

WELFARE EFFECTS OF INTEGRATED SOCIAL INSURANCE SYSTEM*

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This paper explores the optimal social insurance system against unemployment both theoretically and empirically. Using a simple theoretical framework we show that unemployment insurance provides insurance against unemployment risk and enhances distributional equity, whereas self-insurance through borrowings promotes intertemporal consumption smoothing and maintains incentives of individuals. Then we use Korean and U.S. panel data sets to simulate the welfare effects of various insurance systems.

Simulation results demonstrate that the intertemporal income smoothing effect of self-insurance is fairly strong: even for a small degree of moral hazard associated with UI, increasing the portion of self-insurance improves social welfare. This continues to hold even when the government provides some retirement subsidy to poor individuals unless the moral hazard created by government policies is very serious. We also discuss some interesting differences between Korean data-based analysis and U.S. data-based analysis.

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I. INTRODUCTION

The unemployment insurance (UI) is one of the main government income support programs for the unemployed workers. While UI protects workers against the risk of unemployment, it suffers from incentive problems with recipients, for example by discouraging unemployed workers in job search. Hence, UI in itself may not function efficiently as a means of income security against unemployment.¹ Among various potential remedies to UI's incentive problems, 'self-insurance' has recently drawn attention as a reliable measure to complement the existing UI system.²

Previous works on 'self-insurance' have focused upon the role of savings or upon how the savings can affect the efficiency of UI, but relatively little attention has been paid to the borrowings of the unemployed workers against their future incomes. As Stiglitz and Yun (2005) have shown, self-insurance through borrowings improves welfare because it provides the unemployed workers with chances to smooth out their incomes over their lifetime and thereby mitigating the burden associated with unemployment risk, without reducing their incentives for seeking reemployment.³

Considering positive welfare effects of UI, such as provision of insurance and favorable redistribution among different groups of workers, the optimal social insurance system probably involves a mixture of UI and self-insurance through borrowings.

On the other hand, the welfare effects of self-insurance through borrowings could be constrained by the possibility of default on the part of borrowers, whom the government may be compelled to bail out. More specifically, when the government subsidizes those whose savings for retirement is lower than a certain minimum level, the government has to cover not only retirement subsidy but also the repayment of borrowings for those poor individuals. This type of redistributive retirement insurance

¹ See for example Hopenhayen and Nicolini (1991)

² See Costain (1999), Flemming (1978), and Feldstein and Altman (1998)

³ This assumes that individuals are rational enough to consider their borrowings as something they have to repay out of their own pension savings. To the extent that individuals are myopic, however, the incentive effect of self-insurance would be adversely affected. See Stiglitz-Yun (2005).

will surely limit the efficiency of self-insurance because it would create rooms for opportunistic behaviors of the borrowers, and thus will affect the optimal mixture of UI and self-insurance.

The optimal mix of the two types of insurances, which will be called the integrated social insurance system in this paper,⁴ is the main focus of this paper. Finding the right balance between these two types of insurances (traditional UI versus self-insurance) is a delicate matter, and this paper will attempt to assess welfare effects of various mixes of UI and self-insurance.

We first characterize the optimal mix in a simple theoretical framework, and then provide a rough estimate of it based upon the empirical simulation. For the simulation we use two different panel data sets, Korean EAPS and American PSID, reflecting the two different labor market situations.

From the simulation, some interesting results have been obtained that are consistent with the theoretical model. One important finding is that the intertemporal income-smoothing effect of self-insurance is fairly strong compared with insurance or distributional effects of UI; even when UI does not suffer much from incentive problems, the estimated optimal mix includes a substantial portion of self-insurance. In addition, this continues to hold even when the government provides some retirement subsidy to poor individuals, creating some incentive problems for self-insurance.

Another interesting finding is that relative welfare effects of self-insurance or UI are estimated to be different between Korean and US data sets. The intertemporal income-smoothing effect of self-insurance appears to be stronger in the US than in Korea, whereas the redistribution effect of UI turns out to be non-trivial in Korea.

The next section offers a simple theoretical model that can address welfare effects of UI and self-insurance and characterizes the optimal mix of the two, i.e. an integrated social insurance system. Section 3 describes the sources of the data and explains how we construct simulated data sets based upon the original data. Section 4 explains the simulation

⁴ The system integrates UI with retirement insurance in the sense that the unemployed individuals get a part of their future pension savings (through borrowings) as well as UI benefit.

methodology and presents the simulation results comparing welfare effects of various social insurance systems. Section 5 collects the main results of the simulation study and discusses their implications as well as further research topics to be developed from this study.

II. THE MODEL

Consider a 3-period model in which an individual may work for periods 1 and 2 at the wage w per period, and then retires in period 3. For simplicity, the model assumes away the intertemporal wage change and discounting. The worker may be confronted with unemployment shocks in each of the first two periods. The probability of an unemployment shock to an individual in period 1 is q , while that in period 2 depends upon whether or not he gets unemployed in period 1. The probability of a shock in period 2 for a worker who was previously unemployed is p_U , while that for a worker who was not unemployed is p_N .

Upon an unemployment shock a worker may choose to search or not to search for a job. If he searches, he has to incur search cost e_1 (or e_2) in period 1 (or in period 2) and he immediately gets reemployed in the period.⁵ If he chooses not to search, however, he will be unemployed in the period. The search costs e_1, e_2 for an individual are i.i.d. random variables with distribution functions $F(\cdot)$ and $G(\cdot)$, respectively.

When the realized search cost for an individual in a period is lower (higher) than a threshold level, which is determined optimally for the period as will be discussed below, he will choose to search (or not to search).⁶ Let $H_1 \equiv \frac{f(e_1)}{1-F(e_1)}$, $H_2 \equiv \frac{g(e_2)}{1-G(e_2)}$ and assume that H_1, H_2

are constant over e_1, e_2 , respectively. Note that H_1, H_2 indicate the search elasticity of reemployment, i.e., the degree of sensitiveness of reemployment with respect to search activity.

The government implements a program supporting the unemployed

⁵ The search activity in the model takes no time and guarantees a job for the worker with probability 1. Thus, a worker choosing to search will not be unemployed in the period, like the one with no unemployment shock.

⁶ The moral hazard caused by UI benefit is thus captured by the individual choice of the threshold level of search cost.

workers in period 1 (or in period 2), which provides them with unemployment insurance benefit r_1 (or r_2) and allows them to borrow some money R_1 (or R_2) against their future retirement incomes. The borrowers may not be able to repay what they have borrowed at the time of retirement, in which case the government bails them out. The government also implements a retirement insurance program, which provides subsidy to those ending up with low or zero retirement income. In particular, the retirement insurance program provides a fixed amount of subsidy S or $(S + S')$ to those unemployed in one period or to those unemployed in both of the two periods, respectively. The cost incurred by these programs, including expected UI benefits, expected cost of bail-outs and expected subsidy for those with low retirement incomes, is covered by the taxes imposed upon the employed workers.

Given the government programs characterized by $(r_1, R_1, r_2, R_2, S, S')$, let $V_{i,j}$ ($i, j = N, U$, where N, U indicate the state of employment and unemployment, respectively) denote the lifetime utility expected at the beginning of period 2 for a worker whose employment status is i in period 1 and j in period 2. That is,

$$\begin{aligned} V_{NN} &= \text{Max}_{s_2} \{U(1 - s_2) + U(s_1 + s_2)\} = 2U\left(\frac{1 + s_1}{2}\right) \\ V_{NU} &= \text{Max}_{R_2} \{U(r_2 + R_2) + U(s_1 + S - R_2)\} = 2U\left(\frac{s_1 + r_2 + S}{2}\right) \\ V_{UN} &= \text{Max}_{s_2'} \{U(1 - s_2') + U(S - R_1 + s_2')\} = 2U\left(\frac{1 - R_1 + S}{2}\right) \\ V_{UU} &= 2U\left(\frac{S + S'}{2}\right) \end{aligned}$$

Note that individual workers set their savings s_2, s_2' so as to equalize their consumptions between periods 2 and 3. The government will also set its borrowings R_2 to smooth out consumptions of individuals over time, i.e.,

$$R_2 = \frac{s_1 + S - r_2}{2}. \quad (1)$$

Note also that the government provides those unemployed in both of the two periods with the equal amount of subsidy $\frac{S+S'}{2}$ in period 2 and

3.

The total lifetime expected utility will then be

$$\begin{aligned} V = & \text{Max}_{e_1, s_1} (1 - \bar{q})[U(1 - s_1 - T_1) + \text{Max}_{e_2} \{\bar{p}_N V_{NU} + (1 - \bar{p}_N) V_{NN} \\ & - p_N \int_0^{\bar{e}_2'} edG\} + \bar{q}\{U(r_1 + R_1 - T_2) + \text{Max}_{e_2} \{\bar{p}_U V_{UU} \\ & + 2(1 - \bar{p}_U) V_{UN} - p_U \int_0^{\bar{e}_2} edG\}] - q \int_0^{\bar{e}_1} edF \end{aligned} \quad (2)$$

where $\bar{e}_1, \bar{e}_2, \bar{e}_2'$ are the threshold levels of search cost so that

$$\begin{aligned} \bar{q} & \equiv q(1 - F(\bar{e})) \\ \bar{p}_U & \equiv p_U(1 - G(\bar{e}_2)) \\ \bar{p}_N & \equiv p_N(1 - G(\bar{e}_2')) \end{aligned}$$

and

$$\begin{aligned} (1 - \bar{q})T_1 & = \bar{q}(r_1 + S) + (1 - \bar{q})\bar{p}_N(r_2 + S). \\ T_2 & = \bar{p}_U(S' + R_1) \\ P & = \bar{p}_U(1 + t) \end{aligned}$$

Note that the tax T_1 for UI benefit r_1 and the tax T_2 for the cost of defaulting on government borrowings R_1 are set to satisfy the government's budget constraint.

The threshold levels of search cost in period 2, \bar{e}_2, \bar{e}_2' , will be set as follows:

$$\begin{aligned} \bar{e}_2 & = U\left(\frac{1 - R_1 + S}{2}\right) - U(S + S') \\ \bar{e}_2' & = U\left(\frac{s_1 + r_2 + S}{2}\right) - U\left(\frac{1 + s_1}{2}\right) \end{aligned} \quad (3)$$

Also, the threshold level of search cost in period 1, \bar{e}_1 , will be determined as follows:

$$\bar{e}_1 = \text{Max}_{s_1} \{U(1 - s_1 - T_1) + V_N\} - \text{Max}_{R_1} \{U(r_1 + R_1 - T_2) + V_U\} \quad (4)$$

where

$$V_N \equiv \text{Max}_{e_2} \left\{ 2\bar{p}_N U\left(\frac{s_1 + r_2 + S}{2}\right) + 2(1 - \bar{p}_N) U\left(\frac{1 + s_1}{2}\right) - p_N \int_0^{\bar{e}_2'} edG \right\}$$

$$V_U \equiv \text{Max}_{e_2} \left\{ 2\bar{p}_U U\left(\frac{S + S'}{2}\right) + 2(1 - \bar{p}_U) U\left(\frac{1 - R_1 + S}{2}\right) - p_U \int_0^{\bar{e}_2} edG \right\}$$

Let us examine how an individual makes his decision on savings s_1 in period 1. To the extent that the savings s_1 affects the work incentive in period 2, the socially optimal savings would be different from the individual choice. This would impose additional complication upon the design of optimal social insurance system, however, let us assume that $p_N \approx 0$, implying that there is little chance for those who have not been unemployed in period 1 to get unemployment shock in period 2. More specifically, this assumption allows the optimal savings in period 1 to be set so as to smooth out consumption across the periods just like the way the individual choice of savings in period 1 is made. That is,

$$s_1 = \frac{1 - 2T_1}{3}, \quad (5)$$

so that

$$U(1 - s_1 - T_1) = U\left(\frac{1 + s_1}{2}\right) = U\left(\frac{2 - T_1}{3}\right).$$

2.1. Optimal Government Program

Let us denote by $(r_1^*, R_1^*, r_2^*, T_1^*, T_2^*)$ the optimal government program, which will satisfy the conditions, (6), (7), (8) below and (1) given the retirement income support (S, S') provided by the government to those who have been unemployed.

$$r_1 : A(r_1, R_1) \equiv 1 - \frac{H_1}{1 - \bar{q}}(r_1 + S)U'(\frac{2 - T_1}{3}) - \frac{U'(\frac{2 - T_1}{3})}{U'(r_1 + R_1 - T_2)} = 0 \quad (6)$$

$$R_1 : B(r_1, R_1) \equiv \frac{1 - \bar{p}_U}{\bar{p}_U} \left\{ 1 - \frac{U'(\frac{1 - R_1 + S}{2})}{U'(r_1 + R_1 - T_2)} \right\} - H_2 \left\{ R_1 U'(\frac{1 - R_1 + S}{2}) + S' U'(\frac{S + S'}{2}) \right\} = 0 \quad (7)$$

$$r_2 : 1 - H_2(r_2 + S)U'(\frac{2 - T_1}{3}) - \frac{U'(\frac{2 - T_1}{3})}{U'(r_2 + R_2)} = 0 \quad (8)$$

Note that the solutions for (r_1^*, R_1^*) are separated from the others in that we can solve for (r_1^*, R_1^*) from (6) and (7) independently of the other solutions. Once we get (r_1^*, R_1^*) , we will solve for s_1^* by (5), and then solve for (r_2^*, R_2^*) from (8) and (1).⁷

The necessary conditions for the optimal government program illustrate the welfare effects of UI and self-insurance. The conditions (6) and (7) suggest that UI benefit or self-insurance improves welfare by smoothing out consumption between employment and unemployment states or between period 1 and 2, although it is limited by the moral hazard indicated by H_1 or H_2 , respectively.

To examine the characteristics of the baseline government program (r_1^*, R_1^*) we state the following.

PROPOSITION:

- (i) $\frac{\partial r_1^*}{\partial p_U} > 0, \quad \frac{\partial R_1^*}{\partial p_U} < 0$
- (ii) $\frac{\partial r_1^*}{\partial H_1} < 0, \quad \frac{\partial R_1^*}{\partial H_1} > 0, \quad \frac{\partial(r_1^* + R_1^*)}{\partial H_1} < 0$

⁷ The second-order conditions for (r_1^*, R_1^*) are satisfied for an interior solution as $A_{11} < 0$, $B_{22} < 0$, $A_{11}B_{22} - A_{12}B_{21} > 0$, which is proved in Stiglitz and Yun (2005).

$$(iii) \quad \frac{\partial r_1^*}{\partial H_2} > 0, \quad \frac{\partial R_1^*}{\partial H_2} < 0, \quad \frac{\partial (r_1^* + R_1^*)}{\partial H_2} < 0$$

The proof is given in the Appendix. The results are intuitive. First, as the correlation between the two unemployment shocks, indicated by p_U , increases, the need for income smoothing across the two periods will be reduced and the moral hazard cost associated with default in period 2 increases, leading to lower level of government borrowings. Also, the lowered expected income for the unemployed in period 1 necessitates more of UI benefit r_1 . Second, as the incentive problem in period 1 or 2, indicated by H_1 or H_2 , respectively, gets more serious, the optimal UI benefit (and government borrowings) or the optimal government borrowings (and the UI benefit) will be lowered (and will increase), while the sum of the two benefits becomes lower in both cases.

2.2. Motivation for the Empirical Simulation

The theoretical arguments above suggest that the optimal mix of UI and self-insurance is determined by the relative welfare effects of the two insurances – income smoothing effects across the states (insurance) and across periods and moral hazard effects. In the rest of this paper, we shall empirically address this issue.

Based upon the two panel data sets, we will simulate the social welfare that can be attained by the various mixes of UI and self-insurance for different parameter values including the degree of moral hazard. In particular, the data sets allow us to identify the distributional effects of UI and self-insurance as well as the efficiency aspects examined in the theoretical model which analyzes the welfare of a representative individual.

Note, for example, that UI forces those with lower unemployment probability to subsidize those with higher unemployment probability, which is not present in the theoretical model. However, since the social welfare is computed as the sum of individual utilities below in simulation, the insurance effect of UI identified in the model will be captured by its distributional effect in the empirical simulation.

III. DATA

This section describes the data that will be used in the simulation. We rely on two panel datasets, Korean EAPS and U.S. PSID, to create two separate “artificial” societies with hypothetical lifetime profiles of real individuals selected from these data sources.

The construction of the “artificial” data proceeds as follows. First, we select real individuals out of the two panel datasets. Availability of responses on key variables is the major selection criterion.

Second, for each set of selected individuals, we statistically estimate 3 equations explaining 3 key variables – wage, unemployment probability, and unemployment duration (i.e. we estimate 6 different equations since there are 3 equations each for two datasets). The purpose of this procedure is to create full working lifetime profiles of individuals. This is necessary because panel surveys cover only a certain number of years, so the values of key variables are missing over some part of their lifetime. All sampled individuals have their work-related information for some portion of their life (e.g. age 40 through 65), but information for the rest of their working years (e.g. age 25 through 39) is missing in the original dataset. This leads to our next step.

Third, using the estimated equations, we “fill in” the values for the missing years to create hypothetical lifetime profiles over working years (ages 25 through 65) for all selected individuals. We randomly generate unemployment incidences (based on the estimated unemployment probability equations) over the missing years, and when randomly assigned to be employed for a particular year, we give them wage income predicted by the wage equation and if assigned to be unemployed, we determine the duration of unemployment (during which they do not earn any labor income) from the duration equation.

As the result, we construct two data sets (one based on Korean data, the other based on American data) that have actual and created work-related information for all selected real individuals over their full working lifetime. We will use these two hypothetical datasets in examining the impact of alternative insurance systems.

3.1. Data Sources and Selection of Individuals for Simulation

We use two well-known panel data sets. The Korean set is called *Economically Active Population Survey* (EAPS) and the American one is *Panel Study of Income Dynamics* (PSID). Since they are well known and frequently used by researchers, we will give only brief descriptions.

3.1.1. Korean EAPS

The *Economically Active Population*⁸ Survey (hereafter abbreviated as EAPS) is a monthly household survey administered by Korean National Statistical Office. EAPS asks respondents about their individual characteristics such as sex, age, schooling, marital status, their work histories such as employment status (employed, unemployed, not in labor force), job characteristics (regular, temporary, etc), and their search activities when unemployed. We complement EAPS with its *Supplementary Survey* (SS) that has additional information (e.g., labor income) on the same persons.

In EAPS, which began in 1963, a group of individuals is surveyed for four or five consecutive years, and then is replaced by a new group. Thus, it consists of several waves of 5-year (or 4-year) panel data sets. We use the most recent 5-year wave that was conducted from January 1998 through December 2002.

At the beginning of the 1998~2002 wave, a total of 30,000 households were sampled based on 1995 Korean National Census. Each individual is assigned a household key, gender and birth date. We select those who responded in all 60 months over the span, which totals 11,960. Among these, 7,373 (61.6%) were male and 4,586 (38.4%) were female.

3.1.2. American PSID⁹

The *Panel Study of Income Dynamics* (hereafter abbreviated as PSID),

⁸ “Economically Active Population” is a direct translation of the Korean language expression denoting “Labor Force”.

⁹ The following description has been excerpted from the overview of PSID posted at <http://psidonline.isr.umich.edu/Guide/Overview.html>

begun in 1968, is a longitudinal study of a representative sample of U.S. individuals and family units. It is conducted by the Survey Research Center, Institute for Social Research, University of Michigan.

From 1968 to 1996, PSID interviewed and re-interviewed individuals from families in the core sample every year. Adults have been followed as they have grown older, and children have been observed as they advance through childhood and into adulthood, forming family units of their own.

The PSID data files provide information about both families and individuals collected over the span of the study. The focus of the data is economic and demographic, with substantial detail on income sources and amounts, employment, family composition changes, and residential location. The most detailed information is available for the head of a household, so in selecting our individuals for simulation, we focus on household heads over 25 who answered all relevant variables across the span.

In contrast to Korean EAPS (with only 5-year span), PSID covers the period from 1968 through 2002, so the individual's answers cover a longer span but still do not present the full working lifetime of at least 40 years. Hence, both data sets require the following estimation procedures.

3.2. Estimation of Lifetime Profile Equations

Each respondent's portion of lifetime covered in the data varies and most of them do not report on their full working lifetime. For the American PSID, the length of survey is 34 years. The problem is more severe for the Korean EAPS that has only 5-year span.

For most empirical studies, this problem may not be serious or can be amended relatively easily. However, our study aims to examine issues that pertain to whole lifetimes of each individual, so we artificially created missing year information for all individuals. This was done by estimating statistical equations on 3 key variables – wage, unemployment probability, and the duration of unemployment.

For the sake of brevity, we directly present the estimated equations complemented by intuitive motivations for the form of model specifications.

3.2.1 Korean EAPS

1) Wage equation

We posit the determinants of wage to be a person's work experience, economy-wide technological advance (i.e. economic growth), person's education and sex.

We assume that a person begins his working career at age 25, so the variable $EXP (= age - 25)$ is the length of his work experiences for any given year. This term attempts to capture changes in wage over a person's lifetime. We expect the wage to rise as the person progresses over his lifetime at least up to a certain age. We add the quadratic term for EXP to capture the normally expected earning pattern that reaches a climax at some point before retirement over a lifetime.

$TECH$ is another time variable and counts the time distance from the beginning of the survey (1998). This term is meant to capture an economy-wide growth in wage that applies to all individuals. We would expect that wage income to rise as the economy grows with technological advances.

Finally, education levels and sex are obvious determinants of wage. We also allow for several interactions among these determinants.

The estimated equation is as follows (standard errors of coefficients are given in parentheses.) Most of the estimated signs are as expected.

$$\begin{aligned} \ln \text{WAGE} &= 3.81352 + 0.02317 \text{EXP} - 0.00066 \text{EXP}^2 + 0.01401 \text{TECH} + 0.19514 \text{EDU1} \\ &\quad (0.02614) \quad (0.00224) \quad (0.00005) \quad (0.00216) \quad (0.02038) \\ &+ 0.20286 \text{EDU2} + 0.35318 \text{SEX} + 0.03677 \text{EXP SEX} - 0.00090 \text{EXP}^2 \text{SEX} \\ &\quad (0.01575) \quad (0.02113) \quad (0.00229) \quad (0.00006) \\ &+ 0.00178 \text{EXP EDU1} + 0.01038 \text{EXP EDU2} \\ &\quad (0.00092) \quad (0.00088) \end{aligned}$$

where $WAGE$ = monthly wage income

EXP ("experience") = age – 25

$TECH$ ("technological advance") = current year – baseline year (1998)

$EDU1$ ("low education") = 1 if ≤ 9 years of schooling (up to middle school)
= 0 otherwise

EDU2 (“medium education”) = 1 if ≤ 12 years of schooling (high school)
= 0 otherwise

SEX = 1 if male, = 0 if female

2) Probability of unemployment equation

We need our individuals to fall into unemployment occasionally during their lifetimes in simulation. For this purpose, we estimate unemployment “probability” as measured by actual unemployment rates observed in real data.

The determinants of unemployment probability are posited to be person’s work experiences, education level and sex. We do not expect there to be any general trend of employment probability rising or falling as the time progresses, so TECH variable is dropped. As education levels and sex are dummy variables, the specification assumes a common pattern of unemployment incidences with overall “shifts” for each education-sex group.¹⁰ We expect lower education level and being female to be associated with being unemployed more often and assume once these are controlled for, everybody faces similar pattern of unemployment probability as he/she gets older.

Since we are attempting to estimate the probability of an event from actual occurrences, we apply Logit regression method. The estimated equation is as follows. Again all signs are as expected.

$$\begin{aligned} UNEMP = & -1.5949 - 0.0812 EXP + 0.0007 EXP^2 \\ & (0.0878) (0.0077) \quad (0.0002) \\ & - 0.6346 EDU1 - 1.0981 EDU2 + 0.4366 SEX \\ & (0.0530) \quad (0.0709) \quad (0.0459) \end{aligned}$$

where UNEMP = 1 if unemployed, = 0 otherwise

3) Unemployment duration equation

In creating lifetime profiles, how long a person is unemployed (if ever he is unemployed) is important for assessing effects of unemployment insurance. The determinants of duration are similar to those of

¹⁰ We tried estimating separate equations for each sex-education group but opted to use the current specification because separate equations did not show much different pattern and suffered from a smaller number of observations for some groups.

unemployment incidence, namely experiences, education and sex. We do not expect the duration to have any specific time trend, so we drop TECH.

We estimate the equation on all individuals, a majority of whom are *employed* at any given moment. Hence, the dependent variable is censored below, i.e. the duration variable cannot take negative values and are 0 for many, so we use Tobit regression to estimate the following equation.

$$\begin{aligned} DUR = & \\ & -0.9000 - 0.0240 \text{ EXP} + 0.0002 \text{ EXP}^2 - 0.1815 \text{ EDU1} - 0.3210 \text{ EDU2} \\ & (0.0308) (0.0024) \quad (0.0001) \quad (0.0160) \quad (0.0215) \\ & + 0.1482 \text{ SEX} \\ & (0.0139) \end{aligned}$$

where DUR (unemployment duration) = portion of unemployed months in given year

3.2.2. American PSID

We resort to a similar approach in extending data for PSID sample persons.

1) Wage equation

The equation is simpler than that for Korean data in that it does not have the interaction terms. The list of determinants is basically the same.

$$\begin{aligned} \ln \text{ WAGE} & \\ & = 0.27379 + 0.03644 \text{ EXP} - 0.00085 \text{ EXP}^2 + 0.05233 \text{ TECH} \\ & \quad (0.01593) (0.00146) \quad (0.00047) \quad (0.00045) \\ & + 0.28864 \text{ EDU1} + 0.62035 \text{ EDU2} + 0.38734 \text{ SEX} \\ & \quad (0.01049) \quad (0.01050) \quad (0.01163) \end{aligned}$$

where WAGE = wage income

EXP (experience) = age – 25

TECH (technological advance) = current year – baseline year (1968)

EDU1 (“low education”) = 1 if ≤ 9 years of schooling
= 0 otherwise

EDU2 (“middle education”)=1 if ≤12 years of schooling (high school)
 = 0 otherwise
 SEX = 1 if male, =0 if female

2) Probability of employment equation

Again, the equation specification is similar as in the Korean data and we apply Logit regression to estimate it.

$$\begin{aligned} UNEMP = & -0.9513 - 0.0199 EXP - 0.0018 EXP^2 \\ & (0.0713) \quad (0.0078) \quad (0.0003) \\ & - 0.5079 EDU1 - 1.1750 EDU2 - 0.9512 SEX \\ & (0.0441) \quad (0.0491) \quad (0.0569) \end{aligned}$$

where UNEMP = 1 if unemployed, = 0 otherwise
 (See above for other variable definitions)

3) Unemployment duration equation

As for the Korean data, Tobit regression gives us the following equation.

$$\begin{aligned} DUR = & \\ & - 0.2457 - 0.0060 EXP - 0.0004 EXP^2 - 0.1328 EDU1 - 0.2887 EDU2 \\ & (0.0199) (0.0019) \quad (0.0001) \quad (0.0120) \quad (0.0132) \\ & - 0.0760 SEX \\ & (0.0147) \end{aligned}$$

where DUR (unemployment duration) = portion of unemployed months

3.3. Creation of Hypothetical Lifetime Profiles

The values of determinants used in the equations are either determined or easily calculated for each individual: sex and education levels are fixed as reported in the survey, individual specific EXP and common TECH are both year variables.

Using these determinant values for missing years, we can assign predicted wage income for each individual. Due to the nature of this methodology, for a specific calendar year, all persons with the same birth

year, sex and education level would receive the same wage income (the average value for that group). This feature may be a bit troubling at first sight, but since our ultimate use of the data is to calculate the sum of utilities, we may ignore individual idiosyncracies within a group. For example, we could introduce idiosyncracies by adding individual shocks to wage and unemployment durations, but as long as these shocks tend to cancel out in the large, our overall conclusions in social utility will be unaffected.

However, while persons belonging to the same age-sex-education group are exposed to the identical risks of unemployment (e.g. middle age, male, highly educated persons are less prone to be unemployed for any given year compared to young, female, less educated persons), actual unemployment spells occur randomly. So we generate random numbers for each individual for each missing year and using the probability of unemployment predicted from the second equation, randomly assign some individuals to experience unemployment in that year.

The third equation is then used to decide the length of unemployment for those who were randomly assigned to be unemployed. Again, if any two persons in the same group are assigned to be unemployed in a particular year, they face the identical predicted length of unemployment spell.

From these steps, we created whole working lifetime profiles (from age 25 through 65) for all real individuals selected. Then we make a crucial assumption for the purpose of convenience: that *there are no additional births into this society during our analysis*.

For example, for the Korean data, the actual survey years (1998~2002) contain all selected persons. But in the hypothetical data, the earliest years have a small number of young persons only (those who are oldest in 1998 and begin their working careers earlier than others) and the later years have a small number of old persons only (those who were youngest in 2002 and will retire last). In other words, if one examines our society's population size across years the distribution has a "diamond" shape. This poses some difficulty in interpreting results later but we could not find any acceptable remedy. If we allow new births into the society, we then have to create artificial lifetimes for *those new persons*, and the same

problem appears again *ad infinitum*.

One possible remedy¹¹ is to utilize population surveys and forecasts, e.g. by Korean National Statistical Office, to restore the representativeness of the age distribution of the hypothetical society. But unless we disregard the utilities of those new persons injected into the society, our calculations will again face the problem of extending to account for this new data. If we disregard the utilities of new persons and focus only on our original individuals, then the direct effect on welfare of original individuals will be positive because the tax burdens are shared by more individuals. But the new persons also face unemployment risks and they will take away some benefits of social insurance from existing individuals, hence the impact of this remedy is theoretically ambiguous. On the other hand, our current procedure cannot be said to possess any predictable bias, either. Hence we acknowledge the limitations of our approach and proceed.

IV. SIMULATION OF EFFECTS OF ALTERNATIVE INSURANCE SYSTEMS

4.1. Outline of Simulation Methodology

Using the artificial societies created in the previous section, we consider several alternative employment insurance systems and compare the resulting welfare effects.

4.1.1. Evaluation criterion: societal sum of individual utilities from consumption

To simplify the analysis, we posit a simple “current year” utility function (what is sometimes called a felicity function) common to all persons – a CRRA (constant relative risk aversion) utility function with the current year income as the only argument.

¹¹ This was suggested to us by an anonymous referee.

$$U_t(C_t) = \frac{C_t^{-\delta}}{-\delta} \quad \text{where } C_t = \text{income in year } t$$

As is well known, this utility function has a constant measure of relative risk aversion δ .

The income C_t can come from wage, unemployment insurance payment, self-insurance payment, etc and after retirement, pension payment. In summing utility over an individual's lifetime, we discount future utilities with annual interest rate of 5%. In summing over all individuals, we employ "utilitarian" criterion and give equal weight to all persons. In other words, social welfare is judged to be the simple sum over all persons and all working and retirement years, discounted appropriately.

4.1.2 Structure of Baseline System: UI + Pension

The baseline system is designed to reflect the current practices in real life. There are two components to this system: society-wide unemployment insurance funded by insurance payments from labor income earners (or simply "taxes" hereafter) and personal pension funded by personal savings deposited during working years and paid out during each person's retirement phase. The personal pension may be thought of as social security (in U.S.) or national pension (in Korea) in that we require each person to save for future.

In all calculations below, we assume every person's working life is 41 years (age 25 through 65) and retirement phase lasts 15 years (age 66 through 80).

- Unemployment insurance (UI) is designed as follows: An unemployed person receives 50% of his current (i.e. the year in which the unemployment occurs) monthly wage for the duration of his unemployment spell. We impose annual budget constraint on the insurance system, i.e. the total amount of insurance payment must equal the total amount collected from everyone at the identical proportion of their wage incomes. Hence, the tax rate (unemployment insurance premium as percentage of wage income) differs every year as the

numbers of wage earners and unemployed persons change.

- Pension system is designed as follows: A pre-determined¹² proportion (savings rate) of wage income is set aside in personal accounts with annual compound interest rate of 5%. During the 15-year period of retirement phase, the accumulated savings with interests are equally divided per annum (with appropriate discounting) and taken out by the person as annual pension earnings.

There are two crucial differences between unemployment insurance (UI) and pension. First, UI acts as a societal cross-sectional income redistribution mechanism while pension achieves personal intertemporal income reallocation (“consumption smoothing”). This feature applies to all scenarios we consider below.

Second, our UI policy is in principle prone to moral hazard problem. Most critically, since there is no limit to the payment period, nor any requirement for active job search, the unemployed person may not exert the highest efforts in searching for jobs. In the analysis below, we will use a parameter that represents the extent of this moral hazard. The moral hazard parameter simply has the effect of prolonging the duration of unemployment spell. For example, if the parameter is set as 10% (the standard parameter value we use), whenever an unemployed person receives the insurance payment, his unemployment duration gets 10% longer than before.

4.1.3. Alternative System (1) Integrated Insurance

The major alternative to the baseline system is the integration of cross-sectional unemployment insurance and intertemporal personal pensions which can be borrowed against. We call this system Integrated Insurance or “II”. As the name suggests, this system “integrates” the separate

¹² For the Korean data we determined the optimal savings rate for a typical scenario and applied this rate uniformly. Assuming UI system with moral hazard parameter of 10% and risk aversion parameter (“ δ ”) to be 1, we calculated the sum of utilities for various levels of savings rate and found 9.5% to be optimal. Considering the ease of calculation, we set the savings rate to be 10% (which was the second best rate among our trials). The following table shows the calculation decomposed into 6 groups and society as a whole. Similarly for the American data.

components of the previously introduced baseline system. In other words, part of the insurance payment is made out of personal pension savings while the rest is funded by taxes. Hence, it combines the social insurance and the personal self-insurance. For transparent comparison, we keep the unemployment payment level constant at 50% of current wage across different scenarios.

As was explained by the theoretical model above, there are two distinct effects of this integrated system. First, depending on the cross-sectional and intertemporal distributions of income, introduction of self-insurance from pension savings may or may not raise utility since the integration prevents cross-sectional redistribution and enhances intertemporal smoothing. Second, if UI is associated with moral hazard, then the introduction of self-insurance will obviously increase utility due to the mitigating effect on moral hazard. Less moral hazard implies shorter unemployment spells and in turn implies lower rate of taxes for all.

We ran simulations on several different mixes of UI and self-insurance, and report on three representative mixes: (i) 15% of wage is paid out of pension savings (i.e. the remaining 35% is paid out of taxes), (ii) 25% is paid out of savings, (iii) 35% is paid out of savings.

4.1.4. Alternative System (2) Modified Integrated Insurance with Pension Subsidy

The obvious disadvantage of using pension savings for unemployment insurance is that the person's retirement consumption is reduced. For those at the bottom of income groups, introduction of self-insurance may severely jeopardize consumption after retirement. Hence, we add a modification in the form of government subsidy.

We posit the subsidy to be offered to the population's bottom 10% in terms of annual post-retirement pension receipts. Specifically the government gives subsidies to people belonging to the bottom 10% so that each person's pension receipts would equal the threshold 10% level. The source of this subsidy is again taxes. Hence, the subsidy will increase recipients' utility at the expense of the rest of population. Because 90% (those who are better off) of the population support the least well-to-do

10%, it is expected to increase the total utility.

However, the presence of subsidy may also induce moral hazard for those likely to be receiving subsidies in the future and this can nullify the original advantage of self-insurance. It is not theoretically clear whether such modified integrated insurance system is superior to the baseline system or the integrated insurance, hence the need for the simulation.

4.1.5. Research Questions

To summarize, we will be considering baseline system against two broadly defined alternative systems, with varying values of relevant parameters. For some of the scenarios, we have strong theoretical predictions, and for others, the prediction depends on complex considerations requiring simulation.

Broadly speaking, we have following questions to examine.

- (1) Does the integrated insurance enhance social utility from baseline system
 - ☐ when there is no moral hazard associated with unemployment insurance
 - ☐ as the extent of moral hazard varies
 - ☐ as the portion of self-insurance in the integrated package varies
- (2) Does the modified integrated insurance (with subsidy) enhance social utility
 - ☐ when there is no moral hazard associated with subsidy
 - ☐ as the extent of moral hazard of subsidy varies
 - ☐ as the portion of self-insurance in the package varies

4.2. Simulation on Korean data

4.2.1. Simulation (1): Baseline versus Integrated Insurance

In this simulation we compare social utility from integrated insurance with that from the baseline system (UI + personal pension). We present results for three different mixes of social insurance and self-insurance in the II system. The baseline system can be seen as another mix where zero

self-insurance is included. Hence, we are comparing 4 different packages where the pension savings provide 0% (baseline), 15%, 25% and 35% of current wage as unemployment insurance payments.

The results with the representative parameter values are given in the following table. Some explanations are in order for interpreting the table. As noted in the title, the table presents the calculated sum of social utility when the extent of moral hazard (due to lessened incentive in job search leading to longer unemployment) is 10% and the relative risk aversion parameter δ equals 1. We will shortly discuss how the results change when these parameter values are altered.

[Table 1] When moral hazard parameter is 10% and risk aversion parameter is 1

SEX	EDU	Tax 50% Self 0%	ΔU (%)	Tax 35% Self 15%	ΔU (%)	Tax 25% Self 25%	ΔU (%)	Tax 15% Self 35%
Female	L	-242.4775	.09	-242.2493	.06	-242.0967	.06	-241.9437
	M	-78.0192	.06	-77.9698	.04	-77.9368	.04	-77.9036
	H	-18.6103	.06	-18.5989	.04	-18.5913	.04	-18.5838
Male	L	-77.7570	.13	-77.6526	.09	-77.5830	.09	-77.5134
	M	-50.2483	.11	-50.1939	.07	-50.1577	.07	-50.1215
	H	-22.9114	.11	-22.8868	.07	-22.8705	.07	-22.8543
Total		-490.0235	.10	-489.5514	.06	-489.2361	.06	-488.9202

The table shows the results as decomposed into 6 different groups of sex and education levels. In this particular table, all groups show identical patterns in utility change. In other words, society is clearly better off with higher mix of self-insurance in the package for all sex-education groups.

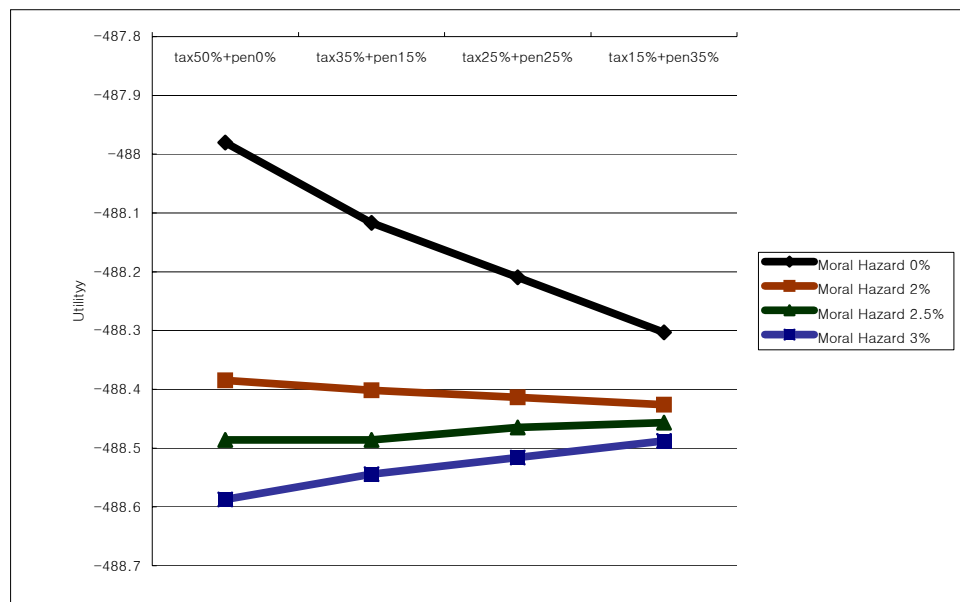
The utility figures are in negative values since the CRRA utility function we posited give negative values. We did not correct this, say, by adding arbitrary positive constant to each individual utility since the direction of utility change is the same and we also wanted to evaluate the relative sizes of utility changes. All utility change (%) figures in the table compare adjacent two mixes. Hence, there is 0.10% increase in total utility in moving from baseline (0 self-insurance) to a “low” mix (15% self-insurance), and then additional 0.60% increase in total utility in moving from the “low” mix to “middle” (25% self-insurance) mix, then finally additional 0.60% increase in moving from “middle” to “high” mix package.

As was explained before, throwing self-insurance into the mix incurs two separate effects – (i) it weakens cross-sectional income redistribution and enables each individual to achieve a better intertemporal smoothing, and (ii) it lessens the adverse consequences of moral hazard leading to shorter unemployment spells and lower taxes.

The second effect is highly likely to increase social utility. But the direction of the first effect is theoretically ambiguous as it results from a trade-off between cross-sectional redistribution and intertemporal smoothing. Depending on the relative sizes of these changes, the result may or may not increase social utility. For the particular parameter values reported in Table 1, the second effect clearly dominates the first effect since every group experiences higher utility.

To see whether this finding applies to other parameter values, we examined lower values of moral hazard (which will lessen the second effect). The results are shown in the following figure. It shows that when there is no moral hazard, (hence there is no second effect) higher portions of self-insurance in fact lowers social utility, implying that the first effect is in the direction of lower utility.

[Figure 1] Social utility across insurance packages as moral hazard varies



In other words, in our hypothetical society created from Korean data, utility gain achieved by intertemporal smoothing is not greater than utility loss incurred by giving up on redistribution. This is in stark contrast to what we will find with the American PSID data (see below). The figure reveals that the threshold level of moral hazard, when various effects are exactly cancelled out, is between 2% and 2.5%. Hence, if UI has the effect of unemployed persons' duration of unemployment to prolong at least 3%, then the integrated insurance system is clearly superior.

4.2.2. Simulation (2): Modified Integrated Insurance with Pension Subsidy

We now add a new feature to our integrated insurance system, namely that the lowest bottom 10% in terms of pension receipts are given subsidies guaranteeing for each of them the equal amount of pensions set at the pre-subsidy bottom 10% level.

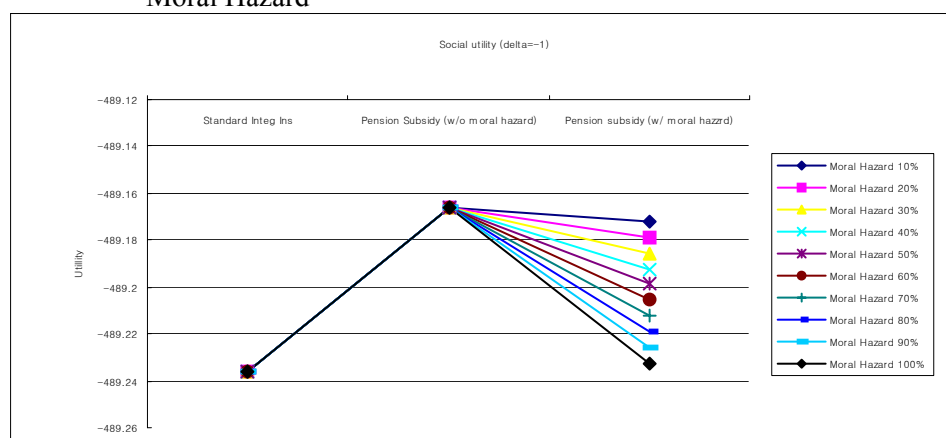
This will enhance the least well-to-do individuals' utilities, while burdening the rest of the population with additional taxes. Since 90% of the population support 10% and the transfer moves down a concave utility function (achieving a better income distribution), this subsidy is likely to enhance the total utility. However, the knowledge of the future subsidies can discourage the younger unemployed workers to search for jobs (just like social insurance does) erasing some merits of self-insurance.

The following figure shows social utility levels for the standard ("middle") integrated insurance (25%-25% mix without any pension subsidies) and modified systems. For modified systems, we allow the moral hazard of subsidy to vary from 0% up to 100%. (This parameter works the same way as the moral hazard parameter for unemployment insurance, i.e. lengthening of the unemployment durations.) Note that for the standard integrated insurance, we still apply 10% moral hazard arising from unemployment insurance.

As a representative case, the following table reports the utility figures for the case when risk aversion parameter is 1, there is 10% moral hazard from unemployment insurance, 50% of current wage is provided from 25:25 mix of unemployment insurance and pension savings and there is

30% moral hazard from pension subsidies.

[Figure 2] Social utility among II without Subsidy (Standard), II with Subsidy and no Moral Hazard, and II with Subsidy and Varying Levels of Moral Hazard



[Table 2] Comparison of Social Utility across Different Systems

		Integrated Insurance	ΔU (%)	Subsidy (w/o MH)	ΔU (%)	Subsidy (w/ MH)
Female	Low	-242.10	0.034	-242.01	0.027	-242.03
	Mid	-77.94	-0.004	-77.94	-0.005	-77.94
	High	-18.59	-0.010	-18.59	-0.010	-18.59
Male	Low	-77.58	-0.004	-77.59	-0.005	-77.59
	Mid	-50.16	-0.006	-50.16	-0.007	-50.16
	High	-22.87	-0.007	-22.87	-0.007	-22.87
Total		-489.24	0.014	-489.17	0.010	-489.19

4.3. Simulation on American data

As in the previous subsection, we carry out similar simulations over PSID-based hypothetical society data. One difference is that for the American PSID data, our sample individuals are mostly male (because we focused on household heads) so we do not decompose the results regarding sex.

4.3.1. Simulation (I): Baseline versus Integrated Insurance

In this simulation we compare social utility from integrated insurance

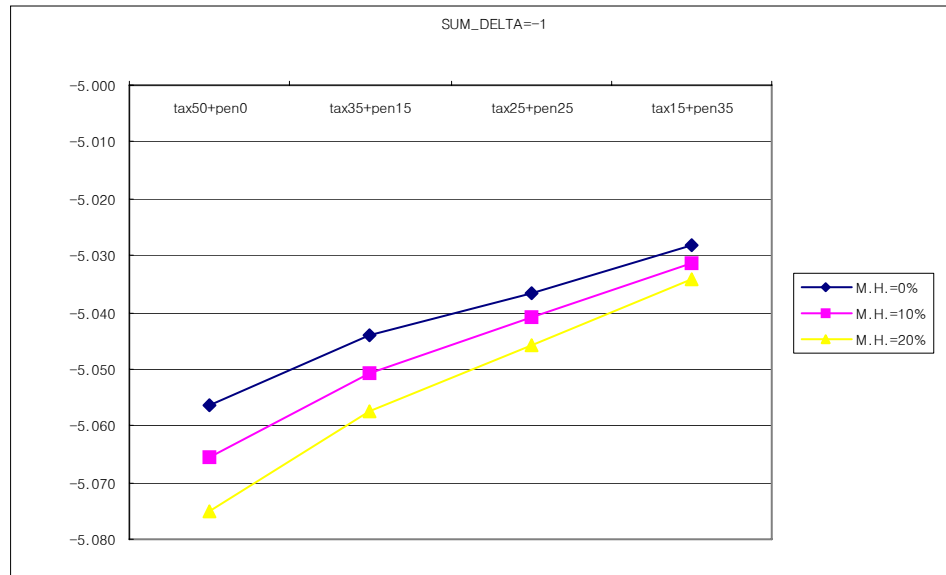
with that from baseline system of unemployment insurance plus personal pensions. Again, we allow for three different mixes of social insurance and self-insurance in the II system. The results with a representative parameter values are given in the following table.

[Table 3] When moral hazard parameter is 10% and risk aversion parameter is 1

EDU	Tax 50% Self 0%	ΔU (%)	Tax 35% Self 15%	ΔU (%)	Tax 25% Self 25%	ΔU (%)	Tax 15% Self 35%
L	-0.75505	0.46	-0.75233	0.30	-0.75048	0.30	-0.74863
M	-2.65258	0.39	-2.64427	0.26	-2.63879	0.26	-2.63336
H	-1.65782	0.28	-1.65409	0.18	-1.65163	0.18	-1.64920
Total	-5.06544	0.37	-5.0569	0.24	-5.04090	0.24	-5.03120

As in the Korean case, all groups show identical patterns in utility change. The society is clearly better off with higher mix of self-insurance in the package regardless of education level. So for the particular case reported in the table, the second effect (reduction of moral hazard) clearly dominates the first effect (trade-off between income redistribution and intertemporal smoothing) of self-insurance.

[Figure 3] Social utility across insurance packages as moral hazard varies

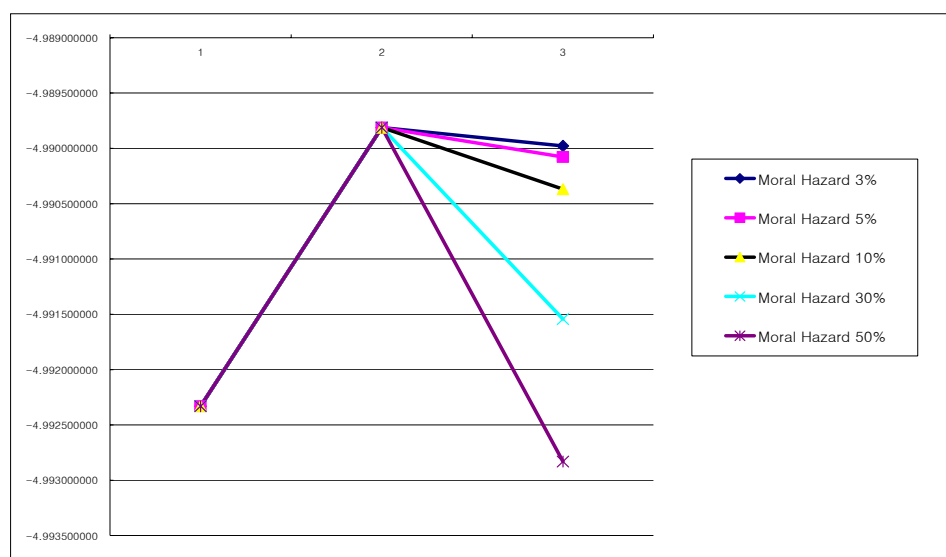


To see whether this finding applies to other parameter values, we examine other values of moral hazard parameters. The results are shown in the following figure. It shows (in contrast to Korean data) that even when there is no moral hazard (hence there is no second effect) higher portion of self-insurance enhances social utility. This can be interpreted as follows: for the American data, self-insurance helps each individual achieve better life-time smoothing so that even without the beneficial effect of reducing moral hazard associated with employment insurance policy, the higher share of self-insurance in the integrated insurance package is socially better. In other words, for this particular hypothetical society, there probably is greater disparity of incomes across one's lifetime than there is across individuals at the same time period.

4.3.2. Simulation (II): Modified Integrated Insurance with Pension Subsidy

Now the lowest bottom 10% in terms of pension receipts are given subsidies guaranteeing for each of them the equal amount of pensions set at the pre-subsidy bottom 10% level.

[Figure 4] Social utility among II without Subsidy (Standard), II with Subsidy and no Moral Hazard, and II with Subsidy and Varying Levels of Moral Hazard



The following figure shows social utility levels for standard integrated insurance (25%-25% mix without any pension subsidies) and modified systems. For modified systems, we allow the moral hazard of subsidy to vary from 0% up to 50%. While for Korean data we allowed the moral hazard to reach 100% and still did not see a decline in social utility, here the utility is lower than baseline for 50% moral hazard.

In other words, for the American data, if subsidy increases recipients' unemployment duration 50%, then subsidy can harm the total population.

The following table reports the utility numbers for the case when risk aversion parameter is 1, there is 10% moral hazard from unemployment insurance, 50% of current wage is provided from 25:25 mix of unemployment insurance and pension savings and there may be 30% moral hazard from pension subsidies.

[Table 4] Comparison of Social Utility

Ed	Integrated Insurance	ΔU (%)	Subsidy w/o Moral Hazard	ΔU (%)	Subsidy with Moral Hazard
Low	-0.738561	-0.29	-0.736438	0.20	-0.737878
Mid	-2.610472	-0.02	-2.610060	0.01	-2.610348
High	-1.643298	0.00	-1.643314	0.00	-1.643317
Total	-4.992330	-0.05	-4.989813	0.03	-4.991543

V. DISCUSSION OF RESULTS

In this section, we recapitulate key findings from simulation analysis reported in the previous section. First, we present findings that pertain to both the Korean data-based analysis and the American data-based analysis. Then, we point out differences between the two analyses and attempt to provide the interpretations.

5.1. Common Findings

- (1) Integrated insurance enhances social utility from baseline system
 - when there exists *some* moral hazard arising from social insurance
 - as the extent of moral hazard increases, positive effects of

integrated insurance (i.e. self-insurance) increases

- as the portion of self-insurance in the package increases, positive effects of integrated insurance increases
- If there exists some moral hazard, all groups benefit from integrated insurance

(2) Subsidy enhances social utility

- when there is no moral hazard associated with subsidy
- while as the extent of moral hazard of subsidy increases, benefit decreases and can result in lower utility
- when the extent of moral hazard from subsidy is similar to that from social insurance

In words, integrated insurance system that uses the self-insurance is able to enhance social welfare given that the prospective workers face at least some moral hazard in job search from social insurance policies. The strengthening of self-insurance can adversely affect low wage workers, but this can be mitigated by introducing a ‘bail-out’ policy guaranteeing a certain minimum level of pension payment for the poorest retirees. While such subsidy or bail-out could cause an additional moral hazard problem, it does not appear to be significant for our hypothetical societies.

5.2. Some Notable Differences between the Two Data Sets

One notable difference between analyses from Korean data and American data is that for Korean data, if there is no moral hazard associated with social insurance, then integration of insurance can be harmful while for American data, even without moral hazard, the integrated insurance is superior.

This finding can be understood in terms of the two effects of self-insurance mentioned above. When there is no moral hazard, only the first effect exists – that of giving up on cross-sectional income redistribution and improving personal intertemporal smoothing. So the fact that the Korean data shows an adverse effect implies that income redistribution is more important than intertemporal smoothing for enhancing social utility. This can be tentatively explained in several ways. When given full

confidence to this finding, this means that Korean workers' wages are more varied than the extent of any single individual's income growth over lifetime. Hence, in Korean context, income redistribution is more important than in American context where there seems to be less cross-sectional variation in income than in intertemporal income growth. This may be due to the fact that EAPS survey was done immediately after Korea experienced the so-called financial crisis, covering a period when the income disparity was getting rapidly worse.

Another possible explanation is the span of the source panel data. Korean EAPS covers only 5-year span, so our hypothetical society data mainly consist of predicted values while American PSID covers longer span. If the difference in original data span is causing this difference, then it could mean that our wage equation understates the possibility of income growth over past and future years. While we cannot verify the accuracy of future predictions, we do have means to examine the predictions of the past against macroeconomic history. We leave this investigation for future work.

Differences observed for modified insurance (pension subsidy) are that American samples are more sensitive to moral hazard associated with subsidy. This can be explained in a similar fashion as above. Pension subsidy is basically an income redistribution policy and the income redistribution appears more significant for Korean data.

Finally, another notable finding is that when there is a high level of moral hazard associated with pension subsidy, even the lowest income group (who are mostly benefactor of subsidy) is adversely affected. This may be explained as follows. Since the effect of moral hazard is in extending unemployment duration, when there is a high level of moral hazard, those who expect to receive subsidies in retirement phase may experience such long unemployment spells that their wage incomes during working years may be seriously lowered and overall level of pension receipts also may suffer, leading to lower lifetime utility. While this is a possible explanation, we would need more probing into the results to confirm it.

VI. CONCLUSION

This paper explores the optimal social insurance system against unemployment both theoretically and empirically. Identifying welfare effects of unemployment insurance and self-insurance through borrowings, we analyze the optimal mix of the two types of insurances in a simple theoretical model. Unemployment insurance provides insurance against unemployment risk and enhances distributional equity. Whereas self-insurance through borrowings promotes intertemporal consumption smoothing and maintains incentives of individuals. Empirical simulations based upon the two panel data sets attempt to estimate the sizes of these welfare effects.

The empirical simulation demonstrates that the intertemporal income smoothing effect of self-insurance is fairly strong compared with insurance or distributional effect of UI: even for a small degree of moral hazard associated with UI, increasing the portion of self-insurance improves social welfare compared to the pure UI system. Also, this turns out to be the case even when the government provides some retirement subsidy to the poor individuals unless the moral hazard created by government policies is very serious. Another interesting finding is that relative welfare effect of self-insurance or of UI is estimated to be different between Korean and American data sets. The intertemporal income-smoothing effect of self-insurance appears to be stronger in the US than in Korea, whereas the redistribution effect of UI turns out to be non-trivial in Korea. In particular, the simulation shows that the introduction of self-insurance would always improve welfare compared to the pure UI system even without the moral hazard associated with UI in the US, while it is not the case in Korea.

One area of future research (suggested to us by an anonymous referee) is concerned with empirical methodology. Equations used in creating hypothetical dataset were estimated separately and the effect of moral hazard was to lengthen unemployment durations at exogenously determined rate. One way to improve this methodology is to allow for interaction between unemployment durations and social insurance receipts. This could be done by including insurance receipts as a determinant in duration equation, or take a simultaneous equations

approach¹³ by introduction a reservation wage equation (with insurance receipts as major determinants).

¹³ Lee, Maddala and Trost (1980)

APPENDIX

$$U_0 \equiv U\left(\frac{1-T_1}{3}\right), \quad U_1 \equiv U(r_1 + R_1 - T_2),$$

$$U_2 \equiv U\left(\frac{1-R_1+S}{2}\right), \quad U_3 \equiv U\left(\frac{S+S'}{2}\right)$$

$$D \equiv A_1 B_2 - A_2 B_1 > 0$$

<Proposition >

$$(i) \quad A_{p_U} > 0 \quad \text{because} \quad \frac{\partial \bar{q}}{\partial p_U} < 0 \quad \text{and} \quad \frac{\partial T_2}{\partial p_U} > 0.$$

$$\text{Also, } B_{p_U} < 0 \quad \text{because} \quad \frac{p_U}{U_1} \text{ is increasing}$$

$$\frac{\partial r_1}{\partial p_U} = \frac{1}{D}(-A_{p_U} B_2 + B_{p_U} A_2) > 0$$

$$\frac{\partial R_1}{\partial p_U} = \frac{1}{D}(-A_1 B_{p_U} + B_1 A_{p_U}) < 0$$

$$(ii) \quad A_{H_1} = -\frac{(r_1 + S)U_0'}{1 - \bar{q}}, \quad B_{H_1} = 0, \quad A_{H_2} = 0, \quad B_{H_2} = -\frac{R_1 U_2' + S' U_3'}{2}$$

$$\frac{\partial r_1}{\partial H_1} = \frac{1}{D}(-A_{H_1} B_2) < 0 \quad \frac{\partial R_1}{\partial H_1} = \frac{1}{D}(A_{H_1} B_1) > 0$$

$$\frac{\partial r_1}{\partial H_2} = \frac{1}{D}(B_{H_2} A_2) > 0 \quad \frac{\partial R_1}{\partial H_2} = \frac{1}{D}(-A_1 B_2) < 0$$

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