NBER WORKING PAPER SERIES

OPTION VALUE OF WORK, HEALTH STATUS, AND RETIREMENT DECISIONS IN JAPAN: EVIDENCE FROM THE JAPANESE STUDY ON AGING AND RETIREMENT (JSTAR)

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Working Paper 20001
http://www.nber.org/papers/w20001

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 2014

This study utilized micro-level data collected through the Japanese Study on Aging and Retirement (JSTAR), which was conducted by the Research Institute of Economy, Trade, and Industry (RIETI) and Hitotsubashi University in 2007 and 2009. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 20001
March 2014
JEL No. H55,I14,J26

ABSTRACT

This study examined the factors that affect the retirement decisions of the middle-aged and elderly in Japan, focusing especially on their earnings, public pension benefits, and health status. Using two-year panel data from the JSTAR and applying the OV model proposed by Stock and Wise (1990a, 1990b), we found that the probability of retirement has a negative and significant correlation with the OV of work, and that correlation does not depend on the health status. Our counter-factual simulation based on the OV model showed that, if the probability of being enrolled in the disability program were zero, the average years of work when individuals are in their 50s and 60s would increase. However, it should be emphasized that, in Japan—where being enrolled in the disability program is unlikely to make one a candidate for the retirement path—the result of this simulation does not indicate that satisfying the eligibility criteria for disability pension receipts will more stringently increase the labor supplied by the middle-aged and elderly.

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1. Introduction

This study examines retirement decisions and their associations with health status in Japan, using the option value (OV) model proposed by Stock and Wise (1990a, 1990b). This model assumes that an individual maximizes the weighted average of the utility from labor income until retirement and that from pension income thereafter. The timing of retirement is determined by comparing the utility gain associated with a delay in retirement, which is summarized as the OV.

Despite the considerable attention recently paid in Japan to "late" retirement, there has been a limited body of literature that addresses retirement decisions there. To our knowledge, only a few studies in Japan empirically use the OV model to examine retirement decisions. The study of Oshio and Oishi (2004) was the first empirical study of this sort in Japan: it used cross-sectional data with insufficient control variables with respect to health status. Oshio, Shimizutani, and Oishi (2010) employed macro-level data to explore the effect of OV on the labor force participation rate; they show that OV significantly correlates with labor force participation among the elderly. These results imply that the exit of the elderly from the labor force has no bearing on job creation for the young.

More recently, Oshio, Oishi, and Shimizutani (2011)—whose study is closely related to that of Oshio, Shimizutani, and Oishi (2010)—used macro-level data to construct several incentive measures vis-à-vis retirement, including OV. This study shows that since 1985, the labor force participation rate of the elderly in Japan has been significantly sensitive to both OV and social security reforms—the latter of which featured reduced benefits generosity and thus significantly encouraged the elderly to remain in the labor force longer.

The current study presents further evidence concerning retirement decisions in Japan, within the framework of the OV model; it makes specific reference to Japan's disability pension program and individual health status.[1] It employs micro-level data collected through the Japanese Study on Aging and Retirement (JSTAR) (Ichimura, Hashimoto and Shimizutani, 2009), which is the Japanese version of the U.S. Health and Retirement Study (HRS), the English Longitudinal Survey on Ageing (ELSA), and the Survey on Health, Aging and Retirement in Europe (SHARE). JSTAR has a longitudinal design and features a rich variety of variables that touch on health status.

We calculate OV for each individual working in 2007, with the disability pension program considered a potential pathway from work to retirement; we also examine the effect of OV on retirement decisions in 2009, while controlling for individual health status. We find that OV negatively and significantly correlates with the probability of retirement, and that the individual's

[1] Ichimura and Shimizutani (2012) also employed similar JSTAR data (i.e., from the first and second waves) to explore retirement behavior in Japan. They grouped a variety of variables into health, family, and socioeconomic factors and explored the effect of each factor in the first wave (2007) on the probability of retirement and hours worked in the second wave (2009).

health does not confound the correlation.

The remainder of this paper is organized as follows. Section 2 describes the institutional background. Section 3 explains, in detail, the study's empirical approach. Section 4 presents the empirical results, and Section 5 assesses the fit of the model. Section 6 shows the results of the counter-factual simulation. Section 7 provides concluding remarks.

2. Background[2]

2.1 History of Japan's social security and disability program

This section provides an overview, from a historical perspective, of Japan's disability program and other related reforms to the social security program. We describe the "disability pension program" below, which approximates that which is often referred to as a disability insurance (DI) program in other countries. The disability pension program is part of Japan's public pension program, and all revisions to the disability program have been linked to those made to core pension programs. Among several programs that assist the disabled, the disability pension program plays the most important role in terms of income compensation.

The Japanese public pension program consists of three programs: Employees' Pension Insurance (EPI; *Kosei Nenkin*), whose pensioners are private employees; National Pension Insurance (NPI; *Kokumin Nenkin*), whose pensioners are self-employed or agriculture, forestry, or fishery cooperative employees; and Mutual Aid Insurance (MAI; *Kyosai Nenkin*), which covers employees in the public sector and in private schools. In terms of their numbers of pensioners, each of EPI and NPI contribute to the total by slightly less than half, and MAI occupies the remaining small portion. An overview of Japan's social security programs is provided in Appendix 1.

Below, we focus on the revisions made over time to Japan's disability pension program, while focusing on EPI and NPI (Table 1). The disability pension program was included as part of the EPI program, when it was launched in 1944.[3] Once disabled individuals were deemed to qualify for the program—based on functional ability to perform activities of daily living, rather than on loss of earning ability—they were rated through the use of two grades. Grade 1 refers to a condition because of which a person is unable to perform activities of daily living (e.g., severe disability affecting both hands, or complete blindness). Grade 2 refers to a condition because of which a person faces very severe limitations in performing activities of daily living (any severe disability affecting either hand). The program at that time, from the very beginning, insured persons with

[2] This section updates the discussion of Oshio and Shimizutani (2012).
[3] A brief review of development of the disability pension program is provided by the Ministry of Health, Labor, and Welfare (2009).

mental disorders, via EPI. The 1954 revision introduced Grade 3, to cover more disabled persons with conditions less severe than those in Grade 2.[4]

Following the establishment of the EPI program, the disability pension program was expanded, and there have been four major revisions during its development. The first revision was accompanied by the introduction of NPI in 1961. NPI launched the universal pension system into the Japanese public pension program, drastically expanding the coverage of the disability pension program to more groups than just employees in the private sector. Unlike EPI, NPI did not cover mental disease at the time of its introduction. The NPI had two types of disability programs: one for recipients with premium contributions ("Disability Pension Program (*Shogai Nenkin*)") and another for those without ("Disability Welfare Pension Program (*Shogai Fukushi Nenkin*)"). Eligibility to receive disability pension benefits is assessed at the time of the first doctor visit to survey the extent of the condition that rendered the person disabled; thus, those who had had that first doctor visit before reaching the age of 20 or before 1961 were not insured by the Disability Pension Program under NPI. Instead, they were covered by the Disability Welfare Pension Program, which was financed by the government. Eligibility for this latter program was means-tested, and its benefit amount was lower than that of the former program.

The second revision, in 1974, called for expanding coverage for mental disease. NPI began to insure mental disorders in 1964 and mental deficiency in 1965, though coverage for mental disability was very limited. Whereas those who paid premiums were eligible to receive disability pension benefits once they satisfied Grade 1 or 2 criteria (NPI had no Grade 3), the disability welfare program insured the disabled only if they satisfied Grade 1 criteria. In 1974, the disability welfare program also began to cover those who satisfied Grade 2 criteria.

The third revision was implemented in 1985 (effective from 1986) as part of the major revision to core public pension programs, which harmonized all the public pension programs into an integrated form. For the first time, it reduced the benefit multiplier and flat-rate benefit in the old age pension program, and sought to restrain increases in total pension benefits. Three revisions were implemented with respect to the disability pension programs.

First, a double-tier structure was introduced, wherein (1) the flat rate "Disability Basic Pension (*Shogai Kiso Nenkin*)" benefit was in the first tier and replaced the "Disability Welfare Pension" funded by the government and by the premium contributions of NPI pensioners, and (2) the wage-proportional "Disability Employees' Pension (*Shogai Kosei Nenkin*)" program was the second tier. NPI pensioners, either with or without premium contributions, were entitled to receive (1).

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[4] Before 1954, EPI had in the old-age pension program only a single layer of wage-proportional benefit. While EPI was reconstructed in 1954 so as to have a double-tier structure, the disability pension program had a single-tier structure until the 1985 revision.

Second, both the disabled without premium contributions and those with premium contributions were entitled to receive the same Disability Basic Pension benefit, but the amount doubled for the former group. Third, the grading of disability conditions was harmonized across all programs. Nonetheless, the Disability Basic Pension covered only Grade-1 or 2 disabled individuals. EPI additionally covered the disabled in Grade 3, and provided "disability compensation" for a disabled pensioner with a disability less severe than Grade 3, if that disability condition were fixed.[5]

Fourth and finally, the government allowed Disability Basic Pension recipients aged 65 years or older to additionally receive EPI benefits, if they had made any EPI contributions since 2006.

2.2 Current scheme

Under the current scheme, a person who visited a doctor for the first time to consult about the cause of disability when he/she was under the age of 20 or when he/she was an NPI pensioner is entitled to receive the Disability Basic Pension benefit. There is no limitation in terms of age for receiving disability pension benefits. The formulas used to calculate the benefit are as follows:

Grade 1 = Basic Pension benefit × 1.25 + additional benefit for dependent children

Grade 2 = Basic Pension benefit + additional benefit for dependent children

The amount of the Basic Pension benefit is JPY786,500 per year; that of the additional child benefit is JPY226,300 for each of the first and second children, and JPY75,400 for each for the third and subsequent children.

In addition to the Disability Basic Pension, any person who first consulted a doctor to identify the cause of disability when he/she was an EPI pensioner is entitled to receive a wage-proportional Disability Employees' Pension benefit, or a Disability Mutual Aid Pension benefit (for the MAI recipients). The formulas used to calculate the second-tier benefit are as follows:

Grade 1 = Wage-proportional benefit × 1.25 + Additional benefit for a spouse

Grade 2 = Wage-proportional benefit + Additional benefit for a spouse

Grade 3 = Max (Wage proportional benefit, JPY589,900)

The amount of additional benefit for a spouse is JPY226,300 per year.[6]

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[5] Since EPI pensioners were required to join the NPI as part of the 1985 reform, the entitlement to receive disability pension became contingent on NPI grading (Disability Basic Pension), even if the disabled person had been approved to receive disability pension benefits through the EPI or MAI programs. Additionally, the MAI program has a Grade 3.

[6] Momose (2008) argues that the amount of benefits from Japan's disability employee pension (Grade 1 or 2) is larger that of the United States or Sweden, while the amount from the disability basic pension (Grade 1) is much smaller in Japan, and that from Grade 2 in Japan is one-half the standard benefit in the United States or Sweden.

2.3 Change in the disability program participation over time

This subsection describes changes in disability program participation over time. The data source is the Annual Report of Social Security Administration (*Shakai Hoken Jigyo Nenpo*), which is published by Japan's Social Security Agency. This report contains data on disability pension recipients, aggregated at the national level. However, it provides only the numbers of disability pension recipients by type of pension; no information on gender or age is available. Figure 1 reports the numbers of recipients who received disability pension benefits between 1970 and 2011.[7] The numbers of recipients have increased four-fold over these four decades, from 0.5 million in 1970 to 2.2 million in 2011. The proportions of NPI, EPI, and MAI pensioners have been about 80%, 20%, and 2–3%, respectively, during this period.[8]

Figure 2 shows trends in the rate of disability pension receipt in comparison to those of the employment rate, during 1970 and 2011. Because of data unavailability, we make the strong assumption that the ratio of recipients aged 50–64 to all total recipients in 2009—52.5% and 28.6% for disability EPI and NPI, respectively—has been the same over time; we also roughly estimate the total number of disability pension recipients within this age group. As already suggested in Figure 1, the disability pension receipt rate shows an upward trend, with some acceleration in the mid-1970s and 2000s. More importantly, the movement of the disability pension recipient rate has been unrelated to that of the employment rate.

2.4 Disability program participation by individual characteristics: JSTAR

We use JSTAR data to explore the characteristics of individuals participating in the disability program. The JSTAR is a longitudinal survey that collects information on middle-aged and elderly individuals in Japan. The first wave of the survey was conducted in 2007, with a baseline sample of more than 4,200 individuals aged 50–75 years who lived in five municipalities in eastern Japan. The respondents in the first wave were interviewed again in 2009; the response rate in the second wave among the respondents from the first wave was about 80% (i.e., an attrition rate of about 20%), with some variation across municipalities.

Although the JSTAR sample is not nationally representative and the sample size is not large enough to contain many disability pension recipients,[9] the dataset does contain a rich set of

[7] In Japan, the fiscal year starts in April and ends in March. The figures are measured as of the end of the fiscal year.

[8] The number of MAI pensioners receiving the disability pension is not available; the number of MAI pensioners eligible to receive benefits is available through the *Annual Report on Social Security Statistics* (Shakai Hoken Tokei Nenpo), compiled by the National Institute of Population and Social Security Research. We compute the number of MAI pensioners to receive the disability pension, assuming the proportion of those who receive out of those who are eligible—both of which are available in the *Annual Report of Social Security Administration*—to be the same for the EPI and MAI programs.

[9] The JSTAR project started in 2005. Its first wave was completed in five municipalities in 2007, and its second wave in seven municipalities (two new municipalities were added) in 2009. Ten municipalities (i.e., three new municipalities were added) were studied in 2011–12. The baseline sample consists of individuals aged 50–75 years. The JSTAR uses random

variables representing individuals' demographic and socioeconomic characteristics, pension receipt, and health status, *inter alia*; hence, we are able to examine the probability of receiving disability pension by exploiting individual-level characteristics. In the first wave of JSTAR, about 1.3% of the sample (aged 50–75) answered that they were receiving a disability pension at the time of the interview; in the second wave, that number was 1.2% (aged 52–78). When restricted to the sample aged 50–64, these percentages were 1.5% in 2007 and 1.6% in 2009—both of which are smaller than the percentages estimated from the aggregated data (Figure 2).

Figures 3a and 3b illustrate the percentages of men and women aged 55–64, respectively, who are receiving a disability pension, by education level and year (i.e., 2007 and 2009). For both men and women and for both 2007 and 2009, we saw the general tendency that a more highly educated person is less likely to receive a disability pension. For men, however, the percentage receiving a disability pension in 2007 was much higher among those who had graduated from a two-year college/vocational school than that among high school graduates; this result may derive simply from the small sample size of men who had graduated from two-year college/vocational schools (60 of 864).

Figures 3c and 3d depict the percentages of men and women aged 55–64, respectively, who are receiving a disability pension, by health status and year (see subsection 3.3 on how the health index is computed). For both men and women, the probability of receiving DI benefits is highest among those in the lowest health quintile (those in the poorest health), while the probability is very small among the other health quintiles. This is not surprising, given that the eligibility requirement for a disability pension in Japan places emphasis on physical and mental conditions and functional limitations (Momose, 2008).

In Table 2, we present the percentage of disability pension receipt by education *and* health status, to highlight those subpopulations in which disability pension receipt is particularly prevalent. As a general tendency, for both men and women, most recipients are concentrated within the lowest health quintile within each educational group. For example, among men, the probability of disability pension receipt in 2007 of those who did not graduate from high school was 17% in the lowest health quintile, while it was 0–1.96% in the higher health quintiles. Within each health quintile, the percentage of disability pension receipt is lowest among those in the highest educational group. For instance, among men, the probability of disability pension receipt in 2007 of those in the lowest health quintile was 17% in the lowest educational group, while it was 10% in the highest educational group.

sampling within a municipality, rather than probabilistic national sampling; it places emphasis on securing a larger sample size within the same socioeconomic environment.

3. Empirical approach

To examine the differences in elderly individuals' labor force participation across countries by the provisions of social security programs, we estimate an "inclusive" OV model, where it is assumed that an individual's retirement decision at age *t* depends on an incentive measure OV, his or her own health status, and other demographic and economic characteristics at age *t*. This section describes the data and sample used in the estimation, the empirical model used to estimate, and how we calculate individuals' OV figures and health status.

3.1 Data source and sample

The data we use to estimate the OV model come from the first and second waves of the JSTAR, conducted in 2007 and 2009, respectively. We restrict our sample to those who were interviewed in both waves, had answered in 2007 that they were working at all, and had provided information on their demographic, socioeconomic, and health-related characteristics in both waves. Individuals who answered in 2007 that they were working at all consisted of company executives, regular employees, part-time workers, casual or temporary workers, self-employed workers, employees on leave, and others. Our final sample consists of 1,575 individuals (996 men, 579 women) who were aged 50–75 in 2007.

3.2 Empirical model

We specify the empirical OV model as follows:

$$P(Y_{i,2009} = 1 \mid OV_{i,2007}, Health_{i,2007}, X_{i,2007}) = \Phi\left(\varepsilon_i > -\beta_0 - \beta_1 OV_{i,2007} - \beta_2 Health_{i,2007} - \beta_3 X_{i,2007}\right), \quad (4)$$

The dependent variable is an indicator that takes a value of one if individual *i* retired in 2009, and zero otherwise. We define an individual as "retired" if he/she answered that he/she was retired or doing housework. $OV_{i,2007}$, one of the main independent variables, is the OV of individual *i* in 2007. $Health_{i,2007}$ is another key independent variable; it represents the health status of individual *i*. Finally, $X_{i,2007}$ represents a vector of the remaining control variables, including age, gender, marital status (married), the existence of working spouse, total assets, occupation, and educational attainment, all as measured in 2007.[10] In the following sections, we describe how the OV and health status are measured.

[10] There are some missing data for each variable; this is especially true for the total assets. We impute the variable by allocating the average value of those who have attributes similar to those of the respondents.

3.3 OV calculations

OV at age t is defined as

$$OV_t = \sum_{k=1}^{K} P_k OV_{kt} , \tag{1}$$

where k refers to the k^{th} pathway to retirement; P_k, the probability weight on the k^{th} pathway; and OV_{kt}, the OV of the k^{th} pathway at age t. Moreover, we define the OV corresponding to each pathway as:

$$OV_{kt} = E_t V_{kt}(r^*) - E_t V_{kt}(t) , \tag{2}$$

$$E_t V_{kt}(r) = \sum_{s=t}^{r-1} p_{s|t} \beta^{s-t} (y(s))^{\gamma} + \sum_{s=r}^{D} p_{s|t} \beta^{s-t} [\kappa B_{rk}(S)]^{\gamma} , \tag{3}$$

where $p_{s|t}$ is the probability of survival at age s, given survival at age t; $y(s)$ refers to wage income at age s while working; $B_{rk}(s)$ refers to pension benefits at age s when retired at age r through the k^{th} pathway; β is the discount rate; γ is the parameter of risk aversion; and κ is the parameter of labor disutility.

In the following sections, we consider in turn the essential components of the OV model: pathways to retirement; weights on the pathways to retirement; the measurement of health, profiles of wage, and pension income; and assumptions regarding model parameters.

3.3.1 Pathways to retirement

Based on Japan's old age pension system and its three related programs, we set up two pathways to retirement—namely, Normal claiming and Disability—for each of the EPI/MAI pensioners. More explicitly, for EPI pensioners, we have:

(A) Normal claiming: "Employed" to "Normal claiming," which entails claiming at the normal retirement age. In this pathway, one claims wage-proportional benefits at ages 60–65 (depending on cohort) and a flat-rate benefit at age 65. The benefits are reduced as per the results of the earnings test under the *Zaushoku* pension scheme, if one continues to work beyond the normal retirement age.[11]

(B) Disability: "Employed" to "Claiming disability pension benefit," which entails claiming EPI/MAI wage-proportional/flat-rate benefits at ages 60–64.

For NPI pensioners, we have:

(A) Normal claiming: "Self-employed" to "Normal claiming," which entails claiming NPI benefits at age 65. Note that no earnings test is applied to NPI beneficiaries.

[11] In addition, there are "early claiming (*Kuriage*)" and "late claiming (*Kurisage*)," which actuarially adjust the benefit. Even when incorporating these claim schemes, we found the estimation results to remain virtually identical.

(B) Disability: "Self-employed" to "Claiming NPI disability pension benefit," which entails claiming disability benefits initially at ages 60–64.

3.3.2 The weight given to each pathway

To compute the weight given to each retirement pathway in calculating OV, we employ a "stock estimator" that uses the share of the population taking each pathway in a combined-age group at a given point in time.[12] In fact, since we assume there to be only two retirement pathways for each pension system (EPI/MAI or NPI), we estimate the weight of one of the pathways (i.e., the disability pathway) and assign 1 – (weight estimate on the disability pathway) to the normal claiming pathway. The stock estimator of the weight of the disability path is calculated by year, gender, and education. More specifically, we calculate the estimate of the weight of each pathway as follows:

(A) EPI/MAI "Disability": Share of EPI/MAI disability pension enrollees aged 60–64, among all EPI/MAI enrollees, by year, gender, and education

(B) EPI/MAI "Normal claiming": Others (1 – (A))

(C) NPI "Disability": Share of NPI disability pension enrollees aged 60–64, among all NPI enrollees, by year, gender, and education

(D) NPI "Normal claiming": Others (1 – (C))

Administrative data from the *Annual Report on Social Security Administration* are used to obtain information by gender; since administrative data lack information by education, data from the JSTAR are exploited to complement the information in terms of education.

Figures 4a and 4b illustrate the weight on each pathway for the EPI/MAI and NPI groups, respectively, by JSTAR wave year and gender. The proportion of "Disability" is negligible for both the male and female EPI/MAI groups, while the amount is somewhat higher for the NPI group.

3.3.3 Earnings and pension benefits

The major components of the OV calculation are the labor income until retirement and the pension income between retirement and death. Labor income until retirement is calculated by taking the following steps. First, we obtain the median earnings by age, gender, and pension membership (NPI or EPI/MAI), using 2007 data (Figure 5). Second, for each gender-by-pension-membership group, we calculate (Median earnings among individuals aged A + 1 – Median earnings among individuals age A)/(Median earnings among individuals aged A) (A = 50, ..,74) and assume that the rates

[12] There are two alternatives to the "stock estimator." One is the "age-specific flow" (i.e., the share of workers at each age who enter a pathway at that age). Another is the "aggregated flow" (i.e., the share of workers starting at an initial age who eventually enter a pathway at any point). This latter approach reflects the actual ultimate experience of the cohort, but it does need to assume perfect foresight vis-à-vis future changes to stringency.

represent how an individual's earnings grow as one ages. Then, to obtain an individual's wage profile from age 50 to 75, we multiply the individual's actual earnings observed in 2007 back and forward by the "growth" rate of median earnings. Finally, we need to "estimate" the earnings for individuals under age 50 or over 75, because the JSTAR sample does not contain individuals within these age ranges. Therefore, for simplicity, we assume that the earnings of those under age 50 are the same as those of individuals at age 50. We also assume that all individuals will stop working by age 75, so we do not need to impute an earnings profile beyond age 75.

The pension benefit between retirement and death of an individual is then estimated, using information on the individual's pension membership, years of premium contributions, career average monthly wage (CAMW), and benefit multiplier. Since information on an individual's years of premium contributions is not available through the JSTAR data, we use the years worked as a proxy. The CAMW is estimated via the earnings projection, as explained in the previous paragraph. The benefit multiplier is determined exogenously by gender and birthday. For technical reasons, spouse and survivor benefits are not included.

3.3.4 Other parameters

In calculating the OV, we assume several parameter values. We set the value of δ, the parameter of risk aversion, to equal 0.03; κ, the parameter of labor disutility, to equal 1.5; and γ to equal 0.75. All of these parameters are uniform across countries.[13] The mortality rates are taken from the 2007 "Life Table," published by the Japanese government.

3.3.5 OV calculations and descriptions

To examine the retirement behavior in 2009 of individuals who were working in 2007, we calculate the OV of these individuals in 2007, using the information described in previous subsections. Figures 6a and 6b show the mean OV by age in 2007 for men and women, respectively. Figure 6a shows that, for men, the mean OV for the normal claiming path (OV-Normal) constantly declines with age, but remains positive even among those aged 74. The mean OV for the disability path (OV-Disability) levels off in the 50s and then begins to decline from the mid-60s, where it overlaps with the mean OV-Normal. The inclusive OV overlaps with the mean OV-Normal, because the weight of the disability path is very small. The result—that the inclusive OV decreases with age—indicates that the utility gained from working until the optimal retirement age, compared to that from retiring at the current age, tends to decline as people age. At the same time, however, the

[13] The likelihood function is very flat, and the greater the assumed value for the risk aversion parameter γ, the lower the estimated OV coefficient will be. Given the flat likelihood function, we believe that little is to be gained from showing estimates based on other values.

result that the inclusive OV remains positive until age 74 implies that, in our OV model, it is optimal to delay retirement until age 74. The relationship between the OV and age is similar for women, except that the OV level is much lower than that of men (Figure 6b).

To further examine the relationship between OV and age, Figures 6c and 6d illustrate—by age in 2007 and for men and women, respectively—the mean present discounted value (PDV) of pension benefits obtained, if retired. Figure 6c shows that, for men, the mean PDV of the normal claiming path (PDV-Normal) rises until age 65 (i.e., the eligibility age for the basic public pension). Beyond age 65, the mean PDV-Normal declines because, by delaying retirement beyond age 65, individuals must relinquish years of benefit receipt. In contrast, the mean PDV of the disability path (PDV-Disability) declines continuously with age and, beyond age 65, becomes the same as that of PVD-Normal (i.e., the age at which the disability program is unified into the core public pension programs (EPI/MAI or NPI)). Figure 6d shows that a similar pattern also holds for women. These results indicate that the mean OV remains positive until age 74, not because the PVD increases with age, but because the additional earnings obtained through continued work more than compensate for the decline in the PVD.

3.4 Health measurements

A measure of individual health status is calculated using the method of Poterba, Venti, and Wise (2010). The idea behind this approach is to construct a single index by using information from many health indicators. More specifically, using data pooled from the first and second JSTAR waves, we apply a principal component analysis to 22 health indicators and use the first principal component to construct a continuous health index.[14] The health index is then converted into percentile values, with 1 representing the worst health and 100 the best health. The Appendix Table 1 reports the loadings on each health indicator.

Figure 7 shows the average percentile of the health index by age, for both men and women. We observe that (1) the mean percentile of the health index declines with age, (2) the speed of the decline is slightly higher in the 60s than in the 50s, and (3) men and women share almost the same pattern, although the mean is slightly higher for men in the late 60s.

[14] The 22 items are as follows: (1) difficulty in walking 100 m, (2) difficulty in lifting/carrying, (3) difficulty in pushing/pulling, (4) difficulty with an activity of daily living, (5) difficulty in climbing a few steps, (6) difficulty in stooping/kneeling/crouching, (7) difficulty in getting up from a chair, (8) self-reported health fair/poor, (9) difficulty in reaching/extending an arm up, (10) body mass index, (11) difficulty in sitting for two hours, (12) difficulty in picking up a dime, (13) ever experienced heart problems, (14) hospital stay, (15) doctor visit, (16) ever experienced psychological problems, (17) ever experienced a stroke, (18) ever experienced high blood pressure, (19) ever experienced lung disease, (20) ever experienced diabetes, (21) ever experienced arthritis, and (22) ever experienced cancer.

4. Results

Table 3a reports the results of estimating the OV model in Equation (4). Columns 1–8 relate to different model specifications, which vary by whether the effect of age is being controlled for linearly or with dummy variables, whether the effect of health is being controlled for using quintile health dummies or a continuous health index, and whether covariates other than OV and health are included. Column 1, which controls only for a continuous age variable and health quintile dummies, shows that the coefficient on OV-Inclusive is negative and statistically significant. The result indicates that OV-Inclusive has a negative effect on retirement. More specifically, a 10,000-unit increase in OV decreases the probability of retirement by 2.2 percentage points; a standard deviation increase in the OV (shown in the brackets), meanwhile, decreases the probability of retirement by 4.8 percentage points. These results also hold for other specifications (Columns 2–8). The coefficients on the other variables generally have the expected signs. Columns 1–4 show that, compared to individuals in the lowest health quintile (i.e., those in the poorest health), those in the higher health quintiles are less likely to retire, although the health effects are neither monotonic nor statistically significant. Similarly, the results in Columns 5–8 indicate that having a larger continuous health index value (i.e., being healthier) makes one less likely to retire, although again the coefficient is not significantly different from zero.

To confirm that the above results are robust to the scale of the OV measure, we also estimate the model using a percent gain in the inclusive OV as a key explanatory variable, instead of its level. Here, the measure of a percent gain in the inclusive OV is calculated by dividing the OV (i.e., the difference between the peak level and the current level of utility) by the current level of utility. Table 3b shows the results of the estimations. The estimated coefficients are again negative and significant, and robust to specification choice.

To investigate whether the effects of OV vary by individual health, we estimate the OV model separately for each health quintile; the estimations results are summarized in Table 4a. Specifications 1–4 in Columns 1–4 are the same as those in Columns 1–4 of Table 3a. The results show that the coefficient on the inclusive OV is negative for all the health quintile groups, but statistically significant only for the second, third, and fifth quintile groups. Similar results hold when we use a percent gain in the inclusive OV (Table 4b). While insignificant coefficients on the OV among some of the health quintile groups may derive from the small sample size used in the estimations (indeed, the standard error of the coefficient on the OV is larger when the model is estimated separately for each health quintile), the results in Table 4c also indicate that the effects of OV on the retirement decision do not vary monotonically with individual health. This table reports the results of estimating a model that includes an interaction between OV and the continuous health index, instead of estimating the model separately for each health quintile. While the estimated coefficient on the interaction term is negative—which may indicate that the financial incentives for retirement matter more for those in better health—it is not statistically significant. .

In Table 5a, we present the results of OV model estimation, for each education group. The results show no consistent pattern of OV effects across the various education groups: the coefficient on the OV is negative and significant only for those who graduated from high school and those graduated from two-year college or vocational school. Using the measure of percent gain in OV-Inclusive does not essentially change this result (Table 5b).

5. Model fit

To examine the fit of the OV model, we first compare the retirement "hazard rate" predicted by the OV model (specified in Column 4 of Table 3a) with the actual "hazard rate." Two things should be noted, however, in conducting the examination. First, since our dataset is a short panel, the "hazard rate" is obtained not by following the same individuals over time, but by assuming that the variation in hazard rates by cohort at a given point in time is the same as that by age of a single cohort. More specifically, we calculate the "hazard rate" by taking the average by age in 2007 of the probability of retirement within a year, given that the individual is working in 2007. Second, the retirement hazard rate averaged by age can be a noisy measure, because the number of observations at each age is small. As an extreme example, in 2007, only three female individuals aged 74 were still working.

Figures 8a and 8b compare the predicted versus actual retirement hazard rates for men and women, respectively. Figure 8a shows that, for men, there are some gaps between the predicted and actual retirement hazard rates; in particular, the actual retirement hazard rate is much higher at age 65 and ages 69–70. For women, the retirement hazard rate is underpredicted by the OV model at higher ages, particularly at ages 71 and 74 (Figure 8b). These results indicate that the model does not seem to predict well the spike in the hazard rate at certain ages, as seen in the actual data.

Figures 8c and 8d illustrate the predicted versus actual survival rates of retirement for men and women, respectively. Figure 8c shows that, for men, the actual survival rate is close to 100% between ages 50 and 56, declines quickly up to age 66, and then decreases moderately up to age 74. Meanwhile, the predicted survival rate declines steadily between ages 50 and 74. The result that the predicted survival rate decreases monotonically with age is the same for women (Figure 8d): the difference in the rate of decline in the actual survival rate by age is not captured by the predicted survival rate.

Figure 9 shows the percentage of people for whom the maximum utility from retirement occurs (i.e., OV becomes zero) at a given age, according to the OV model. That figure also presents the actual proportion of individuals who have retired, at each age. We observe that, for most of the individuals in the sample, the maximum utility from retirement is not achieved until age 74. In other words, the OV continues to be positive until the end point of our calculation. This is because, in our OV model, the additional earnings from continued work exceed the decline in the PDV of pension benefits (see Figures 6c and 6d). In contrast, the actual proportion of individuals who have retired evolves more gradually with age. Hence, the results of the examinations of the model fit presented in this section suggest that our model is not necessarily successful in predicting individuals' actual retirement behavior. The small sample size at each age may be one of the reasons for such results.

6. Counter-factual simulation

As a counter-factual simulation analysis, we examine how individual retirement behavior would change if there existed only one retirement path—that is, either the normal retirement path or the disability path. More specifically, using the regression results in Column 4 of Table 3a, we calculate retirement probabilities and survival rates to retirement, under the two counter-factual cases: when the weight placed on the normal retirement path in calculating OV is zero, and when the weight placed on the disability path is zero.

The results of the simulation are presented in Figures 10a and 10b. If the probability of being part of the disability program is zero, then the probability of retirement would decrease over the age range of 50 to around 60, compared to the case where individuals have no choice but to be on the disability program. Hence, if the possibility of being on the disability program were absent, the survival rate would be higher than the rate where the disability program were the only path to retirement: for example, at age 60, the survival rate would be 80.8% in the former case, but 70.1% in the latter case. This leads to a difference in the simulated average number of work years over the ages of 50–69, between the two counter-factual cases: 15.924 years in the case of there being no disability program, and 14.411 years in the case of there being no normal retirement. Thus, the average number of work years from age 50 to 69 would be 9.5% higher if every individual were on the normal retirement path, rather than the disability path.

7. Conclusion

This study examined the factors that affect the retirement decisions of the middle-aged and elderly in Japan, focusing especially on their earnings, public pension benefits, and health status. Using two-year panel data from the JSTAR and applying the OV model proposed by Stock and Wise (1990a, 1990b), we found that the probability of retirement has a negative and significant correlation with the OV of work, and that correlation does not depend on the health status. Our counter-factual simulation based on the OV model showed that, if the probability of being enrolled in the disability program were zero, the average years of work when individuals are in their 50s and 60s would increase. However, it should be emphasized that, in Japan—where being enrolled in the disability program is unlikely to make one a candidate for the retirement path—the result of this simulation does not indicate that satisfying the eligibility criteria for disability pension receipts will more stringently increase the labor supplied by the middle-aged and elderly.

We recognize that there remains much to be addressed in future research. First, we should further elaborate the specifications of the OV model. The value of an OV depends on the parameters of the utility function, such as parameters for converting income to utility, and the discount rate; these parameters are tentatively assumed in the current study. Second, we should more precisely project wage profiles and capture different pathways to retirement, on the basis of further information obtained from official statistical sources. Third, we should also model couples, rather than individuals, as retirement decisions are likely to be made jointly by elderly couples: we should therefore incorporate information about spouses' and survivors' pension benefits, which are ignored in this study.

Acknowledgements

This study utilized micro-level data collected through the Japanese Study on Aging and Retirement (JSTAR), which was conducted by the Research Institute of Economy, Trade, and Industry (RIETI) and Hitotsubashi University in 2007 and 2009.

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Appendix 1. An overview of social security programs in Japan

Japan's public old age pension system consists of three program types: National Pension Insurance (NPI; *Kokumin Nenkin*), Employees' Pension Insurance (EPI; *Kosei Nenkin*), and Mutual Aid Insurance (MAI; *Kyosai Nenkin*). It has been mandatory since 1961 for every Japanese national to participate in one of these public pension programs, and every citizen in Japan is eligible for one of them.[15]

NPI covers self-employed workers, or forestry or fishery cooperative employees; those covered by NPI constitute slightly less than half of all pensioners in Japan. NPI benefits are disbursed on a flat-rate basis, depending on the number of contribution years (minimum of 25 years and maximum of 40 years). In 2000, the normal eligibility age for NPI was set at age 60, for both genders; every three years, this age has been scheduled to increase by one year to 65. This reform has been in effect since 2001 for males, and since 2006 for females.[16] As a result of this reform, in 2007—the benchmark year of JSTAR—the normal eligibility age was 63 for males and 61 for females.

EPI covers employees in the private sector, and the individuals whom it covers constitute slightly less than half of all pensioners. Unlike that of NPI, the EPI benefit structure consists of two tiers: a flat-rate component and a wage-proportional component. The calculation of the flat-rate benefit (i.e., the "basic pension benefit") is identical to that of NPI. The wage-proportional benefit is calculated by considering the career average monthly wage (CAMW; *Hyojyun Hoshu Getsugaku*) and the number of months of premium contributions, as well as a gender and birthday-dependent benefit multiplier. The normal eligibility age for the wage-proportional component has been set at age 60, but as of 2013 (2018), every three years that age is scheduled to increase by one year, reaching age 65 in 2025 (2030) for males (females).

MAI covers employees of the public sector and of private schools; those covered by MAI constitute the small portion of pensioners covered by neither NPI nor EPI. The contribution–benefit structure and the normal retirement age for MAI benefits resemble those for EPI benefits, in most respects; thus, in the analysis below, we combine EPI and MAI pensioners.

In addition to the core programs, there are three additional features relevant to setting up Japan's retirement pathways: the social security earnings test, early/late claiming, and the disability pension program. Most of the previous studies implicitly assume that the age at which one starts to claim pension benefits corresponds to the retirement age (i.e., marked by one's departure from the labor

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15 The studies of Oshio, Shimizutani, and Oishi (2010) and Oshio, Oishi, and Shimizutani (2011) each describes in detail Japan's old age pension program.

16 Japan's social security program has undergone several large reforms over the last 40 years. The studies of Oshio, Shimizutani, and Oishi (2010) and Oshio, Oishi, and Shimizutani (2011) each provides detailed descriptions of past reforms.

force). However, this is not the case in Japan, and such an assumption ignores some important aspects of the association between pension benefits and labor force participation among the elderly.

First, the social security earnings test (*Zaishoku Rorei Nenkin*) can result in a suspension of payment of part or all of one's pension benefits, if one's labor income exceeds a certain threshold; the discouraging effect of this test on labor supply has been studied intensively in Japan and in other countries. Among recent studies in Japan, Shimizutani (2013) reveals the discouraging effect of the earnings test on the labor supply decisions of workers aged 60–64 years. Shimizutani and Oshio (2013) show that the repeal in 1985 of the earnings test for workers aged 65–69 did not affect the earnings distribution of the elderly, but that its reinstatement in 2002 partially altered earnings distribution.

Under the current program, the earnings test focuses on the average monthly wage and bonus income.[17] For workers aged 60–64, pension benefit payments are not suspended if the average wage and bonus income per month is less than JPY280,000; however, benefits are suspended by JPY0.5 per JPY1 increase in labor income (i.e., a marginal tax rate of 50%) between JPY280,000 and JPY460,000, and suspended by JPY1 per JPY1 increase in labor income (i.e., a marginal tax rate of 100%) in excess of JPY460,000. For workers aged 65 and over, the pension benefit payment is not suspended if the average wage and bonus income per month is less than JPY460,000, but it is suspended by JPY0.5 per JPY1 increase in labor income (i.e., a marginal tax rate of 50%) in excess of JPY460,000. Note that the earnings test is applicable only to the second-tier (i.e., wage-proportional) benefit for EPI beneficiaries, and not at all to NPI or MAI beneficiaries.

Second, all three social security programs allow their beneficiaries to claim within a "window" period; indeed, a nontrivial proportion of those beneficiaries claim at ages other than the normal eligibility ages. First, NPI allows a 10-year window in claiming benefits, and an individual undergoes benefit reductions if he or she claims early, at ages 60–64 (*Kuriage Jyukyu*); alternatively, he or she receives a benefit reward if he or she claims late, at ages 66–70 (*Kurisage Jyukyu*). The actuarial adjustment rate differs across birth cohorts; for example, for those individuals born after April 2, 1941, the actuarial reduction rate before age 65 is 0.5% per month, and the actuarial credit rate after age 65 is 0.7% per month (Shimizutani and Oshio, 2012). Second, EPI also allows some flexibility in terms of claim-timing, and it differs between flat-rate and wage-proportional benefits. As of 2011, one cannot claim the special benefit (i.e., corresponding to the wage-proportional benefit prior to age 65) earlier or later than the normal eligibility age of 60 years, regardless of gender; however, in 2007—when the normal eligibility ages for men and women were 63 and 61, respectively—one could claim the flat-rate component earlier, at ages 60–62 for males and 60 for

[17] The earnings test has been revised many times. Shimizutani (2013) and Shimizutani and Oshio (2013) each reviews previous reforms vis-à-vis the earnings test, over long-term periods.

females.[18] Moreover, an EPI beneficiary can claim either the flat-rate or wage-proportional component later than age 65, and thus enjoy an incremental benefit. Note that once one claims his or her benefits—either before or after the normal eligibility age—one cannot change his or her take-up decision.

Third, the disability pension program—, which is not specific to the aforementioned old age pension programs—covers some elderly individuals in Japan. While the participation rate in Japan with regard to the disability pension program remains low, many European countries have expanded their respective DI programs since the 1970s; in some countries, receiving DI benefits is a typical feature of early retirement (Wise, 2012). Oshio and Shimizutani (2012) argue that this is not the case in Japan, and that the low participation in Japan's disability pension program can be attributed to the stringency of its eligibility criteria. Under the current program, if one consults with a doctor about the cause of disability for the first time before the age of 20, or if one is an NPI pensioner, one is entitled to receive the Disability Basic Pension benefit, which is disbursed on the basis of disability severity (Grade 1 or 2) and the number of dependent children. In addition, if one consulted a doctor to identify the cause of the disability when one was an EPI (MAI) pensioner, one is entitled to receive a wage-proportional Disability Employees' Pension benefit or Disability Mutual Aid Pension benefit (for MAI recipients), the amount of which depends on the disability severity (Grades 1–3) and whether or not one has a spouse (Oshio and Shimizutani, 2012).

[18] There are two types of early claiming in the EPI program: total early claiming (*Zenbu Kuriage*) and partial early claiming (*Ichibu Kuriage*). In the former, one can receive a flat-rate benefit at a reduced rate that is identical to that for an NPI beneficiary, but it is no longer eligible for the special benefit. In the latter, one can receive both part of the flat-rate component of the special benefit and part of the flat-rate component of the formal benefit (as well as the wage-proportional component). See Shimizutani and Oshio (2012) for the detailed formula. If the duration of EPI participation is lengthy, the flat-rate benefit of the special benefit and the formal component are almost identical, and partial early claiming is in general more advantageous than total early claiming. In the current study, we assume that an EPI beneficiary chooses partial early claiming if he or she claims benefits earlier than the normal eligibility age.

Table 1 Development of Disability Pension Programs in Japan

	National Pension Insurance (Self-employed, agricultural, forestry and fishery Sector)		Employee Pension Insurance (private firm employees)
	Disability Pension (with contribution)	Disability Welfare Pension (without contribution)	
1944			Grade 1 and Grade 2 (including mental diseases)
1954			Grade 3 was added
1959	Grade 1 and Grade 2	Grade 1	
1964-65	Covered mental diseases		
1974		Grade 2 was added	
1986-	Merged to Disability Basic Pension		Disability Basic Pension + Wage-proportional Benefit

Source: Oshio and Shimizutani (2012).

Figure 1. The number of recipients of disability pension benefits

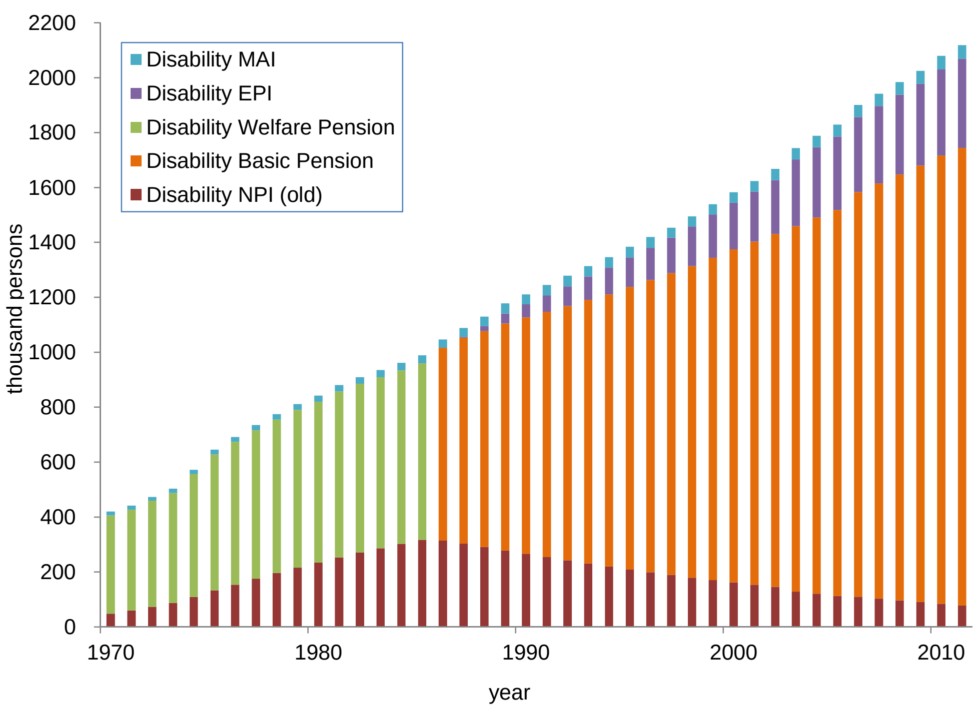
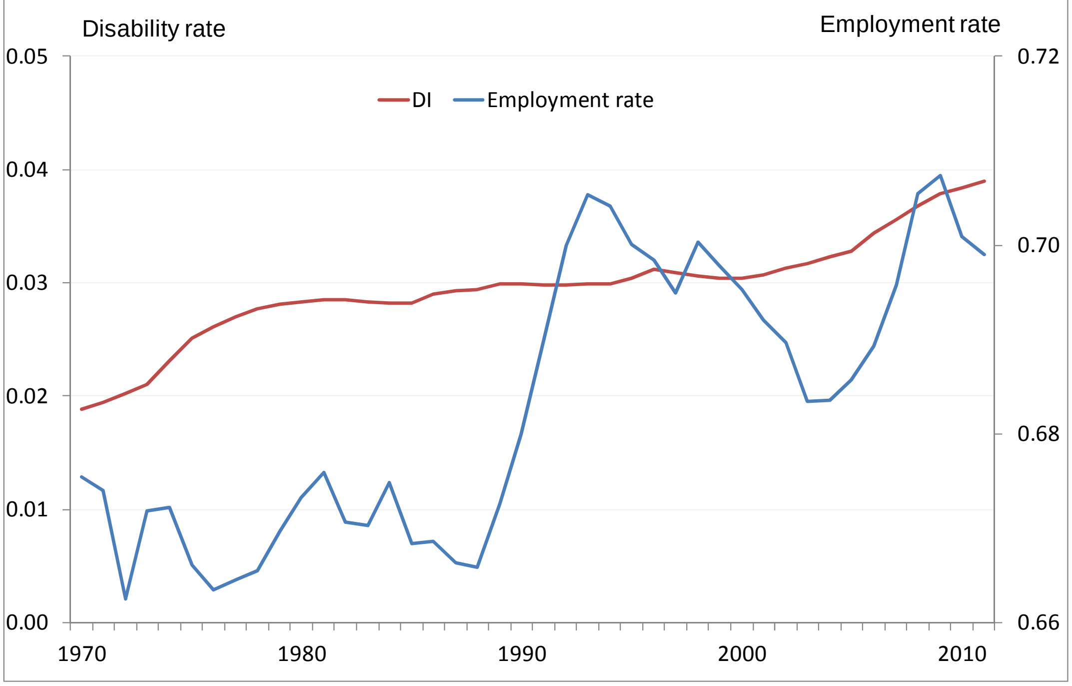


Figure 2. DI and employment for those aged 50-64



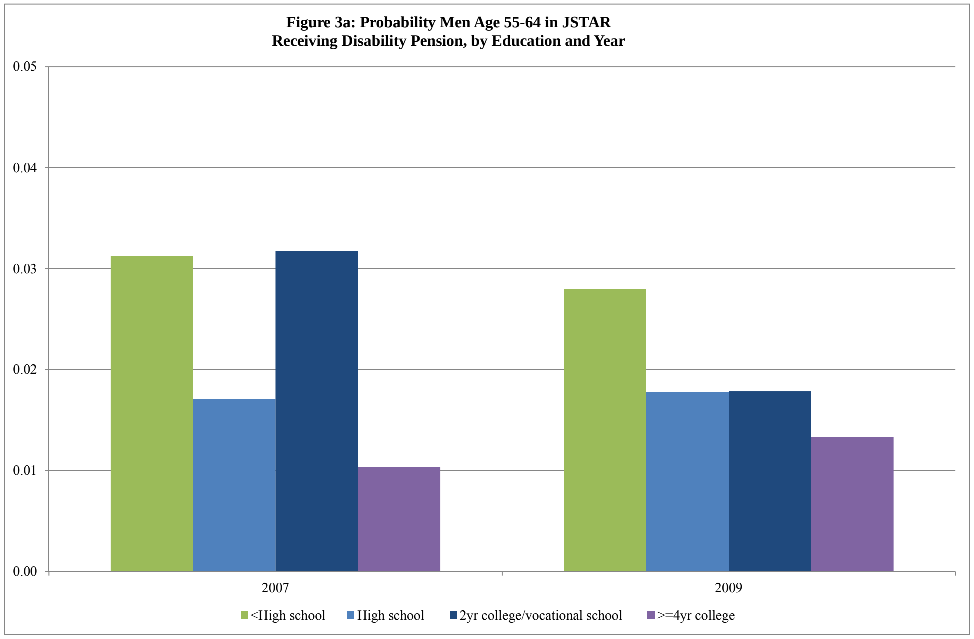


Figure 3a: Probability Men Age 55-64 in JSTAR Receiving Disability Pension, by Education and Year

Note: The total number of observations in 2007 and 2009 were 864 and 591, respectively. In 2007/2009, the sample sizes of those whose final educational attainment is less than high school were 218/137; high school, 399/263; two-year college/vocational school, 60/51; and four-year college, 187/140.

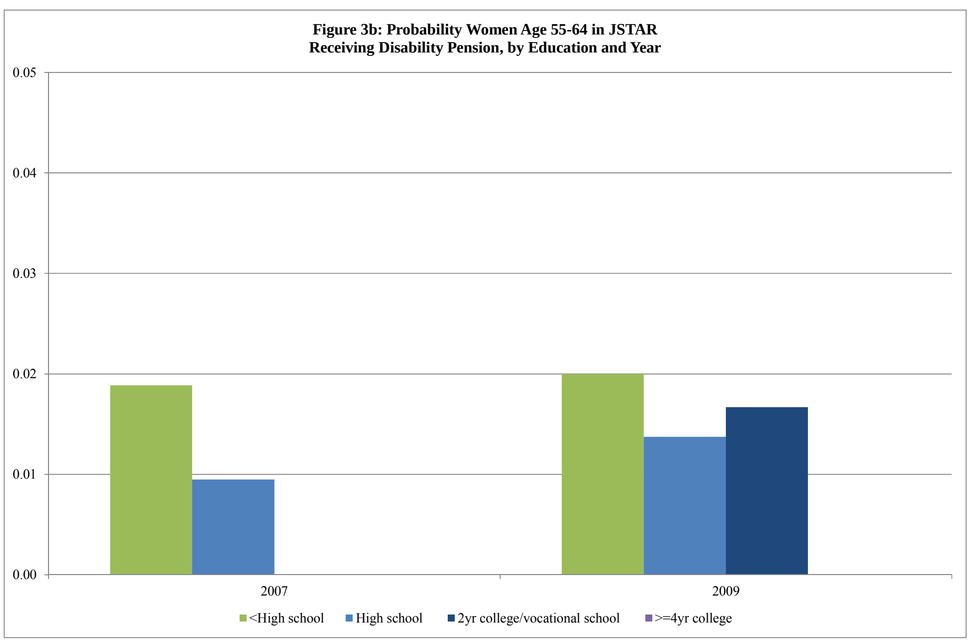
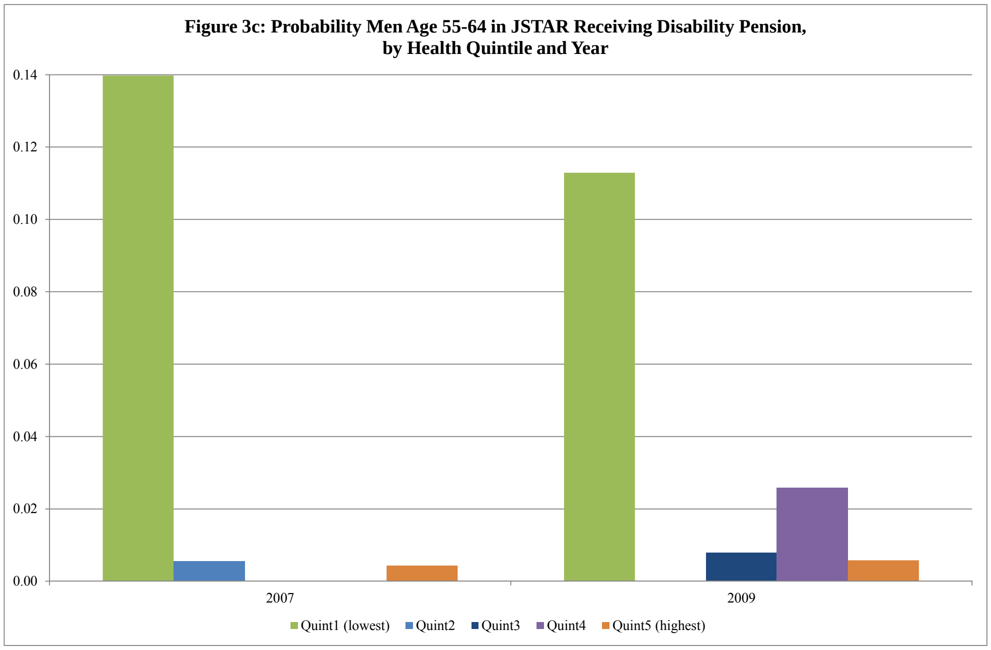
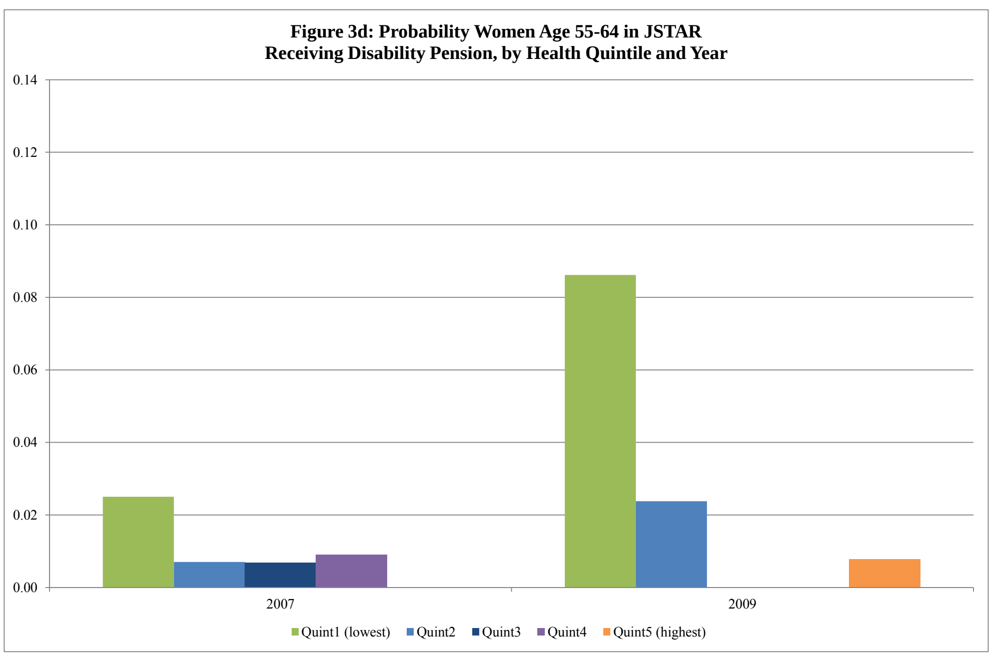


Figure 3b: Probability Women Age 55-64 in JSTAR Receiving Disability Pension, by Education and Year

Note: The total number of observations in 2007 and 2009 were 799 and 514, respectively. In 2007/2009, the sample sizes of those whose final educational attainment is less than high school were 202/96; high school, 409/274; two-year college/vocational school, 150/113; and four-year college, 38/31.



Note: The total number of observations in 2007 and 2009 were 864 and 591, respectively. In 2007/2009, the sample sizes of those in the lowest health quintile were 93/62; the second health quintile, 181/117; the third health quintile, 206/125; the fourth health quintile, 154/116; and the fifth health quintile, 230/171.



Note: The total number of observations in 2007 and 2009 were 799 and 514, respectively. The sample sizes of those in the lowest health quintile were 119/58; the second health quintile, 142/84; the third health quintile, 146/91; the fourth health quintile, 223/155; and the fifth health quintile, 169/126.

Table 2: Percentage of Disability Pension Recipients: JSTAR Men and Women Aged 55–64, by Health Quintile and Education, 2007 and 2009

Year 2007

	Men				
	Percent Receiving				
Education	Health Quintile				
	1	**2**	**3**	**4**	**5**
<High school	17	0	0	0	1.96
High school	12.50	0	0	0	0
2yr college/vo	25	5	0	0	0
>=4yr college	10.00	0	0	0	0

	Women				
	Percent Receiving				
Education	Health Quintile				
	1	**2**	**3**	**4**	**5**
<High school	9.09	2.04	0	0	0
High school	0	0	1.19	1.53	0
2yr college/vo	0	0	0	0	0
>=4yr college	0	0	0	0	0

Note: The total numbers of observations are 864 men and 799 women.

Year 2009

	Men				
	Percent Receiving				
Education	Health Quintile				
	1	**2**	**3**	**4**	**5**
<High school	11.11	0	0	6.90	0
High school	14.81	0	0	2.08	0
2yr college/vo	0	0	6.67	0	0
>=4yr college	7.14	0	0	0	0

	Women				
	Percent Receiving				
Education	Health Quintile				
	1	**2**	**3**	**4**	**5**
<High school	16.67	0	0	0	0
High school	2.94	4.26	0	0	1.59
2yr college/vo	25.00	0	0	0	0
>=4yr college	0	0	0	0	0

Note: The total numbers of observations are 591 men and 514 women.

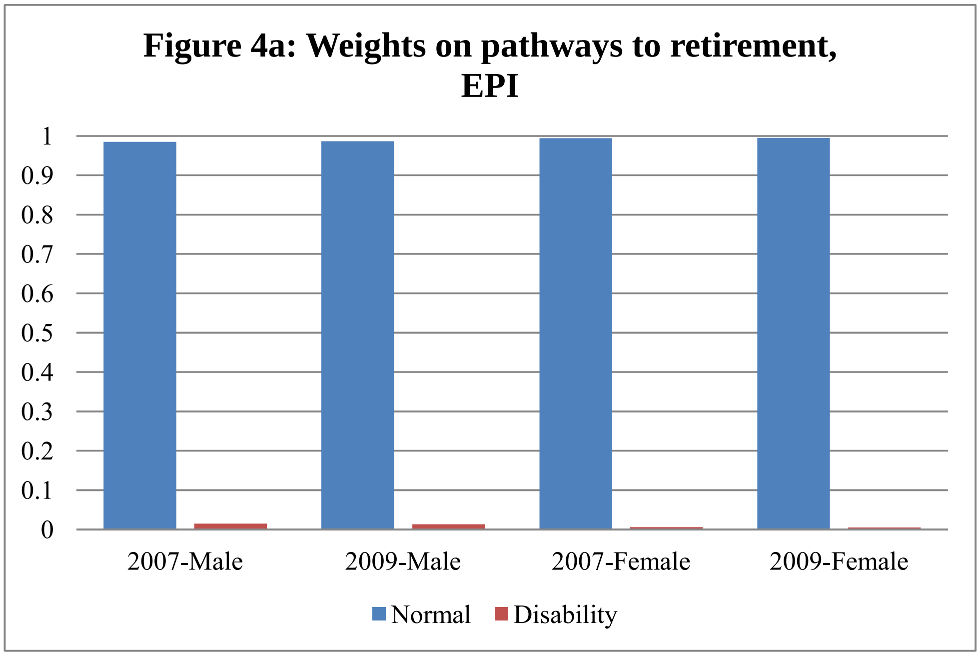


Figure 4a: Weights on pathways to retirement, EPI
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2007-Male
2009-Male
2007-Female
2009-Female
Normal
Disability

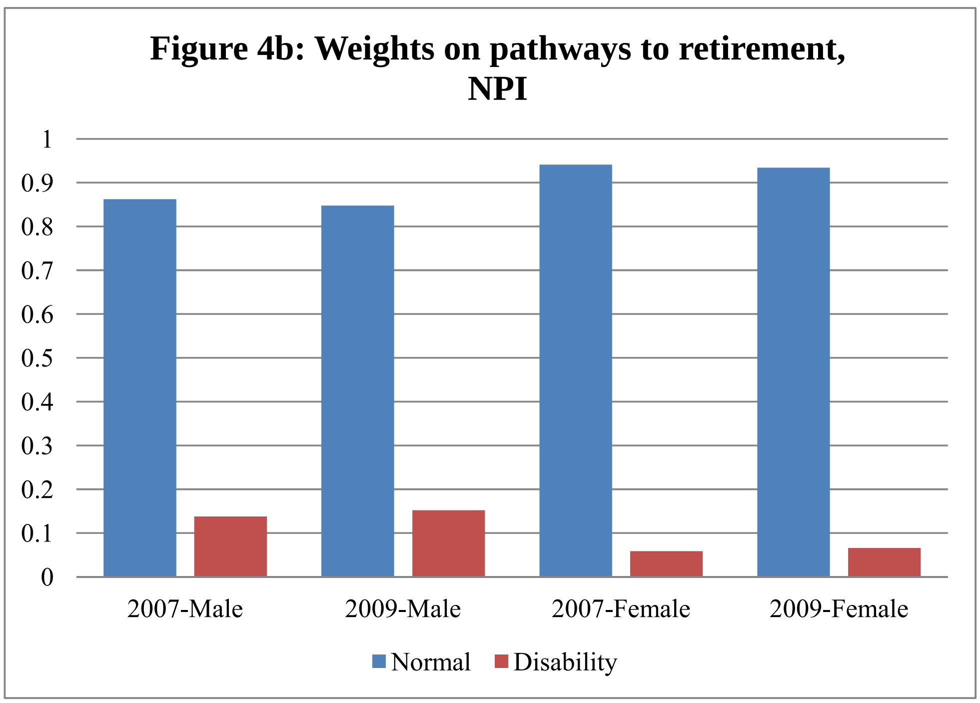


Figure 4b: Weights on pathways to retirement, NPI
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2007-Male
2009-Male
2007-Female
2009-Female
Normal
Disability

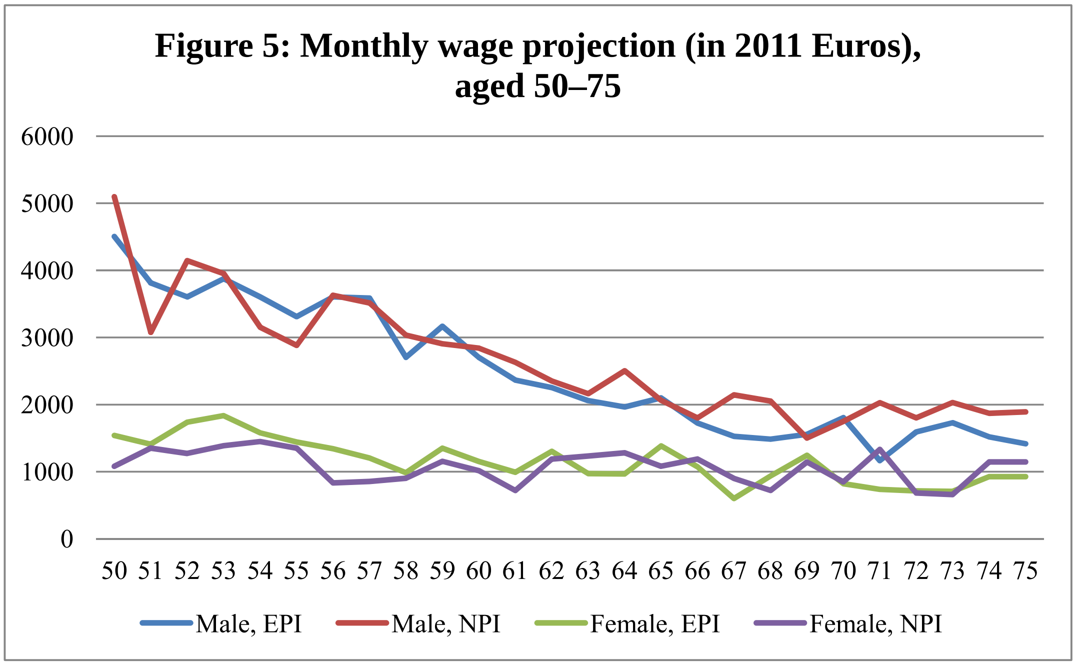


Figure 5: Monthly wage projection (in 2011 Euros), aged 50–75
6000
5000
4000
3000
2000
1000
0
50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
Male, EPI
Male, NPI
Female, EPI
Female, NPI

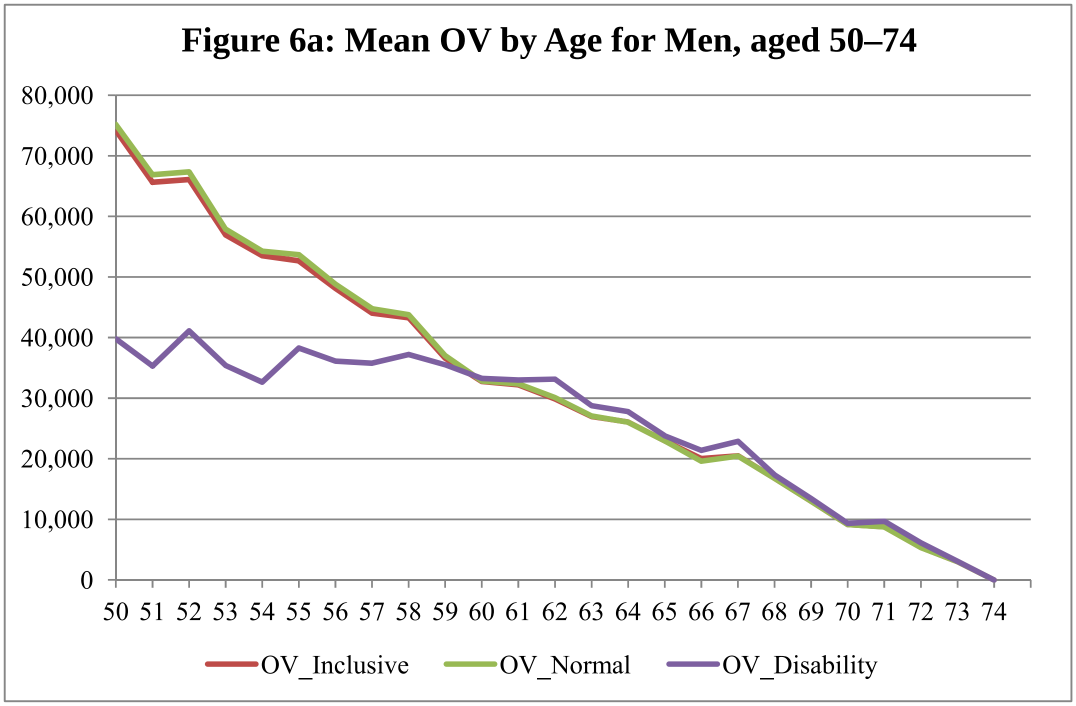


Figure 6a: Mean OV by Age for Men, aged 50–74
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74
OV_Inclusive
OV_Normal
OV_Disability

–

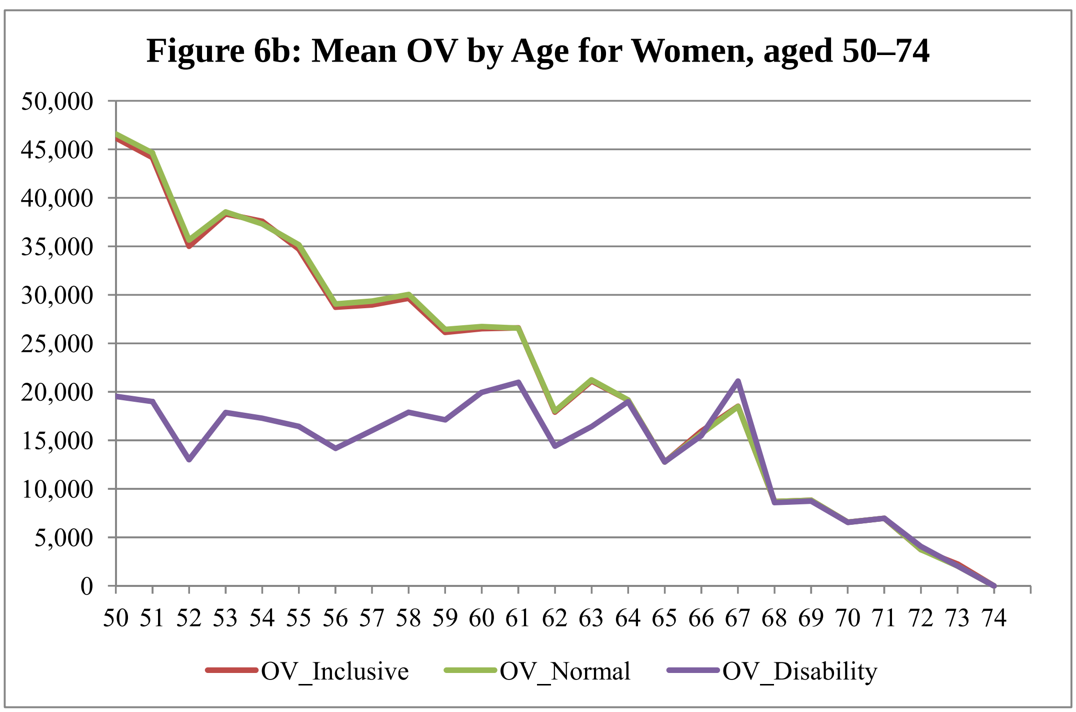


Figure 6b: Mean OV by Age for Women, aged 50–74
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74
OV_Inclusive
OV_Normal
OV_Disability

Figure 6c: Mean PDV-Normal and PDV-Disability by Age, Men (2011 Euros) aged 50–74

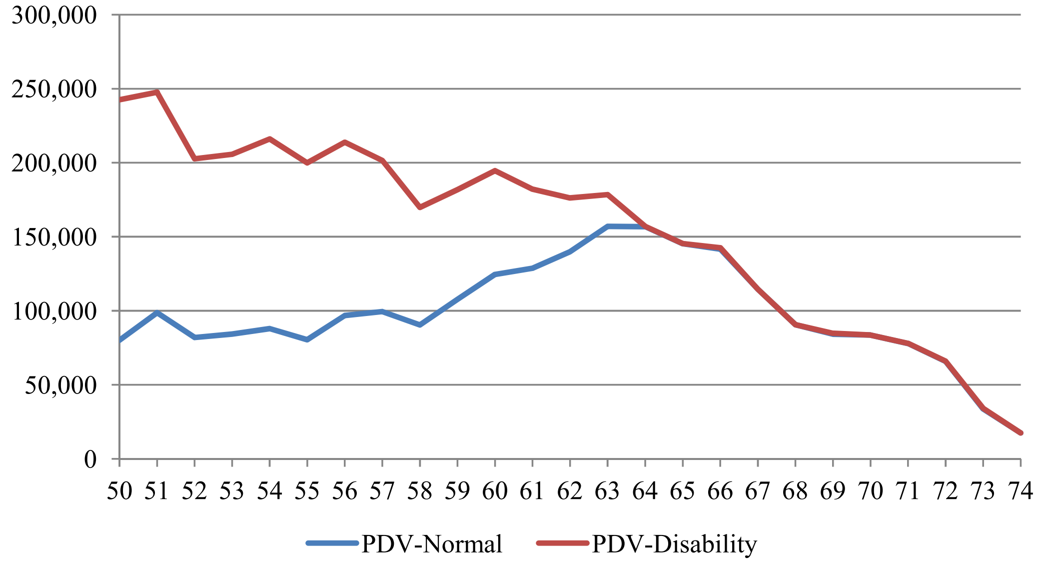


Figure 6d: Mean PDV-Normal and PDV-Disability by Age, Women (2011 Euros) aged 50–74

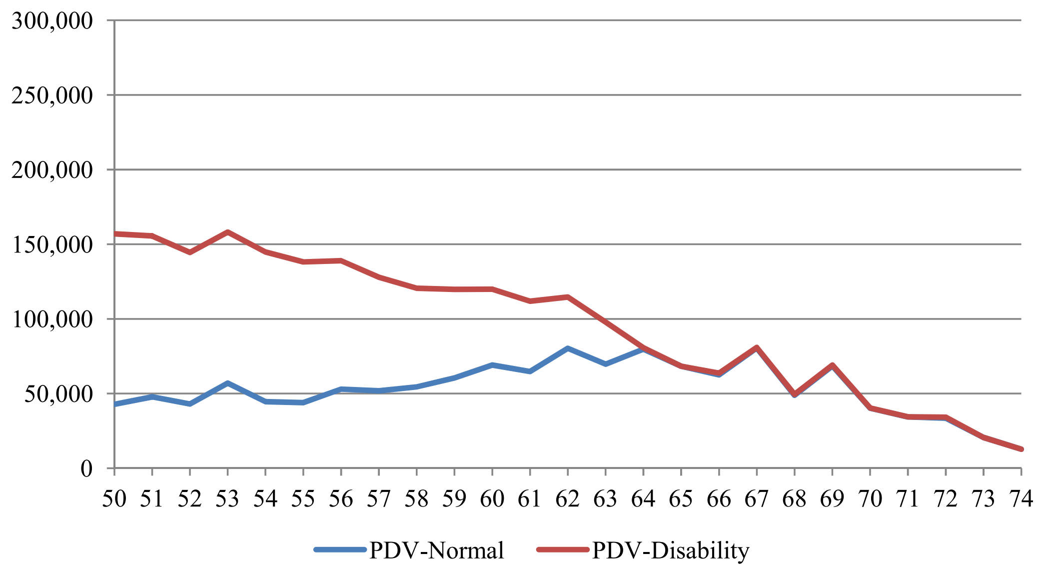


Figure 7: Mean Percentile of Health Index, by Age and Gender, aged 50–78

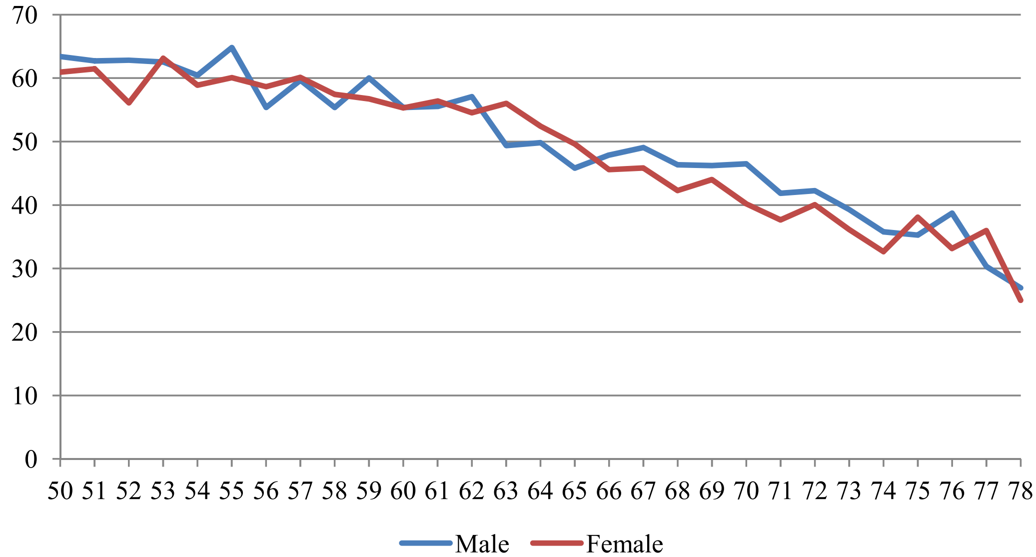


Table 3a: Effect of Inclusive OV on Retirement

	Specification							
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
OV_Inclusive	-0.0213**	-0.0224**	-0.0204**	-0.0219**	-0.0216**	-0.0226**	-0.0207**	-0.0221**
	(0.0056)	(0.0056)	(0.0061)	(0.0061)	(0.0056)	(0.0056)	(0.0061)	(0.0061)
	[-0.048]	[-0.051]	[-0.047]	[-0.052]	[-0.049]	[-0.052]	[-0.047]	[-0.052]
Health Quint 2 (Second Lowest)	-0.0159	-0.0154	-0.0179	-0.0166				
	(0.0184)	(0.0180)	(0.0173)	(0.0169)				
Health Quint 3	0.0064	0.0068	-0.0004	0.0003				
	(0.0209)	(0.0205)	(0.0191)	(0.0187)				
Health Quint 4	-0.0077	-0.0086	-0.012	-0.012				
	(0.0206)	(0.0200)	(0.0192)	(0.0186)				
Health Quint 5 (Highest)	-0.0047	-0.0054	-0.0069	-0.0073				
	(0.0205)	(0.0198)	(0.0193)	(0.0186)				
Health Index					-0.000162	-0.00017	-0.000216	-0.00022
					(0.0003)	(0.0003)	(0.0003)	(0.0002)
Age	0.00355*		0.00321*		0.00335*		0.00300+	
	(0.0016)		(0.0016)		(0.0016)		(0.002)	
Age Dummies		Included		Included		Included		Included
Female			0.0152	0.0128			0.0159	0.0136
			(0.0172)	(0.0167)			(0.0171)	(0.0166)
Married			0.0267+	0.0244			0.0271+	0.0247
			(0.0160)	(0.0159)			(0.0160)	(0.0159)
Spouse works			-0.0528**	-0.0512**			-0.0530**	-0.0513**
			(0.0161)	(0.0157)			(0.0162)	(0.0157)
Total Assets (in millions of Euros)			0.00003	0.00002			0.00002	0.00001
			(0.0001)	(0.0001)			(0.0001)	(0.0001)
Occup Dummies			Included	Included			Included	Included
Educ: <High School			-0.0263	-0.0257			-0.0274	-0.027
			(0.0216)	(0.0210)			(0.0216)	(0.0209)
Educ: High School			-0.0258	-0.0276			-0.0284	-0.0302
			(0.0217)	(0.0212)			(0.0216)	(0.0211)
Educ: 2yr College/Vocational School			-0.0036	-0.00286			-0.00537	-0.00451
			(0.0265)	(0.0262)			(0.0262)	(0.0259)
# of Observations	1575	1575	1575	1575	1575	1575	1575	1575
Mean Ret. Rate	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096
Mean of OV	32185	32185	32185	32185	32185	32185	32185	32185
Std. Dev. of OV	20581	20581	20581	20581	20581	20581	20581	20581

Note:
1) Coefficients are marginal effects of a 10,000-unit change in OV from probit models. Standard errors are shown in parentheses.
The effect of a one standard deviation change in OV is shown in brackets (this is estimated as the effect of increasing inclusive OV from the current value - 0.5 std. dev to the current value + 0.5 std dev).

Table 3b: Effect of % Gain in Inclusive OV on Retirement

	Specification			
	(1)	(2)	(3)	(4)
% Gain in OV	-0.0416**	-0.0424**	-0.0416**	-0.0422**
	(0.0126)	(0.0131)	(0.0123)	(0.0126)
Linear Age	X		X	
Age Dummies		X		X
Health Quintiles	X	X	X	X
Other Xs			X	X
# of Observations	1575	1575	1575	1575
Mean Ret. Rate	0.096	0.096	0.096	0.096
Mean of % Gain in OV	1.380	1.380	1.380	1.380
Std. Dev. of % Gain in OV	1.011	1.011	1.011	1.011

Notes:
1) Models are the same as models 1-4 in Table 1.
2) Coefficients are marginal effects. Standard errors are shown in parentheses.

Table 4a: Effect of Inclusive OV on Retirement
by Health Quintile

	# of Obs	Mean Ret. Rate	Mean of OV	Std. Dev. of OV	Specification (1)	(2)	(3)	(4)
OV: Lowest Quintile (Worst Health)	311	0.1190	27268.89	18995.95	-0.0166	-0.0168	-0.00508	-0.00307
					(0.0159)	(0.0141)	(0.0158)	(0.0140)
					[-0.0322]	[-0.0329]	[-0.0104]	[-0.006]
OV: 2nd Quintile	303	0.0957	30907.59	21073.72	-0.0270**	-0.0322**	-0.0154+	-0.0212*
					(0.0103)	(0.0096)	(0.0088)	(0.0085)
					[-0.08]	[-0.0969]	[-0.0505]	[-0.0715]
OV: 3rd Quintile	287	0.1185	31893.59	20732.61	-0.0394**	-0.0393**	-0.0488**	-0.0443**
					(0.0134)	(0.0139)	(0.0159)	(0.0154)
					[-0.0887]	[-0.0924]	[-0.135]	[-0.132]
OV: 4th Quintile	306	0.0784	35057.42	19704.55	-0.00833	-0.00523	-0.00883	-0.00741
					(0.0110)	(0.0108)	(0.0100)	(0.0089)
					[-0.0172]	[-0.012]	[-0.02]	[-0.0188]
OV: Highest Quintile (Best Health)	286	0.0944	34728.72	21178.41	-0.0168	-0.0199+	-0.0171+	-0.0202*
					(0.0108)	(0.0107)	(0.0100)	(0.0103)
					[-0.04]	[-0.0504]	[-0.0455]	[-0.0531]
Linear Age					X		X	
Age Dummies						X		X
Other Xs							X	X

Notes:

1) Models are the same as models 1-4 on Table 1, but are estimated separately by health quintile; each coefficient on the table is from a different regression.
2) Coefficients are marginal effects of a 10,000-unit change in OV from probit models. Standard errors are shown in parentheses. The effect of a one standard deviation change in OV is shown in brackets (this is estimated as the effect of increasing inclusive OV from the current value - 0.5 std. dev to the current value + 0.5 std dev).

Table 4b: Effect of % Gain in Inclusive OV on Retirement
by Health Quintile

	# of Obs	Mean Ret Rate	Mean of % OV	Std. Dev. Of % OV	Specification			
					(1)	(2)	(3)	(4)
OV: Lowest Quintile	311	0.1190	1.217062	0.9589739	-0.035	-0.0452	-0.0331	-0.0395
(Worst Health)					(0.0288)	(0.0277)	(0.0268)	(0.0250)
OV: 2nd Quintile	303	0.0957	1.166729	0.8397144	-0.0602*	-0.0850**	-0.0403+	-0.0577**
					(0.0289)	(0.0256)	(0.0222)	(0.0217)
OV: 3rd Quintile	287	0.1185	1.426323	1.122353	-0.0525	-0.0435	-0.0558+	-0.0464
					(0.0328)	(0.0342)	(0.0299)	(0.0302)
OV: 4th Quintile	306	0.0784	1.572716	1.028707	-0.0362	-0.0236	-0.0319+	-0.0227
					(0.0242)	(0.0207)	(0.0193)	(0.0161)
OV: Highest Quintile	286	0.0944	1.545694	1.059786	-0.0611**	-0.0676**	-0.0534**	-0.0604**
(Best Health)					(0.0190)	(0.0225)	(0.0169)	(0.0198)
Linear Age					X		X	
Age Dummies						X		X
Other Xs							X	X

Notes:

1) Models are the same as models 1-4 in Table 1, but are estimated separately by health quintile; each coefficient on the table is from a different regression.

2) Coefficients are marginal effects. Standard errors are shown in parentheses.

Table 4c: Effect of Inclusive OV on Retirement
with Health Index Interaction

	Specification			
	(1)	**(2)**	**(3)**	**(4)**
OV	-0.0167	-0.019	-0.016	-0.0185
	(0.0116)	(0.0124)	(0.0113)	(0.0121)
OV*Health Index	-0.00005	-0.00003	-0.00004	-0.00002
	(0.0001)	(0.00005)	(0.0001)	(0.0000)
Health Index	0.00004	-0.00002	-0.00002	-0.00007
	(0.00045)	(0.00046)	(0.00043)	(0.00044)
Linear Age	X		X	
Age Dummies		X		X
Other Xs			X	X
# of Observations	1575	1575	1575	1575
Mean Ret. Rate	0.096	0.096	0.096	0.096
Mean of OV	32185	32185	32185	32185
Std. Dev. of OV	20581	20581	20581	20581

Notes:
1) Models are the same as models 5-8 in Table 1, with the addition of an OV*health index interaction.
2) Coefficients are marginal effects of a 10,000-unit change in OV from probit models. Standard errors are shown in parentheses. The effect of a one standard deviation change in OV is shown in brackets (this is estimated as the effect of increasing inclusive OV from the current value - 0.5 std. dev to the current value + 0.5 std dev).

Table 5a: Effect of Inclusive OV on Retirement
By Education Group

	# of Obs	Mean Ret. Rate	Mean of OV	Std. Dev. of OV	Specification (1)	(2)	(3)	(4)
OV: < High School	428	0.1332	22957.77	17059.07	0.00112	-0.0124	0.0122	-0.00545
					(0.0146)	(0.0125)	(0.0164)	(0.0144)
					[0.002]	[-0.022]	[0.022]	[-0.01]
OV: High School	690	0.0899	30463.16	17817.6	-0.0304**	-0.0305**	-0.0360**	-0.0347**
					(0.0081)	(0.0080)	(0.0085)	(0.0081)
					[-0.0613]	[-0.067]	[-0.0764]	[-0.0801]
OV: 2yr College /Vocational School	177	0.0904	36432.72	18626.52	-0.0346*	-0.0339*	-0.0259*	-0.0217*
					(0.0138)	(0.0132)	(0.0116)	(0.0108)
					[-0.0708]	[-0.0704]	[-0.0653]	[-0.0585]
OV: 4yr College	195	0.0821	49046.99	23500.44	0.00135	0.00532	0.00814	0.0122
					(0.0093)	(0.0095)	(0.0105)	(0.0098)
					[0.00358]	[0.0158]	[0.02271]	[0.0423]
Linear Age					X		X	
Age Dummies						X		X
Health Quintiles					X	X	X	X
Other Xs							X	X

Notes:
1) Models are the same as models 1-4 in Table 1, but are estimated separately by education group; each coefficient on the table is from a different regression.
2) Coefficients are marginal effects of a 10,000-unit change in OV from probit models. Standard errors are shown in parentheses. The effect of a one standard deviation change in OV is shown in brackets (this is estimated as the effect of increasing inclusive OV from the current value - 0.5 std. dev to the current value + 0.5 std dev).

Table 5b: Effect of % Gain in Inclusive OV on Retirement
By Education Group

	# of Obs	Mean Ret. Rate	Mean of % OV	Std. Dev. of % OV	Specification (1)	(2)	(3)	(4)
OV: < High School	428	0.1332	1.007337	0.7619505	-0.0477	-0.0598+	-0.0432	-0.0557+
					(0.0347)	(0.0326)	(0.0351)	(0.0320)
OV: High School	690	0.0899	1.371689	0.9535805	-0.0745**	-0.0701**	-0.0753**	-0.0705**
					(0.0165)	(0.0170)	(0.0157)	(0.0157)
OV: 2yr College /Vocational School	177	0.0904	1.692081	0.8150037	-0.0118	-0.0185	-0.00832	-0.016
					(0.0337)	(0.0334)	(0.0256)	(0.0247)
OV: 4yr College	195	0.0821	1.818536	1.306513	-0.011	0.00103	-0.0118	-0.00073
					(0.0155)	(0.0147)	(0.0139)	(0.0116)
Linear Age					X		X	
Age Dummies						X		X
Other Xs							X	X

Notes:

1) Models are the same as models 1-4 on Table 1, but are estimated separately by education group; each coefficient on the table is from a different regression.

2) Coefficients are marginal effects. Standard errors are shown in parentheses.

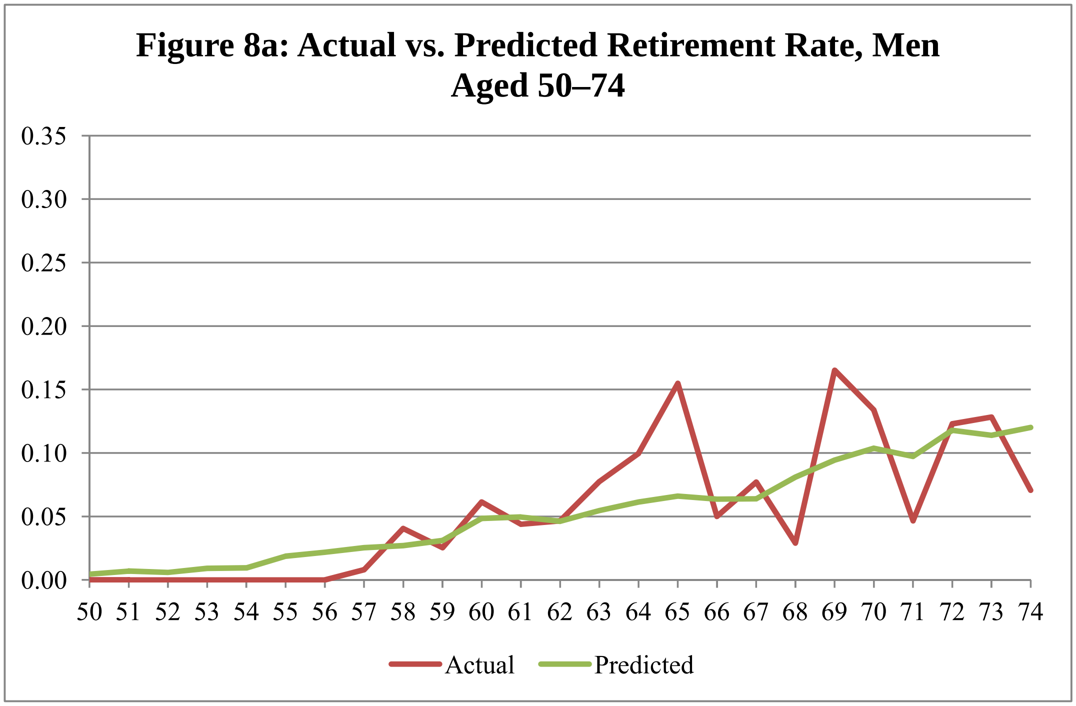


Figure 8a: Actual vs. Predicted Retirement Rate, Men Aged 50–74
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74
Actual
Predicted

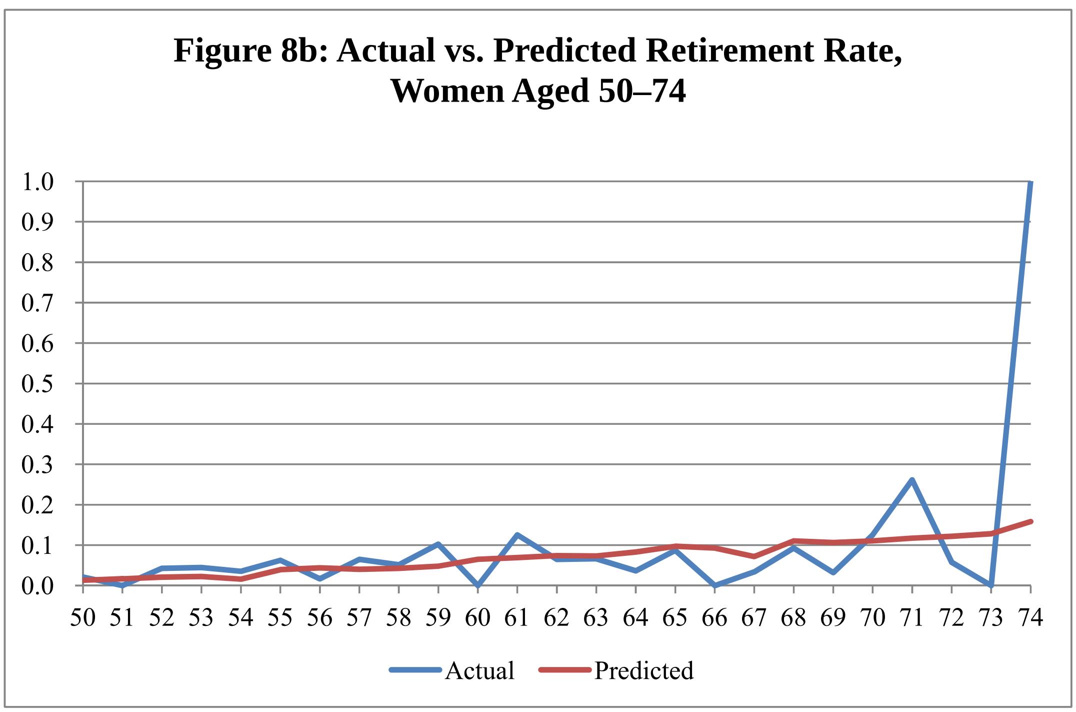


Figure 8b: Actual vs. Predicted Retirement Rate, Women Aged 50–74
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74
Actual
Predicted

Figure 8c: Actual vs. Predicted Retirement Survival, Men Aged 50–74

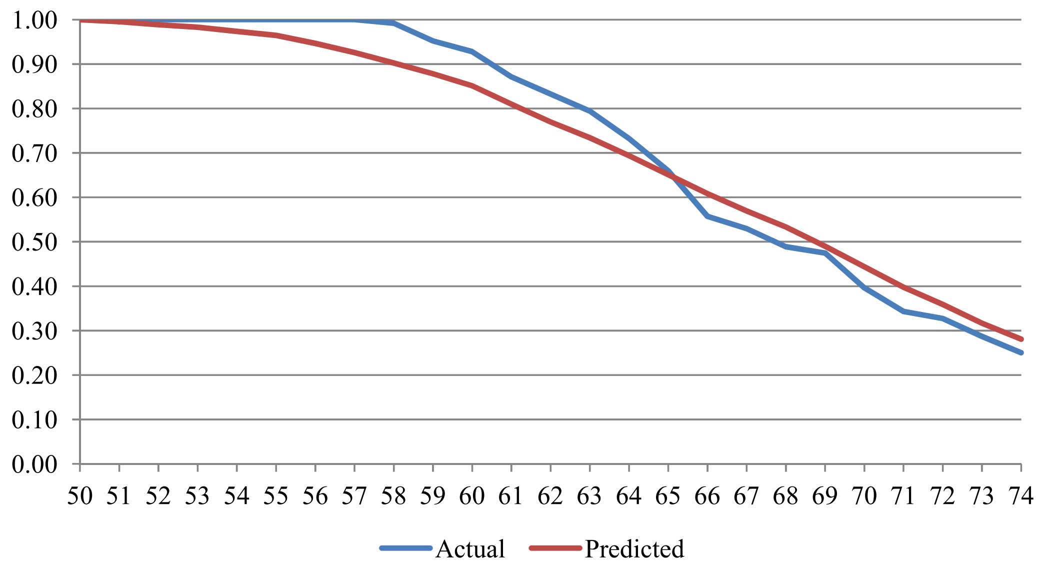
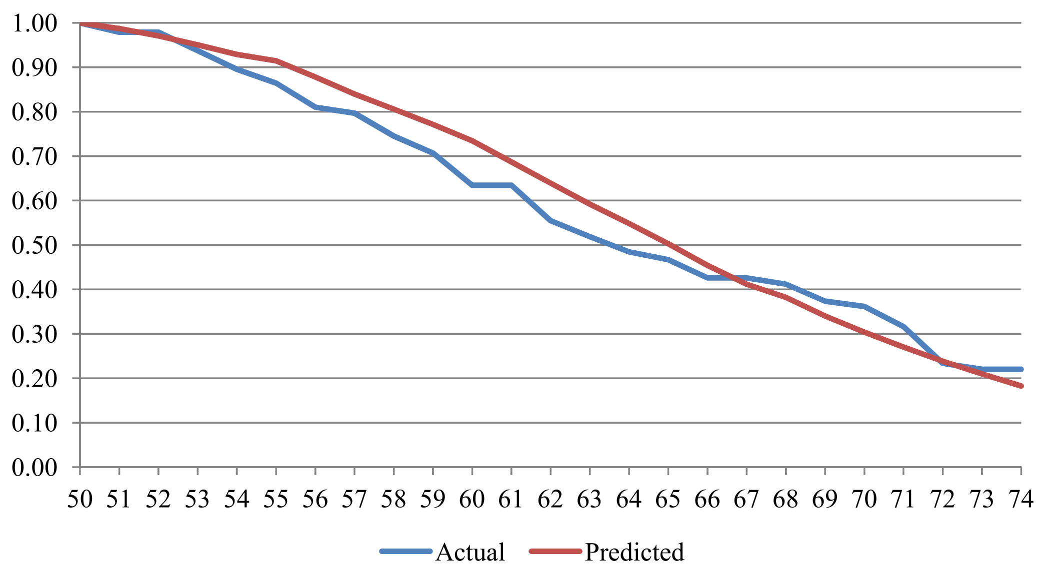


Figure 8d: Actual vs. Predicted Retirement Survival, Women



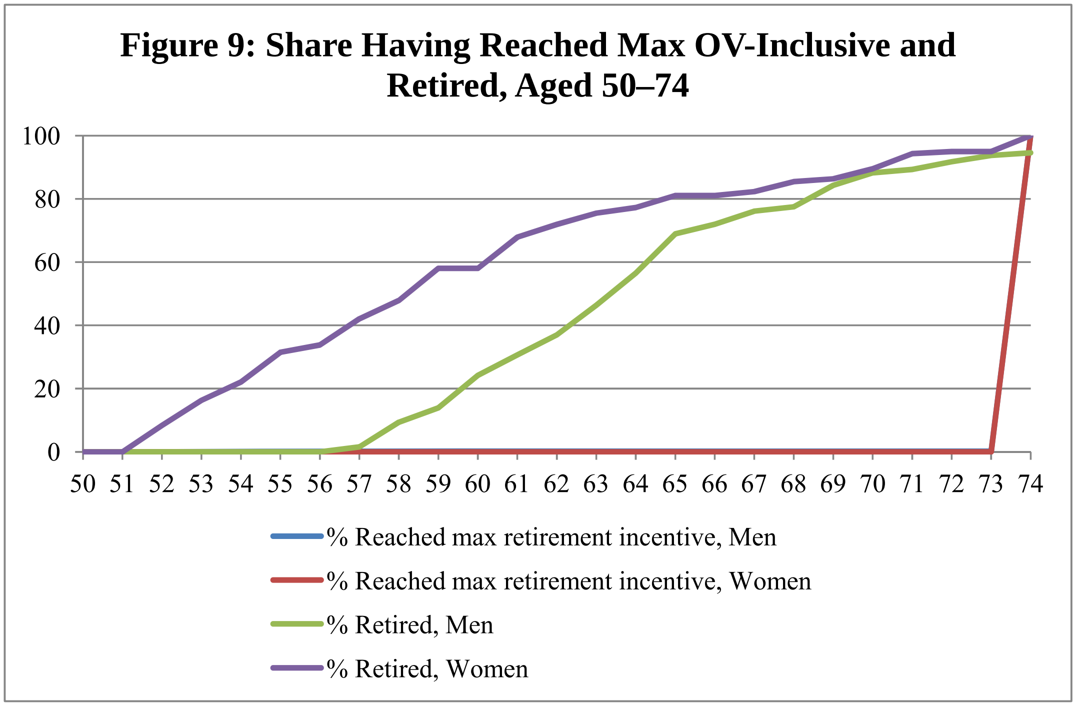


Figure 9: Share Having Reached Max OV-Inclusive and Retired, Aged 50–74
100
80
60
40
20
0
50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74
% Reached max retirement incentive, Men
% Reached max retirement incentive, Women
% Retired, Men
% Retired, Women

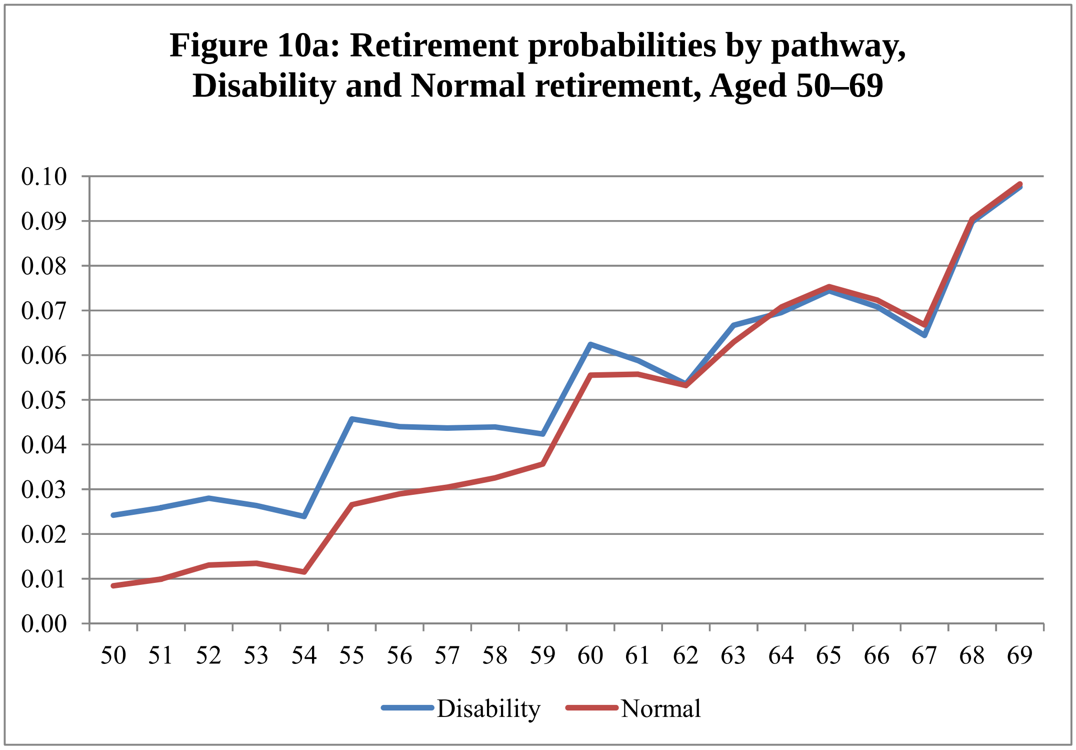


Figure 10a: Retirement probabilities by pathway, Disability and Normal retirement, Aged 50–69
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Disability
Normal

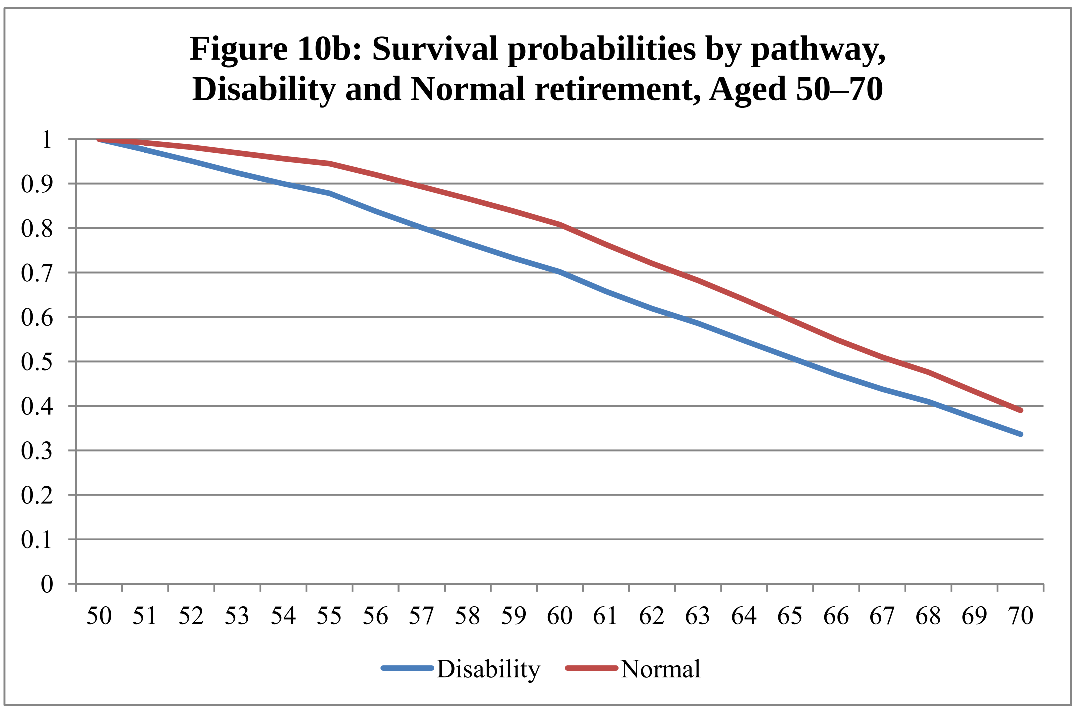


Figure 10b: Survival probabilities by pathway, Disability and Normal retirement, Aged 50–70
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70
Disability
Normal

Appendix Table 1. Principal component analysis on health indicators

Factor loadings of the 1st principle component health index

1. Difficulty walking 100 m	0.311	12. Difficulty pick up a dime	0.248
2. Difficulty lifting/carrying	0.337	13. Ever experienced heart problems	0.094
3. Difficulty pushing/pulling	0.340	14. Hospital stay	0.109
4. Difficulty with an activity of daily living	0.242	15. Doctor visit	0.082
5. Difficulty climbing a few steps	0.315	16. Ever experienced psychological problems	0.017
6. Difficulty stooping/kneeling/crouching	0.309	17. Ever experienced a stroke	0.126
7. Difficulty getting up from a chair	0.304	18. Ever experienced high blood pressure	0.075
8. Self-reported health fair/poor	0.211	19. Ever experienced lung disease	0.040
9. Difficulty reaching/extending arm up	0.269	20. Ever experienced diabetes	0.071
10. Ever experienced arthritis	0.122	21. Body mass index	0.026
11. Difficulty sitting two hours	0.277	22. Ever experienced cancer	0.035

Appendix Table 2. Summary statistics of the variables

		All	Male	Female
Continuous variable				
OV (in ten thousand euro)	*M*	3.22	3.59	2.58
	S.D.	2.06	2.16	1.70
Health index	*M*	56.89	56.45	57.65
	S.D.	26.57	26.09	27.38
Monthly wage (in ten thousand yen)	*M*	25.41	31.22	15.23
	S.D.	18.15	18.40	12.28
Enrolled years	*M*	36.54	39.62	31.24
	S.D.	13.36	11.91	14.04
Assests (in million yen)	*M*	11.37	13.44	7.99
	S.D.	68.07	85.48	15.45
Binary variables				
Age:				
Less than 55		0.21	0.20	0.23
55-59		0.31	0.31	0.31
60-64		0.22	0.21	0.23
65-69		0.17	0.18	0.14
70-		0.10	0.11	0.08
Education:				
Less than high school		0.29	0.31	0.25
High school		0.44	0.40	0.50
2 year college/Vocational school		0.12	0.08	0.20
4 year college or more		0.15	0.21	0.06
Married		0.84	0.90	0.75
Spouse working		0.57	0.55	0.60
Occupation:				
Specialist		0.10	0.10	0.09
Managers		0.08	0.11	0.02
Clerk		0.16	0.12	0.24
Salesperson		0.13	0.13	0.13
Service		0.14	0.07	0.26
Guards		0.01	0.02	0.00
Farmers		0.05	0.05	0.05
Trans and com.		0.05	0.08	0.01
Construction		0.25	0.29	0.17
Unknown		0.03	0.03	0.04
Retired in 2009		0.10	0.09	0.11
Public pension enrollee:				
EPI/MAI enrollee		0.60	0.67	0.50
NPI enrollee		0.40	0.33	0.50
		1575	996	579

Note: M = mean; S.D. = standard deviation.