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The Effect of Enhancing Unemployment Benefits in Korea: Wage Replacement Rate vs. Maximum Benefit Duration[†]

By JIWOON KIM*

This paper studies the macroeconomic effects of an enhancement in unemployment benefits in Korea. In particular, I quantify the welfare effect of two specific policy chances which have been mainly discussed among policymakers in recent years: increasing wage replacement rates by 10%p and extending maximum benefit durations by one month. To this end, I build and calibrate an overlapping generation model which reflects the heterogeneity of the unemployed and the specificity of the unemployment insurance (UI) system in Korea. The quantitative analysis conducted here shows that extending maximum benefit durations by one month improves social welfare, whereas increasing wage replacement rates by 10%p deteriorates social welfare. Extending maximum benefit durations is applied to potentially all the UI recipients, including unemployed workers whose wage before job loss is relatively low and whose marginal utility is relatively high. However, increasing wage replacement rates is applied to only a small number of UI recipients whose wage before job loss is relatively high, while the increase in the UI premium is passed onto all of the employed. This study suggests that given the current UI system and economic environment in Korea, it is more desirable to extend maximum benefit durations rather than to increase wage replacement rates in terms of social welfare.

Key Word: Unemployment Insurance, Unemployment Benefits, Wage Raplacement Rate, Maximum Benefit Duration JEL Code: E24, J64, J65

I. Introduction

The unemployment insurance (UI) system is becoming increasingly important as the unemployment rate is expected to increase given that the restructuring of Korea's main industries (shipbuilding, construction, steel industry, etc.) is ongoing

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[†] This paper is a revised and developed version of Kim (2016) and Kim (2017).

and the dynamics of the Korean economy are need to be restored. Moreover, there has been a constant discussion that Korea's UI system has lower wage replacement rates and shorter maximum benefit durations as compared to those of other OECD nations. The wage replacement rate is 50.5%, lower than the OECD average (64.5%) while the maximum benefit duration is seven months on average, amounting to only half of the OECD average of 15.1 months. In this situation, there is growing recognition that unemployment benefits¹ should be enhanced in Korea among policymakers and researchers. This paper investigates the macroeconomic effects of enhancing unemployment benefits in Korea using the overlapping generation model, which reflects the heterogeneity of the unemployed and the details of the UI system in Korea. In particular, I focus on two specific policy chances which have been mainly discussed among policymakers in recent years: increasing wage replacement rates by 10%p and extending maximum benefit durations by one month. I quantify the effect of these policy changes on aggregate consumption, the employment rate, and social welfare using the calibrated overlapping generation model.

Government support is needed for unemployment because unemployment is type of unexpected income shock, whereas there is no appropriate private insurance for unemployment risk due to the adverse selection problem. Consumption reduction resulting from unemployment not only reduces the welfare of the individual but also reduces the aggregate demand of the economy as a whole. Therefore, the government provides short-term income support on the premise of active job-seeking



FIGURE 1. INTERNATIONAL COMPARISON OF UNEMPLOYMENT BENEFITS

Note: 1) Wage replacement rates specify monthly after-tax wage replacement (unemployment benefit amount/average monthly wage) for the first month of benefit receipt. 2) Comparisons of recipients aged 40 with long and uninterrupted employment records. 3) The OECD average indicates the average of the OECD nations shown in the graphs. 4) It should be noted that Belgium imposes no limits on duration. Therefore, the OECD average does not include the value for Belgium.

Source: Calculated by the author using OECD statistics and OECD (2011b).

¹In this paper, the terms 'unemployment insurance' and 'unemployment benefits' are interchangeable.

through UI that serves as public insurance. The enhanced unemployment benefits can help the unemployed to maintain their consumption level and promote social welfare (consumption smoothing effects). However, more generous unemployment benefits can also have a negative impact on job search efforts (moral hazard effects). In addition, enhanced unemployment benefits potentially raise the UI premium for all workers. Therefore, when analyzing the effects of UI policy changes, it is necessary to reflect the effects on social welfare in a balanced manner in consideration of the positive aspects (consumption smoothing effects) and the negative aspect (moral hazard effects and the increase in the UI premium) of enhanced unemployment benefits.

In order to quantify the comprehensive effects of policy changes, I build an overlapping generation model which reflects the specificity of the UI system in Korea. In Korea, as of 2015, unemployment benefits are provided to involuntarily unemployed workers who have been in insurance-covered employment for at least 180 days during an 18-month period before their job loss. They are given 50% of the average daily wage before severance for terms of 90 to 240 days. The maximum benefit duration varies depending on the age and number of insurance-covered days of the worker (insured periods). The upper limit of the daily wage was set to 86,000 won, meaning that the upper limit of daily unemployment benefits is 43,000 won while the lower limit is 40,176 won—90% of the daily minimum wage (minimum wage $\times 8$ hours).²

The novel feature of the model in this paper is that it incorporates upper and lower limits of unemployment benefits and the maximum benefit duration depending on the age and insured period of each worker into the overlapping generation model. In addition, the eligibility conditions for unemployment benefits (involuntary unemployment and the minimum insured periods) are explicitly reflected in the model. Lastly, the model includes both workers who are covered by the UI and those who are not. As mentioned above, the application of unemployment benefits depends on the age and wage level immediately before the job loss. In addition, the effects of policy changes in the UI system are likely to vary among the unemployed given their different characteristics, such as different ages, income levels, and amounts of net assets. Therefore, the model reflects the heterogeneity of workers in terms of age, individual productivity, and the amount of net assets.

The model is calibrated to match the key features of the Korean labor market, including labor market status by age group and various statistics related to the UI. Using the calibrated model, the overall effects of enhanced unemployment benefits in Korea are examined. In particular, this paper focuses on two specific policy chances: increasing wage replacement rates by 10%p and extending maximum durations by one month. These two polices are compared because they are currently being discussed as feasible policy options to enhance unemployment benefits considering the current actual situation in Korea, whereas the effects of the two policy changes differ greatly. Because the range of the unemployed workers who will be affected by the policy change differs considerably between the two

²Minimum wages have rapidly increased over the past few years, even creating an inversion between the upper and lower limits in 2016. This was corrected recently via a revision of the Enforcement Decree of the Unemployment Insurance Act.

policy changes, the relative sizes of the consumption smoothing effects and moral hazard effects can also be very different. In addition, because the increases in the UI premium to achieve the two policy options differ, all workers who are paying or will pay the UI premium can be affected to some extent. In sum, the two policy options affect the social welfare in different ways through consumption smoothing effects, moral hazard effects, and changes in the UI premium. In order to evaluate the overall effects of policy changes in a comprehensive manner, a structural model which reflects the heterogeneity of the unemployed and the specificity of the UI system in Korea is required.

This paper proceeds as follows. Section II reviews the related literature and describes the contributions of this paper. Section III describes the overlapping generation model. Section IV presents the calibration of the model. Section V shows the results of a quantitative analysis of policy changes in unemployment benefits. Section VI concludes the paper and provides policy implications for the UI system in Korea.

II. Related Literature

Given that previous research on UI is vast and covers various topics, here I introduce relatively recent studies which are directly related to this paper. First, the empirical studies on consumption smoothing effects (one of the positive effects) and moral hazard effects (one of the negative effects) of unemployment benefits are reviewed.³ Then, quantitative studies which use structural models are introduced. Lastly, the contributions of this paper compared to those in previous works are briefly discussed.

This paper is related to several strands in the literature on UI. With regard to the consumption smoothing effects of unemployment benefits, there are few related studies due to the small amount of penal data on consumption expenditures and the status of the labor market at the same time. Gruber (1997) first finds that a 10%p increase in the wage replacement rates of unemployment benefits reduces the reduction rate of consumption by 2.65%p in the U.S. using food expenditure data from the Panel Study of Income Dynamics (PSID) from 1968 to 1987. This implies that unemployment benefits actually help unemployed smooth consumption levels during periods of unemployment. East and Kuka (2015) estimate consumption smoothing effects using the same methodology and data used by Gruber (1997) except that the range of data is from 1986 to 2011. Their estimate of the consumption smoothing effect is 1.0%p, which is weaker than that in Gruber (1997) at 2.65%p. The reason for the lower estimate is that the consumption smoothing effect declined between 1988 and 2011, mainly because unemployment benefits became less generous starting in the 1990s. Moreover, the consumption smoothing effect tends to be relatively small during shallow economic downturns

³In this paper, I focus on the positive and negative effects of unemployment benefits, which were found to be most important in empirical studies. In terms of positive effects other than consumption smoothing effects, unemployment benefits can help the unemployed find a better job (match quality effects) or help them to stay in the labor market (entitlement effects). In terms of negative effects other than the moral hazard effect, more generous unemployment benefits may reduce incentives for firm to hire workers due to the higher wage resulting from the higher value of unemployment as noted in Hagedorn *et al.* (2016).

which are more prominent in the samples after 1988. Browning and Crossley (2001) in a Canadian study estimate the consumption smoothing effect using data on total expenditures from 1993 to 1995. Their estimate of the consumption smoothing effect is 0.8%p, much smaller than that in Gruber (1997) at 4%p, which was adjusted for total expenditures.⁴ The difference can be interpreted as stemming from differences in the countries, sample compositions and estimation methods used. In particular, unlike the other studies mentioned above, only those unemployed for relatively lengthy periods, i.e., for four to nine months, were included in their analysis. The low estimate of Browning and Crossley (2001) suggests that the consumption smoothing effect can be reduced over time after a job loss. In Korea, Kim (2016) estimates the consumption smoothing effect for the period of 1999-2014 using total expenditure data from the Korean Labor and Income Panel Study (KLIPS) and a methodology similar to that by Gruber (1997). Kim's (2016) estimate of the consumption smoothing effect in Korea is 4%p, similar to Gruber's (1997) estimate adjusted for total expenditures.

Unlike research on consumption smoothing effects, there are a large number of studies on the moral hazard effects of unemployment benefits. Moral hazard in this case refers to how long unemployment benefits extend the unemployment period.⁵ Theoretically, more generous unemployment benefits may increase the reservation wages of the unemployed, thereby lowering incentives for the unemployed to seek jobs actively and thus resulting in longer unemployment periods. Although there are some differences in magnitudes, more generous unemployment benefits appear to lead to longer unemployment periods in most previous empirical studies. According to Tatsiramos and Ours (2014), who summarize the empirical results of studies conducted in various countries, unemployment periods increase by 0.4~1.6% when the wage replacement rate increases by 1%p, and unemployment periods are extended by 0.04~0.18 weeks when the maximum benefit duration increases by one week. As in other countries, most of the earlier studies in Korea have concluded that the more generous unemployment benefits increase the unemployment period (e.g., Kim et al. (2007), Yoon and Lee (2010)). However, a few recent studies have reported that there is no significant positive relationship between the generosity of unemployment benefits and the unemployment period (Kim and Yoon (2014), Cheon et al. (2014)).

Based on the literature discussed thus far in this study, it is highly likely that both positive and negative effects will occur when unemployment benefits become more generous. Accordingly, several studies have investigated the optimal level of unemployment benefits in order to maximize the positive effect and minimize the negative effect. Considering both effects, Chetty (2008) finds that the current UI system in the U.S., where the wage replacement rate is 50% and the maximum

⁴Browning and Crossley (2001) convert Gruber's (1997) estimate of food expenditures into that of total expenditures based on a few assumptions regarding the relationship between food and total expenditures.

⁵According to Chetty (2008), some part of the increase in the unemployment period due to more generous unemployment benefits occurs as a positive effect of the provision of liquidity. Although unemployment periods become longer, the receipt of unemployment benefits can help the unemployed to find better jobs due to the provision of liquidity from unemployment benefits. In this sense, the increase in unemployment periods cannot be interpreted solely as a result of the moral hazard effect. However, according to Tatsiramos (2014), who summarized the latest empirical results on the effect of unemployment benefits on the quality of reemployment jobs, there is no significant effect of improving job quality in most cases.

benefit duration is six months, is close to the optimal level. Michelacci and Ruffo (2015) show that the younger the unemployed, the greater the positive effect of unemployment benefits and the smaller the negative effect. These results suggest that it is optimal to provide more generous unemployment benefits to the unemployed who are younger. With regard to for Korea, Chun (2009) derives the optimal structure of the UI system in Korea using the overlapping generation model based on the life cycle model of Hansen and Imrohoroglu (1992). He finds that the optimal wage replacement rate is 60% and that the optimal level of the upper limit for monthly UI benefits is 80% of the average wage before job loss.

In recent years, there have been a growing number of studies quantifying the macroeconomic effects of policy changes in UI systems on production, employment, consumption, and welfare using search and matching models. Nakajima (2012) analyzes the impact of the extension of the maximum benefit duration on the Great Recession in the U.S. Approximately 1.4%p, which amounts to 30% of the total increase in the unemployment rate during the recession, was attributed to the extension of the maximum benefit duration. Faig and Zhang (2016) investigate the effect of Emergency Unemployment Compensation (EUC) program, which allowed an extension of the maximum benefit duration in 2008 up to 99 weeks in the U.S. Their analysis shows that the EUC program increased the unemployment rate by 0.5%p. In Korea, Moon (2010) examines the effect of changes in the maximum benefit duration on labor markets through a three-state search and matching model. He finds that when non-participants are not taken into consideration in the model, an extension of the maximum benefit duration does not have a significant effect on the increase in the unemployment rate. However, when non-participants are included in the model, the extension leads to an increase in the unemployment rate. Hong (2010) quantifies the effect of more generous unemployment benefits on job search efforts, the employment rate, and economic welfare. He finds that an increase in the wage replacement rate has little impact on job search efforts and welfare, whereas an extension of the maximum benefit duration has a significant impact on job search efforts and welfare.

As noted above, a few studies in Korea have already examined the impact of unemployment benefits on the labor market and social welfare. The main differences between this study and previous studies are as follows. In terms of the topic, this paper quantifies the comprehensive effects of two specific policy changes in the UI system in Korea. I explicitly consider that the relative sizes of the positive and negative effects of the enhanced unemployment benefits can differ between the two policy changes because the ranges of unemployed workers affected by the two policy changes differ considerably. In other studies, however, these different effects may not be suitably reflected because either the specificity of the UI system in Korea is not fully modeled or the heterogeneity of the unemployed worker is not sufficiently considered. In terms of the model, the overlapping generation model in this paper reflects the details of the UI system in Korea and the heterogeneity of the unemployed workers so as more precisely to quantify the effects of the policy changes. In particular, the model includes the two eligibility conditions for unemployment benefits (involuntary unemployment and the minimum insured period), the method by which the maximum benefit duration is determined (depending on age and the insured periods), and the lower and upper

limits of the monthly unemployment benefit. It also reflects the heterogeneity of the unemployed in terms of age, insured period, individual productivity, and the amount of net assets considering that the consumption smoothing effects and moral hazard effects may appear differently among different types of unemployed.

III. Model

The model explicitly reflects the heterogeneity of age, individual productivity (skill), amount of net assets, and other factors, considering that the effects of policy changes in the UI system vary with the heterogeneity of the unemployed. The overlapping generation model in this paper is built based on Kitao (2014).⁶

A. Environment

Population

The period in the model is one month.⁷ The model economy consists of a continuum of risk-averse workers. The measure of workers is normalized to one. There are J age groups. Workers face stochastic life spans in the sense that workers belonging to age group $j \in \{1, 2, \dots, J\}$ in the current period transition to age group j + 1 in the next period with a certain probability denoted by ϕ_j .^{8,9} Workers face mortality risk every period, and the probability of surviving until the next period for workers belonging to age group j is denoted by ρ_j .

It is assumed that the remaining assets of the deceased workers at the end of the preceding period are inherited and redistributed equally to all workers in the economy at the beginning of the next period. The amount of these bequests is denoted by x.¹⁰ The size of worker group newly entering the economy (age group 0) is identical to that of the deceased workers every period such that the total population remains at one. The skill distribution of the new entrants is assumed to be identical to that of the deceased workers, implying therefore that the skill distribution of the entire economy remains the same.

⁶The model in Kitao (2014) was originally designed to analyze disability insurance in the United States. I refer to the model in Kitao (2014) because the main ingredients of the model such as labor markets and age structures are suitable for analyzing UI in Korea.

⁷In previous policy changes, the maximum benefit duration had been adjusted by one month. Therefore, it is appropriate to assume that the period of the model is to be one month considering the actual situation in Korea.

⁸The transition probability for the last age group $J(\phi_I)$ is assumed to be 0.

⁹It is necessary to reflect the age structure of the UI system in Korea, in which the maximum benefit duration depends on age. Ideally, I can assume an age structure of one year, but given that the model period is one month and the model has heterogeneity in various dimensions, the assumption that the age increases stochastically reduces the complexity of the model and the burden of the computation greatly.

¹⁰These are also referred to as accidental bequests in the literature.

Labor Market

The economy is composed of the employed (E), the unemployed (U), and the retired (R). The retirement age in the model is denoted by j_R . If the index for the age group (j) is greater than or equal to the retirement age (j_R) , then workers are classified as non-participants. Workers whose index for the age group does not reach the retirement age are classified as either employed or unemployed. Therefore, all non-participants in this model are retirees.¹¹ Workers have different skill levels $(g^j \in [g^j, \overline{g^j}])$ which depends on age, and the skill levels do not change over time within the same age group. When the age group changes stochastically, the absolute value of the skill level changes though the same decile is retained within the age group.

Employed workers work for a fixed amount of hours and earn labor incomes $(g^{j}w)$ which depend on the skill levels of the worker. w denotes the monthly wage for the efficiency unit of the labor supply. The wage rate is assumed to be exogenously given together with the interest rate because the model is a partial equilibrium model. Monthly work hours are constant over time and are normalized to one.¹² Every employed worker can be involuntarily separated with exogenous probability χ at the end of each period. When employed workers have not experienced involuntary unemployment, they quit voluntarily with probability q.¹³

The unemployed workers choose the level of job search efforts ($s \in [0,1]$) at the beginning of each period. Given that a firm's decision on job postings is not explicitly modeled, the job finding probability by age group (p(j,s)) depends only on the job search efforts of the unemployed. The greater the job search efforts of the unemployed. The greater the job search efforts of the unemployed, the greater the job finding probability. Although firms are not explicitly considered, it is assumed that the λ proportion of firms is covered by UI and the $1 - \lambda$ proportion of firms is not. Therefore, for the unemployed who are looking for a job, the probability meeting a firm covered by UI is λ . When a worker works at a firm covered by UI, the insured period (k) for the worker stochastically increases according to the transition probability matrix $\Pi(k, k')$. Retirees neither work nor find jobs as non-participants.

Unemployment Insurance

To be eligible for unemployment benefits, the following two conditions must be met: 1) the unemployment should be involuntary, and 2) the insured period (k) is greater than the minimum insured period (k^e) . During the next period of job loss, the unemployed who are eligible for benefits can decide whether or not to apply for unemployment benefits. If they apply for unemployment benefits, they receive

¹¹For the calibration, statistics related to the labor market such as employment rate and unemployment rate are also adjusted to match the assumptions in the model.

¹²In the case of the Korean labor market, I think this is a reasonable assumption considering that adjustments to working hours are not flexible.

¹³Voluntary unemployment refers to a shift to a better job and a resignation due to personal circumstances such as personal or family issues, dissatisfaction with the current job. This model includes all types of voluntary unemployment in a reduced form.

these benefits from the period of application without rejections.¹⁴ The monthly unemployment benefits (b) can be paid up to the maximum benefit duration (\overline{d}). The amount of the monthly unemployment benefit is determined based on the average wage¹⁵ before job loss and the maximum benefit duration depends on the age group and the insured period. Details about the amount of the monthly benefit and the maximum benefit duration are presented in the calibration section. Lastly, to simplify the model, when the unemployed have not applied for unemployment benefits, it is assumed that they do not have an opportunity to apply thereafter.¹⁶

B. Worker's Problem

The individual state variables for a worker, whose labor market status is divided into the employed (*E*), the unemployed (*U*), and the retired (*R*), are represented by (j, a, k, i, d), $j \in \{1, 2, \dots, J\}$ denotes the index for age groups and *a* denotes the amount of net assets. $k \in \{k_1, k_2, \dots, k_K\}$ indicates the insured period for UI and $i \in \{0,1\}$ indicates whether or not an application is made for unemployment benefits. Lastly, $d \in \{d_1, d_2, \dots, d_D\}$ denotes the number of months for which unemployment benefits are paid up until the current month. Unlike individual state variables which vary with time, an individual's skill level (g^j) is age dependent and does not change over time within the same age group. When the age group changes stochastically, the absolute value of the skill level changes while retaining the same decile within the age group.¹⁷

The Employed Worker ($j < j_R$)

The value function for an employed worker whose skill level is g^{j} and work at a firm which is covered by UI is expressed as shown below.

¹⁶In the current UI system in Korea, the unemployed can apply for the benefits at any time within one year after their job loss. Given that the average time to apply is 29.7 days after the job loss based on the 2015 Yearly Statistics of Employment Insurance (Ministry of Employment and Labor, 2016a), the assumption that an application for the benefits is allowed only the month after they lose their jobs in the model seems innocuous.

¹⁷In this model, similar to Mukoyama (2013), I focus on unemployment risk and conduct a welfare analysis related to the role of UI for unemployment risk. I do not take into account idiosyncratic earning shocks as in the types of models following Aiyagari (1994). If the role of precautionary savings of the employed workers is important and the wage distribution or inequality itself is the main object of the paper, abstracting from time-varying productivity shocks can be an inappropriate assumption. However, considering the purpose of the paper, the most important income risk here is unemployment risk. Therefore, the disadvantages that come from not reflecting idiosyncratic labor productivity shocks are not likely to be large.

¹⁴In reality, the waiting period is seven days.

¹⁵In the current UI system in Korea, the average monthly wage level is determined by the average threemonth wage immediately before the job loss. Because the monthly wage level in the model is assumed to be the skill level of the workers, which is constant within the same age group, the average three-month wage is identical to the skill level of the workers. However, in the case of a stochastic change in the age group, the skill level also changes. Therefore, in the first few months after the change in the age group, the calculation of the average threemonth wage becomes more complicated. In this case, the wage level for the previous age group is used for the calculation of the average three-month wage for the sake of simplicity.

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$$\begin{split} V_{g^{j}}^{L,1}(j,a,k) &= \max_{c,a'} u(c,0) \\ &+ \beta E_{\rho,\phi} \Biggl[\binom{(1-\chi) \Big(q V_{g^{j}}^{U,0}(j',a',k') + (1-q) V_{g^{j}}^{E,1}(j',a',k') \Big)}{+ \chi \Big(I_{(k < k^{e})} V_{g^{j}}^{U,0}(j',a',k') + I_{(k \ge k^{e})} V_{g^{j}}^{U,1}(j',a',k') \Big)} \Biggr] \\ &\text{s.t.} \\ & (1+\tau_{c}) c + a' = (1-\tau_{l}) (1-\tau_{u}) g^{j} w + (1+r(1-\tau_{k})) a + x + T \\ &a' \ge a, k' \sim \Pi(k,k') \\ & \text{where } V_{g^{j}}^{U,0}(j_{R},a',k') = V_{g^{j}}^{U,1}(j_{R},a',k') = V_{g^{j}}^{E,1}(j_{R},a',k') \equiv V^{R}(j_{R},a') \end{split}$$

At the beginning of each period, the employed worker observes his individual state variables and chooses the amount of consumption (c) and net assets (a') to maximize utility (u(c, l)) from consumption and leisure $(l)^{18}$ under a given budget constraint. The employed worker allocates their total income, which consists of after-tax labor income,¹⁹ after-tax asset income, redistribution (x) from deceased workers, and transfer income from the government (T), to consumption and savings $(a').\tau_c,\tau_l,\tau_k$ and τ_u denote the consumption tax rate,²⁰ the labor income tax rate, the asset income tax rate, and the UI premium, respectively. Because the worker is employed by a firm covered by UI, the worker's insured period increases stochastically according to the transition probability matrix $\Pi(k,k')$. All workers, including employed workers, cannot borrow more than -a.

At the end of each period, the employed worker who continues to survive with probability ρ_j makes the following decision. If the worker does not experience involuntary unemployment, he works at the same firm with probability 1 - q or quits voluntarily with probability q^{21} . If the worker quits voluntarily, then he becomes an unemployed worker who is not eligible for unemployment benefits and looks for other jobs without unemployment benefits. $V_{g^j}^{U,0}$ indicates the value

function for the unemployed who are not eligible for unemployment benefits.

If a worker experiences involuntary unemployment, the worker becomes an

¹⁸When engaged in work, the amount of leisure is 0, and when not working, leisure is normalized to one.

¹⁹Because the UI premium is subject to income deduction, labor income excluding the UI premium is regarded as the taxable income subject to the labor income tax.

²⁰This corresponds to the value-added tax (VAT) rate in Korea.

²¹Voluntary unemployment is modeling in a reduced form because doing so enables the distribution of the voluntary unemployed and the involuntary unemployed in the model to be equal to the distribution in the actual data in a simple way. Voluntary unemployment can occur when productivity (wage) at the current job has fallen below the value of unemployment while the value of unemployment remains unchanged. On the other hand, voluntary unemployment can also transpire when the value of unemployment increases for reasons such as personal or family issues arising while productivity at the current job remains unchanged. In both cases, voluntary unemployment occurs when productivity or the market wage at the current job is lower than the reservation wage, which depends on the value of unemployment. In order to model the two types of voluntary unemployment observed in the data properly, both the change in productivity and the value of unemployment should be simultaneously internalized in the model. However, this is not an easy task and is beyond the scope of this paper. With regard to why voluntary unemployment is introduced in this paper, it should be noted that having a realistic share of voluntary unemployment is more important than an endogenous choice for voluntary unemployment. For this reason, I abstract from endogenous voluntary unemployment, and voluntary unemployment is modeled as an exogenous random separation despite the fact that this may not be consistent with the reservation wage theory.

unemployed worker and can apply for unemployment benefits depending on whether his insured period (k) is greater than or equal to the minimum insured period (k^e) , which is one of the two eligibility conditions for unemployment benefits. $I_{(k < k^e)}$ and $I_{(k \ge k^e)}$ are indicator functions showing whether the unemployed meet the eligibility condition related to the insured period. $V_{g^{j}}^{U,1}$ denotes the value function for the unemployed who are eligible for unemployment benefits. The expression on the last line of the constraints defines value functions for employed workers who will reach retirement age (j_R) in the next period.

The value function for an employed worker whose skill level is g^{j} and who works at a firm not covered by UI is as follows:

$$\begin{split} V_{g^{j}}^{E,0}(j,a,k) &= \max_{c,a'} u(c,0) \\ &+ \beta E_{\rho,\phi} \Biggl[(1-\chi) \Bigl(q V_{g^{j}}^{U,0}(j',a',k) + (1-q) V_{g^{j}}^{E,0}(j',a',k) \Bigr) \\ &+ \chi \Bigl(I_{(k < k^{e})} V_{g^{j}}^{U,0}(j',a',k) + I_{(k \ge k^{e})} V_{g^{j}}^{U,1}(j',a',k) \Bigr) \Biggr] \\ &\text{s.t.} \\ &(1+\tau_{c}) c + a' = (1-\tau_{l}) g^{j} w + (1+r(1-\tau_{k})) a + x + T \\ &a' \ge a \\ & \text{where } V_{g^{j}}^{U,0}(j_{R},a',k) = V_{g^{j}}^{U,1}(j_{R},a',k) = V_{g^{j}}^{E,0}(j_{R},a',k) \equiv V^{R}(j_{R},a') \end{split}$$

One difference from the value function for an employed worker who works at a firm covered by UI is that the worker's insured period does not increase and is fixed at the current level. Another difference is that the employed worker does not pay the UI premium, which is reflected in the budget constraint.²²

The Unemployed Worker ($j < j_R$)

The unemployed who quit voluntarily or who do not meet the eligibility condition for the minimum insured period ($k < k^e$) are not eligible for unemployment benefits. The value function for the unemployed who are not eligible for unemployment benefits is as follows:

²²Even if a worker's current job is not covered by UI, the worker can apply for UI benefits if the worker meets the 180-day contribution requirement at the previous job and the worker is involuntarily separated from both the current and previous jobs. The model also allows for this possibility. Because the model does not keep track of all histories of the reasons for unemployment, the worker can apply for UI benefits in the model if the worker meets the 180-day contribution requirement at the previous job and the worker is involuntarily separated only from the current job regardless of the reason for the unemployment at the previous job. Therefore, it should be noted that there may be some imprecision regarding this simplification.

$$\begin{aligned} V_{g^{j}}^{U,0}(j,a,k) &= \max_{c,a',s} u(c,1) - \nu(s) \\ &+ \beta E_{\rho,\phi} \left[p(j,s) \begin{pmatrix} (1-\lambda) \max\left\{ V_{g^{j}}^{E,0}(j',a',k), V_{g^{j}}^{U,0}(j',a',k) \} \\ + \lambda \max\left\{ V_{g^{j}}^{E,1}(j',a',k), V_{g^{j}}^{U,0}(j',a',k) \} \\ + (1-p(j,s)) V_{g^{j}}^{U,0}(j',a',k) \\ \text{s.t.} \\ &(1+\tau_{c})c + a' = (1+r(1-\tau_{k}))a + x + T \\ &a' \geq a \\ & \text{where } V_{g^{j}}^{U,0}(j_{R},a',k) = V_{g^{j}}^{E,0}(j_{R},a',k) = V_{g^{j}}^{E,1}(j_{R},a',k) \equiv V^{R}(j_{R},a') \end{aligned}$$

At the beginning of each period, the unemployed workers who are not eligible for unemployment benefits observes their individual state variables and chooses the amount of consumption and net assets, as well as the level of job search effort (s)to maximize the total utility from consumption and leisure minus disutility from the job search effort (v(s)) under the given budget constraint. It is assumed that the higher the level of job search effort is, the greater the disutility is from the job search.

In this economy, the proportion λ of firms are covered by UI and the proportion $1 - \lambda$ of firms are not. Therefore, the unemployed find a firm covered by UI with probability λ and find a firm not covered by UI with probability $1 - \lambda$.²³ At the end of each period, the surviving unemployed workers who find job with probability p(j,s) make the following decisions after observing their individual state variables. They can either work at a firm or refuse the offer and continue to look for other jobs during the next period. The unemployed workers who do not find jobs with probability 1 - p(j,s) continue to look for jobs.

The unemployed who quit involuntarily and meet the eligibility condition for the insured period $(k \ge k^e)$ are eligible for unemployment benefits. The value function immediately after job loss for the unemployed who are eligible for unemployment benefits is as follows:

²³Random matching with different types of firms may be distant from reality because some unemployed may want only firms covered by UI or only firms not covered by UI. In this paper, although the unemployed receive job offers from both types of firms with some probabilities, they can decide whether or not to accept a specific job offer. The unemployed can refuse the job offer when they want to wait for other job offers in the next period. In this sense, the choice of the unemployed between a firm covered by UI and a firm not covered by UI is not a completely random decision, as in a case of the exogenous voluntary separation (*q*). Of course, in reality, each unemployed worker has a different probability of receiving a job offer from a particular type of firms. In this regard, the model still does not reflect reality because the same probability of receiving a job offer (λ or $1 - \lambda$) is applied to all types of unemployed in the model. Given that having a realistic share of firms covered by UI in a steady state is of primary importance, the heterogeneity of the job offer probability is not reflected in the model for the sake of simplicity.

$$\begin{aligned} V_{g'}^{U,1}(j,a,k) &= \max_{c,a',s,i \in \{0,1\}} u(c,1) - v(s) - i\eta \\ &+ (1-i)\beta E_{\rho,\phi} \left[p(j,s) \begin{pmatrix} (1-\lambda) \max\left\{V_{g'}^{E,0}(j',a',k), V_{g'}^{U,0}(j',a',k)\right\} \\ + \lambda \max\left\{V_{g'}^{E,1}(j',a',k), V_{g'}^{U,0}(j',a',k)\right\} \\ + (1-p(j,s))V_{g'}^{U,0}(j',a',k) \end{pmatrix} \right] \\ &+ i\beta E_{\rho,\phi} \left[p(j,s) \begin{pmatrix} (1-\lambda) \max\left\{V_{g'}^{E,0}(j',a',k), V_{g'}^{U,2}(j',a',k,d=2)\right\} \\ + \lambda \max\left\{V_{g'}^{E,1}(j',a',k), V_{g'}^{U,2}(j',a',k,d=2)\right\} \\ + (1-p(j,s))V_{g'}^{U,2}(j',a',k,d=2) \end{bmatrix} \right] \end{aligned}$$

s.t.

v

$$(1 + \tau_{c})c + a' = (1 + r(1 - \tau_{k}))a + ib(g^{j}) + x + T$$

$$a' \ge \underline{a}$$

where $V_{g^{j}}^{U,0}(j_{R}, a', k) = V_{g^{j}}^{U,2}(j_{R}, a', k, d = 2) \equiv V^{R}(j_{R}, a')$
 $V_{g^{j}}^{E,0}(j_{R}, a', k) = V_{g^{j}}^{E,1}(j_{R}, a', k) \equiv V^{R}(j_{R}, a')$

At the beginning of the period right after the job loss, the unemployed workers who are eligible for unemployment benefits observe their individual state variables and choose the amount of consumption and net assets, the level of the job search effort, and whether or not to apply for unemployment benefits ($i \in \{0,1\}$) to maximize the total utility from consumption and leisure minus the sum of the disutility from the job search effort and the disutility from the application process for unemployment benefits (η) under the given budget constraint. The unemployed who apply for unemployment benefits can receive monthly unemployment benefits ($b(g^{j})$), which depend on their skill level up to the maximum benefit duration ($\overline{d}(j,k)$), which depends on each worker's age group and insured period. If the unemployed apply for unemployment benefits, they receive benefits from the period of application without rejection, as was assumed previously.

At the end of each period, the surviving unemployed workers who find jobs with probability p(j, s) make the following decisions after observing their individual state variables. They can either work at a firm or refuse an offer and continue to look for other jobs during the next period. It is assumed that even if a worker rejects a job offer, the worker can continue to receive unemployment benefits in consideration of the realistic situation.²⁴ The unemployed worker who does not find a job with probability 1 - p(j, s) continues to look for jobs. If the unemployed worker applies for unemployment benefits, then he receives the benefits. $V_{\alpha j}^{U,2}$ denotes the value function for the unemployed who receive UI

²⁴In current UI system in Korea, if a legitimate job offer is rejected by a recipient of unemployment benefits, a job center initially gives a written warning. In the case of a second refusal for a job offer, the job center may suspend unemployment benefits. However, this usually occurs if the unemployed reject a job offered by the job center, whereas in other cases most job offers are likely not to be affected by this rule. Because job offers are private information, even if the unemployed reject a job offer, it is difficult for the job center to observe this in reality.

benefits for more than or equal to two months. If the unemployed have not applied for unemployment benefits, it is assumed that they do not have an opportunity to apply thereafter as was assumed previously.

The value function for the unemployed who have not exhausted their maximum benefit durations (the number of months actually paid (d) < the maximum benefit duration $(\overline{d}(j,k))$) is as follows:

$$\begin{split} V_{g'}^{U,2}\Big(j,a,k,d < \overline{d}(j,k)\Big) &= \max_{c,a',s} u(c,1) - \nu(s) \\ &+ \beta E_{\rho,\phi} \left[p(j,s) \begin{pmatrix} (1-\lambda) \max\left\{V_{g'}^{E,0}\left(j',a',k\right), V_{g'}^{U,2}\left(j',a',k,d+1\right)\right\} \\ + \lambda \max\left\{V_{g'}^{E,1}\left(j',a',k\right), V_{g'}^{U,2}\left(j',a',k,d+1\right)\right\} \end{pmatrix} \right] \\ &+ (1-p(j,s))V_{g'}^{U,2}\left(j',a',k,d+1\right) \\ &\text{s.t.} \\ &(1+\tau_c)c+a' = (1+r(1-\tau_k))a+b(g^j)+x+T \\ &a' \geq a \\ &\text{where } V_{g'}^{U,2}\left(j_R,a',k,d+1\right) = V_{g'}^{E,0}\left(j_R,a',k\right) = V_{g'}^{E,1}\left(j_R,a',k\right) \equiv V^R\left(j_R,a'\right) \end{split}$$

At the end of each period, the surviving unemployed workers who find a job with probability p(j,s) make the following decisions after observing their individual state variables. They can either work at a firm or refuse an offer and continue to look for other jobs during the next period. Even if a worker rejects a job offer, the worker can continue to receive unemployment benefits. The unemployed worker who does not find a job with probability 1 - p(j,s) continues to look for jobs while receiving unemployment benefits.

The value function for the unemployed who are receiving unemployment benefits in the last month (the number of months actually paid (d) = the maximum benefit duration $(\overline{d}(j,k))$) is as follows:

$$V_{g^{j}}^{U,2}(j,a,k,d = \overline{d}(j,k)) = \max_{c,a',s} u(c,1) - v(s) + \beta E_{\rho,\phi} \left[p(j,s) \begin{pmatrix} (1-\lambda) \max\left\{V_{g^{j}}^{E,0}(j',a',k), V_{g^{j}}^{U,0}(j',a',k)\right\} \\ +\lambda \max\left\{V_{g^{j}}^{E,1}(j',a',k), V_{g^{j}}^{U,0}(j',a',k)\right\} \\ +(1-p(j,s))V_{g^{j}}^{U,0}(j',a',k) \\ \text{s.t.} \\ (1+\tau_{c})c + a' = (1+r(1-\tau_{k}))a + b(g^{j}) + x + T \\ a' \ge a \\ \text{where } V_{g^{j}}^{U,0}(j_{R},a',k) = V_{g^{j}}^{E,0}(j_{R},a',k) = V_{g^{j}}^{E,1}(j_{R},a',k) \equiv V^{R}(j_{R},a')$$

At the end of each period, the surviving unemployed workers who find a job with probability p(j,s) make the following decisions after observing their individual state variables. They can either work at a firm or refuse an offer and

continue to look for other jobs without unemployment benefits in the next period. The unemployed worker who does not find a job with probability 1 - p(j, s) continues to look for jobs without unemployment benefits because he has exhausted the maximum benefit duration.

The Retired Worker $(j \ge j_R)$

The Value function for a retired worker is as follows:

$$V^{R}(j,a) = \max_{c,a'} u(c,1) + \beta E_{\rho,\phi} \Big[V^{R}(j',a') \Big]$$

s.t.
$$(1+\tau_{c})c + a' = (1+r(1-\tau_{k}))a + x + Ta)$$
$$a' \ge a$$

At the beginning of each period, the retired worker $(j \ge j_R)$ observes his individual state variables and chooses the amount of consumption and net assets to maximize the utility from consumption and leisure under the given budget constraint. Because the decisions of retired workers are independent of the skill level (g^j) , there is no subscript in the value function for the retired worker.

C. Stationary Recursive Equilibrium

I define an individual state vector of the employed working at a firm not covered by UI, the employed working at a firm covered by UI, the unemployed not collecting unemployment benefits, the unemployed collecting unemployment benefits, and the retired as $s^{E,0} = (j,a,k;g^j)$, $s^{E,1} = (j,a,k;g^j)$, $s^{U,0} = (j,a,k;g^j)$, $s^{U,1} = (j,a,k,d;g^j)$, and $s^R = (a)$, respectively.²⁵ The corresponding state spaces for each type of workers are defined as $S^{E,0}$, $S^{E,1}$, $S^{U,0}$, $S^{U,1}$, and S^R . Lastly, the state space for the entire economy is defined as S.

A stationary recursive equilibrium is a set of 1) value functions for the employed, the unemployed, and the retired; 2) decision rules for the employed (consumption and assets), the unemployed (consumption, assets, job search efforts, application for unemployment benefits), and the retired (consumption, assets); 3) redistribution from deceased workers (x), and lump-sum transfer income from the government (T); and 4) the distribution of workers ($\mu(S)$) such that:

1. Given wages (w) and interest rates (r) exogenously, the decision rules for each type of worker are solutions to the relevant workers' problems.

²⁵Although the skill level (g^j) is not a state variable, it is included in the individual state vector for convenience in defining equilibrium mathematically.

2. The level of redistribution from deceased workers (x) is determined as follows:

$$x = \frac{\int a' (1 - \rho_j) \mu_j dS}{\int \rho_j \mu_j dS + \mu_0}$$

where μ_j denotes the measure of the age group j and μ_0 denotes the measure of new entrants, which is defined as $\mu_0 = \int (1 - \rho_i) \mu_i dS$.

3. Exogenously given the consumption tax rate (τ_c) , the labor income tax rate (τ_l) , the asset income tax rate (τ_k) , and the UI premium (τ_u) ,²⁶ the lump-sum transfer income from the government (T) satisfies the following government budget constraint for the general account budget.²⁷

$$\tau_{c}\int c\mu(S)dS + \tau_{l}\int g^{j}w\mu(S^{E,0})dS + \tau_{l}(1-\tau_{u})\int g^{j}w\mu(S^{E,1})dS + \tau_{k}r\int a\mu(S)dS - \tau_{u}\int g^{j}w\mu(S^{E,1})dS = T$$

4. The distribution of workers is time invariant. That is, the following condition is satisfied.

 $\mu_{t+1}(S) = \mu_t(S)$ for all *S* and t.

IV. Calibration

A. Functional Forms

I use the following CRRA²⁸ utility function for consumption, which is widely

²⁶In this model, the UI premium is exogenously given rather than determined in equilibrium. Unemployment benefits are funded by the Employment Insurance Fund in Korea, which is accumulated and managed separately from the general account budget. Therefore, the budget constraint defined above does not include expenditures for unemployment benefits. The budget constraint for the Employment Insurance Fund is not explicitly considered because in reality it is highly likely that the budget constraint for the Employment Insurance Fund will not be balanced due to complicated issues related to the reserve fund to expenditure ratio and expenditures for maternity protection. Although the budget constraint for the Employment Insurance Fund is not explicitly considered in this paper, it can be defined as follows:

$$\kappa \int b(g^j)\mu(S^{U,1})dS = 2\tau_u \int g^j w\mu(S^{E,1})dS$$

where κ denotes the statutory reserve fund to the expenditure ratio, which is 1~1.5 as of 2015.

²⁷Because firms are not explicitly modeled in this paper, it is assumed that the government pays the employer's contribution to unemployment benefits instead of firms. This is shown in the last term of the left-hand side of the government budget constraint. In Korea, as the employer and the worker pay half of the UI premium, the model assumes that the government pays the same rate as the worker. The last term should be interpreted as expenditures of the government, not revenues from the UI system despite the fact that the term encompasses the UI premium (τ_u). If firms are explicitly considered in the model, the last term is dropped in the government budget constraint. Therefore, the lump-sum subsidy (*T*) does not include UI premiums collected but includes firms' contributions to the UI due to technical issues. Therefore, the only tax revenues are redistributed equally in a lump-sum manner.

²⁸Constant Relative Risk Aversion.

used in various macroeconomic studies. A separable utility function between consumption and leisure is assumed.

$$u(c,l) = \frac{c^{1-\sigma}}{1-\sigma} + \gamma_e(l-1)$$

Because there is no endogenous choice for working hours (intensive margin) in the model, the leisure part of the utility function is simplified. γ_e denotes disutility from working. Given that working hours in this model are normalized to one, leisure for the employed has a value of 0, whereas leisure for the unemployed and retired has a value of 1.

Unemployed workers incur disutility from job searching. The level of disutility depends on job search effort, and it is represented in the following functional form, as in Nakajima (2012) and Kitao (2014).

$$\nu(s) = \gamma_s \frac{s^{1+\psi}}{1+\psi}$$

Lastly, I assume a linear function for the job finding rate p(j,s), which depends on age and the job search effort following Kitao (2014).

$$p(j,s) = p_j s$$

B. Parameters

Parameters in this paper can be categorized into two groups. The first set of parameters is calculated independently of the model or borrowed from previous studies. The second group is determined endogenously in the model by matching the statistics calculated from the data generated by the model with those calculated from actual data. The actual statistics used in the calibration of the model are mostly based on 2015 data. Some data, such as those related to UI and unemployment benefits, are based on the most currently data available as of 2014 or earlier.

Parameters Calibrated Outside of the Model

The parameter for risk aversion (σ) in the utility function is assumed to be 2; this has often been used in macroeconomic studies, such as in Nakajima (2012). The parameter which determines the magnitude of disutility from job search (γ_s) is normalized to one. Because only the relative size of γ_s and the marginal job finding rate by age group (p_j) matter, γ_s is normalized to one in this paper. The parameter for the elasticity of the job search disutility with respect to the job search effort (ψ) is set to 1 based on estimates from Yashiv (2000), Christensen *et al.* (2005), Lise (2012), and Pei and Xie (2016).

The minimum age in the model is assumed to be 20 years considering the actual age of entry into the labor market for high school graduates. The maximum age is

assumed to be 84 years based on the average life expectancy for 2015. The number of age groups (*J*) is set to 4; 20~29 (j = 1), 30~49 (j = 2), 50~64 (j = 3), and 65~84 years ($j = j_R = J = 4$).

This assumption reflects that the maximum benefit duration varies depending on an age of 29 or less, 30 to 49 years, and 50 to 64 years in reality. The last age group is for retired workers.

In this model, workers aged 20 to 64 years are assumed to be either employed or unemployed for the sake of simplicity. Therefore, the employment rates for the age groups, 20~29, 30~49, and 50~64 years are recalculated from the Economically Active Population Survey (EAPS) by excluding non-participants and treating the total population as the sum of the employed and the unemployed in EAPS. The number of people aged 65 to 84 years (the retired) is assumed to be the sum of nonparticipants aged 20 to 64 years in EAPS so that labor force participation rates for all workers (aged 20~84 years) in the model is identical to those from EAPS.²⁹ To summarize the population structure of the model, the total population aged 20 to 64 years is divided into the employed and unemployed, and the total population aged 65 to 84 years is classified as non-participants. The number of employed and unemployed aged 20 to 64 years in the model is identical to the ratio of the employed and unemployed aged 20 to 64 years to the total population aged 20 to 64 years in EAPS. The total population aged 65 to 84 years in the model is identical to the ratio of non-participants aged 20-64 years to the total population aged 20 to 64 years in EAPS. The definition and distribution of the population in the model are summarized in Table 1.

The parameters related to the population structure are the age-group-specific survival probabilities (ρ_j) and the probabilities of transitioning to the next age group (ϕ_j) .³⁰ The age-group-specific survival probabilities are calculated by converting annual age-specific mortality probabilities into the monthly survival probabilities for each age group using the 2015 Life Tables for Korea from the Statistics Korea. The Population shares of each age in 2015 are used as weights when computing the age-group-specific mortality probabilities, which are the weighted averages of the relevant age-specific mortality probabilities. The annual age-group-specific survival probability is then converted into the monthly age-group-specific survival probability. The probability of a transition to the next age group is determined by the age-group-specific survival probabilities (ρ_j) and the population shares by age group (μ_j) that satisfy the following simultaneous equations assuming that the population shares by age group as shown in Table 1 remain stable.³¹

²⁹The assumption of the number of workers aged 65 years or older is immaterial in this paper because workers aged 65 years or older are not covered by the UI system.

³⁰The probability of transitioning to the next age group for the last age group (ϕ_4) is 0 by definition.

³¹The solutions (ϕ_j) satisfying the simultaneous equations can be obtained given the population shares by age group (μ_i) and the age group specific survival probabilities (ρ_i) .

$$\mu_{4} = \rho_{4}\mu_{4} + \phi_{3}\rho_{3}\mu_{3}$$

$$\mu_{3} = (1 - \phi_{3})\rho_{3}\mu_{3} + \phi_{2}\rho_{2}\mu_{2}$$

$$\mu_{2} = (1 - \phi_{2})\rho_{2}\mu_{2} + \phi_{1}\rho_{1}\mu_{1}$$

$$\mu_{1} = (1 - \phi_{1})\rho_{1}\mu_{1} + \mu_{0}$$

$$\mu_{0} = (1 - \rho_{1})\mu_{1} + (1 - \rho_{2})\mu_{2} + (1 - \rho_{3})\mu_{3} + (1 - \rho_{4})\mu_{4}$$

The last equation means that the population share for new entrants into the economy (μ_0) is identical to the sum of deceased workers.

The insured period (k) increases stochastically when the employed work at firms covered by UI. Specifically, I assume eight states for the insured period from 'no insurance history' (k = 1) to '10 years or more' $(k = 8)^{32}$ as shown in Table 2, considering the way in which the maximum benefit duration is actually determined.³³ It is assumed that when the workers who have no insurance history (k = 1) start to work at a firm covered by UI, their insured period becomes '0~6 months' (k = 2) immediately with probability 1. The probabilities of a transition to the next state for the insured period are calculated based on the average duration in each state.³⁴ The probabilities of a transition to the next state for the state of '10 years or more' (k = 8) is assumed to be 0^{35} because it is the last state for the insured period. The transition probability matrix for the insured period is shown in Table 3. The minimum

TABLE 1—POPULATION STRUCTURE IN THE MODEL

Index for age group	Age	Employed	Unemployed	Non-participants	Total (μ_j)
1	20~29 years	0.1111	0.0111	-	0.1222
2	30~49 years	0.3714	0.0102	-	0.3816
3	50~64 years	0.2292	0.0058	-	0.2349
4	65~84 years	-	-	0.2613	0.2613
Total	20~84 years	0.7117	0.0270	0.2613	1.0000

Source: Statistics Korea, EAPS.

TABLE 2—THE INSURED PERIOD (k) IN THE MODEL

-										
	k	1	2	3	4	5	6	7	8	
_	Insured period	No insurance history	0~6 months	6~9 months	9~12 months	1~3 years	3~5 years	5~10 years	10 years or more	

³²The last state for the insured period is assumed to be '10 years or more' because there is no difference in the maximum benefit durations for insured periods greater than or equal to ten years in reality.

³³Although it is sufficient to consider an insured period less than or equal to one year (12 months), the states for '0~6 months', '6~9 months', and '9~12 months' are also included in the model so that it can be used in the policy experiments related to the eligibility condition for the minimum insured period. In the current UI system, the unemployment benefits are provided to involuntarily unemployed workers who have been in insurancecovered employment for at least 180 days (approximately six months) during an 18-month period before their job loss. However, it is often discussed among policymakers that the minimum insured period for the eligibility should be increased from 180 days (six months) to 270 days (nine months).

³⁴For example, when the insured period is '1~3 years' (k = 5), the state will then be maintained for two years (24 months) on average. Therefore, the probability of transitioning to the next state is assumed to be 1/24 because the duration of each state is the inverse of the exit probability from each state.

³⁵In other words, it can be expressed that the probability of staying in the state of '10 years or more' is 1.

k' k	1	2	3	4	5	6	7	8
1	$1 - \pi_{12}$	π_{12}	0	0	0	0	0	0
2	0	$1 - \pi_{23}$	π_{23}	0	0	0	0	0
3	0	0	$1 - \pi_{34}$	π_{34}	0	0	0	0
4	0	0	0	$1 - \pi_{45}$	π_{45}	0	0	0
5	0	0	0	0	$1 - \pi_{56}$	π_{56}	0	0
6	0	0	0	0	0	$1 - \pi_{67}$	π_{67}	0
7	0	0	0	0	0	0	$1 - \pi_{78}$	π_{78}
8	0	0	0	0	0	0	0	π_{88}

TABLE 3-THE TRANSITION PROBABILITY MATRIX FOR THE INSURED PERIOD

Note: π_{ii} denotes the transition probability from k = i to k = j.

insured period to be eligible for unemployment benefits is set to be six months (180 days) based on the Employment Insurance Act.³⁶

The method used to determine the monthly unemployment benefits in the model follows the actual benefit formula in 2015, which is based on the Employment Insurance Act and the Enforcement Decree. The amount of daily unemployment benefits is the wage replacement rate (b_r) multiplied by the three-month average daily wage before the job loss. The wage replacement rate is 50% in actuality. The upper limit of the average daily wage $(\overline{g_d})$ is set to 86,000 won, which means that the upper limit of the daily unemployment benefit is 43,000 won. The lower limit of the daily unemployment benefit is determined by the wage replacement rate for the lower limit $(b_{r,l})$ multiplied by the daily minimum wage (hourly minimum wage × 8 hours). The wage replacement rate for the lower limit was 90% and the daily minimum wage is 44,640 won (5,580 won × 8 hours) in 2015. Therefore, the lower limit of the daily unemployment benefits is calculated to be 40,176 won. Because the period in the model is one month, the monthly unemployment benefits $(b(g^j))$ are the daily unemployment benefits times 30 (days). The amount of the monthly unemployment benefit is summarized using the following equation:

 $b(g^{j}) = \min\{b_{r} \times \overline{g_{d}} \times 30, \max\{b_{r} \times g^{j}, b_{r,l} \times w_{h} \times 8 \times 30\}\}$

The maximum benefit duration $(\overline{d}(j,k))$ in the model is determined in the same manner used in the actual UI system in Korea, as shown in Table 4. It should be noted that the maximum benefit duration depends on the age of the worker and their insured period.

The tax rate for consumption expenditures (τ_c) is set to 10% based on the valueadded tax (VAT) rate in Korea of 10%. The labor income tax rate (τ_l) is assumed to be 13.15%, which is the average labor income tax rate for unmarried individuals in Korea. This represents the OECD (2016) rate of 13.80%³⁷ less the worker's

³⁶In fact, more stringent requirements, 180 days 'over the last 18 months', are required in reality. If the 'over the last 18 months' condition is explicitly included in the model, the model setup becomes more complicated and the computation becomes more difficult due to the additional individual state variable. Therefore, here I use relaxed requirements than the actual eligibility requirements by counting the insured period 'over the whole period of employment' rather than 'over the last 18 months'.

³⁷The rate of 13.80% is the effective tax rate taking into account the workers' contributions to all forms of social insurance.

	Insured period					
Age	Less than 1 year	1~3 years	3~5 years	5~10 years	10 years or more	
	(k = 2,3,4)	(k = 5)	(k = 6)	(k = 7)	(k = 8)	
20~29 years	3 months	3 months	4 months	5 months	6 months	
30~49 years	3 months	4 months	5 months	6 months	7 months	
50~64 years	3 months	5 months	6 months	7 months	8 months	

TABLE 4—THE MAXIMUM BENEFIT DURATION IN THE MODEL

Note: In the actual UI in Korea, the maximum benefit duration is defined in days rather than in months. Because the model period is assumed to be one month, the maximum benefit duration is redefined as months in Table 3 by dividing the maximum benefit duration defined in days by 30.

Source: Employment Insurance Act

contribution of the UI premium (τ_u) in Korea of 0.65%. The asset income tax rate is set to 15.40% based on the actual interest income tax rate of 15.4%. The worker's contribution of the UI premium is 0.65%, which is half of the total insurance premium of 1.30%. Because the model does not explicitly reflect firms, the remaining employer's contribution, 0.65% is assumed to be paid by the government on behalf of the firm, as discussed in the model subsection. The real interest rate (r) is set to 1% based on the interest rate of Korean one-year Treasury bonds as of 2015, 1.794%, and the average consumer inflation rate in 2015, 0.7%. The monthly wage rate for the efficiency unit of labor supply (w) is normalized to one. The parameters related to the utility function, population structure, UI, tax rates, and prices explained above, which are determined regardless of model, are summarized in Table 5.

Because the monthly wage rate for the efficiency unit of labor supply is normalized to one, the monthly wages are identical to the skill levels which are exogenously given and constant within age groups. The monthly wages (skill levels) in the model are described in Table 6. The ten levels of wages for each age group in Table 6 are calculated based on the monthly average wage data from the EAPS Additional Survey by Employment Type (EAPS ASET)³⁸ of 2015. For each age group, there are ten levels of wages which are constant within each age group. However, as the age group changes stochastically, it can be scaled up or down while maintaining the decile within the new age group.³⁹ In this way, the model reflects an age-earnings profile without time-varying labor productivity shocks.⁴⁰ In other words, in cases in which workers stay in the same age group, their levels of wages are fixed in the sense that there is no income risk other than unemployment risk. By considering only income risk from unemployment, this paper focuses on quantifying how much the UI system and private insurance instruments (savings and borrowing) are effective as insurance against income risk from unemployment.

³⁸The data were surveyed every March and August before 2017. Starting in 2017, they are surveyed only every August.

 $^{^{39}}$ For example, as the age group increases stochastically, the first decile wage for those aged 20~29 years, 0.5965, becomes 1.0915, which is the first decile wage for those aged 30~49 years. As the age group of the worker increases further, the wage changes to 0.8700, which is the first decile wage for those aged 50~64 years.

⁴⁰If the role of precautionary savings for employed workers is primarily important, time-varying idiosyncratic shocks should be a necessary component of the model. In this case, we can refer to Storesletten *et al.* (2004), Imrohoroglu and Kitao (2012), Moon (2015), and Kitao (2015), among others, with regard to incorporating time-varying productivity shocks into the OLG model. Because idiosyncratic labor productivity shocks themselves would not play a significant role in this paper, the model does not incorporate them for the sake of simplicity.

Parameter	Explanation	Value	Remarks
	Utility	function	
σ	Degree of risk aversion	2.0000	Nakajima (2012), etc.
γ_s	Disutility from working (level)	1.0000	Normalization
ψ	Disutility from working (elasticity)	1.0000	Yashiv (2000), Lise (2012)
	Populatio	on structure	
ρ_1	Survival probability for 20~29 years	0.9999671	Calculated from Life Tables (2015)
ρ_2	Survival probability for 30~49 years	0.9998976	Calculated from Life Tables (2015)
$ ho_3$	Survival probability for 50~64 years	0.9996430	Calculated from Life Tables (2015)
$ ho_4$	Survival probability for 65~84 years	0.9981198	Calculated from Life Tables (2015)
ϕ_1	Transition probability to 30~49 years	0.0050265	Calculated to match pop. shares
ϕ_2	Transition probability to 50~64 years	0.0015073	Calculated to match pop. shares
ϕ_3	Transition probability to 65~84 years	0.0020922	Calculated to match pop. shares
ϕ_4	Transition probability to stay	1.0000000	Calculated to match pop. shares
μ_0	Population share of new entrants	0.0006182	Calculated to match pop. shares
	Unemploym	nent insurance	
π_{12}	Prob(no history $\rightarrow 0 \sim 6$ months)	1.0000	see text
π_{23}	$Prob(0 \sim 6 \text{ months} \rightarrow 6 \sim 9 \text{ months})$	0.1667	Duration of the state (6 months)
π_{34}	$Prob(6 \sim 9 \text{ months} \rightarrow 9 \sim 12 \text{ months})$	0.3333	Duration of the state (3 months)
π_{45}	$Prob(9 \sim 12 \text{ months} \rightarrow 1 \sim 3 \text{ years})$	0.3333	Duration of the state (3 months)
π_{56}	$Prob(1 \sim 3 \text{ years} \rightarrow 3 \sim 5 \text{ years})$	0.0417	Duration of the state (2 years)
π_{67}	$Prob(3\sim 5 \text{ years} \rightarrow 5\sim 10 \text{ years})$	0.0417	Duration of the state (2 years)
π_{78}	Prob(5~10 years \rightarrow 10 years or more)	0.0167	Duration of the state (5 years)
π_{88}	Prob(stay in '10 years or more')	1.0000	See the text
k _e	The minimum insured period	3	More than 6 months (180 days)
w_h	The hourly minimum wage	5,580 won	Minimum wage in 2015
$\overline{g_d}$	The upper limit of daily wage	86,000 won	Emp. Ins. Enforcement Decree
b_r	Wage replacement rate	0.5	Employment Insurance Act
$b_{r,l}$	Wage replacement rate for lower limit	0.9	Employment Insurance Act
	Ta	ixes	* *
τ_c	Tax rate for consumption expenditures	0.1000	Value-added tax (VAT) rate, 10%
τ_l	Tax rate for labor income	0.1315	OECD (2016) and τ_{μ}
τ_k	Tax rate for asset income	0.1540	Interest income tax rate, 15.4%
τ_u	Worker's insurance premium for UI	0.0065	Emp. Ins. Enforcement Decree
	Pr	ices	
r	Real interest rate	0.0100	One-year Treasury bond, CPI (2015)
w	Wage rate for the unit labor supply	1.0000	Normalization

TABLE 5-THE PARAMETERS CALIBRATED OUTSIDE THE MODEL

Note: Emp. Ins. stands for Employment Insurance.

TABLE 6-THE LEVELS OF MONTHLY WAGES (SKILLS) IN THE MODEL

					(Unit:	1 million won)
Age group	20~29 y	ears	30~49 y	/ears	50~64 y	/ears
Decile	Wages (skills)	Measures	Wages (skills)	Measures	Wages (skills)	Measures
1	0.5965	0.0593	1.0915	0.1105	0.8700	0.1843
2	0.8495	0.0402	1.5345	0.1568	1.4100	0.2789
3	1.1025	0.1022	1.9775	0.1710	1.9500	0.1951
4	1.3555	0.0884	2.4205	0.1560	2.4900	0.0824
5	1.6085	0.2359	2.8635	0.1391	3.0300	0.0673
6	1.8615	0.1298	3.3065	0.0942	3.5700	0.0469
7	2.1145	0.1670	3.7495	0.0392	4.1100	0.0447
8	2.3675	0.0404	4.1925	0.0596	4.6500	0.0275
9	2.6205	0.0814	4.6355	0.0339	5.1900	0.0402
10	2.8735	0.0556	5.0785	0.0399	5.7300	0.0329

Note: The averages of monthly wages in March and August of 2015 EAPS ASET.

Source: March and August of 2015 EAPS Additional Survey by Employment Type (EAPS ASET).

Parameters Calibrated in the Model

A total of ten parameters are determined to fit the target statistics in the model. The parameter for disutility from working (γ_e) and the probability of involuntary unemployment (χ) are jointly determined to match the employment rate and unemployment rate for those aged 20~64 years from 2015 EAPS. The probability of voluntary unemployment (q) is determined to match the ratio of voluntary unemployment to total unemployment in the 2014 Yearly Statistics of Employment Insurance (YSEI) (Ministry of Employment and Labor, 2015). The marginal job finding rates by age group (p_j) are set to fit the corresponding unemployment rates for those aged 20~64 years in EAPS. The time discount factor (β) and the borrowing limit (\underline{a}) are jointly determined to match the ratio of net debt to total income and the share of workers with net debt under the given real interest rate of 1%.

The target statistics for the ratio of net debt to total income and the share of workers with net debt are calculated based on the 2014 Korean Labor and Income Panel Study (KLIPS). The information about net debt (or assets) is surveyed at the household level, not at the individual level. Therefore, the ratio of net debt to total income and the share of workers with net debt can be calculated under appropriate assumptions about the number of members with net debt in each household. Regarding the ratio of net debt to total income, I assume that the net debt and total income are evenly distributed to all household members so that the ratio is independent of the number of household members. The share of workers with net debt is set to 0.2686, which is the simple average of the share when only one member in each household is assumed to have net debt (0.1288) and the share when all members of each household are assumed to have net debt (0.4083).

The parameter for disutility from an application process for unemployment benefits (η) is determined to match the ratio of actual UI applicants to the unemployed who are eligible for unemployment benefits (0.6920) based on the 2014 YSEI. The probability that the unemployed will find a firm covered by UI (λ) is set to match the proportion of wage and salary workers who are covered by UI (0.6313) based on the 2015 EAPS ASET. The ten target statistics and parameters determined in the model described above are summarized in Tables 7 and 8, respectively.

Some of the calibrated parameters in Table 8 are worth mentioning. The monthly probability of voluntary unemployment is calibrated to be 1.00% which is higher than the probability of involuntary unemployment, 0.63%. The calibrated marginal job finding rate by age group increases with age. This implies that the higher the age, the higher the job finding probability given the same level of job search effort. The borrowing limit is 5.32 million won. Lastly, the share of firms covered by UI is calibrated to be 63.20%.

Table 9 below compares the target statistics calculated from the model with those in the actual data. Most target statistics are fairly well matched. In particular, the employment rate and the unemployment rate by age group, which are the most important parts of the calibration, fit very well in the model. Moreover, the target statistics related to UI do not differ greatly from those of the data. In this sense, the model fit most of the target statistics related to the labor market and UI. However,

Target statistics	Value	Source
Employment rate for 20~64	0.7117	2015 EAPS
Unemployment rate for 20~64	0.0907	2015 EAPS
Unemployment rate for 20~29	0.0267	2015 EAPS
Unemployment rate for 30~49	0.0245	2015 EAPS
Unemployment rate for 50~64	0.0366	2015 EAPS
Ratio of net debt to total income	0.7400	2015 EAPS
Share of workers with net debt	0.2686	2015 EAPS
Ratio of voluntary unemployment to total unemployment	0.6110	2014 YSEI
Ratio of actual applicants to the unemployed eligible for UB	0.6920	2014 YSEI
Proportion of wage and salary workers covered by UI	0.6313	2015 EAPS ASET

TABLE 7—TARGET STATISTICS FOR THE CALIBRATION

Note: 1) UB stands for unemployment benefits, 2) EAPS stands for Economically Active Population Survey, 3) KLIPS stands for Korean Labor and Income Panel Study, 4) YSEI stands for Yearly Statistics of Employment Insurance, 5) EAPS ASET stands for EAPS Additional Survey by Employment Type, 6) The employment rate is defined as the number of employed divided by the total population.

Parameter	Explanation	Value
γ _e	Disutility from working	0.0010
χ	Prob. of involuntary unemployment	0.0063
q	Prob. of voluntary unemployment	0.0100
p_1	Marginal job finding rate for 20-29	0.1826
p_2	Marginal job finding rate for 30-49	0.9329
p_3	Marginal job finding rate for 50-64	1.1535
β	Time discount factor	0.9998
<u>a</u>	Borrowing limit	-5.2300
η	Disutility from an application for UI	0.2435
λ	Share of firms covered by UI	0.6320

TABLE 8-PARAMETERS CALIBRATED IN THE MODEL

Note: The unit for the borrowing limit is 1 million won.

Target statistics	Model	Data
Employment rate for 20~64	0.7117	0.7117
Unemployment rate for 20~64	0.0907	0.0907
Unemployment rate for 20~29	0.0267	0.0267
Unemployment rate for 30~49	0.0245	0.0245
Unemployment rate for 50~64	0.0366	0.0366
Ratio of net debt to total income	0.7397	0.7400
Share of workers with net debt	0.2762	0.2686
Ratio of voluntary unemployment to total unemployment	0.6110	0.6110
Ratio of UI applicants to the unemployed eligible for UB	0.6709	0.6920
Proportion of wage and salary workers covered by UI	0.6314	0.6313

TABLE 9-TARGET STATISTICS: MODEL VS. DATA

Note: UB stands for unemployment benefits.

the ratio of actual UI applicants to the unemployed eligible for unemployment benefits is slightly lower than the actual target statistic. It is difficult to match more precisely the ratio of UI applicants to the unemployed eligible for unemployment benefits most likely due to the differences between two data sets, EAPS and YSEI; The labor market statistics are based on data from EAPS, which is survey data, but the statistics related to unemployment benefits are based on data from YSEI, which is administrative data. Regarding the share of workers with net debt, the target statistic itself is problematic because it is could not be accurately measured, as discussed earlier. Because information about net debt is collected at the household level in KLIPS, it is possible to calculate the share of households with net debt relatively precisely. However, only the minimum and maximum values representing the share of workers with net debt can be calculated. In this paper, the simple average of the minimum and maximum values is used. Given that the average may not be an accurate number for the share of workers with net debt, it will be difficult to fit the target statistic in the calibration.

V. Quantitative Analysis

A. Steady State Equilibrium

Table 10 shows the main statistics related to the labor market, consumption, assets, and UI in the steady state economy. The statistics used as targets for the calibration such as the employment and unemployment rates are nearly identical to the actual statistics. The monthly transition probability from employment to unemployment (the average job separation rate) predicted by the model is 1.62%.⁴¹

Statistics	Value	Statistics	Value
	Labor n	narket	
Unemployment rate for 20~64	0.0366	Average job search effort for 20~64	0.8385
Unemployment rate for 20~29	0.0907	Average job search effort for 20~29	1.1685
Unemployment rate for 30~49	0.0267	Average job search effort for 30~49	0.6379
Unemployment rate for 50~64	0.0245	Average job search effort for 50~64	0.5586
Employment rate for 20~64	0.7117	Transition prob. from E to U	0.0162
Transition prob. from U to N		Transition prob. from U to N	0.4484
	Consumption expend	liture and net assets	
Average consumption for 20~84	1.8105	Average net assets for 20~84	11.2485
Average consumption for 20~29	1.4530	Average net assets for 20~29	3.2573
Average consumption for 30~49	2.4257	Average net assets for 30~49	18.2689
Average consumption for 50~64	2.5527	Average net assets for 50~64	19.8885
Average consumption for 65~84	0.4121	Average net assets for 65~84	-3.0258
	Unemployme	ent insurance	
Ratio of voluntary U to total U	0.6709	The ratio of UI recipients to total U	0.3502
	Equilibriu	m objects	
Accidental bequests (x)	0.0009	Transfer income from the gov. (T)	0.4114

TABLE 10-THE STEADY STATE ECONOMY

Note: 1) E and U stand for employment and unemployment, respectively, 2) UB stands for unemployment benefits, 3) The unit for consumption expenditure, net assets, accidental bequests, and transfer income from the government is 1 million won, 4) YSEI stands for Yearly Statistics of Employment Insurance.

⁴¹Because endogenous quitting is not accounted for in the model, the average job separation rate comes purely from the probability rates of involuntary unemployment (0.0063) and voluntary unemployment (0.0100), which are calibrated in the model, with some degree of round-off error in each case.

The monthly transition probability from unemployment to employment (the average job finding rate) is 44.84%. The average job search effort value is 0.8385, and it decreases with age. The job search efforts for workers aged 30~49 and 50~64 years are 53.6% and 47.8%, respectively, relative to that of workers aged 20~29 years. These values are directly related to the parameters for marginal job finding rates by age group presented in Table 7. For those 20~29 years of age, the marginal job finding rate by age group is remarkably low. The marginal job finding rate means an incremental increase in the job finding rate when increasing the job search effort by one unit. A smaller marginal job finding rate implies a lower job finding rate given the same amount of job search effort. Therefore, the higher job search efforts for those aged 20~29 years can be understood by considering that workers aged 20~29 years must make a greater job search effort in order to overcome their relatively low job finding rate per unit of job search effort.

The average consumption expenditure is calculated and found to be 1.81 million won. The consumption expenditure for workers aged 20~29, 30~49 years, 50~64 years, and 65~84 years are calculated and found to be 1.45, 2.43, 2.55, and 0.41 million won, respectively. The average amount of net assets is found to be 11.25 million won. Those values for workers aged 20~29, 30~49, 50~64 years, and 65~84 years are calculated to be 3.25, 18.27, 19.89, and -3.03 million won, respectively.

With regard to unemployment benefits, the ratio of UI applicants to the unemployed eligible for unemployment benefits is calculated at 67.09%, somewhat lower than the ratio in the actual data, as discussed in the calibration subsection.⁴² The ratio of actual UI recipients to the unemployed is predicted at approximately 35%, similar to that from the actual data. Lastly, redistribution from deceased workers (accidental bequests) and transfer income from the government, which are calculated from the equilibrium of the model, are nearly zero and 0.41 million won, respectively. This model assumes that the government pays the same amount of transfer income to all workers by simplifying detailed welfare systems other than unemployment benefits, such as the National Pension, National Basic Livelihood Security, and the Basic Pension system.⁴³ Therefore, the estimated amount of transfer income, 0.41 million won per month, can be interpreted as the average of benefits from all welfare systems other than unemployment benefits.

B. Policy Experiments

In this subsection, I quantify the overall effect of enhanced unemployment benefits in Korea using the calibrated overlapping generation model. In particular, two specific policy chances are examined: increasing wage replacement rates by 10%p and extending maximum benefit durations by one month. Among policymakers and researchers, these two policies are considered feasible policy options in order to enhance unemployment benefits considering the current realistic

⁴²This statistic is used as a target statistic to calibrate the parameter for disutility from the application process for unemployment benefits.

⁴³In the process of reflecting the heterogeneity of workers and the detailed UI system in Korea, the model setup and computation are already complicated. Therefore, welfare systems which do not directly affect unemployment benefits are not explicitly modeled in this paper.

situation in Korea. Because the ranges of unemployed people who would be affected by these two policy changes differ, the overall effects of the two policy changes can also differ. In particular, the relative sizes of consumption smoothing effects and moral hazard effects can differ between the two policy changes. Moreover, because the increases in the UI premium to achieve the two policy options would differ, the welfare of all workers who are currently paying the UI premium and who are likely to pay in the future can be affected to a different extent. In sum, the two policy options affect social welfare in different ways through consumption smoothing effects, moral hazard effects, and changes in the UI premium for workers.

The three effects of policy changes on social welfare are correspondingly represented mainly by changes in consumption levels, job search efforts (or the total employment rate), and the UI premium in the model. Although the model does not explicitly reflect the equilibrium UI premium as discussed earlier, the UI premium is adjusted to maintain the fiscal surplus level of UI funds before the policy changes⁴⁴ in the following policy experiments in order to capture the effect of changes in the UI premium.

Consumption smoothing effects are mostly captured by the changes in the consumption for UI recipients and the employed. An increase in the consumption level of UI recipients means that the decline in consumption upon a job loss for the employed is smaller than that before the policy change. Therefore, if other factors are constant, the welfare level of the employed is expected to increase due to the improved consumption smoothing. It should be noted that the welfare level of employed workers who are currently paying the UI premium as well as the welfare level of workers who are not paying the UI premium will increase, as employed workers working at firms which are not currently covered by UI can also claim unemployment benefits upon a job loss based on their recent history with UI. In addition, they may be employed by firms that are covered by UI in the future. The welfare for workers includes all possibilities of the future, including those mentioned above. Strictly speaking, changes in consumption of UI recipients also reflect possible future burdens caused by the increased UI premium and the negative effects from the reduced job search effort due to the moral hazard effect. Despite the negative effects of policy changes on it, the increase in consumption of UI recipients implies that consumption smoothing effects are relatively large in that they offset the negative effects.

The enhanced consumption smoothing effects come at a cost because more generous unemployment benefits immediately raise the insurance premium for employed workers who are currently paying the UI premium and potentially increase the UI premium for the other workers who may pay the UI premium in the future. If the other factors remain constant, the increased UI premium will lower the consumption and welfare levels. Considering that this paper assumes that the government pays the UI premium on behalf of firms, the increased UI premium will decrease the transfer income from the government (T) for all workers and will slightly reduce welfare for all workers, including the retired workers who are not directly affected by the policy change in UI. Although the welfare effect from the

⁴⁴This amount is approximately 109.68 billion won in a steady state economy in the model.

reduced transfer income from the government is quantitatively negligible, this limitation in the model should be taken into account when interpreting the results, especially with regard to welfare for the retired.

Lastly, the enhanced unemployment benefits are a factor in the reduction of welfare of the unemployed through the decreased job search efforts. Because more generous unemployment benefits reduce the value of employment for UI recipients, they will reduce their job search efforts, resulting in lower job finding probabilities and employment rates. Although a decrease in the disutility from the job search efforts will generally reduce the welfare of the entire economy due to the following composition effects. Because the welfare level of the employed is substantially higher than that of the unemployed, the decline in the employment rate resulting from the reduced job search efforts decreases the welfare of the overall economy, assuming that all other factors remain constant.

Policy Option 1: Increase in Wage Replacement Rates by 10%p

When the wage replacement rate is raised by 10%p from the current level (50%) to 60%, the enhanced UI benefits will mainly impact those whose benefits are above the lower limit of unemployment benefits. This occurs because the lower limit of monthly unemployment benefits is determined by another rule, 90% of minimum wages. Because a majority of UI recipients receive the lower limit of benefits, most UI recipients are not affected by the policy change that increases wage replacement rates. In the steady state economy, the policy change affects 19.31% of all UI recipients, consisting of UI recipients whose benefits are above the lower limit (16.37%) and a small number of UI recipients who receive the lower limit of benefits before the policy change⁴⁵ (2.94%). In other words, the policy change mainly affects UI recipients whose wages before job loss are higher among all UI recipients. The cutoff wage is calculated to be 2.0088 million won such that 60% of the cutoff wage amounts to 1.2053 million won, which is the lower limit of monthly unemployment benefits as of 2015.

Table 11 shows the results of the policy experiment. When the wage replacement rate is increased by 10%p, the overall social welfare for those aged 20~84 years is reduced. On average, the negative effects of the drop in the employment rate due to decreased job search efforts and the rise in the UI premium rate outweigh the positive effects of the increase in consumption for UI recipients. The employment rate for those aged 20~64 years decreases by 0.04%p due to the 1.56% decrease in the average job search efforts. The UI premium increases by 0.08%p while the average consumption of UI recipients increases by 5.82%. Higher monthly UI benefits increase the number of UI applicants and the total number of UI recipients is increased by approximately 9.18%. Total welfare drops by 4.55% in terms of the current consumption for those aged 20~84, indicating that the decrease in welfare is equivalent to a 4.55% reduction in the current consumption of the average worker who currently consumes 1.8105 million won.⁴⁶ The overall welfare effect

⁴⁵83.63% of all UI recipients are calculated to be affected by the lower limit in the steady state economy.

⁴⁶The welfare measure in this paper is different from widely used measures in other papers such as in

Statistics	Baseline	60%	% change
Average consumption for 20~84	1.8105	1.8104	-0.00
for E (covered by UI)	2.3238	2.3230	-0.03
for E (not covered by UI)	2.3343	2.3348	0.02
for U (UI recipients)	1.5654	1.6565	5.82
for U (non-UI recipients)	1.7914	1.7695	-1.22
for R	0.4121	0.4121	-0.00
for 20~64	2.3052	2.3051	-0.00
Average job search effort for 20~64	0.8385	0.8254	-1.56
for U (UI recipients)	0.4243	0.4234	-0.22
for U (non-UI recipients)	1.0618	1.0681	0.60
(Employment rate for 20~64)	0.7117	0.7113	-0.06
UI premium for E (covered by UI)	0.0065	0.0073	11.54
% change in total welfare for 20~84	-	-	-0.0022 (-4.55)
% change in average welfare for 20~84	-	-	-0.0022 (-4.55)
for E (covered by UI)	-	-	-0.0066 (-15.44)
for E (not covered by UI)	-	-	-0.0080 (-18.19)
for U (UI recipients)	-	-	1.3618 (large+)
for U (non-UI recipients)	-	-	-0.3026 (-86.94)
for R	-	-	-0.0004 (-0.22)
for 20~64	-	-	-0.0028 (-7.21)
Measure for 20~84	1.0000	1.0000	0.00
for E (covered by UI)	0.4493	0.4492	-0.03
for E (not covered by UI)	0.2623	0.2621	-0.10
for U (UI recipients)	0.0095	0.0103	9.18
for U (non-UI recipients)	0.0176	0.0171	-2.54
for R	0.2613	0.2613	0.00
The number of UI recipients	0.0095	0.0103	9.18
above lower limits	16.37%	-	-
lower limits	83.63%	-	-
affected by the policy change	19.31%	-	-
above lower limits	16.37%	-	-
lower limits	2.94%	-	-
Accidental bequests (x)	0.0009	0.0009	0.09
Transfer income from the government (T)	0.4114	0.4103	-0.28

TABLE 11—THE OVERALL EFFECTS OF POLICY CHANGE 1

Note: 1) The numbers in the parentheses indicate the % changes in welfare in terms of the % change in the current average consumption for each group to achieve the same welfare level after the policy change (the equivalent variation in the average current consumption). In addition, 'large+' indicates that the welfare measure cannot be applied because the welfare gain is substantially large, 2) % changes in welfare without parentheses indicate % changes in welfare in terms of the utility level, 3) Because the size of the total population is one, the total welfare and the average welfare for those aged 20~84 are identical.

Chattergee *et al.* (2007), Mukoyama (2013), and Conesa *et al.* (2017). In this paper, the consumption equivalent variation (CEV), most commonly used in the literature, cannot be computed due to the assumption that the utility function is separable among consumption, leisure and UI application costs. The equivalent variation in wealth, which is another popular welfare measure, also cannot be applied due to the existence and importance of the borrowing limits (\underline{a}) in this paper. Alternatively, this paper uses the equivalent variation in the current consumption for an average worker, referring to how much the current consumption of the average worker should be changed to achieve the same level of welfare after the policy changes. The definition of the welfare measure is given as follows:

$$u(\overline{c_0}(1+x), l) - u(\overline{c_0}, l) = W_1 - W_0$$

Here, W_0 and W_1 denote the average welfare for a relevant group before and after a policy change. $\overline{c_0}$ denotes the average consumption for the group in the steady state economy before the policy change. x measures how much the current consumption for the average worker of the group should be changed to achieve the same level of welfare after the policy change. Note that if there is no change in welfare ($W_0 = W_1$), x = 0.

The greatest disadvantage of this measure is that the equivalent variation cannot be applied to large welfare gains due to the concavity of the utility function. Specifically, this measure cannot be used for unemployed workers whose welfare gains are large, such as UI recipients and non-UI recipients.

does not appear to be large, but the welfare changes are very different among different workers as noted in Mukoyama (2013).

The changes in the average welfare level by labor market status are as follows. The average welfare for UI recipients increases, reflecting the effect of the increase in monthly unemployment benefits by offsetting the negative effects. Given that the degree of improvement in the consumption smoothing effects is mostly captured by changes in welfare for UI recipients, the average welfare for other workers is expected to increase as well. However, the results of the policy experiment show that the average welfare for workers other than UI recipients is reduced because the negative effect from the increase in the UI premium is overwhelming. As noted above, the policy change that increases the wage replacement by 10%p is applied to only the top 19.31% of UI recipients when they are sorted by wage (or skill) level. This implies that most workers do not benefit from the policy change, whereas they must pay the increased UI premium in the present or the future. Because this negative effect outweighs the positive consumption smoothing effects, the overall welfare is reduced by the policy change.

Table 12 shows the overall effects of the policy change for the groups directly affected and indirectly affected by the policy change. The comparison of changes in the average welfare level by labor market status between two groups clearly reveals

	% change				
Statistics		Directly affected group		Others	
		(high wage)		(low wage)	
Average consumption for 20~84		0.01		-0.03	
for E (covered by UI)		0.00		-0.05	
for E (not covered by UI)		0.06		-0.01	
for U (UI recipients)		7.28		-0.03	
for U (non-UI recipients)		-0.15		-0.04	
for R		-0.00		-0.00	
for 20~64		0.00		-0.04	
Average job search effort for 20-64		-4.05		0.00	
	for U (UI recipients)	-11.59		0.02	
for U (non-UI recipients)		0.56		0.01	
(Employment rate for 20~	64)	-0.11		-0.00	
UI premium for E (covered by UI)		11.54		11.54	
% change in total welfare for 20~84		0.0031	(9.07)	-0.0075	(-10.70)
% change in average welfa	are for 20~84	0.0031	0.0031 (9.07) -0.0		(-10.70)
	for E (covered by UI)	0.0075	(33.07)	-0.0092	(-15.36)
	for E (not covered by UI)	0.0084	(38.92)	-0.0106	(-17.36)
	for U (UI recipients)	0.7552	(large+)	-0.0045	(-8.05)
	for U (non-UI recipients)	0.0807	(large+)	-0.0085	(-11.26)
	for R	-0.0004	(-0.22)	-0.0004	(-0.23)
	for 20~64	0.0046	(18.08)	-0.0096	(-15.84)
The number of UI recipients		47.37		0.04	
Maagura of group	in terms of population	53.49%		46.51%	
Measure of group	in terms of UI recipients	19.31%		80.69%	

TABLE 12-THE OVERALL EFFECTS OF POLICY CHANGE 1 BY SUBGROUP (WAGE)

Note: 1) The numbers in the parentheses indicate the % changes in welfare in terms of the % change in the current average consumption for each group to achieve the same welfare level after the policy change (the equivalent variation in the average current consumption). In addition, 'large+' indicates that the welfare measure cannot be applied because the welfare gain is substantially large, 2) % changes in welfare without parentheses indicate % changes in welfare in terms of the utility level, 3) Because the size of the total population is one, the total welfare and the average welfare for those aged 20~84 are identical.

why the overall welfare is reduced by the policy change. The welfare for the group directly affected by the policy change increases while the welfare for the other group decreases. The consumption smoothing effects are larger than the negative effects, resulting in increased social welfare in the group directly affected by the policy change. On the other hand, the group that is not directly affected by the policy change does not benefit from the increased wage replacement rate, but their current or future burdens from the increased UI premium worsen their welfare. Because the welfare reduction in the latter group (the low-wage group) is larger than the welfare increase in the former group (the high-wage group), the total welfare is decreased. This comparison also explains why the average job search effort for non-UI recipients increases by 0.60% in Table 11. Most of the increase in the job search effort is attributed to non-UI recipients belonging to the high-wage group. As the value of employment for the high-wage group increases, non-UI recipients belonging to this group will have more incentives to look for jobs.

Table 13 shows the overall effects of the policy change by subgroup defined as wage level and age. Although the degree of the welfare effect by age group differs, there is no change in the result showing that welfare increases only in the group of workers with relatively high wage levels, as with higher ages, monthly UI benefits (resulting from the higher wages) and longer maximum benefit durations, the consumption for older UI recipients is expected to increase more. On the other hand, the decline in the job search effort will be more severe for older workers because the average amounts of net assets for older workers are higher than those for younger workers, as shown in Table 10. Workers who have net debts (net assets < 0) are more likely to face liquidity constraints and the moral hazard effects can be smaller for those workers, as noted in Chetty (2008). This result of s significant decrease in the job search effort for older workers, as shown in Table 13, is also consistent with Michelacci and Ruffo's (2015) claim that the older the unemployed are, the larger the moral hazard effects become. The relative size of consumption smoothing effects and moral hazard effects determines the overall welfare changes in each age group.

A a a aroun	Statistics	% change				
Age group	Statistics	High wage		Low wage		
	Consumption for U (UI recipients)	1.14		-0.03		
20, 20	Job search effort for U (UI recipients)	-2.53		-0.01		
20~29	Welfare for U (UI recipients)	0.0307	(176.26)	-0.0073	(-10.60)	
	Welfare for age group	0.0054	(13.92)	-0.0063	(-9.80)	
30~49	Consumption for U (UI recipients)	6.35		-0.06		
	Job search effort for U (UI recipients)	-10.71		0.14		
	Welfare for U (UI recipients)	1.4680	(large+)	-0.0088	(-15.61)	
	Welfare for age group	0.0062	(26.07)	-0.0131	(-22.07)	
50~64	Consumption for U (UI recipients)	12	12.39		-0.00	
	Job search effort for U (UI recipients)	-11.66		-0.10		
	Welfare for U (UI recipients)	0.9567	(large+)	-0.0039	(-6.88)	
	Welfare for age group	0.0018	(6.82)	-0.0070	(-11.37)	

TABLE 13—THE OVERALL EFFECTS OF POLICY CHANGE 1 BY SUBGROUP (WAGE × AGE)

Note: The numbers in the parentheses indicate the % changes in welfare in terms of the % change in the current average consumption for each group to achieve the same welfare level after the policy change (the equivalent variation in the current consumption). Additionally, 'large+' indicates that the welfare measure cannot be applied because the welfare gain is substantially large.

In case of welfare changes for the low-wage group, changes in the current and future burden from the increased UI premium are the most important factor. The size of the future cost is expected to be larger for older workers because the probability of being employed is higher for these workers. On the other hand, considering the remaining period until retirement, this factor will be more burdensome for young workers. As a result of these two factors, the welfare decline is the largest for those aged 30~49 years, followed in order by those aged 50~64 and 20~29 years.

Policy Option 2: Extension of the Maximum Benefit Duration by One Month

When maximum benefit durations are extended by one month, the enhanced UI benefit impacts potentially all UI recipients regardless of their wage levels before a job loss. This is the main difference between the policy that raises wage replacement rates and the policy that extends maximum benefit durations. As discussed earlier, the former policy directly affects only the top 19.31% of recipients whose wage level exceeds 2.0088 million won. Even when the policy that extends the maximum benefit duration is applied to all recipients by rule, UI recipients who are most directly affected by the policy will be those who exhaust their maximum benefit duration can indirectly affect those who do not exhaust the maximum benefit duration through the change in the option value of unemployment benefits.

Table 14 shows the composition of UI recipients who exhaust their maximum benefit duration in the steady state economy in the model. The younger the age is, the shorter the maximum benefit duration becomes in the UI system in Korea. Therefore, the share for those aged 20~29 years is highest. In terms of wage levels, UI recipients whose wages are relatively low are more likely to exhaust their maximum benefit durations. The share of UI recipients aged over 30 whose wage level before their job loss exceeds 2.0088 million won is only 1.2% of all UI recipients. They are less likely to exhaust their maximum benefit duration because for them the value of employment and the job finding probability are relatively high. It can be expected that the policy effect will be more significant, especially for UI recipients aged 20~29 and for UI recipients whose wage level is low because they are more likely to exhaust their maximum benefit durations and will be most affected by the policy change.

The results of the policy experiment are shown in Table 15. When the maximum benefit duration is extended by one month, social welfare overall for those aged 20~84 is improved. On average, the consumption smoothing effects outweigh the negative effects of the drop in the employment rate due to the reduced job search effort and the rise in the UI premium. The average consumption and welfare for employed workers increase due to enhanced consumption smoothing effects in spite of the 0.05%p increase in the UI premium. However, the employment rate for aged 20~64 decreases by 0.06%p due to the 3.03% decrease in the average job search efforts. Extended maximum benefit durations increase the number of UI applicants, and the total number of UI recipients increases by 10.10%. Total welfare increases by 11.49% in terms of the current consumption level for those

A	Wage level			
Age group –	High wage	Low wage	Total	
20~29	11.28	36.97	48.24	
30~49	1.19	25.99	27.18	
50~64	0.01	24.57	24.58	
Total	12.48	87.52	100.00	

TABLE 14-COMPOSITION OF UI RECIPIENTS WHO EXHAUST THE MAXIMUM BENEFIT DURATION

Note: The cutoff wage level is assumed to be 2.0088 million won, which is identical to that used for policy change 1.

Statistics	Baseline	1 mon	% change	
Average consumption for 20~84	1.8105	1.8103	-0.01	
for E (covered by UI)	2.3238	2.3243	0.02	
for E (not covered by UI)	2.3343	2.3355	0.05	
for U (UI recipients)	1.5654	1.5530	-0.79	
for U (non-UI recipients)	1.7914	1.7950	0.20	
for R	0.4121	0.4121	-0.00	
for 20~64	2.3052	2.3049	-0.01	
Average job search effort for 20~64	0.8385	0.8131	-3.03	
for U (UI recipients)	0.4243	0.3983	-6.12	
for U (non-UI recipients)	1.0618	1.0614	-0.04	
(Employment rate for 20~64)	0.7117	0.7109	-0.11	
UI premium for E (covered by UI)	0.0065	0.0070	7.69	
% change in total welfare for 20~84	-	-	0.0047 (11.49)	
% change in average welfare for 20~84	-	-	0.0047 (11.49)	
for E (covered by UI)	-	-	0.0264 (278.23)	
for E (not covered by UI)	-	-	0.0225 (169.34)	
for U (UI recipients)	-	-	-0.3955 (-89.04)	
for U (non-UI recipients)	-	-	0.0219 (92.74)	
for R	-	-	-0.0005 (-0.27)	
for 20~64	-	-	0.0066 (22.39)	
Measure for 20~84	1.0000	1.0000	-0.00	
for E (covered by UI)	0.4493	0.4490	-0.06	
for E (not covered by UI)	0.2623	0.2618	-0.20	
for U (UI recipients)	0.0095	0.0104	10.10	
for U (non-UI recipients)	0.0176	0.0174	-0.85	
for R	0.2613	0.2613	-0.00	
The number of UI recipients	0.0095	0.0104	10.10	
above lower limits	16.37%	-	-	
lower limits	83.63%	-	-	
affected by the policy change	100.00%	-	-	
above lower limits	16.37%	-	-	
lower limits	83.63%	-	-	
Accidental bequests (x)	0.0009	0.0009	-0.09	
Transfer income from the government (T)	0.4114	0.4106	-0.19	

TABLE 15—THE OVERALL EFFECTS OF POLICY CHANGE 2

Note: 1) The numbers in the parentheses indicate the % changes in welfare in terms of the % change in the current average consumption for each group to achieve the same welfare level after the policy change (the equivalent variation in the average current consumption). In addition, 'large+' indicates that the welfare measure cannot be applied because the welfare gain is substantially large, 2) % changes in welfare without parentheses indicate % changes in welfare in terms of the utility level, 3) Because the size of the total population is one, the total welfare and the average welfare for those aged 20~84 are identical.

aged 20~84 years, indicating that the increase in welfare is equivalent to a 11.49% increase in the current consumption of the average worker who currently consumes 1.8105 million won. Based on the changes in consumption and welfare for the employed, the positive effect from the improved consumption smoothing is greater
than the negative effects. However, the average consumption and welfare for UI recipients decrease. This implies that on average the moral hazard effects for UI recipients are substantial, offsetting the positive effects on consumption and welfare for them.

Table 16 shows the overall effects of the policy change for the subgroups defined by wage level. The criterion for dividing the low-wage and high-wage groups is 2.0088 million won, which is used for the case of policy change 1. The comparison of changes in the average welfare for those aged 20~84 years between the two groups reveals where the overall welfare is improved by policy change 2. The welfare for the low-wage group increases, whereas the welfare for the high-wage group decreases. Because the consumption smoothing effects are larger than other negative effects, social welfare for the low-wage group is increased by the policy change. Although the decline in job search effort for UI recipients due to the moral hazard effects is substantial, the positive consumption smoothing effects for the employed are sizable, outweighing the negative effects in the low wage group.

On the other hand, the negative effects mainly due to the increase in the UI premium outweigh the positive consumption smoothing effects for the high-wage group. As shown in Table 14, only 12.48% of UI recipients who will be directly affected by the extension of the maximum benefit durations are in the high-wage group. Therefore, most workers who are part of the high-wage group would not benefit from the policy change; accordingly the consumption smoothing effects and

Statistics			% cha	nge		
Statistics		High	High wage		Low wage	
Average consumption for	20~84	-0	.02	0.02		
for	E (covered by UI)	-0	.04	0	.03	
for	E (not covered by UI)	-0	.00	0	.05	
for	U (UI recipients)	-0	.22	-0	.37	
for	U (non-UI recipients)	0.	17	-0	.02	
for	R	-0	.00	-0	.00	
for	20~64	-0	.03	0	.03	
Average job search effort	for 20~64	-0	.32	-4	.60	
	for U (UI recipients)	-0.42		-7.52		
	for U (non-UI recipients)		-0.04		0.02	
(Employment rate for 20~	-64)	-0.00		-0.23		
UI premium for E (covere	ed by UI)	7.69		7.69		
% change in total welfare for 20~84		-0.0034	(-8.23)	0.0125	(25.10)	
% change in average welf	Fare for 20~84	-0.0034	(-8.23)	0.0125	(25.10)	
	for E (covered by UI)	-0.0056	(-15.65)	0.0313	(160.18)	
	for E (not covered by UI)	-0.0048	(-13.84)	0.0266	(110.21)	
	for U (UI recipients)	0.1391	(large+)	-0.2889	(-84.78)	
	for U (non-UI recipients)	0.0022	(6.29)	-0.0112	(-14.36)	
	for R	-0.0005	(-0.27)	-0.0005	(-0.27)	
	for 20~64	-0.0054	(-15.12)	0.0163	(46.82)	
The number of UI recipies	The number of UI recipients		52	11	.43	
Mangura of group	in terms of population	53.4	49%	46.	51%	
wiedsure of group	in terms of UI recipients	19.	31%	80.	69%	

Note: 1) The numbers in the parentheses indicate the % changes in welfare in terms of the % change in the current average consumption for each group to achieve the same welfare level after the policy change (the equivalent variation in the average current consumption). In addition, 'large+' indicates that the welfare measure cannot be applied because the welfare gain is substantially large, 2) % changes in welfare without parentheses indicate % changes in welfare in terms of the utility level, 3) Because the size of the total population is one, the total welfare and the average welfare for those aged 20~84 are identical.

moral hazard effects for this group would not be large. However, the negative impact of the increased UI premium applies to all workers in the high-wage group, resulting in a decrease in welfare for this group. Because the welfare increase in the low-wage group is greater than the welfare reduction in the high-wage group, the total welfare is increased.

The overall effects of the policy change by subgroup as defined by wage level and age are shown in Table 17. Welfare is improved in the group of all workers belonging to the low-wage group and workers aged 20~29 years belonging to the high-wage group. These results are highly related to the distribution of UI recipients directly affected by the policy change, as shown in Table 14. Most workers aged over 30 in the high-wage group do not benefit from the policy change, but their current or future burden from the increased UI premium worsens their welfare. The welfare increase is highest for workers aged 20~29 years in the low wage group. The reason for the significant increase in welfare for young workers is that their maximum benefit durations are shorter than those of older workers and they are more likely to be affected by the extension of the maximum benefit duration. Moreover, as noted in Michelacci and Ruffo (2015), the moral hazard effects tend to be weaker for young workers.

The preceding analyses tell us which subgroups play a leading role in improving welfare. However, the analyses do not sufficiently explain why the average consumption and welfare for UI recipients decrease while their overall welfare is improved in Tables 15 and 16. The decline in the average consumption and welfare for UI recipients implies that the moral hazard effects for UI recipients are substantial, indicating that the negative effects offset the positive effects on consumption and welfare for UI recipients drop, the heterogeneity of workers in terms of their amounts of net assets is additionally considered in the following analysis. According to Chetty (2008) and Michelacci and Ruffo (2015), the amount of net assets is an important factor when determining the degree of the moral hazard effect.

A go group	Troup Statistics		% c	hange	
Age group Statistics		High wage		Low wage	
	Consumption for U (UI recipients)	0	.43	0	.87
20.20	Job search effort for U (UI recipients)	-2	.44	-8	.26
20~29	Welfare for U (UI recipients)	0.0056	(13.24)	-0.1911	(-75.65)
	Welfare for age group	0.0034	(8.48)	0.0328	(129.42)
Consumption for U (UI recipients)		0.04		-0.50	
20 40	Job search effort for U (UI recipients)	-0	.77	-9	.00
30~49	Welfare for U (UI recipients)	0.0015	(4.06)	-0.3826	(-88.97)
	Welfare for age group	-0.0077	(-20.35)	0.0099	(27.21)
	Consumption for U (UI recipients)	-0	.00	-0	.19
50 64	Job search effort for U (UI recipients)	-0	.02	-9	.43
30~04	Welfare for U (UI recipients)	-0.0037	(-7.61)	-0.1037	(-66.09)
	Welfare for age group	-0.0034	(-10.81)	0.0096	(21.47)

TABLE 17—THE OVERALL EFFECTS OF POLICY CHANGE 2 BY SUBGROUP (WAGE × AGE)

Note: The numbers in the parentheses indicate the % changes in welfare in terms of the % change in the current average consumption for each group to achieve the same welfare level after the policy change (the equivalent variation in the current consumption).

Table 18 shows the overall effects of the policy change by subgroup defined as wage level and the amount of net assets. The cutoff value defining subgroups by the amount of net assets is assumed to be 0. Negative amounts of net assets indicate positive amounts of net debt. This criterion reflects that whether or not workers have net debts may be most crucial in relation to workers' responses to additional income. According to the experiments, the decrease in consumption for UI recipients is attributed to the group of workers with positive net assets, especially the low-wage group. Workers who hold positive amounts of assets can continue to maintain a sufficient level of consumption even when they lose a job. Therefore, additional monthly unemployment benefits would not be used to increase consumption but would replace the role of net assets. Given that the effect of the policy change on consumption of UI recipients is limited, the increase in the number of UI recipients lowers the average consumption after the policy change. In

			% ch	lange	
Sta	atistics	High	wage	Low	wage
		Assets≥0	Assets<0	Assets≥0	Assets<0
Average consumption for	20~84	-0.03	0.10	-0.06	0.17
for	E (covered by UI)	-0.04	0.09	-0.07	0.39
for	E (not covered by UI)	0.00	0.07	0.04	0.91
for	U (UI recipients)	-0.19	0.54	-0.52	2.83
for	U (non-UI recipients)	0.19	-0.12	-0.25	-0.06
for	R	0.00	0.00	-0.00	-0.00
for	20~64	-0.03	0.24	-0.06	0.55
Average job search effort	for 20~64	-0.32	-0.16	-5.09	-1.79
	for U (UI recipients)	-0.45	-3.06	-6.46	-14.52
	for U (non-UI recipients)	-0.06	0.04	0.02	0.21
(Employment rate for 20~	64)	-0.01	1.34	-0.17	-0.65
UI premium for E (covere	d by UI)	7.69	7.69	7.69	7.69
% change in total welfare for 20~84		-0.0049	0.0028	-0.0416	0.1201
		(-13.48)	(1.48)	(-44.71)	(5623.57)
% change in average welfare for 20~84		-0.0049	0.0028	-0.0416	0.1201
		(-13.48)	(1.48)	(-44.71)	(5623.57)
		-0.0056	-0.0018	-0.0295	0.2026
for E (covered by UI)		(-15.61)	(-3.87)	(-37.23)	(large+)
		-0.0046	-0.0294	-0.0134	0.4729
	for E (not covered by UI)	(-13.38)	(-39.88)	(-21.25)	(large+)
		0.1368	0.1111	-0.3571	0.5374
	for U (UI recipients)	(large+)	(large+)	(-87.50)	(large+)
		0.0022	0.0043	-0.2594	0.1811
for \cup (non- \cup I recipients)		(6.38)	(5.10)	(-81.75)	(large+)
for D		-0.0002	-0.0005	-0.0005	-0.0005
	lof R	(-0.14)	(-0.22)	(-0.35)	(-0.22)
	6 20 (1	-0.0053	-0.0081	-0.0434	0.2747
tor 20~64		(-14.99)	(-13.27)	(-46.55)	(large+)
The number of UI recipier	nts	4.38	20.48	11.29	12.98
	in terms of population	40.29%	13.20%	32.13%	14.37%
Measure of group	in terms of UI recipients	19.14%	0.16%	74.07%	6.63%

TABLE 18-THE OVERALL EFFECTS OF POLICY CHANGE 2 BY SUBGROUP (WAGE×ASSET)

Note: 1) The numbers in the parentheses indicate the % changes in welfare in terms of the % change in the current average consumption for each group to achieve the same welfare level after the policy change (the equivalent variation in the average current consumption). Furthermore, 'large+' indicates that the welfare measure cannot be applied because the welfare gain is substantially large, 2) % changes in welfare without parentheses indicate % changes in welfare in terms of the utility level, 3) Because the size of the total population is one, the total welfare and the average welfare for those aged 20~84 are identical.

Average ich soorch offert for U (UI recipiente)	High	High wage		wage
Average job search enort for 0 (01 recipients)	Assets≥0	Assets<0	Assets≥0	Assets<0
Before the policy change	0.6433	0.9748	0.3481	0.6296
After the policy change	0.6404	0.9450	0.3256	0.5382
Change in level	-0.0029	-0.0298	-0.0225	-0.0914
% change	-0.45	-3.06	-6.46	-14.52

TABLE 19-THE AVERAGE JOB SEARCH EFFORT BY SUBGROUP (WAGE×ASSET)

other words, the decrease in consumption can be understood as a result of the increase in the number of UI recipients with positive amounts of net assets, while the effect of the policy change on their consumption levels is minimal. This effect is greater for the low-wage group than for the high-wage group because the low-wage group contains more UI recipients directly affected by the policy.

The decrease in welfare for UI recipients is mostly attributed to workers with positive amounts of assets in the low-wage group. Because they are able to maintain their consumption levels when they become unemployed without unemployment benefits, additional income support from the unemployment benefit will further reduce their already low level of job search efforts, as shown in Table 19. On the other hand, welfare for UI recipients with positive net assets in the high-wage group is increased. Given that the value of employment is relatively high and they are less likely to exhaust their maximum benefit duration, their decline in the job search efforts due to moral hazard effects is not large. The consumption smoothing effects outweigh the negative effects, resulting in improved welfare for those workers.

C. Discussion

Welfare assessments can vary depending on the magnitudes of policy changes. A fair comparison of two competing policy changes should be based on the identical costs incurred due to the policy changes. Increases in UI premiums resulting from policy changes can be regarded as the magnitudes or costs of the policy changes. In this sense, the comparison of the two policy changes in this paper may appear to be unfair because the increment in the UI premium stemming from the policy change that increases wage replacement rates by 10%p (0.08%p) is slightly higher than that by the policy change that extends the maximum benefit duration by one month (0.05%p). Although the increases in the UI premium in the two competing policies do not differ greatly, in order to address this issue more accurately, I compared a policy change that increases wage replacement rates by 5%p (from 50% to 55%) with a policy change that extends the maximum benefit duration by one month because the former policy change was found to increase the UI premium by 0.05%p. Similar to the case in which the wage replacement rate is increased by 10%p, this policy change results in a decrease in social welfare and does not change the main results in the paper.

Additionally, I computed the gradient of the welfare improvement at the current system with respect to wage replacement rates and maximum benefit durations, as shown in Table 20. When wage replacement rates are increased further, social welfare declines at a faster rate. In particular, if the wage replacement rates exceed

	Wage replacement rat	tes	Max	imum benefit dura	tions
%	% change in welfare	UI premium	Extended # of month	% change in welfare	UI premium
50	-	0.0065	0	-	0.0065
60	(-4.55)	0.0073	1	(11.49)	0.0070
70	(-7.40)	0.0085	2	(25.33)	0.0075
80	(-95.95)	0.0100	3	(42.44)	0.0080
90	(-97.81)	0.0130	4	(60.62)	0.0086

TABLE 20—THE GRADIENTS OF WELFARE IMPROVEMENT

Note: The numbers in the parentheses indicate the % changes in welfare in terms of the % change in the current average consumption for each group to achieve the same welfare level after the policy change (the equivalent variation in the current consumption). Here, 'large+' indicates that the welfare measure cannot be applied because the welfare gain is substantially large.

70%, there is a sharp reduction in welfare. On the other hand, when the maximum benefit durations are extended further, social welfare increases almost linearly. We can take away two massages from the findings in Table 20. First, the current wage replacement rates (50%) are likely to be near or higher than an optimal level, and the current maximum benefit duration appears considerably shorter than the optimal level. Of course, a more accurate analysis should be done in subsequent research on optimal UI reform. Second, for a fair comparison of the competing policies, we can also consider the two cases shown in Table 20: 1) 60% vs. a two-month extension, 2) 70% vs. a four-month extension given a similar increment in the UI premium. Again, the main massage of the paper, extensions of the maximum benefit duration are more desirable than increases in wage replacement rates, is maintained.

The main reason why the policy change that increases wage replacement rates reduces social welfare is that there exists a lower limit of the UI benefit, and most UI recipients who receive the lower limit are not affected by this policy change. This result implies that the UI benefit formula in Korea appears to have room to improve beyond wage replacement rates and maximum benefit durations. Social welfare can be improved by adjusting the upper and lower limits of the UI benefits. In Korea, the upper limit of the UI benefit is fixed at a certain level (as of 2015, 43,000 won), and the lower limit of the UI benefit is 90% of minimum wages. Table 21 shows whether the upper and lower limits of UI benefits are applied in major OECD member countries. Most countries except for the UK, Finland, Poland, and Greece set an upper limit. On the other hand, many countries, including the UK, Germany, and Japan, do not set a lower limit.

		Upper limit		
		Not set	Set	
	Not set	UK, Finland, Poland, Greece	Japan, Germany, Austria, Canada, Netherlands, Norway, Czech Republic,	
Lower limit			Switzerland, Italy, Luxembourg	
Lower minit			United States, France, Denmark, Sweden,	
	Set		Hungary, Portugal, Spain, Turkey,	
			Belgium, Iceland, Korea	

TABLE 21—UPPER AND LOWER LIMITS OF UI BENEFITS IN MAJOR OECD COUNTRIES

Source: Ministry of Employment and Labor (2016b); OECD (2011a).

In view of the fact that some countries have not set upper and lower limits of UI benefits, I conducted additional policy experiments in which the upper and lower limits of UI benefits are abolished. These policy experiments will provide implications on methods which improve UI benefits in terms of the upper and lower limits. Table 22 shows the results of the policy experiments that abolish the upper or lower limits of UI benefits.

When the upper limit of the UI benefits is abolished, social welfare decreases mainly due to a large increase in the UI premium. This result is similar to that from the assessment of the policy change that increases wage replacement rates. The policy change significantly improves welfare for a small number of UI recipients whose wages before job loss are relatively high, but most workers suffer welfare losses due to the increase in the UI premium. On the other hand, when the lower limit of the UI benefit is abolished, social welfare increases mainly due to a large decrease in the UI premium. Although the consumption smoothing effects for UI recipients who receive the lower limit before the policy change are reduced, a significant reduction in the UI premium improves the welfare of all workers who are currently paying or will pay the UI premium. Lastly, when both the upper and lower limits are abolished, social welfare decreases. The reason for the decrease in welfare in this case is that there is not a sufficient decrease in the UI premium. which plays a large role in the welfare increase when the lower limit is abolished. The results of the three policy experiments help to explain why most OECD members set an upper limit but do not set a lower limit of the UI benefit, as shown in Table 21.

Based on the results of the three policy experiments, abolishing the lower limit of UI benefits is desirable in terms of social welfare. However, it should be noted that policy experiments that abolish upper or lower limits can be too extreme. Policy changes that adjust the levels of the upper and lower limits while maintaining the current system may have different outcomes. The results of the three policy experiments described above imply that the overall impact of a policy that adjusts the upper or lower limit of UI benefits on social welfare is determined mainly by how much the UI premium is adjusted. Therefore, for example, when the lower limit is reduced without being abolished, social welfare can decrease due to an insufficient reduction in the UI premium. An analysis of the optimal levels of the upper and lower limits is beyond the scope of this paper, though this issue will be studied in more detail in the future.

Statistics	Baseline	No upper limit	No lower limit	No upper & lower limits
Average consumption for 20~84	1.8105	1.8100	1.8146	1.8108
Average job search effort for 20~64	0.8385	0.8074	0.9802	0.9402
(Employment rate for 20~64)	0.7117	0.7106	0.7155	0.7145
UI premium for E (covered by UI)	0.0065	0.0091	0.0037	0.0062
% change in total welfare for 20~84	(0.00)	(-32.56)	(large+)	(-16.06)
The number of UI recipients	0.0095	0.0123	0.0057	0.0085

TABLE 22-EFFECTS OF A POLICY CHANGE WHICH ABOLISHES UPPER AND LOWER LIMITS

Note: The numbers in the parentheses indicate the % changes in welfare in terms of the % change in the current average consumption for each group to achieve the same welfare level after the policy change (the equivalent variation in the current consumption). Additionally, 'large+' indicates that the welfare measure cannot be applied because the welfare gain is substantially large.

VI. Concluding Remarks

This paper investigates the macroeconomic effects of an enhancement in unemployment benefits in Korea. In particular, the paper quantifies the welfare effects of two specific policy changes which have been frequently discussed among policymakers and researchers in recent years: increasing wage replacement rates by 10%p and extending the maximum benefit duration by one month. To this end, an overlapping generation model which reflects the heterogeneity of the unemployed and the specificity of the UI system in Korea is built and calibrated to match the key features of the Korean labor market and the UI system. A quantitative analysis shows that extending the maximum benefit duration by one month improves social welfare, whereas increasing wage replacement rates by 10%p reduces social welfare.

The policy change that increases the wage replacement rate by 10%p is applied only to the top 19.31% of UI recipients whose wage level is relatively high. The welfare of the high-wage group directly affected by the policy change increases while the welfare of the low-wage group not directly affected by the policy change decreases. In the high-wage group, the consumption smoothing effects outweigh the negative effects, resulting in improved welfare. On the other hand, the lowwage group does not benefit from the policy change, and their current or future burden from the increased UI premium deteriorates their welfare. Given that the welfare reduction in the low-wage group exceeds the welfare increase in the highwage group, welfare overall is decreased.

In contrast, the policy change that extends the maximum benefit duration by one month increases the welfare of the low-wage group but decreases the welfare of the high-wage group. Although the policy that extends the maximum benefit duration is applied to all recipients by rule, UI recipients who are directly affected by the policy will be those who exhaust their maximum benefit durations before the policy change, and most of them belong to the low-wage group. In the low-wage group, the consumption smoothing effects are greater than the negative effects, leading to a welfare improvement. On the other hand, the negative effects mainly due to the increase in the UI premium outweigh the positive consumption smoothing effects for the high-wage group. Because most workers in the highwage group would not benefit from the policy change, the consumption smoothing effects and moral hazard effects for this group would not be large. However, the negative impact of the increased UI premium applies to all workers in the highwage group, and thereby the welfare for the high-wage group decreases. Because the welfare increase for the low-wage group is greater than the welfare reduction for the high-wage group, the total welfare is increased.

When analyzing the effects of the policy changes, it is confirmed that the amount of assets held plays an important role in determining welfare levels for the unemployed. If the amount of assets is sufficient large, it is probable that workers will be able to maintain their consumption levels if they become unemployed without unemployment benefits. Therefore, for those workers with a sufficient amount of assets, additional unemployment benefits may lead to savings rather than consumption while reducing job search efforts significantly. In other words, the moral hazard effects are likely to be greater than the consumption smoothing effects for workers who have sufficient amounts of assets. This suggests that unemployment benefits need to be enhanced for those groups that are likely to face liquidity constraints in order to maximize the effects of such a policy change in UI.

Starting with the shipbuilding industry, it is expected that unemployment will increase as the restructuring of the main industries of Korea, such as the steel and petrochemical industries, continues. Therefore, the role of UI is becoming more important. Furthermore, UI will play a central role in expanding the social safety net which is essential to improve the productivity and dynamics of the Korean economy. This study suggests that it is more desirable to extend maximum benefit durations rather than to increase wage replacement rates in terms of social welfare. More generally, enhancements to unemployment benefits should focus on groups for which amounts of assets are likely to be insufficient, such as young workers and socially disadvantaged groups, if possible.

In this study, I attempted to account for the heterogeneity of the workers and the characteristics of the Korean UI system to the greatest extent possible. Nevertheless, there are certain aspects that cannot be reflected in the model due to the complexity of the model, the difficulty of computation, and limitations on data which are essential to the calibration. First, this paper does not offer a deeper reflection on idiosyncratic earning shocks other than unemployment risk in that it focuses on the roles of UI and assets for income shocks only from unemployment, and to lessen the computation burden. However, in future studies, it would be worthwhile to examine how the roles of unemployment benefits and asset holdings change when other income shocks such as individual productivity shocks or match quality shocks are included in the model. In this case, the model can reflect the extent to which unemployment benefits contribute to better job matching, which is another positive aspect of unemployment benefits in addition to consumption smoothing effects, as discussed in Tatsiramos (2014). Second, firms' decisions to post vacancies are not explicitly considered in the model. Because firms' endogenous decisions are not reflected, the job finding rates in the model depend only on the workers' job search efforts. According to Hagedorn et al. (2016), more generous unemployment benefits can reduce a firm's incentive to post vacancies because more generous unemployment benefits increase the value of outside options for unemployed workers and increase equilibrium wages. If this effect is found to be significant in Korea, this margin should be included in the model in future research. Lastly, if administrative data regarding unemployment benefits are available, the calibration of the model can become more sophisticated.

This paper investigates only two specific policy options which can be implemented immediately considering the current actual situation in Korea. However, ideally it would be worthwhile to conduct additional studies on optimal unemployment benefits in Korea by reflecting the aforementioned content, and this is left as future research.

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Nexus between Inflation, Inflation Perceptions and Expectations[†]

By MINHO NAM AND MINJI GO*

We uncover a nexus between actual inflation, inflation perceptions and expectations in Korea through analyzing micro as well as aggregate data from the Consumer Survey. We document two novel findings. First, households' subjective perceptions of inflation exert more impact on expectation formation than actual inflation. Second, inflation perceptions are broadly in line with the trajectory of the inflation trend. This is attributable to the fact that changes in actual inflation have been generated mainly by the consumption items whose price changes are perceived more sensitively as those items are frequently bought or have a larger share in household expenditures. Conducting a crosscountry comparison, we find that information rigidity in expectation formation process and the nexus between perceptions and expectations of inflation prove to be stronger in Korea. Additionally, we reconfirm the existing finding that the scope of information utilized for forming inflation expectations is fairly circumscribed.

Key Word: Inflation Expectations, Inflation Perceptions, Expectation Formation, Information Rigidity, Monetary Policy JEL Code: D84, E31, E52

I. Introduction

Inflation expectations are deemed to affect actual inflation through pricing and wage negotiation of economic agents. Accordingly, if inflation expectations become unstable, actual inflation will become volatile, making it difficult for central banks to achieve price stability target and possibly lowering the credibility

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of monetary policy. As such, inflation expectations can directly affect the effectiveness of monetary policy. Hence, it is one of the foremost tasks of central banks to discover the causes of changes in inflation expectations and strive persistently to explore alternative measures to stabilize them. One of the prerequisites for fulfilling that task successfully is to secure a firm understanding of how households form their inflation expectations.

In modern macroeconomic theory, it is assumed that economic agents are forward-looking and form expectations in a rational manner, *i.e.*, utilizing all available information at the time of expectation formation. However, considering the findings from existing foreign studies which attempted to uncover how inflation expectations are formed through various methods, such as empirical analyses, surveys and experiments, households are more likely to form inflation expectations in a backward-looking manner using fairly limited, not full, information (Blanchflower and MacCoille, 2009; Rowe, 2016; Bank of Japan, 2016). In a similar vein, research on inflation expectations in Korea commonly shows that households' inflation expectations (1) are formed while depending heavily on past inflation information; (2) move in tandem with, and do not precede, actual inflation; and (3) show systematic forecast errors in relation to actual inflation. In particular, Lee (2012) finds through a correlation analysis that inflation expectations comove with inflation at the time of expectation formation rather than future inflation over the sample period from January 2000 to October 2011. Likewise, a vector autoregression (VAR) analysis in that paper reveals that inflation expectations turn out to be affected mainly by historical inflation. Choi (2012) estimates the proportion of the households whose expectations are formed in an adaptive manner to be around 60% using a sample spanning from February 2002 to June 2012. As a result, the persistence of inflation expectations in Korea proves to be stronger compared to that in the US, the UK, Sweden and New Zealand. Lee (2012) and Choi (2012) commonly confirm the existence of systematic bias in inflation expectations with regard to actual inflation.

Indisputably, those studies have greatly advanced our understanding of inflation expectation formation which had been recognized as a black box. However, the possibility that subjective inflation perceptions may play an important role in forming inflation expectations and they can account for the observed strong nexus between actual inflation and inflation expectations has been overlooked. To the best of our knowledge, there exists no academic attempt to verify these hypotheses in Korea. Even in overseas research, efforts to explore a link connecting inflation, its perceptions and expectations altogether appears to be scarce, although studies which examine inflation perceptions are abundant.

There is an additional limitation in the existing research on inflation expectations in Korea in that those studies used mainly pre-2013 data on inflation expectations which were compiled while providing survey respondents with *an average inflation rate over the last 12 months*. Therefore, the survey question *per se* may have induced households to form expectations in a backward-looking manner.¹

¹Choi (2012) raised the possibility that the provision of inflation information on the Consumer Survey questionnaires caused inflation expectations to be nearly equal to actual inflation. To resolve this issue, the Bank of Korea which conducts the Consumer Survey decided not to provide historical inflation on the questionnaire starting in 2013. This new survey method changed fundamentally the property of data on inflation expectations.

Motivated by these considerations, we analyze the relationships between actual inflation, inflation perceptions and expectations using the data from the Consumer Survey. Our analysis consists of three parts. In the first part, we attempt to validate the high level of correlation between actual inflation and inflation expectations documented in earlier work using post-2013 data which were compiled without providing survey respondents with inflation information. To take an additional step from a correlation analysis, we attempt to verify whether there exists a causality running from actual inflation to inflation expectations and examine the relationship between perceptions and expectations of inflation. From the results of these analyses, we derive a hypothetical reason why actual inflation, inflation perceptions and expectations are closely associated and then substantiate it by probing into item-level data in the CPI (Consumer Price Index) and microdata from the Consumer Survey.

In the second part of the analysis, we conduct a cross-country comparison to assess to what extent our findings on expectation formation in Korea can be generalized. We analyze data from the four advanced economies of the U.S, the Euro area, the UK and Japan, and survey a wide range of related empirical studies from overseas. In the last part, we estimate the scope of information households utilize when forming inflation expectations in Korea and then present the findings documented in overseas studies.

The following novel findings in this paper are expected to contribute to the literature along these three lines. First, inflation expectations are affected more strongly by inflation perceptions than by actual inflation. Secondly, the apparently strong correlation between inflation expectations and actual inflation stems from the fact that inflation perceptions closely follow the trend of actual inflation. In turn, the reason for why households perceive the past trend of inflation somewhat accurately is that changes in actual inflation have been generated mainly by the consumption items whose price changes are perceived more sensitively by households as they are frequently bought or take a larger share of household expenditures. Lastly, a cross-country comparison, rarely conducted in the literature, reveals that the inflation expectations of households are formed in a backward-looking manner in general and that the nexus between inflation perceptions and expectations in Korea is stronger compared to that in advanced economies.

The paper proceeds as follows. Section II presents evidence of the nexus between actual inflation, inflation perceptions and expectations. Section III provides commonalities and differences in how households in Korea and in the aforementioned advanced economies form inflation expectations. Section IV presents the result of an analysis regarding the scope of information used when forming expectations and presents the findings of relevant overseas studies. Section V concludes with a summary and policy implications.

II. Nexus between Inflation Perceptions and Expectations

In this section, we make an attempt to reveal a hidden nexus between inflation,

inflation perceptions and expectations.² We start by defining the key terms which are used in this paper. Henceforth, *inflation* refers to the CPI inflation rate announced by Statistics Korea. It is also expressed as *actual inflation* to make it clearly distinct from inflation perceptions and expectations. *Inflation expectations* refer to households' forecast for one-year ahead inflation and *inflation perceptions* mean the perceived level of inflation over the last year the data for which are compiled by the Consumer Survey of the Bank of Korea. *Past inflation* and *future inflation* mean the average CPI inflation rate for one year before and after a certain time point, respectively.

A. Nexus between Actual Inflation and Inflation Expectations

As mentioned in the introduction, the previous studies on inflation expectations in Korea share a common finding irrespective of differences in the methods and time periods of analysis used: inflation expectations are formed in a backwardlooking manner.³ In order to check whether this commonality is still valid using post-2013 data, the coefficients of cross-correlation are estimated between inflation expectations and actual inflation at three different time horizons, *i.e.*, over the past one year, at the time of expectation formation and over the next year. The sample period starts from January 2013, when the new method of questioning households about their forecasts for inflation was introduced, and ends with October 2017. In Figure 1, the panels on the left show the trend of actual inflation and its expectations. Those on the right in the same figure present the coefficients of the cross-correlation between the two indicators.



²A variety of methods are used to measure inflation expectations, which are non-observable in nature. There are two typical measures: survey-based and market-based indicators. Survey-based indicators are compiled by aggregating the collected forecasts for future inflation data from a group of economic agents, such as households, corporations and experts. Market-based indicators include the break-even inflation rate (BEI) referring to the gap between the yields of inflation-linked government bonds and plain government bonds, and inflation-linked interest rates applied to transactions of inflation swaps, a derivative for transferring inflation risk.

³Lee (2012) estimated the correlation between actual inflation and inflation expectations for the period from February 2002 to October 2011. Lee and Choi (2015) and Choi (2012) used a regression analysis to estimate the relationship between those two indicators for the period from February 2002 to December 2012 and from February 2002 to June 2012, respectively. All of these studies show that inflation expectations are formed in a backward-looking manner. However, as noted earlier, the analysis periods in these studies end before 2013, with survey respondents given the information about the past CPI inflation rates.



[Inflation at the time of expectation formation]



Source: Bank of Korea; Statistics Korea; Authors' calculations.

To take one step beyond the correlation analysis above, we test whether past inflation has any causal effect on inflation expectations. The following regression model in Ehrmann (2015) is estimated for the same sample period used in the correlation analysis above.⁴

(1)
$$\pi_t^e = \alpha + \beta_1 \pi_{t-n}^{aver} + \beta_2 D_t + \beta_3 D_t \pi_{t-n}^{aver} + \varepsilon_t$$

where π_t^{e} refers to inflation expectations at time t and π_{t-n}^{aver} is the average of past inflation from time t-n to t. The dummy variable D_t denotes the period in which past inflation continued to rise. It is included to examine whether the influence of past inflation on inflation expectations varies depending on the phases of the inflation trend. The dividing time point between the *inflation-rising* and *inflation-declining* phases is set as September 2016 based on the results of a

⁴In Ehrmann (2015), the entire sample period is divided into two categories depending on whether or not the inflation of the preceding month exceeds the inflation target. Assigning dummies to one type of period, Ehrmann (2015) examines whether the dependence of inflation expectations on actual inflation varies depending on the periods. Unlike Ehrmann (2015), we divide the sample period into only two parts depending on whether or not inflation continues to rise.

structural break test.⁵ Specifically, the *inflation-declining* phase lasts from January 2013 to August 2016 and naturally the other part of the sample period, from September 2016 to October 2017, is defined as the *inflation-rising* period. Therefore, the regression coefficient β_1 represents the dependency of inflation expectations on past inflation in the *inflation-declining* phase and $\beta_1 + \beta_3$ denotes that for the *inflation-rising* phase.

As shown in Table 1 below, β_1 is estimated to belong to the interval of [0.49, 0.61], which implies that inflation expectations in the *inflation-declining* phase react sensitively to actual inflation. In more detail, it is estimated that the average inflation over the *past* three to twelve months has a greater impact on inflation expectations than *current* inflation. From this result, it can be inferred that households regard the longer-term trend of past inflation as more important than the most recent inflation when forming expectations.⁶ On the other hand, in the *inflation-rising* phase, inflation expectations are estimated to still be less dependent on actual inflation than in the *inflation-declining* phase given that the estimates of $(\beta_1 + \beta_3)$ are in the interval of [0.03, 0.10], i.e., close to zero.

However, these estimation results cannot be viewed as a weakening in the backward-looking nature of inflation expectations in the *inflation-rising* era. Considering that actual inflation has continued to rise since the second half of 2016 while inflation expectations remain nearly flat within the narrow range of 2.5%-2.6% as indicated in the bottom left panel of Figure 1, it is more convincing to regard the results as an indication that households became less attentive to recent inflation information over the same period. This can be considered a puzzle in that the participants in overseas experimental studies show a tendency to be more sensitive to hikes than reductions in prices. One possible explanation is that households in Korea might not actively update inflation information expecting inflation to remain low as it had been at a historically low level for a prolonged period. However, this hypothetical proposition must be corroborated through an additional analysis after a longer time series of inflation expectations is secured.

	α	β_1	β_2	β_3	$\beta_1 + \beta_3$	R^2	F statistics
n=0 (current)	2.21***	0.49***	0.19	-0.39***	0.10	0.62	29.30***
<i>n</i> =2 (3-month average)	2.11***	0.57^{***}	0.38***	-0.52***	0.05	0.69	40.87***
<i>n</i> =5 (6-month average)	2.05***	0.61***	0.46***	-0.56***	0.05	0.74	52.42***
<i>n</i> =11 (12-month average)	2.02***	0.59***	0.52***	-0.56***	0.03	0.80	72.99****

TABLE 1-ESTIMATED RESULTS: LINK BETWEEN ACTUAL AND INFLATION EXPECTATIONS

Note: 1) ******* denotes statistical significance at the 1% level. 2) The Newey-West HAC estimator is used for generating the variance-covariance matrix of the residuals.

⁵The structural break point is estimated by an autoregression model using CPI to conform to the purpose of the regression analysis above.

⁶The result showing that inflation expectations are significantly affected by past inflation suggests that the inflation target scarcely influences inflation expectations. This hypothesis, however, must be verified by estimating a regression equation with different explanatory variables. According to a recent study, in New Zealand which introduced inflation targeting for the first time, 88% of all respondents to a business executive survey reported that their own purchasing experiences are most important when forming inflation expectations (Kumar *et al.*, 2015).

B. Nexus between Inflation Perceptions and Expectations

Numerous foreign studies have shown that the inflation expectations of households are influenced not only by objective information on, *e.g.*, inflation, business and economic policy but also by subjective inflation perceptions.⁷ In Figure 2, the perceptions and expectations of inflation in Korea appear to be nearly identical during the sample period from January 2013 to October 2017 in Korea. The average gap between these two indicators is merely 0.05%p. Naturally, the correlation coefficient between the expectations and perceptions of inflation is 0.97, i.e., close to one. On the other hand, the coefficient of the correlation between actual inflation and inflation expectations is 0.68, far from one, and the average gap between these two amounts to 1.47%p. Most remarkable is that the correlation coefficient between inflation perceptions and actual inflation is estimated to be as high as 0.72. This suggests that households perceive the trend, but not the level, of inflation relatively accurately.



FIGURE 2. INFLATION, INFLATION EXPECTATIONS AND PERCEPTIONS

Source: Bank of Korea; Statistics Korea.

TABLE 2-CORRELATION AND GAP BETWEEN INFLATION, INFLATION EXPECTATIONS AND PERCEPTIONS

	Correlation	Mean Absolute Deviation (%p)
Perceptions and Expectations	0.97	0.05
Perceptions and Actual Inflation	0.72	1.45
Expectations and Actual Inflation	0.68	1.47

Note: 1) The sample period is from January 2013 to October 2017. 2) Inflation is the average CPI inflation rate over the past one year.

⁷According to the Household Survey conducted by the Bank of England in February 2008, about half of the respondents noted that their own inflation perceptions are the most important determinant of inflation expectations (Benford and Driver, 2008).

Parenthetically, the notion that inflation perceptions are important in forming inflation expectations appears to have attracted attention even in the 1980s. ("The perceived rate of inflation, that is, the public's knowledge about the historical behavior of the price level, plays an extremely important—although little observed—role in much of recent work on the formation of inflationary expectations," Jonung (1981)). However, research on the determinants of inflation perceptions became active only after the 2000s.

To test whether a causality runs from inflation perceptions to inflation expectations, the following model is estimated for the period from January 2013 to October 2017. Considering the cointegrated relationship between the perceptions and expectations of inflation and the minute differences between those two variables, the model is expressed in an error correction form.⁸

(2)
$$\Delta \pi_t^e = \alpha + \beta \Delta \pi_t^p + \gamma GAP_{t-1} + \varepsilon_t$$

where π_t^e and π_t^p refer to inflation expectations and inflation perceptions, respectively. GAP_{t-1} denotes the estimate of the long-run equilibrium error between the perceptions and expectations of inflation.⁹ According to the estimation results, the coefficient β representing the impact of inflation perceptions on inflation expectations turns out to be significant at the 1% level.

Next, to compare the effects of inflation perceptions with those of actual inflation on inflation expectations, we re-estimate β after substituting the average inflation over 12 months π_{t-12}^{aver} for the inflation perceptions π_t^p in the equation (1) above. The result presented on the right-hand side of Table 3 shows that actual inflation is estimated to be insignificant.

Microdata from the Consumer Survey also lend firm support to the hypothesis that inflation perceptions are an overriding determinant of inflation expectations. In the individual responses of the survey, 68% of the respondents on average expected one-year-ahead inflation to be equal to the currently perceived level of inflation during the same period as in the analysis above.¹⁰ Although this proportion varies slightly depending on the interval of expected inflation, it is approximately 70% in all intervals as shown in Figure 3.¹¹

Notable is that for the respondents whose forecasts are in the range of 0% to 3%, which is close to the range of actual inflation, 0.4% to 2.6% during the sample period, the tendency to expect future inflation to be equal to inflation perceptions is found to be stronger. If these respondents had had relatively more opportunities to ascertain that their inflation perceptions were close to actual inflation by updating inflation information, this would have enhanced their trust in their own perceptions and hence strengthened their backward-looking inclination.¹²

⁸Equation (2) represents the short-term dynamics of the relationship between inflation perceptions and expectations and the *GAP* term refers to short-term deviations from the long-run equilibrium. We ascertain that there exists at least one cointegrating vector between inflation perceptions and expectations through a Johansen cointegration test, which implies the existence of a long-run equilibrium relationship between those two variables.

 9 That long-run equilibrium error indicates the estimate of the error term ξ_t in the following long-term equilibrium equation.

$$\pi_t^e = l + \delta \pi_t^P + \xi_t$$

 10 By age group, the average percentage of respondents with inflation perceptions are equal to inflation expectations is 64.3% in their 20s, 68.9% in 30s, 70.4% in 40s, 67.4% in 50s, and 65.6% in 60s or older. The percentages for respondents in their 30s and 40s are higher. By gender for this measure, males are at 68.2%, higher than females, for whom this rate is 64.6%.

¹¹In the Consumer Survey, the question on inflation expectations is designed such that respondents select one of 1%p-wide intervals in the range of 0% to 6%. For more detailed information about this, the reader can refer to Appendix A. *Consumer Survey Questions about Inflation Perceptions and Expectations.*

¹²From the perspective of Bayesian learning, if one assigns a high weight to prior belief about actual inflation

FABLE 3—IMPACT OF PERCEIVED ANI	ACTUAL INFLATION ON	INFLATION EXPECTATIONS
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Inflation Perceptions (π_t^P)	Inflation over the past year (π_{t-12}^{aver})
0.79***	0.18
$R^2 = 0.57, DW = 2.09$	$R^2 = 0.12, DW = 2.23$

Note: 1) The *impact* refers to the regression coefficient β of the equation (2). 2) *** denotes statistical significance at the 1% level.



FIGURE 3. PROPORTION OF RESPONSES EXPECTING FUTURE INFLATION TO BE EQUAL TO INFLATION PERCEPTIONS

C. Synthesis: Nexus between Actual Inflation, Inflation perceptions and Expectations

Based on the analysis results presented above, we can reaffirm the common view that the inflation expectations of households in Korea are formed in a backwardlooking manner. Moreover, two novel findings derive from the results which are overlooked in existing domestic studies. First, inflation expectations are more strongly influenced by subjective inflation perceptions than by actual inflation. Second, the reason for the close correlation observed between actual inflation and inflation expectations is that inflation perceptions, exerting a decisive impact on inflation expectations, are approximately in line with movements in the trend of actual inflation. This second finding implies that households in Korea have recognized inflation trends correctly to a large extent. Then, a question arise here how common households can perceive the inflation trend with such exactness.

As a possible rejoinder, we propose that changes in actual inflation have been led mainly by consumption items whose price changes are remembered more clearly as they have larger proportions in household expenditures and hold high purchasing frequencies. This hypothesis can be corroborated if the following two propositions prove to be true in order: first, inflation perceptions have been more

in the process of forming expectations, information friction such as forecast error occurs, as hesitation can arise whether to accept new inflation information (Cavallo *et al.*, 2017).

Note: The proportion is the average proportion from January 2013 to October 2017. *Source*: Bank of Korea; Statistics Korea.

closely correlated with the price inflation of those items than that of other items, and second, the price inflation of those items of interest has contributed considerably to changes in actual inflation.

Regarding the first proposition, as shown in Figure 4, the correlation coefficients are higher between inflation perceptions and the price changes in the following five item groups, *rent, textiles, household utilities, fuel* and *processed food*, which are frequently bought and which command large proportions of household expenditures.¹³ This is true also for the composite price index for those items. As indicated in Figure 5, the correlation coefficient is 0.76 between inflation perceptions



FIGURE 4. CORRELATION BETWEEN INFLATION PERCEPTIONS AND PRICE INFLATION BY ITEM GROUP

Note: 1) The sample period is from January 2013 to October 2017. 2) Price inflation is the average over the past one year.

Source: Authors' calculations.



FIGURE 5. INFLATION PERCEPTIONS AND THE GROWTH RATES OF THE COMPOSITE PRICE INDICES ITEM GROUPS

Note: 1) The five item groups are *rent, textile, household utilities, fuel* and *processed food*. 2) Inflation perceptions and the growth rates of the composite indices are the six-month moving average.

Source: Bank of Korea; Authors' calculations.

¹³According to the data of the Household Survey conducted by Statistics Korea from 2013 to 2016, the average expenditure shares on *rent, textiles, household utilities, fuel* and *processed food* out of total expenditures are 6.7%, 2.8%, 3.6%, 9.0%, and 10.2%, respectively, substantially higher than those of other item groups.



Note: 1) The five item groups are *rent, textile, household utilities, fuel* and *processed food.* 2) Inflation is the average over the past one year and does not include the effect of an increase in the tobacco tax in January 2016. 3) Changes in inflation are month-to-month changes of inflation itself.

Source: Statistics Korea; Authors' calculations.

and the growth rate of the composite price index of those five item groups, whereas the same indicator for the other item groups is negatively correlated with inflation perceptions.

At this stage, it is necessary to provide evidence of the second proposition to substantiate the hypothesis presented above. In Figure 6, the five item groups whose price inflation levels are highly correlated with inflation perceptions account for a considerable share of the changes in overall inflation.

Synthesizing all of the pieces of evidence presented above, it can be concluded that households could track the trend of actual inflation accurately, as the item groups strongly affecting inflation perceptions contributed substantially to overall inflation fluctuations.¹⁴ This synthesis reveals that inflation perceptions act as a hidden hinge linking inflation expectations and actual inflation.

III. Cross-country Comparison with Advanced Economies

In this section, we conduct a cross-country comparison to assess to what extent our findings regarding expectation formation in Korea can be generalized. By analyzing the data from the four advanced economies, *i.e.*, the US, the Euro area, the UK, and Japan and surveying overseas research findings, we derive certain commonalities and peculiarities of each individual economy in terms of expectation formation.¹⁵

¹⁵Statistical agencies in the Euro area including Eurostat have been amassing internally the unpublished

¹⁴The contribution to overall inflation fluctuations of the item group of *agricultural products, livestock, marine products* is not minor, but its correlation with inflation perceptions is quite tenuous. This outcome is mysterious considering that price changes in this item group should be discerned more clearly, as households purchase these products frequently as part of their daily lives. To infer, this stems from the fact that consumers are aware that prices of this item group are highly volatile due to irregular factors such as weather and seasonal factors and that they return to their long-term trend quickly. Hence, it is likely that households dismiss the price changes of such products when perceiving inflation.

A. Effects of Past Inflation on Expectations

Numerous studies from advanced countries have also shown that inflation expectations are formed in a backward-looking manner. Blanchflower and MacCoille (2009), Rowe (2016) and Bank of Japan (2016) present survey results which reveal that personal purchasing experiences in the past exert a significant effect on expectation formation. Specifically, in Rowe (2016), the respondents report that recently perceived price changes in retail stores over the past twelve months as the most important determinant of their inflation expectations as shown in Figure 7. That survey result is surprisingly in good agreement with the data analysis outcome presented in the previous section showing that inflation expectations. In addition, Ehrmann (2015) presents an empirical finding which shows that inflation expectations are formed in a backward-looking manner by estimating the extent to which inflation expectations react to actual inflation in 15 advanced countries.¹⁶

With the same method used in Section Π , we examine the correlation between inflation expectations and actual inflation at three different time horizons. Considering Table 4, it is notable that the correlation coefficients of *current* and *future* inflation in all four advanced economies are higher than those for Korea. This suggests that households in those economies are more active in updating inflation information. When comparing the coefficients by time horizon in the individual economies, the correlation coefficients of *past* inflation. In the US and the UK, the correlation coefficient of *current inflation* is highest, but is nearly identical to that of *past* inflation.



FIGURE 7. IMPORTANT FACTORS REPORTED AS DETERMINING INFLATION EXPECTATIONS IN THE UK *Source:* Rowe (2016).

results of consumer surveys on inflation perceptions and expectations conducted at the level of individual EU member states since 2004. We obtained the data from January 2004 to July 2015 from Roberta Friz, one of the authors of Arioli *et al.* (2016) who compiled the data of inflation perceptions and expectations at the Euro area level based on the unpublished national survey results.

¹⁶Easaw et al. (2013) presents similar survey results for Italy.

	US	Euro area	UK	Japan	Korea
Past Inflation	0.46	0.93	0.89	0.64	0.68
Current Inflation	0.52	0.82	0.90	0.53	0.31
Future Inflation	0.42	0.54	0.76	0.57	0.09

TABLE 4—CORRELATION BETWEEN INFLATION EXPECTATIONS AND ACTUAL INFLATION AT THREE DIFFERENT TIME HORIZONS

Note: 1) *Past* and *future* inflation refer to the average CPI inflation rate over the 12 months before and after the time of expectation formation, respectively. *Current* inflation means the CPI inflation rate at the time of expectation formation. 2) The sample period is from January 2010 to September 2017 for the US, from January 2010 to July 2015 for the Euro area, from Q1 2010 to Q3 2017 for the UK and Japan, and from January 2013 to October 2017 for Korea. 3) The data used for the Euro area come from Arioli *et al.* (2016).

B. Effects of Past Inflation Perceptions on Expectations

The tables on the right in Figure 8 below present the correlation coefficients between actual inflation, inflation perceptions and expectations during the period from 2010 to 2017 in the Euro area, the UK and Japan.¹⁷ The correlation coefficients between perceptions and expectations are 0.97 and 0.93 for the Euro area and the UK, respectively, similar to that of Korea. In Japan, it is relatively low compared to the other economies at 0.72 but is still high considering an absolute standard. On the other hand, in the US, where no data on inflation perceptions are available, recent surveys found that most respondents expected the future inflation rate to be close to the recent level of actual inflation (Detmeister *et al.*, 2016).¹⁸ Considering all of the results from this cross-country analysis, it can be concluded that households' subjective perceptions in general play the most vital role in the formation of inflation expectations.



¹⁷The sample periods for the UK and Japan are identical, from Q1 2010 to Q3 2009, and that for the Euro area is from January 2010 to July 2015. The UK and Japan compile data on inflation perceptions and expectations on a quarterly basis. The data for the Euro area come from Arioli *et al.* (2016).

¹⁸The Federal Reserve asked the survey agency to add a new question about inflation perceptions to the existing questionnaire of the University of Michigan survey and to conduct surveys four times in 2016 using the augmented questionnaire. The results presented above are based on the two surveys conducted in February and May of 2016.



Note: 1) The data used for the Euro area come from Arioli *et al.* (2016). 2) To ensure the statistical significance of the correlation coefficients, the sample period for the UK and Japan is extended to 2010 because these two countries compile data on inflation expectations and perceptions on a quarterly basis. 3) Actual inflation means the average inflation over the past one year.

Source: National statistical office and the central bank of each country; Arioli et al. (2016).

However, gaps between inflation perceptions and expectations in the advanced economies are larger than in Korea and vary with time appreciably, as indicated in Figure 9. It is deducible from the difference that in Korea, stronger is households' inclination to forecast future inflation to be close to the currently perceived level of

inflation. In other words, backward-looking behaviors of households are more pronounced in Korea. It suggests that households in Korea may update inflation information less frequently; i.e., information rigidity in Korea is higher.¹⁹

As there are noticeable gaps between the perceptions and expectations of inflation in the advanced economies, the impact of perceptions on expectations in those economies should be weaker than in Korea. This inference can be verified using equation (2). The results are presented in Table 5 below. Specifically, in the



Source: National statistical office and the central bank of each country; Arioli et al. (2016).

TABLE 3—ESTIMATED IMPACT ON INFLATION EXPECTATIONS IN ADVANCED	d Economies
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	Inflation perceptions (π_t^P)	Inflation over the past year (π_{t-12}^{aver})
Euro area	0.62***	1.05**
UK	0.88***	0.34***
Japan	0.54***	0.22
Korea	0.79***	0.18

Note: 1) *Estimated impact* refers to the coefficient β in equation (2): $\Delta \pi_t^e = \alpha + \beta \Delta \pi_t^P + \gamma GAP_{t-1} + \epsilon_t$. 2) The sample period is from January 2010 to July 2015 for the Euro area, from Q1 2010 to Q3 2017 for the UK and Japan, and from January 2013 to October 2017 for Korea. 3) *** and ** denote statistical significance at the 1% and 5% level, respectively.

¹⁹Because it is beyond the purpose of this paper to elucidate the reason why information rigidity appears to be stronger in Korea, we leave this issue for future studies.

Euro area, inflation over the past one year influences expectations more heavily than inflation perceptions, while in Japan, the impacts of the two indicators are estimated to be similar.

C. An Additional Commonality

The results of the cross-country analysis above can be considered as provisional evidence that inflation expectations of households are formed universally in a backward-looking manner. We find an additional commonality in the relationship between actual inflation and inflation expectations. As presented in Figure 10, inflation perceptions always outstrip actual inflation in all of the economies, thereby causing systematic forecast errors in inflation expectations.²⁰ We ascribe this phenomenon to households' cognitive biases operating when perceiving inflation. Experimental studies have shown that general consumers are more susceptible to price increases, especially larger increases, than decreases and hence remember them more clearly. Jungermann *et al.* (2007) find that the participants in an experiment tend to perceive price increases more accurately compared to price



Source: National statistical office and the central bank of each country; Arioli et al. (2016).

 $^{^{20}}$ The estimation results presented in Appendix *B* verify systematic forecast errors in inflation expectations in Korea and in the advanced economies.

decreases.²¹ Bruine de Bruin *et al.* (2011) also present an experimental result showing that larger price changes are more strongly remembered.²² As a consequence, this asymmetric perception of price changes acts as a factor that widens the gap between inflation expectations and actual inflation in an *inflation-declining* era. Arithmetically, inflation declines if consumption items whose prices decrease or increase by less than before multiplies. In such a situation, economic agents become less sensitive to price changes, consequently, the gap between inflation perceptions and actual inflation would become larger.

Additionally, the tendency of selecting the central intervals on the Consumer Survey question with regard to inflation perceptions may act as a marginal factor causing inflation perceptions to remain higher than actual inflation when the latter is below 2%. On the survey questionnaires for Korea and the UK, respondents are asked to choose one among 1%p-wide intervals from 0% to 6%. With this type of questionnaire design, respondents are more likely to choose intervals in the range of 2% to 4%, leading inflation perceptions to exceed actual inflation.

IV. Scope of Information for Forming Inflation Expectations

A. Case of Korea

The rational expectation theory assumes that economic agents utilize all information available at the time they form expectations for the future.²³ Applying this to inflation expectation formation, economic agents should employ not only price information but also information on macroeconomic variables and economic policies. However, contrary to this hypothesis, previous studies have verified that economic agents mainly use their personal memories of specific price changes and a narrow range of economic information.²⁴ Below, we estimate the scope of information presumably utilized when forming inflation expectations in Korea à *la* Forsells and Kenny (2002) for the period from January 2013 to October 2017.²⁵ The estimation model is specified as follows.

²⁵Lee (2012), using data from February 2002 to October 2010 and the methodology of Forsells and Kenny (2002), indicated earlier that inflation expectations are not formed in a rational manner. However, the data, as noted earlier, were compiled by asking inflation forecasts while providing past CPI inflation rates.

²¹Research in behavioral economics suggests the loss aversion tendency maintained by Kahneman and Tversky (1979) as the reason for economic agents reacting more sensitively to increases in prices than decreases (Brachinger, 2008; Jungermann *et al.*, 2007).

²²These findings apparently contradict the estimation result of equation (1) presented in the previous section, showing that inflation expectations react more sensitively to actual inflation in the *inflation-declining* period. To reiterate our hypothetical explanation proposed in the same section regarding that puzzle, households might expect low inflation to persist longer into the future without active updating of inflation information as inflation remained subdued for too long a period.

²³Hall (1978) maintains that inflation expectations can be said to be formed rationally only when economic agents understand the structure of the economy accurately and hold all information necessary for generating optimal forecasts in a statistical sense.

 $^{^{24}}$ This is supported by results of analyses using various methodologies such as surveys (Benford and Driver, 2008; Rowe, 2016) and experiments (Georganas *et al.*, 2014, *inter alia*). Unlike these findings, Forsells and Kenny (2002) show that the level of rationality is estimated to be intermediate in the expectation formation process in the Euro area.

(3)
$$\pi_t - \pi_t^e = \delta + \lambda \Omega_t + \varepsilon_t$$

where π_t is the average inflation over the coming twelve months after time tand π_t^e denotes inflation expectations formed at time t. The dependent variable, $\pi_t - \pi_t^e$, is the forecast error. Ω_t is the information set employed by economic agents at the time of expectation formation, which includes the indicators of price, business and financial condition. Specifically, price indicators are the CPI inflation rate and the growth rates of nominal wages and house prices. Business indicators include the cyclical components of the composite leading index and composite coincident index, and the growth rate of industrial production. Financial indicators are the yields of 91-day CDs (Certificates of Deposit) and three-year government bonds, and exchange rates. Following Forsells and Kenny (2002), we conduct univariate regressions including each indicator as a unique explanatory variable to prevent multi-collinearity problem.

If the regression coefficient λ is statistically significant, it implies that the information content of a specific indicator remains in the forecast error. In other words, the indicator is not sufficiently taken into account in the process of forming inflation expectations. To interpret the estimation results presented in Table 6, all the price indicators are utilized when forming inflation expectations while most of the business indicators and financial indicators are not. Based on this result, it can be concluded that inflation expectations in Korea are formed using fairly limited information, such as inflation, wages, and housing prices, not with all available information.²⁶

	Ω_t	λ	p-value
Price Indicators	CPI inflation rate	-0.114	0.623
	Nominal wage growth rate	0.045	0.173
	House prices growth rate	0.037	0.228
Business Indicators	Composite leading index	-0.112	0.637
	Coincident composite index	0.622	0.029**
	Industrial production growth rate	0.102	0.014**
Financial Indicators	91-day CD rate	-0.459	0.009***
	Three-year government bond yields	-0.377	0.019**
	Exchange rate	0.003	0.009***

TABLE 6-ESTIMATION RESULT OF THE INFLATION EXPECTATION RATIONALITY TEST

Note: 1) The Newey-West HAC estimator is used to generate the variance-covariance matrix of the residuals. 2) *Growth rate* means year-on-year change. 4) *Business indices* specifically refers to its cyclical components, not the level. 4) *** and ** denote statistical significance at the 1% and 5% level, respectively.

²⁶Among the business indicators, the λ of composite leading index proves to be insignificant. However, considering the coefficients of the other two business indicators are significant, it is questionable that households allow for composite leading index in practice when forming inflation expectations..

B. Case of Foreign Countries: A Survey of the Literature

Research findings accumulated in advanced countries have also substantiated that only a limited range of information is considered when forming inflation expectations. This section summarizes the main findings from those studies, instead of performing the same econometric analysis applied to Korea in the previous subsection. Table 7 presents the studies and the associated analysis methodology.

Among those studies, Georganas *et al.* (2014) show in a US-based experiment that price inflation for items with high purchasing frequency influences inflation perceptions strongly. Cavallo *et al.* (2017) present an experimental result showing that the prices of goods sold in supermarkets exert greater effects on inflation expectations than CPI inflation. Kamada *et al.* (2015) also ascertain that the impact of food and energy prices on inflation expectations is greater than CPI inflation in Japan. Coibion and Gorodnichenko (2015) estimate that more than 50% of the gap between the expectations of experts and general consumers can be explained by fluctuations in crude oil prices in the US from 2009 to 2011.

Additionally, Rowe (2016) found using a survey method that most households report that their inflation perceptions are determined mainly by the price inflation of the items with high purchase frequency such as food and drinks, household utilities, clothing and footwear, fuel and housing, among others, as indicated in Figure 11. Strikingly, this survey result is in fairly good agreement with the results of the data analysis presented in Section II, which showed inflation perceptions in Korea are closely correlated with the price inflation of the consumption items which account for a high proportion of household expenditures or which are frequently bought.

Country	Research	Research method
US	Cavallo <i>et al.</i> (2017) Georganas <i>et al.</i> (2014) Souleles (2004) Vlasenko and Cunningham (2015)	Experiment Experiment Regression analysis Creating a new price index and regression analysis (Granger causality)
Germany	Jungermann et al. (2007)	Experiment
UK	Rowe (2016)	Household survey
Switzerland	Huber (2011)	Experiment
Sweden	Jonung (1981)	Household survey and regression analysis
Australia	Kumar et al. (2015)	Company survey
Japan	Kamada et al. (2015)	Regression analysis

TABLE 7—RESEARCH ON THE FORMATION OF INFLATION PERCEPTIONS AND EXPECTATIONS IN ADVANCED COUNTRIES



FIGURE 11. MOST IMPORTANT FACTORS REPORTED AS DETERMINING INFLATION PERCEPTIONS IN UK *Note*: Respondents were allowed to choose up to four factors in the survey. *Source*: Rowe (2016).

V. Summary and Policy Implications

The inflation expectations of households in Korea are determined mainly by subjective inflation perceptions and historical inflation, that is, in a backward-looking manner. In particular, considering the fact that inflation expectations are nearly identical to inflation perceptions while hovering above actual inflation, inflation perceptions are inferred to be more influential in expectation formation process than actual inflation. In the related research in Korea, the high level of co-movement between inflation expectations and actual inflation has been proposed as an empirical basis for backward-looking expectation formation. According to our analysis, the observed close correlation between inflation expectations and actual inflation expectations move in tandem with the actual inflation trend. In turn, the strong correlation between inflation perceptions and the inflation trend originates from the fact that households perceive inflation fluctuations mainly utilizing the price information of consumption items that contribute substantially to changes in actual inflation.

Turning to the scope of information used for forming inflation expectations, inflation expectations are estimated to be formed with fairly bounded information rather than with all available information at the time of expectation formation. In particular, two categories of information are predominant: first, the price information of consumption items such as fuel, clothing, rent that are more frequently purchased and that have a larger share of household consumption expenditures, and second, price indicators such as CPI, wages and house prices.

From the results of the cross-country analysis of this paper and existing research findings, we derive two commonalities in terms of expectation formation. First, inflation expectations are formed in a backward-looking manner in general with only limited information. Second, inflation perceptions and expectations continue to outstrip actual inflation mainly due to asymmetric price perceptions. On the other hand, there exist several differences between Korea and the advanced economies compared in the analysis. While inflation perceptions and expectations are nearly equal in Korea, there is an appreciable time-varying gap between the two indicators in the advanced economies. Furthermore, the impact of inflation perceptions on expectations is estimated to be not as predominant as it is in Korea. One possible explanation for these differences is that the propensity of households in Korea to forecast the current level of inflation to persist into the future, *i.e.*, the backward-looking nature of expectation formation, is more pronounced than in the advanced economies.

Considering the analysis results of this paper overall, stabilizing actual inflation through monetary policy implementation appears to be the most effective means for anchoring inflation expectations. Put differently, the scope for central banks to affect inflation expectations with measures other than monetary policy is narrower. The reason is that inflation expectations are estimated to be determined mainly by the price changes of a few consumption items such as rent, clothing, petroleum and by past inflation trends. Overseas central banks which have emphasized the importance of anchoring inflation expectations fail to devise any additional stabilization measures. However, strengthening communication on the topic inflation expectations.²⁷ In particular, if inflation expectations diverge excessively from actual inflation while showing a highly volatile path, it may be necessary for central banks to communicate its intention to stabilize inflation to the public aggressively by, for instance, publicizing its inflation target more frequently.

Furthermore, conducting this study, we have realized that it is necessary to study to what extent *inflation expectations affect actual inflation in practice* using a variety of methods, such as surveys and quantitative analyses. The common knowledge that *inflation expectations affect actual inflation through price setting and wage negotiations* is based mainly on the theoretical Phillips Curve relationship, the cornerstone of the New Keynesian theory rather than on empirical evidence. Future studies on that issue will hopefully prompt discussions leading to re-examination of the importance of inflation expectations from the viewpoint of monetary policy.

²⁷Ehrmann *et al.* (2017) argue that communication from central banks regarding inflation stabilization can contribute to anchoring inflation expectations, as inflation expectations respond sensitively to news about inflation. In addition, Fritzer and Rumler (2015) suggest that forecast errors in inflation expectations of respondents who are aware of inflation targets are smaller than those of the other respondents.

APPENDIX

A. Consumer Survey Questions for Inflation Perceptions and Expectations

 By how much do you expect the CPI to change 		
over the coming year?		
a. decreased		
b. 0% to less than 1%		
c. 1% to less than 2%		
d. 2% to less than 3%		
e. 3% to less than 4%		
f. 4% to less than 5%		
g. 5% to less than 6%		
h. 6% or more		
i. don't know		

B. Systematical Forecasting Error of Inflation Expectations

The following regression model proposed by Mincer and Zarnowitz (1969) is estimated to examine whether the gap between inflation expectations and future inflation for the next year occurs regularly and continuously.

$$\pi_{t+12}^{aver} = \alpha + \beta \pi_t^e + \varepsilon_t$$

In this equation, π_{t+12}^{aver} denotes the annual average inflation for one year after time *t*, which is the time of expectation formation. π_t^e denotes expectations for average inflation over the next year, *i.e.*, inflation expectations in the Consumer Survey. The null hypothesis is ' $\alpha = 0$ and $\beta = 1$ ', which means that the bias of inflation expectations (π_t^e) is not systematic. As shown in Table A1, the null hypothesis is rejected in Korea and in the major advanced countries, which implies the forecasting error in inflation expectations occurs systematically.

	Korea	US	Euro area	UK	Japan
α	-1.53****	-1.00*	-2.07****	-1.88**	-2.03**
β	0.91***	0.86***	2.32***	1.31***	0.63***
F statistics	40.16****	20.62***	25.35***	26.36***	10.96***

TABLE A1—FORECASTING ERROR OF INFLATION EXPECTATIONS

Note: 1) If the null hypothesis ' $\alpha = 0$ and $\beta = 1$ ' is rejected, forecasting error in inflation expectations occurs systematically. 2) The sample periods are from January 2013 to August 2016 for Korea, from January 2010 to September 2017 for the US, and from Q1 2010 to Q3 2017 for the others economies. 3) ***, **, and * denote the 1%, 5%, and 10% significance level, respectively.

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The Effects of Non-Recourse Mortgages on Default Risks and Households' Surplus[†]

By KEEYOUNG RHEE*

We study whether a default option attached to non-recourse mortgages improves borrowers' surplus from mortgage financing. By defaulting on mortgage debt, borrowers can save their non-collateralized income from being foreclosed. In exchange, borrowers must forgo nonmonetary surplus from retaining any collateral. Banks may charge a high mortgage rate due to increased default rates. We find that the interest rate of non-recourse mortgage decreases with the borrower's surplus from home ownership. Moreover, non-recourse mortgages benefit only borrowers who deem housing property as an investment asset. Hence, the transition to a non-recourse mortgage is detrimental to welfare if the borrower enjoys a large surplus from home ownership. Although the borrower privately knows how much surplus she enjoys from home ownership, a menu of non-recourse mortgage contracts may exist, yielding a separating equilibrium without information rent.

Key Word: Non-recourse Mortgage, Strategic Default, Adverse Selection JEL Code: D82, G18, G21

I. Introduction

Having observed the rapid increase in household debt in Korea, policy practitioners have launched numerous measures to resolve the problems associated with household economies and their ballooning levels of debt. One of these measures was to introduce *non-recourse mortgages*, by which lending banks are not allowed to foreclose on borrowers' non-collateralized income to recover their losses. For instance, the Didimdol loan program of public mortgages funded by the National Housing and Urban Fund (NHUF) has offered non-recourse

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mortgage product to low-income households since 2015. The Financial Services Commission (FSC) also encouraged other government-run mortgage enterprises (such as the Korea Housing Finance Corporation (HF)) as well as private banks to sell non-recourse mortgage products.¹

Obviously, these non-recourse mortgage products were introduced to protect household income from being used to meet possible hefty repayment obligations during economic downtowns. In the mortgage markets in Korea, banks have sold recourse mortgage products which guarantee lenders recourse to borrowers' future income streams in the event of a default on their mortgage repayment. However, under the alternative non-recourse mortgage contracts, borrowers can decide to forgo nothing but the collaterals of the mortgages to the lending banks. Therefore, the borrowers preserve non-collateralized income to pay living expenses, even during times of economic distress.

Nevertheless, determining whether or not this provision of a default option is always better off for household borrowers is not always clear. Lifting the obligation to repay the outstanding debt will surely improve households' surplus *ex post* amounts when recessions hit household economies. To the lending banks, however, less liquidation will increase the risk of default in the mortgage business. Out of fear of losses during economic downtowns, lending banks may charge a high risk premium to household borrowers. As a result, introducing non-recourse mortgages may increase the costs of mortgage financing, which may in fact make borrowers worse off (Bang, 2015).

Therefore, a careful examination is required of the effects of non-recourse mortgage contracts before they are introduced into the market. Particularly, borrowers may strategically exercise the default option even if they have a sufficient amount of income to repay the outstanding debt, which may result in welfare losses due to the costly liquidation process. Moreover, speculative investors may abuse this default option as a means of reducing their exposure to investment losses. In such cases, the introduction of non-recourse mortgages may only subsidize speculators. Given that speculation in the housing market has always been an important policy consideration in Korea, investigations of the links between non-recourse mortgage instruments and borrowers' motives for home purchases are necessary.

Since the pioneering work of Vandell (1978), the economic impacts of alternative mortgage instruments (including non-recourse mortgages) on borrowers' repayment decisions has attracted the attention of many academic researchers. Particularly, the literature expanded rapidly after the U.S. subprime mortgage crisis of 2007-2009. For instance, Campbell (2012) compared the U.S. and Europe with regard to differences in mortgage market structures in terms of various economic and institutional aspects. Hatchondo *et al.* (2015) proposed LTV limits as a policy instrument to complement traditional recourse mortgages. Kim (2015) analyzed and simulated how households' optimal default decisions change over time with their selection to finance home purchases, such as with non-recourse mortgages and unsecured loans. Lastly, Piskorski and Tchistyi (2010)

solve an optimal mortgage design problem in a general continuous-time dynamic contract framework.

There are also empirical works related to alternative mortgage instruments. For instance, Ghent and Kudlyak (2011) and Corbae and Quintin (2010) both found that non-recourse mortgages yield higher default rates than recourse mortgages. Using survey data, Guiso *et al.* (2013) found that non-financial factors, such as fairness and morality, associated with households may determine their decisions strategically to default on their mortgages. Cocco (2013) used U.K. household panel data to estimate that non-recourse mortgage products can be useful for households to smooth their future consumption patterns.

However, despite its importance, there is scant literature found in Korea on the impacts of non-recourse mortgages on household economies. To the best of the author's knowledge, there are few theoretical studies of a strategic link between household demand for houses and their decisions regarding the fulfillment of their repayment obligations. Without a careful examination of the economic impacts of relevant policies, no one can appropriately predict the ramifications of introducing non-recourse mortgage products. To address this problem, we present a simple and stylized model to analyze why borrowers strategically default on their non-recourse mortgage debt. Specifically, we focus on how the default risk of non-recourse mortgage contracts varies with households' purposes for buying housing.

In our model, a borrower purchases a house via mortgage financing, in which a lending bank collateralizes the purchased house. The borrower has two future sources of income in the future: capital gains from the collateralized house and non-collateralized labor income. Every individual bank competes with others to sell the mortgage to the borrower by offering certain mortgage repayment terms. If the household defaults on the debt, the lending bank forecloses and liquidates the collateral so as (partially) to recover its loss. We assume that the liquidation process incurs a loss of value from the collateral, which constitutes the welfare loss.

We consider two types of mortgage products in our model. With a *recourse* mortgage, if the household defaults on its mortgage, the lending bank will foreclose and make a claim to all of the borrower's income, including non-collateralized income. However, under a *non-recourse* mortgage, the borrower can avoid her remaining mortgage debt by surrendering the collateralized property. By doing so, the borrower can preserve her non-collateralized labor income from going towards the outstanding debt. To capture the impact of non-recourse mortgages, we compare the borrower's gains from mortgage financing for these two types of mortgage products.

A key assumption is that the borrower enjoys an additional non-monetary (and possibly subjective) surplus by retaining ownership of the property purchased via mortgage financing. This surplus can be obtained if the borrower fulfills her mortgage repayment. This additional surplus can be referred to as the value of living in the purchased house. For example, if the borrower gains a surplus of zero from homeownership, she views the housing property merely as an investment asset for capital gains. On the other hand, if the borrower gains a high level of homeownership surplus, she views this housing property as a residence. Thus, this type of borrower is, if necessary, willing to repay the mortgage debt with her non-

collateralized income.

We show that the probability of default in the case of a non-recourse mortgage decreases with the borrower's surplus from repaying the mortgage debt.² If the borrower's homeownership surplus is relatively low, the mortgage repayment cost may outweigh the associated benefit. Given this low value of homeownership surplus, the concept of *HDP equilibrium* comes into play (where HDP stands for "high default probability"), in which the borrower retains non-collateralized income when the housing price decreases below the total amount of the mortgage debt. The banks charge high mortgage rates due to the increased default risk. In contrast, if the borrower's homeownership surplus is relatively high, the benefit of repaying the mortgage will outweigh the cost. Given this high value of homeownership surplus, there exists *LDP equilibrium* (where LDP denotes "low default probability"), in which the borrower uses non-collateralized labor income to repay her mortgage debt fully. Accordingly, banks do not charge high mortgage rates because the default risk level does not increase compared to that under a recourse mortgage.

We also determine whether or not a transition to a non-recourse mortgage improves the borrower's gains from mortgage financing. We find that there is a threshold of the borrower's homeownership surplus such that the non-recourse mortgage improves the borrower's gains if and only if the borrower's homeownership surplus is under that threshold. In such a case, the default option enabling the borrower to avoid the repayment obligation presents a high value to the borrower when the value of the homeownership surplus is low. Meanwhile, the increased interest rate may harm the borrower's gains from mortgage financing. Given a high value of the default option, the borrower will realize higher gains with a non-recourse mortgage, although she faces a high interest rate compared to the recourse mortgage product. Otherwise, the borrower will be worse off due to the increased cost of borrowing, whereas the default option presents a low value.

Similarly, we find that the transition to a non-recourse mortgage improves welfare if and only if the borrower's homeownership surplus is low. The total welfare is the borrower's gains from mortgage financing minus the expected social cost from liquidation in the event of a default. Under a non-recourse mortgage, the increased default probability in the state of HDP equilibrium yields a greater welfare loss due to the costly liquidation of the foreclosed property. As explained above, the value of the default option is decreasing in the event of a borrower homeownership surplus. Therefore, a non-recourse mortgage improves social welfare if and only if the borrower's homeownership surplus is sufficiently low and, therefore, the value of the borrower's default option is very high.

In the main model, the borrower's surplus from retaining homeownership is assumed to be publicly known by the banks. However, it may be more realistic to assume that such homeownership surplus is private information available only to the borrower. Indeed, banks may not be able fully to verify whether the borrower

²This analytical result resonates with the empirical works by Bhutta *et al.* (2017) and Guiso *et al.* (2013). For instance, Bhutta *et al.* (2017) finds that borrowers are more reluctant to default on their mortgage repayment obligations than the level predicted by traditional models. They interpreted their finding as meaning that emotional and behavioral factors may influence borrowers' repayment decisions. The surplus gained mortgage repayment in our model plays a role similar to such "non-rational" factors.

buys housing as a residence or for speculative purposes. To enhance fully relevance of our analysis, we augment our model by introducing informational asymmetry with regard to each borrower's homeownership surplus.

We analyze whether or not the adverse selection problem will make the borrower worse off compared to complete information.³ We find that there may be a separating equilibrium by which the borrower realizes the same gains as she would under a scenario of complete information. Consider the borrower with a high homeownership surplus first, who receives low repayment terms in equilibrium. If the housing price is lower than the mortgage debt, this type of the borrower would rather use her non-collateralized income to fulfill her repayment obligations. Because such borrowers rarely exercise the default option, they prefer a mortgage product that offers the lowest mortgage repayment terms, leading to the highest residual income after repayment. Next, consider the borrower with a low homeownership surplus, who receives the high repayment terms by reporting her true type in equilibrium. If the homeownership surplus is not too low, this type of the borrower will actively exercise her default option to prevent her noncollateralized income from being foreclosed upon compared to the other type of borrower. If the borrower lies about her type, she will be offered low repayment terms to an extent such that she needs not exercise the default option. Put differently, this type of borrower will endogenously surrender her default option by mimicking the other type. However, the equilibrium repayment terms offered by competitive banks are not hefty enough for the borrower to misreport her type for the sake of low repayment terms. Therefore, it is optimal for the borrower to report her type truthfully.

The remainder of the paper proceeds as follows. Section 2 presents our model. In Section 3, we discuss equilibrium under the recourse mortgage contract as a benchmark of our main analysis. In Section 4, we study the strategic interaction between borrowers and banks under non-recourse mortgage contracts and derive related policy implications. In Section 5, we conduct the equilibrium analysis under asymmetric information regarding borrowers' surplus amounts from retaining homeownership. Section 6 concludes the paper.

II. Model

Consider a two-period (t = 0, 1) economy with a household and a number of competitive banks. When the game begins in t = 0, there is a house available for sale in this economy. The borrower can purchase this house at a price of $p_0 > 0$. We assume that the household has zero initial wealth such that the house is unaffordable without external financing. However, the borrower can buy the house by borrowing from one of the banks via mortgage financing. Specifically, the borrower can borrow money p_0 from a bank by collateralizing the house she would like to purchase. In return, she is obliged to repay the mortgage debt with an

³The heterogeneity of borrowers' characteristics is similar to that in the setting of Campbell and Cocco (2015).

amount D > 0 in t = 1.⁴ If the borrower does not repay her mortgage, the ownership of the collateralized house is transferred to the lending bank. The bank liquidates the collateral to recover (partially) the loss from the default. We assume that banks in the mortgage market compete \dot{a} la Bertrand with regard to selling mortgage products such that the repayment term D is determined to break the lending bank even.

After purchasing the house, the borrower can repay the mortgage debt by spending either capital gains or labor income realized in t = 1. Specifically, the household can realize a capital gain (or loss) from the purchased house in t = 0: the house price in t = 1, denoted by p_1 , may increase to $p_h > p_0$ with probability $\pi \in (0,1)$ or decrease to $p_i < p_0$ with probability $1 - \pi$. In addition, the borrower gets a separate labor income w_1 in t = 1. We assumed that w_1 is a binary random variable such that the household gains high labor income $(w_1 = w_h)$ with probability $y \in (0,1)$ and low labor income $(w_1 = w_l)$ with probability 1-y, where $w_h > w_l$. We also assume that w_1 is mutually independent of p_1 .

A key assumption in this model is that the household enjoys an additional surplus from retaining ownership of the purchased house. Specifically, we assume that if the borrower fully repays her mortgage debt, she gains a non-monetary surplus r > 0 in t = 1. In contrast, if the household defaults on her mortgage debt, the collateralized house will be foreclosed and thus the borrower cannot gain r. We can interpret r > 0 as the benefit the borrower enjoys from having her own residential unit. If r is high, the household then has a strong incentive to repay her mortgage debt. In contrast, a borrower with a low r can be interpreted as one who deems the house as an investment asset rather than a residential unit. In **Sections 4** and **5** below, we discuss in more detail how this non-contractible surplus from homeownership will influence the default decisions of borrowers.

If the borrower defaults on her debt, the lending bank liquidates the collateralized house (partially) to recover its loss. We assume that the liquidation process cases a loss. One can consider the loss of the transaction and the legal costs incurred when the ownership of the collateral is transferred to the lenders. A liquidation loss can be also incurred by the inefficient allocation of collateral due to a fire sale in the secondary market.⁵ Throughout, we assume that the bank retains λp_1 at most by liquidating the collateral, where $\lambda \in (0,1)$.⁶ Furthermore, we

⁵Because this paper focuses primarily on the strategic interaction between banks (lenders) and households (borrowers) at the institutional level, we abstract from potential issues pertaining to the allocation efficiency levels of collateralized properties at the market level.

⁶This setup is standard in the finance literature, as in Diamond and Dybvig (1983) for the case of bank runs; and Brunnermeier and Pedersen (2008), Malherbe (2014), and Parlour and Plantin (2008) for cases of liquidity shortfalls in the secondary market. One may find that any alternative formulation of the default cost (such as a fixed cost imposed on the lending bank) does not change the main result.

⁴It may be more plausible to assume that banks offer a variety of contractual benefits to prospective borrowers. For instance, some banks may offer to relax the loan-to-value (LTV) constraint on the mortgage in order to attract borrowers who want to use high leverage for investing in real estate (Bester, 1985). However, it may not abstract from reality even if the mortgage rate is the only contractual term of the mortgage. In fact, any contractual terms exist in a replaceable relationship with the mortgage rate. Particularly, although there may be a state of equilibrium in which banks are allowed to offer various mortgage terms, one can also find another equilibrium state with a mortgage contract containing repayment terms only, in which the borrower gains the same utility as they would in any other state of equilibrium with a mortgage with various terms.

assume the following:

(1)
$$p_h + w_h > p_h + w_l > p_l + w_h > p_0 > p_l + w_l$$

Equation (1) can be interpreted as follows. If the borrower realizes capital gains $(p_1 = p_h)$ in t = 1, she does not have to use her non-collateralized income w_1 in order to fulfill her repayment obligation D. Under this assumption, the capital gains from the house price are the primary source of income to repay the mortgage debt. This setting also takes into account the possibility that when the borrower finances her home purchase, she may have to take on the risk of losing all of her income.

We consider two types of mortgage products initially as to whether or not lenders (banks in our model) have recourse against losses from their mortgage business. First, banks can offer a *recourse mortgage contract*, in which the borrower is obliged to fulfill her outstanding debt. Under this type of contract, the borrower's labor income is foreclosed to be used to repay the mortgage debt when the borrower defaults on her debt. In other words, the household's total income is collateralized by the lending bank. Second, banks can offer a *non-recourse mortgage contract* in which the borrower does not need to repay the outstanding debt after defaulting on her mortgage. Under this contract, the borrower can preserve all of her labor income in t = 1 by defaulting on her mortgage.

The game proceeds with the following timeline of actions:

- 1. In t = 0, each competitive bank offers a mortgage contract with repayment term D to the household.
- 2. The household decides whether or not to sign a mortgage contract to finance the home purchase.
- 3. In t = 1, w_1 and p_1 are realized.
- 4. Under a non-recourse mortgage contract, the household decides whether to repay the mortgage or to default on it. Under a recourse mortgage, the household gains the residuals of its total income after repayment of the mortgage.
- 5. In the event of a default, the lending bank takes over and liquidates the collateralized house.

III. The Equilibrium under the Recourse Mortgages

As a benchmark, we initially characterize the state of equilibrium under a recourse mortgage, in which banks have recourse against losses incurred by borrower defaults on mortgage debt. This analysis will facilitate an understanding

of the strategic interaction not only among competing banks but also between lending banks and borrowers.

We analyze how the mortgage repayment terms are determined in equilibrium. In our model, a bank which offers a mortgage contract with the lowest repayment terms will win the competition. Hence, the equilibrium repayment term, denoted as D_R^* , will make zero expected profit. For simplicity of our analysis, we assume the following:

Assumption 1.

(i) $p_0 \leq (\pi + (1 - \pi)y) p_h + (1 - \pi)(1 - y)\lambda p_l$ (ii) $w_l = 0$ (iii) $\lambda \leq \frac{p_0}{p_l} - \pi$

Assumption 1-(ii) is introduced to normalize all sources of the future income in t = 1.

Under Assumption 1, there exists a repayment term $D \in [p_0, p_h]$ which gives zero expected profit to the banks. Given this D, it follows from the equation (1) that the borrower may default on her mortgage debt only given the state of the lowest income which occurs with probability $(1-\pi)(1-y)$. In this state, the bank liquidates the collateralized house to obtain λp_l . In the other states, the lending bank expects to receive the full repayment with probability $\pi + (1-\pi)y$. Therefore, the repayment term D_R^* must be determined by the following indifference condition:

(2)
$$[\pi + (1-\pi)y]D_{R}^{*} + (1-\pi)(1-y)\lambda p_{I} = p_{0}$$

The left-hand side of equation (2) is the expected payoff from lending to the borrower, and the right-hand side is the total amount of money lent to the borrower. From equation (2), the equilibrium repayment term is determined as

(3)
$$D_R^* = \frac{p_0 - (1 - \pi)(1 - y)\lambda p_1}{\pi + (1 - \pi)y}$$

The next proposition presents how equilibrium under the recourse mortgage contract is characterized.

Proposition 1.

Suppose the bank has recourse against losses incurred by the mortgage. In such a case, there exists a unique equilibrium in which every bank offers repayment term D_R^* as determined by equation (3).

Proof.

From Assumption 1, D_R^* determined by equation (3) is the only repayment term by which the bank breaks even. Suppose there exists an equilibrium state in which banks offer $D' \neq D_R^*$. If $D' > D_R^*$, an individual bank has an incentive to offer $D \in (D', D_R^*)$. If $D' < D_R^*$, lending to the borrower is unprofitable by the equation (2), so all banks will not offer such a mortgage contract, a contradiction. Using the same logic, one can also find that it is optimal for each individual bank to offer D_R^* , given all other banks offer the same contract. *Q.E.D.*

One noteworthy feature from **Proposition 1** is that the equilibrium repayment term does not change with the borrower's surplus from retaining homeownership r > 0, as the borrower's labor income is subject to foreclosure under the recourse mortgage contract. In other words, the borrower cannot exercise her default option in order to preserve her labor income.

However, this does not necessarily mean that the borrower is worse off when the mortgage contract does not grant the default option. The foreclosure of future income in a poor state clearly harms the household's welfare. In this regard, the household can set the labor income w_1 apart for future consumption. However, giving recourse to the lender may increase the risk that the borrower is more likely to default on her mortgage debt. Thus, the lack of the default option may lower the default risk and thus the borrower can fund the home purchase more inexpensively. Due to this tradeoff of the default option, a careful examination of the value of the default option under a non-recourse mortgage contract is necessary.

IV. Equilibria under Non-Recourse Mortgages

In this section, we analyze how a borrower strategically exercises the default option under a non-recourse mortgage. By defaulting on her mortgage, the borrower can prevent her non-collateralized income from being foreclosed. However, the borrower must forgo any non-monetary surplus from retaining homeownership. Thus, the equilibrium mortgage repayment terms will be closely related to the borrower's valuation of the default option.

Under a non-recourse mortgage, the benefit r > 0 from fulfilling the repayment obligation will determine the borrower's default decision. Let D_{NR} denote the repayment term under the non-recourse mortgage contract. Given the house price p_1 and the labor income w_1 , the borrower repays her mortgage debt if and only if

(4)
$$p_1 + w_1 + r - D_{NR} \ge w_1 \Longrightarrow p_1 + r \ge D_{NR}$$

If the borrower fully repays her mortgage D_{NR} , she gains net payoff $(p_1 + w_1 - D_{NR}) + r$. If the household defaults on her mortgage debt, the

collateralized house will be foreclosed but she can keep her labor income w_1 away.

Equation (4) reveals the tradeoff of the mortgage debt repayment. If the borrower fully repays the mortgage debt, she will lose her non-collateralized income, which may otherwise have been used for her own consumption. In return, she enjoys the additional utility stemming from securing her place as a residence. If it is too costly for the household to repay D_{NR} , then the household will default on the mortgage debt in order to prevent the labor income from being foreclosed.

Here, we characterize equilibria under a non-recourse mortgage contract. To this end, we assume the following:

Assumption 2. $p_0 \leq \pi p_h + (1-\pi)\lambda p_l$

Under this assumption, there will be no equilibrium in which the repayment term exceeds p_h . Therefore, we can focus on equilibrium where the borrower may (strategically) default on her mortgage debt only if the future price of the house is equal to p_l . Indeed, it appears unrealistic to postulate that the borrower defaults on her mortgage debt even if she earns capital gains from her property.

There are two possibilities leading to the borrower's default decision in equilibrium. First, there may exist a state of equilibrium in which the borrower chooses to default when her income in t = 1 is $p_l + w_h$.⁷ We label this equilibrium as the **HDP** type, which stands for "high default probability." From equation (4), the borrower will default on her mortgage debt if and only if

$$(5) p_l + r < D_{HDP}^*.$$

Because $p_l + w_h > p_i$, the borrower will surely go bankrupt in the state $p_l + w_h = p_i$, which takes place with probability $1 - \pi$. Thus, the equilibrium repayment term D_{HDP}^* must satisfy the following zero-profit condition:

(6)
$$\pi D_{HDP}^* + (1-\pi)\lambda p_1 = p_0$$

The house price goes up to p_h with probability π , in which case the lending bank receives full repayment. In the state $p_1 = p_i$ with probability $1 - \pi$, however, the borrower defaults on her mortgage debt, in which case the lending bank forecloses on the house and liquidates the collateral (partially) to recover its loss.

⁷More precisely, the household's net income in t=1 is the sum of labor income w_1 plus capital gains

 $p_1 - p_0$. However, it is more important in our analysis to focus on $p_1 + w_1$, which is the total amount of income payable to fulfil the mortgage. For convenience of exposition, we throughout the paper abuse the term "income," which refers to the total amount of money which can be used to repay the mortgage.

Because the equilibrium repayment term must allow the lending bank to break even, D_{HDP}^* is determined as

(7)
$$D_{HDP}^{*} = \frac{1}{\pi} (p_0 - (1 - \pi) \lambda p_i).$$

To support the borrower's equilibrium default decision, D_{HDP}^* as determined by equation (7) must satisfy constraint (5), which yields the necessary condition of r > 0:

(8)
$$r < \frac{1}{\pi} \left(p_0 - (1 - \pi) \lambda p_1 \right) - p_1$$

Equation (8) indicates that r > 0 should be sufficiently small. As discussed above, the borrower faces a tradeoff with regard to mortgage repayment. By repaying the mortgage debt, the borrower enjoys the homeownership surplus r > 0. However, if the housing price drops below the total mortgage debt, she may have to spend all or some of w_1 to repay the outstanding debt. If the surplus from retaining homeownership is relatively low, she will strategically decide to default on her mortgage debt.

Next, we consider an alternative type of equilibrium in which the borrower fulfills her mortgage repayment obligation despite the fact that a capital loss occurs in t = 1. We label this equilibrium type as the **LDP** type, where LDP is an acronym for "low default probability." In this equilibrium state, the borrower prefers repaying her mortgage when her income is $p_l + w_h$ in t = 1. From equation (4), we have

$$(9) p_l + r \ge D_{l,DP}^* \,.$$

As in the HDP equilibrium state, the borrower will repay her mortgage debt when her homeownership surplus is greater than the total mortgage repayment. Hence, the borrower defaults on her mortgage debt only if her total income in t = 1is not high enough to fulfill her repayment obligation. Therefore, the repayment term will be determined by the following zero-profit condition:

(10)
$$(\pi + (1 - \pi) y) D_{LDP}^* + (1 - \pi) (1 - y) \lambda p_i = p_0.$$

From equation (10), we have

(11)
$$D_{LDP}^{*} = \frac{1}{\pi + (1 - \pi) y} (p_0 - (1 - \pi) (1 - y) \lambda p_1).$$

Because D_{LDP}^* determined by (11) must satisfy the necessary condition (9), we have the following condition pertaining to r > 0:

(12)
$$r \ge \frac{1}{\pi + (1 - \pi)y} (p_0 - (1 - \pi)(1 - y)\lambda p_1) - p_1$$

If the surplus from homeownership is high, the borrower does not have an incentive strategically to default on her mortgage debt. Thus, equation (12) means that LDP equilibrium can exist only if the borrower's homeownership surplus is sufficiently high.

From equations (5)-(12), we can characterize HDR and LDR equilibria as follows:

Proposition 2.

Under a non-recourse mortgage contract, there exist \overline{r}^* such that HDP equilibrium arises from $r \leq \overline{r}^*$ and LDP equilibrium arises from $r \geq \overline{r}^*$.⁸

Proof.

First, we establish some of the technical results used in the proof. Define $r_{LDP}^* \coloneqq \frac{1}{\pi + (1 - \pi)y} (p_0 - (1 - \pi)(1 - y)\lambda p_i) - p_i \text{ and } r_{LDP}^* \coloneqq \frac{1}{\pi} (p_0 - (1 - \pi)\lambda p_i) - p_i.$

One can easily show that $r_{LDP}^* < r_{HDP}^*$.

Next, let $U_{HDP} := \pi p_h + (1 - \pi) y p_l + y w_h + \pi r - (p_0 - (1 - \pi) \lambda p_l)$ denote the borrower's expected payoff under a non-recourse mortgage with repayment term D_{HDP}^* , and $U_{LDP} := \pi p_h + (1 - \pi) y p_l + y w_h + (\pi + (1 - \pi) y) r - (p_0 - (1 - \pi)(1 - y) \lambda p_l)$ denote the borrower's expected payoff under a non-recourse mortgage with D_{LDP}^* . One can then find that there exists $r_l^* := \lambda p_l$ such that $U_{LDP} - U_{HDP} > 0$ if and only if $r > r_l^*$, Note from **Assumption 1**-(iii) that $r_l^* \le r_{HDP}^*$.

We will initially show that only HDP equilibrium can exist for every $r < \max\{r_{LDP}^*, r_I^*\}$. Suppose to the contrary that LDP equilibrium exist for some $r < r_{LDP}^*$. Because banks compete *a la* Bertrand, the equilibrium repayment term must be D_{LDP}^* . However, we have $D_{LDP}^* > p_I + r$ according to (12), a contradiction. Next, suppose $r_{LDP}^* < r_I^*$ and that LDP equilibrium exists for some $r \in [r_{LDP}^*, r_I^*)$. From the definition of r_I^* , a bank can profitably deviate by offering $D' = D_{HDP}^* + \varepsilon$ for a small case of $\varepsilon > 0$ such that the borrowers' expected payoff

⁸The author is highly indebted to one of the anonymous referees, who pointed out an error in the proof of **Proposition 2** in a previous version of this paper. The author also acknowledges that the same error was found in the baseline paper written by Rhee (forthcoming).

from buying the mortgage at D' is strictly greater than U_{LDP} , a contradiction.

Next, we show that HDP equilibrium cannot exist for every $r > \max\{r_{LDP}^*, r_I^*\}$. Proceeding similarly to the previous argument, suppose to the contrary that HDP equilibrium exists for some $r > \max\{r_{LDP}^*, r_I^*\}$. In such a case, a bank can profitably deviate by offering mortgage rate $D' = D_{LDP}^* + \varepsilon$ for a sufficiently small $\varepsilon \in (0, p_i + r - D_{LDP}^*)$ such that the borrower's expected payoff from buying the mortgage at D' is strictly greater than U_{HDP} , a contradiction.

Next, we prove that HDP equilibrium exists for all $r \le \max\{r_{LDP}^*, r_l^*\}$. To this end, first we show that it is optimal for the borrower to use the prescribed equilibrium strategies in each state, given repayment term D_{HDP}^* . Because any $r \le r_{HDP}^*$ satisfies equation (8), D_{HDP}^* also satisfies the equation (5) for all $r \leq \max\left\{r_{LDP}^*, r_{L}^*\right\}$. Thus, it is optimal for the borrower to default on her mortgage if $p_1 + w_1 = p_1 + w_h$. If $p_1 + w_1 = p_1$, the borrower cannot repay D_{HDP}^* and thus goes bankrupt. If $p_1 + w_1 > p_1 + w_2 \ge D_{HDP}^*$, the borrower then prefers to repay her mortgage. We show next that it is optimal for banks to offer D_{HDP}^* . If a bank offers repayment term $D > D_{HDP}^*$, the borrower will not buy the mortgage. If a bank offers repayment term $D \in (p_1 + r, D_{HDP}^*)$, the borrower will sell the mortgage but such a deal will generate a loss according to equation (8). Suppose a bank offers repayment term $D \in \left[D_{LDP}^*, p_l + r\right]$. If $r \le r_{LDP}^*$, such an offer will generate a loss for the bank according to equation (12). If $r \le r_l^*$, the borrower will not buy the mortgage under this repayment term because the borrower's expected payoff with D is weakly lower than U_{LDP} but $U_{LDP} - U_{HDP} < 0$. Lastly, a bank will realize a loss by offering $D < D_{LDP}^*$.

Lastly, we prove that LDP equilibrium exists for all $r \ge \max\{r_{LDP}^*, r_l^*\}$. Proceeding in a manner similar to the previous argument, one can show that it is optimal for the borrower to utilize the prescribed equilibrium strategies in each state given repayment term D_{LDP}^* . Next, we show that it is optimal for banks to offer D_{LDP}^* . If a bank deviates and offers $D' < D_{LDP}^*$, it can attract the borrower but will make a loss by the equation (12). If a bank offers $D \in (D_{LDP}^*, p_l + r]$, it cannot sell the mortgage to the borrower. If a bank offers $D' > p_l + r$ and the borrower buys the mortgage under this repayment term, the borrower's expected payoff will be weakly less than U_{HDP} . Because $U_{HDP} - U_{LDP} \le 0$ for all $r \ge \max\{r_{LDP}^*, r_l^*\}$, the borrower will not buy the mortgage from the deviating bank, i.e., *Q.E.D.* During the equilibrium characterization step, how the borrower values the default option attached to a non-recourse mortgage is crucial.⁹ Suppose the borrower enjoys a high level of homeownership surplus $(r \ge \overline{r}^*)$. In this case, forgoing this surplus severely harms the borrower's expected gains from mortgage financing. Thus, the borrower is willing to fulfill her mortgage repayment obligation even if it requires her to use her non-collateralized income. Because the default risk remains unchanged compared to that in a recourse mortgage, the bank does not charge a high mortgage rate to the borrower compared to the case of a recourse mortgage.

Next, suppose the borrower's homeownership surplus is relatively low $(r \le \overline{r}^*)$. In this case, the borrower deems the housing property to be a financial asset rather than a residence. If the housing price is lower than the mortgage debt, the borrower will exercise the default option because the opportunity cost of default is not high. Due to the increased default risk, the bank will charge a high mortgage rate to the borrower. With a high repayment term, the borrower becomes even less willing to use non-collateralized income to repay the mortgage. However, the Bertrand competition among banks keeps the mortgage rate in the state of HDP equilibrium not overly high. Hence, the borrower chooses the mortgage contract with D_{HDP}^* as opposed to other mortgage contracts with repayment terms lower than D_{HDP}^* .

The equilibrium characterization in **Proposition 2** also provides a hint pertaining to how the transition to a non-recourse mortgage affects the borrower's gains from a mortgage. As presented in the following observation, a non-recourse mortgage indeed makes the borrower who buys housing property for speculative purposes better off.

Proposition 3.

There exists $\bar{r}^* \leq \bar{r}^*$ such that the borrower's expected payoff is higher under a non-recourse mortgage than under a recourse mortgage if $r < \bar{r}^*$, the borrower's expected payoff under a non-recourse mortgage is strictly lower than otherwise if $r \in [\bar{r}^*, \bar{r}^*)$, while the borrower's expected payoff does not change with alternative types of mortgage products if $r > \bar{r}^*$.

Proof.

Recall
$$r_{LDP}^* := \frac{1}{\pi + (1 - \pi)y} (p_0 - (1 - \pi)(1 - y)\lambda p_1) - p_1$$
 and $r_I^* := \lambda p_1$ from the

proof of **Proposition 2.** Let

$$U_{R} := \pi p_{h} + (1 - \pi) y p_{l} + y w_{h} + (\pi + (1 - \pi) y) r - (p_{0} - (1 - \pi) (1 - y) \lambda p_{l})$$

denote the borrower's expected surplus under a recourse mortgage. According to

⁹This result is consistent with Albanesi *et al.* (2017), which documents that borrowers' residential levels of demand for housing properties are an important factor in determinations of default probabilities.

equation (3), one can easily find that $U_R = U_{LDP}$,¹⁰ where U_{LDP} is the expected surplus with repayment term D_{LDP}^* under a non-recourse mortgage.

There are two possibilities, either $r_{LDP}^* \leq r_I^*$ or $r_I < r_{LDP}^*$. Consider $r_{LDP}^* \leq r_I^*$ first. From the proof of **Proposition 2**, HDP equilibrium arises under a nonrecourse mortgage if and only if $r \leq \overline{r}^* = r_I^*$. According to the definition of r_I^* , we have $U_R - U_{HDP} = U_{LDP} - U_{HDP} > 0$ if and only if $r < r_I^* = \overline{r}^* = \overline{r}^*$. Furthermore, $U_R - U_{LDP} = U_{LDP} - U_{LDP} = 0$ for all $r \geq \overline{r}^*$, where the inequality is strict if and only if $r \in (\overline{r}^*, \overline{r}^*)$. *Q.E.D.*

The key contribution of the non-recourse mortgage to the borrower's gains from mortgage financing is the default option. The value of the default option varies with the borrower's surplus from retaining homeownership. When the housing price falls below the repayment term *ex post*, the cost of defaulting is $r \ge 0$, the borrower's surplus from homeownership. The benefit of defaulting is the retention of non-collateralized income. Thus, it is straightforward to consider that the ex-post net benefit of the default option is a decrease in r. However, the increased probability of default leads to a high borrowing cost *ex ante*. If r is relatively low $(r < \tilde{r}^*)$, the benefit of the default option outweighs its total cost, indicating that a transition to a non-recourse mortgage improves the borrower's gains from mortgage financing. If r is relatively high $(r \ge \tilde{r}^*)$, the non-recourse mortgage leads to an increase in the borrowing cost, which makes the borrower worse off.¹¹

Proposition 3 features a noteworthy policy implication: the introduction of a non-recourse mortgage may not always make households better off. Particularly, a non-recourse mortgage mainly benefits "speculative" homebuyers who use leverage with their investments in housing properties (i.e. those with low values of r's). In contrast, households buying houses for residential purposes (i.e., those with high values of r) will take residual income into account after debt repayment as compared to post-default income. Therefore, these homebuyers prefer relatively low mortgage rates to the default option. From this perspective, the policymakers should carefully examine the characteristics of the beneficiaries of non-recourse mortgage products.

We conclude this section by comparing the social welfare between the two different types of mortgage products. Because banks gain zero expected profit

¹⁰The result $U_R = U_{LDP}$ does not change even if we relax the assumption of and allow $w_l = 0$. Under a recourse mortgage, the borrower will lose her labor income w_l in the worst state of $p_1 + w_1 = p_l + w_l$, but enjoys a lower repayment term $D_R^* < D_{LDP}^*$ compared to that in a non-recourse mortgage. One can algebraically find that this tradeoff is precisely cancelled out.

In this setup, the main result remains unchanged, although the value of the threshold \breve{r}^* increases compared to that in the baseline model.

¹¹This result will not be substantially altered even if we assume that the borrower is risk averse. To understand this easily, one can augment our model with an extra reduced-form variable added to the borrower's state-dependent payoff, which is zero if the net income after repaying the mortgage is large and positive otherwise.

under either of the two mortgage products, the social welfare is calculated as the borrower's expected payoff minus the expected liquidation cost of the collateral $(1-\lambda) p_1$.

Proposition 4.

There exists $\hat{r}^* \leq \check{r}^*$ such that non-recourse mortgages yield (weakly) higher welfare than recourse mortgages for all $r < \hat{r}^*$, but yields (weakly) lower welfare otherwise.

Proof.

Because LDP equilibrium arises from any $r \ge \overline{r}^*$, both recourse mortgages and non-recourse mortgages yield the same amount of welfare. Consider $r < \hat{r}^*$ for which HDP equilibrium uniquely exists under a non-recourse mortgage. The net non-recourse borrower's surplus from the mortgage is $U_{HDP} - U_R = U_{HDP} - U_{LDP} = (1 - \pi) y (\lambda p_l - r)$. Given that the borrower defaults on the mortgage debt in the state $p_1 + w_1 = p_1 + w_h$ with a non-recourse mortgage, shifting to a non-recourse mortgage adds an expected cost of default $(1-\pi)y(1-\lambda)p_{i}$ to the welfare amount; thus, the net welfare of the non-recourse mortgage is $(1-\pi) y (\lambda p_{1} - r) - (1-\pi) y (1-\lambda) p_{1} = (1-\pi) y ((2\lambda - 1) p_{1} - r)$. Therefore, there exists $\hat{r}^* := \min\{\overline{r}^*, \max\{(2\lambda - 1)p_{i,0}\}\}$ such that a non-recourse mortgage yields higher welfare than a recourse mortgage. $\hat{r}^* \leq \tilde{r}^*$ is immediate from $(2\lambda - 1) < \lambda \cdot Q.E.D.$

The default option granted to the borrower yields a potential welfare loss from the costly liquidation process. Thus, a non-recourse mortgage can improve the total welfare only if the borrower's value of the default option is sufficiently high. This can occur if and only if the opportunity cost of default - $r \ge 0$ in our model – is sufficiently low ($r < \hat{r}^*$). In contrast, such a welfare improvement effect no longer exists once the cost of default is relatively high ($r \in [\hat{r}^*, \check{r}^*]$). Therefore, as argued similarly in **Proposition 3**, it is important to investigate whether or not prospective users of non-recourse mortgages want to buy houses either as an investment or as a residence.¹²

V. Optimal Mortgage Design under Informational Asymmetry

Thus far, we have assumed that the borrower's surplus from retaining homeownership is publicly known to the lender. In reality, however, households subjectively define the value of retaining their homeownership. Moreover, banks

¹²Similar to **Proposition 3**, the welfare comparison result in Proposition 4 will not be significantly altered even if we assume that the borrower is risk averse regarding her future consumption.

cannot precisely verify whether prospective borrowers want to buy housing properties for speculative purposes or for residential purposes. Hence, the main result in **Section 4** may not have relevance.

To add reliability, we augment our model by introducing informational asymmetry to the household's surplus from homeownership r > 0. Specifically, we assume that nature draws $r \in \{r_l, r_h\}$ such that $0 < r_l < r_h < \infty$ with probability $\Pr(r = r_h) = q \in (0,1)$ before the game begins. The borrower privately knows the true value of r. For convenience of exposition, we throughout refer to $r \in \{r_l, r_h\}$ as the borrower's "type." To restrict our attention to the cases of interest, we assume the following:

Assumption 3. $r_l < \overline{r}^* \leq r_h$

The main question is whether there exists a mechanism which addresses the adverse selection problem potentially faced by a type- r_h borrower. As argued previously, the borrower with type r_h is more willing to repay her mortgage debt than the other type. At a glance, one may conjecture that the type- r_l borrower has an incentive to mimic type r_h for more favorable borrowing terms. If a borrower of type r_h is lumped together with those of type r_l , her borrowing terms will be worsened to an extent that she may default in states she would not given complete information. The following proposition holds that the adverse selection problem of the mortgage market can be fully eliminated under a non-recourse mortgage only if r_l is relatively high.

Proposition 5.

- (i) If $r_l \ge D_{LDP}^* p_l$, there exists a separating equilibrium by which a borrower of type r_l borrows with repayment term D_{HDP}^* and a borrower of type r_h borrows with repayment term D_{LDP}^* under a non-recourse mortgage.
- (ii) If $r_l < D_{LDP}^* p_l$, there exists no separating equilibrium under a non-recourse mortgage.

Proof.

To prove part (i), recall from the proof of **Proposition 2** that the borrower will gain U_{HDP} if she reports her type as r_l and U_{LDP} if she reports her type as r_h . Recall also that $U_{HDP} - U_{LDP} > 0$ if $r = r_l$ and $U_{HDP} - U_{LDP} < 0$ if $r = r_h$.

First, we show that it is optimal for each type of borrower to utilize the prescribed equilibrium strategies. Consider a borrower of type r_l first. Because $U_{HDP} - U_{LDP} > 0$, type r_l has no incentive to misreport her type as r_h . Likewise, a borrower of type r_h cannot gain a higher payoff from mimicking type r_l as

 $U_{HDP} - U_{LDP} < 0 \quad \text{if} \quad r = r_h \,.$

We now show that banks have no incentive to deviate from the prescribed equilibrium offer strategies. Because both D_{HDP}^* and D_{LDP}^* yield zero expected profit in equilibrium, banks offering either D_{HDP}^* or D_{LDP}^* have no incentive to make the other offer. If a bank deviates and offers $D' > D_{HDP}^*$, then no borrower will buy the mortgage from this bank. Moreover, any offer $D' < D_{LDP}^*$ leads to a loss to banks regardless of whether such an offer attracts type r_l , type r_h , or both. Suppose a bank offers $D' \in (D_{LDP}^*, p_l + r]$. If type r_h buys the mortgage from this bank, her total payoff will be strictly less than U_{LDP} . If type r_l buys the mortgage from this bank, her payoff is then strictly less than U_{LDP} . Because $U_{HDP} > U_{LDP}$ for $r = r_l$, type r_l will not buy the mortgage from the deviating bank. Lastly, suppose a bank offers $D' > p_l + r$. Proceeding similarly as in the previous argument, one can find that no type will buy the mortgage under such repayment terms.

We next prove part (ii). Suppose there is a separating equilibrium under a nonrecourse mortgage. A borrower of type r_l can then gain a strictly large payoff by being untruthful regarding her type, i.e., reporting it as $r = r_h$, and defaulting on her repayment in the state of $p_1 + w_1 = p_l + w_h$, a contradiction. Q.E.D.

Suppose r_i is relatively high to an extent that she will not exercise her default option with the low repayment term D_{LDP}^* . For a type- r_l borrower, the default option is valuable compared to the lower mortgage rate $(D_{IDP}^* < D_{HDP}^*)$ such that she can enjoy by lying about her type to the banks. In other words, the repayment term D_{LDP}^{*} offered to type $r = r_h$ in equilibrium is not favorably low enough for the type- r_i borrower to mimic the other type. In contrast, the type- r_h borrower finds exercising the default option too costly due to the high value of her homeownership surplus. Hence, type- r_h prefers a contract with the lowest repayment term $(D = D_{LDP}^{*})$, which is offered when the type- r_h borrower truthfully reports her own type. On the other hand, such a separating equilibrium cannot be supported if r_l is too low; a borrower of type r_l will realize high gains by misreporting her type for the favorable mortgage rate D_{LDP}^{*} and exercising the default option in the state $p_1 + w_1 = p_1 + w_h$. In order to ensure truth-telling to be a compatible incentive for type r_i , a non-recourse mortgage with repayment term D_{IDP}^{*} in the menu of mortgage contracts should be replaced by a recourse mortgage product with the same repayment term.

One interesting feature is that information rent is not given to any type of borrower in the separating equilibrium stated in **Proposition 5**. However, it remains an open question as to whether we have the same result when the mortgage market is not as competitive, as in our model. In fact, the bank's increased market power is likely to decrease the borrower's expected gains from using mortgage services in a non-linear fashion. Hence, how the level of information rent given to certain types of borrower changes with the degree of competition among banks in the mortgage market deserves a thorough analysis.

We can derive a policy implication from **Proposition 5**: setting a limit on the interest rate of non-recourse mortgage products may not improve a (non-speculative) borrower's gains. When introducing non-recourse mortgage instruments into the market, policymakers are plausibly concerned that high mortgage rates due to the increased default risk may worsen households' debt problems. In order to protect households from hefty repayment duties, policymakers may regulate banks by ordering them not to charge high interest rates to borrowers using non-recourse mortgage products.¹³ However, such a measure may prevent households with high levels of residential demand from distinguishing themselves from speculative borrowers, exacerbating the adverse selection problem. For the same reason, prohibiting the sales of traditional recourse mortgage products may worsen the adverse selection problem in the mortgage market.

VI. Conclusion

This paper presents a simple reduced-form model to analyze how the provision of a default option to borrowers influences the level of default risk in the mortgage business. By defaulting on their debts under non-recourse mortgages, borrowers can prevent their non-collateralized income from being foreclosed upon. However, the default option is not always better for borrowers because lenders can raise mortgage rates.

We show that the equilibrium default probability under a non-recourse mortgage decreases as households enjoy a high surplus from retaining their purchased properties. We also find that a non-recourse mortgage can improve a borrower's overall gains from mortgage financing (and their total welfare) if and only if the default option presents a sufficiently high value to borrowers. Lastly, we modify our model so that it contains the adverse selection problem in which the borrower's surplus from homeownership is private information. We find that there exists a menu of non-recourse mortgage contracts that implements a separating equilibrium state without the payment of information rent to any type of borrower.

One avenue for future research is to analyze how each alternative type of the equilibria arises over the long run under aggregate levels of uncertainty. For

¹³For instance, the Financial Supervision Committee (FSC) recently announced that the non-recourse type of Bogeumjari mortgage products as provided by the Korea Housing-Finance Corporation (HF) will charge interest rates identical to those of recourse mortgage products. For more details, see the new article (in Korean) posted at the following website: http://www.fnnews.com/news/201701151722011785

instance, it is possible for certain changes in the probability distribution of future housing prices to lead to extraneous uncertainty via a self-fulfilling prophecy (Azariadis, 1981), which then causes a state of equilibrium with a high default probability to arise frequently over time even if borrowers' surplus amounts from homeownership are relatively high. An investigation of the mechanism of such self-fulfillment in a long-run model will have important policy implications regarding how to stabilize the mortgage market.

Another interesting topic would be to study whether households' saving decisions are influenced by the types of mortgage contracts. Suppose that a household expects to finance their home purchase in the future via a traditional recourse mortgage contract. Because the default risk of a recourse mortgage is small, the household anticipates a low cost of buying the house and thus will not save a large portion of their current income for the home purchase. Furthermore, the household's savings will be foreclosed upon in the event of a default, which implies the savings cannot serve as a buffer against negative income shocks. Therefore, one may conjecture that a household may save less under a recourse mortgage types and households' consumption behaviors using a general equilibrium approach is an interesting area for future research.

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Relative Effectiveness of Various Development Finance Flows: A Comparative Study

By KYE WOO LEE AND MINJI HONG*

This paper aims to identify the most effective mode of development finance flows for the economic growth of middle-income developing and least developed countries, separately. It also attempts to confirm whether governance has any significant role in the causal relationship between development finance flows and economic growth. Policymakers in each developing country should select the most effective modality of development finance inflows among the different modalities (such as Official Development Assistance (ODA) grants, Official Development Assistance (ODA) loans, FDI, and international personal remittances) and expand it for their economic growth. Dynamic panel regression models were used on 48 least developed countries and 89 middle-income developing countries, respectively, during the Millennium Development Era: 2000-2015. The empirical analysis results show that ODA grants and remittances were most effective in promoting economic growth for least developed countries, while FDI was most effective for middle-income developing countries. These findings were not affected by the status of governance of the individual country.

Key Word: ODA Grants, ODA Loans, FDI, Remittances, Economic Growth, Least Developed Countries, Effectiveness, Middle-income Developing Countries JEL Code: C36, F24, G15, O11, P45

I. Introduction

This paper aims to identify the most effective mode of development finance flows for the economic growth of middle-income developing and least developed countries, separately. Policymakers in developing countries should select the most effective modality of development finance flows and expand it for the economic growth of developing countries.

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Mainstream development economists have emphasized that growth cannot take place in the absence of capital. In the absence of technical progress, output growth is limited by the rates of capital formation and population growth. In relatively labor-abundant developing countries, this implies that capital shortages constrain growth given that national income is lower; therefore, savings and investment rates are lower. Naturally, many development economists have advised policymakers in developing countries to attract foreign savings or development finance flows from advanced countries. This helps to resolve another critical constraint on development, i.e., foreign exchange shortages.

However, selecting the most effective mode of development finance flows has proved challenging for developing countries. FDI (foreign direct investment) has been criticized for having negative social side effects and for its concentration on rapidly growing emerging economies; concessional and non-concessional loans have been criticized for their debt accumulation effects, while ODA (official development assistance) grants have been criticized for their tendency to induce corruption and their fungibility with regard to domestic resources; and international remittances have been limited by advanced countries' regulations on immigration and remittances. (The category known as Other Official Flows (OOF) is not explicitly dealt with in this study owing to its relatively small size and nondevelopment assistance characteristics.)

Moreover, concerns have been expressed over the adequacy of development finance flows. On the supply side, private capital flows towards developing countries experienced an abrupt decline in the middle of 2008. After a short recovery, net private capital flows to developing countries still exhibit a downward trend (IMF: World Economic Outlook 2016). On the demand side, the financial resources required to implement the SDGs (sustainable development goals) for the period ending 2030 are so enormous and amorphous that a reasonable estimate of the demand has not yet been agreed upon (Martin and Walker, 2015). Policymakers of developing countries will not only have to prioritize their investment priorities but also must take a strategic approach in accessing different types of development finance flows.

The need to assess the relative effectiveness of the different types of development finance flows is also accentuated by the converging trend of the different types of development finance inflows selected by developing countries in recent years, although the relative sizes of those finance flows have varied in the past (Figures 1 and 2). Since 2004, capital inflows to developing countries have been largely dominated by FDI. However, recently all four types of development finance which have flowed into developing countries (FDI, remittances, private debt and portfolio and ODA flows) have shown a tendency to converge (Figure 1). Since 2002, the number of developing countries, which favored a certain type of foreign capital flows most, has been tending toward four types of capital inflows (Figure 2). This tendency naturally raises the question of whether developing countries find that all four types of development finance flows are equally conducive to their economic growth and thus find themselves indifferent to their roles in economic growth.

The process and stage of development and industrialization of an economy do matter when establishing the relative priorities of foreign capital inflows for



FIGURE 1. TYPES OF FINANCIAL FLOWS TO DEVELOPING COUNTRIES (1990-2019)

Source: World Bank Group (2017).



FOR EACH YEAR (1990-2011)

Source: Mulakala (2017).

accelerating economic growth in developing countries. When writing this paper, we deemed it necessary to investigate at least two groups of countries at different development stages, i.e. middle-income developing and least developed countries, and examine which mode of foreign capital inflows has the most favorable effect on growth for each group.

Furthermore, the existing empirical literature is ambiguous as to whether foreign aid or ODA promotes economic growth in recipient countries, and it provides widely divergent estimates of the cross-country relationship between foreign aid inflows and economic growth rates. However, earlier studies have one common characteristic: they all examined the impact of aggregate aid on growth. Not all aid, however, affects growth similarly, and types may vary depending on the motives, purposes, donors, and characteristics of the aid (Akramov, 2012). Therefore, an increasingly popular direction in the literature is to examine the impact of disaggregated aid on developmental outcomes (Clemens *et al.*, 2004; Dreher, Nunnenkamp and Thiele, 2008; Mishra and Newhouse, 2009; Birchler and Michaelowa, 2016). Thus, this study builds on the recent attempts to investigate whether different types of aid (i.e., grants and loans) influence the effectiveness of the aid in promoting economic growth.

Moreover, in the literature pertaining to the effectiveness of aid, one of the most controversial findings was that "good policy and/or an institutional environment" will determine the effectiveness of aid on economic growth. Aid has a statistically significant positive effect on economic growth, mainly in aid-recipient countries with good policies and institutional environments, but it is limited in those with poor policies and poor institutional environments (Burnside and Dollar, 2000; Collier and Dollar, 2002). Similar findings were also reported with respect to the effectiveness of FDI and international remittances. Therefore, when comparing the effectiveness of different types of development finance flows into developing countries, it is important to control for the effect of the quality of policies and institutions.

Specifically, the research questions of this study are as follows:

- Which type of external capital inflow has the most significant impact on the economic growth of middle-income developing countries and least developed countries, separately?
- How important is the governance of middle-income developing countries and least developed countries for foreign capital inflows to have positive effects on economic growth?

Based on the limited availability of private capital inflows for least developed countries and their low level of economic and political governance and capacity relative to those of middle-income developing countries, we presume that ODA will more likely have a greater impact on economic growth for least developed countries. In contrast, for middle-income developing countries, which are equipped with relatively better economic and political institutions and infrastructures for investment compared to those of least developed countries, private capital inflows such as FDI will have a more significant impact on economic growth.

In carrying out empirical tests on the research questions presented above, dynamic panel regression models were used on 48 least developed countries (with 2015 per capita GDP<\$1,025, following the World Bank classification) and 89 middle-income developing countries (per capita GDP: \$1,026 - \$12,475) during the Millennium Development Era, i.e., from 2000 to 2015. All data were collected from the World Bank Development Indicators of the World Bank.

This study is structured as follows. The following section reviews the literature on the topic. Section 3 provides a detailed description of the methodology and data used in this study. Section 4 analyzes the empirical results, and section 5 summarizes the key findings and derives policy implications with suggestions for future research.

II. Literature Review

We will review the existing literature on the effectiveness of foreign capital

inflows for economic growth in developing countries. Initially we review the literature on the effectiveness of official development assistance (ODA), after which we examine the scholarship on the effectiveness of private capital inflows.

A. Effectiveness of ODA

The overall body of literature can be divided into four groups. The first holds that aid is ineffective in almost all cases. Second, aid is, on average, effective only with decreasing returns. Third, aid is ineffective in general but effective when the economic management policies and/or political and economic institutions of the aid-recipient countries are good. Lastly, different components of aid show disparate degrees of effectiveness.

1. Aid is ineffective

These studies represent the conventional views expressed by Bauer (1976); Friedman (1995); Boone (1996); Easterly, Levine, and Roadman (2004); and Rajan and Subramanian (2008). Their results show no significant positive or negative relationship. Furthermore, some in this group even argue that aid is potentially counterproductive as it helps expand bureaucratic organizations or helps make them inefficient; enriches the elite class or special interest groups; sustains corrupt regimes, causing Dutch disease in aid-receiving countries; reduces farmers' incomes by lowering the prices of agricultural products; promotes the interests of donor governments, their enterprises, or interest groups; and encourages any positive effects to disappear into unproductive government consumption, adversely affecting legal and economic institutions (Remmer, 2004; Rajan and Subramanian, 2005; 2007; Heckelman and Knack, 2008).

2. Aid is effective on average

The research results of the economists belonging to this group show that although aid does not have the same effects everywhere and that it does have, on average, a positive impact on growth. According to this group, aid does stimulate investment or enhance long-term productivity when foreign aid is modeled as an exogenous transfer of income or capital to recipient countries, and foreign aid has only decreasing returns. Therefore, as the amount of aid increases, the effects of the aid on growth would rise at a decreasing rate. Many IMF economists have argued along these lines since the 1990s (Cassen, 1994; Dalgaard, Hansen, and Tarp 2004; Arndt, Jones, and Tarp, 2010).

3. Aid is conditionally effective

This group includes research results that show that aid has been effective in promoting growth only when aid recipients meet certain conditions. Such conditions

have been advanced mostly by World Bank economists either as good political institutions, i.e. democracy or civil liberty (Isham, Kaufmann, and Pritchett, 1995; Kosack, 2003) or good economic institutions and policies (World Bank, 1998; Burnside and Dollar, 2000; Collier and Dollar, 2002).

4. Disaggregated aid has disparate degrees of effectiveness

One of the increasingly popular directions in the literature is to examine the impact of disaggregated aid on development outcomes (Akramov, 2012). Official development assistance (ODA) is largely divided into grants and loans depending on whether repayment of the loan is required or not. Lerrick and Meltzer (2002) claimed that grants are preferable to loans in making aid programs effective and preventing the accumulation of unpayable debt. Cordella and Ulku (2007) also find that grants prove effective only in highly indebted poor countries with bad policies, as grants imply fewer repayment obligations, though there are also fewer resources available for donors to provide to recipients. A study by Clemens et al. (2004), disaggregating aid by sector, finds that only "direct aid," which is used for building infrastructure (e.g., roads, irrigation, power, ports) and for enhancing productive sectors such as agriculture and industry, stimulates economic activities over a fouryear period ("short-impact aid," about 53% of all ODA flows recently) and that it has strong positive and causal effects on economic growth, albeit showing diminishing returns. "Indirect aid" for the human resource development (i.e., education and health), governance, and environmental sectors contributes to economic growth only over longer periods. Mishra and Newhouse (2009) reveal a small but statistically significant effect of health aid on infant mortality. Similarly, Dreher, Nunnenkamp, and Thiele (2008) find that a higher level of per capita aid for education has a statistically significant positive impact on primary school enrollment rates; recently Birchler and Michaelowa (2016) present a similar finding. Furthermore, Lee and Lee (2014) show that different types of aid (grants vs. loans) result in different public finance management responses from recipient governments, and Rugare and Lee (2016) demonstrate that different delivery modes of aid (project aid vs. program aid) lead to disparate effects on the percapita income growth of aid recipient countries in Sub-Saharan Africa.

The fundamental proposition of this disaggregated aid effectiveness approach is that different aid components may have different transmission channels with regard to their impact on economic growth. Moreover, ODA plays an instrumental role in development financing, particularly in countries with a limited capacity to attract private direct investment (United Nations, 2002). Most if not all of these countries are in the group of least developed countries, highly devoid of features that would attract foreign private investment. Thus, for least developed countries, the relatively steady and easily available external finance source of ODA can play a pivotal role in building necessary infrastructure, which may then help attract foreign private resources for further investment. In contrast, middle-income developing countries, especially emerging development countries, can be relatively more capable of repaying loans and have easier access to loans, foreign direct investment, and international remittances. A serious problem with many of these studies as reviewed above is that they concentrated on a single group of developing countries with a similar per-capita income level. In this study, therefore, we will examine whether countries at different stages of development show disparate impacts of foreign capital inflows, specifically both middle-income developing countries and least developed countries.

Consequently, in this study, we will disaggregate total aid into grants and loans and will analyze their impacts on the economic growth of developing countries at different stages of development (middle-income developing countries vs. least developed countries). This leads to our first hypothesis:

H1: For least developed countries, of all foreign capital inflows, official grants have the most significant positive impact on economic growth.

B. Effectiveness of Private Capital Inflows

Private capital generally consists of foreign direct investment (FDI), portfolio investments, and international remittances. However, under the judgment that portfolio investment constitutes a scant proportion of total developmental capital inflows for least developed countries, while remittances are perceived as significant private earnings for many households, we take into account remittances but exclude portfolio investments in this study.

1. Effectiveness of FDI

FDI, a type of investment made by a company based in one country in a company based in other developing countries in this study, has shown mixed effects in the literature. Findlay (1978) asserted that FDI increased the rate of technical progress in the host country through a "contagion effect" emanating from the advanced technology and management practices used by foreign firms. Further evidence of the effect of FDI on economic growth in Latin America was provided by De Gregorio (1992), who stated that the increased growth from FDI was three times greater than that by domestic investment.

Other scholars challenged the positive effect of FDI, arguing that FDI crowds out domestic investment (Fry, 1993) and has limited or no effects on industrial growth in developing countries (Singh, 1988). Mencinger (2003) highlighted the adverse effect of FDI in developing countries, where it can force small emerging local competitors out of business, with multinationals paradoxically contributing more to imports than exports.

Still others showed that FDI proved effective only under certain circumstances. The effectiveness of FDI prevails when the host country has a minimum threshold stock of human capital (Borensztein, 1995). Borensztein *et al.* (1998) investigated the effect of FDI on the economic growth of developing countries using panel data over two decades, concluding that human capital development is crucial for a country to benefit from FDI inflows. Blomstrom and Kokko (2001) demonstrated that FDI is not effective for lower income developing countries, as they lack the

technological level and capacity to imitate foreign invested firms, and their poor business environments may lead to insignificant or even detrimental outcomes (Bruno and Campos, 2011).

Considering the dependent feature of FDI on the economic condition of recipient countries, the high political instability and poor infrastructures in least developed countries, and clearly the limited amount of FDI, we presume that FDI is ineffective in promoting economic growth in least developed countries.

This leads to our second hypothesis:

H2: Foreign direct investment has a significant positive impact on the economic growth of middle-income countries but not on least developed countries.

2. Effectiveness of Remittances

Regarding the effectiveness of international personal remittances transferred by migrant workers to their countries of origin, Giuliano and Ruiz-Arranz (2009) hold an optimistic view, corroborating it with an empirical analysis showing that remittances promote growth in countries with underdeveloped financial systems by offering an alternative means to finance investment and ease liquidity constraints. Gupta, Pattillo, and Wagh (2009) suggest that remittances have a direct impact on reducing poverty and promoting financial development. Their bottom line statement is that remittances offer unbanked small-saver households the opportunity to access the formal financial sector.

However, Chami, Fullenkamp, and Jahjah (2003), taking an opposing stance, developed a unified model to examine the causes and effects of remittances on an economy. They concluded that a moral hazard problem that arises between remitters and recipients, under asymmetric information and a lack of observability of the recipients' actions, had a negative impact on economic growth. Their explanation is that recipients' dependency on remittances will reduce the supply of labor.

3. Contributions to the Literature

On balance, previous studies focused narrowly on the impact of a single type of capital inflow on the economy, and they paid insufficient attention to least developed countries. A comparative study by Benmamoun and Lehnert (2013), who examined the effects of FDI, ODA, and international remittances, shows a significant positive impact from all three types of capital inflows on low-income countries, finding that international remittances have dominant effects over the two other types of capital flows. However, their study shows no significant impact of any of the three types of capital inflows on middle-income developing countries. Moreover, governance has significant positive effects on national income growth for low-income countries but shows significant negative effects on national income growth for middle-income countries. In general, governance in middle-income countries is superior to that in low-income countries. Such contradictory and incomprehensible statistical results may be due to the misspecification of the

estimation model. Since 1960, it has been well known that economic growth can be promoted not only by investment in physical capital but also by investment in human capital (Schultz, 1961). However, the estimation model of Benmamoun and Lehnert (2013) lacks both investments in physical and in human capital. Such missing variables may have led to the mixed and incomprehensible results.

Therefore, we intend to include in our estimation model investments in both physical and human capital, as well as governance interacting with the three different types of capital inflows. In this way, we are able to preclude bias due to missing variables and know whether governance plays any significant role through interactions with any type of capital inflows. In other words, certain types of capital inflows by themselves may not statistically significantly influence the growth of national income but may be statistically significant if they interact with the good governance of the country in question, as Burnside and Dollar (2000) and Collier and Dollar (2002) show the effectiveness of ODA in promoting the economic growth of recipient countries. This has led us to test a third hypothesis:

H3: The different types of development finance flows would become effective only when the governance of recipient developing countries is sound or reformed.

Another recent comparative study of the effectiveness of different types of development finance flows (Driffield and Jones, 2013) did incorporate both human capital and governance in the estimation model. However, the authors of that study also used aggregate ODA for all developing countries in their analysis, assuming that all developing countries, irrespective of their development level, would face the same problems with respect to development finance inflows and therefore would need the same strategy regarding the use of development finance inflows. Their findings indicate that both FDI and remittance have similar levels of significant positive effects on economic growth, whereas the effect of ODA is not straightforward. The existing body of literature, however, advises us to disaggregate ODA and holds that least developed and middle-income developing countries face different problems and need differentiated strategies, as Benmamoun and Lehnert. (2013) has shown. Therefore, in our study, we intend to disaggregate ODA into grants and loans and determine if least developed and middle-income countries face the same problems and thus require the same foreign capital inflow strategy.

III. Methodology and Data

A. The Model

To examine the impact of distinct external capital inflows consisting of two types of ODA (official grants and official loans) and two types of private capital (foreign direct investment and remittances) on the economic growth at two stages of development (middle-income and least developed countries), we use the following estimation models.

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(1)
Growth_GDPCap_{ii} =
$$\beta 0 + \beta 1$$
Growth_GDPCap_{ii-1} + $\beta 2$ Growth_GDPCap_{ii-2}
+ $\beta 3$ ODAGrant_{ii} + $\beta 4$ ODALoan_{ii} + $\beta 5$ FDI_{ii} + $\beta 6$ REMIT_{ii}
+ $\beta 7 \chi_{ii} + n_i + \varepsilon_{ii}$

Growth_GDPCap_{*it*} is the dependent variable; Growth_GDPCap_{*it*-1} and Growth_GDPCap_{*it*-2} represent the lagged dependent variables in the previous periods; ODAGrant, ODALoan, FDI, and REMIT all represent key independent variables; χ_{it} represents the control variables; n_i is the unobserved time-invariant country-specific effect; and ε_{it} is the error term.

(2)
Growth_GDPCap_{ii} =
$$\beta 0 + \beta 1$$
Growth_GDPCap_{ii-1} + $\beta 2$ Growth_GDPCap_{ii-2}
+ $\beta 3$ ODAGrant_{ii} + $\beta 4$ ODALoan_{ii} + $\beta 5$ FDI_{ii} + $\beta 6$ REMIT_{ii}
+ $\beta 7 (ODAGrantii * Governanceii) + \beta 8 (ODALoanii * Governanceii)
+ $\beta 9 (FDI_{ii} * Governanceii) + \beta 10 (REMITii * Governanceii)
+ $\beta 11 \chi_{ii} + n_i + \varepsilon_{ii}$$$

	Measurement	Source of Data				
Dependent Variable						
Growth_GDPCapit _{it}	GDP per capita growth rate	World Bank, World Development Indicators				
Independent Variables (ODA)						
ODAGrant _{it}	ODA Grant received (% of GDP)	World Bank, World Development Indicators				
ODALoan _{it}	IBRD loans and IDA credits received (% of GDP)	World Bank, World Development Indicators				
Independent Variables (Private Capital)						
FDI _{it}	Foreign Direct Investment, net inflows (% of GDP)	World Bank, World Development Indicators				
REMIT _{it}	Personal Remittances received (% of GDP)	World Bank, World Development Indicators				
Control Variables						
Trade _{it}	Trade (import and export) (% of GDP)	World Bank, World Development Indicators				
Inflation _{it}	Consumer Price Index	World Bank, World Development Indicators				
Capital formation _{it}	Gross domestic investment (% of GDP)	World Bank, World Development Indicators				
Population growth _{it}	Population growth rate	World Bank, World Development Indicators				
Governance _{it}	CPIA overall score (range 1-16)	World Bank, World Development Indicators				
Primary enrollment _{it}	Primary net enrollment rate, both sexes (%)	World Bank, World Development Indicators				

 TABLE 1—SUMMARY OF VARIABLES

Source: World Development Indicators, World Bank.

The two equations are basically identical, except that equation (2) has several interaction terms between governance and each of the four different types of development finance flows added to equation (1). This is done to test the hypothesis that each of the four different types of development finance flows is effective only in countries with good governance, as Burnside and Dollar (2000) and Collier and Dollar (2002) asserted. Equation (2) here would be used if the governance variable is effective despite the fact that each of the four different types of development finance inflows is statistically insignificant. In such cases, development finance inflows could be effective through interaction with good governance.

Equations (1) and (2) overcome the shortcomings of the oversimplified Benmamoun and Lehnert (2013) model by including the omitted variables critical for economic growth. These are selected after a close examination of Bassanini and Scarpetta (2001) and are physical capital accumulation, human capital measured by the primary school enrollment rate, population growth, trade openness, and governance.

The dependent variable, GDP per capita growth, which is the annual growth rate of the total output of a country divided by number of people, signals the growth of the economy. The key independent variables of ODA grants, ODA loans, foreign direct investment (FDI), and international remittances, all expressed as a share of GDP, represent their respective impacts on the economic growth of middle-income countries and least developed countries. We subdivide ODA into grants and loans to act as separate variables exhibiting distinct economic impacts. FDI inflows and international remittances constitute private financial inflows into the country, and both are measured as a percentage of GDP.

The control variables (χ_{it}) are derived from economic growth theories with the intention to control the other determinants of the economic growth rate and provide an inclusive model, with minimized omitted variable biases. The Solow-Swan model, a simple neoclassical growth model, postulates that economic growth is the result of capital accumulation and technological progress. Capital accumulation is largely grouped into physical capital and human capital. Physical capital accumulation, one of the main determinants of output per capita, measures the investment rate of a country. In alignment with Bassanini and Scarpetta (2001), we measure the accumulation of physical capital by gross capital formation as a share of gross domestic investment in GDP. Human capital, which represents the labor force, is considered to have significant impact on economic growth as there is a high correlation between a skilled labor force and technological progress. In this empirical study, we use the net primary school enrollment rate as a proxy for human capital.

In the macroeconomic context, other variables pertaining to economic growth include trade, the inflation rate, population growth, and governance, as in other growth studies (Barro, 1996; Bassanini and Scarpetta, 2001). According to the neoclassical growth model, increasing population growth has a negative effect on economic growth, as a higher rate of population growth implies shared capital among a larger number of people. A country's governance, derived from the Country Policy and Institutional Assessment (CPIA), World Development Indicators, consists of four clusters: Economic Management, Structural Policies,

Policies for Social Inclusion and Equity, and Public Sector Management and Institutions. We use the sum of the four CPIA clusters, with a range of 1 to 16 points. Trade, expressed as the sum of exports and imports of goods and services measured as a share of GDP, has often been stressed as having a significant influence on economic growth. The inflation rate, as measured by the consumer price index (CPI), is also controlled for its association with economic growth. Lower or stable inflation rates suggest reduced uncertainty in the economy and thus a well-functioning price mechanism.

The lagged dependent variable, which is GDP per capita growth in the initial year in our model, is considered under the assumption that GDP per capita of the given initial year can have a consequent impact on the GDP per capita of the following consecutive periods. The use of a lagged dependent variable, akin to the four international capital inflow variables (ODA-Grant, ODA-Loan, FDI, and Remittances), however, creates an endogeneity problem which arises from the possible reverse causality between the dependent variable and the key independent variables. To overcome this endogeneity problem, we use the generalized method of moments (GMM) estimation method.

B. The GMM Estimation Method

System and difference GMM estimators are powerful tools to estimate dynamic panel data models, using instruments which are available from within the system of equations, without external instruments. System and difference GMM estimators are designed for panel analyses of short time periods (t) and large elements (N). More specifically, they are suitable in situations such as when the dependent variable is likely to be influenced by past variables or when independent variables are not strictly exogenous and may be correlated with past and current realizations of error.

The GMM estimation method is adopted here because this study is confined to a relatively short period, ranging from the year 2000 to 2015, an intended selection to estimate the sheer effect of ODA, which once was highly contingent on diplomatic purposes in the early 1990s. Moreover, our concern about endogeneity calls for the need to adopt GMM estimation as an efficient methodology to conduct the hypothesis test. Several studies of donor policies for aid allocations to recipient countries show that donor countries explicitly consider the income level or growth rate of each recipient (Dollar and Levin, 2006; Lee and Lee, 2014; Bandyopadhyay *et al.*, 2013). Private capital inflows to developing countries are also determined in consideration of the economic growth of the host developing countries. Furthermore, the dependent variable, GDP per capita growth, is largely affected by that in previous years.

The GMM uses first-differences to transform equation (1) into:

(3)

$$\Delta \text{Growth}_\text{GDPCap}_{it} = \beta 0 + \beta 1 \Delta \text{Growth}_\text{GDPCap}_{it-1} + \beta 2 \Delta \text{Growth}_\text{GDPCap}_{it-2} + \beta 3 \Delta \text{ODAGrant}_{it} + \beta 4 \Delta \text{ODALoan}_{it} + \beta 5 \Delta \text{FDI}_{it} + \beta 6 \Delta \text{REMIT}_{it} + \beta 7 \Delta \chi_{it} + \Delta n_i + \Delta \varepsilon_{it}$$

where $\Delta \text{Growth}_\text{GDPCap}_{it} = \text{Growth}_\text{GDPCap}_{it} - \text{Growth}_\text{GDPCap}_{it-1}$ and so on for the other variables.

By first-differencing the regressors, the difference GMM eliminates the unobserved country-specific effect because the disturbance n_i does not vary with time ($\Delta n_i = n_i - n_i = 0$).

The difference GMM helps to overcome endogeneity using the first-differenced values of the explanatory variables as instruments. The system GMM, on the other hand, estimates concurrently two distinctly instrumented equations: the first-differenced equation (2) (i.e., equation (3)) and level equation (1), the two equations being distinctly instrumented. The use of the system GMM depends on two conditions: (i) the validity of these additional instruments, and (ii) the absence of a second-order autocorrelation.

In our study, where the number of least developed countries with full data is rather limited (23), we use the difference GMM (3), as the system GMM employs too many instruments. We utilized both the difference GMM and the system GMM to test and compare the consistence and efficiency of the model. Considering the Sargan test and AR(2) test, both methodologies proved consistent. However, the difference GMM proved more efficient than the system GMM in our study. By employing fewer instruments, the difference GMM kept the number of instruments below the number of groups (23). Furthermore, in order to ensure that the number of instruments remains equal to or less than the number of groups (23), we also 'collapsed' the instruments by combining instruments through additions into smaller sets. This offers the potential advantage of retaining more information, as no lags are actually dropped as instruments.

C. Data

These models are applied to the panel data of 48 least developed countries (Table A1) and 89 middle-income developing countries (Table A2) and over the period of a decade and a half, from the year 2000 to 2015, for the following three main reasons. First, private capital inflows in least developed countries only began to show a significant increment in the early 2000s. Second, in agreement with Hlavac (2007), this period begins more than a decade after the end of the Cold War and thus is likely to be unaffected by the strategic and political purposes of foreign aid. Third, the period covered coincides with the period during which both ODA donors and recipients actively pursued the Millennium Development Goals in developing countries by mobilizing both ODA and external private capital inflows. Any empirical findings with the data from this period would offer useful lessons regarding the implementation of the Sustainable Development Goals (2016-2030).

To test the severity of multicollinearity among the explanatory variables, we examined the variance inflation factor (VIF), which showed a mean VIF figure of 1.69, confirming that the predictor variables are not linearly related.

IV. Results

A. Summary Statistics

The summary statistics are provided in the following tables for the least developed countries and middle-income developing countries, separately:

Variables	Ν	mean	sd	min	max
Country	768	24.50	13.86	1	48
Year	768	2008	4.613	2000	2015
GDP per capita growth	717	2.354	5.902	-48.39	57.99
ODA Grants	664	14.35	14.43	0.00722	181.2
ODA Loans	617	1.264	5.962	0	67.27
FDI	707	4.726	8.223	-5.981	89.48
Remittances	552	5.907	8.689	3.58e-05	61.99
Trade	656	77.10	45.39	0.309	351.1
Inflation rate	715	12.70	100.1	-29.55	2,630
Capital formation	630	23.62	14.25	0	147.9
Population growth	764	2.521	0.863	0.162	5.598
Governance	476	2.752	0.575	1.500	3.500
Primary enrollment rate	379	72.33	18.27	25.76	99.38

TABLE 2—SUMMARY STATISTICS FOR THE LEAST DEVELOPED COUNTRIES (LDCS)

TABLE 5—SUMIMART STATISTICS FOR THE MIDDLE-INCOME DEVELOFING COUNTRIES (MIDCS	TABLE 3—	-SUMMARY	STATISTICS FOR	THE MIDDLE-INCOME	Developing	COUNTRIES ((MDCs)
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Variables	Ν	mean	sd	min	max
Country	1,424	45	25.69949	1	89
Year	1,424	2007.5	4.611392	2000	2015
GDP per capita growth	1,388	3.035942	5.587528	-62.2144	104.658
ODA Grants	1,232	4.346128	7.33023	-2.59441	56.084
ODA Loans	1,136	1.923866	4.197511	0	33.81634
FDI	1,363	4.802107	8.98763	-56.4645	217.92
Remittances	1,238	6.33233	7.596496	.003489	49.5936
Trade	1,309	87.47446	34.94808	22.106	220.407
Inflation rate	1,385	8.021516	11.5469	-29.691	185.291
Capital formation	1,245	24.31157	7.930574	4.70372	58.1507
Population growth	1,423	1.151673	1.098232	-3.58213	7.10757
Governance	373	3.246649	.4788772	1.5	4
Primary enrollment rate	845	90.57666	7.941936	53.4157	99.9247

Although it is more efficient and consistent to estimate the parameters using the GMM estimation method, pooled OLS and fixed effects estimators are also obtained to compare the results with those of the GMM estimators. The estimators for the least developed countries are presented first.

B. Analysis Results and Discussion: Least Developed Countries

Variables	(1)	(2)	(3)	(4)		
	OLS	Fixed Effect	Difference GMM	System GMM		
L.gdppercapitagrowth	0.244***	0.00577	0.311	-0.0103		
	(0.0647)	(0.0607)	(0.425)	(0.102)		
odagrants_gdp	0.00973	0.0586	0.125**	0.0894*		
	(0.0238)	(0.0517)	(0.0624)	(0.0505)		
odaloans_gdp	-0.0498	-0.821**	-3.052**	-0.103		
	(0.179)	(0.390)	(1.541)	(1.461)		
fdi_gdp	0.0512*	-0.0680	-0.0225	-0.00511		
	(0.0273)	(0.0499)	(0.0989)	(0.0862)		
romittanoog adn	-0.0888***	-0.0218	0.290*	-0.0877		
remittances_gdp	(0.0313)	(0.0855)	(0.154)	(0.0809)		
trada adm	-0.00243	0.0345	0.0541	0.0579*		
trade_gdp	(0.00819)	(0.0232)	(0.0547)	(0.0297)		
Inflation	0.0149	0.0140	0.0309	-0.00237		
	(0.0297)	(0.0331)	(0.0810)	(0.0473)		
Capitalformation	0.000732	0.0651	0.0969	-0.00390		
	(0.0247)	(0.0488)	(0.0901)	(0.0661)		
Populationgrowth	-1.656***	-0.166	-1.759	-0.911		
	(0.393)	(1.366)	(2.964)	(1.402)		
Governance	1.234*	2.699	-1.748	1.634		
(CPIA overall)	(0.694)	(1.973)	(6.050)	(1.269)		
Primaryenrollment	-0.0124	-0.0175	-0.0347	-0.101		
	(0.0167)	(0.0390)	(0.178)	(0.0613)		
Constant	3.597	-8.552		3.587		
	(2.980)	(7.018)		(7.993)		
Observations	169	169	117	169		
Number of country		32	23	32		
R-squared	0.317	0.116				
Dependent Variable: GDP per capita growth						
Arellano&Bond Test	AR(1)		Pr>z(39)=0.163			
	AR	R(2) Pr>z(1.13)=0.257				
Sargan test		Pr> chi ² =0.251				
Hansen test			Pr> chi ² =0.201			

TABLE 4—DYNAMIC PANEL REGRESSION RESULT FOR THE LEAST DEVELOPED COUNTRIES (LDCS)

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, *p<0.1.

The estimators of the difference GMM (equation 3) (column 3) and system GMM (equations 1 and 3) (column 4) for LDCs are distinct from those of the other estimation methods (pooled OLS and fixed-effects panel data). The Arellano and Bond test rejects the automatic serial correlation in time series, and both the Sargan and Hansen tests confirm that the overidentification of IV restrictions and the adopted IVs are adequate. The system GMM uses too many instruments, especially compared to the number of groups, and therefore the coefficients must be biased. Hence, we prefer the difference GMM results.

For LDCs, of the four different types of international capital inflows, only ODA grants and remittances showed positively significant effects on economic growth at
the 5% and 10% significance levels (column 3), respectively, confirming our first hypothesis only partially.

Result of the H1 Test: For the least developed countries, ODA grants and remittances contribute most to economic growth.

In contrast, ODA loans showed significantly negative effects on growth, and FDI showed statistically insignificant effects on economic growth. These findings imply that for LDCs, remittances and ODA grants constitute the only foreign resources able to exert a significantly positive impact on economic growth during the observed period. This finding differs from that of Benmamoun and Lehnert (2013), where it was found that only remittances are significantly effective development flows for LDCs. Our finding is different from the assertion that aid for Sub-Saharan African countries is wholly ineffective and therefore should be ceased immediately (Moyo, 2009). Our finding also stands in contrast to the conditional ODA effectiveness theory, which states that ODA is effective only when aid recipients have sound economic and political governance (Burnside and Dollar, 2000; Collier and Dollar, 2002; Kosack, 2003). Our finding confirms that ODA grants are effective irrespective of the governance status in least developed countries (LDCs), consistent with findings of Clemens *et al.* (2004).

We presume that such differences in our empirical findings pertaining to the effectiveness of aid stem from the disaggregated analysis of ODA (between grants and loans) and recipient countries (between LDCs and MDCs). The negative association between ODA loans and economic growth in LDCs compared to the positive relationship between ODA grants and economic growth in LDCs can be explained by the higher costs of loans (obligations to repay the principal and interest) and the weaker government capacities in LDCs to select investment projects with high rates of return and implement them efficiently.

In the difference GMM result (equation 1), the governance variable is a statistically insignificant variable, like other control variables. Therefore, it is meaningless to test the robustness of our estimation based using equation (3), with the interaction term of governance applied to ODA loans, FDI, and remittances (equation 2). The governance variable may not contribute to economic growth in LDCs, as the range of the difference in the variable across countries and in time periods is relatively narrow, while substantial governance improvements in those countries would take many years, i.e., beyond the time allocated for this study.

Therefore, we can conclude that for LDCs, ODA grants and remittances were effective in promoting per capita GDP. However, the existence of sound governance in LDCs was not a necessary precondition for the effectiveness of ODA grants and remittances.

C. Analysis Results and Discussion: Middle-income Developing Countries

THE MIDDLE-INCOME DEVELOPING COUNTRIES (MDCS)							
Variables	(1)	(2)	(3)	(4)			
valiables	OLS	Fixed Effect	Difference GMM	System GMM			
L.gdppercapitagrowth	0.294***	0.00361	0.553**	0.0319			
	(0.0631)	(0.0617)	(0.236)	(0.135)			
odagrants_gdp	-0.239***	-0.106	0.172	-0.233			
	(0.0819)	(0.104)	(0.127)	(0.174)			
odaloans_gdp	0.165	-0.384**	-0.205	-0.154			
	(0.100)	(0.184)	(0.177)	(0.126)			
£1: _ 1.	0.146**	0.0873	0.565***	0.196**			
lai_gap	(0.0585)	(0.0684)	(0.200)	(0.0780)			
·	0.0721*	-0.150	-0.0930	-0.172			
remittances_gdp	(0.0371)	(0.0976)	(0.126)	(0.117)			
	-0.00957	0.112***	0.0273	0.0941*			
trade_gdp	(0.0124)	(0.0351)	(0.0703)	(0.0518)			
× 0	0.0220	-0.00573	-0.0187	0.00333			
Inflation	(0.0291)	(0.0252)	(0.0355)	(0.0169)			
~	0.196***	0.347***	0.221	0.228***			
Capitalformation	(0.0463)	(0.0667)	(0.216)	(0.0770)			
	-0.415	-3.804**	-1.442	-2.646			
Populationgrowth	(0.403)	(1.719)	(1.843)	(1.691)			
Governance	0.0863	1.012	2.185	1.439			
(CPIA overall)	(1.334)	(2.088)	(4.584)	(1.611)			
	-0.146***	-0.124	-0.169	-0.355***			
Primaryenrollment	(0.0418)	(0.0829)	(0.143)	(0.0850)			
-	10.26*	-0.457		21.52**			
Constant	(5.725)	(10.72)		(10.80)			
Observations	174	174	133	178			
Number of country		29	27	30			
R-squared	0.391	0.441					
Dependent Variable: GDP per capita growth							
Arellano&Bond Test	AR(1)		Pr>z(-2.21)=0.027				
	AR(2)		Pr>z(-0.84)=0.401				
Sargan test			Pr> chi ² (1.62)=0.444				
Hansen test			Pr> chi ² (1.80)=0.406				

TABLE 5—DYNAMIC PANEL REGRESSION RESULT FOR THE MIDDLE-INCOME DEVELOPING COUNTRIES (MDCS)

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, *p<0.1.

For middle-income developing countries (MDCs), we also conducted a similar dynamic panel regression analysis using the difference GMM (equation 1) and system GMM inflows (equations 1 and 3). Again, the difference GMM estimators for MDCs (column 3) are distinct from those of other estimation methods (pooled OLS and fixed-effects panel data). The Arellano and Bond test rejects the automatic serial correlation in the time series (except AR (1), as often observed in many studies, and over concerns about GMM, the AR(2) test is more important (Roodman, 2006), while both the Sargan and Hansen tests confirm that the overidentification of IV restrictions and the adopted IVs are adequate.

The results for MDCs (equation 3) are quite different from those for LDCs. Foreign direct investment (FDI), as hypothesized, proved to be the only significant foreign capital inflow showing a positive impact on economic growth at the 1% significance level irrespective of the status of governance in the MDCs. This finding is supported by the system GMM (column 4) outcomes, though it differs from that of Benmamoun and Lehnert (2013), who did not find any type of international development finance flow having a significantly positive impact on economic growth.

In contrast, international remittances had a negative impact on growth but were insignificant even at the 10% significance level. Likewise, both types of ODA variables (grants and loans) are statistically insignificant irrespective of the status of governance. The result can be interpreted as follows: when FDI inflows increase by 1%, the per-capita income growth of MDCs rises by approximately 0.565 percentage points.

This shows that FDI has a substantially positive impact on the economic growth of MDCs.

Our empirical finding of a positive impact of FDI is consistent with several widely cited studies which provided evidence of a positive causal link between FDI and growth in developing countries in general via the transfer of knowledge and the adoption of new technology as well as additional investments (Hansen and Rand, 2006). However, the uniqueness of our finding is that while FDI in LDCs did not have a positive impact on their per-capita income growth, FDI for MDCs showed significant positive impacts on their per-capita income growth irrespective of the status of their governance. We suspect that the difference between MDCs and LDCs may be due to the fact that MDCs in general have sounder and better levels of governance in comparison with LDCs, which has worked better for attracting and taking advantage of FDI. Such distinctions in our findings may originate from the disaggregated analysis of developing countries between LDCs and MDCs, in contrast with the overall research on developing countries in general in the past.

One of many previous studies on the impact of FDI on economic growth of developing countries located in Africa estimated it to be positive in most countries but statistically insignificant (Adewumi, 2007). The statistical insignificance in this earlier study can be explained partly by the inclusion of several least developed countries in the sample and partly given its use of different time periods (time series data from 1970 to 2003), during which the proportion of foreign direct investment inflows as a percentage of GDP was virtually limited and started to increase at a fair rate only in the early 2000s (World Development Indicators, World Bank).

Thus, the positive and significant coefficient of FDI for MDCs implies that there is a positive effect of FDI on the growth of middle-income developing countries, confirming the validity of our second hypothesis:

Result of the H2 Test: For middle-income developing countries, foreign direct investment contributes most to economic growth.

Given that the governance variable by itself is statistically insignificant in

promoting economic growth of MDCs, there is no strong motivation to analyze the effect of governance and how it interacts with each of the four different types of international capital inflow variables.

Result of the H3 Test: For LDCs, sound governance is not a prerequisite for ODA grants to become effective in promoting their economic growth. For MDCs, the most effective type of international capital inflow to MDCs is FDI, irrespective of the soundness of governance.

The insignificant role of governance may be due to the many missing observations, especially during the early 2000s, and the rather short period of the analysis to reflect governance changes.

To check the robustness of our test as to whether soundness of governance is a prerequisite of our findings, we applied different measures of governance instead of the total CPIA score. However, these results did not have much significant difference. (These results are not shown here but are available upon request.)

To test the robustness of our test results, we also applied an average value of a much longer period (i.e., 8 years) twice in each country for the four different types of foreign capital inflows to run the difference GMM equation (3). The results show that no capital variables are significant for LDCs; however, only the FDI variable is significant for MDCs, partly supporting the robustness of our basic model using capital inflow observations for every year.

IV. Results

By means of a dynamic panel regression analysis, we studied the effectiveness of different types of ODA and private capital inflows (grants, loans, FDI, and international personal remittances) on economic growth in both middle-income developing countries (MDCs) and least developed countries (LDCs), separately. The literature did not focus strongly on LDCs, which were overshadowed by the rapid economic growth of emerging economies, which drew much scholarly attention. This research is meaningful because it analyzes the subject in a disaggregate manner. First, it compares the impacts of different types of external capital inflows on both MDCs and LDCs separately. In addition, the study disaggregates ODA into ODA grants and ODA loans, as previous studies have shown that they have different degrees of effects on the economic growth of developing countries.

Foreign capital inflows into developing countries, however limited they may be, constitute an important source of investment for their economies. However, not all types of foreign capital inflows into developing countries contribute to their economic growth by the same degree; in fact, some types of development finance inflows can harm the economy in a poor institutional setting, as shown in previous studies. Therefore, this research has policy implications for both MDCs and LDCs regarding the optimal selection of the specific types of development finance inflows that contribute most to their economic growth.

The empirical finding of this study indicates that out of all types of development finance inflows, remittances and ODA grants contribute most to the economic growth of LDCs irrespective of the status of their governance. As shown in the difference GMM estimations, ODA grants and remittances display the most statistically significant and positive impacts on the per capita GDP growth of LDCs. This result is not surprising considering that LDCs have easier access to a steady supply of ODA grants compared to other types of foreign capital inflows due to their low levels of per capita income and economic and financial resources management capacities.

For MDCs, unlike LDCs, FDI has the most statistically significant and positive impact on their economic growth. MDCs are generally equipped with some physical and human capabilities to attract, absorb, and utilize foreign capital inflows. Considering that FDI currently constitutes the largest proportion of foreign capital inflows in middle-income countries, it is not surprising that our empirical analysis confirms our intuitive analysis.

Therefore, policymakers in both MDCs and LDCs should review their current strategies and practices designed to attract different types of development finance inflows, and they should attempt to increase the type of foreign capital inflow most suitable to their development stage and situation. From the perspective of advanced economies, such a division of labor will also contribute to the optimal allocation of international development finance capital. Advance countries are advised to focus on providing FDI for MDCs and on offering ODA grants and remittances for LDCs.

Despite the optimal strategic guidelines for selecting different types of development finance inflows drawn from this empirical analysis, both ODA grant donors and LDC recipients should be wary for the corruptive practices related to grant allocation and application. LDCs should also make efforts to use remittance inflows for sustainable welfare improvements for the poor and for investment purposes. Remittances prove effective under sound financial systems and healthy policy environments (Ratha and Mohapatra, 2007). According to the IMF (2005), a country with good institutions can more effectively use remittances as a means of investment in physical and human capital.

A large amount of remittances can be particularly harmful in developing countries as well as in least developed countries, where the economies are small and remittances are high (Gupta *et al.*, 2007). Gupta *et al.* (2007) suggests that large inflows of remittances in small economies can create a vulnerability to Dutch disease, an appreciation of the real value of the local currency and losses in export competitiveness, both of which have negative impacts on economic growth.

Likewise, policymakers in MDCs should take concurrent measures to overcome the volatility of FDI inflows (Figure 1) and their negative social and economic effects, including the crowding out of local businesses and the expanding income inequity among their labor forces.

Despite the significant findings here, our research is not without limitations. The methodology of our research may be subject to potentially omitted variable bias, as there are several immeasurable factors that may affect economic growth, such as cultural characteristics. These potentially omitted variables can result in biased or inconsistent estimators, as the significant impacts of ODA or FDI may partially be

due to other immeasurable factors that may affect economic growth, causing an upward bias, which even the GMM method cannot fully avoid.

Another limitation lies in our inability to include sufficient elements of private development finance inflows, such as portfolio investments, microfinance, and private loans. Data on private foreign loans, including foreign microfinance targeted developing and least developed countries, were insufficient for a rigorous statistical analysis.

APPENDIX

1	Afghanistan	25	Madagascar
2	Angola	26	Malawi
3	Bangladesh	27	Mali
4	Benin	28	Mauritania
5	Bhutan	29	Mozambique
6	Burkina Faso	30	Myanmar
7	Burundi	31	Nepal
8	Cambodia	32	Niger
9	Central African Republic	33	Rwanda
10	Chad	34	Sao Tome and Principe
11	Comoros	35	Senegal
12	Congo, Democratic Republic	36	Sierra Leone
13	Djibouti	37	Solomon Islands
14	Equatorial Guinea	38	Somalia
15	Eritrea	39	South Sudan
16	Ethiopia	40	Sudan
17	Gambia, The	41	Tanzania
18	Guinea	42	Timor-Leste
19	Guinea-Bissau	43	Togo
20	Haiti	44	Tuvalu
21	Kiribati	45	Uganda
22	Lao PDR	46	Vanuatu
23	Lesotho	47	Yemen, Republic
24	Liberia	48	Zambia

TABLE A1—LEAST DE	EVELOPED COUNTRIES
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1	Albania	31	Guatemala	61	Palau
2	Algeria	32	Guyana	62	Panama
3	American Samoa	33	Honduras	63	Papua New Guinea
4	Armenia	34	India	64	Paraguay
5	Azerbaijan	35	Indonesia	65	Peru
6	Belarus	36	Iran, Islamic Republic	66	Philippines
7	Belize	37	Iraq	67	Romania
8	Bolivia	38	Jamaica	68	Russian Federation
9	Bosnia and Herzegovina	39	Jordan	69	Samoa
10	Botswana	40	Kazakhstan	70	Serbia
11	Brazil	41	Kenya	71	South Africa
12	Bulgaria	42	Kosovo	72	Sri Lanka
13	Cabo Verde	43	Kyrgyz Republic	73	St. Lucia
14	Cameroon	44	Lebanon	74	St. Vincent and the Grenadines
15	China	45	Libya	75	Suriname
16	Colombia	46	Macedonia, FYR	76	Swaziland
17	Congo, Republic	47	Malaysia	77	Syrian Arab Republic
18	Costa Rica	48	Maldives	78	Tajikistan
19	Cote d'Ivoire	49	Marshall Islands	79	Thailand
20	Cuba	50	Mauritius	80	Tonga
21	Dominica	51	Mexico	81	Tunisia
22	Dominican Republic	52	Micronesia, Fed. Sts.	82	Turkey
23	Ecuador	53	Moldova	83	Turkmenistan
24	Egypt, Arab Republic	54	Mongolia	84	Ukraine
25	El Salvador	55	Montenegro	85	Uzbekistan
26	Fiji	56	Morocco	86	Venezuela, RB
27	Gabon	57	Namibia	87	Vietnam
28	Georgia	58	Nicaragua	88	West Bank and Gaza
29	Ghana	59	Nigeria	89	Yemen, Rep.
30	Grenada	60	Pakistan		

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