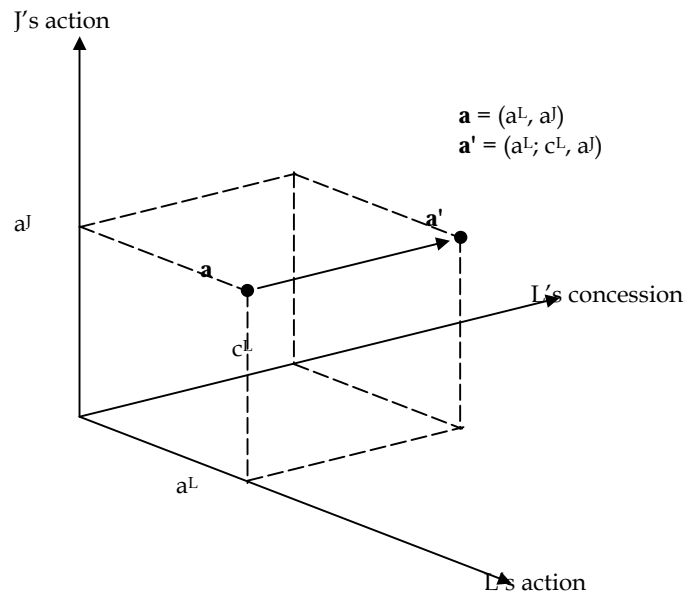


Figure 2-2. A Joint Action with L's Concession Presented on L-J Utility-Disutility Space

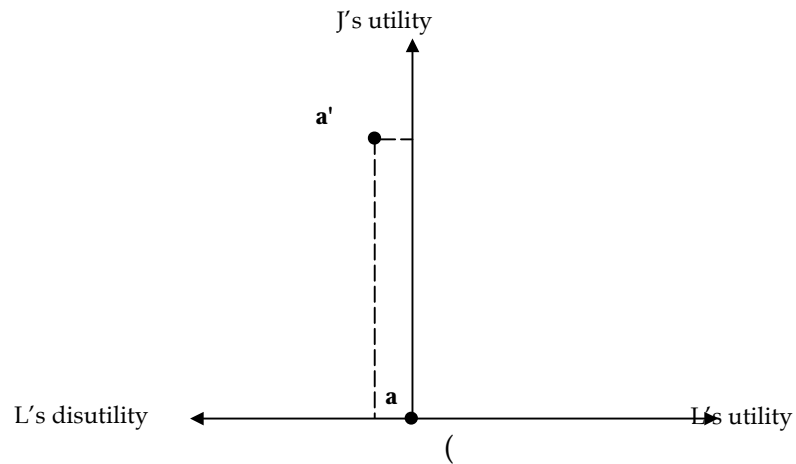


Figure 2-3. L-J Joint Action Space with J's Concession on the Third Dimension

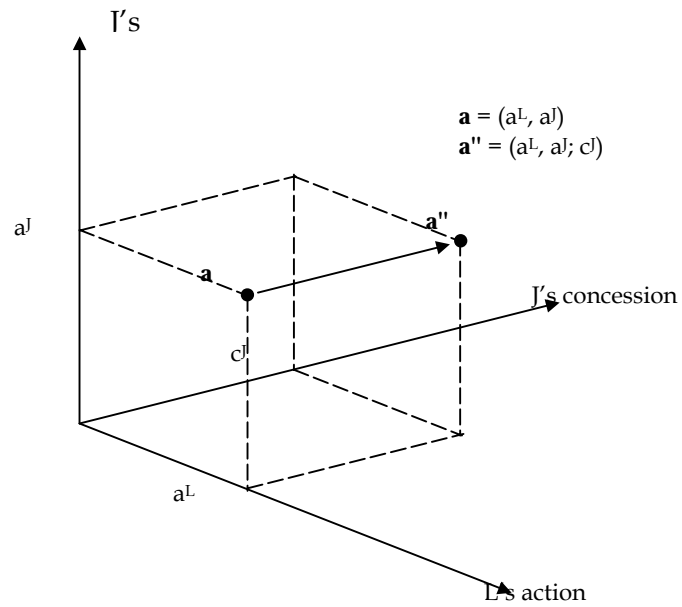
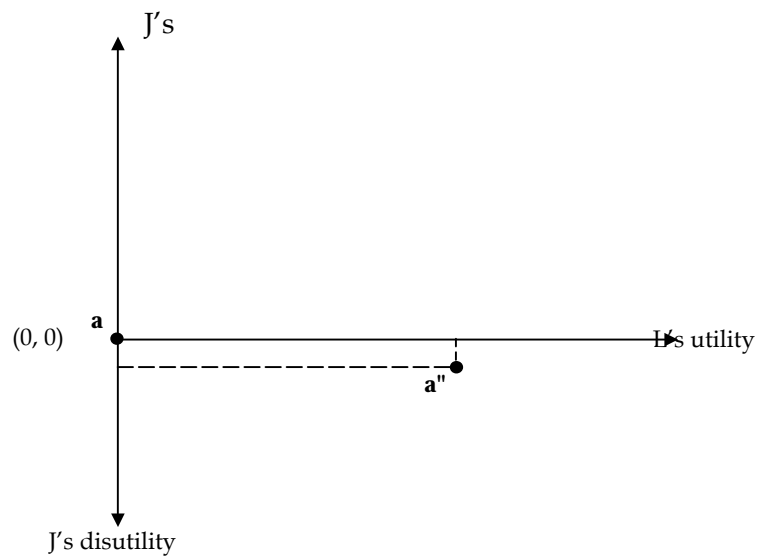


Figure 2-4. A Joint Action with J's Concession Presented on L-J Utility-Disutility Space

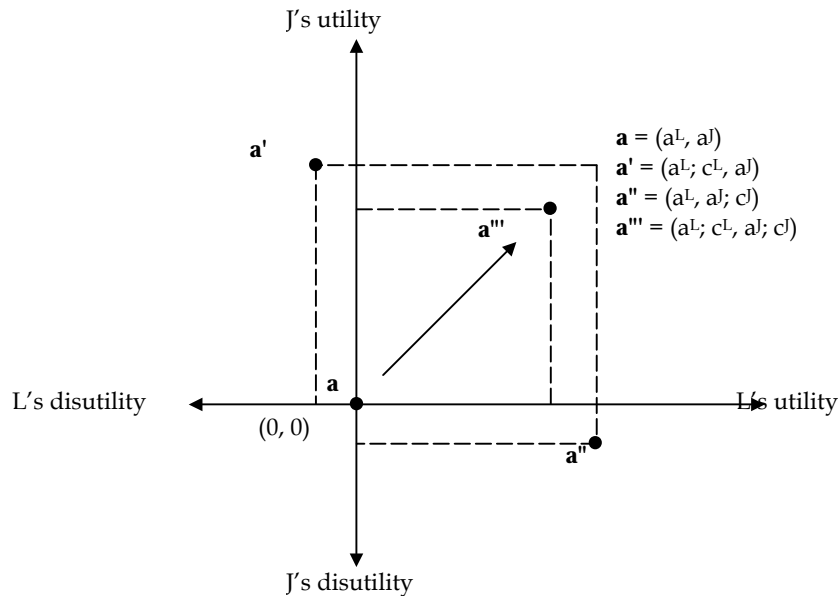


So far, we have looked graphically at the changes in utility levels from the concession in two separate sets of figures, one for L's concession and the other for J's concession. But, the concessions are made simultaneously by each participant for an agreement on a more improved potential joint action and we need to see the net effect on the utility level to each participant from the both concessions. In Figure 2-5, the net effect of the concessions on both L and J's utility levels is illustrated in a utility-disutility space for L and J.

Notice that the new joint action a''' now reflects the concessions made by both L and J to the others based on the initial joint action a , and also that each action of L and J from the initial joint action is unchanged. From the initial joint action a , each experiences a small loss of utility, or minimally increased disutility, from the concessions which they provide the others with, but at the same time, they experience a big gain from the concessions that the other participant has made, and thus the net effect of the utility is positive to both participants.

The significance of this method is that we have tried to find a way of expanding the action space rather than to find a compromised solution from the initial joint action. In this way, neither of the participants involved the conflict would have to give up the important issues based on their objectives.

Figure 2-5. Effect of Concessions by L and J on a Joint Action Presented on L-J Utility-Disutility Space



III. Nuancing Conflict—Application

In other papers, we have presented the pairwise comparison procedure yielding priorities among a set of policies, or the most likely one (including do nothing), and in general relative utilities of joint actions.¹⁵ A key feature of this approach is that one can accumulate data on a conflict situation where otherwise there is only dialogue and discussion, for example, as in the North and South Korea and the Kashmir conflicts. These data are to be elicited, in a friendly and non-suggestive way, from well-informed (usually non-political) members from each party to the conflict. It is assumed that the views and perceptions of each member can be taken as representative (reflective) of those of his/her party. These data are based on pairwise comparisons made by each member and yield the relative importance of objectives and goals and other relevant factors to the parties. These objectives, goals and factors are those that are perceived and specified by the participants themselves. They can be both general and specific, the specific factors generally being disaggregates of the former, so that a hierarchy of factors is obtained. Further, each participant can specify the scale he/she considers most appropriate for him/her in making pairwise comparisons; and if inconsistencies creep up in his/her statement of pairwise comparisons, these inconsistencies can easily be weeded out. If a participant insists on sticking to a set of highly inconsistent statements, then this proposed procedure cannot be used.

1. Recognizing the Conflict

To illustrate the use of pairwise comparisons and the relative utility approach, let us start with an application of this approach regarding to the important conflict between Indonesia and the IFIs.¹⁶ As is well known in the world financial community, Indonesia was disastrously affected by IMF conditions indirectly imposed on Indonesia in the years of the Asian crises. There has resulted political disintegration. Currently it is estimated that as many as 400 largely independent regional authorities will result, each handling considerable fiscal and regulatory matters; and already the central government has been considerably weakened.¹⁷ In a recent conference on sustained long-term development of Indonesia and its regions, one new proposal for financial aid by the IFIs (primarily the IMF) amounting to \$400 million has been taken up.

¹⁵ See Isard and Chung (2000a, 2000b) and for a more theoretic presentation of this method, Chung (2001).

¹⁶ For an earlier study of this approach, see Isard and Chung (2000a) where a proposal was made which resulted from a careful application of this method to the intense North and South Korea conflict of 1997 and earlier years. In this study, participants stated the general and specific objectives for economic cooperation they considered to be relevant. They then were asked to make pairwise comparisons. A number of possible joint actions were found to be unacceptable by one or both parties. Finally, there emerged a proposal for a small economic development in or close by the DMZ (De-Militarized Zone) of North Korea. This study and the resulting proposal was reported upon in a paper delivered at the December 1997 Peace Science Conference in Sydney Australia. This proposal was later implemented in June by the Hyundai Group and North Korea's ruling party when permission was given to the Hyundai Group to develop tourism business on the Mt. Kumgang area (on the East Coast of North Korea near the DMZ zone). This step broke the ice and the subsequent cooperative agreements of the two Koreas and the effective entrance of North Korea into the international community are well-known.

¹⁷ See Azis (2003) for his critique on IMF policies during the financial crisis in Indonesia in late 1990s.

Before proceeding to any project with the \$400 million from the IFIs, we need to consider the question of sustainable development for Indonesia. From the experience with the financial crisis during the late 1990s, we have learned what is significant for the sustainability of current and future Indonesian development. In a recent paper by Azis (2003), he presented a table (which we have modified to be Table 3-1) in which he listed sources of vulnerability.

It should be noted that the presentation of Azis contains all the elements of a basic learning model except that it doesn't represent explicitly the final outcome, namely learning. His aim was to suggest alternative joint actions (policies) that would have been more stable and satisfactory. However, his discussion leads us to an important piece of learning—namely, that one-sided imposition of policy by one party with little knowledge of the culture and desires (aims) of recipients can lead to disastrous results. From here on the policies of the IFIs that are imposed, or hopefully set forth for discussion, must recognize the specific objectives and goals, and take into consideration the culture and perspectives of recipients.

The IFIs in particular may respond that they have now learned this and are now trying to take into account the desires and perspectives of recipients. They may, however, maintain that desires and perspectives are subjective matters and lead to endless discussion of what joint action, or what conditions should be set when they are involved in financially supporting needy nations. There always emerge conflicts (differences) over what these conditions should be.

To begin to overcome this problem of overcoming endless discussion and debate we will present an approach that is based on the framework introduced in the previous chapter. This approach aims to reach some agreement on conditions (joint policy or joint action), however small. Such agreement may potentially lead to other small (or large) concessions.¹⁸ Incidentally, this approach will also be relevant to help manage conflicts over policies set forth to obtain sustainable development for Indonesia.

2. Identifying the Hierarchy of Objectives

To examine the feasibility of this proposal, (a) well-informed Indonesians were asked to identify the general and specific objectives of Indonesia for sustainable long-term development and (b) well-informed individuals were asked to specify the objectives of the IMF regarding financial aid to developing countries—in particular to Indonesia and her sustainable development program. The procedure in detail is presented in the appendix.

In Figure 3-1A in the appendix we present the hierarchy of general and specific objectives proposed by one Indonesian. Hierarchies were obtained from other Indonesians that were not presented but considered on our analysis. There were major differences over the relative importance of political and economic objectives. But in each hierarchy, jobs loomed large, although in one hierarchy political objectives (in particular, effective democracy in a integrated national government) was considered of primary significance. However, in every one sound environmental management (inclusive of sustainable resource exploitation) was considered to be of small importance.¹⁹

¹⁸ This approach stems from the pioneering work of Saaty (1994) who has developed what he has designated the Analytic Hierarchy Process (AHP).

¹⁹ It should be noted that there are different possible ways to derive and apply hierarchies. For example, in the case of the North and South Korea conflict, it was possible to construct for each party both a benefits hierarchy and a costs hierarchy so that benefit/cost ratios of different policies could be derived. See Isard and Chung (2000a).

In Figure 3-2A in the appendix we present what were obtained as the key conditions (objectives) of the IMF for provision of financial aid to Indonesia. They were sound exchange rate management by Indonesia and avoidance of major fluctuations in that rate, stability of Indonesia's banking system involving adequate reserves and balance between short-run and long-term loans, open capital markets in Indonesia with no controls of capital flows, and avoidance of government deficits. On these four key conditions there were differences among the interviewees in their statement of conditions and weights assigned; but they were minor. In all, environmental regulation and management played a small role.

From examining the set of objectives perceived by (a) Indonesians to be of primary significance for Indonesia's sustainable development and (b) the conditions for financial aid perceived by well informed persons to be necessary for IMF participation, it is clear that little chance exists for the \$400 million loan to be realized. The central authorities of Indonesia may be willing to agree to these conditions, but will not be able to meet (before full financial aid is provided) the conditions that are required. Its cultural heritage, and especially its politically disintegrated system stand in the way. The decision-makers (political figures) at the IMF and Indonesia involved in these discussions are barking up the wrong tree. Effective enforcement and regulation of Indonesia's financial institutions and effective governance in Indonesia to meet IMF conditions (however the IMF may relax them) cannot be achieved. Now we need to consider what accommodations can be made.

3. Plan for Sustainable Development

As implied in the previous chapter, areas that might be explored are those of other than economic objective. The economic objectives for both Indonesia and IFIs are by far the most important—0.8 (out of 1) for Indonesia and 0.85 for IFIs. However, the specific objectives under the general 'economic' objective are perceived by Indonesia differently from IFIs. Indonesia values some immediate results, such as concerns of jobs, exports and imports, more than medium- or long-term structural changes, such as sound exchange rate, free flow of capital and stability of banking system, which the IFIs value more. Any policy of the IFIs toward Indonesia's sustainable development focused on the economic objective will confront the resistance from Indonesia. It is in the same context as the lesson that we have learned from IMF operation during the Asian crisis.

Consistent with our current approach in seeking cooperative action between Indonesia and the IFIs (where in the minds of many, the IFIs are morally bound to help out Indonesia given the disastrous results of the conditions imposed in their past interaction with Indonesia),²⁰ we look for a possible situation where agreement on a small package of aid is possible. The situation that we look for need to satisfy not only that it is agreeable by Indonesia and the IFIs but also that it is not against the most important objectives perceived by both Indonesia and the IFIs.

First of all, we must recognize that sound exchange rate management associated with the proper variation of the interest rate is a basic requirement of the IFIs. Secondly, the open market, the free (unencumbered) flow of capital is still perceived as basic for the growth and healthy development of the global system and its constituent nations. Environmental management is also being increasingly considered to be a basic goal of the IFIs; however, here there is not much experience with this problem and there are great differences among scholars as to what the environmental dangers are and what tools are available for their effective

²⁰ See Tobin and Ranis (1998) for a critical evaluation of IMF policy in the Asian crises.

management. Just to point to pollution from automobile and other energy use is not very useful. We need to know wind conditions, diffusion processes, useful scientific studies about the effects on health etc., and not intelligent guesswork. Here is an area where the IFIs have views that seem to us to be less uniform, more flexible and about which useful dialogue can be attempted. Civil rights is also an area where scientific studies cannot be effectively conducted, and thus where there is less evidence of what precise policies would yield improvement. Here, there is less uniformity on what good policy is, and thus dialogue can be gainfully pursued in a flexible manner by the IFIs.

Looked at from Indonesia's standpoint, we imagine that, on the basis of the experience of the recent crisis and the continuing problems, a number of conditions that the IFIs might set for financial assistance may be regarded as unacceptable. These conditions might relate to government deficits, to control of short-run and long-run capital, to bank and government reserves and to other regulations and their enforcement. This might be so even if the IFIs interpret more flexibly their mandates and objectives. On the other hand, discussions on environmental policy and enforcement, and on civil rights and their improvement are matters for discussion by interested parties in Indonesia. There are no fixed, inflexible views, but rather much diversity. These are policy areas where much useful dialogue is possible.

The agreement on some joint policy by both the IFIs and Indonesia would be significant in more ways than directly with regard to environmental management and civil rights. One way that is important relates to establishing friendliness, trust and mutual respect among the parties. Here we can visualize 'concession' and agreement by Indonesia and the IFIs on some joint policy with regard to environmental management and civil rights.

For example, one specific environmental project that is likely to achieve mutual improvement would involve the replacement of burning by cutting in forest commercial operations. As Azis has noted, the "use of fire in forest conversion, combined with the dry weather partially caused by El Nino, led to massive forest fire (damage) in 1997. More than 300,000 hectares of forest was burnt, and thick smoke spread over large areas of South East Asia. The smoke, combined with urban air pollution, caused immense health, social and economic damage. The agricultural and forestry officials have neither the political will to enforce the laws nor sufficient budget to deal with the matter" (Azis, 2000, p. 310).

Burning to clear Indonesian forest areas for commercial exploitation is a less costly operation than cutting. However, it is recognized widely throughout the world as highly undesirable, particularly by the IFIs, the UN and the neighbors of Indonesia who suffer directly from the pollution generated. Thus, mutual improvement could clearly be realized if the World Bank, the UN, neighboring countries and others were to provide funds for Indonesia for a resource management project such as follows:

- (1) Wood burning to clear forests would be legally prohibited
- (2) To avoid higher costs of timber operation to the private firms, the costs of their cutting operations would not be allowed to exceed their current costs of burning.
- (3) The resulting increase in costs from wood cutting rather than burning would be borne by Indonesia in the use of a grant that would be provided to Indonesia for this resource management project.
- (4) New Jobs, the current most important objective of Indonesia in its sustainable development program, would be provided. These in turn would increase the income of the population of the timber resource regions of Indonesia. Through spread effects to jobs and income in other regions, it would have non-negligible positive impact on the reduction of poverty and perhaps alleviate the highly uneven pattern of income distribution throughout Indonesia.

(5) If the financial aid is in the form of a loan, repayment should be effected through a feasible tax on commercial operations. Or to the extent that Indonesia spends its own funds on cutting to avoid burning, its outstanding debt to the IFIs and others should be correspondingly reduced.

(6) This project should not be viewed as a final step in one of Indonesia's efforts to achieve sustainable development. Obviously, it should be followed by legislation governing the extent of the utilization of Indonesia's forest resources—legislation that would need to be designed in the light of the best available research on what a highly desirable sustainable resource management plan might be, including an alternative to destroying Indonesia's forests.

The resource management project outlined above would be a first step only in Indonesia's plan for sustainable development. More specifically and pointedly, the Indonesian effort to obtain a \$400 million loan from the IMF, which has little chance of being effectively arranged (from the standpoint of both Indonesia and the IMF), could be replaced by the effort for a \$400 million resource project to be financed by the World Bank, the UN, and other interested parties. Positive job and income effects are much more likely to be realized than the hypothetical effects of a financial loan from the IMF which is consistent with conditions that IMF interpretation of its mandate dictates. At best, it seems that such financial aid can be realized only in piecemeal fashion.

IV. Concluding Remarks

Our relative utility approach is, as we have indicated, a way of gathering empirical materials on specific objectives as perceived by participants, and the relative importance of specific policies for achieving these objectives, again as perceived by participants. Where there are areas of major differences regarding the perceptions of participants as to what policies should be, we have not investigated at this stage conflict management in these areas. Rather we look at less important areas of differences where more flexibility may exist, and where concessions are perceived to involve small losses if losses do arise. Thus we look for dialogue, discussion that might lead to concessions that have a positive probability of realizing mutual improvement in less important policy areas. Once such is realized, more trust, more friendliness and willingness to discuss other conflictual issues of greater import can be taken up and hopefully more successfully dealt with. This was the experience of our use of the relative utility approach in the case of Indonesia on its sustainable development.

In this paper, we have only considered how to reach agreement on a financial aid package for Indonesia's sustainable development. In doing so, we have suggested a simple proposal based on environmental management and civil rights improvement that are common in perspectives of both the IMF and Indonesia. However, reaching agreement between the IMF and Indonesia is by no means final in planning for sustainable development of Indonesia. It would be necessary to develop a better geographic information system (GIS) for Indonesia to obtain a more adequate data base of the resources of each Indonesian region. When there are jobs created with the aid package, it would also be necessary to develop an appropriate program to balanced contribution among regions. Furthermore, direct or indirect effects of the program need to be evaluated for Indonesia's sustainable development. For these matters, we suggest that the further research be in an inter-disciplinary manner. The inter-disciplinary research would only be done when scholars from many fields—such economics, political science, geography, humanities, and even natural science, to name a few—share their perspectives and attack the problem. These matters will be left as the further research topics.

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Appendix

Procedure to Identify the Hierarchy of Objectives

To begin we set down one perspective that was obtained from an interview with Azis.²¹ We asked him to make pairwise comparisons of the importance of specific objectives for achieving sustainable development for Indonesia where the IFIs may be involved for their own benefit given their concern over environmental degradation, civil rights (in part to protect the interests of certain politically powerful labor unions), etc. and to achieve their basic objective of free trade.

The set of perspectives perceived by Azis are presented in Figure 3-1A.

We have at the top Indonesia's Objectives for Sustainable Development. This goal, Azis breaks down into three categories of general objectives: economic, environmental, and political and social. Using pairwise comparisons, we then asked him to indicate the relative importance of these three general factors. He stated that economic objective was 16 times as important as environmental and 5 to 6 times as important as political-social factor (we later set this figure at 5 1/3 times as important.) The comparison matrix is presented in the following table.

In each cell of the matrix, the relative importance of its row element compared to its column element is to be entered. Thus, in the first cell of the first row the unity, 1, is entered, indicating that the economic objective is equally important to itself. In the next cell of the first row, the entry is 16, indicating that the economic objective is 16 times as important as environmental objective.

Table 3-1A. Pairwise Comparisons of General Objectives and Their Weights – Indonesia

	Economic	Environmental	Political and Social	Weights
Economic	1	16	5 1/3	16/20
Environmental	1/16	1	1/3	1/20
Political and Social	3/16	3	1	3/20

²¹ The interview with Azis was conducted and mainly used to this analysis assuming that he would well represent the views of Indonesian policy makers. He, in fact, is an expert on the development issues in Indonesia, and has spent significant amount of time on consulting Indonesian policy makers. As noted in Chapter 3, we have also interviewed a group of three Indonesian graduate students at Cornell, where the author initially designed this research, who used to be policy makers in Indonesia. However, as also noted in Chapter 3, the views from those three students are only considered to construct the objective hierarchy for Indonesia which is mainly from the interview with Azis. There was no significant distortion from the students' views in getting a policy suggestion for Indonesia.

Note that the entry in the first cell of the second row is 1/16 for consistency of pairwise comparisons between economic and environmental objectives. Once the entries are made in the pairwise comparison matrix, then these comparisons are to be normalized and listed in the last column of the table as weights. We adjusted these ratios to the decimals 0.8, 0.05 and 0.15 which preserve the relative importances. These decimals are placed next to the three general objectives in Figure 3-1A.

We next asked Azis to break down each of these general objectives into specific objectives. The general economic objective breaks down into the specific objectives: creation of jobs; expansion of export trade; and increase of imports of required raw materials, equipment and other desired imports for desirable industrial development and consumption. We then asked him to make pairwise comparisons. He stated that jobs were twice as important as exports and six times as important as imports. Thus we set next to these specific objectives the relative weights 0.6, 0.3, and 0.1 which preserve his statements on relative importance, and which we will find useful later.

In similar manner, we obtained from Azis pairwise comparisons that yield the relative weights of each specific objective under the general category environmental, and of each specific objective under the category political and social. These relative weights are recorded at the appropriate places in Figure 3-1A.

We now set down set of objectives that reflects the perspectives of the IFIs.²² Here we are assuming that there is some recognition that financial assistance to Indonesia is appropriate to counter the unintended negative consequences of some of IFIs past policies. We have at the top IFIs' Objectives for Cooperation (Re: Indonesia's Sustainable Development Program and Global Welfare). Then what would be the set of specific objectives that the IFIs might have? Based on some beginning interviews, we accept the following hierarchy of general and specific objectives. There are three general objectives: economic, political, and social and environmental. From pairwise comparisons, economic objective was stated to be 17 times more important than political, and social and environmental objective was judged to be two times as important as political. And the relative weights turn out to be approximately represented by the decimals 0.85, 0.05 and 0.10.

In turn, of the specific economic objective the relative importance of sound exchange rate management and free market were each considered to be of the same importance but at the same time 6/5 times more important²³ than stability of banking system; and the banking system was considered five times as important as avoidance of government deficits. The approximate decimals 0.33, 0.28, 0.33 and 0.06 are appropriately placed in Figure 3-2A. Of the specific political objective, the participant suggested only the elimination of corruption and cronyism as an important sub-objective. And, of course, the relative importance of the specific objective is obviously the unity, 1. Finally, we note that with regard to the general objective,

²² To get the perspectives of the IFIs, we interviewed a professor of Regional Science Program at Cornell and two graduate students in the same program whom we assumed to be well acquainted with the IFIs' policies toward Indonesia. The author's selection of those interview participants was based on their then-current research experience on Asian financial crisis including the Indonesian case and the fact that they are all US citizens.

²³ During the usual interviews, the participants do not specify 6/5 times more important for one over another. Instead, they indicate that one is about 20 percent more important than another, and for writing manner it is recorded as 6/5 times more important.

social and environmental, contained environmental degradation is only 2/3 as important as improvement of civil rights. Thus, the decimals 0.4 and 0.6 are appropriately recorded.

Table 3-1. Sources of Vulnerability and Policy Response: IMF Perspectives and Alternative Views

IMF VIEWS			UNINTENDED OUTCOMES	ALTERNATIVE VIEWS	
Sources	Policy	Expected Outcomes		Sources	Policy
Weak banking system	Government budget balancing to control inflation, bank restructuring, fundamental reforms	Resumption of bank lending	High cost of bank recapitalization and ineffective restructuring	Massive capital inflows and resulting increases in corporate debts	Debt rescheduling to reduce extensive foreign debt of corporate and banking sectors
Pegged (Fixed) exchange rate subject to informal appreciation	Tight money policy – Raise interest rates to achieve net capital inflows	Positive net capital flows – Reduction of capital outflow, increase of inflow	No real (effective) improvement in the balance sheet positions and lending capability	Contagion – starting from Thailand's recession	Combination of moderately tight net financial policy and gradual bank and corporate restructuring
Poor management in corporations, financial institutions and government	Liquidity support from IMF and open capital accounts	Low inflation to avoid real exchange rate appreciation Improved governance and improved balance of payments	No capital inflows and big windfall to savers from the increase in interest rates High social cost – Severe deterioration of social conditions from tightening of government budget	Lack of and/or weak enforcement of prudential financial regulations	Some control measures on capital outflow

Source: Iwan J. Azis (2003).

Figure 3-1A. Indonesia's Objectives for Sustainable Development

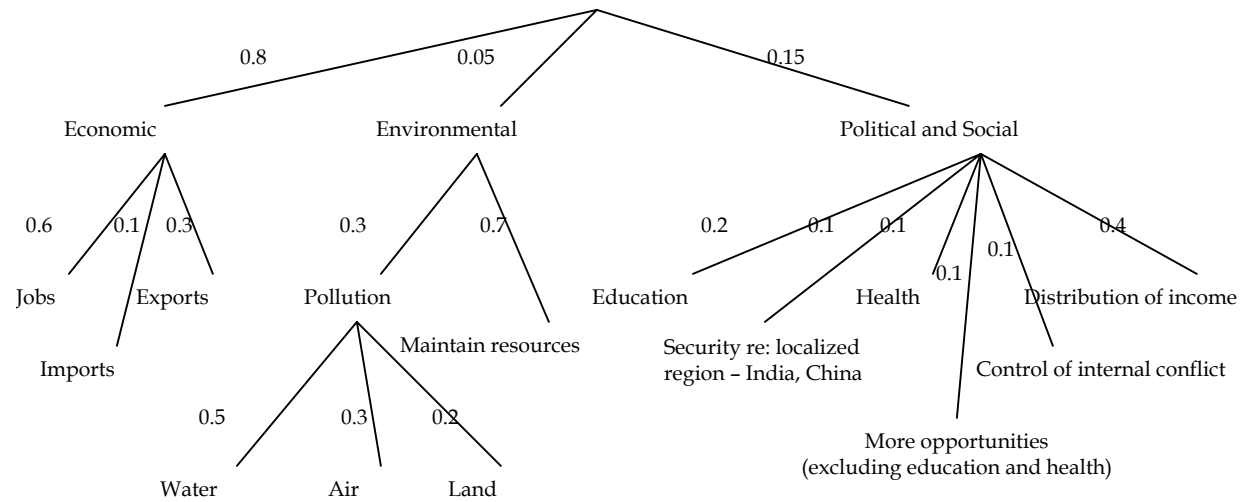
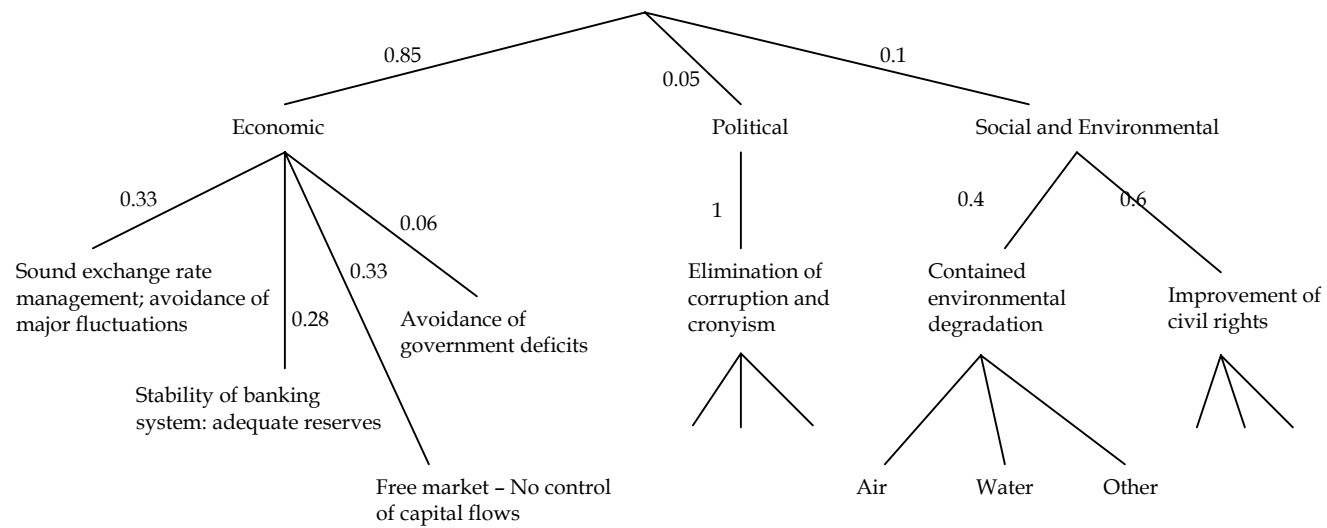


Figure 3-2A. IFIs' Objectives for Cooperation (Re: Indonesia's Sustainable Development Program and Global Welfare)



Comments on “Art and Science” on Nuancing Conflict: Theoretic Approach and Its Application

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Professor, GSIS, Sookmyung Women's University*

The paper provides an important lesson to the traditional "Game Theory researchers" daring to employ the theory for "international" or "global" level economic aspects, while not taking consideration of limited scope of its application.

Emphasizing the so called "outliers" in traditional economics largely relying upon "scientific research module", the paper takes non-scientific or non-economic factors in international economic aspects as one of the critical independent variables for the relevant researches.

Critiques and amended ideas over Mr Kanbur's theoretical and conceptual approaches are truly contributive in its research analysis and description. The presenter's points are well developed in the paper.

Contagion nature of IFI's policy around the developing region and countries could be an important hunch for research area of state-level simulation among actors, including IFIs, state, domestic civil groups. In this sense, Indonesian case is very important, since this case study employs crucial but not ordinary considered intangible factors, called in this paper "non-economic". The paper of experimental research also urges state governments in developing economies take serious consideration of national intelligence management system, which should be able to correspond the world trend of open economy.

As for theoretical stuff, the paper opens the discussion of constructivism, extending traditional levels of analysis in international studies to that of social and micro-cultural.

- 1) In section 1-2, critical description upon Kanbur's terminology can be more persuasive, when the writer enlarges the scope of "actors" from institutional ones to the one including 'international regimes' in relevant area. This idea can help the writer extend his research idea to other important cases, as global debt issue.
- 2) In conclusion, the writer can make comments over the dire need of further research in the subjects of human resource development and sustainable development issues as more practical and advanced area of research following the issue raised by this research.

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