Public Pension Reforms and Private Savings

Minki Hong[1]

Korea Labor Institute

May, 2008

Abstract

The 1999 reforms of the Korea National Pension Scheme resulted in a very unique situation in which those who are insured by the pension scheme and those who are not coexist. Exploiting this situation, this paper evaluates the effect of public pension on private savings comparing outcomes of two groups without estimating expected pension wealth. Instead of using the standard Difference-in-Difference estimator, this paper uses the Changes-in-Changes estimator by Athey and Imbens (2006) in order to accommodate treatment effect heterogeneity. The estimation results show that the mean effect of pension is close to zero. Households with low or very high saving rates were little affected, while for the households with around mean saving rates the introduction of public pension reduced private wealth by about 25 percentages.

JEL Classification: H55, C14, D10.
Keywords: *Public Pension, Savings, Heterogeneous Treatment Effects*

---

[1] Financial Support for this research was provided through Korea Labor Institute grants. The views expressed herein are those of the author and do not necessarily reflect the views of the Korea Labor Institute. Electronic Correspondence: hminki@kli.re.kr.

1. Introduction

This paper empirically examines the effects of social security on private savings. In the simplest life-cycle models in which workers save only for retirement, increases in pensions are offset completely by reductions in private wealth. However, there are several factors that weaken the substitution effect: precautionary and bequest motives of savings, liquidity constraints, uncertainty on future pension benefits and so on.

Previous empirical studies also differ widely in their results. Many suggest no offset (Kotlikos, 1979; Gulliason, Kolluri & Panik, 1993), or offsets of 20 percent or less (King and Dicks-Mireaux, 1982; Diamond & Hausman, 1984; Hubbard, 1986; Novos, 1989, Gustman and Steinmeier, 1999). A few studies have found substantial offsets (Feldstein & Pellcchio, 1979; Bernheim, 1987; Gale, 1998).

Most of previous studies estimate expected pension wealth, the expected present discount value of future benefits that workers are entitled to, in a first step and estimate the relationship between private wealth and the expected pension wealth. Obviously, in estimating expected pension wealth, one has to account all the institutional details and make a number of strong assumptions on expected earning profiles, retirement age, and so on. It is known that empirical results may be extremely sensitive to methods of computing expected pension wealth[2].

---

[2] This sensitivity has been documented by Leiner and Lesnoy (1982) and Bernheim and Levin (1989). Bernheim and Levin (1989) argue that previous studies also employ highly questionable identifying restrictions and results will be extremely sensitive to specification

Furthermore, as we are interested in the individual saving behavior, we would ideally require an estimate of expected pension wealth as perceived by the individual (Attanasio and Brugiavini, 2003). Since people may not be completely certain that they will receive all the benefits to which they are entitled or expect a change in the social security legislation, estimates of social security wealth might deviate substantially from perceived wealth. Therefore, using estimates of social security wealth without considering uncertainty of future benefits may overestimates the effect of social security on private savings[3].

In this context, the 1999 reform to the Korean pension schemes provides a very unique opportunity to examine the effect of social security. Before 1999, the Korean National Pension Schemes (KNPS), which is a funded and defined benefits plan, had covered only who were working workplace with more than five full-time workers. In April 1999, the KNPS has extended compulsory coverage to all residents in Korea. As a result of this reform, the number of insured persons increased from about 6.5 million in 1998 to about 16 million in 1999. However, even if the participation is compulsory, due to limited enforcement, many have not participated in the KNPS. For example, 26 percent of the self employed aged 26 to 59 did not join the KNPS. As a result, we have a situation that those who are covered by the KNPS (the treatment group) and those who are not (the control group) coexist.

---

3. Exploiting pension reforms in Italy, Attanasio and Brugiavini (2003) examines the effect on savings using two methods: Difference-in-Difference (DID) comparing changes in mean saving rates of two different groups and regression method using estimated social security wealth. They found insignificant effect of social security from the DID method, while the regression method results in 35 percent offset of savings.

Some previous papers exploit reforms to public pension schemes. Attanasio and Brugiavini (2003) and Attanasio and Rohwedder (2003) exploit the 1992 Italian pension reform and three major U.K. pension reforms respectively. They use the changes in pension wealth across cohorts and employment groups induced by the reforms but rely on the estimated pension wealth computed from legislation. Also exploiting the Italian pension reforms, Bottazzi et al. (2006) compute expected pension wealth by using individual expectations of retirement age and replacement rate. On the contrary, this paper evaluates the effect of social security on saving by comparing the outcomes between the treatment group and the control group without estimating the expected pension wealth

This paper uses Changes-in-Changes (CIC) method developed by Athey and Imbens (2006) for evaluating the effects of the pension reforms. The CIC method has some advantages over the standard Difference-in-Difference method. The CIC allows (1) the effect of the treatment to differ across individuals and (2) the possibility that the treatment group adopted the policy because it expected greater benefits that in the control group. The standard DID method assumes that treatment effects are the same for all individuals and the policy changes are exogenous. The assumptions of the standard DID method are not likely fit to the situation of the 1999 reforms in Korea.

Estimation Results show that the mean effects of the introduction of public pension scheme in Korea are close to zero, while the effects were not the constant across households. Households below 50th percentile of savings rate and very high saving rates were little affected. On the other hand, savings rates for the households from around 50^{th} to 75^{th} percentiles decreased about 5~6 percentage points due to the public pension. This value

is correspondent to 25 percentages offset of savings by public pension compared to complete offset. No effect on households with low level of saving can be explained by the presence of the liquidity constraint and the very low level of awareness on the pension scheme. Small effect of pension for households with high saving rates can be explained by income effect and the low level of replacement rate. The mean effects from the DID estimator are very close to those from the CIC estimators. However, the DID estimator tends to overestimate the negative effect of pension for the households with high saving rates.

This paper proceeds as follows. The overview of the KNPS is presented in the next section. Section 3 discusses characteristics of data. A simple life-cycle model of pension and its implications are presented in Section 4. Section 5 presents the estimation methods and Section 6 and 7 show estimation results. Section 8 concludes.

2. Overview of the Korean National Pension Scheme

In this section I describe the structure of the Korean National Pension Scheme. The social security system in Korea, called the National Pension Act, came into effect in January 1988

The KNPS is a funded and defined benefits scheme. In this scheme, the government accumulates funds in pension accounts and pays benefits to retirees that depend on the number of years the individual has paid payroll tax and his past level of earnings. Since it is a defined benefit scheme, the benefits that an individual will receive are independent of the

actual investment performance of the funds. Unlike a pay-as-you-go system, current retirees do not receive benefits under the KNPS.

At its initial stage, the KNPS covered only those who were working in workplaces with more than ten full-time employees. Since then, the KNPS has extended coverage to workplaces with more than five full-time employees (January 1992), and farmers and fishermen (July 1995). In April 1999, the KNPS extended compulsory coverage to all residents aged 18 to 60 in Korea. Despite limited enforcement, the number of insured persons spiked from about 6.5 million in 1998 to about 16 million in 1999, as shown in Figure 1. The new participation of about 9.5 million persons accounted for 44.4 percent of the total labor force and 26.9 percent of the population over fifteen years of age.

The main sources of the new participants in 1999 (which are also the main sources of non-participants) are: (1) the self-employed, (2) employees in small business (i.e. workplaces with less than five workers), and (3) part time workers. Self-employed workers aged 26 to 59, which is the focus of this paper, account for 34 percent of total employment and 74 percent of them participated in the program. Full time workers account for 53 percent of total employment and 80 percent of these are covered by the program. The remaining 20 percent (who are therefore non-participants) are either workers in small businesses or irregular full-time workers.

Lax enforcement results from the fact that the audit or tax gathering system in Korea is incomplete and hence the government relies on voluntary reporting by the self-employed. Once a self-employed person is identified by the National Pension administration, he is sent notification that he is eligible for the pension program. The notification includes a request

that the individual report his annual income on which the contribution rate would be based. If he fails to reply by the due date, the administration sends a notice for payment of a contribution based on an estimated annual income. However, the administration has no enforcement mechanism for those who wholly refuse to participate in the pension program. A warning letter or threats of fines have been ineffective. Under the current system it is virtually impossible for the government to obtain information on the earnings of the self-employed. Therefore, because of the government's reliance on voluntary self-reporting, many of the self-employed escape participation. Workers in small businesses and irregular full-time workers are similarly able to avoid participation.

The contribution of workers is equally shared by the employer and the employee, while individually insured persons (the self-employed) pay their contributions entirely by themselves. The contribution rate was set low at the initial stage of the program and has gradually been increased. Since 1999, the contribution rate for laborers has been 4.5 percent while the self-employed pay 9 percent. This contribution of 9 percent is used to finance both old age insurance and disability insurance.

At present, the age at which individuals are eligible for the old-age pension is 60 years of age, but this increases to 61 years in 2013 and thereafter increases by one year every 5 years until it reaches 65 in 2033. A means-test is not applied to benefits. The benefits of the KNPS are largely determined by average monthly earnings. The income replacement rates are high for lower income households and low for higher income households. Figure 2 compares income replacement rates by income class in Korea and the U.S. In this figure income levels are normalized by the average monthly earnings of entire labor force. For

example, those whose earnings are half of the average income of total population and contribute for 20 years would receive 45 percent of their previous earnings after age 65. Those whose earnings are one and half times as much as the average income would get 21 percent of their previous earnings. The social security payroll tax for the self-employed in Korea (9 percent) is lower than that in the U.S. (12.4 percent[4]), whereas benefits are similar in both countries; the KNPS is more generous than the U.S. pension program.

Because the KNPS began as a funded system, the contribution and benefits structures are different across cohorts. Table 1 shows the differential structure of the program across cohort. For younger cohorts, the contribution period is long and hence the replacement rate is high, whereas for older cohorts the replacement rate is very low due to the very short period of contribution. For example, the replacement rate for cohorts aged 30-34 is 45 percent and that for cohorts aged 50-54 is only 10 percent. The last column of table 1 shows the ratios of social security wealth to social security benefits. The ratios are about 2.5 for all cohorts. This means that current KNPS structure is not sustainable in the long run. As this issue is being widely debated, it is reasonable to think that a change in the legislation will be expected. Because of this uncertainty of future reform as well as uncertainty of future benefits itself, perceived wealth might be much smaller than social security wealth given by the legislation.

Since the program is a funded system, the number of beneficiaries has been much

---

4 In the U.S., the Federal Insurance Contributions Act tax is levied at a rate of 15.3 percent. The tax is shared by employees and their employers. Of the total 15.3 percent tax, 12.4 percent is used to finance the Old-Age, Survivors, and Disability Insurance (OASDI) program, and 2.9 percent is used to finance the Medicare and Hospital Insurance Program

smaller than that of contributors and hence a huge pension fund has been accumulated. The ratio of the pension funds to GDP was 13.2 percent in 2000 and was expected to be 25.2 percent in 2005, 36.7 percent in 2010, and 44 percent in 2020.

3. Characteristics of Data and Sample

I use data from the Korea Labor and Income Panel Study (KLIPS), which is a longitudinal survey of the labor market and income activities of households and individuals. The KLIPS is a sample of households from urban areas and was designed to yield 5000 households whose members (aged 15 and over) interviewed annually. The KLIPS contains information about consumption, savings, income, demographics, and whether individuals participate in the KNPS.

I use the sample of households whose head is the self-employed aged from 25 to 55[5] those who are actually affected by the pension scheme. The self-employed are the main target group of the 1999 reforms. Data on 1998, which is the first wave of KLIPS, contains information about households prior to the pension policy reforms. This paper uses data from 2000 to 2003 as ones for the post-reforms. In order to evaluate the effect of the policy reforms, this paper uses four pairs of data: (1) data on 1998 and on 2000, (2) data on 1998 and 2001, (3) data on 1998 and on 2002, and (4) data on 1998 and on 2003. In this way, we can examine how the reactions of household evolve over time after the policy changes.

---

[5] I excluded households whose head change employment status, say from the self-employed to salary workers after 1999 if at least once.

One deficiency of the KLIPS associated with the topic of savings is that the data on 1998 do not have information about assets[6]. Accounting the data availability, this paper considers the relationship between social security and the saving rate of individual households instead of private wealth. Using saving rates instead of private wealth do not generates differences in the interpretation of the empirical results, as will be shown in the next section. Moreover, data on savings are likely to have better measurement error structure than data on assets.

Table 2 compares some characteristics of the control group and the treatment group in 1998, before the policy changes. The control group and the treatment group are determined according to whether the household head takes part in the KNPS or not[7]. The saving rate is the ratio of the amount of savings by individual household to the household's net income. The net income includes labor income, financial income, estate income, and transfer exclusive of debt payment. As shown in the Table 2, households in the treatment group are likely to have more household members, more household incomes, more housing assets, and higher savings rate. And households' heads in the treatment are likely to be more educated.

Mean saving rates for the control group and the treatment group before and after the policy change are shown in Table 3.

Note that the number of observation is reduced over time because of the attrition. When

---

[6] KLIPS since 1999 contains information on assets held by households.

[7] Household in which only the spouse of the head participates account for only 1.3 percentages of the self-employed that are eligible.

using data on 2000, the number of observation for the control and the treatment groups are 142 and 522 respectively, which the numbers are 119 and 402 respectively in data on 2003. Since the KLIPS has very low rate of attrition relative to other panel data such as PSIP, the potential bias from the attrition would not be severe. However one could still concern about the attrition bias.

The direction of the attrition bias is not obvious. The attrition rate is higher for the treatment group. The households dropped out have higher saving rates and income than the household remained. Considering the fact that the replacement rates of benefits are higher for the higher income household, it is reasonable to think that the effect of public pensions are smaller for the higher income households. Therefore, ignoring the samples dropped out leads to overestimation of the effects of public pensions. However, note that households with lower income more likely to face liquidity constraints and have low level of credibility on pension benefits[8]. These factors make the effect of pensions on lower income households much smaller and hence attrition may generate underestimate of the effect. Since the attrition has both directions in bias, we can not expect the direction of the attrition bias in either way.

4. Theoretical Framework and Its Empirical Implications

[8] Estimation results in section 6 support this argument.

I use the life-cycle model as a conceptual framework to investigate the relationship between public pension and household savings. I analyze a four-period model so that we can study how the introduction of social security affects people of different ages. The model assumes that in the first three periods households work and receive an exogenous income Y_t , t=1,2,3. In the last period they retire.

In the absence of social security, households choose optimal consumption and savings to maximize the sum of discount values of utilities:

$$\frac{C_1^{1-\gamma}}{1-\gamma}+\beta\frac{C_2^{1-\gamma}}{1-\gamma}+\beta^2\frac{C_3^{1-\gamma}}{1-\gamma}+\beta^3\frac{C_4^{1-\gamma}}{1-\gamma}$$

subject to

$$A_t = A_{t-1}(1+r)+Y_t-C_t, \qquad t=1,2,3,4$$

where A_t is the amount of asset held at the end of period t.

Solving the maximization problem yields the optimal saving rates in the absence of social security for each period. For example, the optimal saving rate in the absence of social security for the second period without liquidity constraints is:

$$SR_2^N \equiv \frac{Y_2-C_2}{Y_2}=1-\frac{1}{1+d+d^2}\left[1+\frac{(1+r)A_1}{Y_2}+\frac{Y_3}{(1+r)Y_2}\right]$$

where, $d = \beta^{1/\gamma}(1+r)^{(1-\gamma)/\gamma}$.

Suppose social security is introduced in period 2. Then, the budget constraint becomes

$$A_t = A_{t-1}(1+r) + (1-\tau)Y_t - C_t, \qquad t = 1,2,3$$
$$A_t = A_{t-1}(1+r) + B - C, \qquad t = 4$$

where τ is the social security contribution rate and B is the social security benefits. When households do not expect the introduction of the social security at the beginning of the period 2, the optimal saving rate in the presence of social security in period 2 without liquidity constraint is:

$$SR_2^I \equiv \frac{Y_2 - C_2}{Y_2} = 1 - \frac{1}{1+d+d^2}\left[1 + \frac{(1+r)A_1}{(1-\tau)Y_2} + \frac{(1-\tau)Y_3}{(1+r)(1-\tau)Y_2} + \frac{B}{(1+r)^2(1-\tau)Y_2}\right]$$

Define

$$\Psi(\beta) = \frac{1}{1+d+d^2}$$

The $\Psi(\beta)$ is a adjustment factor, which is a function of the time discount factor β hence a function of age. It can be shown that in a more general model with T periods of work before retirement, the adjustment factor is generalized by (Attanasio and Brugiavini, 2003):

$$\Psi(a,d) = \frac{1}{\sum_{j=0}^{ra-a} d^{j}}$$

where ra is retirement age, and a is the current age.

The presence of the adjustment coefficient $\Psi(\beta)$ represent that the way in which the pension wealth affects on savings are different ages and different planning horizon as stressed in Gale (1998). It implies that the change in saving by the policy reform is greater, the closer the individual is to retirement age. This is because younger individuals have a longer horizon over which to absorb the unexpected shock to pension wealth.

However, the institutional framework of the KNPS, a funded scheme, makes the greater effect of pension on older individual alleviate much. As shown Table 1, for younger cohorts, the contribution period is long and hence the replacement rate is high, whereas for older cohorts the replacement rate is very low due to the very short period of contribution under the KNPS. For example, the replacement rate for cohorts aged 30-34 is 45 percent and that for cohorts aged 50-54 is only 10 percent. Only considering this institutional framework, we can expect that the effect of pension on older individuals is much smaller. Taking into accounting these two opposite forces, the actual effect of pension are likely to be much flatter across ages

The effect of the introduction of social security on private savings is measured by the difference between the saving rate in the absence of social security, SR_t^N, and the saving rate in the presence of social security, SR_t^I. That is the treatment effect for each household, indicated by Δ, can be defined as:

$$\Delta \equiv SR_t^N - SR_t^I$$

The degree of effect of the introduction of social security on savings depends on the values of parameters that characterize the utility function and social security legislations. This paper calibrates the values of parameters based on some previous literatures and characteristics of Korea National Pension Scheme. This paper sets (β, γ, τ, r)=(0.97, 2.2, 0.09, 0.04). With these values of parameters, the treatment effect Δ becomes around 21.5 percentage point[9].

Note that the model in this section is a simple multi-period model without uncertainty, excluding any other motives savings such as precautionary or bequest motives and labor supply decisions. Therefore, I use the treatment effect Δ measured in the model as a measure of one-to-one or complete offset of public pension.

5. Estimation Method

For settings where panel of individuals are observed in a treatment group and a control

---

[9] I calculated the treatment effect using different values of parameters for the robustness check. The results do not change much around 21.5 percent with different values of parameters. When calculating the treatment effect, I assume that the ratio of benefits to contributions is 2.4 considering the features of the KNPS. If the KNPS were actuarially fair, the treatment effect would be around 9.6 percentage point.

group, before and after the policy changes[10], this paper uses Changes-in-Changes (CIC) method for estimating the effect of pension policy reforms on private savings. The CIC method, suggested by Athey and Imbens (2006), differ from the standard Difference-in-Difference[11] (DID) method in several ways. The CIC method allows treatment effect heterogeneity while the DID method assumes that the treatment effect is constant across individuals. Also, the CIC method accommodates the possibility that the treatment group adopted the policy because it expected greater benefits that in the control group, while the DID method assumes that the policy changes are exogenous. Using the CIC method, we can address many interesting questions such as what is distribution of effects of policy reforms or which individuals are more affected.

Suppose we have a random sample $i = 1,...,N$. Individual i belongs to a group, $G_i \in \{0,1\}$, where group 1 is the treatment group, and is observed in time period $T_i \in \{0,1\}$. Let I_i be an indicator for the treatment, that is, $I_i = G_i T_i$ Let SR_{gt}^N denote the saving rate when individual belongs to group g does not receive the treatment at time t, and $F_{N(g,t)}$ be the corresponding distribution function. Likewise this, let SR_{gt}^I denote the saving rate when individual belongs to group g does receive the treatment at time t, and $F_{I(g,t)}$ be the corresponding distribution function

I assume that in the presence of the pension scheme,

---

10 The CIC method can be applied to the setting with repeated cross sectional data.

11 The "standard DID" model means a model that assumes outcomes are additive in a time effect, a group effect, and an unobservable that is independent of the time and group.

$$SR_i^I = h^I(u_i, t_i) + x'\beta \qquad (1)$$

where u is unobservable propensity of savings and h is strictly increasing function in u. And x is a vector of observable household's characteristics. This implies that the model (1) assumes that the higher the unobservable propensity of savings is, household's savings rate is higher holding other things constant.

In order to apply CIC method to the model (1), we follow two-step estimation. In the first stage, we estimate the regression

$$SR_i = D_i'\delta + X_i'\beta + \varepsilon_i$$

where D is the four-dimensional vector $((1-T)(1-G), T(1-G), (1-T)G, TG)'$. In the estimation, X includes the size of household, indicator variable of owing house, household net income, head's age, the square of head's age, head's gender, marital status, and indicator whether a head is employer or self-employed. Then construct residuals with the group/time effect added back in:

$$\widetilde{SR}_i = SR_i - X_i'\hat{\beta} = D_i'\hat{\delta} + \hat{\varepsilon}_i$$

The second stage applies the CIC estimator to the $\widetilde{SR}$ as follows. Let $F_{N(g,t)}$ denote the

distribution function of $S\hat{R}_{gt}^{N}$, which is the augmented residuals of saving rate when individual belongs to group g does not receive the treatment at time t. Likewise this, Let $F_{I(g,t)}$ denote the distribution function of $S\hat{R}_{gt}^{I}$, which is the augmented residuals of saving rate when individual belongs to group g does receive the treatment at time t.

We need to estimate the counterfactual distribution function of saving rates for the treatment group in the absence of treatment, denoted by $F_{N(1,1)}$, in order to evaluate the effect of the pension policy reforms. The $F_{N(1,1)}$ can be estimated as, using the representation from Theorem 3.1 of Athey and Imbens (2006):

$$F_{N(1,1)}(SR) = F_{(1,0)}(F_{(0,0)}^{-1}(F_{(0,1)}(SR)))$$

Comparing $F_{I(1,1)}$, which is observable, with $F_{N(1,1)}$, we can evaluate the effect of social security on private savings for the treatment group. The standard errors are estimated from 1000 bootstrap draws.

6. Estimation Results

Table 4 shows the main results. The results on this table represent the effects of social security on private savings on the treated group. The mean effects are close to zero in 2000,

2001, and 2002.

The effects of the introduction of public pension scheme were not the constant across households. The lower percentile groups, households below 50th percentile of savings rate, were not affected by the introduction social security. As noted in Table 3, households below 50^{th} percentile of saving rate have almost zero saving rates. So, the estimation results imply that the public pension scheme did not change the saving behaviors of households with almost zero savings rates. On the other hand, savings rates for the households from around 50^{th} to 75^{th} percentiles decreased about 5~6 percentage points due to the public pension from 2001. The households with high savings rate (for example, 90^{th} percentile) do not show a clear pattern.

No effect on households with low level of saving can be explained by some reasons. The first reason is the presence of the liquidity constraint. The households around and below 25 percentile of saving rates has almost zero savings and are likely to be liquidity constrained. Households liquidity constrained had zero savings even without public pension. Therefore, those households cannot reduce their savings when the pension scheme introduced.

The second possible reason is the very low level of awareness on the pension scheme. As the level of education is positively related with the saving rate via income, the households with low saving rate is likely to be less educated and hence have low level of awareness on the pension scheme. The indirect evidence of this comes from the relationship between the level of income (or asset holdings) and participation in the pension program among the self-employed aged 16 to 55. The rate of participation in the KNPS is proportionally, positively related with the level of income. It means that households with lower income are less likely

to be participated in the KNPS. Considering that households with lower income can benefit from the KNPS legislation, low participation for the lower income households might suggest that they have very low level of awareness on the KNPS structure and hence little affected by the KNPS.

Small effect of pension for households with high saving rates can be explained by income effect and the low level of replacement rate. For the households with high savings rates, the pension wealth account for small portions of their whole wealth. Therefore, their saving behavior may little affected by the pension. As saving rates are positively related with income, the replacement rates for the households with higher saving rates is likely to be lower, reducing the incentive to change their saving behavior due to public pension.

The bottom panel of Table 4 shows the results from the DID estimator. The mean effects from the DID estimator are very close to those from the CIC estimators. However, the effects on different percentiles are different between CIC and DID estimators. The results from DID estimator show that the effect of pension is almost proportional to the savings rate: the degrees of offset of saving are proportionally increasing with households' savings rates. On the other hand, in the results from the CIC estimator, the effect of pension shows concave with saving rates. As a results, the DID estimator tends to overestimate the negative effect of pension for the households with high saving rates.

7. Results from Different Data on Savings

The KLIPS contains information on consumption, savings, and debt payment. Using this information, we can construct net income, denoted by net income 2, in indirect way: net income 2= consumption + savings – debt payment. One can say that information on consumption or savings are less likely to have measurement error than that on income.

I obtained another variable of savings rates, denoted by savings rate 2, using this net income 2. Table 5 shows the results using the savings rate 2. Overall, the results by using the saving rate 2 are not qualitatively different from those by using savings rate 1. As previous results shown in Table 4, the DID estimators tend to overestimate the effect of public pension, especially on the households with high savings rates (above 50^{th} percentile).

8. Conclusion

References

Athey, Susan and Imbens, Guido (2006), “Identification and Inference in Nonlinear Difference-in-Difference Models,” *Econometrica*, 74 (2), 431-497.

Attanasio, Orazio and Brugiavini, Agar (2003), “Social Security and Households’ Saving,” *The Quarterly Journal of Economics*, August, 1075-1119.

Attanasio, Orazio and Rohwedder, Susann (2003), “Pension Wealth and Household Saving: Evidence From Pension Reforms in the United Kingdom,” *American Economic Review*, Vol. 93 (5), 1499-1521.

Bernheim, Douglas (1987), "The Economic Effects of Social Security: Toward a Reconciliation of Theory and Measurement." *Journal of Public Economics*, 33, 273-304.

Bernheim, Douglas and Levin. L. (1989), "Social Security and Personal Saving: An Analysis of Expectations*", American Economic Review*, vol. 79, no. 2, 97-102.

Bottazzi, Renata, Jappelli, Tullio, and Padula, Mario (2006), “Retirement expectation, pension reforms, and their impact on private wealth accumulation,” *Journal of Public Economics*, 90, 2187-2212.

Diamond, Peter A., and Hausman, Jerry A. (1984), "Individual Retirement and Savings Behavior." *Journal of Public Economics*, 23, 81-114.

Dominitz, Jeff, Manski, Charles, and Heinz, Jordan (2003), "Will Social Security Be There For You? : How Americans Perceive Their Benefits." NBER working paper.

Feldstein, Martin. (1974), "Social Security, Induced Retirement and Aggregate Capital Accumulation." *Journal of Political Economy*, 82, 905-926.

Feldstein, Martin. and Liebman, J.B. (2001), "Social Security." Handbook of Public Economics.

Gale, William (1998), "The Effects of Pensions on Household Wealth : A Reevaluation of Theory and Evidence." *Journal of Political Economy*, 106(4), 706-723.

Gullason, Edward, Kolluri, Bharat, and Panik, Michael (1993), "Social Security and Household Wealth Accumulation: Refined Microeconometric Evidence." *Review of Economics and Statistics*, 75(3), 548-551.

Hubbard, Glenn (1986), "Pension Wealth and Individual Saving: Some New Evidence." *Journal of Money, Credit and Banking*, 18, 167-178.

Kotlikoff, Laurence (1979), "Testing the Theory of Social Security and Life Cycle Accumulation." *American Economic Review*, 69, 396-410.

Novos, Ian (1989), "Social Security Wealth and Wealth Accumulation: Further Microeconomic Evidence." *Review of Economics and Statistics*, 71(1), 167-171.

Table 1: The Generosity of the Korean National Pension Scheme

Age (as of 2002)	Eligible Ages	Contribution Periods (Years)	Replacement Rates	Benefits (1)	Contribution (2)	Ratio (1)/(2)
25-29	65	36-40	0.54	3.98	1.53	2.60
30-34	64-65	30-35	0.45	3.49	1.41	2.48
35-39	63-64	24-29	0.36	2.94	1.26	2.34
40-44	62-63	18-23	0.26	2.39	0.99	2.41
45-49	60-61	11-16	0.16	1.73	0.71	2.44
50-54	60	6-10	0.10	1.13	0.47	2.41

(Note) The Benefits and the contributions are measured by ten million Korean Won.

Table 2: Characteristics of the Control Group and the Treatment Group in 1998 (Prior to the Policy Reform)

	Control Group	Treatment Group
Household size	3.81 (1.29)	4.12 (1.03)
Own house (own=1)	0.51 (0.50)	0.59 (0.50)
Education (years)	10.82 (3.14)	11.50 (2.97)
Age	42.17 (6.60)	42.4 (6.5)
Marriage (marry=1)	0.82 (0.38)	0.92 (0.27)
Self-employed	0.73 (0.44)	0.67 (0.47)
Net Income (ten thousand won/year)	1719.70 (1055.88)	2080.23 (1615.5)
Saving Rates	0.189 (0.238)	0.194 (0.205)
Observations	145	529

(Note) Standard deviations are in parentheses. Self-employed is a indicator that equals one if a household's head is a self-employed and zero if a household's head is a employer. Education, age, and Marriage are on households' head. Net income=financial income + estate income + transfer + other incomes – debt payments. Saving Rates = savings / net income.

Table 3: Summary Statistics: Savings Rates

1. 1998 and 2001

	mean	(s.d.)	10th perc.	25th perc.	50th perc.	75th perc.	90th perc	N
Control Group, First Period	0.1550	0.2380	0	0	0.0199	0.2318	0.4902	131
Control Group, Second Period	0.1644	0.1929	0	0	0.0960	0.2479	0.4085	128
Treatment Group First Period	0.1979	0.2188	0	0	0.1508	0.3308	0.4975	439
Treatment Group, Second Period	0.1962	0.2987	0	0.0412	0.1426	0.2777	0.4680	427

2. 1998 and 2002

	mean	(s.d.)	10th perc.	25th perc.	50th perc.	75th perc.	90th perc	N
Control Group, First Period	0.1390	0.2028	0	0	0	0.2062	0.4473	111
Control Group, Second Period	0.1665	0.1746	0	0.0171	0.1015	0.2604	0.4138	112
Treatment Group First Period	0.2025	0.2268	0	0	0.1508	0.3311	0.4975	432
Treatment Group, Second Period	0.1868	0.2002	0	0.0500	0.1263	0.2685	0.4200	434

3. 1998 and 2003

	mean	(s.d.)	10th perc.	25th perc.	50th perc.	75th perc.	90th perc	N
Control Group, First Period	0.1387	0.2159	0	0	0	0.2275	0.4902	119
Control Group, Second Period	0.1240	0.2884	0	0	0.0643	0.2137	0.3636	123
Treatment Group First Period	0.2021	0.2232	0	0	0.1508	0.3311	0.4950	402
Treatment Group, Second Period	0.1742	0.1848	0	0.0213	0.1289	0.2567	0.4474	403

Table 4: Estimation Results

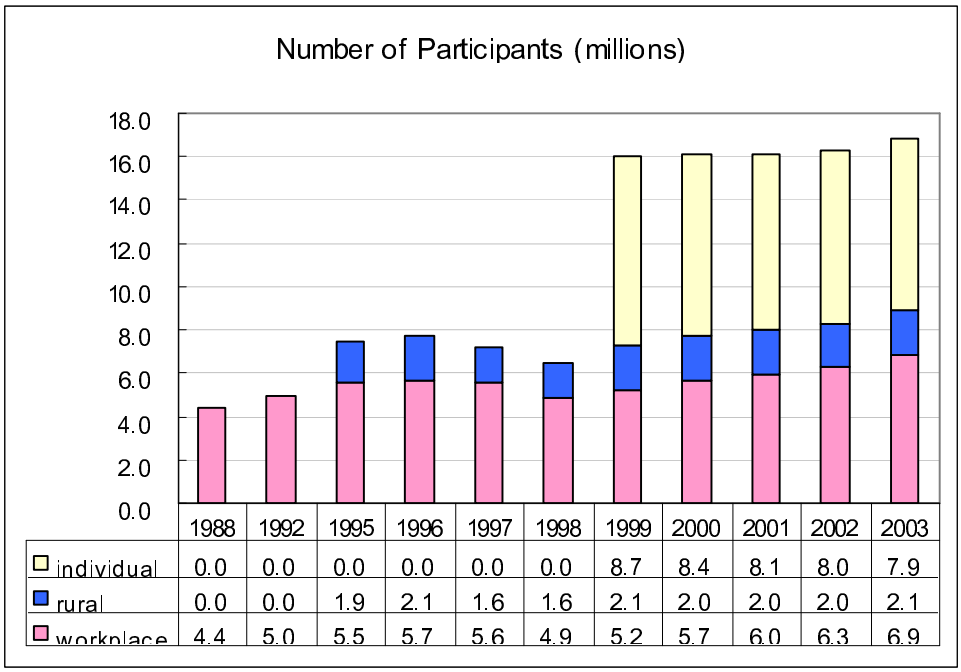
	1998 and 2000	1998 and 2001	1998 and 2002	1998 and 2003
	CIC	CIC	CIC	CIC
mean	0.0097 (0.0280)	-0.0081 (0.0343)	-0.0417 (0.0290)	-0.0014 (0.0491)
10th perc	0.0114 (0.0134)	0.0070 (0.0159)	-0.0098 (0.0174)	-0.0049 (0.0117)
25th perc	-0.0055 (0.0120)	0.0055 (0.0227)	0.0026 (0.0192)	-0.0254 (0.0254)
50th perc.	0.0202 (0.0413)	-0.0577 (0.0335)	-0.0668 (0.0484)	-0.0628 (0.0483)
75th perc.	0.0235 (0.0428)	-0.0460 (0.0547)	-0.0644 (0.0504)	-0.0331 (0.0704)
90th perc.	0.0428 (0.0379)	0.0451 (0.0742)	-0.1869 (0.0902)	0.0267 (0.0964)
	DID	DID	DID	DID
mean	0.0094 (0.0276)	-0.0088 (0.0316)	-0.0460 (0.0256)	-0.0137 (0.0364)
10th perc	0.0478 (0.0235)	0.0002 (0.0296)	-0.0132 (0.0232)	0.0247 (0.0326)
25th perc	0.0441 (0.0236)	0.0125 (0.0257)	-0.0028 (0.0212)	0.0172 (0.0343)
50th perc.	0.0426 (0.0333)	-0.0114 (0.0316)	-0.0617 (0.0328)	-0.0220 (0.0438)
75th perc.	-0.0003 (0.0300)	-0.0635 (0.0380)	-0.0835 (0.0321)	-0.0499 (0.0395)
90th perc.	-0.0627 (0.0333)	-0.0372 (0.0420)	-0.1210 (0.0325)	-0.0529 (0.0428)

(note) The bootstrap standard errors are in parenthesis.

Table 5: Estimation Results from Different Data on Saving Rate

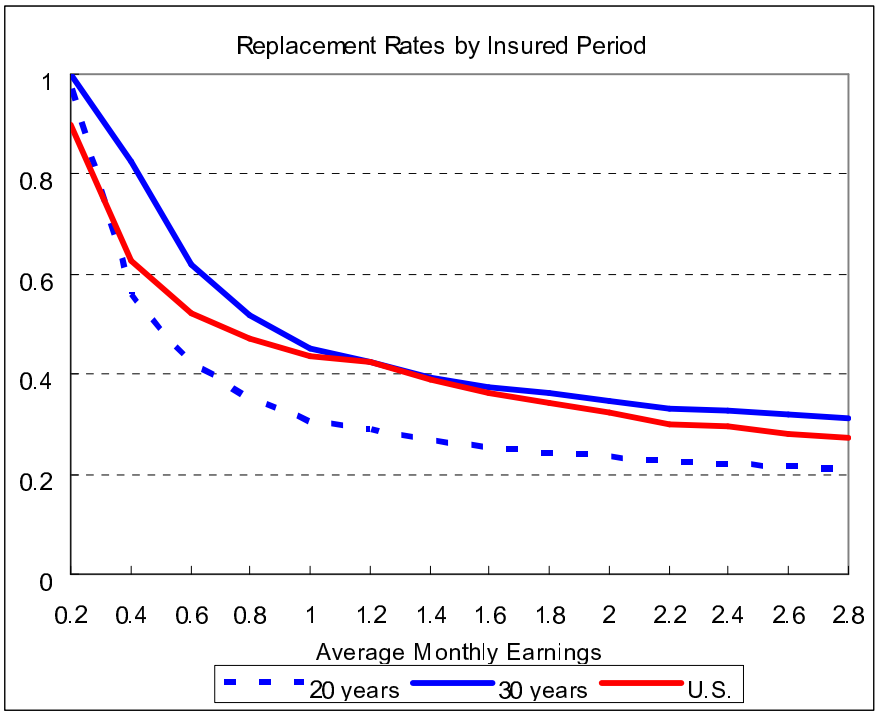
	1998 과 2000	1998 과 2001	1998 과 2002	1998 과 2003
	CIC	CIC	CIC	CIC
mean	**0.0041 (0.0327)**	**-0.0204 (0.0228)**	**-0.0487 (0.0261)**	**-0.0325 (0.0257)**
25th perc	-0.0060 (0.0152)	0.0080 (0.0141)	0.0009 (0.0217)	-0.0174 (0.0226)
50th perc.	0.0100 (0.0475)	-0.0449 (0.0346)	-0.0468 (0.0387)	-0.0398 (0.0383)
75th perc.	0.0151 (0.0670)	-0.0346 (0.0279)	-0.0661 (0.0438)	-0.0765 (0.0442)
90th perc.	0.0047 (0.0550)	-0.0222 (0.0510)	-0.0805 (0.0649)	-0.0123 (0.0572)
	DID	DID	DID	DID
mean	**0.0022 (0.0299)**	**-0.0402 (0.0230)**	**-0.0628 (0.0282)**	**-0.0497 (0.0234)**
25th perc	0.0287 (0.0275)	0.0106 (0.0225)	0.0035 (0.0237)	0.0064 (0.0228)
50th perc.	-0.0014 (0.0342)	-0.0157 (0.0295)	-0.0384 (0.0307)	-0.0287 (0.0288)
75th perc.	-0.0197 (0.0325)	-0.1006 (0.0277)	-0.1231 (0.0316)	-0.1177 (0.0257)
90th perc.	-0.0558 (0.0343)	-0.1128 (0.0315)	-0.1561 (0.0315)	-0.1358 (0.0361)

Figure 1: The Number of Participants for the Korea National Pension Scheme



	1988	1992	1995	1996	1997	1998	1999	2000	2001	2002	2003
individual	0.0	0.0	0.0	0.0	0.0	0.0	8.7	8.4	8.1	8.0	7.9
rural	0.0	0.0	1.9	2.1	1.6	1.6	2.1	2.0	2.0	2.0	2.1
workplace	4.4	5.0	5.5	5.7	5.6	4.9	5.2	5.7	6.0	6.3	6.9

Figure 2: Replacement Rates by Insured Period in Korea and the U.S.



(Note) The average Monthly Earnings are normalized by the average earnings of the whole population. For example, 2 in the Average Monthly Earning indicates