This paper proceeds as follows. Section 2 provides a historical overview of major reforms in social security programs and employment policies concerning the elderly in Japan. Section 3 explains how to construct incentive measures. Section 4 assesses the changes in the generosity of social security programs over the past reforms and examines the relation between incentive measures and labor supply of the elderly. Section 5 conducts counter-historical simulations to capture the impact of social security reforms on the LFP of the elderly. Finally, Section 6 provides the concluding remarks.

2. Overview of social security reforms in Japan

This section provides a brief overview of the major social security reforms for the elderly since the 1970s.[3] Table 1 summarizes the history of previous reforms in terms of the benefits of the Employees' Pension Insurance (EPI; *Kosei Nenkin*) and National Pension Insurance (NPI; *Kokumin Nenkin*), both of which form the core of Japanese social security programs.[4] EPI benefits comprise a flat-rate component, which is referred to as the Basic Pension benefit since the 1985 Reform, and a wage-proportional component. NPI has a flat-rate benefit only, and the amount is equal to that of the flat-rate component of EPI.

We observe a remarkable difference in the direction of reforms before and after 1985 in terms of the overall generosity of the programs. Before the 1985 Reform, the government continued to raise the benefit levels by increasing the benefit multiplier for the wage-proportional benefit and/or the benefit unit for its flat-rate benefit. In addition, price indexation was introduced to accommodate the high inflation rate in 1973. These reforms sought to improve the standard of living of the elderly in accordance with a steady increase in the per capita GDP during the phase

[3] Komamura (2005) presents a comprehensive survey of social security reforms in Japan. Takayama (2005, Ch.6) discusses the key issues in the 2004 Reform.

[4] EPI and NPI respectively cover 48.0 and 45.5 percent of population insured by the public pension programs in 2007. The Mutual Aid Insurance (*Kyosai Nenkin*) covers the remaining 6.5 percent, most of whom are employees in the public sector and private schools.

of rapid economic growth.

However, a fall in the economic growth after the oil crisis in the early 1970s as well as the declining trend of fertility raised concerns about the financial sustainability of social security programs. In addition, structural changes in the industry and labor force led to a larger disparity in financial positions among the programs. These concerns motivated the 1985 Reform, which called for a reduction in the benefit multiplier and flat-rate benefit for the first time. At the same time, the Basic Pension benefit, which was commonly paid to all public pension members as a first-tier flat benefit, was introduced.

While the dependent spouses of EPI beneficiaries became eligible to receive the Basic Pension benefit without any premium in this reform, the EPI programs became less generous in terms of benefits. Under the 1985 Reform scheme, a male EPI beneficiary who earned an average income of 254,000 yen per month in 1985, contributed 40 years in the labor market, and had a dependent wife was eligible to receive a total of around 176,000 yen per month; this was less than the amount provided under the pre-1985 Reform scheme—approximately 198,000 yen—by more than 10 percent.

Subsequent reforms have consistently sought to improve the financial balance of the programs by reducing the benefit multiplier, scaling down benefit indexations, raising the eligibility age as well as the premium rates. Most recently, the 2004 Reform introduced the automatic adjustment of benefit levels to demographic and macro-economic factors. Meanwhile, the eligibility age for receiving EPI benefits continues to be raised. For male pensioners, the eligibility age for receiving both flat-rate and wage-proportional benefits was raised from 55 to 60 years in 1973. Since 2001, the eligibility age for the flat-rate component has been scheduled to increase by one year for every three years to reach 65 years in 2013; further, that for the wage-proportional component has been scheduled to rise from 2013 by one year for every three years to reach 65 years in 2025. For females, the eligibility age was 55 years until 1985 and was gradually raised to 60 years in 2000. The eligibility age for females is set to be raised, keeping a five-year lag relative to that for men. The eligibility age for the flat-rate benefit will be raised beginning 2006 and that for the wage-proportional benefit will be raised beginning 2018.

Another reform in the EPI scheme is *Zaishoku* Pension. This income-tested pension program applies to those who remain in the labor force past their eligibility age. Starting with a 20 percent reduction in the benefit for working beneficiaries in the 1950s, the effective tax rate on additional work has been revised several times. Under the current scheme, 0.5 yen is reduced for each additional 1 yen of the sum of the original benefit and monthly wage in excess of 480,000 yen. Indeed, many empirical studies have estimated the impact of the *Zaishoku* Pension program based on micro-level data.[5] Most of them found that the reforms in the program encouraged the elderly to remain longer in the labor force, although the magnitude of the estimated impact varies substantially. As discussed in the next section, we explicitly incorporate *Zaishoku* Pension in constructing incentive measures, as well as the Additional Pension (*Kakyu Nenkin*) benefit provided to EPI beneficiaries for their dependent spouses.

In addition to the social security programs, the government introduced the wage subsidy program for the elderly in 1995. This program started by subsidizing 25 percent of the wages of individuals aged 60–64 years who continued to work in the same firm at a wage rate less than 64 percent of what they earned at the pre-retirement level.[6] We interpret this wage subsidy as negative premium and incorporate it to calculate the SSW and incentive measures on a net basis. Since 1998, the *Zaishoku* Pension benefit has been reduced for those who receive the wage subsidy, and the subsidy rate was reduced to 15 percent in 2003.

Finally, the employment policies for the elderly have aimed at providing additional job opportunities to the elderly, whose eligibility age was raised. In 1973, the government began to encourage firms to raise the mandatory retirement age to 60 years, which was set as the obligatory target in 1986. In 2000 and 2004, the government proposed that firms to either raise

[5] See the references listed in footnote 2.
[6] The wage subsidy is reduced for higher-wage earners. Our calculations also incorporate this formula.

the mandatory retirement age to 65 years or to completely abolish it. In response to these policy changes, the average mandatory retirement age has been rising substantially, and we take this into account in our empirical analysis by including the share of firms with a mandatory retirement age of 60 years or above as a covariate.[7]

3. Incentive measures for inducing retirement

3.1 Defining incentive measures

This section explains how to construct incentive measures for inducing retirement, which aim to highlight the key aspects of the incentive measures including the eligibility age, the benefits given eligibility, and actuarial adjustment when retirement is delayed. The basic idea underlying these measures is that an individual is forward-looking and that his/her labor supply decision is affected not only by the current economic resources but also by the discounted value of future benefits. As mentioned earlier, we consider three types of incentive measures—SSA, OV, and PV—all of which are based on or related to SSW.

To begin with, we explain how to compute SSW for an individual in a specific year and age cohort. Suppose that an individual who is now aged t considers when he/she should retire. If he/she retires at age r ($\geq t$), his/her (gross) SSW, which is denoted by $SSW_t(r)$, is calculated as

$$SSW_t(r) \equiv \sum_{s=r}^{D} p_{s|t} d^{s-t} B_s(r), \qquad (1)$$

where $B_s(r)$ is the benefit that he/she is expected to receive at age s ($\geq r$), d is the cumulative discount rate, $p_{s|t}$ is the probability that he/she is being alive at age s conditional on being alive at age t, and D is the maximum age. $B_s(r)$ usually tends to rise as r increases, reflecting a longer period of premium contributions, and is equal to zero if s is below the eligibility age. $SSW_t(r)$ is

[7] We do not take into account income tax in constructing incentive measures because most of the income earned by the elderly has been exempted by the income tax system.

likely to be an increasing function of r provided r is not far from t. However, it may decline once r increases to a certain level because larger contributions exceed the benefits received over a lifetime. Furthermore, we compute SSW on a net basis because an individual is likely to take account of the additional premium payment if he/she continues working as an employee. Finally, we set $t = 55$, assuming that an individual starts considering retirement at age55. This assumption is reasonable given that the number of people who retire before 55 is extremely limited.

Then, we derive the three incentive measures. We begin with SSA, which is defined as the change in the promised social security benefits in the future derived from working for one additional year (see Gruber and Wise (1999)). The SSA at age r when the retirement age is t is given by

$$SSA_t(r) \equiv SSW_t(r+1) - SSW_t(r) \tag{2}$$

If an individual continues to work for one additional year, he/she has to give up the benefits that he/she is eligible to receive in that year; however, he/she can expect a future increase in the benefits. Therefore, SSA can be either positive or negative on a net basis. If it is positive (negative), an individual would want to continue working (retire). Further, it should be noted that SSA is most likely to be positive before the eligibility age because although an individual does not receive any benefits until that age, he/she can expect an increase in future benefits.

However, a rational individual may be more forward-looking and take account of his/her financial position beyond one-year accruals. Stock and Wise (1990) proposed the option value model by comparing the utility today with that at the optimal retirement age in future. The option value model is based on an individual's indirect utility function over work and leisure, expressed as follows:

$$V_t(r) \equiv \sum_{s=a}^{r-1} p_{s|t} d^{s-t} (y_s)^g + \sum_{s=r}^{D} p_{s|t} d^{s-t} [kB_s(r)]^g,\ 0 < g < 1,\ k \geq 1, \tag{3}$$

where y is the wage income while working, g is the parameter of risk aversion, and k is the parameter to account for the disutility of labor. The optimal age of retirement is the age at which the indirect utility is maximized; the age at which the utility gain derived from the wage increase resulting from additional work begins to be outweighed by the utility loss from the decrease in the retirement income.[8]

Next, OV is defined as the difference between the indirect utility from retirement at the optimal age r^* and the indirect utility from retiring today. It can be expressed as

$$OV_t(r) \equiv V_t(r^*) - V_t(r). \qquad (4)$$

In our estimations and simulations, we follow Stock and Wise (1990), who assumed values of 1.5 and 0.75 for k and g, respectively.[9]

One possible drawback of the option value model is that much of the variation in this measure arises from the differences in the wage income, which may not be a legitimate source of identification for the retirement effects. To address this shortcoming, Coile and Gruber (2000a, 2000b) proposed another measure. PV is defined as the difference between SSW at the maximum expected value and SSW at the value at each age, such that

$$PV_t(r) \equiv SSW_t(r^{**}) - SSW_t(r), \qquad (5)$$

where SSW is maximized at age r^{**}. If the individual retires at an age beyond r^{**}, then it is reasonable to define PV as the difference between retirement this year and the next, thereby making it identical to SSA.

3.2 Computing incentive measures

To calculate SSW and incentive measures, we follow two steps. First, we compute these measures for an individual aged 55 years for each year, assuming him/her to be a "typical person" as defined earlier. Second, we aggregate them by considering the weighted averages of the three age groups (55–59, 60–64, and 65–69 years) for each year. One reasonable way to understand the

[8] The second term on the right-hand side in (3) is equivalent to $SSW_t(r)$, if $g = 1$ and $k = 1$.
[9] Coile and Gruber (2004) reported that the estimation results on the relation between OV and the elderly labor force are not sensitive to the choice of these two parameters in the U.S.

changes in the generosity of social security programs is to place the typical person in each year and provide him/her with the social security programs available at that time. Based on his/her earnings profile, we calculate his/her SSW and the related incentive measures under the existing social security program for each year. Then, we evaluate the benefits—more specifically, the benefit per month of contributions for both flat-rate and wage-proportional benefits as well as other nominal values of fixed benefits—at 2005 prices, using the consumer price index.

We choose male and female employees who were born in 1935 as typical persons and obtain their average wage incomes. They were 55 years old in 1990, which is approximately the middle year in our estimation period between 1968 and 2007. Although official statistics do not provide any longitudinal data on the history of workers' wage earnings, the Annual Report of the Social Insurance Agency (SIA) presents the average of the career average monthly income (CAMI) of the initial EMI beneficiaries for each year. The 1995 SIA Report showed that the average CAMI for the initial beneficiaries was 337,549 yen and that the average months of contribution amounted to 409. The Report also showed that 56 percent of those who initially claimed EPI benefits in 1995 were aged 60 (their birth year being 1935) and were eligible for EPI benefits. For a typical female, the 1993 SIA Report showed the average CAMI to be 158,737 yen and the average months of contribution to be 276 months, given that the eligibility age of females was 58 at that time.

Then, each year, we make the typical person aged 55 consider the timing of his/her retirement under the existing social security programs. We calculate his/her CAMI at age 55 on the basis of the wage incomes and the period of premium contribution at age 60 or 58, as obtained from the SIA Report. We also assume that the typical person expects future wage profiles beyond the age of 55, as per the actual observations made from the Basic Survey on Wage Structure (Wage Census) compiled by the Ministry of Health, Labour and Welfare (MHLW).

Then, we apply the EPI benefit formula to calculate the benefit that an individual who retires between 55 and 69 years of age is supposed to receive. The EPI benefits to be received at age s on condition of retiring at age r are expressed as

$$B_s(r) = k_0 m + k_1 CAMI(r, m) \text{ for } r \geq r_e; \quad (6)$$

$$= 0 \quad \text{for } r < r_e,$$

where the first and second terms of the RHS correspond to the flat-rate and wage-proportional components, respectively; k_0 and k_1 are their respective multipliers; m is the months of premium contribution; and r_e is the eligibility age.[10] If an individual works for Δr additional years after age r and earns wage income y_r per year, his/her benefit is recalculated as

$$B_s(r + \Delta r) = k_0(m + \Delta r) + k_1[mCAMI(r, m) + y_r \Delta r]/(m + \Delta r), \quad (7)$$

where social security reforms are expressed in the shape of the changes in the statutory parameters k_0, k_1, and r.[11]

In addition, we take into account the following three points. First, we assume that 90.8 percent of male workers have non-working dependent wives two years their junior.[12] More specifically, we assume that they receive an additional 90.8 percent of the flat-rate Additional Pension benefit for their wives until their wives turn 65 and become eligible to receive their Basic Pension benefits.[13] Second, if one chooses to both continue working and receive EPI benefits, the benefits are reduced according to the *Zaishoku* Pension program. In addition, provided that an individual continues working and paying premiums, his/her future benefits will increase corresponding to additional premium contributions. Third, the EPI premiums paid during work are subtracted when SSW is calculated on a net basis.[14] If one retires before the age of 60, he/she has to pay NPI

[10] To avoid drastic changes in the generosity of benefits, the government usually applies a gradual shift of parameter values corresponding to the year of birth. We ignore price indexation because all variables are based on the prices in 2005 in our calculations.

[11] The main parameter values for individuals aged 55 in each year have not been reported owing to space constraints; however, they are available from the authors upon request.

[12] 90.8 percent was the rate of married males aged 55 in 1990, which is estimated from the Census in 1990. Under the current social security system, a wife is regarded as "a non-working dependent wife" unless she earns more than 1.3 million yen annually or her weekly working hours exceed 30 hours a week (see Abe and Oishi (2007)).

[13] We do not add the wife's Basic Pension benefit to SSW, because the couple receives it once the wife turns 65, regardless of the husband's decision on retirement. There is another additional pension benefit for the wife aged 65 and above, but we ignore it for simplicity.

[14] Until 2001, the EPI members did not have to pay premiums at age 65 and above. Since 2002, they have been required to pay them, as the *Zaishoku* Pension program has been reintroduced.

premiums until that time. To compute OV, we subtract premiums from wage earnings. We disregard income and other taxes for simplicity. Although we compute the benefits and SSW for a female EPI member in almost the same manner, we assume that she considers only her own benefit.

When computing SSW and the incentive measures, we have to set up the values of the cumulative discount rate d^{s-55}, and the probability of being alive conditional on being alive at age 55, $p_{s|55}$, in (1). We assume that $d^{s-55} = (1/1.0319)^{s-55}$, where the yield on the ten-year government bond was 3.19 percent in 1990, when the typical person was aged 55[15]. We estimate the probability of being alive based on the 17th Life Table compiled by the MHLW in 1990.

Next, we proceed to the second step. After constructing SSW and the incentive measures for each year and age, we obtain the aggregates for each age group and each year. Let $SSW_r(y)$ denote SSW for those who retire at age r in year y. For example, consider the average SSW of all persons aged between 55 and 59 who withdrew from the labor force in 1990; let $\overline{SSW}_{55\text{-}59}(1990)$ denote this average. We need the SSW of those individuals aged 55 in 1990 who would have retired in this year, that is, $SSW_{55}(1990)$. Since individuals aged 56 in 1990 would have retired either at 55 in 1989 or at 56 in 1990, we need both $SSW_{55}(1989)$ and $SSW_{56}(1990)$.

Next, we weight these wealth numbers by $q_{55}(1989)$ and $q_{56}(1990)$, where $q_r(y)$ measures the odds of exposure to the retirement incentives for each age given the year. In the same manner, individuals aged 57 in 1990 would have retired at age 55 in 1988, 56 in 1989, or 57 in 1990. Thus, we need $SSW_{55}(1988)$, $SSW_{56}(1989)$, and $SSW_{57}(1990)$. Further, we weight these numbers by $q_{55}(1987)$ and $q_{55}(1988)$, $q_{56}(1989)$, and $q_{57}(1990)$, respectively. In order to compute the weighted average of SSW for all persons aged between 55 and 59 who retired in 1980, we calculate the weighted average of the exposure to the incentive measure provided to retired persons at a given

[15] We realized that the assumptions of different interest rates do not change the main estimation results.

age in 1990, and then, we weight the expected exposure at the given age by the proportion of retirees at that age a, using the following formula:

$$\overline{SSW}_{55\text{-}59}(y)=\sum_{s=55}^{59}\left[\frac{\gamma_s(y)}{\sum_{s=55}^{59}\gamma_s(y)}\right]\left[\frac{\sum_{t=0}^{s-55}q_{s-t}(y-t)SSW_s(y)}{\sum_{t=0}^{s-55}q_{s-t}(y-t)}\right]. \qquad (8)$$

Here, we assume that weight $q_r(y)$ reflects the proportion of persons who retired at age r in year y and were thus provided $SSW_r(y)$; hence, we consider the proportion of people in the labor force at age r in year t-1, that is, $q_{r\text{-}t}(y\text{-}t) = LFP_{r\text{-}t}(y\text{-}t\text{-}1)$, where LFP is the LFP rate. Similarly, we compute the weighted average of all ages by attaching weights with the proportion of retired persons aged r in year y, denoted by $\gamma_r(y)$. In the same manner, we can calculate the weighted average of each incentive measure for each age group by gender for each year. We follow the same process to aggregate the SSW and incentive measures for persons aged between 60–64 and 65–69.

Although our methodology cannot completely disregard the following two endogeneity biases, we believe that they hold little importance. First, the wage profile of the typical person was affected by the social security programs that he/she were actually provided with. This bias is unlikely to substantially affect the estimation results, provided we focus on the change in the impact of the incentive measures over time. In other words, we set a cohort in order to separate the effect of social security reforms from the changes in the earnings profiles.

Second, the observed LFP, on which our calculations of the weighted averages of incentive measures for each year are based, is also affected by the existing programs. Although this bias cannot be disregarded, it is obviously smaller than what it would have been if we used the actual wage profile of each cohort, which is more jointly determined with the actual LFP than the fixed wage profile.

3.3 Labor market outcomes

For labor market outcomes, we use the data on the labor force and employment, which are available from the LFS as compiled by the MIAC. The LFS provides annual data on labor force and employment for males and females separately from the year 1968. We will focus on employees because the self-employed elderly are covered by the flat-rate NPI and they seem to make different decisions on retirement as compared to those employees. However, the LFS does not classify employees into private- and public-sector employees, the latter of whom are covered by the Mutual Aid Insurance (MAI, *Kyosai Kumiai*). This empirical analysis is based on all employees because MAI programs and their reforms are similar to those of EPI and because MAI members account for less than 8 percent of the overall labor force.

In addition, we redefine the LFP rate in this analysis as the ratio of employees to the population, excluding the self-employed and unpaid family workers, in order to concentrate on the retirement decisions by the employees. We refer to this redefined LFP rate as the "employment-based" LFP rate hereafter. This definition disregards the course of retirement from being employees in the main workplace to becoming self-employed, unpaid family workers, or unemployed.[16] However, this bias is far less serious than that stemming from the conventionally defined LFP rate, which is affected by a structural shift from being self-employed and family workers to becoming employees.[17] Figure 1 compares the long-term trends of the conventionally defined, employee-based LFP rates for those aged between 55 and 69 over the past four decades. While these two LFP rates move in a parallel manner, the gap has become smaller in recent years.

We also note that the LFS provides the data only for five-year age groups rather than for each age. Hence, we have to limit our analysis to three age groups (55–59, 60–64, and 65–69 years) and use the same LFP rates and corresponding $q_r(y)$ for those who are included in each age group.

[16] According to the Survey on the Labor Participation of Older Workers 2004 compiled by the MHLW, the gaps in the proportion of self-employed persons (including unpaid family workers) in the population aged between 55–59 and 60–64 years were 1.3 and 0.5 percentage points for males and females, respectively, implying that the pathway to becoming self-employed is narrow.

[17] In fact, the share of employees in the total labor force aged 55-69 increased—for males and females, respectively—to 90.7 percent and 90.5 percent in 2007 from 68.7 percent and 54.2 percent in 1968.

However, we can obtain the annual data of population by each age group from the Population Estimates provided by the MIAC. Therefore, we estimate the numbers of employees (individuals who are in the labor force, by our definition) and retired persons by multiplying the population by the employee-based LFP rates calculated from the LFS. Then, we estimate $\gamma_r(y)$, the proportion of retired persons of each age group based on these figures.

4. Empirical results

4.1 Social security reforms and changing generosity

This section assesses the change in the generosity levels of social security programs and examines the relation between the incentive measures and retirement. Table 2 shows the SSW and incentive measures for each retirement age in 1970, 1985, and 2005, all of which are based on the same wage profile of the typical person (born in 1935), evaluated based on 2005 prices. We choose the year 1985 because social security reforms changed their direction in that year, as described in Table 1.

The following five points are noteworthy. First, we confirm that SSW was the highest in 1985 for both males and females. This is consistent with the history of social security reforms; the generosity of the programs increased until the 1985 Reform and has been steadily decreasing since then. This pattern is more obvious in females than in males who enjoyed an increase in the Additional Pension benefit, which partly offset a reduction in the generosity of the main body of EPI benefits.

Second, over the 35 years, the age for the maximum SSW was raised by just one year from 59 to 60 for males, whereas after 1985, it was raised by six years from 55 to 61 for females. This mainly reflects a difference in the shift of the eligibility age for the wage-proportional component between males and females; eligibility age for females was 55 until 1985 and was subsequently gradually raised to 60, while it had already been raised from 59 to 60 in the early 1970s for males.

Third, SSA and PV show similar patterns for males and females across age groups. For males, both SSA and PV remain positive until SSW reaches its maximum at age 59 or 60 and then turn negative in each year. This implies that it was reasonable for males to retire at 59 or 60, judging by these incentive measures. For females, in 1970 and 1985, when the eligibility age for the wage-proportional component was fixed at 55, SSA and PV began with a negative figure at that age. They turned positive at age 65, reflecting that they could receive the complete benefit if they work after age 65, in 1970 and 1985. In 2005, however, the patterns of SSA and PV across ages turned to be the same as those for males; they remained positive until age 60 and then turned negative because the benefit formula and eligibility was almost the same between males and females.

Next, the absolute values of SSA and PV for males were higher in 1985 than in 1970 and 2005, reflecting that the benefit was the highest in 1985. In 1985, individuals were encouraged to continue work until the age of 60 and to retire after 60, as compared to the situation in 1970 and 2005. Hence, it is likely that the weighted average of SSA or PV tended to rise until 1985 and then fall, because the share of cohorts who faced higher positive values increased first and, subsequently, that of those who faced higher negative values increased.

Finally, OV monotonically declined with age for both males and females with the increase in their age each year. This is because the sum of utility from wage income and that from benefits—$V(r)$ in (3)—increased monotonically until age 69 because in most cases, those aged 65 and older could obtain a full benefit even if they continued working. Hence, OV—which is defined as $V(69)-V(r)$ at age r—declined as the age increased to 69. An interesting revelation is that OV was the lowest in 1985 for both males and females. At first glance, this appears to be inconsistent with a long-term change in the benefits, which rose until 1985 and decreased afterwards. However, it is important to note that greater generosity implied greater benefits to be given up when postponing retirement. This effect was likely to be more than an offset of an increase in future benefit gains, and led to a reduction in OV.

Figure 2 depicts the long-term trends of SSW and incentive measures for those aged 55–69 years to capture the change in the overall generosity of the social security programs. An inverse-U-shaped SSW curve confirms that the generosity peaked in the mid-1980s for both males and females and ascertains the change in the direction of social security reforms, which is summarized in Table 2. The change was more remarkable for females than males.

The OV curves also demonstrate almost the same U-shaped trends for both males and females. A downward sloping part of the OV curve corresponds to the enhanced benefits, pointing to the rising incentives to retire. However, OV has been on an upward trend due to reduced benefits for females since the mid-1980s, and somewhat later for males. An earlier turnaround of the curve for females is due to an increase in their eligibility age since the mid-1980s.

In contrast, the SSA and PV curves present rather different shapes for males and females. For females, both the SSA and PV curves are U-shaped, which is consistent with the SSW and OV curves. Before the mid-1980s, a rise in benefits with a fixed eligibility age tended to reduce SSW and these trends turned around in the mid-1980s, reflecting a gradual shift to less generous programs. For males, the PV curve has an inverse-U shape and shows a cyclical movement. As already suggested by Table 2, the programs' increasing generosity tended to raise both the positive (before the age of 60) and negative (after the age of 60) values of SSA and PV, thus rendering the direction of their averages across age groups unclear. For example, the PV curve shows an upward trend until the mid-1980s due to a rise in the maximum SSW at age 60, which dominated a larger reduction in SSA after that age. It is difficult, however, to conclude from this curve that an increase in the generosity toward the 1985 Reform encouraged the elderly to postpone their retirement. This is also the cause for the downward slope of the PV curve after the mid-1980s. Indeed, our regression results on the relation between the LFP and SSA or PV for males are difficult to interpret.

4.2 Regression results

Next, we examine how the LFP of the elderly has been affected by social security programs in terms of the incentive measures.[18] The dependent variable is the employee-based LFP rate, which is defined as the share of employees in the population excluding the self-employed and family workers. This empirical analysis is based on 120 observations of males and females in the age groups of 55–59, 60–64, and 65–69 years over a period of forty years (1968 to 2007). The LFP rate, SSW, and three incentive measures are all aggregated for each age group. We estimate three regression models for SSA, PV, and OV (and for SSW, for reference), for males and females:

Model 1: $$LFP_{ya} = \alpha + \beta IM_{ya} + \sum_j \gamma_j COV_y^j + \varepsilon_{ya} \quad (9)$$

Model 2: $$LFP_{ya} = \alpha + \beta IM_{ya} + \delta_1 D6064_{ya} + \delta_2 D6569_{ya} + \sum_j \gamma_j COV_y^j + \varepsilon_{ya} \quad (10)$$

Model 3: $$\Delta LFP_{ya} = \alpha + \beta \Delta IM_{ya} + \sum_j \gamma_j \Delta COV_y^j + \varepsilon_{ya} \quad (11)$$

Here, *LFP* is the employee-based LFP rate; *IM* is an incentive measure (SSA, PV, or OV); *COV*s are the covariates; *D6064* and *D6569* are the dummies for the age groups 60–64 and 65–69, respectively; and ε is an error term. We include three covariates: per capita real GDP, the share of manufacturing in nominal GDP, and the share of firms with the mandatory retirement age of 60 or above. The first two covariates are obtained from the national accounts published by the Cabinet Office, and the last from the Employment Management Survey compiled by the MHLW.[19] The per capita real GDP is a proxy for the real wage rate and is used to adjust for cyclical movements in the LFP. The share of manufacturing and that of firms with the mandatory retirement age of 60 or above are used to capture the structural changes in demand for the elderly labor force.

Model 1 is the simplest version among the three models. Although the coefficient on the

[18] Oshio and Oishi (2004) is an early example of a study that applies the incentive measures to the Japanese micro data.
[19] The Employment Management Survey concluded in 2004. We assume that the share of firms with the mandatory retirement age of 60 or above has remained at 99.3 since 2004.

incentive measure is expected to be positive, it may fail to distinguish the impact of the incentive measure from age-specific factors. Hence, Model 2 controls for these factors by including dummies of two age groups. Given that the retirement rate tends to rise as age increases, the coefficients on those dummy variables are expected to be negative. Model 3 is a difference model, which intends to control for trend as well as age-specific factors. We also attempt to use SSW as *IM* instead of incentive measures because we cannot rule out the possibility that the elderly take into account SSW itself rather than the change in it. In contrast to other incentive measures, it should be noted that the coefficient on SSW is expected to be negative.

Table 3 summarizes the regression results of each model for both males and females. We focus on the coefficients on the incentive measures and SSW to save space. In Model 1, we observe that SSA, PV, and OV have significant and positive coefficients for both males and females, as predicted. However, we should consider the possibility that this model overestimates the impact of the incentive measures, which are strongly age-specific, as suggested by Table 2.

Model 2 includes age group dummies and produces different results between males and females, while the fitness is much improved for both males and females. For males, although the coefficient on OV remains significant and positive, that on SSA or PV turns negative. The coefficient on SSA or PV is not consistent with the prediction; however, it may suggest that the weighted averages of SSA and PV over age groups are not a good indicator of the overall incentives to postpone retirement, as already inferred from Figure 2. For females, SSA, PV, and OV remain significant and positive in Model 2. The sizes of the coefficients on the incentive measures are much smaller than those in Model 1, in line with the expectation.

Model 3, which uses five-year differences of all variables, reveals the same pattern in the size and significance of the incentive measures as Model 2 does. All measures are significant and positive for females, whereas only OV is significant and positive for males.

Finally, we observe that SSW is significant and negative for both males and females in Models 2 and 3 and that the goodness-of-fit is not worse than in the cases of the incentive measures, suggesting that the elderly may be concerned about the current SSW to almost the same extent as they are its future changes.

5. Policy simulations

This section performs counter-historical simulations to estimate the extent to which a series of social security reforms have affected the labor supply of the elderly since 1985. First, we explore the effects on SSW and incentive measures had the government not implemented major social security reforms. For example, to understand the impact of the 1985 Reform and subsequent reforms, we construct all the parameters in the social security programs including the benefit multiplier, premium rates, and eligibility ages fixed in 1984, and construct the paths that SSW and the incentive measures would have taken since 1985 without any reform. In the same manner, we can construct the paths without reforms since the 1989 Reform, which followed the 1985 Reform. It is also reasonable to roughly interpret the difference between these simulated paths as the impact of the 1985 Reform. We can repeat the same experiments to capture the impact of each reform.

Figure 3 illustrates the results of these counter-historical simulations in terms of SSW for males and females. For example, the curve labeled "Without reform since 1985" depicts the path that SSW would have taken if the social security reform stopped just before the 1985 Reform. In this case, SSW for males would have continued to increase and would have leveled off in the early 2000s, as all the cohorts would have adopted the scheme that was applied just before the 1985 Reform. A series of reforms since 1985 led the SSW curve to peak in the mid-1980s and then slope downward. The decline continued with all the subsequent reforms; however, the impact of the 1985 Reform has been larger than that of any other reforms.

The impact of social security reforms is also clearly observed in the case of females. The impact differs from that for males in that SSW continued to decline before rising again and stabilizing in the early 2000s when there were no reforms since 1985. This is because the flat-rate component, which accounted for more in total benefits for females than for males, was reduced in real terms since the late 1970s, this holding the former's total benefit down. Nevertheless, the figure confirms that the generosity of social security reforms has been steadily reducing since 1985.

Based on these observations, we confirm a substantial reduction in the overall generosity of social security programs over the past two decades. Indeed, in the absence of the 1985 Reform and subsequent reforms, the average SSW for age 55–69 (evaluated at 2005 prices) would have been 1.84 million for males and 1.03 million for females in 2007, which are 31.4 percent and 45.1 percent lower than the actual levels (2.68 million and 1.88 million), respectively. In the same manner, we can construct the path which each incentive measure would have taken in the absence of social security reforms. Figure 4 shows how the OV has been affected by the reforms. Had there been no reform since 1985, OV would have kept declining until the late 1990s for males and remained a while longer at a low level for females.

Further, we estimate the impact of social security reforms on the LFP of the elderly. One reasonable way is to compute the LFP rates by substituting the values of the incentive measures obtained from each simulation as well as the values of covariates into (10) or (11) and using the estimated coefficients reported in Table 3. We use the OV results, which are most reasonable and consistent between males and females. Table 4 presents the simulation results, which are based on the estimation results from Model 2 (levels) and Model 3 (differences). The top and bottom panels are based on the OV and SSW results, respectively.

In the top panel, we observe that in Model 2, the male labor force aged 55–69 years would have been an average of 6.484 million per year during 1985 and 2007, in the absence of the 1985 Reform and subsequent reforms. Given that the baseline result is 6.697 million (which is close to the actual 6.717 million), these reforms since 1985 as a whole increased the male labor force by 214 thousand per year—equivalent to 3.3 percent of the LFP that would have been realized had there been no reform since 1985. The size of the impact is smaller in the case of Model 3, which shows an additional 87 thousand employees or 1.3 percent of the LFP in the case of no reform. Table 4 also reports the results for females. The total impact for females is estimated to have been an average of 89 thousand (2.3 percent) in Model 2 and 25 thousand (0.6 percent) in Model 3 per year during 1985 and 2007; both figures are somewhat smaller than that for males.

The bottom panel shows that the SSW and LFP of the elderly are reasonably related to each other as in the cases of the incentive measures. This result is reasonable, given that SSW and OV moved rather symmetrically over the past 40 years, as shown in Figure 2. In fact, Table 4 states that the impact is somewhat greater than in the OV version for both Models 2 and 3 for both males and females, underscoring that the impact of a series of social security reforms since 1985 on the LFP of the elderly is not negligible.

6. **Conclusion**

We examined how social security programs affect the LFP of the elderly in Japan. Using publicly available data, we construct forward-looking incentive measures based on the concepts of SSW and related incentive measures. This empirical analysis covers a period of forty years (1968–2007) that have marked significant changes in social security programs. Further, we compare the impact of major social security programs in the past on the labor supply of the elderly in a consistent manner. We acknowledge that our methodology can avoid, albeit not completely, the endogeneity bias regarding social security benefits and labor supply outcomes.

Our main findings are summarized as follows. First, our calculations concerning SSW and the incentive measures reveal a substantial change in the social security policy in the mid-1980s. Although the generosity of social security programs was increasing, the 1985 Reform reversed the trend and the subsequent reforms featured a reduction in the generosity.

Second, our regression analysis confirms that the LFP of the elderly is significantly affected by forward-looking incentive measures for inducing retirement. In particular, the option value model of Stock and Wise (1990) appropriately explains the relation between social security and LFP for both the male and female elderly population.

Third, our counter-historical simulations show that social security reforms encourage the elderly to continue working and postpone retirement via reduced generosity and increase in the eligibility age. The option value model estimates that the 1985 Reform and subsequent reforms increased the elderly labor force by 1.3–3.3 percent for males and 0.6–2.3 percent for females during the past two decades, as compared to the levels that would have been realized in the absence of a reform since 1985. The magnitude of the impact is sizable, given that Japan has already entered the phase of a declining population growth rate.

This analysis can be extended in a variety of respects, provided the micro data with longitudinal information and family background are available. First, we can explicitly examine the impact of social security programs on multiple pathways to retirement (see Clark and Ogawa (1992)), which has been disregarded in many Japanese studies including our analysis. Second, we can analyze the impact of social security reforms by taking into account the simultaneous relations among LFP, benefit receipts, and living arrangements (see Raymo *et al.* (2004)). Third, we can compare social security programs with health status, financial support from children, and other factors in terms of the effect on the retirement decisions of the elderly. Finally, we can also discuss the impact of the changes in the generosity of social security programs on the overall well-being of the elderly, which covers health, poverty, and other socioeconomic aspects as well as income itself.