の後の 20 年間において男子で 0.7–6.7%、女子で 0.6–2.2%の労働力人口の引き上げ効果があったことが分かる。

D. 考察

公的年金やその制度変更が高齢者の就業行動に及ぼす影響については、これまでも数多くの実証研究が進められてきたが、本研究は動学的な枠組みに基づくものであり、そこで得られた効果はより正確であると考えられる。

E. 結論

本研究では、これまでの公的年金改革が高齢者の就業行動に無視できない影響を及ぼしてきたことが確認できた。次の研究課題としては、公的年金の制度変更による人々の行動変化を内生化した上で、今後の労働供給の変化や年金財政への影響をダイナミック・マイクロシミュレーションモデルに基づいて分析することが考えられる。

F. 健康危険情報

なし

G. 研究発表

1.論文発表

Oshio, T., Oishi, A. and Shimizutani, S., "Social Security Reforms and Labor Force Participation of the Elderly in Japan" forthcoming in *Japanese Economic Review*

2.学会発表

なし

H. 知的所有権の取得状況の出願・登録状況

1.特許取得

なし

2.実用新案登録

なし

3.その他

なし

Social Security Reforms and Labor Force Participation of the Elderly in Japan

Takashi Oshio[a], Akiko Sato Oishi[b], and Satoshi Shimizutani[c]

Abstract

We examine how social security programs have affected the labor force participation (LFP) of the elderly over the past forty years in Japan. Using publicly available data, we construct incentive measures for inducing retirement, to ascertain actual changes in the generosity of the programs and to explore the impact of the reforms on the labor supply of the elderly. We show that the LFP of the elderly is significantly sensitive to the measures, and our counter-historical simulations show that social security reforms since 1985 featuring reduced generosity have significantly encouraged the elderly to remain longer in the labor force.

Key words: social security program, social security wealth, labor force participation of the elderly

JEL classification codes: H55, J26

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1. Introduction

In addition to health status, the generosity of social security programs is considered to be one of the key determinants of retirement decisions. A significant amount of literature concerning the relationship between social security benefits and the labor force participation (LFP) of the elderly has highlighted the importance of policy reforms in many developed countries. In particular, a series of studies by Gruber and Wise (1999, 2004, 2007), which are recent examples of cross-country studies on this issue, reveal that social security incentives have a sizeable effect on retirement decisions across countries with different labor market institutions and other social characteristics. In recent years, Japan has also experienced major reforms of the social security and employment policy for the elderly, motivated by serious concerns about the sustainability of the current system and future deterioration of fiscal balances. However, in contrast to the significant number of discussions on the fiscal effects of such reforms, the impact of the changing generosity of social security programs on the labor supply of the elderly has been largely disregarded.

Quantifying the labor supply effect of social security programs is important to both academics and policymakers in the context of future reforms, which will take place under conditions of harsher demographic pressures and reduced feasibility of further raising the mandatory retirement age. Moreover, separating out the effects of social security programs from other factors is also critical to explore why Japanese people are motivated to retire later than people in other developed countries. It has often been argued that less generous social security programs encourage Japanese workers to remain longer in the labor force. However, most preceding studies in Japan are limited to analyses of the effects of changes in the income-tested (*Zaishoku*) pension program. A more important issue that is yet to be examined concerns the effects of a series of major reforms of the main body of social security programs on the LFP of the elderly.

This paper investigates the manner in which the changing generosity of social security programs has affected the withdrawal of the elderly from the labor force in Japan over the past 40 years. To examine the relation between social security programs and the retirement decisions of the elderly, we construct some forward-looking measures that provide an incentive to retire, on the basis of publicly available year-by-age data. These measures are based on the notion of social security wealth (SSW), which is defined as the expected present value of net social security benefits received over a lifetime (see Gruber and Wise (1999)). Retirement decisions are determined not only by income at the time of retirement but also by the flow of future social security benefits and their present value (see Stock and Wise (1990a, 1990b)). Moreover, a rational individual is likely to determine his/her retirement age by considering potential gains from postponing his/her retirement (see Coile and Gruber (2000, 2004)). To address these issues, we construct three incentive measures for inducing retirement—social security wealth accrual (SSA), peak value (PV), and option value (OV)—derived from or related to SSW and, subsequently, examine the effects of these measures on the labor supply of the elderly.

In addition to understanding the dynamic elements of incentive measures for inducing retirement, two econometric issues need to be resolved. The first is the simultaneity bias in estimations. Relating the incentive measures to the actual probability of retirement is not free from a simultaneous estimation bias because observed decisions and social security benefits are determined jointly. Thus, we focus solely on variation in benefits that arise from institutional changes in social security programs that are exogenous to individual retirement decisions. The second is the limited availability of data in Japan. We recognize that it is advantageous to utilize household-level data on households who are provided with a variety of incentive measures. Unfortunately, there is no micro-level dataset with longitudinal information that entails a long period and several social security reforms.

This analysis focuses on aggregate year-by-age-group data of LFP and incentive measures for inducing retirement because only data concerning five-year age groups are available from the

Labor Force Survey compiled by the Ministry of Internal Affairs and Communications. Our empirical analysis is based on 120 observations of males and females belonging to the age groups of 55-59, 60-64, and 65-69 years over a period of 40 years (1968 to 2007). We adopt the following empirical strategy to address the simultaneity bias in estimations. First, we establish a typical person—specifically, one who was born in 1935 and whose earnings profile over his/her lifetime is identical to the average for his/her cohort—and assume that he/she is 55 years old. We compute his/her benefits and incentive measures under the social security programs available in each year. Second, we compute the weighted averages of the incentive measures for each age group for each year to understand the overall generosity of social security programs for each age group. Then, we estimate the regression models to relate the LFP of each age group to the estimated incentive measures along with the covariates. This typical person approach aims to mitigate the bias arising from simultaneity between the LFP and the incentive measures. Moreover, we conduct counter-historical simulations to assess the impact of key reforms on the LFP of the elderly since the mid-1980s.

This empirical analysis yielded three findings. First, the estimated age-average SSW peaked in the mid-1980s as social security programs became more generous until the 1985 Reform and has been declining since then. Second, the regression results reveal that the retirement decisions of elderly workers are significantly sensitive to incentive measures. Finally, the counter-historical simulations show that the 1985 Reform and subsequent reforms encouraged the elderly to remain longer in the labor force.

This paper proceeds as follows. Section 2 provides a historical overview of major reforms of social security programs and employment policies concerning the elderly in Japan. Section 3 explains how to construct incentive measures. Section 4 assesses changes in the generosity of social security programs over 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 presents concluding remarks.

2. Overview of social security reforms in Japan

This section provides a brief overview of major social security reforms for the elderly since the 1970s.[1] Table 1 summarizes the history of previous reforms in terms of the benefits of Employees' Pension Insurance (EPI; *Kosei Nenkin*) and National Pension Insurance (NPI; *Kokumin Nenkin*), both of which form the core of Japanese social security programs.[2] EPI benefits comprise a flat-rate component, which has been 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 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 a high inflation rate in 1973. These reforms sought to improve the standard of living of the elderly in accordance with a steady increase of per capita GDP during the phase of rapid economic growth.

However, falling economic growth after the oil crises in the early 1970s, as well as a 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

[1] Komamura (2007) presents a comprehensive survey of social security reforms in Japan. Takayama (2005, Ch.6) discusses the key issues in the 2004 Reform.

[2] EPI and NPI respectively cover 48.0 and 45.5 percent of population insured by 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.

reduction of 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 having to pay 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, paid premiums for 40 years, 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, and raising the eligibility age as well as premium rates. Most recently, the 2004 Reform introduced automatic adjustments of benefit levels based on 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 to be raised, while 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 to the EPI scheme is the *Zaishoku* pension program. This income-tested pension program applies to those who remain in the labor force past their eligibility age. Starting with a 20 percent reduction of 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.[3] Most found that the reforms of 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 the *Zaishoku* pension program when 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 for the same firm at a wage rate less than 64 percent of the pre-retirement level.[4] We interpret this wage subsidy to be a 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, 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 either raise the mandatory retirement age to 65 years or 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.[5]

[3] For example, Seike (1993), Ogawa (1998a, 1998b), Iwamoto (2000), Abe (2001), Ohtake and Yamaga (2004), and Shimizutani and Oshio (2008).

[4] The wage subsidy is reduced for higher-wage earners, which is incorporated in this formula.

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

We should also keep in mind the mandatory retirement condition that prevails in Japan, which is often considered to be one of the distinctive features of the Japanese labor market. According to the 2008 *Employment Conditions Survey*, 98 percent of firms (with 30 or more employees) applied the mandatory retirement practice and 85 percent of them set the mandatory retirement age at 60. This system provides an important initial step toward retirement and in all likelihood affects the elderly labor supply. It should be noted, however, that mandatory retirement implies that an elderly worker quits his/her job but does not exit the labor force. Indeed, based on the recent *Survey on the Labor Participation of Older Workers*, Shimizutani and Oshio (2009) showed that more than 80 percent of males and 70 percent of females who experienced mandatory retirement continued to remain in the labor market. Thus, it would be interesting to examine whether—if yes, to what extent—the elderly's decisions to work are affected by retirement-related incentives provided by social security programs.

3. Incentive measures for inducing retirement

3.1 Defining incentive measures

In this section we explain how to construct incentive measures for inducing retirement, which aim to highlight key aspects of incentive measures including eligibility age, 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 current economic resources but also by the discounted value of future benefits. As mentioned earlier, we consider three types of incentive measure—SSA, PV, and OV—all of which are based on or are related to SSW.[6]

To begin with, we explain how to compute SSW for an individual in a specific year and age

[6] See Gruber and Wise (1999, 2004, 2007) for more details on the concepts of these variables and the results of cross-country analyses based on them.

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 SSW, which is denoted by $SSW_t(r)$, is calculated as

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

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 of he/she 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 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 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 age 55. 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 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, an individual would want to continue working. 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. Coile and Gruber (2000) proposed another measure, Peak value (PV), which is a straight extension of SSA. PV is defined as the difference between SSW at the maximum expected value and SSW at the value at each age, such that

$$PV_t(r) \equiv SSW_t(r^{**}) - SSW_t(r), \tag{3}$$

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.

Lastly, we turn to the option value (OV) model, which is proposed by Stock and Wise (1990a). The OV model assumes that an individual compares utility today with that at the optimal retirement age in the future and chooses an optimal retirement age. An individual's indirect utility function over work and leisure is expressed as follows:

$$V_t(r) \equiv \sum_{s=a}^{r-1} p_{s|t} d^{s-t} (y_s)^g + \sum_{s=r}^{D} p_{s|t} d^{s-t} [kB_s(r)]^g, \; 0 < g < 1, \; k \geq 1, \tag{4}$$

where y is wage income while working, g is parameter of risk aversion, and k is parameter that accounts for the disutility of labor ($k \geq 1$). We assume that people get more utility from income earned by not working than that earned by working. The optimal age of retirement is the age at which 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 of retirement income. Note that the second term on the right-hand side in (4) is reduced to $SSW_t(r)$, if $g = 1$ and $k = 1$.

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

$$OV_t(r) \equiv V_t(r^*) - V_t(r). \tag{5}$$

Among the incentive measures, OV is the most general and flexible variable, and it is explicitly related to an individual's utility maximization. PV is a special case of OV; OV is reduced to PV if

g = 1 and k = 1 and wage income is disregarded. Hence, we use OV as the main incentive measure and compare its estimation results with those of other measures.

To compute OV, we need to determine the values of k and g. Stock and Wise (1990a) assumed values of 1.5 and 0.75 for k and g, respectively, and 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. Using data obtained from the *Labor Force Survey*, we search for the combination of k and g that maximizes the goodness of fit of the model, which regresses LFP on OV. As discussed below, we find that the combination of $k = 2.0$ and $g = 0.75$ and that of $k = 3.0$ and $g = 0.75$ are most appropriate for males and females, respectively.

3.2 Computing incentive measures

The conventional way of assessing the impact of incentive measures on LFP might be to regress the observed LFP on the observed incentive measures. However, this methodology is problematic, because due to the time-series nature of our analysis there may be omitted variables that are correlated with changes of both LFP and incentive measures. For instance, increases of aggregate productivity and human capital accumulation over time could affect both LFP and incentive measures through changes of lifetime earnings. Thus, even when we observe an inverse correlation between elderly LFP and incentive measures, it may be simply because of rising aggregate productivity.

One way to circumvent this problem is to adopt the typical person approach developed by Engelhardt and Gruber (2004). The essence of this approach is to apply the *same* earnings profile to all birth cohorts and construct incentive measures according to the social security programs available at that time. To do so, we use the 1935 birth cohort as a benchmark and assign its earnings profile to every birth cohort to construct the incentive measures. This insures that all of the variations in the incentive measures arise from institutional changes in the benefit rules and not from changes in the earnings profile caused by human capital accumulation and productivity increase.

To calculate SSW and incentive measures for this typical person approach, 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 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 of age in 1990, which is approximately the middle year of our estimation period between 1968 and 2007. Although official statistics do not provide 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 contributions was 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 contributions to be 276 for initial claimers, given that the eligibility age for 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 wage income and period of premium contributions 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.

Then, we apply the EPI benefit formula to calculate the benefit 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

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

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

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 contributions; and r_e is the eligibility age.[7] 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

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

where social security reforms are expressed in the shape of changes in the statutory parameters k_0, k_1, and r.[8]

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.[9] More specifically, we assume that they receive an additional 90.8 percent of the flat-rate Additional Pension benefit for

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

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

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

their wives until their wives turn 65 and become eligible to receive their Basic Pension benefits.[10] 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 an individual continues working and paying EPI premiums, his/her future benefits will increase corresponding to additional premium contributions. Third, to compute OV, the net SSW is calculated by subtracting the total pension premiums paid by the individuals from the gross SSW.[11] We disregard income and other taxes for simplicity. Although we compute the incentive measures and SSW for female EPI members in almost the same manner, we assume that a female worker considers only her own benefit even if she is married to a male who is eligible for the EPI benefit.

When computing SSW and 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 a ten-year government bond was 3.19 percent in 1990, when the typical person was aged 55.[12] We estimate the probability of being alive based on the 17th Life Table compiled by the Ministry of Health, Labour and Welfare 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, $SSW_{55}(1990)$. Because 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}

[10] We do not add the wife's Basic Pension benefit to the husband's SSW because the wife receives the Basic Pension benefit once she turns 65, regardless of the husband's employment status. There is another additional pension benefit for the wife aged 65 and above, but we disregard it for simplicity.

[11] Until 2001, workers aged 65 and above were exempt from paying EPI premiums. Since 2002, when the EPI coverage was extended to workers aged between 65 and 69, these workers have been subject to paying EPI premiums. If an individual retires before he/she turns 60, he/she has to pay NPI premiums until he/she reaches 60 years of age.

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

(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 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. To compute the weighted average of SSW for all persons aged between 55 and 59 who retired in 1990, we calculate the weighted average of exposure to the incentive measure provided to retired persons at a given age in 1990; then, we weight the expected exposure at the given age by the proportion of retirees at that age a using the following formula:

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

Here, we assume that weight $q_r(y)$ reflects the proportion of persons who retired at age r in year y; hence, we consider the proportion of people in the labor force at age r in year t-1, that is, $q_{r-t}(y-t) = LFP_{r-t}(y-t-1)$, 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 60-64 and 65-69.

Although our methodology cannot completely disregard the following two endogeneity biases, we believe they are largely mitigated. First, the wage profile of the typical person was affected by the social security programs he/she was actually provided. This bias is unlikely to substantially affect the estimation results, provided we focus on the change in the impact of incentive measures over time. In other words, we set a representative cohort (born in 1935) to separate the effects of social security reforms from changes in earnings profiles.

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

3.3 Labor market outcomes

For labor market outcomes, we use data on labor force and employment from the *Labor Force Survey*, which provides annual data on labor force and employment for males and females separately from the year 1968. We focus on employees because the self-employed elderly are covered by the flat-rate NPI, and they seem to make different decisions on retirement compared to employees. However, the *Labor Force Survey* does not classify employees into private- and public-sector employees, of whom the latter are covered by 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 the sum of employees and the unemployed to the population excluding the self-employed and unpaid family workers, to concentrate on the retirement decisions of 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 or unpaid family workers.[13] However, this bias is far less serious than that stemming from the conventionally defined LFP rate,

[13] According to the *Survey on the Labor Participation of Older Workers* 2004 compiled by the Ministry of Health, Labour and Welfare, the gaps in the proportion of self-employed persons (including unpaid family workers) in the population aged 5559 and 6064 years were 1.3 and 0.5 percentage points for males and females, respectively, implying that the pathway to becoming self-employed is narrow.

which is affected by a structural shift from being self-employed and family workers to becoming employees.[14] Figure 1 compares the long-term trends of the conventionally defined, employment-based LFP rates for those aged between 55 and 69, over the past four decades. While these two LFP rates move in parallel, the gap has become smaller in recent years.

We also note that the *Labor Force Survey* provides 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. However, we can obtain annual population data by each age group from the *Population Estimates* provided by the Ministry of Internal Affairs and Communications. Therefore, we estimate the number of employees (individuals who are in the labor force, by our definition) and retired persons by multiplying the population by the employment-based LFP rates calculated from the *Labor Force Survey*. Then, we estimate $\gamma_r(y)$, the proportion of retired persons in each age group based on these figures.

4. Empirical results

4.1 Social security reforms and changing generosity

This section assesses changing generosity levels of social security programs and examines the relation between 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), expressed in inflation-adjusted 2005 prices. We choose the year 1985 because social security reforms changed direction in that year, as described in Table 1.

The following five points are noteworthy. First, we confirm that SSW was highest in 1985 for

[14] 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.

both males and females. This is consistent with the history of social security reforms; the generosity of programs increased until the 1985 Reform and has been steadily decreasing since then. This pattern is more obvious for females than for 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 five years from 55 to 60 for females. This mainly reflects a difference in the shift of the eligibility age for the wage-proportional component between males and females; the eligibility age for females was 55 until 1985 and was 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 from 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 value at that age. They turned positive at age 65, reflecting that they could receive the full benefit if they work after age 65, in 1970 and 1985. In 2005, however, the patterns of SSA and PV across ages became the same as those for males; they remained positive until age 60 and then turned negative because the benefit formula and eligibility were almost the same for males and females.

Fourth, the absolute values of SSA and PV for males were higher in 1985 than in 1970 and 2005, reflecting the fact that the benefit was highest in 1985. In 1985, individuals were encouraged to continue working until the age of 60 and to retire after 60, 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.

Fifth and finally, OV, which is calculated using $g = 0.75$ and $k = 2.0$ for males and $g = 0.75$ and

$k = 3.0$ for females, monotonically declined with age for both males and females with the increase of their ages in 1970 and 2005. 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 when age reached 69. An interesting revelation is that OV was lowest in 1985 for both males and females, and that it was rather low or zero for males beyond the age of 60. 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 given up when postponing retirement. This effect was likely to be more than an offset by an increase of future benefit gains, and led to a reduction of OV.

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

The OV curves also demonstrate almost the same U-shaped trends for both males and females. A downward slope of the OV curve corresponds to enhanced benefits, pointing to 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 appear rather different for males and females. The SSA and PV curves for females are U-shaped; this is consistent with the SSW and OV curves. Before the mid-1980s, an increase in benefits with a fixed eligibility age tended to reduce the SSW; however, these trends changed in the mid-1980s, reflecting a gradual shift to the less generous programs. The PV curve for males has an inverse U-shape and shows a cyclical movement. As