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Equity across Generations and Uncertainty within a Generation: A Welfare Analysis of the National Pension System†

By KYOOHO KWON*

This paper utilizes a life-cycle overlapping-generations model to quantify the welfare effects of plans to postpone the depletion of the National Pension Fund. In order for the model to incorporate the rapidly changing demographic structure of Korea fully, we build and calibrate a model in transition directly. The model is considered suitable for analyzing the effects of demographic changes on the Korean economy and the effects of plans to change the National Pension System. According to a simulation of the model, to postpone the depletion of the National Pension Fund for 30 years, the premium rate must be increased to 18.3% from the current rate of 9%. By postponing the depletion of the fund reserve, young and future generations gain significantly at the expense of the older generations. The simulation results should be, however, interpreted as meaning that the current system is unjustifiably partial to the older generations. Moreover, given the current premium rate, it is desirable to strengthen the income-redistribution function of the National Pension System.

Key Word: Heterogeneous Agent Models, Population Aging, National Pension System, Pension Reform
JEL Code: C68, E21, J11

I. Introduction

The long-term financial outlook of the National Pension System is a grave concern. According to the Third Official Fiscal Projections in 2013 by the Ministry of Health and Welfare, the National Pension Fund will begin to run a deficit in 2044 and will run out of funds and enter insolvency by 2060 under the current system. The projected path of the National Pension Fund in proportion to the nominal GDP is shown in Figure 1. Also shown in the figure is the author's extension

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of the path employing the officially projected macroeconomic variables if the current premium rate (9%) is maintained after the depletion of the reserve funds. As the deficit will explode, the debt issued by the National Pension will increase rapidly after 2060 and reach an unsustainable amount, exceeding 100% of GDP by 2080.

The long-term fiscal problems of the National Pension System are attributable in part to the rapidly changing demographic structure of Korea. According to Statistics Korea, as of 2010 the working-age (15~64) population, which largely determines the size of the labor force, is forecast to shrink at an accelerated rate due to a persistently low fertility rate, dwindling to 21.8 million by 2060, a mere 59% of its peak of 37.0 million in 2016. It is approximated that the working-age population will decrease by 0.3 million, or 1~2 percent per annum, over the next 45 years. Korea's demographic structure is also changing at an unprecedentedly rapid pace, even by international standards. In terms of the old-age dependency ratio, Korea is projected to become one of the most aged countries by 2050 among OECD member countries, as shown in Figure 2. Korea's old-age dependency ratio is the 27th lowest among the 32 OECD members as of 2014, but it is expected to become the third lowest in 2050.

In addition to the rapid population aging, the long-term fiscal problem is deepened by the structural issues of the National Pension System, which has been referred to as the "low burden but high benefits" issue. Despite the two revisions of the National Pension Act in 1998 and 2007, current generations are expected to receive generous pension benefits compared to their contributions. According to Choi and Shin (2015), the cohorts born between 1930 and 1990 are expected to receive benefits much more than the twice their contributions if measured by the present value term. As a result, workers who will be working in the labor market after 2060 must bear a considerable burden to maintain the current system. As stated in the Third Official Fiscal Projections, if the National Pension System becomes a pay-as-you-go system after it is depleted, it is projected that the premium rate must rise sharply to 21.4~22.9 percent from the current level of 9 percent in order to balance the budget until 2083.

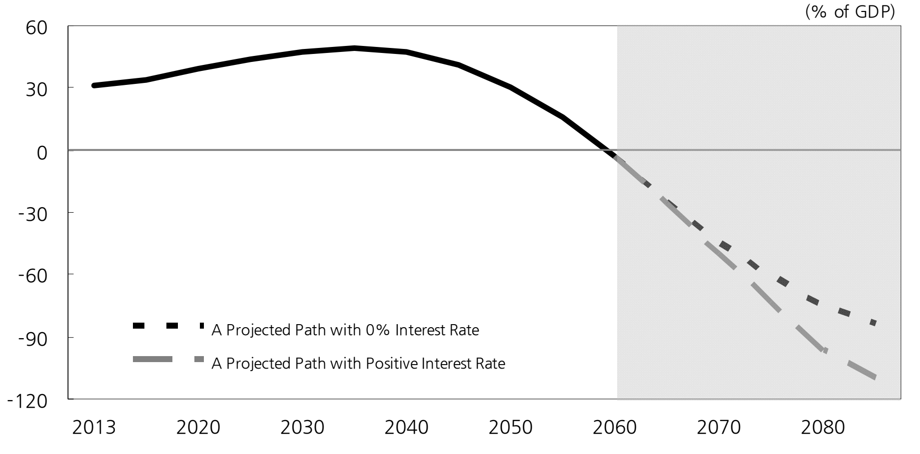


FIGURE 1. THE PROJECTED PATH OF THE NATIONAL PENSION FUND (% OF NOMINAL GDP)

Note: The dashed line is a projection by the author based on the projected macro-variables by the Ministry of Health and Welfare.

Source: Third National Pension Fiscal Projection, The Ministry of Health and Welfare, 2013.

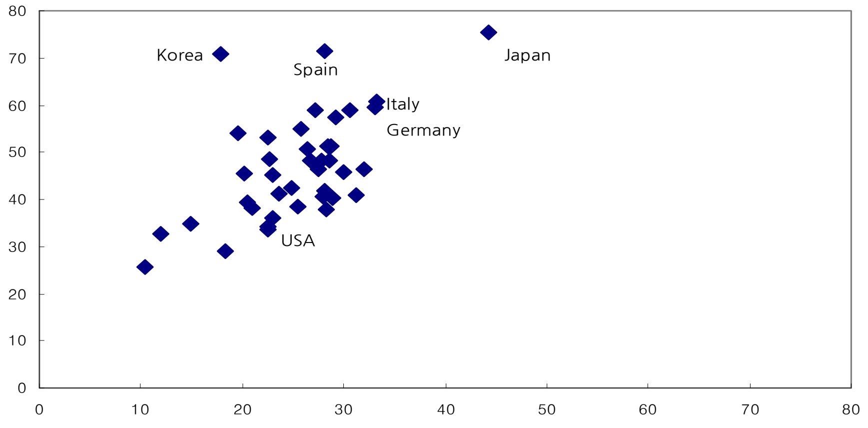


FIGURE 2. PROJECTION OF THE AGED DEPENDENCY RATIO FOR OECD COUNTRIES

Note: The horizontal axis indicates the old-age dependency ratio in 2014. The vertical axis indicates the old-age dependency ratio in 2050.

Source: Kwon (2017).

In Japan, where the pension fund is being depleted, it is reported that the functioning of its pension system is being threatened because only 40 percent of the young insured are paying their scheduled pension premiums. In order for the National Pension System to be sustainable for a longer period of time, it seems inevitable to reform the current system in some way.

The purpose of this paper is to analyze plans to postpone the exhaustion of the National Pension Fund and study welfare implications from an intergenerational perspective. Because a reform of the National Pension System will affect macroeconomic variables as it will affect the labor supply, consumption and savings behavior of the majority of workers, it is desirable to study this within a general equilibrium framework. To do this, we build a life-cycle overlapping-generations macroeconomic model populated by heterogeneous agents. In addition to the differences across generations arising from the differences in the macroeconomic environment over time, such as changes in the GDP growth rate, wage growth rate, and the interest rate, the model economy is composed of heterogeneous economic agents in terms of income histories and wealth holdings, even within a generation.

The macroeconomic models in this class have been widely applied to analyses of the macroeconomic effects and to the study of welfare implications. Examples include population aging, pension reforms, and labor market institutions. For example, Nishiyama and Smetters (2007), Nishiyama (2003), Imrohoroglu and Kitao (2012) analyze and evaluate plans to improve the Social Security System. Heathcote, Storesletten, and Violante (2010) study the welfare implications of the rising wage inequality starting in the 1970s. However, this type of model has not been popularly applied to the Korean economy thus far. Notable exceptions are Kim and Chang (2008) and Hong, Lee, and Kang (2016). Kim and Chang (2008) analyzed the macroeconomic effects of the introduction of the EITC policy and Hong, Lee, and Kang (2016) analyzed the macroeconomic effects of the extension of the retirement age.

There are many papers which present research on the macroeconomic effects of reforms of the National Pension System employing a structural macroeconomic model such as a variant of Auerbach and Kotlikoff (1987). These include Shin and Choi (2010), Chun and Yoo (2004), Choi, Shin and Kwon (2015), and Hong (2016) to name a few. Most previous studies are, however, silent with regard to how much the model economy can explain the growth path of the Korean economy. Moreover, by unrealistically assuming the complete capital market, this model ignores the effect of labor market uncertainties on individual welfare considerations and may not properly gauge the social value of the National Pension System.

Concerning the building of the structural model in this paper, we attempt to incorporate the features listed below in addition to those of the typical overlapping-generations model. First, workers are heterogeneous in terms of income history and asset holdings, and the modelling of the National Pension System is based on the actual system. Second, because a reform in the National Pension System involves the future growth path of Korean economy, the model economy should have at least some explanatory power of Korea's past growth path. , in order to reflect the rapid changes in the population structure, not only changes in the population due to changes in fertility rates but also changes in life expectancy should be modelled explicitly.

To the best of our knowledge, this study is the first attempt to build a macroeconomic model encompassing these features. Moreover, given that the Korean economy is never considered to have reached a steady state, it is inadequate to calibrate a structural macroeconomic model of Korea based on the steady state assumption. If the steady state assumption is adopted to calibrate a model, it is practically impossible to replicate the rapid demographic transition of Korea, which is unacceptable when evaluating the fiscal reforms of the National Pension System. To bypass this difficulty, we directly build and calibrate a model economy in transition by adopting the calibration strategy suggested by Kwon (2017).

According to the model simulations of this study, the National Pension System should be reformed in the direction of a more equitable system across generations and changed to strengthen the income redistribution function within a birth cohort even at the current premium rate. We simulate the model economy to evaluate plans to fiscally stabilize the National Pension System. Because there is no explicit agreement pertaining to the definition of the fiscal stabilization of the National Pension system, we calculate the equilibrium premium rate to delay the depletion of the reserve funds for 30 years from the date of insolvency in the benchmark model economy. According to the model simulation, we find that it is necessary to raise the premium rate by 9.3 percentage points from the current premium rate of 9 percent. In order to push back 50 years instead of 30 years, a rate increase of 11.0 percentage point is required. Although these plans are not strong enough to prevent the National Pension Fund from becoming depleted, they will enhance equity across generations significantly. Aside from the goal of postponing the depletion of the reserve funds, we also evaluate a plan to strengthen the income redistribution function of the system. By redistributing more income within a cohort, the welfare of the young and future generations can be expected to increase, as this effort reduces the uncertainty of the consumption path within a generation.

This paper is organized as follows: Section 2 specifies the model economy;

Section 3 calibrates the model based on various macro- and micro-datasets; Section 4 reports the benchmark model simulation results; Section 5 conducts a welfare analysis based on the model economy; Section 6 concludes the paper.

II. A Macroeconomic Model of the National Pension System

A. *Demographic Structure*

Time t is discrete and the model period is one year. The model economy is populated by J_D overlapping generations. Individual workers may live up to J_D periods and face mortality risks in each period. Let $\psi_T(j,t)$ denote the conditional probability that an individual of age j in period t survives to the next period $t+1$. Let $n_T(t)$ denote the growth rate of the population of age 1 in period t. Let $N_{j,t}(1 \le j \le J_D)$ denote the population of age j in period t. The total population in period t is calculated as $N_t = \sum_{j=1}^{J_D} N_{j,t}$.

Then, the population of each age evolves over time, as follows:

$$N_{1,t+1} = [1+n_T(t+1)]N_{1,t}$$
$$N_{j+1,t+1} = \psi_T(j,t)N_{j,t},\ 1 \le j \le J_D - 1$$
$$N_{J+1,t+1} = 0$$

We refer to the population of age j in period t as the k_{th} cohort. Note that age, time, and cohort indices are not independent given the one-to-one function that $k = t - j + 1$. In order to simplify the notations and present the model clearly, individual workers' utility maximization problems are laid out with cohort and time indices, whereas macro-variables are done so with age and time indices.

B. *Individual Worker's Problem*

An individual worker is a unit that makes independent economic decisions concerning consumption-savings and the labor supply. Each worker starts to participate in the labor market at the age of J_W and retires at the exogenous age of J_R . Enrollment in the National Pension is determined at the age of J_W if the worker starts working after the introduction of the system. Otherwise, the enrollment is determined at the time of the introduction. We assume that the enrollment decision is not a choice but an exogenous assignment.

Utility Maximization Problem of a Retired Worker

At the exogenous age of J_R, workers retire from the labor market and make consumption and savings decisions. Retired workers who are eligible for National Pension benefits q are characterized by the individual state vector $(a,q;j,k)$, where a is the amount of asset holding, q is the amount of National Pension benefit, j denotes the person's age, and k is the cohort index. Let r_t denote the market interest rate, and borrowing is not allowed. The tax rate for asset income is denoted as τ_t^a.

A retired worker's decision problem is formulated recursively. Let V_K^R denote the value function of the retired agent in the state of $(a,q;j,k)$. The decision problem can be represented as

$$V_K^R(a,q;j,k) = \max_{c,a'}\{u(c,h) + \beta\psi_K(j;k)V_K^R(a',q';j+1,k)\}$$

s.t.

$$c + a' \le [1+(1-\tau_t^a)r_t]a + b_t + q,$$
$$h = 0,\ a' \ge 0,\ q = q',$$

where c, a' and b_t denote the consumption, savings, and transfer income other than the pension benefit, respectively. The parameter β denotes the preference discount rate, and $\psi_K(j;k)$ denotes the conditional probability that an individual in the k_{th} cohort of age j survives to the next period.[1] The amount of q' is equal to q, which is determined at the time of each worker's retirement. $u(\cdot)$ is the instantaneous utility function, which is separable with regard to consumption and hours of work. It is determined as follows:[2]

$$u(c,h) = \log(c) - Bh^{1+\frac{1}{\gamma}} / (1+\frac{1}{\gamma})$$

This type of utility function is chosen to support a balanced growth path. The parameter γ denotes the intertemporal substitution elasticity of work hours. The decision rules that solve this problem are expressed as

$$c = c_K^R(a,q;j,k) \text{ and } a' = a_K^R(a,q;j,k).$$

[1] $\psi_K(j;k) \equiv \psi_T(j;k+j-1)$.

[2] Note that $h=0$ for a retired worker.

Let V_K^{NR} denote the value function of a retired worker who is not eligible for pension benefit. The decision problem of this type can be recursively written as

$$V_K^{NR}(a;j,k)=\max_{c,a'}\{u(c,h)+\beta\psi_K(j;k)V_K^{NR}(a';j+1,k)\}$$

s.t.

$$c+a'\leq[1+(1-\tau_t^a)r_t]a+b_t$$
$$h=0,\ a'\geq 0.$$

The decision rules that solve this problem are $c=c_K^{NR}(a;j,k),\ a'=c_K^{NR}(a;j,k)$.

Utility Maximization Problem of a Worker

Individual workers begin participating in the labor market at the age of J_W and retire from the market at the age of J_R. Workers are heterogeneous in terms of labor market productivity. Labor market productivity measured in efficiency units is assumed to be composed of three parts. First, a type-dependent fixed effect z is determined at the age of J_W drawn from the probability distribution, $\pi_z(z)$. Second, an age-dependent component ε_j is assumed to be deterministic, a persistent idiosyncratic shock x evolves following the conditional probability distribution, $\pi_X(x,x')$. We assume that there is no difference in the labor market productivity structure across generations.[3]

When an individual worker aged j supplies h hours to the labor market, he supplies $\varepsilon_j zxh$ units of efficiency labor and earns $w_t\varepsilon_j zxh$, where w_t denotes the market wage rate for an efficiency unit of labor in period t. If he is enrolled in the National Pension, his pension contribution is calculated as $\tau_t\min\left\{w_t\varepsilon_j zxh,\overline{y_t}\right\}$, which is not part of his taxable income under current Korea tax law. Here, τ_t denotes the pension premium rate. The amount of income over the predetermined level $\overline{y_t}$ is exempt from pension contributions. Hereafter, following the National Pension Act, we refer to $\overline{y_t}$ as the maximum Standard Yearly Income and $\min\left\{w_t\varepsilon_j zxh,\overline{y_t}\right\}$ as the Standard Yearly Income. We assume that individual workers begin their economic lives with no financial assets, and borrowing against the future labor income is not allowed.

A worker enrolled in the National Pension is characterized by the state vector

[3]Therefore, the difference in the labor market productivity rates among cohorts reflects the differences in the level of the total factor productivity and the degree of capital deepening.

$(a, p, x, z; j, k)$. The variable p denotes his average Standard Yearly Income up to the age of $j-1$, which summarizes his individual labor income history. Let V_K^W denote the value function of a worker in the state of $(a, p, x, z; j, k)$. The decision problem of the agent can be recursively represented as

$$V_K^W(a, p, x, z; j, k) = \max_{c, a', h} \{u(c, h) + \beta \psi_K(j; k) NVF(j+1, k)\}$$

s.t.

$$NVF(j+1, k) = \begin{cases} V_K^R(a', q'; j+1, k) & , \ if \ \ j = J_R - 1 \\ \sum_{x'} \pi_X(x, x') V_K^W(a', p', x', z; j+1, k) & , \ if \ \ j < J_R - 1 \end{cases}$$

$$c + a' \leq [1 + (1 - \tau_t^a) r_t] a + b_t + (1 - \tau_t^l)(w_t \varepsilon_j z x h - \theta),$$

$$\theta = \tau_t \min\left\{w_t \varepsilon_j z x h, \overline{y_t}\right\},$$

$$p' = \frac{1}{j - J_K(k) + 1} \left[p[j - J_K(k)] + \theta \frac{A_K(k)}{A_T(t)} \right]$$

$$q' = Q_K(p'; k), \ \ if \ \ j = J_R - 1,$$

$$0 \leq h \leq 1, \ \ a' \geq 0,$$

where $J_K(k)$ denotes the age at which k_{th} cohort workers are enrolled in the National Pension, $A_T(t)$ denotes the Average Yearly Income, which is the average Standard Yearly Income of all insured workers in period t. $A_K(k)$ denotes the three-year average value of the Standard Yearly Income of all k_{th} cohort workers immediately before their retirement. It is determined using the equation below.

$$A_K(k) = \frac{1}{3} \sum_{\tau=1}^{3} [A_T([k + J_R - 1] - \tau)]$$

The decision rules that solve this problem are expressed as

$$c = c_K^W(a, p, x, z; j, k), \ \ h = h_K^W(a, p, x, z; j, k), \ \ and \ \ a' = a_K^W(a, p, x, z; j, k).$$

The pension contribution reflecting the optimal working hours is denoted as $\theta_K^W(a, p, x, z; j, k)$.

As noted above, the amount of the National Pension benefit is determined at the beginning of retirement. Here, we specify how it is determined. The amount of the pension benefits depends on (i) how long a worker contributes to the service, i.e., the insured period, and (ii) how much a worker contributes over the insured period as summarized by his average Standard Yearly Income p. Roughly, the variable p recodes and summarizes the history of labor earnings. Let $Q_K(p;k)$ denote the amount of pension benefits paid to a k_{th} cohort individual worker with p. Under the modified formula suitable for the model, it is determined as

$$(1) \qquad Q_K(p;k) = D_K(k)[\alpha_A A_K(k) + (1-\alpha_A)p][1+0.05(n_K(k)-20],$$

where $n_K(k)$ denotes the insured period of a k_{th} cohort worker. The variable $D_K(k)$ determines the income replacement ratio, and it depends on k due to the reforms of the National Pension System in 1998 and 2007.

We now clarify how the average Standard Yearly Income p is determined in the model. The process of calculating the value of p is most easily explained by a simplified example. Suppose there is an insured worker who contributed for T periods before he retires, as shown in Table 1. In period 1, let B_1 be his Standard Yearly Income when the average Standard Yearly Income amounts to A_1. Let B'_1 denote the reevaluated value of B_1 in the period T, which is determined as $B'_1 = B_1 \times (A_t / A_1)$. Note that A_T is the Average Standard Yearly Income in period T.[4] The multiplying factor A_t / A_1 can be, therefore, interpreted as the cumulative average income growth rate for T periods. If the amount of B_1 is to be put into a saving account for T periods, the bank would roll over B_1 with the market interest rate. What the National Pension does is similar to what the bank does, but it promises to return the savings compounded not with the interest rate but with the labor income growth rate. The future values of $B_2, B_3, \cdots, B_T$ are determined similarly, which are $B'_2, B'_3, \cdots, B'_T$, respectively. Finally, the reevaluated average

TABLE 1—AN EXAMPLE: REEVALUATION OF THE INDIVIDUAL AVERAGE STANDARD YEARLY INCOME

Insured Period (t)	Average Standard Yearly Income (of all insured workers)	Standard Yearly Income (of an worker)	Reevaluated Standard Yearly Income
1	A_1	B_1	$B'_1 = B_1 \times (A_T/A_1)$
2	A_2	B_2	$B'_2 = B_2 \times (A_T/A_2)$
…	…	…	…
T	A_T	B_T	$B'_T = B_T \times (A_T/A_T)$

[4] The current national pension system is being revalued based on average earnings for the three years immediately preceding the pension receipt. For the sake of clarity, an example was given to reevaluate the average earnings of the year before the pension receipt.

Standard Yearly Income for the periods during which it is insured is calculated as $p=(1/T)\sum_{t=1}^{T} B_t \times (A_T / A_t)$, and the period-by-period update formula is shown in the decision problem.

Here, we investigate equation (1) further. The parameter α_A determines the degree of income redistribution within a cohort. If the value of α_A increases, the benefit amount will be closer to the average income among insured people so that the benefit difference among the insured decreases. Conversely, if the value of α_A decreases, the benefit will depend more on the individual earnings history such that the National Pension plays a role similar to that of a bank. The variable $D_K(k)$ in equation (1), known as the income replacement ratio, determines the annual pension payment given the pension contribution history. The value of $D_K(k)$ in equation (1) can be calculated with the officially announced proportional constant d_t. Given the time series of d_t, the value of $D_K(k)$ is calculated as

$$D_K(k) = \frac{1}{(k+J_R-1)-(k+J_W-1)} \sum_{t=k+j_W-1}^{k+J_R-1} d_t \tag{2}$$

A worker who is not enrolled in the National Pension is characterized by the individual state vector $(a,x,z;j,k)$.[5] Let V_K^{NW} denote the value function of this type of worker. The decision problem can be recursively represented as

$$V_K^{NW}(a,x,z;j,k) = \max_{c,a',h} \{u(c,h) + \beta \psi_K(j;k) NVF(j+1,k)\}$$

s.t.

$$NVF(j+1,k) = \begin{cases} V_K^{NR}(a';j+1,k) & , \ if \ \ j = J_R - 1 \\ \sum_{x'} \pi_X(x,x') V_K^{NW}(a',x',z;j+1,k) & , \ if \ \ j < J_R - 1 \end{cases}$$

$$c + a' \leq [1 + (1-\tau_t^a) r_t] a + b_t + (1-\tau_t^l) w_t \varepsilon_j zxh$$

$$0 \leq h \leq 1, \ \ a' \geq 0$$

The decision rules that solve this problem are denoted as

[5]As noted above, enrollment in National Pension Service is not a choice but a random assignment among the same cohort workers, which implies that labor market productivity does not depend on enrollment in the National Pension Service.

$$c = c_K^{NW}(a,x,z;j,k),\ \ h = h_K^{NW}(a,x,z;j,k),\ \ a' = a_K^{NW}(a,x,z;j,k).$$

It is convenient to reorder the value functions and the decision rules in the order of time t to construct the macroeconomic variables, as follows:

$$v_T^W(a,p,x,z;j,t) = v_K^W(a,p,x,z;j,k),\ \ \phi_T^R(a,q;j,t) = \phi_K^R(a,q;j,k),$$

$$\text{where } v \in \{c,h,a,\theta\},\ \phi \in \{c,a\},\ \textit{and}\ \ k = t - j + 1.$$

$$v_T^W(a,x,z;j,t) = v_K^{NW}(a,x,z;j,k),\ \ \phi_T^{NR}(a;j,t) = \phi_K^{NR}(a;j,k),$$

$$\text{where } v \in \{c,h,a\},\ \phi \in \{c,a\},\ \textit{and}\ \ k = t - j + 1.$$

Finally, let $N_T^W(a,p,x,z;j,t)$ and $N_T^R(a,q;j,t)$ denote the insured population aged j in period t in the states of (a,p,x,z) and (a,q), respectively. In the same manner, $N_T^{NW}(a,x,z;j,t)$ and $N_T^{NR}(a;j,t)$ denote the population who are not enrolled in the National Pension.

C. *The Representative Firm's Problem*

In the model economy, there exists a representative firm which produces output Y_t by combining capital K_t and labor L_t using a constant return-to-scale Cobb-Douglas production function for each time period t,

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha},$$

where A_t denotes the total factor productivity in period t and α is the output elasticity of capital. The aggregate labor L_t is measured in units of efficiency. Capital stocks are depreciated at the rate of δ_t in period t after production occurs. We assume that both the factor markets and the goods market are competitive.

The firm's profit maximizing problem can be stated as follows,

$$(K_t^d, L_t^d) = \text{argmax}_{K_t,L_t} A_t K_t^{\alpha} L_t^{1-\alpha} - w_t L_t - (r_t + \delta_t) K_t,$$

where L_t^d and K_t^d denote the demand for labor and the demand for capital during period t, respectively. Then, L_t^d and K_t^d satisfy the following first-order conditions:

$$\alpha A_t (K_t^d)^{\alpha-1} (L_t^d)^{1-\alpha} = r_t + \delta_t$$

$$(1-\alpha) A_t (K_t^d)^{\alpha} (L_t^d)^{-\alpha} = w_t$$

D. *Construction of Macroeconomic Variables and Procedure of Market Clearing*

The aggregate supply of capital in period $t+1$, K_{t+1}^s is determined by the individuals' decisions on savings and the evolution of the National Pension Fund. On the one hand, in order to calculate the aggregate savings by individuals, we need to specify how unintended bequests are distributed to living individuals. The amount of assets that the individual aged j in period t in the state of (a,p,x,z) saves is $a_T^W(a,p,x,z;j,t)$. There are $N_T^W(a,p,x,z;j,t)$. people in this state. The individual survives in period $t+1$ with a probability of $(1-\psi_T(j,t))$. If a mortality shock arrives, we assume that the assets, $a_T^W(a,p,x,z;j,t)$, are distributed evenly to the living population. The same process holds for the retired population. Under these assumptions, the aggregate savings by individuals during period $t+1$ are calculated as follows:

$$S_{t+1}^s = \sum_{j=J_W}^{J_R-1} \sum_{a,p,x,z} \psi_T(j,t) a_T^W(a,p,x,z;j,t) N_T^W(a,p,x,z;j,t) + \sum_{j=J_R}^{J} \sum_{a,q} \psi_T(j,t) a_T^R(a,q;j,t) N_T^R(a,q;j,t)$$

Similarly, the total amount of unintended bequests in period $t+1$ to living households is calculated as follows:

$$\begin{aligned} B_{t+1}^s = & \sum_{j=J_W}^{J_R-1} \sum_{a,p,x,z} [1-\psi_T(j,t)] a_T^W(a,p,x,z;j,t) N_T^W(a,p,x,z;j,t) \\ & + \sum_{j=J_R}^{J} \sum_{a,q} [1-\psi_T(j,t)] a_T^R(a,q;j,t) N_T^R(a,q;j,t) \\ & + \sum_{j=J_W}^{J_R-1} \sum_{a,x,z} [1-\psi_T(j,t)] a_T^{NW}(a,x,z;j,t) N_T^{NW}(a,x,z;j,t) \\ & + \sum_{j=J_R}^{J} \sum_{a} [1-\psi_T(j,t)] a_T^{NR}(a;j,t) N_T^{NR}(a;j,t) \end{aligned}$$

On the other hand, the National Pension Fund (SF) evolves as follows:

$$SF_{t+1} = (1+r_t)SF_t - \sum_{j=J_R}^{J} \sum_{a,q} qN_T^R(a,q;j,t) + \sum_{j=J_W}^{J_R-1} \sum_{a,p,x,z} \theta_K^W(a,p,x,z;j,t) N_K^W(a,p,x,z;j,t) \quad (3)$$

If the National Pension Fund is to be depleted in some period $t+1$, we assume that the National Pension System switches to a pay-as-you-go system. In this case, the pension premium rate τ_t is endogenously set to ensure the period-by-period budget balance of the National Pension.

We assume that the model economy is closed such that the rate of return on capital is determined in the domestic capital market. Regarding assumption, we rely on the empirical findings of Feldstein and Horioka (1980), who show that the correlation between the investment rate and the savings rate is close to one in the long run. Despite the fact that the open economy assumption is much more realistic for Korea, we would have to project the world interest rate until 2300 to solve the model if such an assumption were to be adopted.[6]

With the assumption of a closed economy, the aggregate supply of capital in period $t+1$, K_{t+1}^s, is the sum of the aggregate savings by individuals and the National Pension Fund.

$$K_{t+1}^s = S_{t+1}^s + SF_{t+1}$$

The aggregate supply of labor in period t, L_t^s, is the sum of efficiency unit of labor supplied by individuals:

$$L_t^s = \sum_{j=J_W}^{J_R-1} \sum_{a,p,x,z} \varepsilon_j zxh_T^W(a,p,x,z;j,t) N_T^W(a,p,x,z;j,t) + \sum_{j=J_W}^{J_R-1} \sum_{a,p,x,z} \varepsilon_j zxh_T^{NW}(a,x,z;j,t) N_T^{NW}(a,x,z;j,t)$$

The Average Yearly Income in period t, $A_T(t)$, is calculated as follows:

[6]Considering that other economies also have aging populations, the trend in the future capital flows will be determined by the relative speed of Korea's demographic transition. It may be beneficial to model a multi-country large-scale overlapping-generations model to account for the effects of the world-wide demographic transition on the global rates of return on capital, as was done in Attanasio, Kitao, and Violante (2007) and Krueger and Ludwig (2007). The effects of Korea’s demographic transition on the Korean economy can then be analyzed in a single framework under the open economy assumption.

$$A_T(t) = \left\{ \sum_{j=J_W}^{J_R-1} \sum_{a,p,x,z} \min\{w_t \varepsilon_j zxh_T^W(a,p,x,z;j,t), \overline{y_t}\} N_T^W(a,p,x,z;j,t) \right\}$$
$$/ \sum_{j=J_W}^{J_R-1} \sum_{a,p,x,z} N_T^W(a,p,x,z;j,t)$$

Finally, we need to specify the evolution of the population distribution over the state space. The distribution of the retired population aged $j+1$ in period $t+1$ is determined as follows: For any asset holdings a' in period $t+1$,

$$N_T^R(a',q;j+1,t+1) = \psi_T(j,t)\sum_{a,q} 1[a_T^R(a,q;j,t)=a']N_T^R(a,q;j,t),$$
$$N_T^{NR}(a';j+1,t+1) = \psi_T(j,t)\sum_{a} 1[a_T^{NR}(a;j,t)=a']N_T^{NR}(a;j,t).$$

The distribution of the retired population aged J_R in period $t+1$ is determined as follows: For any asset holdings a' and the pension benefits q' in period $t+1$,

$$N_T^R(a',q';j+1,t+1)$$
$$= \psi_T(j,t) \sum_{a,p,x,z} \begin{pmatrix} 1[a_T^W(a,p,x,z;j,t)=a'] \times \\ 1[Q_K(p_T^W(a,p,x,z;j,t), t-j+1)=q'] \end{pmatrix} N_T^W(a,p,x,z;j,t).$$

Note that the amount of the pension benefit is being determined for the eligible population aged J_R in period $t+1$.

The distribution of workers aged J_R in period $t+1$ who are not eligible for the pension benefit evolves as follows: For any asset holdings a' in period $t+1$,

(4)
$$N_T^{NR}(a';j+1,t+1)$$
$$= \psi_T(j,t)\sum_{a,x,z} \left(1[a_T^W(a,x,z;j,t)=a']\right) N_T^{NW}(a,x,z;j,t).$$

The distribution of the workers aged $J_W \le j < J_R - 1$ in period t evolves as follows: For all combinations of (a',p',x'), (a',x') in period $t+1$,

(5)
$$N_T^W(a',p',x',z';j+1,t+1)$$
$$= \psi_T(j,t) \sum_{a,p,x,z} \begin{matrix} \pi_X(x,x')1[a_T^W(a,p,x,z;j,t)=a'] \times \\ 1[p_T^W(a,p,x,z;j,t)=p'] \times 1[z=z'] N_T^W(a,p,x,z;j,t) \end{matrix}$$

$$N_T^{NW}(a',x',z';j+1,t+1) = \psi_T(j,t)\sum_{a,x,z}\pi_X(x,x')1[a_T^{NW}(a,x,z;j,t)=a']N_T^{NW}(a,x,z;j,t) \tag{6}$$

The distribution of the population aged $j=J_W$ in period $t+1$ is determined as follows: For any z,

$$\begin{aligned} &N_T^{W}(0,0,\bar{x},z;J_W,t+1)=\pi_Z(z)\chi_T(t+1)[1+n_T(t+1)]N_{J_W,t}, \ \textit{and} \\ &N_T^{NW}(0,\bar{x},z;J_W,t+1)=\pi_Z(z)[1-\chi_T(t+1)][1+n_T(t+1)]N_{J_W,t}, \end{aligned} \tag{7}$$

where $\chi_T(t+1)$ denotes the insured rate by the National Pension Service for the birth cohort who will become aged J_W in period $t+1$. Here, $\bar{x}$ denotes the average value of the persistent part of the individual productivity, x.

E. *Definition of the Competitive Equilibrium*

Let $S_T(t)=\{n_T(t),\psi_T(j,k),A_t,\delta_t,d_t,\tau_t,\overline{y_t},B_t,K_t,L_t,\tau_t^{\alpha},\tau_t^{l},SF_t\}$ be the aggregate state of the model economy in period t. We assume that economic agents perfectly foresee the entire path of the state of the aggregate economy, $\{S_T(t)\}_{t=T_0}^{\infty}$.

Given the path of the aggregate state of the economy, the equilibrium of the economy consists of the value functions $\{V_T^W,V_T^R,V_T^{NW},V_T^{NR}\}$; the associated decision rules $\{c_T^W,c_T^R,c_T^{NW},c_T^{NR}\}$, $\{a_T^W,a_T^R,a_T^{NW},a_T^{NR}\}$, and $\{h_T^W,h_T^{NW}\}$; the sequence of the production plans for firms $\{K_t,L_t\}$; the factor prices $\{w_t\}$, $\{r_t\}$, the National Pension System $\{\tau_t,\overline{y_t},SF_t\}$; transfer income $\{B_t\}$; and the population measures $\{N_T^W,N_T^R,N_T^{NW},N_T^{NR}\}$ such that

1. Given the path of the aggregate state of the economy and the factor prices, the value functions and the decision rules solve the workers' dynamic problems.

2. Given the path of the factor prices, $\{K_t,L_t\}$ denotes the solution to the representative firm's profit maximization problems.

3. Given the path of the factor prices, the factor markets clear and satisfy

$$K_t=K_t^s=K_t^d,\ L_t=L_t^s=L_t^d.$$

4. The goods market clears as follows: for all t, $Y_t=C_t+I_t+G_t$, where C_t denotes private consumption, I_t denotes investment, and G_t denotes government

expenditures. C_t and I_t are calculated as follows:

$$
\begin{aligned}
C_t = &\sum_{j=J_W}^{J_R-1} \sum_{a,p,x,z} C_T^W(a,p,x,z;j,t) N_T^W(a,p,x,z;j,t) \\
&+ \sum_{j=J_R}^{J} \sum_{a,q} C_R^W(a,q;j,t) N_R^W(a,q;j,t) \\
&+ \sum_{j=J_W}^{J_R-1} \sum_{a,x,z} C_T^{NW}(a,x,z;j,t) N_T^{NW}(a,x,z;j,t) \\
&+ \sum_{j=J_R}^{J} \sum_{a,q} C_R^{NW}(a;j,t) N_R^{NW}(a;j,t)
\end{aligned}
$$

$$I_t = K_{t+1} - (1-\delta_t) K_t$$

5. The National Pension Funds evolves following the equation (3) and switches to a pay-as-you-go system if it is depleted.

6. The government's budget maintains a period-by-period balance for all t:

$$
\begin{aligned}
G_t = &\tau_t^{\alpha}(r_t - \delta_t) K_t^s \\
&+ \tau_t^l \sum_{j=J_W}^{J_R-1} \sum_{a,p,x,z} \psi_T^W(a,p,x,z;j,t) N_T^W(a,p,x,z;j,t) \\
&+ \tau_t^l \sum_{j=J_W}^{J_R-1} \sum_{a,x,z} \psi_T^{NW}(a,x,z;j,t) N_T^{NW}(a,x,z;j,t)
\end{aligned}
$$

7. The amount of accidental bequests is equal to the amount of transfers to the living population:

$$
\begin{aligned}
B_t^s = B_t^d = &\sum_{j=J_W}^{J_R-1} \sum_{a,p,x,z} b_t N_T^W(a,p,x,z;j,t) + \sum_{j=J_R}^{J} \sum_{a,q} b_t N_T^W(a,q;j,t) \\
&+ \sum_{j=J_W}^{J_R-1} \sum_{a,x,z} b_t N_T^{NW}(a,x,z;j,t) + \sum_{j=J_R}^{J} \sum_{a,q} b_t N_T^{NR}(a;j,t)
\end{aligned}
$$

8. The distribution of the population over the state space evolves following the equations (4), (5), (6), and (7).

In order to quantify the model economy, we must specify the characteristics of the balanced growth path to which the model economy eventually converges.

First, we assume, in the end, that the net fertility rate and the conditional survival probabilities converge and become constant such that the following conditions are satisfied.

$$n_T(t) = n^*,\ \psi_T(j,t) = \psi^*(j)\ \ for\ 1 \le j \le J_R\ \ and\ all\ t \ge T^*.$$

After passing J_D periods upon satisfaction of these conditions, we have

$$N_{t+1}^* = (1+n^*)N_t^*,$$
$$N_{j,t+1}^* / N_{t+1}^* = N_{j,t}^* / N_t^*$$

In other words, the growth rate of the total population is equal to the net fertility rate, and the age distribution of the population becomes stationary.

Second, we assume that the growth rate of the total factor productivity converges in the end, i.e.,

$$A_{t+1} / A_t = \gamma_A^*\ \ for\ all\ t \ge T^*.$$

Suppose that a stationary population distribution is achieved and that the growth rate of total factor productivity is constant over time. In such a case, the stationary recursive competitive equilibrium is recursive competitive equilibrium in which the following characteristics are satisfied. For all t, the consumption and savings of the representative household increase in proportion and the supply of labor remains constant:

$$C_T^W(a,p,x,z;j+1,t+1) = \gamma_c^* C_t^W(a,p,x;z,j+1,t),$$

$$C_T^R(a,q;j+1,t+1) = \gamma_c^* C_t^R(a,q;z,j+1,t),$$

$$a_T^W(a,p,x,z;j+1,t+1) = \gamma_a^* a_t^W(a,p,x;z,j+1,t),$$

$$a_T^R(a,q;j+1,t+1) = \gamma_a^* a_t^R(a,q;z,j+1,t),$$

$$h_T^W(a,p,x,z;j+1,t+1) = h_t^W(a,p,x;z,j+1,t),$$

$$C_T^{NW}(a,x,z;j+1,t+1) = \gamma_c^* C_t^{NW}(a,x;z,j+1,t),$$

$$C_T^{NR}(a;j+1,t+1) = \gamma_c^* C_t^{NR}(a;z,j+1,t),$$

$$a_T^{NW}(a,x,z;j+1,t+1)=\gamma_a^* a_t^{NW}(a,x;z,j+1,t),$$

$$a_T^{NR}(a;j+1,t+1)=\gamma_a^* a_t^{NR}(a;z,j+1,t),$$

$$h_T^{NW}(a,x,z;j+1,t+1)=h_t^{NW}(a,p,x;z,j+1,t),$$

$$\text{where}\quad \gamma_c^*=\gamma_a^*=(\gamma_A^*)^{\frac{1}{1-\alpha}},\quad \text{for all}\ i\ \text{and}\ t\geq T^*.$$

Fourth, the National Pension Service operates as a pay-as-you-go system on the balanced growth path.

Finally, with the conditions above being satisfied, the aggregate supply of savings also increases at a fixed rate and the factor prices are determined as follows:

$$r_t=r^*,\ w_{t+1}=\gamma_w^* w_t,\ \text{where}\ r_W^*=(\gamma_A^*)^{\frac{1}{1-\alpha}}$$

F. *A Welfare Measure*

In order to analyze the welfare implications of changes to the National Pension Service, a welfare criterion must be defined beforehand. The welfare function in this study is the total utility obtainable during a lifetime of an individual, which is expected at the time the individual initially become economically active. In order to specify the welfare function, some notations must be introduced.

An allocation of individual consumption and labor supply during a lifetime can be expressed as $(c,h)\equiv\{c_j,h_j\}_{j=J_W}^{J_D}$.[7] The lifetime utility (W) obtainable with this allocation is, then, calculated as $W[(c,h)]\equiv\sum_{j=J_W}^{J_D}\beta^{j-J_W}u(c_j,h_j)$. As there is some uncertainty about individual labor productivity, there is also uncertainty in the above allocation. The expected lifetime utility reflecting this uncertainty is expressed as follows and used here as a welfare measure of a given cohort.

$$EW[(c,h)]\equiv E\{W[(c,h)]\}=E\left[\sum_{j=J_W}^{J_D}\beta^{j-J_W}u(c_j,h_j)\right]$$

This measure has the following characteristics. First, because the consumption of goods and the consumption of leisure are assumed to be normal, the expected lifetime utility increases as the consumption increases or the working hours decreases. Second, the uncertainty of the allocation (c,h) reduces the expected lifetime utility because we assume a risk-averse utility function.

[7] In this subsection, subscripts for cohorts are omitted for convenience.

In order to quantify the change in welfare according to a reform of the system, this study applied the certainty equivalent variation, CEV, which can be regarded as the answer to the next question: "In order to avoid a change of the expected lifetime utility after a reform of the system, how much consumption should be increased or decreased from the optimal allocation before the reform?" Specifically, we denote the optimal allocation during a lifetime in the benchmark economy as (c^0, h^0) and the optimal allocation in the new equilibrium after a reform as (c^*, h^*). At this point, the changes in welfare due to institutional changes can be measured as

$$\begin{aligned} EW[(c^*, h^*)] &= E\left[\sum_{j=J_W}^{J_D} \beta^{j-J_W} u(c^*, h^*)\right] \\ &= E\left[\sum_{j=J_W}^{J_D} \beta^{j-J_W} u\left((1+CEV)c_j^0, h_j^0\right)\right] \\ &= EW\left[\left((1+CEV)c^0, h^0\right)\right]. \end{aligned}$$

We can decompose CEV into the component (CEV_C) resulting from the change in consumption from c^0 to c^* and the component (CEV_H) resulting from the change in labor supply from h^0 to h^*. These components are calculated as follows:[8]

$$\begin{aligned} EW[(c^*, h^0)] &= EW[((1+CEV_C)c^0, h^0)] \\ EW[(c^*, h^*)] &= EW[((1+CEV_H)c^*, h^0)] \end{aligned}$$

The part of the welfare change due to the change in consumption schedule, CEV_C, can be further decomposed into a component reflecting the change in the consumption level (CEV_{CL}) and a component reflecting the change in consumption schedule uncertainty (CEV_{CD}) as follows:

$$\begin{aligned} EW[(\hat{c}^0, h^0)] &= EW[((1+CEV_{CL})c^0, h^0)] \\ EW[(c^*, h^0)] &= EW[((1+CEV_{CD})\hat{c}^*, h^0)] \end{aligned}$$

$$\hat{c}^0 = \left\{\hat{c}_j^0\right\}_{j=J_W}^{J_D} \equiv \left\{\left(\frac{c_j^*}{c_j^0}\right)c_j^0\right\}_{j=J_W}^{J_D},$$

where c_j^0 and c_j^* are the average consumption values of the populations whose

[8] CEV, CEV_C, and CEV_H are related such that $(1+CEV_c)(1+CEV_H)$ or $CEV \approx CEV_c + CEV_H$.

ages are j before and after the system change, respectively. Similarly, the welfare change due to the change in labor supply, CEV_H, can be divided into CEV_{HL} and CEV_{HD}.

III. Calibration

A. *Demographic Transition*

The demographic transition of the model economy is calibrated to match the history and the projection by Statistics Korea as of 2010. To solve the model, projections of fertility and survival probabilities are required to produce the age distribution of the population at each period. The net fertility rates $n_T(t)$ are calculated to match the growth rate of the one-year-old population until 2060. However, to completely solve the model economy quantitatively, we need information beyond 2060. Between 2060 and 2100, the net fertility rate projections are obtained from the Statistical Research Institute. After 2100, they are assumed to be fixed at zero. The conditional survival probabilities, $\psi_T(j,t)$, are drawn from the life tables projected by Statistics Korea. Because the projected life tables are in five-year periods, the probabilities for the interim periods are approximated by linear interpolation. After 2060, the survival probabilities are assumed to remain fixed at the 2060 levels. Under the assumptions specified above, the population distribution reaches a steady state in 2200, wherein the population growth rate is zero percent and the age distribution of the population does not change over time.

B. *Utility and Labor Market Productivities*

The parameter γ denotes the intertemporal substitution elasticity of work hours. Micro-estimates of γ range from 0.1 to 0.7. We choose a value of 0.4, which is a widely accepted value for the class of the model economy considered in this paper. We choose the weight parameter for disutility from working, B, such that the average number of hours of work is 1/3 between 1989 and 2014 in the model simulation. The preference discount factor β is set such that the average K/Y ratio of the model economy during 1989~2014 matches the average value of the K/Y ratio data for the same period, which is 2.9. Note that the average K/Y ratio of the model economy between 1989 and 2014 is pinned down, but the dynamics is determined endogenously in the model. The definition of the capital stock for calculating the K/Y ratio is the private production capital stock from the National Balance Sheet.

As specified in the previous section, individual workers are heterogeneous along three dimensions that affect their labor productivity: a deterministic age-dependent component $\{\varepsilon_j\}_{j=24}^{65}$, a type-dependent fixed effect z, and a persistent idiosyncratic shock, x. These specifications and the calibration strategy are adopted from Conesa, Kitao, and Krueger (2009). For the type-dependent fixed effect, we consider two ability types $z_1 = \exp(-\sigma_z)$ and $z_2 = \exp(\sigma_z)$ with an equal population mass of 0.5. We assume that $E[\ln(z)] = 0$ and $Var[\ln(z)] = \sigma_z^2$.

For the persistent idiosyncratic shock, we specify the stochastic process such that $\ln(x)$ follows the AR(1) process, as follows:

$$\ln(x') = \rho_x \ln(x) + \varepsilon_x,\ \varepsilon_x \sim N(0, \sigma_\varepsilon^2).$$

We discretize the AR(1) process with seven nodes using the method suggested by Rouwenhorst (1995). We further assume that x is equal to the unconditional average $(\equiv \bar{x})$ when workers enter the economy.

The variance of logged productivity is, then, determined along the age dimension as follows:

$$(8) \qquad Var[\ln(\varepsilon_j) + \ln(z) + \ln(x_j)] = 0 + \sigma_z^2 + \sigma_\varepsilon^2 \sum_{h=0}^{j-1} \rho_x^{2h}$$

In order to quantify the specified labor productivity, we need the parameter values for $\{\varepsilon_j\}_{j=24}^{65}$ are determined in such way that the model-generated age profile of log earnings in 2014 matches the data. In Figure 3, the age earnings profile from the model simulation is represented by the thick straight line and the calibrated values of $\{\varepsilon_j\}_{j=24}^{65}$ put into the model are represented by the thick dashed line. Moreover, the values of σ_z^2, ρ_x, and σ_ε^2 are calibrated jointly to match the cross-sectional variance of individual labor earnings. As shown in the panel on the right in Figure 3, the cross-sectional variance of logged individual labor earnings increases almost linearly along the age dimension. To mimic this pattern, we must have $\rho_x \approx 1$, as implied by equation (8). We, however, limit the value to 0.99 for the parameter

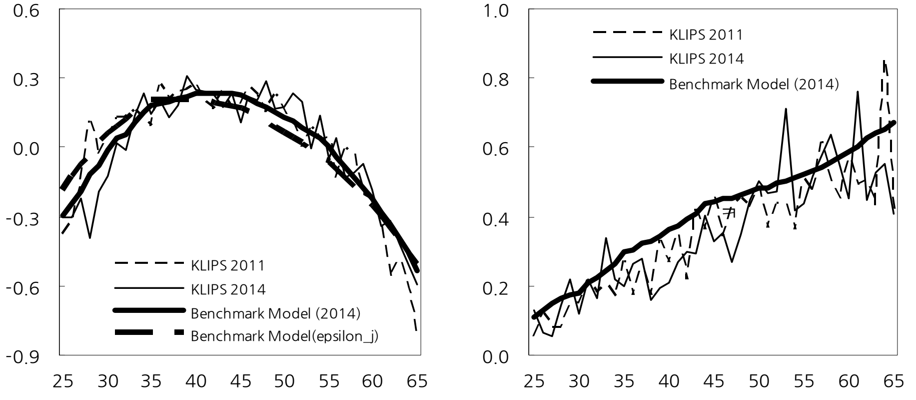


FIGURE 3. NORMALIZED LIFE-CYCLE PROFILE AND VARIANCE OF LABOR EARNINGS

Source: Korean Labor & Income Panel Study, 2012 and 2015.

ρ_x for technical reasons. The parameter σ_z^2 is determined to match the variance for the age of 24, which is 0.1, and the calibrated value is $\sigma_z^2 = 0.1$. Finally, the parameter σ_ε^2 is calibrated for the model-generated variance for the age of 60 to match the data, making this value 0.6. The calibrated value for the parameter σ_ε^2 is 0.016.

C. *National Pension System*

The National Pension System was introduced in 1988 and has since been revised twice through reforms, in 1997 and in 2007. The model parameters determining the contributions and benefits are calibrated to mimic the current system, which includes the changes put into place by the two reforms. The premium rates are set to 3%, 6% and 9% for the periods of 1988~92, 1993~97, and 1998 onwards, respectively. Note that the system is switching to a pay-as-you-go system if the National Pension Fund becomes insolvent. In such a case, the premium rate is set endogenously to ensure the period-by-period budget constraint. Between 1988 and 1998, the value of α_A was 0.43, but the value has been set to 0.5 since then. The pension reform in 1997, therefore, strengthened slightly the income-redistribution role of the National Pension System.

When the National Pension was introduced, the value of the proportional constant d_t was set to 0.35, which implied an income replacement ratio of 35% for the 20-years-of-enrollment period. As part of the first reform in 1997, the value was lowered to 0.30. With the second reform in 2007, the value of d_t was set to decrease annually by 0.005 until reaching the level of 0.2 in 2028. After 2028, it is assumed to remain fixed at the value of 0.2. Given the time-series of d_t, the values of $D_K(k)$ are calculated using equation (2). Figure 4 reports the calculated income replacement ratios $D_K(k)$ across birth cohorts. When the system was introduced in 1988, an income replacement ratio of 35% after the 20-years-of-enrollment period was targeted, but it is slated to be reduced to the level of 20% eventually. Because the system must honor the previous contributions at the time of the reform, only the future proportional constants had to be decreased to cut the pension benefits, which implied a loss in benefits for the young and for future generations.

In the model economy, the proportion of the insured in each cohort is determined exogenously. For each birth cohort, it is calculated by dividing the number of insured by the number of the population when the cohort reaches the age range of 55~59, as shown in Figure 5. For the 1962~1970 cohort for whom the values are not yet realized, this proportion is assumed to increase to 70%. For those born after 1970, it is assumed to stay at 70%, which is in line with official projections.

The maximum Standard Yearly Income $\overline{y_t}$ is approximately the twice of the Average Yearly Income $A_T(t)$ in 2014. We assume that this ratio is maintained for all simulation periods.

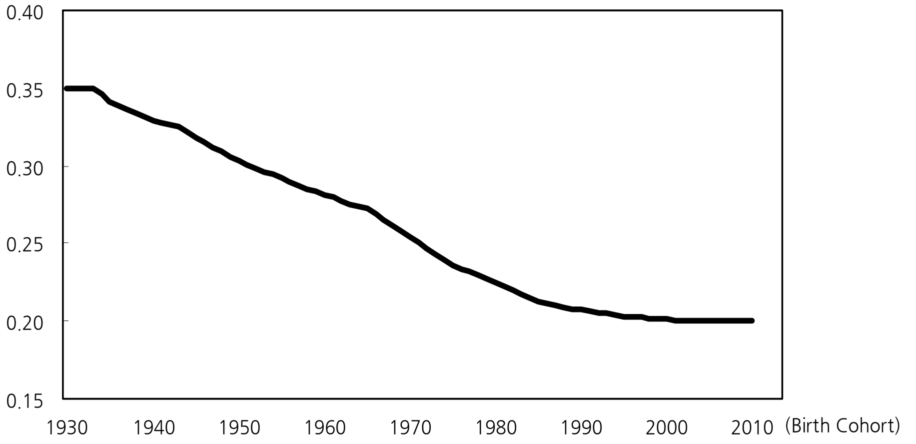


FIGURE 4. THE PROJECTED INCOME REPLACEMENT RATIO BY BIRTH COHORT ($D_K(k)$)

Note: Based on the author's calculation. An insured period of 20 years before retirement is assumed.

Source: The National Pension Act, 1988, 1997, and 2007.

FIGURE 5. THE ENROLLMENT RATE IN THE NATIONAL PENSION BY BIRTH COHORT

Note: The enrollment rates for the age group of 55~59 are reported in the figure.

Source: 1995~2015 National Pension Statistics Facts Book, National Pension Service.

D. *Production function and other parameters*

With the Cobb-Douglas production function assumption, if the goods and factor markets are competitive, the output elasticity of capital α turns out to be equal to the capital income share. We choose a value of 0.35, which is the average capital income share between 2000 and 2014. The definition of the capital income share we employ is $1-(\text{labor income} + \text{self-employed income}) / GDP$.

The total factor productivity (TFP) is calculated with the standard growth accounting method. In this paper, the TFP is assumed to be identified as the Solow residual. Thus, different measures of labor and capital input yield different values of the TFP. To maintain consistency with the model economy, we define the labor input as the total number of employees weighted by the age-productivity profiles. For the future values of total factor productivity, we adopted the TFP growth rate from Cho (2014) until 2035 and assume that there is continued growth thereafter at a constant rate of 1.3 percent per annum. The depreciation rate of capital stock is calculated to match the average private gross real fixed investment of national accounts during the period of 1989 and 2014, which is 29%. The calculated depreciation rate is 8%. We used a value of 5.5% before 2000 to reflect the rising pattern of the depreciation rate in the data. Given the value of the output elasticity of capital of 0.35 and the mean value of the capital-output ratio of 3 after 2000, the implied marginal productivity of capital is about 4% between 2000 and 2015. The labor income tax rate and capital income tax rate are set to 15%.

Model simulations require the initial asset holdings by age in the year 1989. We use Statistics Korea's Household Asset Survey of 2006 to determine the age-asset distribution in 1990; although this survey was conducted for the year 2006, to the best of our knowledge, it is the earliest data available. The aggregate wealth of the model economy in 1989 is then then rescaled to match the K/Y ratio in 1990, which is 2. Within each cohort in the year 1989, the assets are evenly distributed.

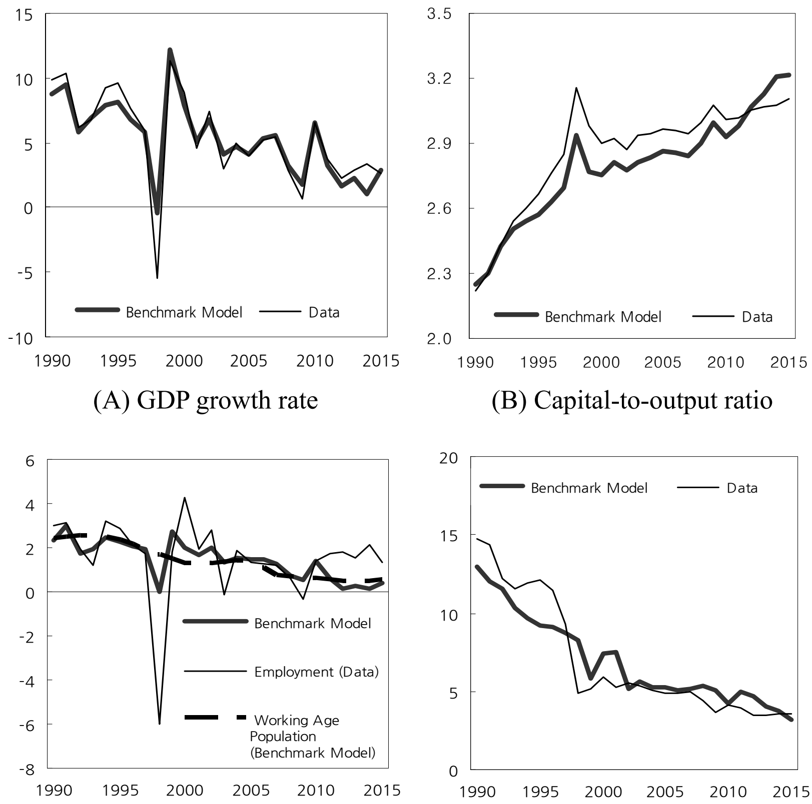
IV. Benchmark Model Simulation

A. *In-sample Performance of the Model*

We compare the simulated aggregate variables with the relevant historical data, in this case the employment growth rate and the real GDP growth rate. Panel A in Figure 6 shows the time series of the GDP growth rate. The model captures the downward trend in the GDP growth well, as the endogenous variables of the model react in a consistent manner with the actual data when the demographic structure and the TFP are fed into the model.

Panel C of Figure 6 depicts the aggregate labor growth rate of the model economy and the employment growth rate from the Economically Active Population Survey.[9] Also shown in the figure is the growth rate of the population aged 24~64 in the model economy. The employment growth rate exhibits a slow downward trend and short-run fluctuations. The trend in the employment growth rate is well captured by the growth rate of the population aged 21~64 of the model economy. As reported in Table 2, the contribution of labor to GDP growth was 1.0% per annum in the 1990s and 0.8% per annum in the 2000s. In the model economy, the corresponding numbers are 1.3% and 0.9%, respectively. However, not well replicated by the model economy are the relatively high employment growth rates in the first half of the 2010s. During this period, we observe a slowdown in GDP growth and a relatively

[9]A closer empirical counterpart for our aggregate labor here can be constructed using total working hours weighted by the age-productivity profile. However, the time series of average working hours can be obtained for the years after 2004, which is much shorter than the in-sample time horizon.



(A) GDP growth rate

(B) Capital-to-output ratio

(C) Labor input growth rate

(D) Growth rate of capital

FIGURE 6. MACROECONOMIC VARIABLES OF THE BENCHMARK MODEL ECONOMY

Note: 1) The working-age is between 24 and 64. 2) The definition of capital stock is private production capital stock as reported in the National Balance Sheet.

Source: Economically Active Population Survey, Statistics Korea; National Account, National Balance Sheet, Bank of Korea.

high growth rate of employment, resulting in low values of the TFP. In turn, when we feed the realized TFP into the model, it is difficult to generate the high employment growth observed in the data. Part of the problem stems from the fact that we assume that TFP growth accelerates in the second half of the 2010s. Given that agents perfectly foresee the entire path of TFP growth, the working hours chosen by the agents are opposite to what we observe in the data.

Panel D in Figure 6 shows the growth rate of capital stock. Capital stock refers to the share of capital stock held by the private sector from the National Balance Sheet. The long-term downward trend in capital accumulation is also well captured in the model simulation. The secular decline reflects the fact that the slowdown in TFP growth and the decline in the growth rate of the working-age population have lowered the demand for investment. However, the investment boom in the 1990s is not well explained by the model. We view this shortcoming as also stemming partly from the perfect-foresight information assumption. That is, the investment boom during this period may have been based on optimistic expectations for the Korean

TABLE 2—GROWTH ACCOUNTING FOR THE BASELINE MODEL

(Unit: %, %p)

Period	Output Growth Rate (1+2+3)			Contribution of Labor (1)		Contribution of Capital (2)		Contribution of TFP (3)		Wage Growth		Real Interest Rate	
1991~2000	6.8	(6.7)		1.3	(1.0)	3.1	(3.3)	2.4	(2.4)	4.8	[3.8]	8.0	[8.2]
2001~2010	4.6	(4.3)		0.9	(0.8)	1.8	(1.6)	1.9	(1.9)	3.3	[3.8]	4.2	[2.5]
2011~2020	2.3	(2.9*)	3.8	0.1	(1.1*)	1.2	(1.2*)	0.9	(0.6*)	2.1	[1.8*]	3.0	[1.4*]
2021~2030	1.5	( )	2.9	-0.5		0.7		1.3		2.2		2.3	
2031~2040	0.8	( )	1.9	-0.9		0.3		1.3		2.1		2.0	
2041~2050	0.3	( )	1.4	-1.1		0.1		1.3		2.0		2.0	
2051~2060	0.6	( )	1.1	-0.8		0.1		1.3		1.8		2.2	
2061~2070	0.7	( )	0.7	-0.8		0.1		1.3		1.8		2.4	
2071~2080	0.9	( )	0.9	-0.7		0.3		1.3		1.9		2.7	
2081~2090	0.8	( )		-0.8		0.3		1.3		2.0		2.6	
2091~2100	0.7	( )		-0.8		0.3		1.3		2.0		2.6	
…	…			…		…		…		…		…	
2200~2210	2.0			0.0		0.7		1.3		2.0		3.0	

Note: 1) Growth accounting outcomes based on data are reported in the parentheses. The results from the benchmark model economy are reported on the left side of the parentheses. The numbers on the right side of the parentheses are the GDP growth rates from the Third National Pension Fiscal Projection. 2) The numbers in the angled parentheses represent the average of hourly real wages and the corporate bond yields (three-year, AA-). The results from the benchmark model economy are reported on the left side of the angled parentheses. 3) The numbers with the superscript, *, are average values for 2011~2015.

economy. However, economic agents in the model who perfectly forecast the slowdown in the economy afterwards do not invest as much, as indicated by the data for that period.

Panel B in Figure 6 shows the time series of the capital-output ratio. Because the Cobb-Douglas production function is assumed, the degree to which the capital to output ratio changes is closely related to the changes in the price variables. Shown in Figure 7 are the wage growth rate and the real interest rate. Despite the fact that short-term fluctuations are not well replicated, the trends of these variables are well captured by the model economy, which is crucial for the purpose of this paper. The trend of the model interest rates is similar to that of real corporate bond yields, but these rates have been approximately 1%p higher since the 2000s. The interest rate of the model reflects the marginal productivity of capital, which is not a concept directly comparable to corporate bond yields. However, corporate bond yields are known to be an important variable for forecasting the future fiscal condition of the National Pension, and these are reported here for interested readers.

The growth path of the benchmark model economy, including future projections, is reported in Table 2. To analyze the factors contributing to the secular decline in GDP growth, we also report the results in the growth accounting form. The numbers in parentheses are the growth accounting results based on the data to extract the time series of the TFP. In addition, on the right of the parentheses are the GDP growth projection rates quoted from the Third Long-Term Fiscal Projections in 2013 for comparison.

The ten-year average GDP growth rate of the model economy declines from 6.8% in the 1990s to 4.6% in the 2000s, and to 2.3% in the 2010s, and is projected to stabilize at around 0.7~0.9% after 2050s. The declines in the GDP growth rate are mainly attributable to the decreased contribution of labor input. In the model economy after 2030, the contribution of labor is close to -1%p per annum, which reflects the dramatic decrease in the population aged 21~64. The decline in the working-age population will slow the GDP growth rate further through less

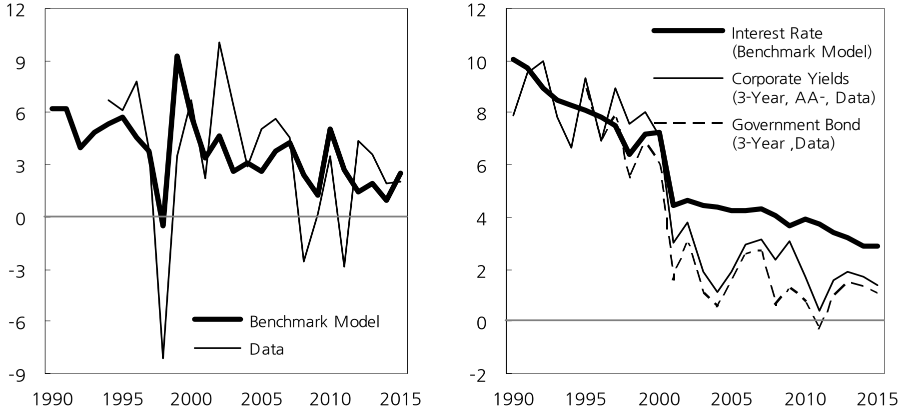


FIGURE 7. WAGE GROWTH RATES AND REAL INTEREST RATES

Note: The hourly wage rate is calculated as the ratio of the total wage bill to the total working hours.

Source: Business Labor Force Survey, 1993~2015, Ministry of Employment and Labor; ECOS, Bank of Korea.

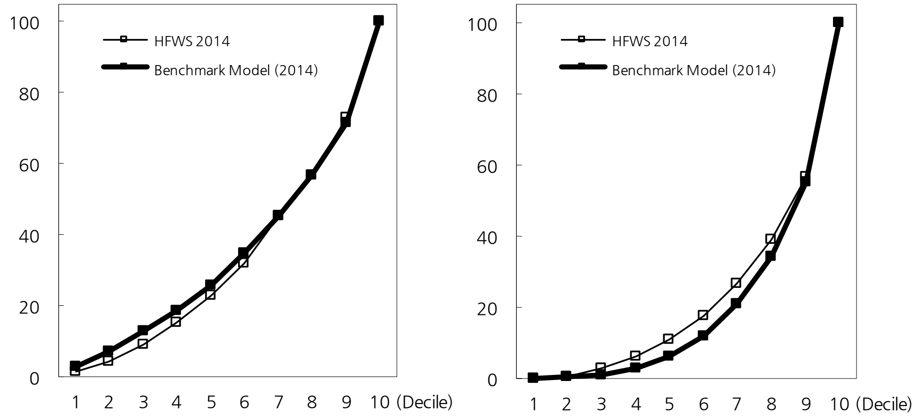


FIGURE 8. LORENZ CURVE FOR LABOR INCOME (LEFT) AND NET WORTH (RIGHT)

Source: Household Finance and Welfare Survey, 2014.

accumulation of physical capital. The contribution of physical capital to GDP growth is also steadily declining, reaching only 0.1% per annum in the 2050s. As shown later, the National Pension Fund in the model begins to decline from its peak in 2030 and becomes depleted in 2050. The accumulation of capital is in part negatively affected by the decumulation of the fund from 2030 to 2050.

In the long run, the model economy reaches a balanced growth path, where the population structure and the TFP growth stabilize. As presented in Table 2, total factor productivity increases by 1.3% per annum and physical capital increases by 0.7% per annum. In addition, GDP grows at a rate of 2.0% per annum.

We examine the cross-sectional inequality of income and wealth among economic agents in the model. The panel on the left in Figure 8 shows the Lorenz curve for labor earnings in 2014 from the model. Also shown is the Lorentz curve from actual data (Data) using the Household Finance and Welfare Survey for 2014. The inequality of earned income is slightly lower in the model economy, but the difference is not meaningfully significant. The Gini coefficients of the earned income are 0.35 in the model and 0.38 in the data. The Lorentz curve for wealth is shown in the panel on the right in Figure 8. The degree of wealth inequality is determined endogenously by workers' optimal choices. It can be seen that the degree of wealth inequality is somewhat greater in the model. In 2014, the Gini coefficient of net asset holdings was 0.58 in the Household Finance and Welfare Survey, but it is 0.64 in the model. The Lorentz curve for wealth indicates that the model generates too many workers with relatively low wealth, which is commonly observed in the class of model applied in this study according to Hugget (1996).

B. *Benchmark Model Simulation Results for the National Pension System*

In the benchmark model economy, the National Pension Fund reaches its peak in 2030 relative to GDP and runs out of funds in 2049, as reported in Figure 9. After that date, the National Pension System shifts from a partially funded system to a pay-as-you-go system and the equilibrium premium rate soars to a level of 29.3% from

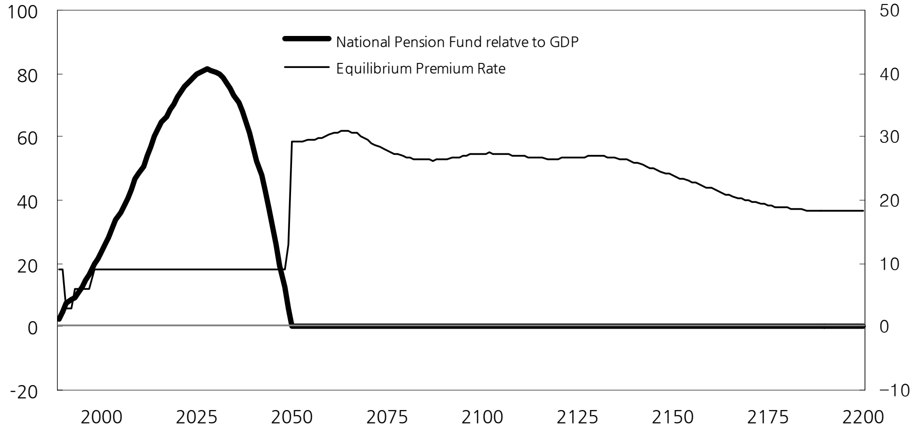


FIGURE 9. PATH OF THE NATIONAL PENSION FUND RELATIVE TO GDP AND THE EQUILIBRIUM PREMIUM RATES: BENCHMARK MODEL

the level of 9% in 2050. The premium rate stays at about 30% until 2070 and then falls slightly to 26~27% for a considerable period after 2070. On the balanced growth path, the equilibrium premium rate turns out to be 18.3%, which is still very high compared to the then-current value of 9%. Thus, even without population aging, the 9% premium rate is insufficient to maintain the financial stability of the National Pension System in the benchmark model economy.

In order to examine the generational burden and benefits associated with the current National Pension System in the model, Table 3 reports the average premium rate and the income replacement ratio for selected cohorts. The income replacement ratios are calculated based on 20 years of enrollment. The average premium rate refers to the overall average premium rate during the insured period for each cohort in the model. The drop in the income replacement ratio reflects the two national pension reforms in 1998 and 2007. The average premium rate increases very rapidly for young and future generations because the system switches to a pay-as-you-go system in 2050. The premium rate must skyrocket in order to balance the pension budget in the benchmark model economy.

TABLE 3—BENEFITS AND COST OF THE NATIONAL PENSION BY COHORT: BENCHMARK MODEL

(Unit: %)

Birth Cohort	1950	1960	1970	1980	1990	2000	2010	2020	2030	2040	2050	···	2200
Income Replacement Raito	30.3	28.1	25.4	22.4	20.7	20.1	20.0	20.0	20.0	20.0	20.0	···	20.0
Average Premium Rate	8.0	8.3	8.6	9.0	11.5	16.6	21.5	25.8	28.4	27.7	27.0	···	18.3
Benefits-Cost Ratio													
Benchmark Model	2.9	2.6	2.3	2.0	1.4	1.0	0.7	0.6	0.5	0.6	0.6	···	0.8
Choi and Shin (2015)	3.2	2.4	2.2	2.1	1.9	·	·	·	·	·	·	...	·

Note: Table 3 from Choi and Shin (2015).

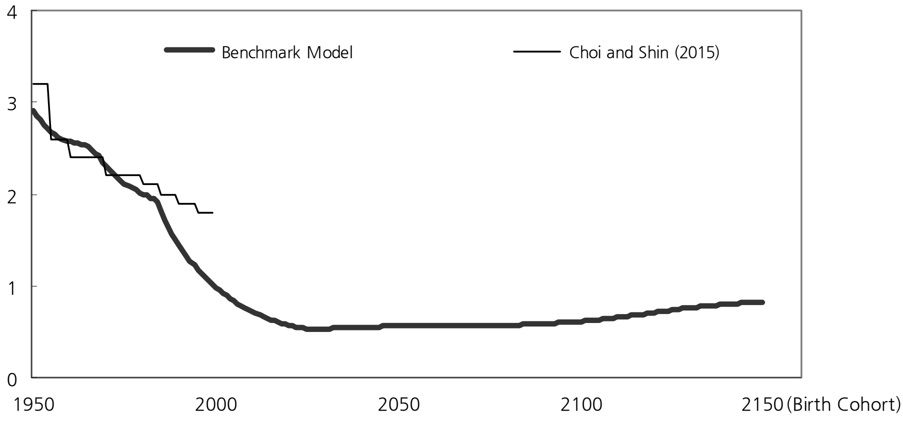


FIGURE 10. BENEFIT-COST RATIO BY BIRTH COHORT: BENCHMARK MODEL

Also reported in Table 3 is the benefits-cost ratio for the selected cohorts. The benefits-cost ratio is defined as the ratio of the present value of the total amount of pension benefits to the present value of the total contributions by a cohort. The present value is calculated with the equilibrium interest rate of the model and is evaluated on the start of economic activity for each cohort. The ratio decreases with the birth cohorts because the income replacement ratio decreases though the premium rate increases. Note that in the long run, the ratio converges not to the level of 1.0 but to the level of 0.8 in the benchmark model simulation.[10] Thus, having a profit ratio lower than 0.8, the 2010~2050 cohorts in Table 3 are sacrificing themselves to support the National Pension System in the benchmark model simulation. On the other hand, the earlier birth cohorts benefit from the system.

Choi and Shin (2015) estimated the benefits-cost ratio by cohort based on historical data and the Third Long-Term Fiscal Projections. Their results are shown at the bottom of Table 3 and in Figure 10. In general, our simulation results are consistent with theirs, but the benefits-cost ratio for the 1990 birth cohort is much lower in the benchmark model. This occurs because the premium rate soars when the fund reserve becomes insolvent, whereas Choi and Shin (2015) assume the then-current 9% premium rate to continue indefinitely. In comparison with Choi and Shin (2015), we contend that our model can be considered reasonably successful in replicating the core features of the National Pension System.

V. An Analysis of Welfare Changes in the National Pension System Improvement Plans

A. *Increase in the Premium Rate*

This subsection reports simulation results to achieve the fiscal stabilization of the

[10]As discussed earlier, pension benefits are affected by the Standard Yearly Income revaluated using the average labor income growth rate. The benefits-cost ratio in the long run will, therefore, be affected by the gap between the wage growth rate and the market interest rate.

National Pension System by raising the premium rate. Because there is no explicit agreement on the definition of fiscal stabilization as it pertains to the National Pension System, we adopt the definition suggested by the Third National Pension Improvement Committee in 2013. It suggested as a goal to maintain a reserve fund at more than twice the projected annual expenditure until 2083. In this subsection, we calculate the equilibrium premium rate necessary to remain solvent for another 30 and 50 years from the date of the depletion in the benchmark model economy. More specifically, we find the minimum premium rates that allow the National Pension Fund to avoid depletion until 2080 (Plan 1) and 2100 (Plan 2). We then analyze the welfare consequences based on the welfare criterion presented in Section 3. To simplify the problem, we assume that the government will announce a one-time unexpected premium rate increase in 2021 and implement the plan immediately. Reported in the left panel of Figure 11 is the equilibrium premium rate after the reforms. It was found that is necessary to raise the premium rate by 9.3%p for Plan 1 and 11.0% p for the Plan 2 from the current premium rate of 9%.

The macroeconomic effects of the Plan 1 are reported in Table 4. The numbers reported in Table 4 are the percentage deviation in levels from the benchmark model for the selected years. The numbers in the parentheses are the simulation results, in which the wage growth rate and the interest rate are fixed at the level of the benchmark model.

If the price variables are not allowed to vary, the capital stock increases by 19.2% in 2060 compared to the benchmark model mainly due to the large increase in the National Pension Fund. In the long run, the capital stock, however, converges to the level of the benchmark model given that Plan 1 is only a temporary measure.

The labor supply is low relative to the benchmark model until 2049, when the fund depletes in the benchmark model. However, the labor supply increases significantly between 2050 and 2080 in response to the drop in the premium rate compared to the benchmark model. Like the capital stock, the labor supply returned to the same level as the benchmark economy in the long run. With regard to GDP, the effect of the increase in the capital stock outweighs that of the decrease in the aggregate labor input. Therefore, output also increases except for a few periods

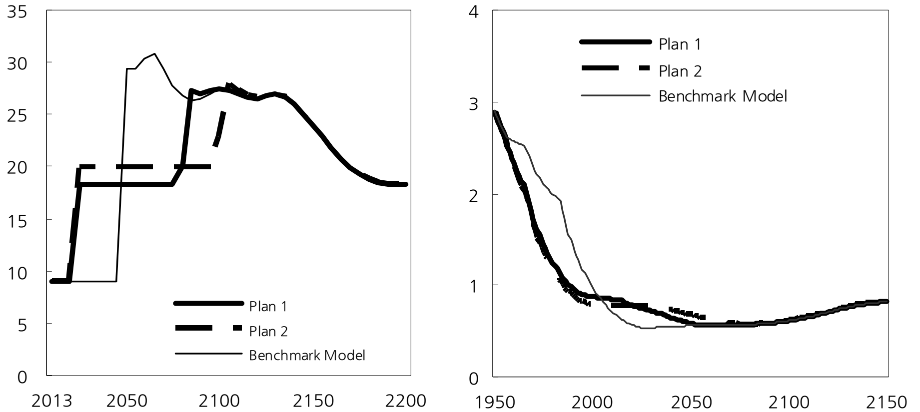


FIGURE 11. PATH OF THE EQUILIBRIUM PREMIUM RATE (LEFT) AND THE BENEFITS-COST RATIO (RIGHT)

TABLE 4—CHANGES IN MACROECONOMIC VARIABLES: PLAN 1

(Unit: %, %p)

Period	GDP		Labor		Capital		Wage		Premium Rate(τ)		Real Interest Rate	
2021	-0.4	(-0.1)	-0.72	(-0.30)	0.00	(-0.05)	0.23	(0.00)	0.09	(0.09)	-0.04	(0.00)
2030	0.8	(2.1)	-0.58	(-0.33)	3.46	(6.44)	1.42	(0.00)	0.09	(0.09)	-0.26	(0.00)
2040	1.6	(3.9)	-0.88	(-0.97)	6.67	(13.23)	2.64	(0.00)	0.09	(0.09)	-0.47	(0.00)
2050	4.3	(7.3)	3.11	(2.91)	8.93	(18.08)	2.35	(0.00)	-0.11	(-0.11)	-0.42	(0.00)
2060	3.8	(7.0)	2.01	(1.59)	9.03	(19.23)	2.67	(0.00)	-0.12	(-0.12)	-0.49	(0.00)
2070	2.8	(5.8)	1.33	(0.93)	6.71	(16.23)	2.01	(0.00)	-0.11	(-0.12)	-0.38	(0.00)
2080	1.6	(3.9)	0.61	(0.31)	3.69	(10.97)	1.11	(0.00)	-0.07	(-0.07)	-0.22	(0.00)
2090	0.4	(1.7)	-0.41	(-0.76)	1.53	(6.02)	0.63	(0.00)	0.01	(0.01)	-0.12	(0.00)
2100	0.2	(0.9)	-0.08	(-0.15)	0.48	(2.79)	0.18	(0.00)	0.00	(0.00)	-0.03	(0.00)
2150	0.0	(0.0)	0.00	(0.00)	0.00	(0.12)	-0.01	(0.00)	0.00	(0.00)	0.00	(0.00)
2200	0.0	(0.0)	0.00	(0.00)	-0.01	(0.00)	0.01	(0.00)	0.00	(0.00)	0.00	(0.00)

Note: The results for Plan 1 are reported on the right side of the parentheses. Reported in the parentheses are the partial equilibrium results for Plan 1. The percentage deviation levels from the benchmark model are reported.

immediately after the implementation of Plan 1.

In the general equilibrium case, the adjustments in prices to clear markets significantly dampen the response of the macroeconomic variables. As the National Pension Fund expands, the equilibrium interest rate falls sharply as capital stock relative to labor input increases rapidly. The equilibrium interest rate falls by 0.5%p in 2060, when its difference reaches the maximum. On the other hand, the increased wages induce workers to supply more labor to the market. The expansionary output effect reaches its maximum relative to the benchmark simulation in 2050, and the GDP increases by 4.3%. To increase the GDP by 4.3% in 30 years, it must grow more rapidly by approximately 0.15% per annum from 2021 to 2050, which is a significant growth effect given the low growth rate projection in the benchmark model economy. The macroeconomic effects of the implementation of Plan 2 are reported in the appendix. In order to facilitate comparison with Plan 1, the results for Plan 1 are reported again in the parentheses.

Table 5 shows the changes in the average premium rate and the benefits-cost ratio according to Plan 1 and Plan 2. Recall that the equilibrium premium rate to implement Plan 1 is 18.2%. Because the transition to the pay-as-you-go system is delayed for 30 years, the equilibrium premium rates between 2050 and 2080 drop significantly. As a result, the average premium rates during a lifetime for the generations working for that period are significantly lower. For example, the average premium rate for the 2030 cohort fell by 7.1%. However, the effect on the average premium rate for the 2050 cohort was insignificant, as they start working in the mid-2070s. As shown in Figure 11, Plan 1 is not a long-term solution to the fiscal problems of the system, though it postpones the depletion of the fund. On the other hand, the average premium rate for the generations born before 2000 increases due to the reform. For example, in case of the 1980 cohort, the average premium rate rises by 5.3%p by Plan 1, which is still lower than the long-run steady state premium rate of 18.3%.

With the implementation of Plan 2, the fund's insolvency is postponed until 2100

TABLE 5—BENEFITS AND COSTS OF THE NATIONAL PENSION BY COHORT: REFORMS

(Unit: %)

Birth Cohort	1950	1960	1970	1980	1990	2000	2010	2020	2030	2040	2050	···	2200
Income Replacement Ratio	30.3	28.1	25.4	22.4	20.7	20.1	20.0	20.0	20.0	20.0	20.0	···	20.0
Average Premium Rate													
Benchmark Model	8.0	8.3	8.6	9.0	11.5	16.6	21.5	25.8	28.4	27.7	27.0	···	18.3
Plan 1	8.0	9.3	11.7	14.3	16.5	18.2	18.2	19.2	21.3	23.5	25.6	···	18.3
Plan 2	8.0	9.5	12.3	15.3	17.9	20.0	20.0	20.0	20.0	20.8	22.6	···	18.3
Benefits-Cost Ratio													
Benchmark Model	2.9	2.6	2.3	2.0	1.4	1.0	0.7	0.6	0.5	0.6	0.6	···	0.8
Plan 1	2.9	2.3	1.7	1.2	1.0	0.9	0.8	0.8	0.7	0.6	0.6	···	0.8
Plan 2	2.9	2.3	1.6	1.2	0.9	0.8	0.8	0.8	0.8	0.7	0.7	···	0.8

and the premium rate rises to 20%. As shown in the panel on the right in Figure 11, the premium rate and the benefits-cost ratio are greatly equalized across generations, despite the fact that Plan 2 does not avoid the depletion of the reserve fund. Note also that the benefits-cost ratios for the young and future generations become similar to the long-run steady-state value under Plan 2.

We now turn to look at the welfare implications of the reforms. The change in welfare in terms of CEV for the selected birth cohorts are reported in Table 6 and Table 7. The patterns of welfare changes among the generations are similar to the changes in the average premium rate reported in Table 5. The welfare of the 2020~2050 cohorts, who supply labor actively between 2050 and 2080, increases significantly due to the reform as the burden of paying a premium falls sharply. For example, the welfare gain of the 2030 cohort is found to be 9.3% in terms of CEV, which means that the gain amounts to an increase in consumption of 9.3% for every possible contingency during the lifetime of this cohort. Note that most of the welfare change is explained by the increase in consumption, CEV_C. Further decomposition of CEV_C shows that the gain from the reduction in uncertainty, CEV_{CD} is negligible relative to CEV_{CL}. However, note that CEV_{CD} is positive for the

TABLE 6—CHANGES IN WELFARE FOR THE SELECTED COHORTS: PLAN 1

(Unit: %)

Birth Cohort	CEV	CEV_C			CEV_H		
			CEV_{CL}	CEV_{CD}		CEV_{HL}	CEV_{HD}
1998	-2.2	-2.3	-2.0	-0.3	0.1	-0.1	0.2
2000	-1.4	-1.4	-1.2	-0.2	0.1	-0.1	0.2
2010	3.1	3.2	3.3	-0.1	-0.1	-0.3	0.2
2020	6.7	7.0	7.1	-0.1	-0.3	-0.4	0.1
2030	9.3	9.3	8.4	0.8	0.0	0.0	0.0
2040	6.2	6.0	5.4	0.6	0.1	0.1	0.0
2050	2.6	2.4	2.1	0.4	0.1	0.1	0.0
2060	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0
2100	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2150	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 7—CHANGES IN WELFARE FOR THE SELECTED COHORTS: PLAN 2

(Unit: %)

Birth Cohort	CEV	CEV_C			CEV_H		
			CEV_{CL}	CEV_{CD}		CEV_{HL}	CEV_{HD}
1998	-3.4	-3.5	-3.4	-0.2	0.1	0.0	0.2
2000	-2.6	-2.7	-2.5	-0.2	0.1	-0.1	0.2
2010	1.8	1.9	2.0	0.0	-0.1	-0.3	0.2
2020	6.7	6.9	6.8	0.1	-0.2	-0.3	0.1
2030	10.7	10.7	9.8	0.8	0.0	-0.1	0.1
2040	8.7	8.7	8.1	0.5	0.0	-0.1	0.1
2050	6.0	6.0	5.5	0.5	0.0	0.0	0.0
2060	3.6	3.6	3.4	0.2	0.0	0.0	0.0
2100	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2150	0.0	0.0	0.0	0.0	0.0	0.0	0.0

2030~2050 cohorts; moreover, the magnitude is not too small so as to be ignored. As the average premium rates for these cohorts drop sharply, their ability to accumulate savings to buffer the effects of productivity shocks on consumption is improved significantly.

The decomposition of welfare change shows that for the young and future generations, the reduction in the burden to support the National Pension System greatly improves their welfare. Of course, they benefit from the reform at the expense of the older generations. However, the welfare analysis in Table 6 together with the changes in the benefits-cost ratios reported in Figure 11 clearly indicate that the current system is unjustifiably partial to those in the older generations.

Shown in Table 7 are the welfare changes caused by the implementation of Plan 2. As expected, the results are qualitatively similar to those of Plan 1 and are quantitatively larger than those of Plan 1. However, the results in Table 5 are interpreted as meaning that Plan 2 distributes more evenly the burden of supporting the National Pension System than Plan 1 across generations, as the benefits-cost ratios become closer to the steady-state value for many more generations. However, in the model economy, older cohorts that start working before 2021 lose due to the reforms. If the implementations of Plans 1 and 2 are determined by voting in 2021, it turns out that even Plan 1 is not implementable, as the future generations are not eligible to vote.

We also attempted to find ways to achieve the goal of Plan 1 by reducing the benefits of the National Pension, i.e., by adjusting the proportional constant d_t. However, if the system is to be modified akin to how the second National Pension reform was in 2007, this goal cannot be achieved. The reform in 2017 guaranteed proportional constants before the reform and announced a lowering of the proportional constants for the years to come. By honoring this vested right, we could not achieve the goal of postponing the depletion of the reserve fund for 30 years.

B. *Strengthening Income Redistribution*

As noted in the previous section, the degree of income redistribution is determined by the weight parameter α_A in equation (1). If the weight parameter were 1, regardless of individual earnings histories, the amounts of pension benefits would be identical for all beneficiaries within a birth cohort. At the other extreme, if the weight parameter were 0, the amount of pension benefits only depends on the individual earnings history, and there would not be any income redistribution by the National Pension System. In this subsection, the change in welfare is measured when the weight parameter changes to the value of 0.99 from the current value of 0.5. As the value of α_A increases, it turns out that the welfare evaluated by CEV for future generations increases. Therefore, we only report the simulation results of α_A being equal to the value of 0.99. We assume that the government will announce unexpectedly the change in the weight parameter in 2021 and implement it immediately in that year. We further assume that only the beneficiaries who retire after the announcement are affected by the reform. We refer this reform as Plan 3 hereafter.

The macroeconomic effects of Plan 3 are summarized in Table 8. As in Table 4, the percentage deviations in levels from the benchmark simulation are reported. Unlike the fiscal stabilization plans in the previous subsection, the reform in this subsection changes the system permanently and the macroeconomic variables are affected even in the long run. The aggregate labor supply and savings increase, resulting in an increase in the total output compared to the benchmark model. The wage rate is higher and the interest rate is lower than in the benchmark simulation as the aggregate labor supply relative to capital stock increases.

Researchers who are familiar with the class of model in this paper may see the results shown in Table 8 as counterintuitive. Because the uncertainty about allocation is expected to decrease due to the reform, the workers directly affected by the reform would supply less and save less as the precautionary motive decreases. However, the results in Table 8 are considered to be a somewhat special case because there is an upper limit on the Standard Yearly income $(\overline{y_t})$. We checked the case in which there is no maximum Standard Yearly Income in equation (1). In that model economy, the reform caused decreases in the labor supply, savings and output.

Reported in Table 9 are the changes in welfare in terms of CEV for the selected

TABLE 8— CHANGES IN THE MACROECONOMIC VARIABLES: PLAN 3

(Unit: %, %p)

Period	Output	Labor Input	Capital Stock	Real Wage	Real Interest Rate
2021	0.07	0.01	0.00	-0.02	0.00
2030	0.20	0.02	0.34	0.08	-0.01
2040	0.34	0.00	0.71	0.19	-0.04
2050	0.50	0.05	1.06	0.29	-0.05
2060	0.66	0.15	1.42	0.39	-0.07
2070	0.76	0.17	1.65	0.46	-0.09
2080	0.80	0.16	1.76	0.50	-0.10
2090	0.78	0.12	1.77	0.51	-0.10
2100	0.78	0.13	1.74	0.50	-0.10
2150	0.70	0.11	1.58	0.45	-0.09
2200	0.57	0.07	1.22	0.35	-0.07

TABLE 9—CHANGES IN WELFARE FOR THE SELECTED COHORTS: PLAN 3

(Unit: %)

Birth Cohort	CEV	CEV_C			CEV_H		
			CEV_{CL}	CEV_{CD}		CEV_{HL}	CEV_{HD}
1998	1.5	1.6	0.2	1.4	-0.1	0.0	0.0
2000	1.6	1.7	0.2	1.4	-0.1	0.0	0.0
2010	1.7	1.8	0.4	1.4	-0.1	-0.1	0.0
2020	1.8	1.9	0.5	1.4	-0.1	-0.1	0.0
2030	1.9	2.0	0.5	1.5	-0.1	-0.1	0.0
2040	2.0	2.1	0.6	1.4	-0.1	-0.1	0.0
2050	2.2	2.3	0.6	1.6	-0.1	-0.1	0.0
2060	1.9	2.1	0.7	1.4	-0.1	-0.1	0.0
2100	1.9	2.0	0.6	1.3	0.0	-0.1	0.0
2150	1.9	1.9	0.4	1.5	0.0	0.0	-0.1
2200	1.5	1.5	0.5	1.0	-0.1	-0.1	0.0

cohorts who start working after 2021. The welfare increases for all cohorts in Table 9 and the improvement show consumption increases of approximately 1.5% to 2.2% for every possible contingency compared to the benchmark economy. This increase in expected lifetime utility is attributable to the increase in consumption (CEV_C) rather than to a change in working hours. However, unlike the effects of fiscal stabilization reforms, the improvement in welfare arises from a reduction in the uncertainty of consumption path (CEV_{CD}) as opposed to being an effect of the level of consumption (CEV_{CL}).This result implies that in addition to the self-insurance mechanism through adjustments to the labor supply and savings, the National Pension System plays a role in providing additional insurance from labor market productivity shocks. Given the calibrated labor income process, workers in the benchmark economy desire more insurance to be provided by the National Pension System, which is reflected in the increase in the expected lifetime utility by the reform. The majority (64.3%) of the current population in 2021 are found to be in favor of the reform in the benchmark model simulation.

VI. Summary and Conclusion

The long-term financial outlook of the National Pension System is a grave concern. According to the Third Official Fiscal Projection in 2013 by the Ministry of Health and Welfare, the National Pension Fund will begin to run a deficit in 2044 and will run out of funds in 2060 under the current system. The long-term financial problems associated with the National Pension are attributable in part to the rapid change in the demographic structure of Korea. In addition to the rapid population aging, the long-term financial problems are deepened by certain structural issues of the National Pension System, referred to the “low burden but high benefit” issue here.

The purpose of this paper is to analyze plans to postpone the depletion of the National Pension Fund and to study welfare implications across generations. To do this, we build a life-cycle overlapping-generations macroeconomic model populated by heterogeneous agents. The model economy is composed of heterogeneous economic agents in terms of income histories and wealth holdings even within a generation.

According to simulation results, as in many other studies, it is desirable for the National Pension System to be improved in order to increase the equity across generations, and it should be promoted to strengthen the income redistribution function within a birth cohort, even at the current premium rate. We calculate the equilibrium premium rate to delay the depletion of the fund reserve for 30 years from the year of depletion in the benchmark model economy. We find that it is necessary to raise the premium rate by 9.2%p from the current premium rate of 9%. Although the plan is not strong enough to prevent the National Pension Fund from depletion, it enhances the equity across generations significantly. Aside from the goal of postponing the depletion of the fund, we also evaluate a plan to strengthen the income redistribution function of the system. A shortcoming of the welfare measure in the paper is that it does not reflect the overall welfare of the current and future population. To overcome this difficulty, Nishiyama and Smetters (2007) introduce what they term the Lump-Sum Redistribution Authority (LSRA) to analyze the social welfare of the older and future generations in a single framework. We leave a welfare analysis of this type for future research.

APPENDIX

TABLE A1—CHANGES IN MACROECONOMIC VARIABLES: PLAN 2

(Unit: %, %p)

Period	GDP (%)		Labor (%)		Capital (%)		Wage		Real Interest Rate (%p)	
2021	(-0.4)	-0.5	(-0.7)	-0.9	(0.0)	0.0	(0.2)	0.3	(-0.0)	-0.1
2030	(0.8)	1.0	(-0.7)	-0.6	(3.5)	4.2	(1.4)	1.7	(-0.3)	-0.3
2040	(1.6)	2.1	(-0.9)	-1.0	(6.7)	8.2	(2.6)	3.2	(-0.5)	-0.6
2050	(4.3)	5.1	(3.1)	3.1	(8.9)	11.3	(2.4)	3.2	(-0.4)	-0.6
2060	(3.8)	4.8	(2.0)	2.0	(9.0)	12.3	(2.7)	3.8	(-0.5)	-0.7
2070	(2.8)	3.9	(1.3)	1.0	(6.7)	10.5	(2.0)	3.4	(-0.4)	-0.6
2080	(1.6)	2.8	(0.6)	0.5	(3.7)	7.9	(1.1)	2.6	(-0.2)	-0.5
2090	(0.4)	2.0	(-0.4)	0.6	(1.5)	5.1	(0.6)	1.6	(-0.1)	-0.3
2100	(0.2)	1.1	(-0.1)	0.4	(0.5)	2.5	(0.2)	0.8	(-0.0)	-0.2
2150	(0.0)	-0.1	(0.0)	0.0	(0.0)	-0.0	(-0.0)	-0.0	(0.0)	0.0
2200	(0.0)	0.0	(0.0)	0.0	(-0.0)	-0.0	(0.0)	0.0	(0.0)	0.0

Note: The results for Plan 1 in Table A1 are reported in the parentheses for comparison. Reported on the right side of the parentheses are the results for Plan 2. The percentage deviation levels from the benchmark model are reported.

REFERENCES

Auerbach, Alan, J., and Laurence J. Kotlikoff, 1987. *Dynamic Fiscal Policy*, Cambridge University Press.

Attanasio, Orazio, Sagiri Kitao, and Giovanni L. Violante, 2007. “Global Demographic Trends and Social Security Reform,” *Journal of Monetary Economics*, 54(1): 144-198.

Cho, Dongchul, 2014. "Economic Dynamism of Korea: With a Focus on the Comparison with Japan", Korea Development Institute. *(in Korean)*

Chun, Youngjun and Ilho Yoo, 2004. “Welfare analysis of Social Welfare Program Based on a Computable General Equilibrium Model,” 52(1): 226-266. *(in Korean)*

Choi, Keehong and Seunghee Shin, 2015. “A measurement of the Intra- and Intergenerational Income Redistribution Based on a Microsimulation Model,” National Pension Research Institute. *(in Korean)*

Choi, Keehong, Sunghui Shin, and Miae Kwon, 2015. “An Assessment of Fiscal Stabilization Plans for the National Pension,” National Pension Research Institute. *(in Korean)*

Conesa, Juan Carlos, Sagiri Kitao, and Dirk Krueger, 2009. “Taxing Capital? Not a Bad Idea After All,” *American Economic Review*, 99(1): 25-48.

Heathcote, Jonathan, Kjetil Storesletten, and Giovanni L. Violante, 2010. “The Macroeconomic Implications of Rising Wage Inequality in the United States,” *Journal of Political Economy,* 118(4): 681-722.

Hong, Jay H, Youngjae Lee, and Taesu Kang, 2016. “Population Aging and Extension of

Retirement Age: Quantitative Analysis using Overlapping Generation Model", Economic Analysis, Economic Research Institute, Bank of Korea, 16(2):1-49. *(in Korean)*

Hong, Kisuk, 2016."National Pension Reform Scenarios: A Computable General Equilibrium Approach", Sogang Economic Papers, 45(1): 89-133. *(in Korean)*

Hugget, Mark, 1996. "Wealth Distribution in life-cycle Economies," *Journal of Monetary Economics* 38: 469-494.

Imrohoroglu, Selahattin, and Sagiri Kitao, 2012. "Social Security Reforms: Benefit Claiming, Labor Force Participation, and Long-run Sustainability," *American Economic Journal: Macroeconomics,* 4(3): 96-127.

Kim, Sunbin and Yongsung Chang, 2008. "Effects of Fiscal Policy on Labor Markets: A Dynamic General Equilibrium Analysis", KDI Journal of Economic Policy, 30(2): 185-224. *(in Korean)*

Krueger, Dirk and Alexander Ludwig, 2007. "On the Consequences of Demographic Change for Rates of Returns to Capital, and the Distribution of Wealth and Welfare," *Journal of Monetary Economics*, 54: 49-87.

Kwon, Kyooho, 2016, "A Welfare Analysis of Sustainable Pension Reforms," Research Monograph 2016-11, Korea Development Institute. *(in Korean)*

Kwon, Kyooho, 2017. "Korea's Demographic Transition and Long-Term Growth Projection Based on an Overlapping-generations model," *KDI Journal of Economic Policy*, 39(2): 25-52.

Nishiyama, Shinichi, 2003. "Analyzing Tax Policy Changes Using a Stochastic OLG Model with Heterogeneous Households," CBO.

Nishiyama, Shinichi and Kent Smetters, 2007. "Does Social Security Privatization Produce Efficiency Gains?" *Quarterly Journal of Economics,* 122(4): 1677-1719.

Rouwenhorst, K. Geert, 1995. "Asset Pricing Implications of Equilibrium Business Cycle Models," in T. F. Cooley (ed.), *Frontiers of business Cycle Research*, Chapter 10, Princeton University Press.

Shin, Sunghui and Keehong Choi, 2010. "The Intra and Inter-generational Welfare Impact of the Financing Policies of the National Pension System", Economic Analysis, Economic Research Institute, Bank of Korea, 16(2): 1-46. *(in Korean)*

LITERATURE IN KOREAN

권규호, 2016,『국민연금제도 개혁방안의 거시경제적 파급효과 및 세대 간 비용부담 분석』, 정책연구시리즈 2016-11, 한국개발연구원.

김선빈·장용성, 2008.「조세·재정정책이 노동시장에 미치는 영향: 동태적 일반균형분석」, 한국개발연구, 제30권 제2호: 185-224.

신성휘·최기홍, 2010.「중첩세대 동태 일반균형 모형에 의한 국민연금 재정정책의 세대 내, 세대 간 후생 변화 분석」, 경제분석, 제16권, 제2호: 1-46.

전영준·유일호, 2014.「일반균형계산모형을 이용한 사회보장정책에 대한 후생분석」, 경제학연구, 제52집, 제1호: 221-266.

조동철 편, 2014.『우리경제의 역동성: 일본과의 비교를 중심으로』, 한국개발연구원.

최기홍·신성휘·권미애, 2015.「국민연금 재정안정화 정책의 평가: OG 모형 파레토 개선 접근법」, 국민연금연구원.

최기홍·신승희, 2015.「미시모의실험 모형에 의한 국민연금의 세대 간·세대 내 소득재분배 측정」, 국민연금연구원.

홍기석, 2016.「국민연금 재정안정화 정책의 효과: 캘리브레이션 분석」, 시장경제연구, 제45권, 제1호: 89-133.

홍재화·이영재·강태수, 2016,「인구고령화와 정년연장 연구: 세대 간 중첩모형(OLG)을 이용한 정량 분석」, 경제분석, 제22권 제2호: 1-49.

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Health Capacity to Work at Older Ages in South Korea: Estimates and Implications for Public Pension Policies†

By DOHYUNG KIM*

Health capacity to work for the elderly is an essential piece of information for designing social policies in an aging society. Here, we assess the health capacity to work of older men in South Korea and provide a cross-country comparison. Following the methodology proposed by Milligan and Wise (2012), which uses the cohort mortality rate as a proxy for overall health status, we quantify the additional employment capacity of current older men in reference to the mortality-employment relationship of a generation ago. Despite the high employment rate of older men in South Korea, we find substantial additional employment capacity among older men (those aged 55 or more) as of 2016 comparable in size to those found in other advanced countries. We also find evidence that older men are not merely capable of working but are also willing to work, and many of them are increasingly combining pension income and work. These findings suggest that labor supply disincentives for older men embedded in public pension systems in South Korea need to be thoroughly reexamined and adjusted accordingly lest they should inhibit the labor supply of older workers.

Key Word: Employment, Mortality, Work Capacity, Retirement, Public Pension
JEL Code: J14, J21, J26

I. Introduction

Policymakers often presume that there would be substantial untapped health capacity to work among older people based on the simple observation that longevity has noticeably improved in South Korea, particularly over the past few

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decades. Moreover, this presumption can lead to policy proposals which may force older people to work longer over their life cycle. For example, the reform of the National Pension in 2009 raised the pensionable age from 60 in 2009 to 65 in 2033 and, more recently, the committee for the fourth actuarial projection of the National Pension suggested a further increase of the pensionable age to 68 by 2048.[1] These measures imply extended work years of individuals before they are allowed to receive the full benefits. Furthermore, the government organized a task force to set a higher age cutoff regarding the definition of an older person, which is currently 65, and this change, if implemented, will have much broader implications for social policies, including those related to the Basic Pension and Long-Term Care Insurance.

All of these policy measures attest to the fact that the health capacity to work among older workers represents essential information related to the design of public policies in an aging society, but there exists little empirical research based on which the underlying policy presumptions can be assessed. Country studies have already been conducted for twelve advanced countries through the International Social Security (ISS) project, which employed common methodologies to enhance cross-country comparisons of the results (Milligan and Wise, 2015; Wise, 2017). Providing an overview on the twelve country studies included in the ISS project, Coile, Milligan and Wise (2017) noted several common themes. First, older males in most countries as of 2010 have substantial additional work capacity when compared to men in 1977 with similar health status as measured by the mortality rate. Second, the estimated additional work capacity is reduced when compared to that of older men in 1995 because older men's employment rates reached a historical low in many countries during the mid-1990s owing to social security clauses that discouraged work. These findings from advanced countries, however, may not be directly extended to South Korea. Unlike most advanced countries where employment rates for older males declined substantially due to liberal benefit provisions of their public pension systems, the employment rate of older men in South Korea has remained at a high level at least over the last thirty years, possibly due to the absence or the low level of pension benefits.[2] The persistence of the high employment rate among older men in South Korea suggests that older men may not have much additional work capacity despite the improvement in their health status.

Thus, this paper aims to quantify older men's health capacity to work in South Korea for a comparison to those in other advanced countries and to examine the implications of the findings on social policy for the elderly. Using the method proposed by Milligan and Wise (2012) and also employed in several other country studies included in Wise (2017), we estimate substantial additional employment capacity among older men in South Korea in 2016 compared to those at similar health statuses a generation ago. The estimated total additional work capacity among men aged 55 to 69 is about 2.8 work-years, which is comparable in size to those found in other advanced countries. Notably, we find that the estimated total

[1]By 2030, the pensionable ages of the earnings-related pension plans will be 67 in many advanced countries, including the US, UK, Germany, Italy, Spain, and France, whereas Japan and South Korea will be notable exceptions with a pensionable age of 65 by that time (Lee, 2017).

[2]The National Pension System was enacted in 1971 but implemented in 1988. Given that many workers in the past remained uncovered by the National Pension during their work years while the full old-age benefits are provided for forty years of contributions, benefits from the public pension were minimal until very recently.

additional work capacity of men in their 70s is also quite large in South Korea. Furthermore, we provide evidence that many older men are not just capable of working but are also willing to work at later ages; nearly 76 percent of older men aged 55 to 79 in 2018 report that they are willing to work longer, and the desired age of labor market exit is well beyond the age of 70. In particular, we find that the share of pensioners who continue to work has increased over the last decade, supporting the aforementioned findings. In sum, many older men in South Korea are not only capable of working longer but are also willing to work longer, as noted above. These findings suggest that in response to improvements in life expectancy and health status which have continued for decades, policymakers must thoroughly reexamine and adjust the current institutional labor market environment so that capable and willing older people can work longer and are not discouraged by disincentives that may be embedded in current social policies, especially in the public pension policy and in legal institutions.

This article is organized as follows. In the next section, we first document the trend in the labor force participation of older workers in South Korea and compare it to the trends observed in other advanced countries. In section 3, we estimate the health capacity to work among the elderly in South Korea using micro data and compare the results with those found in other advanced countries. In section 4, we examine whether older people are willing to work more and the extent to which they combine work and pension income. In the last section, we conclude with policy implications as they may pertain to social security.

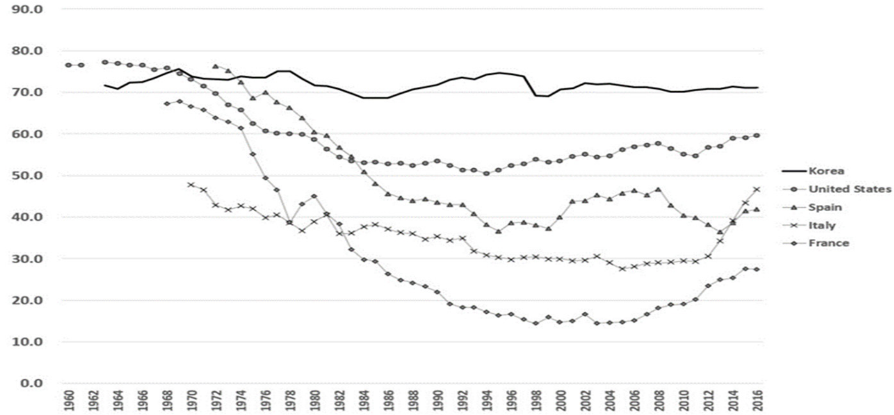
II. Trends in the Employment Rates of Older Men

A. *The Secular Decline in the Employment Rate of Older Men*

One of the most prominent features of the labor markets of advanced countries in the late twentieth century is the dramatic decline in the employment rates of the older men (Gruber and Wise, 1999). Figure 1 shows that the employment rate of men aged 60-64 in the United States dropped by 26.5 percentage points between 1960 and 1994, that in France fell by 53 percentage points between 1968 and 1998, and that in Germany declined by 44 percentage points between 1970 and 1994. Aside from Japan, other advanced countries underwent similar declines in the employment rates of older men over the same period (see panel B).

One explanation for the decline may be higher income. Because retirement is a normal good, the age of retirement may well decrease with higher incomes (Barr and Diamond, 2006). Indeed, this secular decline in labor force participation by older men has been documented in several countries, such as the United States, Great Britain, France, and Germany, with the beginning of the decline dating back to late nineteenth century (Costa, 1998). However, the depth of the decline in the employment rates during the 1970s and 1980s and the subsequent rebound after the 1990s can be better explained by the incentives embedded in social security systems. The postwar changes in pension provisions such as a reduction in the early retirement age without corresponding actuarial adjustment in pension benefits and an increase in the replacement rate of pension benefits led to the decline of the employment rates

[Panel A]



[Panel B]

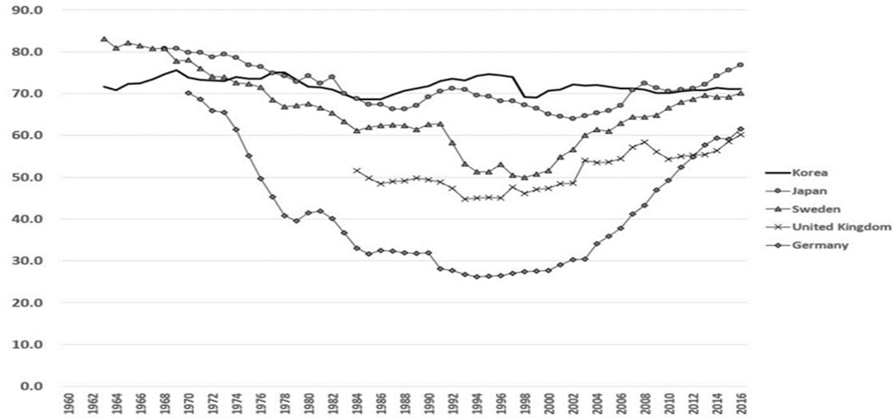


FIGURE 1. TRENDS OF THE LABOR FORCE PARTICIPATION RATES OF MEN AGED 60 TO 64, 1960-2014

Source: OECD (https://stats.oecd.org/Index.aspx?QueryId=67615; Last accessed: 9 Feb 2019).

in the advanced countries during the 1970s and 1980s (Gruber and Wise, 1999; 2004). The subsequent pension reform mitigating work disincentives embedded in pension provisions generated a rebound in the employment rates of older men in these countries during the mid-1990s.

It is notable that the employment rate of older men in South Korea shown in figure 1 did not exhibit a U-shaped pattern, unlike those in most advanced countries. This exceptionality is actually consistent with the explanation given above because the National Pension in South Korea was belatedly and partially implemented in 1988 while some of the features imposing work disincentive were redressed in the 1998 reform, and therefore, the labor supply of the older men who are eligible for the early retirement benefits was barely affected by pension provisions.[3]

[3]Lee (2005) calculated the simulated social security wealth accrual of the National Pension, showing that, prior to the normal retirement age of 60, the provisions of the National Pension do not impose implicit taxes on the additional year of work of the elderly (those who are born in 1947, began contributing in 1988, and would become eligible for the full benefits in 2007), and therefore, do not induce these workers to retire early.

B. *Unused Productive Capacity*

The withdrawal of older men from the labor force represents foregone productive capacity of the economy. To capture the extent of the labor force withdrawal of older men, Gruber and Wise (1999) utilized the measure of the *unused productive capacity* of older men, which is defined as the upper area of the age profile of the labor force participation rate. This measure does not have a natural unit and is hence useful only for cross-country comparisons, which was the primary objective of the project in Gruber and Wise (1999). During the 1990s, the unused productive capacity of older men in major European countries, including France, Italy, Germany, Spain, and the United Kingdom, ranged from 50 to 60 percent, whereas it was lower in the United States (37 percent), Sweden (35 percent), and Japan (22 percent).

Albeit simple and intuitive, the unused productive capacity does not account for cross-country differences in the health status of older men and labor market institutions. In the next section, we explain the concept of the *health capacity to work*, an alternative measure of the additional work capacity of older men. This measure differs from the unused productive capacity in that additional work capacity is measured after adjusting for the health status of a given age cohort. Another difference is that the upper bound of work capacity for a given health status is set by the employment rate of men in the same country a generation ago. Therefore, health capacity to work can be seen as a measure of additional work capacity for which health statuses and country-specific time-invariant factors are adjusted.

III. Estimating the Health Capacity to Work at Older Ages

A. *Milligan-Wise Method*

Following the eleven country studies in Wise (2017), we employ the same method developed in Milligan and Wise (2012) to estimate the health capacity to work of those aged 55 to 69. The Milligan-Wise Method answers the following question: Compared to men of the same level of health status thirty years ago, how much more can the current older men work? Using mortality as the primary measure of health status, they evaluate the current relationship between employment and mortality in light of the same relationship thirty years ago.

Evaluating the additional work capacity of a certain age cohort at a given year (the target year hereafter) in comparison to that in the past necessarily involves setting a reference year (thirty years before the target year, for example). Suppose that we set the target year 2016, which is the most recent year when the data are available, and the reference year 1986, which is the earliest year when the data are available. The additional work capacity of men aged 55 in 2016 can then be calculated based on the difference between the employment rates of men aged 55 in 2016 and of men in 1986 with the same mortality rate. This can be formally written as follows:

(1)
$$c_{t=2016,\, a=55} = e_{t=1986,\, a=\bar{a}} - e_{t=2016,\, a=55},$$

where t denotes the year, a the age, c the additional work capacity, e the employment rate, m the mortality rate, and $\bar{a}$ the age in 1986 such that $m_{t=1986,\, a=\bar{a}} = m_{t=2016,\, a=55}$. The first term on the right-hand side of equation (1) can be interpreted as a point on the "labor supply possibility frontier," which health status permits, and thus the additional work capacity can be seen as a measure for evaluating the current relationship between the employment rate and mortality rate based on that labor supply possibility frontier. Here, $e_{t=1986,\, a=\bar{a}}$ can be estimated by linear interpolation.[4] The total additional work capacity of men aged 55 to 69 can then be obtained by summing the estimated additional work capacity of men over the ages from 55 to 69. The total additional work capacity of men aged 55 to 69 can be formally written as follows:

$$\sum_{g=55}^{69} c_{t=2016,\, a=g} \,.$$

It has to be noted that the employment rate in equation (1) is essentially conditioned solely on the mortality rate. This approach does not account for the fact that there can be many factors other than health affecting employment, such as educational attainment, pension wealth, industrial composition, and institutional environment. Therefore, the additional work capacity estimated by the Milligan-Wise Method should be interpreted as the *health capacity to work* of the elderly today in the sense that their health may not constrain them from working more, as it did not a generation ago for those having the same health status. If one is more concerned about work capacity conditional on other factors as well, a different approach is warranted, although results obtained after adjusting for demographic characteristics are broadly consistent with those obtained from the Milligan-Wise Method in most advanced countries (see Wise, 2017).[5]

We acknowledge that mortality is a limited measure of health, as it may not reflect chronic diseases, disabilities, and other activity limitations, all of which may be important determinants of work capacity.[6] Nevertheless, we focus on mortality for two reasons. First, a cross-country comparison of the estimated additional work capacity is one of the main objectives of this study, and this can be best achieved by using mortality, which is a reliable and common measure of health status across countries. Comparison based on self-assessed measures, another commonly used measure of health status, may not be directly comparable across countries due to differences in the wordings and scales used in the different surveys (Carlson, 1998;

[4]The estimated additional work capacity is not sensitive to the functional form of the interpolation.

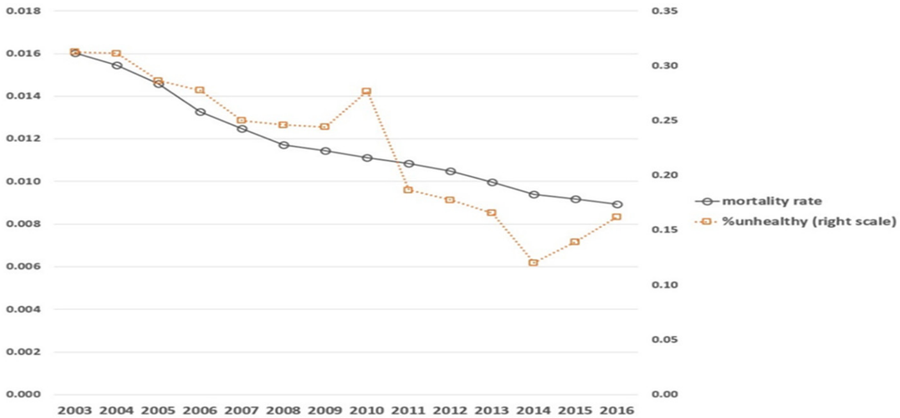
[5]An alternative approach can partly address this limitation of the Milligan-Wise Method. A simulation-based method developed by Cutler *et al.* (2011) measures work capacity by comparing the observed labor force participation rates of men aged 65 to 69 to simulated labor force participation rates for these cohorts ("capacity for work") based on estimated coefficients obtained for men aged 62 to 64. In the work-decision equation, this method adjusts for individual characteristics, including education, marital status, pension coverage, and self-reported health status. While this approach has the advantage of adjusting for some non-health characteristics that can affect the employment rate, substantial differences in the survey design and questionnaires across countries make it difficult to compare the results across countries.

[6]In early efforts to assess the work capacity of older people in the United States, Munnell and Sass (2008) examine long-term trends in disabilities, self-assessed health, as well as life expectancy of older people.

Jürges, 2007). Second, using mortality allows us to cover an extensive time span for the analysis. Previous studies compared the relationship between employment and mortality in 2010 to that in 1977 or 1995 (Wise, 2017). Mortality series go back to 1970 in South Korea, whereas the series of self-assessed health (SAH) measures in surveys are available only after 2003.

To verify that these alternative measures move together, we plot the SAH and the mortality rate together for the period when data are available. Since 2003, the Korean Labor and Income Panel Study (KLIPS) has collected information on self-assessed health status. The respondents are asked about their overall health status, reporting whether they are either very healthy, healthy, in fair health, in poor health, or in very poor health. Based on the responses, we calculate the SAH, the share of older respondents who reported their health status as poor or very poor. Figure 2 shows the SAH and mortality rate since 2003 for men aged 60 to 64 and those aged 65 or

[Panel A] Men aged 60 to 64



[Panel B] Men aged 65 or more

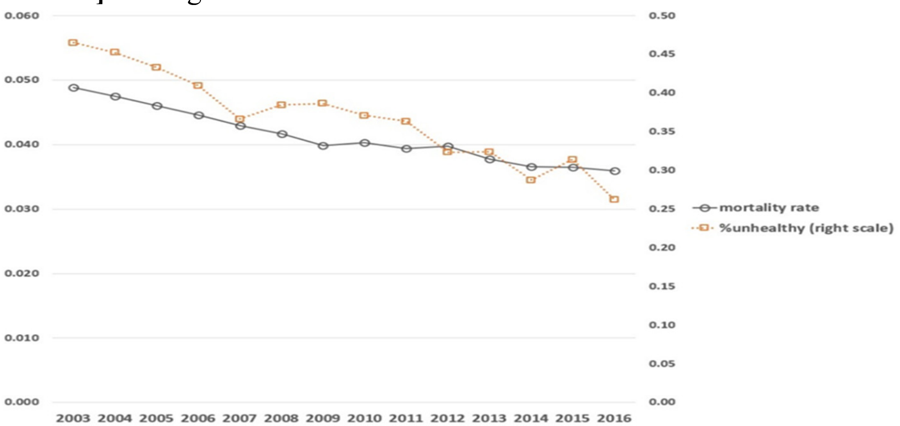


FIGURE 2. SELF-ASSESSED HEALTH (SAH) AND MORTALITY RATES FOR OLDER MEN

Note: All numbers are calculated based on sample weights.

Source: Author's calculations from the 2003-2016 waves of the Korean Labor and Income Panel Study.

more. We find that for both age groups, the SAH clearly declined with the mortality rate. Panel A in figure 2 shows that the share of men aged 60 to 64 who reported poor or very poor health has nearly been cut in half for the last fifteen years, along with the mortality rate. Similarly, the share of men aged 65 or more who reported poor or very poor health in panel B in figure 2 decreased by a third with the mortality rate.

B. *Data*

Mortality data for South Korea cannot be found in the Human Mortality Database, the common source of long-term mortality and birth data for many countries, mainly because infant mortality data in South Korea are considered to be unreliable before 1970. Instead, we calculate sex- and age-specific mortality rates, which were converted from the sex- and age-specific death rates that can be found in the Life Table, published by Statistics Korea since 1970.[7] We use employment data from the Korean Labor Force Survey (LFS) which are available from 1986 to 2016. The target year is 2016 and our preferred baseline year is 1986, a generation before the target year.

Following the literature, we restrict our analysis to men only, as the secular rise in women's labor participation makes it difficult to interpret the results for women. Although we can predict that the underlying relationship between work and health should be similar between men and women, changes in factors affecting decisions to work over life cycles across different cohorts of women (Schirle, 2008; Goldin and Katz, 2018) complicate analysis of the historical work-health relationship.

C. *Additional Work Capacity among Men Aged 55 to 69*

One can easily grasp the underlying idea of the Milligan-Wise Method by inspecting figure 3, which plots the relationships between employment rates and mortality rates in 1986 and 2016. Consider first the 2016 employment-mortality curve. In 2016, the mortality rate for 55-year-old men was 0.005 and the employment rate was 89.1%. Men's employment rate decreases as the mortality rate increases. In 2016, the mortality rate for 69-year-old men was 0.016 and the employment rate was 49.7%. In figure 3, the 1986 employment-mortality curve clearly lies above the 2016 curve. For a given health status, the employment rates of men in 1986 were higher than those in 2016. The gap in the employment rate for a given mortality rate is substantial. In 2016, the employment rate of men having a mortality rate of 0.011 (at age 65) was 62%. In 1986, the employment rate of men having the same mortality rate (at age 50) was 88.5%. This suggests that in 2016, the employment rates of men at age 65 could be higher by 26.4 percentage points if these men had worked at their maximum health capacity.

Similar calculations can be done for each mortality rate, and these results are presented in table 1. For example, 3.85 percent of men aged 55 in 2016 could have worked more, which implies 0.385 additional work-years. By aggregating the estimated additional employment capacity over the ages from 55 to 69, we obtain

[7] $q_x = \frac{m_x}{1+m_x}$, where q_x denotes the death rate at age x and m_x is the mortality rate at age x, which is defined as the ratio of the number of deaths at age x over the size of the population at age x (Statistics Korea, 2016).

2.82 work-years of the *total additional employment capacity* of men aged from 55 to 69 in 2016 in reference to 1986, which can be found at the bottom of column (5) in table 1. This is a 26.6 percent increase from the 10.6 work-years for men aged 55 to 69 in 2016.

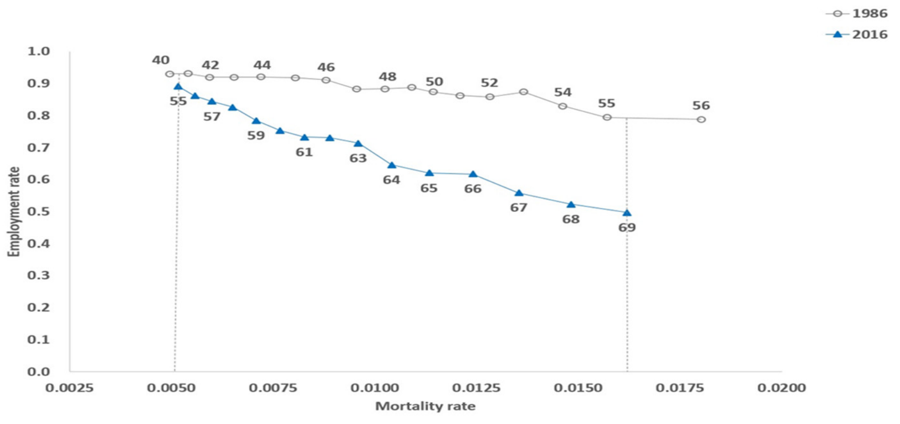


FIGURE 3. MEN'S EMPLOYMENT RATES AND MORTALITY RATES IN 1986 AND 2016 FOR THOSE AGED 55-69

Note: The curve below is plotted for male cohorts aged 55 to 69 in 2016. The curve above is plotted for male cohorts in 1986 having the same mortality rate.

Source: Author's calculations.

TABLE 1—ADDITIONAL EMPLOYMENT CAPACITY OF MEN AGED 55-69 IN 2016 COMPARED TO 1986

Age of men (1)	Mortality rate in 2016 (%) (2)	Employment rate in 2016 (%) (3)	Employment rate in 1986 at same mortality rate (%) (4)	Additional employment capacity (%) (5)	Number of employees in 2016 (6)	Potential number of additional employees (7)
55	0.52	89.14	92.99	3.85	381,121	16,457
56	0.56	86.21	93.08	6.88	375,937	29,990
57	0.60	84.44	92.80	8.36	349,923	34,654
58	0.65	82.60	91.98	9.37	326,440	37,035
59	0.71	78.48	91.97	13.49	285,940	49,156
60	0.77	75.36	92.06	16.70	225,899	50,064
61	0.83	73.33	91.92	18.59	253,990	64,372
62	0.89	73.08	91.40	18.33	197,455	49,516
63	0.96	71.41	89.33	17.92	196,732	49,362
64	1.04	64.62	88.33	23.71	172,778	63,405
65	1.13	62.07	88.48	26.41	121,232	51,576
66	1.24	61.79	86.37	24.58	131,607	52,351
67	1.35	55.89	86.25	30.36	112,818	61,276
68	1.48	52.34	84.90	32.57	109,450	68,103
69	1.62	49.69	80.35	30.66	105,130	64,858
Total additional employment capacity		10.60		2.82	3,346,450	742,177

Note: The figures in column (4), which correspond to the mortality rates in column (2), are obtained by means of linear interpolation. The unit of total additional employment capacity is work years or number of persons.

Source: Author's calculations.

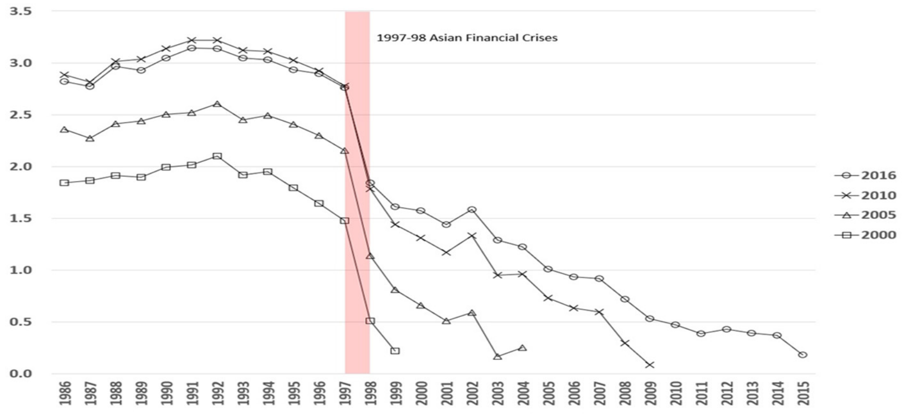


FIGURE 4. ESTIMATED TOTAL ADDITIONAL WORK CAPACITY ACROSS DIFFERENT REFERENCE YEARS

Note: The horizontal axis represents the reference year, and the vertical axis denotes the estimated total additional work capacity among men aged 55 to 69. Four different curves are obtained for different target years of 2000, 2005, 2010, and 2016. The box shows the 1997-97 Asian Financial Crisis.

Source: Author's calculations.

This exercise is based on the implicit assumption that the cohort size is equal across all age groups. We can use the size of the population as the weight to calculate the potential number of additional employees, as presented in column (7) of table 1. The potential number of additional employees for men aged 55 to 69 is 742,177, a 22.2 percent increase from the current pool of 3,346,450 employees aged 55 to 69 in 2016. The rate of increase in the number of employees is smaller than that in work-years because older men having a greater work capacity comprise less of the population aged 55 to 69. The potential number of additional employees is easier to interpret than the total additional work-years, but we will use the latter as our primary measure to maintain cross-country comparability of the results.

The additional employment capacity can critically depend on the choice of reference year because the employment-mortality curve in the reference year acts as an employment possibility frontier as a function of health. Figure 4 clearly shows that the total additional employment capacity in 2016 does depend on each reference year for 1986-2015. It should also be noted that the total additional employment capacity becomes quite small when compared to those in recent years. However, the employment-mortality curve did not change much before the major supply shock in 1998, when the Asian Financial Crisis generated massive layoffs of older men in South Korea.[8] Lastly, figure 4 also indicates that for a given reference year, additional employment capacity increases over time, although the increasing trend appears to wane starting in 2010.

[8]Over the years 1997-98, about 0.63 million male workers lost their jobs. Most of them were in their late 20s and early 30s, i.e., early in their careers, but many men aged 54 and 55 were also laid off before their normal retirement age.

D. *Additional Work Capacity among Men Aged 70 to 84*

In South Korea, the effective age of labor market exit of men in 2016 was seventy two, which is highest among OECD countries (OECD, 2017).[9] Therefore, we also examine additional employment capacity for men aged 70 to 84. Figure 5 depicts the employment -mortality curves in 1986 and 2016 for men aged 70 to 84. The employment rate of men aged 70 in 2016 is quite high, but we still find a nontrivial size of work capacity, and men's additional employment capacity mostly disappears only at the age of 79.

The additional employment capacity measured in terms of work-years of men aged 70 to 84 can be found at the bottom of column (5) in table 2, and it is surprisingly similar in size to that of men aged 55 to 69. In terms of the potential number of additional employees, the size is much smaller as the population of men aged 70 to 84 is much smaller than that of men aged 55 to 69.

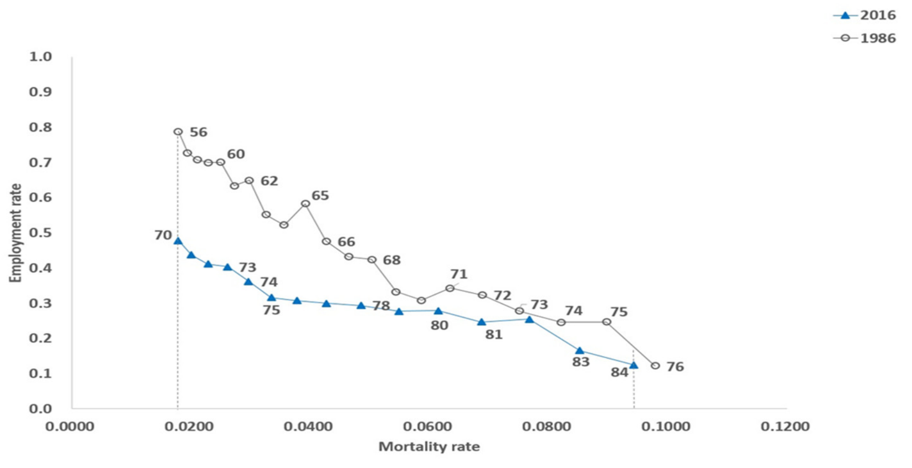


FIGURE 5. MEN'S EMPLOYMENT RATES AND MORTALITY RATES IN 1986 AND 2016 FOR THOSE AGED 70-84

Note: The curve below is plotted for male cohorts aged 55 to 69 in 2016. The curve above is plotted for male cohorts in 1986 having the same mortality rate.

Source: Author's calculations.

[9]This may not be surprising because most older men and women in South Korea do not have pension wealth, partly because the pension system was implemented relatively recently, and income support from their children has increasingly weakened. On the other hand, it also reflects that the older people are quite healthy in South Korea.

TABLE 2—ADDITIONAL EMPLOYMENT CAPACITY OF MEN AGED 70-84 IN 2016 COMPARED TO 1986

Age of men (1)	Mortality rate in 2016 (%) (2)	Employment rate in 2016 (%) (3)	Employment rate in 1986 at same mortality rate (%) (4)	Additional employment capacity (%) (5)	Number of employees in 2016 (6)	Potential number of additional employees (7)
70	1.78	47.82	78.86	31.05	77,103	50,060
71	2.01	43.74	71.96	28.22	62,926	40,609
72	2.29	41.15	70.03	28.88	60,370	42,361
73	2.61	40.38	66.82	26.44	63,935	41,868
74	2.97	36.20	64.90	28.70	58,032	46,006
75	3.35	31.65	54.28	22.63	45,933	32,834
76	3.78	30.77	56.03	25.26	43,880	36,020
77	4.27	30.02	47.60	17.58	35,680	20,898
78	4.85	29.41	42.82	13.41	29,200	13,320
79	5.48	27.75	33.06	5.32	26,305	5,041
80	6.15	27.89	32.89	5.01	20,935	3,758
81	6.87	24.71	32.43	7.72	20,544	6,419
82	7.67	25.49	27.06	1.57	16,898	1,040
83	8.52	16.56	24.68	8.13	8,391	4,119
84	9.42	12.55	17.79	5.24	5,280	2,206
Total additional employment capacity		4.66		2.55	575,412	346,559

Note: The figures in column (4), which correspond to the mortality rates in column (2), are obtained by means of linear interpolation. The unit of total additional employment capacity is work years or number of persons.

Source: Author's calculations.

E. *Cross-country Comparison*

Table 3 presents a cross-country comparison of the additional employment capacity of men aged 55 to 69 in 2010 as measured in terms of the total additional

TABLE 3—ADDITIONAL EMPLOYMENT CAPACITY OF MEN IN 2010: CROSS-COUNTRY COMPARISON

Country	2010 vs. 1977 (1)	2010 vs. 1995 (2)
Belgium	5.0	1.0
Canada	4.9	1.3
Denmark	4.7	1.6
France	8.0	2.2
Germany	5.9	2.6
Italy	7.7	2.7
Japan	3.7	2.2
Netherlands	3.4	-0.1
Spain	7.0	2.2
Sweden	3.2	0.8
United Kingdom	8.4	1.8
United States	4.2	1.8
South Korea	2.9	3.0

Note: In some cases, the years used differ, as follows: Belgium (1983 not 1977); Germany (2005-09 not 2010, 1989-1995 not 1995, 1976-1980 not 1977); Japan (1975 not 1977); Netherlands (1981 not 1977); South Korea (1986 not 1977), and Sweden (2009 not 2010, 1985 not 1977).

Source: Author's calculations for South Korea, and Wise (2017: 13) for the other countries.

work-years. The reference years are 1977 and 1995, but they can vary by country depending on data availability. Column (1) of table 3 shows the total additional employment capacity of men aged 55 to 69 in 2010 when the reference year is 1977. The 2.9 work-years of total additional employment capacity in South Korea is less than those in other countries, whose average amounts to 5.5 work-years. This may have arisen because the reference year was actually 1986, rather than 1977, for South Korea due to data availability. When the reference year is changed to 1995, as in column (2) in table 3, the total additional employment capacity becomes smaller for most countries. South Korea is the exception here because the employment rate in the reference year remained high, although it clearly declined after 1998, as shown in figure 4.

IV. Willingness to Work among Older People and Pensioners

Health capacity to work is one consideration and willingness to work is another. Even when improved health enables older people to work longer in their life cycle, they may not be willing to work if they value post-retirement leisure more than extended work. Therefore, information on willingness to work among older people is no less relevant for policymakers than information on the health capacity to work. In particular, willingness to work among pensioners has important implications for public pension policies given that one of the overarching themes of pension policy in an ageing society is to combine "work and pension" (OECD, 2017).

To shed light on the willingness to work among the elderly, including pensioners, we examine survey evidence pertaining to willingness to work among the elderly in South Korea. First, using a nationally representative survey, we document the share of older people reporting that they are willing to work longer regardless of their age. We acknowledge that the labor supply decisions of the elderly will ultimately depend on the nature of the work and on the wage rates in the market, but we proceed by making the implicit assumption that the older people who responded to the survey questions were aware of the prevailing market conditions. Second, we examine the trend in the labor force participation rate of pensioners, which will reflect willingness to work among the more affluent elderly.

A. *Willingness to Work among Older Men*

To examine willingness to work among older men in South Korea, we use the most recent wave of the Elderly Supplement to the LFS from Statistics Korea. In the 2018 supplement, respondents aged 55 to 79 are asked whether they are willing to do paid work regardless of their age. If they answer in the affirmative, they are further asked about the main reason for wanting paid work and their desired age of labor market exit.

Table 4 shows the share of older men who want to work longer for earnings as well as the distribution of the desired age of labor market exit for men by age group. Panel A in table 4 shows that seventy six percent (about 4.8 million) of male respondents aged 55 to 79 wanted to work longer for earnings. Although willingness to work declines for older age groups, it is notable that men over age 70 still wanted

TABLE 4—ADDITIONAL EMPLOYMENT CAPACITY OF MEN IN 2010: CROSS-COUNTRY COMPARISON

Age group	55-59 (1)	60-64 (2)	65-69 (3)	70-74 (4)	75-79 (5)	Total (6)
Panel A. *Number of men who are willing to work longer*						
Male population	2,148,176	1,651,883	1,128,372	810,864	655,903	6,395,197
Willing to work longer	1,931,766	1,397,849	812,811	458,457	235,208	4,836,092
Share	0.90	0.85	0.72	0.57	0.36	0.76
Panel B. *Distribution of desired age upon labor market exit*						
Exit at 55 to 59	0.00	n/a	n/a	n/a	n/a	0.00
60 to 64	0.04	0.00	n/a	n/a	n/a	0.02
65 to 69	0.23	0.09	0.01	n/a	n/a	0.12
70 to 74	0.49	0.58	0.32	0.02	n/a	0.42
75 or more	0.25	0.33	0.68	0.98	1.00	0.45

Note: "n/a" means not applicable.

Source: Author's calculations from the 2018 wave of the Elderly Supplement of the Korean Labor Force Survey.

to work longer: fifty seven percent of men aged 70 to 74, and thirty six percent of men aged 75 to 79. For most of the elderly (59%), the main reason for wanting paid work was to earn money to pay living expenses, but about thirty four percent reported that they wanted to work as long as their health allows, as working is a pleasure for them. Panel B in table 4 shows that the mean desired age at retirement was seventy three, but many in their late 70s wanted to retire at age 81. Most men aged 55 to 59 who are close to the statutory retirement age wanted to retire at age 70.

B. *Labor Force Participation among Pensioners*

To investigate trends with regard to the extent of pensioners who are engaging in paid work, we use six waves (2006-2016) of the Korean Longitudinal Study of Aging (KLoSA), which contains information both on employment status and benefit receipt from the public pension (the National Pension, and occupational pensions).[10] KLoSA is a nationally representative biennial public-use survey from the Korea Employment Information Service. The survey began in 2006 with 10,254 people aged 45 or more who resided in South Korea other than Jeju Island. In 2014, 920 people born around 1962-63 were added, and the size of the consolidated sample in 2016 was 7,460. All numbers presented in tables are produced based on sample weights.

We define pensioners as those receiving benefits either from the National Pension or from occupational pensions such as the Government Employees Pension, the Teachers' Pension, or the Military Pension. Table 5 shows the changes over the years

[10]The Elderly Supplement of the LFS also contains information about public pension receipt, but the coded responses do not distinguish between contributory public pensions and noncontributory pensions. The distinction can be important for policy purposes because the labor disincentives discussed in the next section only apply to contributory public pensions such as the National Pension and to occupational pensions.

TABLE 5—COMBINING PENSION INCOME AND WORK IN SOUTH KOREA

Survey year		2006	2008	2010	2012	2014	2016
Panel A. *Pensioner share*							
National Pension	Aged 60 to 64	0.39	0.46	0.49	0.45	0.44	0.41
	65-69	0.30	0.43	0.51	0.60	0.60	0.62
	70-74	0.13	0.20	0.30	0.35	0.42	0.47
Occupational Pension	60-64	0.07	0.09	0.08	0.07	0.10	0.07
	65-69	0.08	0.10	0.11	0.15	0.12	0.11
	70-74	0.08	0.09	0.10	0.11	0.11	0.10
Panel B. *Worker share by pensioner status*							
National Pension	Aged 60 to 64	0.50	0.56	0.58	0.53	0.63	0.71
	65-69	0.37	0.38	0.40	0.44	0.39	0.47
	70-74	0.14	0.17	0.17	0.18	0.19	0.17
Occupational Pension	60-64	0.30	0.19	0.16	0.30	0.32	0.31
	65-69	0.10	0.14	0.23	0.20	0.09	0.12
	70-74	0.10	0.03	0.05	0.06	0.06	0.06
None	60-64	0.53	0.58	0.64	0.58	0.66	0.65
	65-69	0.30	0.32	0.43	0.47	0.42	0.46
	70-74	0.09	0.14	0.16	0.16	0.16	0.15

Source: Author's calculations from the 2006-2016 waves of the Korean Longitudinal Study of Aging.

2006 to 2016 in the share of pensioners by age group as well as the share of men participating in the labor force among the pensioners. In panel A of table 5, we find that the share of pensioners among men aged 60 or more is rising steadily, although the share among men aged 60 to 64 has declined since 2010, possibly due to the increase in the pensionable age. Panel B of table 5 shows that until 2014, those who were receiving benefits from the National Pension were slightly less active in the labor market than those who are not entitled to the National Pension, but this trend reversed in 2016 across all age groups. The majority of pensioners from the National Pension aged 60 to 64 are participating in the labor market throughout the sample periods, and the share increased to seventy one percent in 2016. Among men aged 65 to 69, the share of pensioners participating in the labor force increased to fourty seven percent in 2016, although the share among men aged 70 or more stagnated at around seventeen percent. In contrast, pensioners from occupational pensions do not appear to be as active, mainly because the replacement rates of occupational pensions are substantially higher than that of the National Pension.

In sum, substantial numbers of pensioners from the National Pension are participating in the labor market, and the share has been rising for the last ten years. Without raising the replacement rate of the National Pension substantially, which is unlikely given public sentiment against higher pension contributions, we can expect that the majority of pensioners will continue to participate in the labor force.

V. Policy Implications

When measured by mortality rate, the current older men are as healthy as those who were younger by ten years a generation ago, and this remarkable improvement in health status has led to substantial potential employment capacity. Moreover, a large share of capable older men (mostly in their 60s, but some in their 70s) is willing to do paid work regardless of their age or pensioner status. It has to be noted that our results imply neither that the elderly should work more given the additional work capacity nor that their participation in the labor force will be necessarily welfare-enhancing. Rather, our results imply with regard to policy that it would be undesirable to impose labor disincentives for the elderly when they are actually healthy enough and willing to work more.[11] Lest the government should discourage the labor supply of older people who are healthy and willing to work, it must thoroughly examine the tax and social insurance system while also making timely and proper adjustments in provisions.

For instance, public pensions in South Korea impose on pensioners aged 60 to 64 an apparent labor disincentive. The benefits of the National Pension can be reduced by 50% at a maximum if pensioners aged 60 to 64 earn more than the average earnings of the contributors (monthly earnings of about two million won). This implies that for these groups, the overall marginal tax rate ranges from 20 to 49 percent within a relatively modest income bracket (See table 6).[12] Moreover, the number of pensioners subject to a benefit reduction has been increasing rapidly in recent years as those in the baby-boom generation born after 1955 begin to retire, as shown in table 6. This benefit reduction due to work is not the rule in advanced economies, and many countries have recently abolished it, acknowledging its clear disincentives for work (OECD, 2017).

We have not considered the labor demand for older people, which remains the clearest limitation of this paper. Thus, we briefly discuss the labor-market environment, which may decrease the demand for older people. Labor contracts in South Korea typically consist of a seniority-based wage for loyalty combined with a performance wage, with the former implying that wages may well exceed marginal productivity at some point in one’s career. In this case, mandatory retirement should be part of the labor contract or the legal system. Hence, to improve the labor market environment for older people, institutional adjustments such as the introduction of a peak-wage system should be considered along with an increase (or the abolishment) of the mandatory retirement age (Kim, 2011; Cho, 2012).

[11]Although we do not formally analyze the welfare implications of a potential increase in the labor supply among the elderly, tax wedges will impose substantial excess burden to the extent that older people’s labor supply is elastic with respect to the wage rate. Another concern for welfare implications of higher labor participation among the elderly is that they may compete with and replace younger workers in the labor market. However, evidence suggests that they are not substitutes, and even more so in the long run, considering that women’s labor force participation did not replace the male labor force (see Gruber and Wise 2010 for more discussion).

[12]There exists a ceiling for the amount of pension reduction, but it will not bind unless pensioners earn much more than their pre-retirement earnings.

TABLE 6—TAX WEDGES FOR THE LABOR SUPPLY OF PENSIONERS RECEIVING THE NATIONAL PENSION AGED 60 TO 64

Average monthly earnings	Implicit marginal tax rate of pension reduction	Marginal income tax rate	Overall marginal tax rate	Number of pensioners subject to pension reduction		
				2015	2016	2017
[100, 200)	0.00	0.06	0.06	n/a	n/a	n/a
[200, 300)	0.05	0.15	0.20	3,738	104,643	202,606
[300, 400)	0.10	0.15	0.25	1,543	5,714	9,047
[400, 500)	0.15	0.15	0.30	823	2,948	4,461
[500, 600)	0.20	0.24	0.44	424	1,425	2,189
[600, 700)	0.25	0.24	0.49	1,411	4,063	6,420
[700, 800)	0.25	0.24	0.49			
[800, 900)	0.25	0.24	0.49			
900 or more	0.25	0.35 or higher	0.60 or higher			
Total	n/a	n/a	n/a	7,939	118,793	224,723

Note: Monthly earnings are shown in current ten thousand won. The marginal tax rates are simulated. To calculate marginal income tax rate, we applied standard earnings exemptions and personal exemptions for two (worker and spouse). The tax rates are calculated based on the mean monthly earnings in each bracket. Here, "n/a" means not applicable.

Source: Author's calculations and the National Pension Service.

REFERENCES

Barr, Nicholas, and Peter Diamond. 2006. "The Economics of Pensions," *Oxford Review of Economic Policy* 22(1): 15-39.

Carlson, Per. 1998. "Self-perceived Health in East and West Europe: Another European Health Divide," *Social Science & Medicine,* 46(10): 1355-1366.

Cho, Yongman. 2012. "A Legal Study of the Improvement of Retirement Systems," *Quarterly Journal of Labor Policy* 12(3): 1-23 *(in Korean)*.

Coile, Courtney, Kevin Milligan, and David A. Wise. 2017. "Introduction," David A. Wise (Ed.), *Social Security Programs and Retirement around the World: The Capacity to Work at Older Ages*, Chicago and London: University of Chicago Press.

Costa, Dora. 1998. *The Evolution of Retirement: An American Economic History, 1880-1990*, Chicago and London: University of Chicago Press.

Cutler, David M., Ellen Meara, and Seth Richards-Shubik. 2011. "Healthy Life Expectancy: Estimates Implications for Retirement Age Policy," Working Paper.

Goldin, Claudia, and Lawrence F. Katz. 2018. "Women Working Longer: Facts and Some Explanations," in Claudia Goldin and Lawrence F. Katz (eds.), *Women Working Longer: Increased Employment at Older Ages*, Chicago and London: University of Chicago Press.

Gruber, Jonathan, and David A. Wise. 1999. *Social Security Programs and Retirement around the World*, Chicago and London: University of Chicago Press.

Gruber, Jonathan, and David A. Wise. 2004. *Social Security Programs and Retirement around the World: Micro-Estimation*, Chicago and London: University of Chicago Press.

Gruber, Jonathan, and David A. Wise. 2010. *Social Security Programs and Retirement around the World: The Relationship to Youth Employment*, Chicago and London: University of Chicago Press.

Jürges, Hendrik. 2007. "True health vs response styles: Exploring cross-country differences in self-reported health," *Health Economics* 16: 163-178.

Kim, Dohyung. 2018. “Health Capacity to Work at Older Ages in South Korea and Its Implications for Public Pension Policies,” Working Paper, Korea Development Institute *(in Korean)*.

Kim, Jin-Tae. 2011. “A Study of the Improvement of the Mandatory Retirement System for Employment Promotion for the Aged,” *Dong-A Law Review* 52: 807-843 *(in Korean)*.

Lee, Jihye. 2005. “The National Pension and the retirement incentives of the elderly,” *Korean Economic Journal* 44(1): 101-132 *(in Korean)*.

Lee, Yongha. 2017. “An International Comparison of the Contribution and Pensionable Age in Public and Private Pension Systems: Policy Issues,” *Issues in Pension & Analyses of Trends* 37: 9-14, National Pension Service *(in Korean)*.

Milligan, Kevin, and David A Wise. 2012. “Health and Work at Older Ages: Using Mortality to Assess the Capacity to Work Across Countries,” NBER Working Paper No. 18229.

Milligan, Kevin, and David A Wise. 2015. “Health and Work at Older Ages: Using Mortality to Assess the Capacity to Work Across Countries,” *Journal of Population Ageing* 8(1): 27-50.

Munnell, Alicia H., and Steven A. Sass. 2008. *Working Longer: The Solution to the Retirement Income Challenge*, The Brookings Institution.

OECD. 2017. *Pensions at a Glance 2017: OECD and G20 Indicators*, OECD Publishing, Paris.

Schirle, Tammy. 2008. “Why have the labor force participation rates of older men increased since the mid-1990s?” *Journal of Labor Economics* 26(3): 549-594.

Statistics Korea. 2016. *Life Tables for Korea, 1970-2015*, Statistics Korea *(in Korean)*.

Wise, David A. 2017. *Social Security Programs and Retirement around the World: The Capacity to Work at Older Ages*, Chicago and London: University of Chicago Press

LITERATURE IN KOREAN

김도형. 2018. 「노년기 근로를 위한 건강여력과 연금정책적 함의」, 연구자료, 한국개발연구원.

김진태. 2011. 「고령자 고용촉진을 위한 정년제의 문제점과 법제화방안」, 『동아법학』, 제52호: 807-843.

이용하. 2017. 「공사연금의 가입 및 지급연령의 국제비교와 정책과제」, 국민연금연구원, 『연금이슈와 동향분석』, 제37호: 9-14.

이지혜. 2005. 「국민연금과 고령층 노동시장의 은퇴 유인」, 서울대경제연구소, 『경제논집』, 제44권 제1호: 101-132.

조용만. 2012. 「정년연장의 법적 과제」, 『노동정책연구』, 제12권 제3호: 1-23.

통계청. 2016. 「생명표, 1970-2015년」, 통계청.

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Sales Compensation and Recommendations as the Fund of the Month†

By YOONHAE OH*

This study analyzes whether mutual fund distributors are more likely to recommend products with higher sales compensation to maximize their profit. The lists of the 'fund of the month' on their webpages are utilized from April of 2015 to August of 2015. A simple comparative analysis shows that the average sales fees and the average front-end load are significantly higher in the recommended funds among the A share class of domestic equity funds. The results of a regression analysis confirm that funds with high sales compensation levels are more likely to be recommended. This holds true for both domestic equity funds and hybrid bond funds even after controlling for fund age, fund size, and past returns.

Key Word: Mutual Fund, Sales Compensation, Conflict of Interest
JEL Code: G20, G24, G28

I. Introduction

Since the global financial crisis, the importance of financial consumer protection has been strengthened. The UK and Australia have especially focused on conflicts of interest in recommendation services caused by the compensation scheme employed. From 2013, they banned commissions for financial advisors who recommend retail investment products to consumers. However, in Korea, sales personnel who recommend retail investment products in financial institutions may still prioritize products with higher commissions than the best products for the consumers.

Recently, the financial authorities in South Korea introduced the IFA (independent financial advisor) to ease conflicts of interest in existing sales channels. However, Korean consumers do not recognize possible conflicts of interest, which can easily stem from the sales compensation scheme, and the demand for IFAs is very low in the market.[1] Therefore, to activate the demand for IFAs, it is necessary to make consumers aware of the possibility of the conflicts of interest in the product

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recommendation of fund distributors.

This study analyzes the relationship between product recommendations by mutual fund companies and their corresponding sales compensation amounts. Specifically, the recommendation lists posted on the webpage as the fund of the month are analyzed. This approach serves to confirm whether financial institutions attempt to sell products with higher remuneration.

Mutual fund investors must pay various expenses to the sales personnel for the services of investment soliciting, product recommendations and the conclusion of a contract. Among mutual funds, fee structures and sizes vary.[2] Hence, mutual fund distributors have an incentive to recommend a fund product with a greater sales fee or commission to maximize their profit. Therefore, this study focuses on conflicts of interest which can arise due to this type of sales compensation. Therefore, this study analyzes the effects of seller incentives on recommending what is termed the fund of the month. The roles of brokerage firms or asset management companies are not the main concern of this study.[3]

Some studies analyzed domestic equity funds before 2010 to examine conflicts of interest. Shin and Cho (2014) show that the mutual funds with the higher sales fees show higher fund inflows. Won (2009), Cho and Shin (2012) and Ban (2015) show a negative or insignificant relationship between ongoing sales fees and rates of return.

These studies confirm that policies are needed to ease conflicts of interest in the fund market. Accordingly, the compensation system of funds has changed significantly since 2010 in Korea. The structure of fees has diversified into various share class funds. The sales fee amounts have also fallen. However, these changes have made it difficult to analyze the effects of sales compensation on inflows in the market recently. Information about fund inflow and outflow amounts are not divided into share class levels. Thus, though an analysis remains necessary, related studies are limited.

In this context, the present study utilizes lists of the ‘fund of the month’ posted on financial institutions’ web pages from April of 2015 to August of 2015. In particular, the sales compensation amounts, in this case ongoing sales fees and one-time front-end load fees, are compared between the funds on the lists versus those which are not recommended. A regression analysis is also conducted, and these results show that funds with high sales compensation amounts are more likely to be recommended even after controlling for other characteristics of the mutual funds.[4]

This paper is organized as follows. Section II introduces related studies, and Section III covers the background of the fund market in Korea and the research question. Section IV presents the comparative analysis, and Section V presents the regression results. Section VI concludes the paper.

[1]Consumers may consider a recommendation service by banks or security companies to be free, and they do not want to pay separate fees for IFAs.

[2]The forms of these fees also vary, from one-time front/back-end load commissions to ongoing annual maintenance fees.

[3]Although the regression results in the appendix include variable for management fees and brokerage fees, they are not discussed further, as they are additional control variables.

[4]For this analysis, it is necessary to assume that fund-selling institutions recommend funds from an online recommendation list to offline customers. Because financial institutions declare that their recommendation fund council selected the online list according to quantitative and qualitative criteria, an offline recommendation list would share the evaluation criteria. Therefore, it is considered reasonable to analyze online recommendation lists to evaluate conflicts of interest in the mutual fund market.

II. Literature Review

The issue of conflict of interest in the retail investment products is related to the problem of principal-agent when the incentive scheme is inconsistent (Arrow, 1963; Hormstrom, 1982). This study focuses on conflicts of interest that arise during the product recommendation process. This problem is caused by the fact that sales personnel receive compensation from the product manufacturer indirectly instead of receiving an advisory fee from the consumers directly.

The literature indicates that recommendation services in financial markets are distorted due to indirect commissions. According to Mullainathan *et al.* (2012), financial advisors tend to recommend a portfolio with transaction and management costs higher than those of index funds. Anagol *et al*. (2017) find that in India, life insurance sellers recommend products with higher commissions for themselves despite the fact that other products are better for consumers.

Previous studies analyze conflicts of interest in the financial market, reporting higher sales amounts for products with higher commissions. Siri and Tufano (1998) and Christoffersen *et al.* (2013) report a positive relationship between the inflow of U.S. mutual funds and commission sizes.

The Korean literature also focuses on the equity mutual fund market. Before 2010, share class C funds, which receive high ongoing sales fees, dominated the Korean mutual fund market. However, they were cited as having excessive sales fees, and the sellers did not provide maintenance services in exchange for the ongoing sales fees. In this context, Shin and Cho (2014) report a positive relationship between sales fees and fund inflows, suggesting a conflict of interest. Shin and Cho (2014) analyze C-Class domestic equity fund from 2007 to 2010, finding a significant positive relationship in a sample of funds with no affiliated asset management company. In contrast, among funds with affiliated asset management companies, the relationship is negative or insignificant.

Other strands of studies analyze the relationship between sales compensation and fund performance in the domestic equity fund market. Won (2009) pointed out that funds with higher sales fees show lower rates of return, and the amounts of the sales fees are high for funds sold by banks. Cho and Shin (2012) also report a negative relationship between sales fee amounts and fund performance. Ban (2015) analyzes equity funds between 2001 and 2009, reporting no significant relationship between risk-adjusted returns and sales fee amounts.

Despite the fact that earlier studies showed evidence of a conflict of interest in the mutual fund market in Korea, there is a lack of more recent research on conflicts of interest in the mutual fund market. After 2010, the scheme of sales compensation became more diversified. There are now sales fees which decrease over time (C1, C2) and those for funds sold online (E class). Although various share class funds have been introduced as mutual funds, information about outflow and inflow amounts is not distinguished at the share class level.[5]

For this reason, this study examines disclosed recommendations by fund-selling

[5]The Financial Investment Association does not provide separate information about inflows and outflows at the class level.

institutions on their webpages in 2015. Unlike previous studies which utilize fund inflows or net flows as a dependent variable, this study utilizes a dummy variable indicating a recommendation as a fund of the month as the dependent variable. This approach serves to circumvent the problem of information on new inflows for each class fund being unavailable since September of 2010. This approach also has the advantage of directly confirming recommendations by fund sellers.

III. Background and Hypothesis

A. *Mutual Fund Market in Korea*

This section explains the market structure of the mutual fund market. In South Korea, the net assets of mutual funds increased significantly between 2007 and 2008 and then declined until 2012. Since 2012, net assets in the mutual fund market began to rise again, but the net assets of equity funds decreased steadily until 2015.

As shown in Table 1, mutual funds can be classified into equity funds, hybrid bond funds, and fixed income funds for the purposes of this study. Usually, the levels of sales fees are similar within the same fund type, and differences in sales fee are considerable across different types of funds.

Table 2 shows the average sales fee according to the type of fund. The sales fee tends to increase when the fund invests in riskier assets. The derivative bond fund shows the highest average sales fee, at 0.823 percent, while the hybrid bond fund

TABLE 1—TYPES OF MUTUAL FUNDS

Type	Characteristics
Equity fund	A mutual fund invests in stocks with more than 60% of assets under management (AUM).
Fixed-income fund	A mutual fund invests in bonds with more than 60% of AUM. It does not invest in stocks.
Hybrid fund	A mutual fund invests in both stocks and bonds in various proportions. If the portion of stocks is less than 50% of the AUM, it is a hybrid bond fund.

Source: Korea Financial Investment Association (http://dis.kofia.or.kr, last accessed: 2015. 12. 7).

TABLE 2—SALES-RELATED COSTS ACCORDING TO VARIOUS FUND TYPES

(Unit: %)

Fund type	Front-end Load	Sales fee	Management fee
Bond-derivatives fund	0.227	0.823	0.577
Equity fund	0.162	0.779	0.699
Hybrid Equity fund	0.164	0.690	0.563
Hybrid Bond fund	0.077	0.521	0.358
Fixed-income fund	0.037	0.281	0.197

Note: Management fees are fees that are paid out of the fund's assets to the fund's investment adviser for investment portfolio management.

Source: Korea Financial Investment Association (http://dis.kofia.or.kr, last accessed: 2015. 12. 7).

shows the lowest average sales fee of 0.281 percent. Accordingly, there is an incentive for fund sales personnel to promote riskier products to earn higher sales fees.

Certain studies, including that by Shin and Cho (2014), focus on equity mutual funds to examine the relationship between fund inflows and sales fee. This approach is used because it is difficult to compare various types of funds based on identical criteria. This paper also compares the sales compensation amounts within each mutual fund type, in this case domestic equity funds and hybrid bond funds.

B. *Characteristics of Funds of the Month*

1. Selection Criteria

Most financial institutions which sell mutual funds provide a recommendation list on their websites. This list, with a name in the form of "OO Bank (OO) recommended funds," is selected by the internal recommended products council. They regularly select promising products through both quantitative and qualitative measures. Quantitative measures include past returns, fund age, AUM, and fund balance levels, among other measures, and qualitative evaluations are based on such factors as the operation strategies, post-administrative services, and the provision of information. The weights of the qualitative measures in the selection criteria vary depending on the institution. For example, Woori Bank announced that they assign a weight of 90 percent to quantitative measures and 10 percent to qualitative measures, while HMC Securities Corp. assigns a weight of 40 percent to qualitative measures.

2. Updating Period

Although financial institutions explicitly mention that the updating period of a recommendation list and the timing of updates are irregular, the lists generally change every month.[6] Some products remain on the list even after an update. During the survey period of four months, the retention rates of previously selected funds remaining in the list were 85.4% and 85.9% among banks and security corporations, respectively. On the list of the financial institutions with affiliated asset management companies, 23% funds were products of affiliated firms among the banks and the 16% funds were from affiliated firms among the security corporations.

The recommended funds for each institution differ considerably. For example, when funds recommended by more than two institutions are defined as duplicated funds, the ratio of duplicated funds is only approximately 5.3% among banks.

3. Fund Classes and Types

The recommendation lists of fund-selling institutions include both online and offline funds. In particular, recommendation lists in the banking industry tend to include more products sold online, and the ratio of the CE class was highest, referring to funds sold online with no front-end commission. On the other hand, securities

[6] Ten out of twenty-six institutions have clearly stated that they update their recommendation lists every month.

companies recommended more funds sold offline, and the ratio of A-Class funds, which incur a front-end commission and which also have small ongoing fees, was highest.

While all institutions recommended equity funds, the securities industry's lists include more equity funds and derivative funds. On the other hand, the lists recommended by banks have a higher portion of hybrid bond funds and bond funds.

C. *Research Question and Econometric Model*

This study examines whether fund-selling companies tend to recommend products with higher sales fees or front-end load commissions to customers, testing the hypothesis below.

Hypothesis. Fund-selling institutions tend to recommend funds with high sales compensation levels.

This study uses lists of what are referred to as funds of the month, which are recommended on the websites of fund-selling companies to identify recommendations by fund distributors. First, a simple comparative analysis is conducted to compare the sales fee amounts or front-end loads between recommended funds and non-recommended funds. This comparative analysis is performed separately for each share class and type. A-Class (one-time front-end load type) and C-Class (ongoing fee type) funds sold offline are analyzed, as they are the most common types of Korean mutual fund share classes. This study also undertakes a regression analysis to examine whether financial institutions tend to select funds with higher sales compensation rates as the 'fund of the month,' even after controlling for other characteristics such as past returns and the size of the fund.

$$(1) \qquad Recommend_{i,t} = \alpha + \beta_{AF} Front_i + \beta_{AS} Afee_i + \beta_{CS} Cfee_i + X_{i,t}\gamma + \varepsilon_{i,t}$$

The econometric model is shown in equation (1), and an unbalanced random-effect panel logistic regression analysis is utilized.[7] The dependent variable, $Recommend_{i,t}$, has a value of one when fund i is recommended during the month of t by any fund sales institution. When the fund is not recommended at all, it has a value of zero.

Independent variables are sales personnel's compensation amounts, in this case sales fees and front-end load commissions, represented by $Front_i$. As ongoing sales fees are higher in the C-Class fund than in the A-Class fund, $Afee_i$ and $Cfee_i$ are separately included, indicating sales fees of A-Class and C-Class, respectively.[8] The analyses are separately conducted for domestic equity funds and hybrid bond funds,

[7]The random effect model is used because the main regressor, sales compensation, is fixed while other control variables such as past returns and fund sizes change.

[8]Front-end loads and sales fees may vary over time. Changes in the sales costs are disclosed on the website of KOFIA. However, these changes do not arise frequently, and there were no changes in the sample during this study. For this reason, the econometric model includes non-time-varying sales compensation.

as past returns differ from one another. I add four control variables in the regression. These are the natural log of AUM (assets under management) to represent the size of a fund,[9] fund age (natural log of the fund age calculated in units of years), past market-adjusted net returns,[10] and the volatility of the previous rates of return. Time fixed effects are also included.

D. *Data Collection Method*

The lists of funds of the month were collected for five months from April 15 to August 18, 2015. The lists were collected manually from the webpages of 26 fund sales companies (nine banks and 17 securities companies) each week. A fund is classified as a recommended fund if it appeared on the list during the survey period.

The others are categorized as non-recommended funds. To rule out small-scale funds with no cash flow from the sample, funds with an AUM of less than one billion won in both March and April of 2015 were excluded. In addition, if a fund is less than one year old or if the past rate of returns is not available for a new fund, those funds are excluded. For domestic equity funds, index funds are excluded.

Information on fund sales fees and front-end loads was collected from the Korea Financial Investment Association's homepage as of August 18, 2015. Past balances and fund ages were calculated using materials provided by Zeroin. Information on the monthly rate of return for calculating past performance was also provided by Zeroin.

Past performance as market-adjustment earnings is calculated based on early May of 2015 by subtracting the KOSPI rate from the previous rate of returns. Furthermore, abnormal rates of return over the past 18 months were also calculated using the three-element model of Fama and French (1992; 1993).[11]

E. *Calculating Past Performances of Funds*

In this study, we use 12-month market-adjusted returns in the regression analysis to indicate a funds' past performance. Market-adjusted returns are net returns for which market indices are subtracted from the return of a fund. The market indices of domestic equity funds and hybrid bond funds are the KOSPI index and the KIS Index, respectively.

Meanwhile, 18-month abnormal returns are also utilized in the comparative analysis. Abnormal returns are calculated using market and scale factor information obtained from FnGuide's DataGuide 5 and the KIS index.

Market-adjusted return can be easily calculated by market indices, but the performance of market indices cannot reflect normal expected returns. Thus, bias can arise when estimating excessive returns.[12] On the other hand, abnormal returns

[9]This is calculated according to each class at the point of the previous month.

[10]This is calculated as the previous 12-month market-adjusted return at the point of the previous month.

[11]We also calculated 12-month abnormal returns, and these results were similar to those for 18-month abnormal returns.

[12]According to Brown and Warner (1980), the market-adjusted return rate implicitly regards all securities beta values as a type of market index, assuming that the expected return rate of the securities is identical to the expected return rate of the market index.

can be measured by eliminating the influence of market factors, scale factors, value factors, period factors, and credit factors, but this method is not intuitive compared to market-adjusted returns.

IV. Comparative Analysis

In this section, the sales fee amounts and front-end loads are compared, as are the fund sizes and previous performance outcomes between recommended funds and non-recommended funds. I focus on A-Class and C-Class funds sold offline, which are domestic equity funds and hybrid bond funds. The significance test for the mean difference is in this case a one-sided T-test. For fund types with few observations, the Wilcoxon rank-sum test is also used, comparing the median values. The results of the Wilcoxon rank-sum test are shown in the Appendix, and the results are similar to those of the T-tests.

A. *Amounts of Sales Compensation*

Overall, the average sales compensation is higher for recommended funds than for non-recommended funds. Table 3 compares the funds on the recommended lists with all non-recommended funds in share class A. Among the domestic equity funds, the average ongoing sales fee is significantly higher for the recommended funds by 0.065 percentage points. The average front-end load is also higher in the recommended funds by 0.092 percentage points. Among the hybrid bond funds, the sales fee and front-end load amounts are both higher for the recommended funds, but the differences are not insignificant.

Table 4 shows that the average sales fees for recommended funds are significantly higher for the hybrid bond funds, also showing that the average sales fee is higher for hybrid bond funds by 0.163 percentage points. The average sales fee is higher for recommended funds among domestic equity funds, but the difference is not significant.

TABLE 3—COMPARATIVE ANALYSIS: AVG. SALES FEE AND AVG. FRONT-END LOAD (A CLASS)

(Unit: %)

Fund type	Mean Sales fee			Mean Front-end load		
	Recommended	Non-Recommended	Gap	Recommended	Non-Recommended	Gap
Domestic equity	0.777	0.712	0.065**	0.956	0.864	0.092*
Hybrid bond	0.529	0.472	0.057	0.586	0.477	0.109

Note: 1) The numbers of observations of (recommended, non-recommended) funds are (32, 154) for domestic equity funds and (7, 18) for hybrid bond funds. 2) ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively. 3) Index funds are excluded from domestic equity funds.

TABLE 4—COMPARATIVE ANALYSIS: AVG. SALES FEE (C CLASS)

(Unit: %)

Fund types	Mean Sales fee		
	Recommended	Non-recommended	Gap
Domestic equity fund	1.078	0.995	0.083
Hybrid bond fund	0.884	0.721	0.163**

Note: 1) The numbers of observations of (recommended, non-recommended) funds are (9, 77) for domestic equity funds and (7, 58) for hybrid bond funds. 2) ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively. 3) Index funds are excluded from domestic equity funds.

B. *Assets Under Management and Past Performance*

In the previous section, it was confirmed that funds recommended on the fund-selling companies' webpages have higher sales fees or front-end loads than other funds. Next, we compare other characteristics to determine whether the recommended funds have other benefits to offset the high sales-related fees. In this section, we compare past AUM and past performance.

1. Assets Under Management (AUM)

Table 5 shows that the average AUM value is much higher for recommended funds than for non-recommended funds. Among domestic equity A-Class funds, the average past AUM levels amount to 183 billion won for recommended funds and 24.1 billion won for non-recommended funds. The difference in the average AUM remains very large regardless of the class type or type classification. Hence, it is confirmed that the size of the fund is an important criterion in the selection of the fund of the month for financial institutions.

In general, large-sized funds can set diverse operational strategies and reduce some costs. Therefore, it is considered reasonable for fund sellers to recommend large-scale funds. However, the large scale of recommended funds judged to be high in sales-related costs may stem from the fact that financial institutions have long recommended these funds. However, it is difficult to determine the cause of the size difference with currently available data.

TABLE 5—COMPARATIVE ANALYSIS: AVG. AUM (ASSETS UNDER MANAGEMENT)

(Unit: 1 billion Won)

Fund Type	Share Class	Recommended			Non-recommended		
		median	mean	s.d.	median	mean	s.d.
Domestic equity fund	A	123.5	183.06	204.09	7.08	24.16	48.36
	C	159.66	358.69	458.78	8.45	15.81	25.34
Hybrid bond fund	A	47.66	85.41	84.27	1.99	10.42	29.78
	C	140.05	183.19	134.54	7.54	52.33	190.8

Note: 1) The value for AUM is calculated at the beginning of May of 2015. Funds which started after May of 2014 are excluded. 2) The numbers of observations of (recommended, non-recommended) funds among domestic equity funds are (32, 154), (10, 78) for A-Class and C-Class funds, respectively. The numbers of observations of (recommended, non-recommended) funds among hybrid bond funds are (7, 18) and (7, 60) for A-Class and C-Class funds, respectively.

2. Past Performance

As the form of remuneration varies according to the share class, even within the same type of fund, past net returns are compared at the share class level after the subtracting sales compensation amounts. According to the comparative analysis, recommended funds tend to have higher returns, but the differences in the past net returns become insignificant at the share class level.

In Table 6, the average past 12-month market-adjusted return and 18-month abnormal return for recommended funds are significantly higher before the sales cost deduction. However, when comparing net returns at the share class level, as shown in Table 7, the average past net return for recommended funds is only significantly higher with the 12-month market-adjusted return for hybrid bond funds.

TABLE 6—COMPARATIVE ANALYSIS: PAST FUND PERFORMANCE (MANAGED FUND LEVEL)

Fund type	12-month market-adjusted return			18-month abnormal return		
	Recommended	Non-recommended	Gap	Recommended	Non-recommended	Gap
Domestic equity	-0.0077	-0.0082	0.0004***	-0.025	-0.025	0.000
Hybrid bond	0.0853	0.0850	0.0004***	-0.026	-0.030	0.004**

Note: 1) Past returns are calculated at the point of May 4th, 2015. 2) Abnormal returns are estimated by alpha from the three-factor model of Fama and French (1993). For the market factor, the KOSPI index is used for equity funds and the KIS index is used for hybrid bond funds. 3) Market-adjusted returns are calculated by subtracting the KOSPI rate from the previous rate of returns. 4) For 12-month market-adjusted returns, the numbers of observations of (recommended, non-recommended) funds are (22, 198) for domestic equity funds and (6, 122) for hybrid bond funds. 5) For the 18-month abnormal returns, the numbers of observations of (recommended, non-recommended) funds are (17, 170) for domestic equity funds and (3, 108) for hybrid bond funds. 6) ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively.

TABLE 7—COMPARATIVE ANALYSIS: PAST FUND PERFORMANCE (SHARE CLASS LEVEL)

Fund type	Share Class	12-month market-adjusted return			18-month abnormal return		
		Recommended	Non-recommended	Gap	Recommended	Non-recommended	Gap
Domestic equity	A	-0.0080	-0.0082	0.0002	-0.025	-0.025	0.000
	C	-0.0080	-0.0081	0.00005	-0.024	-0.025	0.001
Hybrid bond	A	0.0854	0.0848	0.0006***	-0.055	-0.046	0.01
	C	0.0852	0.0849	0.0003**	-0.050	-0.047	0.003

Note: 1) Past returns are calculated at the point of May 4th, 2015. 2) Abnormal returns are estimated by alpha from the three-factor model of Fama and French (1993). For the market factor, the KOSPI index is used for equity funds and the KIS index is used for hybrid bond funds. 3) Market-adjusted returns are calculated by subtracting the KOSPI rate from the previous rate of returns. 4) For 12-month market-adjusted returns, the numbers of observations of (recommended, non-recommended) funds are A (32, 154) and C (9, 78) for domestic equity funds and A (7, 18) and C (7, 59) for hybrid bond funds. 5) For 18-month abnormal returns, the numbers of observations of (recommended, non-recommended) funds are A (30, 151) and C (8, 70) for domestic equity funds and A (5, 15) and C (6, 49) for hybrid bond funds. 6) ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively.

V. Regression Analysis

A. *Descriptive Statistics*

1. Summary Statistics

Table 8 shows the summary statistics of the sample for the regression analysis. Among all funds during the five months of the sample period, 11.3% and 10.9% of funds were recommended from among hybrid bond funds and domestic equity funds, respectively. Fund size refers to the natural log of assets under management, and Fund age is the natural log of the survival period based on the year. The means of Fund size and Fund age are both slightly larger for domestic equity funds. The number of A-Class funds, 95, is smaller than the number of C-Class funds, 320, among the hybrid bond funds, while the number of A-Class funds is twice as large as the number of C-Class funds among domestic equity funds. The average C-Class sales fee is slightly larger than the A-Class front-end load in both panels.

TABLE 8—SUMMARY STATISTICS

Panel I: Hybrid Bond Funds					
Variable	Obs.	Mean	S. D.	Min	Max
Recommended (dummy)	415	0.113	0.317	0.000	1.000
Fund size (log)	415	2.334	1.925	-6.705	7.331
Fund age (log, year)	415	1.522	0.798	-0.083	2.654
Past 12-month market-adjusted return (%)	415	8.218	0.914	7.146	9.838
Volatility of 12-month past return (%)	415	11.501	1.358	9.206	12.899
A-Class front-end loads (%)	95	0.631	0.223	0.2	1
A-Class sales fees (%)	95	0.497	0.155	0.1	0.9
C-Class sales fees (%)	320	0.737	0.193	0.4	1.05
Panel II: Domestic Equity Funds					
Variable	Obs.	Mean	S. D.	Min	Max
Recommended (dummy)	1,270	0.109	0.311	0.000	1.000
Fund size (log)	1,270	2.523	1.709	-3.213	7.337
Fund age (log, year)	1,270	1.770	0.576	-0.042	2.799
Past 12-month market-adjusted return (%)	1,270	-0.419	0.245	-1.043	0.200
Volatility of 12-month past return (%)	1,270	2.504	0.238	1.928	3.122
A-Class front-end loads (%)	845	0.957	0.143	0.5	1.5
A-Class sales fees (%)	845	0.724	0.187	0.2	1.1
C-Class sales fees (%)	425	1.000	0.233	0.5	1.5

2. Correlation Tables

Pearson's correlation coefficients between variables are presented in Table 9. As the funds are divided into two classes, A and C, the correlation coefficients are calculated for each class of funds. The explanatory variables, the front-end loads or the sales fees, have a significant positive correlation, except for C-Class funds among domestic equity funds. This implies that higher sales compensation amounts

TABLE 9—CORRELATION TABLES

Panel I: Hybrid Bond Funds

		Recommend	Size	Age	Past Return	sd.exReturn	A Front	Sales fee
A	Recommend	1						
	Fund size	0.533***	1					
	Fund age	0.137	0.219**	1				
	Past Return,	0.091	0.056	-0.006	1			
	sd.ex return	0.030	-0.024	0.058	0.002	1		
	A Front load	0.176*	0.431***	-0.222*	0.016	0.006	1	
	A Sales fee	0.246**	0.218**	0.591*	-0.002	0.002	-0.209**	1

		Recommend	Size	Age	Past Return	sd_exReturn	Sales fee
C	Recommend	1					
	Fund size	0.384***	1				
	Fund age	0.034	0.356***	1			
	Past Return,	0.026	0.011	-0.014	1		
	sd. ex return	0.020	0.009	0.034	0.001	1	
	Sales fee	0.242***	-0.143**	0.187***	-0.001	-0.001	1

Panel II: Domestic Equity Funds

		Recommend	Size	Age	Past Return	sd.exReturn	A Front	Sales fee
A	Recommend	1						
	Fund size	0.472***	1					
	Fund age	-0.096***	0.212***	1				
	Past Return,,	0.009	0.036	-0.064*	1			
	sd. ex return	0.028	0.007	0.027	-0.690***	1		
	A Front load	0.065*	0.079**	-0.064*	0.050	-0.010	1	
	A Sales fee	0.113***	0.274***	0.297***	0.013	-0.004	0.111***	1

		Recommend	Size	Age	Past Return	sd.exReturn	Sales fee
C	Recommend	1					
	Fund size	0.516***	1				
	Fund age	-0.023	0.113**	1			
	Past Return,	-0.005	0.031	-0.069	1		
	sd. ex return	-0.010	-0.013	0.045	-0.688***	1	
	Sales fee	0.044	-0.017	0.192***	0.073	0.081*	1

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively.

are related to a higher probability of being recommended by the fund-selling company. The front-end loads and sales fees for A-Class funds are positively correlated among domestic equity funds, whereas they are negatively correlated among hybrid bond funds.

Fund size is significantly correlated with the dependent variable in all cases. Fund size and fund age show a significantly positive correlation, reflecting that older funds have had enough time to obtain more inflow.

The VIF index for each variable is less than two, and there is no evidence that refutes multicollinearity between the variables.

B. *Regression Results*

1. Hybrid Bond Funds

In this section, the results of the regression analysis are presented. These results show that the amounts of sales-related costs have significant effects on the probability of a fund being selected as a fund of the month, even after controlling for other characteristics of the funds.

Table 10 shows the results of the estimation of equation (1) with the sample of hybrid bond funds. Columns (1)-(4) show positive and significant coefficients of the sales fees for the A-Class and C-Class funds. This indicates that high ongoing sales fees explain the probability of a fund being selected as a fund of the month from among other hybrid bond funds. This positive relationship between a recommendation and the sales cost is consistent with the findings of Siri and Tufano (1998), Christoffersen *et al.* (2013), and Shin and Cho (2014).

The coefficient of the front-end load is also positive, but it is only significant in column (4), the model without the volatility of past returns and with time fixed effects. The results of the additional robustness checks are shown in the Appendix. Table A1 shows the results of the robustness check after adding management fees

TABLE 10—REGRESSION: SALES COMPENSATION UPON A RECOMMENDATION FOR HYBRID BOND FUNDS I

Variables	Dependent Variable: recommended=1, non-recommended=0				Marginal Effect
	(1)	(2)	(3)	(4)	(4)
A-Class front-end loads (%)	5.584	5.620	5.608	8.499*	0.157**
	(4.801)	(4.710)	(4.834)	(4.479)	(0.072)
A-Class sales fees (%)	25.42***	25.15***	25.46***	31.43***	0.582***
	(9.512)	(9.477)	(9.495)	(10.09)	(0.104)
C-Class sales fees (%)	17.82**	17.79**	17.84**	24.75***	0.458***
	(7.439)	(7.360)	(7.438)	(8.597)	(0.103)
Fund size (log)	2.795***	2.755***	2.813***	2.819***	0.052***
	(0.867)	(0.843)	(0.866)	(0.938)	(0.008)
Fund age (log, year)	-1.660	-1.635	-1.650	0.360	0.006
	(1.658)	(1.563)	(1.669)	(1.606)	(0.030)
Past 12-month market-adjusted return (%)	0.506		0.509	66.72***	1.235***
	(0.399)		(0.408)	(20.82)	(0.226)
Volatility of past return (%)			-0.0420		
			(0.297)		
Constant	-32.08***	-27.66***	-31.75***	-523.8***	
	(9.451)	(7.879)	(9.555)	(161.0)	
Monthly fixed effect	x	x	x	o	
No. of observations	415	415	415	415	
Log likelihood	-47.148	-48.08	-47.132	-38.986	

Note: 1) New funds less than one year of age and small-scale funds with less than one billion won in March and April of 2015 were excluded. 2) Past 12-month market-adjusted returns are calculated using the KIS index, and it is share class level net return after subtracting sales compensation amounts. 3) ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively, and the numbers in ( ) are the robust standard errors.

TABLE 11—REGRESSION: SALES COMPENSATION UPON A RECOMMENDATION FOR HYBRID BOND FUNDS II

Variables	Dependent Variable: recommended=1, non-recommended=0				Marginal Effect
	(1)	(2)	(3)	(4)	(4)
A-Class sales cost (%) (sales fee + front-end load)	12.341***	0.157*	12.372***	15.532***	0.283***
	(4.271)	(0.072)	(4.289)	(5.359)	(0.062)
C-Class sales fees (%)	14.853***	0.582***	14.880***	20.087***	0.367***
	(5.494)	(0.104)	(5.505)	(7.341)	(0.083)
Fund size (log)	2.639***	0.458***	2.659***	2.680***	0.489***
	(0.796)	(0.103)	(0.796)	(0.939)	(0.009)
Fund age (log, year)	-0.883	0.052***	-0.870	1.068	0.194
	(1.697)	(0.008)	(1.721)	(1.771)	(0.032)
Past 12-month market-adjusted return (%)	0.498	0.006	0.500	63.405***	1.157***
	(0.396)	(0.030)	(0.402)	(22.16)	(0.252)
Volatility of past return (%)		1.235***	-0.040		
		(0.226)	(0.295)		
Constant	-30.616***	-25.773***	-30.310***	-496.944***	
	(7.666)	(5.846)	(7.776)	(170.4)	
Monthly fixed effect	x	x	x	o	
No. of observations	415	415	415	415	
Log likelihood	-48.90	-49.83	-48.89	-41.90	

Note: 1) New funds less than one year of age and small-scale funds with less than one billion won in March and April of 2015 were excluded. 2) Past 12-month market-adjusted returns are calculated using the KIS index, and they are the share class level net return after subtracting the sales compensation amount 3) ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively, and the numbers in ( ) are the robust standard errors.

and brokerage fees and adjusting the sample size. The regression results show all positive, significant coefficients for the sales fees for the A-Class and C-Class funds.

The control variable, the fund size, shows significant and positive coefficients in all models (model (1), 2.795). This confirms that funds with larger AUM levels are more likely to be included on the recommendation list. The past 12-month market-adjusted return shows a significant coefficient only in column (4).

A-Class funds have two types of sales costs, while C-Class funds have only a sales fee. As the correlation table shows a significant correlation between a front-end load and a sales fee for A-Class funds, some studies use a variable which combines these sales costs instead of using two separate variables.

Table 11 shows the regression results using the variable of the A-Class sales cost, a combination of the sales fee and the front-end load for the A-Class funds. The coefficients of the A-Class sales cost and the C-Class sales fee remain positive and significant. According to the average marginal effect of the model (4), the probabilities of being recommended are increased by 2.83%p and 3.67%p, respectively, if the size of the sales cost for both A-Class funds and C-Class funds is increased by 0.1%p.

2. Domestic Equity Funds

Table 12 reports the results the estimation of equation (1) with the sample of domestic equity funds. These results show positive and significant coefficients of

TABLE 12—REGRESSION: SALES COMPENSATION UPON A RECOMMENDATION FOR DOMESTIC EQUITY FUNDS I

Variables	Dependent Variable: recommended=1, non-recommended=0				Marginal Effect
	(1)	(2)	(3)	(4)	(4)
A-Class Front-end loads (%)	9.442***	9.269***	9.279***	10.81***	0.188***
	(2.840)	(2.810)	(3.014)	(3.572)	(0.050)
A-Class sales fees (%)	0.814	0.787	1.338	1.226	0.021
	(2.868)	(2.857)	(3.169)	(3.643)	(0.062)
C-Class sales fees (%)	6.339**	6.173**	6.245*	7.316*	0.127**
	(2.996)	(2.966)	(3.302)	(3.855)	(0.056)
Fund size (log)	3.730***	3.685***	3.868***	4.308***	0.745***
	(0.834)	(0.810)	(0.944)	(1.211)	(0.006)
Fund age (log, year)	-3.947***	-3.847***	-4.250***	-4.671***	-0.081***
	(1.287)	(1.257)	(1.440)	(1.713)	(0.020)
Past 12-month market-adjusted return (%)	-0.770		1.510	3.166	0.055
	(0.728)		(1.045)	(5.434)	(0.093)
Volatility of past return (%)			3.557*		
			(1.904)		
Constant	-22.68***	-22.15***	-31.07***	-24.30***	
	(4.971)	(4.773)	(7.843)	(6.964)	
Monthly fixed effect	x	x	x	o	
No. of observations	1,270	1,270	1,270	1,270	
Log likelihood	-149.338	-149.663	-146.137	142.520	

Note: 1) Index funds are excluded. 2) New funds less than one year of age and small-scale funds with less than one billion won in March and April of 2015 were excluded. 3) Past 12-month market-adjusted returns are calculated using the KOSPI index, and the corresponding share class level net returns after subtracting sales compensation amounts. 4) ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively, and the numbers in ( ) are the robust standard errors.

the front-end load for A-Class funds and the sales fee for C-Class funds, as expected. The coefficients of the sales fee for A-Class funds are not significant, but they are still positive. Thus, funds with high sales compensation amounts are also more likely to be recommended as a fund of the month among domestic equity funds. Table A2 in the Appendix also verifies the positive effect of sales compensation on a recommendation even after management fees, brokerage fees, and adjusting for the sample size.

Fund-scale factors in all models still show significant coefficients (model 1, 3.730). Moreover, unlike the hybrid bond funds above, the coefficient of the fund age shows a significant and negative value (model 1, -3.947), indicating that fund-selling companies tend to recommend relatively new funds. The coefficient of the 12-month market-adjusted return is insignificant.

In Table 13, even after accounting for the combined compensation of the front-end loads and sales fees for A-Class funds, the coefficients are still positive and significant. Thus, we can confirm that the funds higher sales-related costs are also the more likely to be selected as a fund of the month from among domestic equity funds. According to the average marginal effect in model (4), the probability of being recommended is increased by 1.02%p if the sales cost of A-Class funds is increased by 0.1%p.

TABLE 13—REGRESSION: SALES COMPENSATION UPON A RECOMMENDATION FOR DOMESTIC EQUITY FUNDS II

Variables	Dependent Variable: recommended=1, non-recommended=0				Marginal Effect
	(1)	(2)	(3)	(4)	(4)
A-Class sales cost (%) (sales fee + front-end load)	4.825**	4.715**	5.127*	5.832*	0.102**
	(2.359)	(2.319)	(2.650)	(3.074)	(0.045)
C-Class sales fees (%)	4.966	4.806	5.119	5.984	0.105
	(3.291)	(3.255)	(3.607)	(4.195)	(0.064)
Fund size (log)	3.659***	3.606***	3.828***	4.258***	0.075***
	(0.850)	(0.818)	(0.986)	(1.267)	(0.007)
Fund age (log, year)	-4.109***	-3.997***	-4.441***	-4.884***	-0.085***
	(1.324)	(1.287)	(1.505)	(1.803)	(0.021)
Past 12-month market-adjusted return (%)	-0.754		1.584	3.424	0.060
	(0.729)		(1.054)	(5.647)	(0.098)
Volatility of past return (%)			3.649*		
			(1.909)		
Constant	-20.687***	-20.132***	-29.671***	-22.310***	
	(5.180)	(4.952)	(8.044)	(7.285)	
Monthly fixed effect	x	x	x	o	
No. of observations	1,270	1,270	1,270	1,270	
Log likelihood	-149.84	-150.16	-146.50	-142.96	

Note: 1) Index funds are excluded. 2) New funds less than one year of age and small-scale funds with less than one billion won in March and April of 2015 were excluded. 3) Past 12-month market-adjusted returns are calculated using the KOSPI index and the corresponding share class level net return after subtracting sales compensation amounts. 4) ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively, and the numbers in ( ) are the robust standard errors.

VI. Concluding Remarks

This study examined whether fund sellers tend to recommend funds with higher sales-related costs in Korea. This assessment is meaningful as there are not many recent studies which focus on this issue. For the analysis, we utilized the recommendation lists posted on actual financial institutions' webpages as a 'fund of the month.' This approach is useful as the size of net inflows to mutual funds could not be identified at the share class fund level.

The averages of the sales fees and front-end loads of recommended funds and non-recommended funds are compared. The comparison is conducted for A-Class and C-Class funds among domestic equity funds and hybrid bond funds. The comparative analysis indicates that the recommended funds on the webpages have higher sales fees and front-end loads than the non-recommended funds. Moreover, past performance outcomes of recommended funds are not significantly superior to those of non-recommended funds at the class fund level after deducting sales-related costs.

The regression analysis results confirm that funds with higher sales fees tend to be selected by fund sellers as a fund of the month, even after controlling for the effects of size and past performance. The results of the regression analysis show that fund-selling companies are making efforts to maximize their sales compensation when creating the list of recommended funds.

As sales fees or commissions are directly related to the profit of the fund-selling institutions, it is natural for these companies to make efforts to realize high sales compensation. Therefore, it is necessary to establish proper regulations pertaining to disclosures or other behavioral obligations to mitigate such conflicts of interest so that the rational economic behavior of fund sellers does not infringe upon their consumers' interests.

As this study examined only recommendation lists on webpages, there is a limitation when interpreting all recommendation services of actual fund sales channels with these results. For example, during the actual recommendation process, net inflows could be even higher in funds with greater sales fees. However, as this study could not utilize information about inflows, weighting according to inflow size was not utilized.

Furthermore, because these recommended fund lists as posted on the webpages are open to the public, objectively excellent funds may have also appeared on the webpages. It is also possible that with face-to-face recommendations, fund sales personnel can be more sensitive to sales compensation levels in these cases as compared to publicly disclosed lists. Another limitation here is that the data collection period was short at five months. The future performances of recommended funds are also unaddressed in this study, and it is possible that consumers pay high sales costs to sellers, anticipating high future returns. These tasks all remain for future researchers.

APPENDIX

TABLE A1—ROBUSTNESS CHECKS ON REGRESSION: HYBRID BOND FUNDS

	Dependent Variable: recommended=1, non-recommended=0			
	(1)	(2)	(3)	(4)
A-Class front-end loads	1.335	3.049	5.521	5.710
	(5.414)	(2.898)	(4.749)	(4.975)
A-Class sales fees	18.47***	23.81***	25.51***	25.66***
	(6.738)	(8.074)	(9.600)	(9.706)
C-Class sales fees	12.46*	16.08***	17.88**	18.02**
	(6.943)	(6.003)	(7.519)	(7.616)
Fund size	8.437***	3.221***	2.840***	2.913***
	(3.007)	(0.924)	(0.837)	(0.740)
Fund size^2	-0.661**			
	(0.286)			
Fund age	-1.845	-1.881	-1.704	-1.750
	(1.402)	(1.567)	(1.617)	(1.576)
Past 12-month market-adjusted return	0.507	0.512	0.507	-3.510
	(0.394)	(0.425)	(0.400)	(15.91)
Volatility of past return		-0.0601		
		(0.315)		
Management fee	2.579			
	(13.55)			
Brokerage fee	38.07***	38.91***		
	(10.73)	(11.47)		
Constant	-41.32***	-34.41***	-32.25***	15.68
	(10.58)	(10.01)	(9.523)	(208.0)
Time fixed effect	x	x	x	o
Sample adjustment	x	x	o	o
No. of observations	415	415	585	585
Log likelihood	-39.290	-41.225	-47.190	-47.138

Note: 1) New funds less than one year of age and small-scale funds with less than one billion won in March and April of 2015 were excluded. 2) In models 3 and 4, samples are adjusted by excluding funds with less than one billion won in June and July of 2015. 3) Past 12-month market-adjusted returns are calculated using the KOSPI index and the corresponding share class level net returns after subtracting sales compensation amounts. 4) ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively, and the numbers in ( ) are the robust standard errors.

TABLE A2—ROBUSTNESS CHECKS ON REGRESSION: DOMESTIC EQUITY FUNDS

	Dependent Variable: recommended=1, non-recommended=0			
	(1)	(2)	(3)	(4)
A-Class front-end loads	9.955***	10.02***	9.305***	11.89***
	(3.412)	(3.308)	(3.302)	(4.115)
A-Class sales fees	0.483	1.280	0.743	1.388
	(3.349)	(3.406)	(3.033)	(3.829)
C-Class sales fees	6.356*	6.563*	6.198*	7.966*
	(3.777)	(3.588)	(3.523)	(4.356)
Fund size	3.758***	3.898***	3.744***	4.370***
	(0.919)	(1.045)	(0.827)	(1.462)
Fund age	-4.057***	-4.413***	-3.934***	-4.870**
	(1.460)	(1.621)	(1.284)	(2.190)
Past 12-month market-adjusted return	-0.757	1.556	-0.773	3.725
	(0.755)	(1.058)	(0.728)	(5.756)
Volatility of past return		3.619*		
		(1.945)		
Management fee	0.958		0.426	
	(5.246)		(4.933)	
Brokerage fee	-2.379	-2.337		-3.622
	(4.617)	(3.492)		(10.39)
Constant	-22.81***	-31.07***	-22.85***	-24.19***
	(5.827)	(8.578)	(5.257)	(8.648)
Time fixed effect	x	x	x	o
Sample adjustment	x	x	o	x
No. of observations	1,270	1,270	2,075	1,270
Log likelihood	-149.039	-145.793	-149.422	-142.169

Note: 1) Index funds are excluded. 2) New funds less than one year of age and small-scale funds with less than one billion won in March and April of 2015 were excluded. 2) In models 3 and 4, samples are adjusted by excluding funds with less than one billion won in June and July of 2015. 3) Past 12-month market-adjusted returns are calculated using the KOSPI index and the corresponding share class level net returns after subtracting sales compensation amounts. 4) ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively, and the numbers in ( ) are the robust standard errors.

TABLE A3—WILCOXON RANK-SUM TEST: MEDIAN SALES FEE AND FRONT-END LOAD (A CLASS)

(Unit: %)

Fund types	Median sales fee			Median front-end load		
	Recommended	Non-Recommended	Z-stat	Recommended	Non-Recommended	Z-stat
Domestic equity	0.75	0.7095	1.667*	1	1	1.466
Hybrid bond	0.5	0.5	0.154	0.7	0.5	0.913

Note: 1) The numbers of observations of (recommended, non-recommended) are (32, 154) for domestic equity funds and (7, 18) for hybrid bond funds. 2) ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance level, respectively. 3) Index funds are excluded from domestic equity funds.

TABLE A4—WILCOXON RANK-SUM TEST: MEDIAN SALES FEE (C CLASS)

(Unit: %)

Fund types	Median sales fee		
	Recommended	Non-recommended	Z-stat
Domestic equity fund	0.95	1	-0.306
Hybrid bond fund	0.9	0.8	2.232**

Note: 1) The numbers of observations of (recommended, non-recommended) are (9, 77) for domestic equity funds and (7, 58) for hybrid bond funds. 2) ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively. 3) Index funds are excluded from domestic equity funds.

TABLE A5—WILCOXON RANK-SUM TEST: MEDIAN PAST FUND PERFORMANCE (SHARE CLASS LEVEL)

Fund type	Share Class	12-month market-adjusted return			18-month abnormal return		
		Recommended	Non-recommended	Z-stat	Recommended	Non-recommended	Z-stat
Domestic equity	A	-0.0082	-0.0083	0.433	-0.0246	-0.0252	0.626
	C	-0.0079	-0.0081	0.43	-0.0245	-0.0247	0.412
Hybrid bond	A	0.0853	0.0847	3.268***	-0.0612	-0.0469	-1.353
	C	0.0852	0.0848	1.735*	-0.0532	-0.0443	-0.702

Note: 1) For the 12-month market-adjusted returns, the numbers of observations of (recommended, non-recommended) are A (32, 154) and C (9, 78) for domestic equity funds and A (7, 18) and C (7, 59) for hybrid bond funds. 2) For 18-month abnormal returns, the numbers of observations of (recommended, non-recommended) are A (30, 151) and C (8, 70) for domestic equity funds and A (5, 15) and C (6, 49) for hybrid bond funds. 3) Past returns are calculated at the point of May 4th, 2015. Abnormal returns are estimated by alpha from the three-factor model of Fama and French (1993). For the market factor, the KOSPI index is used for equity funds and the KIS index is used for hybrid bond funds. 4) ***, **, and * denote statistical significance at the 1%, 5%, and 10% significance levels, respectively.

REFERENCES

Anagol, Santosh, Shawn Allen Cole, and Shayak Sarkar. 2017. "Understanding the Advice of Commissions-Motivated Agents: Evidence from the Indian Life Insurance Market," *Review of Economics and Statistics*, 99(1): 1-15.

Arrow, Kenneth J. 1963. "Uncertainty and the Welfare Economics of Medical Care," *The American Economic Review*, 53(5): 941-973.

Ban, Juil. 2015. "Effects of Sales Expenses and Management Expenses on Mutual Fund Performance and Flows," *Asia-Pacific Journal of Financial Studies*, 44.

Brown, Stephen J. and Jerold B. Warner. 1980. "Measuring Security Price Performance," *Journal of Financial Economics*, 8(3): 205-258.

Cho and Shin. 2012. "Effects of Fund Sales Fees on Fund Flows and Fund Performance," *Journal of Money and Finance*, 26(1): 78-108 *(in Korean)*.

Christoffersen, Susan E. K., Richard Evans, and David K. Musto. 2013. "What Do Consumers' Fund Flows Maximize? Evidence from Their Brokers' Incentives," *The Journal of Finance*, 68(1): 201-235.

Fama, Eugene F. and Kenneth R. French. 1992. "The Cross-section of Expected Stock Returns," *The Journal of Finance,* 47(2): 427-465.

Fama, Eugene F. and Kenneth R. French. 1993. "Common Risk Factors in the Returns on Stocks and Bonds," *Journal of Financial Economics*, 33(1): 3-56.

Holmstrom, Bengt. 1982. "Moral Hazard in Teams," *The Bell Journal of Economics*, 13(2): 324-340.

Korea Financial Investment Association (http://dis.kofia.or.kr, last accessed: 2015. 12. 7).

Mullainathan, Sendhil, Markus Noeth, and Antoinette Schoar. 2012. "The Market for Financial Advice: An Audit Study," No. w17929, National Bureau of Economic Research.

Oh, Yoonhae. 2015. *Analysis on the Conflict of Interests between Financial Products Recommendation Service of Sales Channel and Retail Clients*, Research Monograph, 2015-06: 25-56 *(in Korean)*.

Shin and Cho. 2014. "Determinants of Fund Investment Flows: Asymmetry between Fund Inflows and Fund Outflows," *KDI Journal of Economic Policy*, 36(4): 33-69 *(in Korean)*.

Siri, Erik R. and Peter Tufano. 1998. "Costly Search and Mutual Fund Flows," *Journal of Finance*, 53(5): 1589-1622.

Won Seung Yeon. 2009. "Function of Fund Distributor and Appropriateness of Sales Fees in Funds," *The Korean Journal of Financial Management*, 26(1): 31-64 *(in Korean)*.

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신인석·조성빈. 2014.「펀드투자 자금흐름의 결정요인」,『한국개발연구』, 제36권 제4호: 33-69.

오윤해. 2015.「펀드 판매사의 추천상품과 이해관계 분석: 추천펀드리스트 분석」,『금융소비자보호 관점에서 평가한 판매와 자문과정: 이해상충 현황과 개선방안」, 연구보고서, 2015-06, 한국개발연구원: 25-56.

원승연. 2009.「펀드 판매사의 역할과 판매 보수의 적정성: 한국의 주식형 펀드를 대상으로」,『재무관리연구』, 제26권 제1호: 31-64.

조성빈·신인석. 2012.「판매보수의 펀드투자자금과 투자성과에 대한 영향」,『금융연구』, 제26권 제1호: 78-108.

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