KDI Journal of Economic Policy 2018, 40(3): 1–44
http://dx.doi.org/10.23895/kdijep.2018.40.3.1

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

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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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* Received: 2018. 5. 10
* Referee Process Started: 2018. 5. 14
* Referee Reports Completed: 2018. 7. 31
† 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 benefits[1] 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

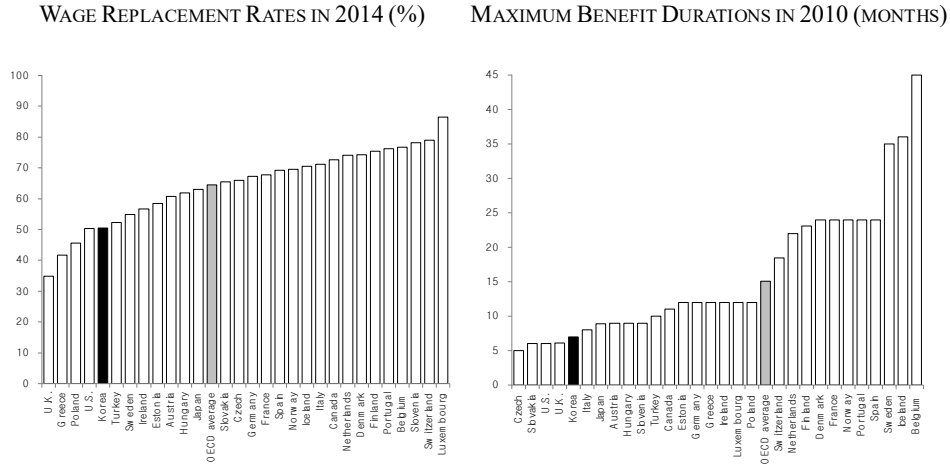

FIGURE 1. INTERNATIONAL COMPARISON OF UNEMPLOYMENT BENEFITS

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).

[1]In 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 × 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 policy changes, the relative sizes of the consumption smoothing effects and moral

[2]Minimum 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.

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

[3]In 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

[4]Browning 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.

[5]According 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 $j \in \{1,2,\cdots,J\}$ 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.

[6]The 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.

[7]In 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.

[8]The transition probability for the last age group J (ϕ_J) is assumed to be 0.

[9]It 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.

[10]These 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 ($g^j \in [\underline{g^j}, \overline{g^j}]$) 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 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

[11]For 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.

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

[13]Voluntary 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 wage[15] 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), $j \in \{1,2,\cdots,J\}$ denotes the index for age groups and a denotes the amount of net assets. $k \in \{k_1, k_2, \cdots, k_K\}$ indicates the insured period for UI and $i \in \{0,1\}$ indicates whether or not an application is made for unemployment benefits. Lastly, $d \in \{d_1, d_2, \cdots, d_D\}$ 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.

[14]In reality, the waiting period is seven days.

[15]In the current UI system in Korea, the average monthly wage level is determined by the average three-month 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 three-month 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.

[16]In 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.

[17]In 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.

$$V_{g^j}^{E,1}(j,a,k) = \max_{c,a'} u(c,0) + \beta E_{\rho,\phi}\left[\begin{array}{l}(1-\chi)\left(qV_{g^j}^{U,0}(j',a',k') + (1-q)V_{g^j}^{E,1}(j',a',k')\right) \\ +\chi\left(I_{(k<k^e)}V_{g^j}^{U,0}(j',a',k') + I_{(k\geq k^e)}V_{g^j}^{U,1}(j',a',k')\right)\end{array}\right]$$

s.t.

$$(1+\tau_c)c + a' = (1-\tau_l)(1-\tau_u)g^j w + (1+r(1-\tau_k))a + x + T$$

$$a' \geq \underline{a}, k' \sim \Pi(k,k')$$

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

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').τ_c, τ_l, τ_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

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

[19]Because 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.

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

[21]Voluntary 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 $I_{(k\geq k^e)}$ 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:

$$
\begin{aligned}
V_{g^j}^{E,0}(j,a,k) = \max_{c,a'} & \; u(c,0) \\
& + \beta E_{\rho,\phi}\left[\begin{array}{l}(1-\chi)\left(qV_{g^j}^{U,0}(j',a',k)+(1-q)V_{g^j}^{E,0}(j',a',k)\right) \\ +\chi\left(I_{(k<k^e)}V_{g^j}^{U,0}(j',a',k)+I_{(k\geq k^e)}V_{g^j}^{U,1}(j',a',k)\right)\end{array}\right] \\
& \text{s.t.} \\
& (1+\tau_c)c+a' = (1-\tau_l)g^j w+(1+r(1-\tau_k))a+x+T \\
& a' \geq \underline{a} \\
\textit{where } & V_{g^j}^{U,0}(j_R,a',k) = V_{g^j}^{U,1}(j_R,a',k) = V_{g^j}^{E,0}(j_R,a',k) \equiv V^R(j_R,a')
\end{aligned}
$$

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:

[22]Even 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.

$$V_{g^j}^{U,0}(j,a,k)=\max_{c,a',s} u(c,1)-v(s)$$
$$+\beta E_{\rho,\phi}\left[\begin{array}{l} p(j,s)\left(\begin{array}{l}(1-\lambda)\max\left\{V_{g^j}^{E,0}(j',a',k),V_{g^j}^{U,0}(j',a',k)\right\}\\ \quad+\lambda\max\left\{V_{g^j}^{E,1}(j',a',k),V_{g^j}^{U,0}(j',a',k)\right\}\end{array}\right)\\ +\left(1-p(j,s)\right)V_{g^j}^{U,0}(j',a',k)\end{array}\right]$$

s.t.

$$(1+\tau_c)c+a'=\left(1+r(1-\tau_k)\right)a+x+T$$
$$a'\geq \underline{a}$$

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

At the 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 ($k\geq k^e$) are eligible for unemployment benefits. The value function immediately after job loss for the unemployed who are eligible for unemployment benefits is as follows:

[23]Random 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.

$$
\begin{aligned}
V_{g^j}^{U,1}(j,a,k) = \max_{c,a',s,i\in\{0,1\}} & u(c,1) - v(s) - i\eta \\
& + (1-i)\beta E_{\rho,\phi}\left[\begin{array}{l} p(j,s)\left(\begin{array}{l}(1-\lambda)\max\left\{V_{g^j}^{E,0}(j',a',k), V_{g^j}^{U,0}(j',a',k)\right\} \\ \quad +\lambda\max\left\{V_{g^j}^{E,1}(j',a',k), V_{g^j}^{U,0}(j',a',k)\right\}\end{array}\right) \\ +(1-p(j,s))V_{g^j}^{U,0}(j',a',k)\end{array}\right] \\
& + i\beta E_{\rho,\phi}\left[\begin{array}{l} p(j,s)\left(\begin{array}{l}(1-\lambda)\max\left\{V_{g^j}^{E,0}(j',a',k), V_{g^j}^{U,2}(j',a',k,d=2)\right\} \\ \quad +\lambda\max\left\{V_{g^j}^{E,1}(j',a',k), V_{g^j}^{U,2}(j',a',k,d=2)\right\}\end{array}\right) \\ +(1-p(j,s))V_{g^j}^{U,2}(j',a',k,d=2)\end{array}\right] \\
& \text{s.t.} \\
& (1+\tau_c)c + a' = (1+r(1-\tau_k))a + ib(g^j) + x + T \\
& a' \geq \underline{a} \\
\text{where } & V_{g^j}^{U,0}(j_R,a',k) = V_{g^j}^{U,2}(j_R,a',k,d=2) \equiv V^R(j_R,a') \\
& V_{g^j}^{E,0}(j_R,a',k) = V_{g^j}^{E,1}(j_R,a',k) \equiv V^R(j_R,a')
\end{aligned}
$$

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 ($\bar{d}(j,k)$), 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. $V_{g^j}^{U,2}$ denotes the value function for the unemployed who receive UI

[24]In 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:

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

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:

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

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 ($j \geq j_R$)

The Value function for a retired worker is as follows:

$$V^R(j,a) = \max_{c,a'} u(c,1) + \beta E_{\rho,\phi}\left[V^R(j',a')\right]$$
$$\text{s.t.}$$
$$(1+\tau_c)c + a' = \left(1+r\left(1-\tau_k\right)\right)a + x + T$$
$$a' \geq \underline{a}$$

At the beginning of each period, the retired worker ($j \geq j_R$) 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.

[25]Although 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:

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

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

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]

$$\tau_c \int c\mu(S)dS + \tau_l \int g^j w\mu\left(S^{E,0}\right)dS + \tau_l\left(1-\tau_u\right)\int g^j w\mu\left(S^{E,1}\right)dS + \tau_k r\int a\mu(S)dS - \tau_u \int g^j w\mu\left(S^{E,1}\right)dS = T$$

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

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

IV. Calibration

A. *Functional Forms*

I use the following CRRA[28] utility function for consumption, which is widely

[26]In 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.

[27]Because 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.

[28]Constant 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).

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

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 non-participants 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 mortality 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]

[29]The 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.

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

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

$$\mu_4 = \rho_4\mu_4 + \phi_3\rho_3\mu_3$$
$$\mu_3 = (1-\phi_3)\rho_3\mu_3 + \phi_2\rho_2\mu_2$$
$$\mu_2 = (1-\phi_2)\rho_2\mu_2 + \phi_1\rho_1\mu_1$$
$$\mu_1 = (1-\phi_1)\rho_1\mu_1 + \mu_0$$
$$\mu_0 = (1-\rho_1)\mu_1 + (1-\rho_2)\mu_2 + (1-\rho_3)\mu_3 + (1-\rho_4)\mu_4$$

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

[32]The 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.

[33]Although 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 insurance-covered 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).

[34]For 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.

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

TABLE 3—THE TRANSITION PROBABILITY MATRIX FOR THE INSURED PERIOD

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}

Note: π_{ij} 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:

$$b\left(g^j\right)=\min\left\{b_r\times\overline{g_d}\times 30,\ \max\left\{b_r\times g^j, b_{r,l}\times\underline{w_h}\times 8\times 30\right\}\right\}$$

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 value-added 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

[36]In 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'.

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

TABLE 4—THE MAXIMUM BENEFIT DURATION IN THE MODEL

Age	Insured period				
	Less than 1 year ($k = 2,3,4$)	1~3 years ($k = 5$)	3~5 years ($k = 6$)	5~10 years ($k = 7$)	10 years or more ($k = 8$)
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

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.

[38]The 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.

[40]If 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.

TABLE 5—THE PARAMETERS CALIBRATED OUTSIDE THE MODEL

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)
	Population 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)
ρ_3	Survival probability for 50~64 years	0.9996430	Calculated from Life Tables (2015)
ρ_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
	Unemployment insurance		
π_{12}	Prob(no history → 0~6 months)	1.0000	see text
π_{23}	Prob(0~6 months → 6~9 months)	0.1667	Duration of the state (6 months)
π_{34}	Prob(6~9 months → 9~12 months)	0.3333	Duration of the state (3 months)
π_{45}	Prob(9~12 months → 1~3 years)	0.3333	Duration of the state (3 months)
π_{56}	Prob(1~3 years → 3~5 years)	0.0417	Duration of the state (2 years)
π_{67}	Prob(3~5 years → 5~10 years)	0.0417	Duration of the state (2 years)
π_{78}	Prob(5~10 years → 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)
$\underline{w_h}$	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
	Taxes		
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_u
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
	Prices		
r	Real interest rate	0.0100	One-year Treasury bond, CPI (2015)
w	Wage rate for the unit labor supply	1.0000	Normalization

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 years		30~49 years		50~64 years	
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 20~29, 30~49, and 50~64 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,

TABLE 7—TARGET STATISTICS FOR THE CALIBRATION

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

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.

TABLE 8—PARAMETERS CALIBRATED IN THE MODEL

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
$\underline{a}$	Borrowing limit	-5.2300
η	Disutility from an application for UI	0.2435
λ	Share of firms covered by UI	0.6320

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

TABLE 9—TARGET STATISTICS: MODEL VS. DATA

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

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]

TABLE 10—THE STEADY STATE ECONOMY

Statistics	Value	Statistics	Value
Labor market			
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	0.4484
Consumption expenditure 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
Unemployment insurance			
Ratio of voluntary U to total U	0.6709	The ratio of UI recipients to total U	0.3502
Equilibrium objects			
Accidental bequests (x)	0.0009	Transfer income from the gov. (T)	0.4114

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.

[41]Because 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

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

[43]In 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 changes[44] 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

[44]This 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 effort may slightly improve the welfare of the unemployed, lower 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 change[45] (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

[45] 83.63% of all UI recipients are calculated to be affected by the lower limit in the steady state economy.

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

TABLE 11—THE OVERALL EFFECTS OF POLICY CHANGE 1

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	

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:

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

Here, W_0 and W_1 denote the average welfare for a relevant group before and after a policy change. $\bar{c_0}$ 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

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

Statistics		% change			
		Directly affected group (high wage)		Others (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 welfare for 20~84		0.0031	(9.07)	-0.0075	(-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**	
Measure of group	in terms of population	53.49%		46.51%	
	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.

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.

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

Age group	Statistics	% change			
		High wage		Low wage	
20~29	Consumption for U (UI recipients)	1.14		-0.03	
	Job search effort for U (UI recipients)	-2.53		-0.01	
	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)	12.39		-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)**

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 before the policy change. Of course, an extension of the 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

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

Age group	Wage level		
	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

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

TABLE 15—THE OVERALL EFFECTS OF POLICY CHANGE 2

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	

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

TABLE 16—THE OVERALL EFFECTS OF POLICY CHANGE 2 BY SUBGROUP (WAGE)

Statistics		% change			
		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 (covered by UI)		**7.69**		**7.69**	
% change in total welfare for 20~84		-0.0034	**(-8.23)**	0.0125	**(25.10)**
% change in average welfare 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 recipients		**4.52**		**11.43**	
Measure of group	in terms of population	53.49%		46.51%	
	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 a deeper investigation of the reason why average 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.

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

Age group	Statistics	% change			
		High wage		Low wage	
20~29	Consumption for U (UI recipients)	0.43		0.87	
	Job search effort for U (UI recipients)	-2.44		-8.26	
	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)**
30~49	Consumption for U (UI recipients)	0.04		-0.50	
	Job search effort for U (UI recipients)	-0.77		-9.00	
	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)**
50~64	Consumption for U (UI recipients)	-0.00		-0.19	
	Job search effort for U (UI recipients)	-0.02		-9.43	
	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)**

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

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

Statistics		% change			
		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 (covered by UI)		**7.69**	**7.69**	**7.69**	**7.69**
% change in total welfare for 20~84		-0.0049 **(-13.48)**	0.0028 **(1.48)**	-0.0416 **(-44.71)**	0.1201 **(5623.57)**
% change in average welfare for 20~84		-0.0049 (-13.48)	0.0028 (1.48)	-0.0416 (-44.71)	0.1201 (5623.57)
	for E (covered by UI)	-0.0056 (-15.61)	-0.0018 (-3.87)	-0.0295 (-37.23)	0.2026 (large+)
	for E (not covered by UI)	-0.0046 (-13.38)	-0.0294 (-39.88)	-0.0134 (-21.25)	0.4729 (large+)
	for U (UI recipients)	0.1368 **(large+)**	0.1111 **(large+)**	-0.3571 **(-87.50)**	0.5374 **(large+)**
	for U (non-UI recipients)	0.0022 (6.38)	0.0043 (5.10)	-0.2594 (-81.75)	0.1811 (large+)
	for R	-0.0002 (-0.14)	-0.0005 (-0.22)	-0.0005 (-0.35)	-0.0005 (-0.22)
	for 20~64	-0.0053 (-14.99)	-0.0081 (-13.27)	-0.0434 (-46.55)	0.2747 (large+)
The number of UI recipients		4.38	20.48	11.29	12.98
Measure of group	in terms of population	40.29%	13.20%	32.13%	14.37%
	in terms of UI recipients	19.14%	0.16%	74.07%	6.63%

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.

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

Average job search effort for U (UI recipients)	High wage		Low wage	
	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

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

TABLE 20—THE GRADIENTS OF WELFARE IMPROVEMENT

Wage replacement rates			Maximum benefit durations		
%	% 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

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.

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

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

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.

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

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

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 low-wage 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 high-wage 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 high-wage 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 high-wage 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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