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PATHWAYS TO RETIREMENT AND THE ROLE OF FINANCIAL INCENTIVES IN SWEDEN

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Working Paper 20123
http://www.nber.org/papers/w20123

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

The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research. Lisa Laun gratefully acknowledges financial support from the Swedish Research Council for Health, Working Life and Welfare, FORTE (dnr 20130209). Per Johansson gratefully acknowledges the financial support from the Swedish Research Council for Health, Working Life and Welfare, FORTE (dnr 20132482).

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NBER Working Paper No. 20123
May 2014
JEL No. J14,J26

ABSTRACT

We study how economic incentives affect labor force exit through different income security programs, old-age pensions as well as income taxes in Sweden. We use the option value for staying in the labor force as a measure of economic incentives and estimate an econometric model for the choice of leaving the labor market. Besides old-age pension, we focus on the Disability Insurance (DI), which is the most important exit path before age 65. By simulating the effect of different probabilities to be admitted DI we show how changes in the stringency of DI admittance affects labor supply among older workers through economic incentives.

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1. Introduction

In absence of a state early retirement scheme, the Disability Insurance (DI) program in Sweden is by far the most common pathway for labor market exit for those who exit before age 65. In the early 1990s the share of the age group 60-64 receiving DI was around 35 percent for both men and women. Although this share has decreased considerably following a series of reforms of eligibility rules, still about 17 percent of men and 25 percent of women in this age group receive DI. This is a larger share than in most other comparable countries (see e.g. Wise, 2012).

In Jönsson et al. (2012) it was shown that historical changes in eligibility rules affected utilization of the DI program. However, an outstanding question is to what extent general changes in DI stringency will lead to increased labor force participation. This depends on the economic incentives induced by the old age pension scheme and the DI program as well as on how people react on economic incentives in their retirement decision. If the generosity in benefits is very similar in the old-age and DI programs or if people are not very sensitive to economic incentives in their retirement decisions, the effect of changes in the stringency of DI acceptance will lead to only very small changes in labor force participation rates. Conversely, if differences in economic incentives between the two schemes are very large and if people are very sensitive to these differences there will be comparatively large effects on labor force participation rates.

In this paper we use an option value model (see Stock and Wise, 1990) to estimate the effect of economic incentives on retirement behavior of older workers in Sweden. We consider two different pathways to retirement: the old-age pension path and the social insurance path. The latter includes the Unemployment Insurance (UI), the Sickness Insurance (SI) and DI, but we focus on the incentives provided by the DI program. We use data including the entire Swedish population aged between age 50 and 69 and estimate the model on the observed retirement behavior between 2001 and 2008. We use the estimated model to simulate the employment effect of different policy regimes for DI acceptance.

We find that there is a significant effect of economic incentives on DI utilization. Our results also suggest that there are important between group heterogeneity: the quintile group with the most inferior health status as well as low educated respond more strongly on economic

incentives. The simulation exercises, however, show that the effects of economic incentives, through changes in the stringency of DI admittance, overall are quite small.

The paper is organized as follows. Section 2 gives a brief overview of Sweden's income security systems, describes recent developments in DI rates and employment among older workers and, finally, describes different pathways for exit from the Swedish labor market. Section 3 presents our data and the empirical approach. Section 4 presents the estimation results from the econometric models. Section 5 discusses the outcomes from the policy simulations. Section 6 concludes.

2. Background

2.1 Sweden's social security and income security systems

In this section we describe the institutional details of Sweden's income security systems that we account for in this paper. We consider both the public system as well as the centrally bargained plans. We also describe the simplifications we made in the calculations of the incentive measure. The empirical analysis includes individuals aged between 50 and 69 during the period 2001 to 2008, i.e., born between 1932 and 1958. We only describe the rules that applied to these cohorts.

2.1.1 The old-age pension system

Sweden recently went through a major reform of its public old-age pension system. The old system was a pay-as-you-go defined benefit pension system, whereas the new system is a mixture of a notional defined contribution pay-as-you-go pension system and a fully funded pension scheme with individual accounts. The new pension system was implemented in 1999 and the first payments were made in 2001. The new system is phased in by cohort. Cohorts born before 1938 are completely in the old pension system. The 1938 cohort receives their pension to 4/20 from the new system and to 16/20 from the old system. Each successive cohort until the 1953 cohort receives an additional 1/20 from the new system and 1/20 less from the old system. The 1954 cohort receives their pension completely from the new pension system. Since we include individuals born between 1932 and 1958, we include those who are completely in the old system, different mixtures of the systems as well as those who are completely in the new system.

The pre-reform old-age pension system consists of two main parts: a basic pension and an income-related supplementary pension. All Swedish citizens permanently living in Sweden are entitled to a basic pension, which is 96 percent of one Basic Amount (BA)[1] for singles and 78.5 percent for married. The BA is an indexation unit that price adjusts the Swedish income security system. It is politically determined, but has followed the CPI very closely. There is also a supplementary pension (ATP), which is determined by the average of the 15 best years in the individual's income history up to 7.5 BA.[2,3,4] It is linearly reduced if the person contributed less than 30 years to the scheme. The normal retirement age for both the basic and the supplementary pension is 65, but both could be claimed in advance with a 0.5 percent actuarial reduction per month of early withdrawal from age 61 and delayed with an actuarial addition of 0.7 percent for each month of delay until age 70. Individuals with no, or low, ATP are entitled to a special supplement of 56.9 percent of a BA, reduced on a one-to-one basis against the supplementary pension.

In the new public pension system contributions amount to 18.5 percent of pensionable income, of which 16 percent is credited to a notional defined contribution scheme and 2.5 percent is credited to a financial defined contribution scheme. In the calculations, we disregard the financial defined contribution scheme and attribute the full 18.5 percent to the notional defined contribution scheme. Therefore, we also do not describe the financial scheme but refer to Hagen (2013) for a detailed description.

[1] One BA was SEK 45,900/USD 6,600 in 2010.

[2] From 1996 the ceiling was 7.5 increased price base amounts and from 2001 the ceiling is 7.5 income base amounts. The increased price base amount follows the prices in the economy, and the income base amount follows incomes. This means than the income price base amount is higher than the price base amount and accordingly the increased price base amount.

[3] The pensionable income is the annual income from labor earnings and public transfer systems below the social security ceiling of 7.5 price base amounts. To simplify calculations, we only account for the pensionable income that comes from labor earnings and the collection of disability benefits, but no other public transfer systems.

[4] The benefit level from the ATP is determined in several steps. First, the pension points for each year are calculated as the pensionable income above one price base amount divided by the current year price base amount. Since the social security ceiling is 7.5 price base amounts, the maximum number of pension points that can be collected each year is 6.5. Thereafter, the average pension points is calculated as the average of the individual's 15 best years in terms of pension points collected. Finally, the individual's ATP pension income is calculated by applying the formula

$$Y_i = 0.6 \times AP_i \times \min\left(\frac{N_i}{30}, 1\right) \times BA,$$

where AP_i is the average pension points, BA is the price base amount, and N_i is the number of years with pension-rights income greater than zero.

In the notional defined contribution scheme individuals collect notional pension rights based on their annual pensionable income and the annual contributions are used to finance current pension benefits in a pay-as-you-go system. The pensionable income is the total wage and public transfer income minus a 7 percent general pension contribution paid by all employees.[5] The maximum pensionable income is 7.5 income base amounts. Annual pensionable income must exceed a threshold of 42.3 percent of the price base amount to yield pension rights. The new pension system is based on the life-income principle and pension rights are accumulated from age 16 or from year 1960. Accumulated pension rights are adjusted annually according to an income index reflecting the average wage growth. In this paper, we assume an average wage growth of 1.6 percent throughout the period.

There is no normal pension age in the new public pension system but the minimum age of withdrawal is 61. Pension benefits at the age of retirement are calculated as the accumulated pension rights divided by an annuity divisor that is determined by average life expectancy for the given cohort at the given retirement age and an imputed real return of 1.6 percent. If the current year contributions are too small to cover the pension payments an automatic balance mechanism is activated. In this paper, we assume that funds are enough to finance the pension payments and disregard the automatic balance mechanism but for further details, see Hagen (2013).

For individuals with no or low earnings, the new pension system also contains a means-tested pension supplement that replaced the universal basic pension and the special supplement in the old pension system from 1 January 2003. For cohorts born from 1938 onwards, the so called guaranteed pension amounts to 2.13 income base amounts minus public pension benefits if public pension benefits are smaller than 1.26 income base amounts. If public pension benefits are larger than 1.26 income base amounts, the guaranteed pension is 0.87 income base amounts minus 48 percent of the public pension benefits that exceed 1.26 income base amounts. This implies that the guaranteed pension is phased out for individuals with public pension benefits above 3.07 income base amounts.

For those born before 1938, the rules for guaranteed pension are slightly different. For these cohorts, both public pension benefits and occupational pension benefits are taken into

[5] The general pension contribution was introduced in 1999 and amounted to 6.95 percent in 1999 and 7 percent from 2000 onwards.

account. Given the sum of public and occupational pension (P), the formulas for the guaranteed pension benefits are:

$$P \times 1.5174 - 0.1193 - P, \quad \text{if } 0.25 < P < 1.354 \text{ income BA}$$
$$P \times 1.343 + 0.1168 - P, \quad \text{if } 1.354 \leq P < 1.529 \text{ income BA}$$
$$P \times 2.17 + (P - 1.51) \times 0.6 - P, \quad \text{if } 1.529 \leq P \leq 3.16 \text{ income BA.}$$

2.1.2 The disability insurance system

Before 2003, the disability insurance was part of the old public pension system. Benefits were calculated in the same way as old-age pension, consisting of the basic pension and an income-related ATP supplement. As for old-age pension, the basic pension amounted to 96 percent of the basic amount for a single and 78.5 percent for a married disability pensioner. The special supplement for disability benefits was substantially larger than for old-age pension, however, at 112.9 percent of a basic amount, reduced on a one-to-one basis against the supplementary pension.

The supplementary pension in the old disability insurance system was based on an "assumed" income. The assumed income was calculated as the most favorable outcome from two different calculations. The first one was the average income of the two best out of the last four years before retirement. The second was the average income of half of the years during which the individual had positive pension points. The assumed income was used in the same formula as for old-age pension, but was not subject to the actuarial reduction for withdrawal in advance. The number of contribution years was calculated as the sum of the actual number of contribution years and the number of years between retirement and age 64. If this sum was lower than 30, benefits were reduced in the same way as for the old-age pension.

Since 2003, the disability insurance system is part of the social insurance system. Benefits are based on the assumed income, which is calculated as the average of the three highest annual earnings up to 7.5 income base amounts during the frame time immediately preceding labor force exit. The frame time is 8 years for individuals below age 47, 7 years for individuals between age 47 and age 50, 6 years for individuals between age 50 and 53, and 5 years for individuals above age 53. Disability benefits amount to 64 percent of the assumed income. Individuals with low assumed income receive a guaranteed level of disability benefits (amounting to 2.4 income BAs). Individuals collect pension points and pension rights also

during periods with disability benefits. The collection is based on the total assumed income, not only on the benefit payments, during the years until age 65. At age 65, individuals are transferred from the disability insurance system to the public pension system, with no reduction in public pension benefits due to early withdrawal.

The eligibility rules for the DI have been changed on several occasions since the early 1970s.[6] Since the early 1990s there have been a series of reforms leading to more stringent rules for DI admittance. In 1991 the right to receive DI for long-term unemployed workers older than age 60 was abolished and the right to DI for labor market reasons combined with health reasons was abolished in 1997. In 2003 the eligibility rules were further strengthened. The rules changed so that the ability to work should be tested against the entire labor market, not just the job that the insured worker was on when applying for DI. Finally, in 2008 a number of changes affecting eligibility were implemented. Most importantly, eligibility now required permanent disability.

2.1.3 Occupational pension plans, taxation and means-tested benefits

In addition to the public pension system, the most important pension schemes on the Swedish labor market are the occupational pension plans. Sweden has a highly unionized labor market. More than 90 percent of the labor market is covered by central agreements. These agreements contain, among other things, pension benefits and supplementary disability insurance. There are four main programs: one for white collar workers in the private sector, one for blue collar workers in the private sector, one for central government employees and, finally, one for local government employees. A main motivation for all these programs is to insure earnings above the social security ceiling at 7.5 BA. Palme and Svensson (1999 and 2004) give a detailed description of these programs. We also provide a detailed description of the rules that applied during our period of study in the Appendix.

The option value of delaying retirement also depends on taxes. During the period under study there has been a tax bracket creep in the state income tax system, but also an introduction of an earned income tax credit in 2007. The details of the tax system during this period are described in the Appendix. We further account for means-tested benefits which are also described in the Appendix.

[6] The institutional changes are described and their employment effects are analyzed in Karlström et al. (2008) and Jönsson et al. (2012).

2.2. The development of disability rates and employment

The DI program is one of the most important programs in Sweden's income security system. Figure 1 shows the participation in the DI program since the early 1960s by different age groups for males and females, respectively. Figure 1 shows that there are huge variations in the participation rates, in particular for the age group 60-64. This partially reflects the fact that, as described in Section 2.1.2, the DI program has served somewhat different purposes over the period under study. In the 1970s and 1980s it was for example possible to get DI for labor market reasons. Older long-term unemployed workers were eligible for DI first for health reasons in combination with labor market reasons and then for labor market reasons alone. The decline in the DI participation rate reflects several changes in eligibility rules.

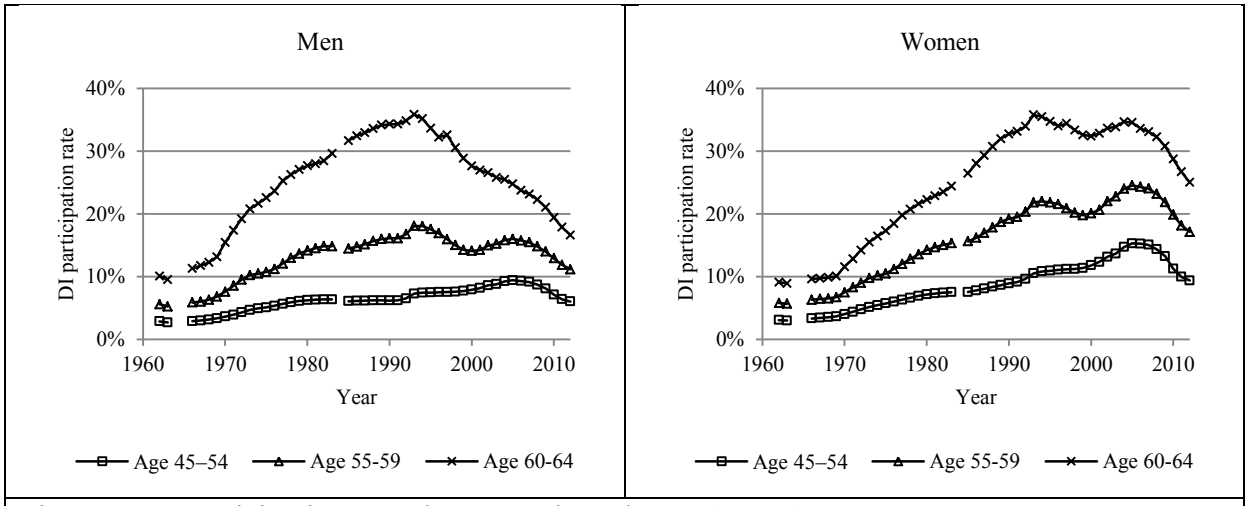


Figure 1. DI participation rates by age and gender, 1962–2012

A key question in the study of how the DI affects the labor market is of course to what extent the DI participation rate affects employment and labor supply. Figure 2 presents the development of employment along with share receiving DI for each age and gender group. The development for females is affected by a strong trend towards higher female labor force participation in all age groups during the period under study. For males in all age groups, however, it is apparent that there is a relationship between employment and DI participation: when the DI participation rate increased from the early 1960s until the mid 1990s there is a trend towards a lower employment rate in this group. Likewise, when DI participation declined in the 1990s there is an increase in the employment rate in this age group.

Figure 2. DI participation rates and employment rates by age and gender, 1962–2012

2.3 The social insurance pathway to retirement

Although the disability insurance program is by far the most common pathway for labor force exit for those who do not use old-age pensions it is common that the insured worker starts his or her exit route in another program, such as the Unemployment Insurance (UI) or the

Sickness Insurance (SI).[7] Since there is substitutability between these programs we will lump them together in the empirical analysis as a simplification. We label this pathway the "social insurance pathway". In the empirical analysis we study retirement behavior between 2001 and 2008. Section 3 describes the data we use, the definition of retirement and the pathways we consider in more detail. However, we will already in this Section give a brief overview of how the prevalence of the social insurance pathway has changed over time and how this prevalence differs within different population groups.

Figure 3 shows the share of individuals in the age groups 50–54, 55–59 and 60–64 who have retired through the social insurance pathway between 2001 and 2008 among men and women, respectively. The social insurance pathway has been more commonly used among women than men in all age groups throughout the studied period. For both men and women, however, the share of the population who has retired through the social insurance pathway has decreased substantially over the studied period. The share has decreased from over 30 percent to about 20 percent among men in the age group 60–64 and from about 40 percent to less than 30 percent among women in the same age group between 2001 and 2008.

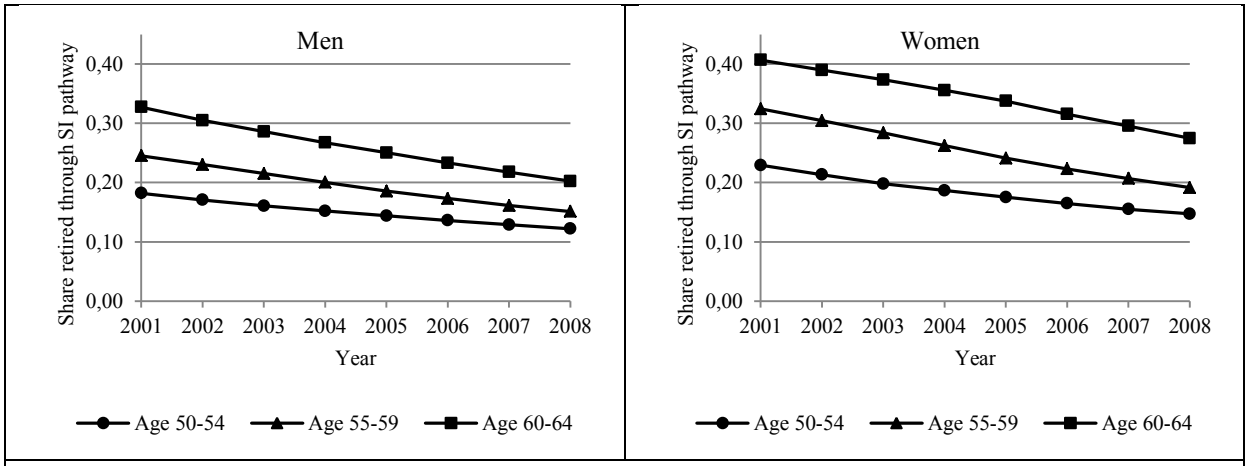


Figure 3. Share retired through the social insurance pathway by age and gender, 2001–2008

Figure 4 shows the share of individuals aged 50–64 in different education groups who have retired through the social insurance pathway between 2001 and 2008 among men and women, respectively. Retiring through the social insurance pathway is much more common in low education groups among both men and women. The share of women retiring through the

[7] See Palme and Svensson, 2004, for a detailed analysis of different exit routes from the Swedish labor market.

social insurance pathway is higher than for men in all education groups. The decrease in the use of the social insurance pathway over time is apparent for all education groups.

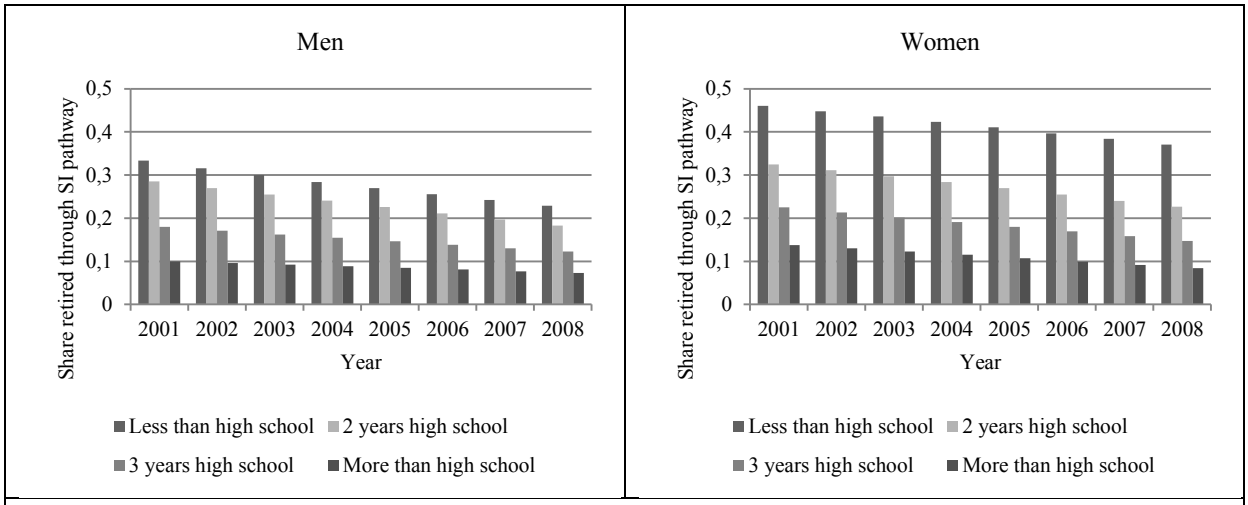


Figure 4. Share retired through the social insurance pathway in age 50–64 by education and gender, 2001–2008

Figure 5 reveals that the higher disability rates among the low educated are also reflected in lower employment rates in the age group 50-69 for males and females, respectively. The figure also shows that there is a much larger difference in employment by education group among women than men. Employment is almost twice as high – around 40 percent compared to almost 80 percent – for college educated women compared to those with only compulsory schooling. The corresponding figures for men are 80 versus 60 percent, i.e., the difference is in that low educated women work substantially less than the corresponding group among men.

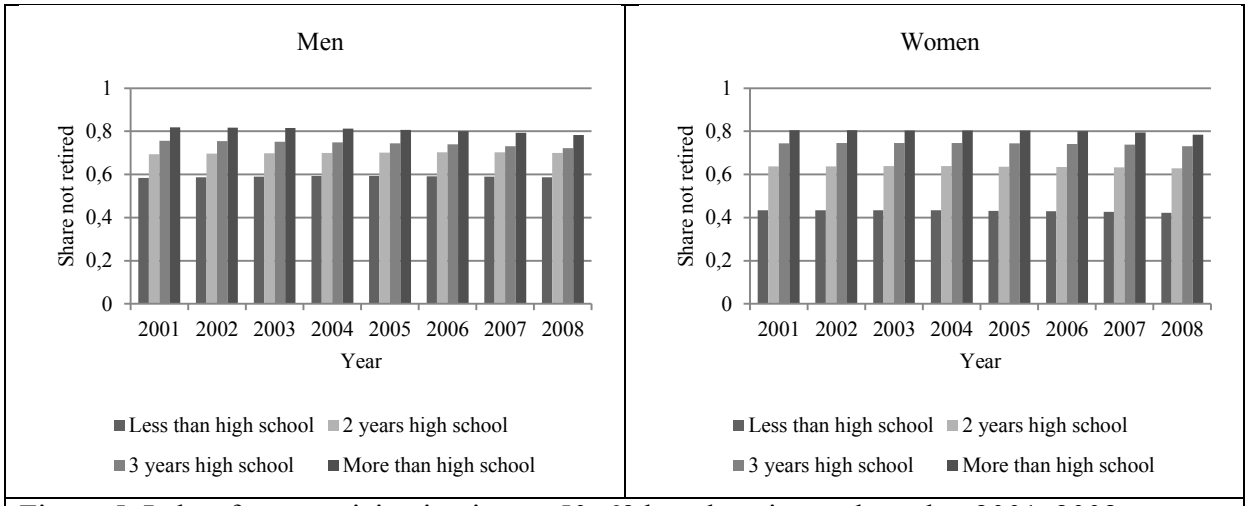


Figure 5. Labor force participation in age 50–69 by education and gender, 2001–2008

Figure 6 shows the share of individuals aged 50–64 in different health quintiles who have retired through the social insurance pathway between 2001 and 2008 among men and women, respectively. The construction of the health measure is explained in section 3.3. The first quintile is the group with the most inferior health status. It is not surprising that the figure shows that the individuals in this group are most likely to retire through the social insurance pathway and that this likelihood decreases as health improves across the quintiles.[8] It is interesting to note that the difference between the first quintile group and the other groups increases over time as the stringency in DI admittance increases. The likelihood to receive DI in the lowest health quintile is almost unchanged over time.

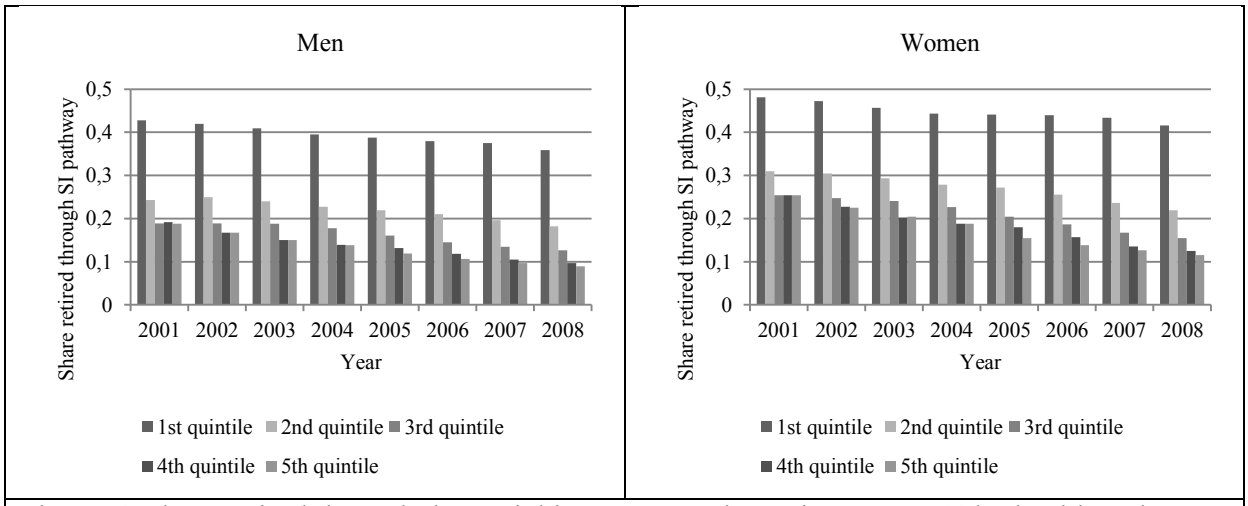


Figure 6. Share retired through the social insurance pathway in age 50–64 by health and gender, 2001–2008

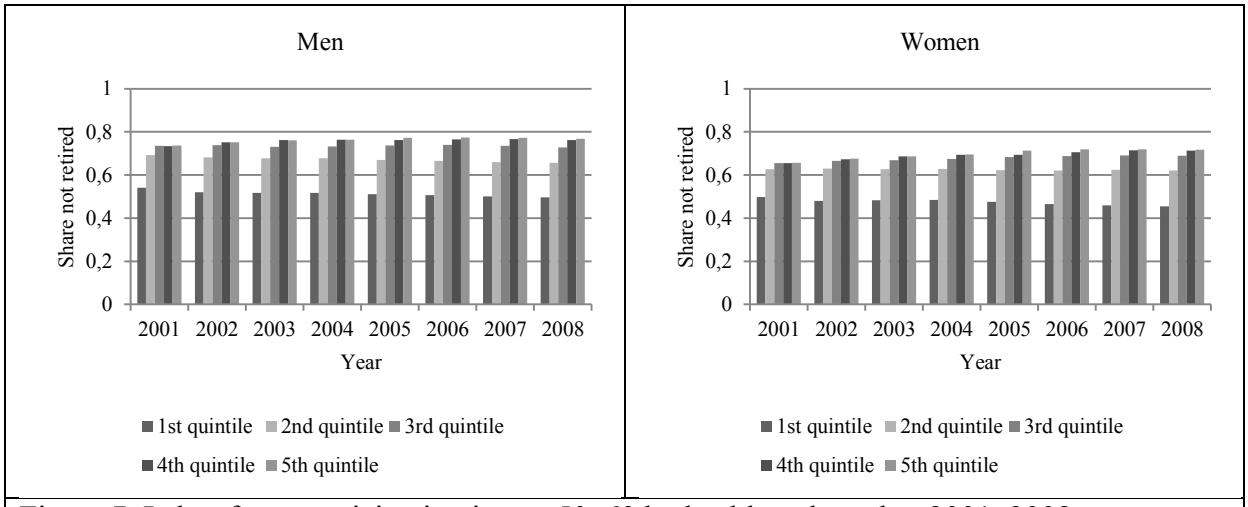


Figure 7. Labor force participation in age 50–69 by health and gender, 2001–2008

[8] As we explain in Section 3.3, the health measure is improving over time due to more data. From 2005 we also have the drug prescription register, which improves the health index primarily for the highest quintiles.

Figure 7 shows that the pattern from Figure 6 on the probability of retiring through the social insurance pathway is repeated for labor force participation rates by health quintile in the age group 50–69 for both men and women. The figure also shows that the increased labor force participation rate is primarily attributed to the groups with a good health status both among men and women.

Finally, Figure 8 shows the share of individuals who retired through the social insurance pathway in the age group 50–64 by health quintile and education group, combined over the entire period 2001–2008. The figure shows that that the pattern across health quintiles seen in Figure 6 is stable within education groups. It also shows that the pattern across education groups is stable within health quintiles, i.e., the fact that low educated are more likely to retire through the social insurance pathway is not only attributed to inferior health.

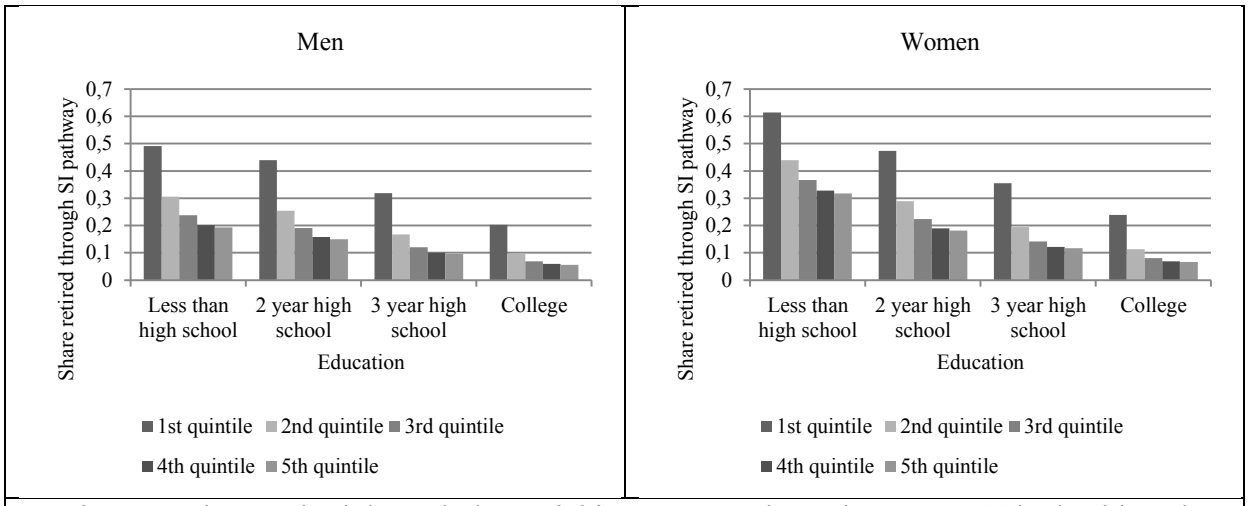


Figure 8. Share retired through the social insurance pathway in age 50–64 by health and education, combined over the period 2001–2008

3. Data and Empirical approach

3.1 Data and Definition of Retirement

We use data collected from different administrative registers including the entire Swedish population aged between 50 and 69. The registers were matched using the unique personal identification number (*personnummer*). Data on earnings by source of income along with different demographic characteristics are collected from the National tax register. We use the tax authority definition of spouse as either cohabiting or formally married (*samtaxerad*). This allows us to identify and match information on spousal income and demographic

characteristics. Information on educational attainments is collected from the National education register. In Section 3.3 below we provide information about the registers used for obtaining individual measures of health status.

We use information on income from labor to define the year of labor force exit. In each year, a worker is defined as employed if labor earnings from employment or self-employment exceed one basic amount (BA), which corresponds to SEK 45,900 or USD 6,600 in 2010. A worker is defined as retired if not being employed for two consecutive years. If such periods occur several times, the last occurrence is used to define retirement. For a worker who is not observed in the data during the second year after the last year with income from labor or self-employment, which may occur due to death or the individual moving abroad, we use the last year with sufficient labor income as year of retirement. The retirement age is the age in the last year of employment before retirement. An individual who is employed in the last year of observation has retirement age. We have data of the Swedish population until 2010. Because of the way we define retirement, we are able to study retirement behavior until year 2008. About 11.5 million person-year observations are included in the empirical analysis.

3.2 Pathways to retirement

We consider two main pathways to retirement: the social insurance pathway and the old-age pension pathway. The pathway to retirement is defined on the basis of main income source during the years after the exit from the labor force and before age 64. For each of these years we define the pathway from the largest income source. We then assign the pathway with most years to the individual. The social insurance pathway includes the total income from the sickness, disability and unemployment insurances. The pension pathway includes the total income from occupational pension and public pension. A worker that retires at age 65 or later is assigned to the pension pathway, since eligibility for most social insurance benefits ceases at age 65.

Figure 9 shows the pathways to retirement for men and women, respectively, during 2001–2008. The figure includes all individuals who retire between age 50 and 69 during the period. The figure shows that the importance of the pension pathway has steadily increased for both men and women over the studied period. Although the pension pathway was less common among women than men in the beginning of the period, the importance of the pension

pathway has increased more rapidly among women. By 2008, the pension pathway accounts for about 80 percent of all labor force exits in the age group 50–69 among both men and women.

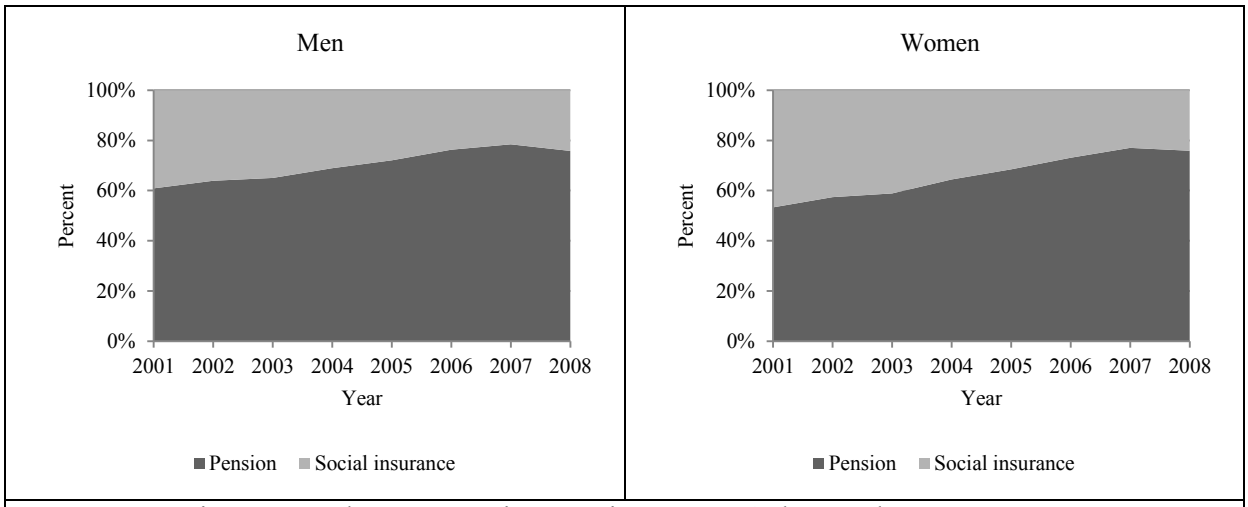


Figure 9. Pathways to retirement in age 50–69 by gender, 2001–2008

3.3 The measurement of health

We construct four different variables measuring health. The first one is the number of days the individual receives inpatient care during the year, i.e., hospital care that requires the patient to stay overnight at the hospital. This information is available for the years 1986–2010 from the National Swedish Patient Register (see Socialstyrelsen, 2009b). The second variable consists of the number of days receiving outpatient care during the year. This includes hospital care that does not require the patient to stay overnight at the hospital. The information for this variable comes from the National Swedish Patient Register and is available for the period 2001–2010.[9] The third variable consists of the total value of drug prescriptions to the individual during the year obtained from the National Prescription Register available for the period 2005–2010. Finally, the fourth variable is subsequent mortality, which is available from the 1960s in the Cause of Death Register (see Socialstyrelsen, 2009a).

In a second step, we use these four variables to construct a health index for all individuals included in our sample. For each year, we create a health index based on the first principal

[9] The coverage of the outpatient care register is not complete during the first years of the period and increases for each year. However, since we construct a health index for each year separately this is not a concern. The information contained in the register helps dividing individuals into health quintiles, and the increased coverage of the register over time may lead to better measures of health during the later years.

component of the available health variables that year. We include the yearly values and two lags of in-patient care, out-patient care and drug prescriptions, as well as two leads of mortality.

Figure 10 shows the average health percentile by age for men and women averaged for the years between 2001 and 2008. Men are on average in a higher health quintile than women, and health declines with age for both men and women. At older ages, however, the health of women is very similar to the health of men.

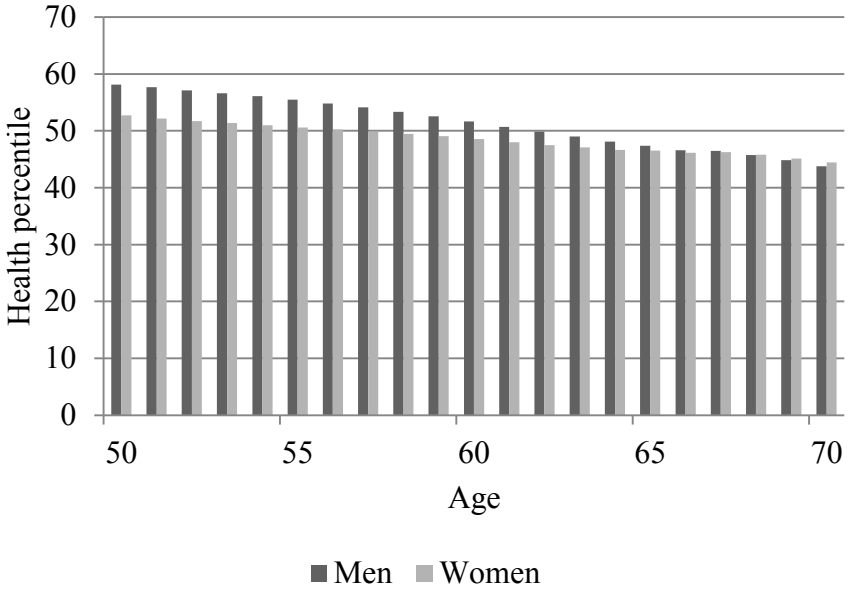


Figure 10. Average health percentile by age for men and women

3.4 Option value calculations

We use the option value measure (see Stock and Wise, 1990) for the economic incentive to remain in the labor force. The option value uses the value function measuring the utility for a particular individual at a particular age *t* for retiring at a particular age *r* as:

$$V(t,r) = \sum_{s=t}^{r-1} \beta^{s-t}[Y(s)^{\gamma}]probalive(s|t) + \sum_{s=r}^{\max age} \beta^{s-t}[kB(s,r)]^{\gamma}\ probalive(s|t),$$

where $Y(s)$ is income from labor at age *s*, $B(s,r)$ is income from the income security system at age *s* if retiring at age *r*, β is the subjective discount rate $\frac{1}{1+\delta}$, *k* reflects the marginal utility of leisure and γ measures the marginal utility of consumption; $probalive(s|t)$ gives the probability of being alive at age *s* given survival until age *t*. The option value is then defined

as the difference between the utility of retiring at age *t+1* compared to the utility of retiring at the optimal age r^*, the age yielding the highest utility value, i.e.,

$$OVSS(t) = V(t, r^*) - V(t, t+1).$$

We do not estimate the parameters *δ, k* and γ, but assign values similar to those that have been obtained in previous studies (see primarily Gruber and Wise, 2004). We have chosen to set the subjective discount rate (*δ*) to 3 percent, *k* to 1.5 and γ to 0.75.

The income from the income security system depends, in addition to the retirement age, on how the individual leaves the labor force. As mentioned above, we consider two pathways to retirement: the social insurance pathway and the pension pathway. There is a possible endogeneity problem related to assigning possible pathway to retirement for each individual in our sample. If we assign the more generous DI pathway to all, although we know that this is not an available option for a large share of the sample, it will appear as the individuals in the sample do not react on the more generous incentives to retire than they actually face and we will consequently underestimate the effect of economic incentives on retirement. If we instead assign the DI pathway when we observe that he or she has access to it, we will of course overestimate the effect of economic incentives.

To handle this endogeneity problem we use a probabilistic approach. This means that we calculate a weighted sum of the option value measure for the two pathways that we consider, i.e.,

$$OVweighted = DIweight * OVDI + (1 - DIweight)OVSS,$$

where the *OVDI* is the option value measure for the DI pathway and *OVSS* is the option value for the old-age pension pathway. *DIweight* captures the likelihood that the DI path is available to the individual. These are determined based on the "stock estimator". The weight for the DI pathway is determined by the share of individuals between age 50 and 64 who have exited through the social insurance pathway in each year, gender and education group. The pathway probabilities were thus shown in Figure 4.

In the data, the social insurance pathway includes income from the disability, sickness and unemployment insurances. The major source, however, is the disability insurance with about

75 percent of the person*year observations including only disability benefits. Those who exit from the labor market through the unemployment or the sickness insurances switches in most cases to the disability insurance after some time (see Palme and Svensson, 2004, for a detailed analysis of different pathways). To simplify, we will only consider the economic incentives in the disability insurance for the social insurance pathway.

The pension pathway consists of occupational pensions and the public old-age pension system. In the option value calculations, we consider, in addition to benefits from these two pension systems, also take housing supplements as well as the special housing allowance for old-age pensioners, the so called old-age support into account (see the Appendix Section A3). For both pathways, we calculate the option value net of income taxes.

To make earnings back-casts and forecasts, we use earnings data for the entire population of Sweden during 1985–2010. Using an earnings equation as a function of age, age squared and individual fixed effects, we back-cast earnings to age 23 and forecast earnings until age 70. That is, we assume that a worker starts working and collecting pension rights at age 23. The option value is expressed in EUR 10,000 (2011).

We do not account for spouse or survivor benefits, but treat all individuals as if they were singles. Most of the financial incentives in the Swedish systems apply to the individual and not the household and the differences that do exist between married and singles are relatively minor.

Figure 11 shows the averages of the three different option value measures by age for men and women, respectively. The figure reveals some interesting features. First, it can be seen that the option value for the old-age pension pathway has a much steeper negative slope than the option value for the DI pathway and the weighted average reflected in the inclusive option value. This reflects the fact that the economic loss of retiring early is much larger for those who only have access to the old-age pathway. Second, it can be seen that the inclusive option value is as expected between the option value measures for the two main pathways, but much closer to the graph for the old-age pathway. This is because the weights, as reported in Figures 4a and 4b, are larger for the old-age pension pathway. It should be noted, however, that these figures are based on a cross-section and thus affected by sample attrition by age.

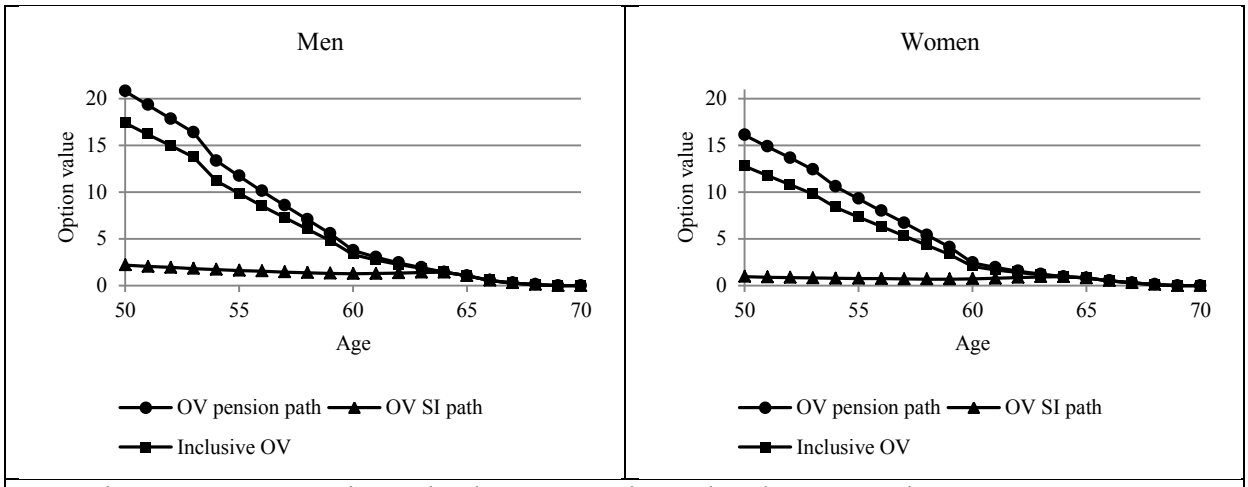


Figure 11. Mean option value by age, gender and pathway to retirement, 2001–2008

As a background to the option value figures, Figure 12 shows the average social security wealth by age and pathway to retirement for men and women, respectively. It can be seen that the social security wealth for the DI pathway declines with retirement age, since the value of the DI payments that one gives up by delaying retirement exceeds the expected value of increases in the size of the benefits from longer work history. However, for the old-age pension pathway it increases up to age 60, the minimum age for early withdrawal, and then reaches a horizontal phase. This suggests that, on average, the present value of the benefit payment one has to give up by remaining in the labor force is equal to the increase in the size of the future benefits from delaying retirement.

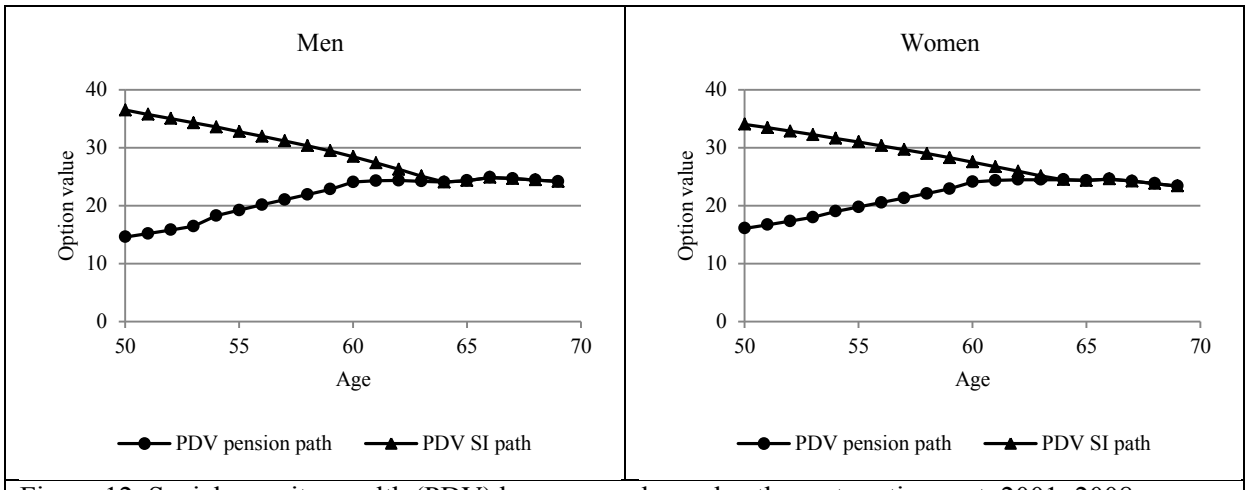


Figure 12. Social security wealth (PDV) by age, gender and pathway to retirement, 2001–2008

4. Results

4.1 Main estimates

This section presents the results from the reduced form retirement choice models. The estimates are obtained using probit models and are presented in three main sets. Table 1 shows the overall results for the entire sample. Table 2 describes sample heterogeneity in response to economic incentives with respect to health status and, finally, Table 3 shows heterogeneity of the result with respect to differences in educational attainments.

The results for the coefficient of the option value variable should be interpreted as the effect of a 10,000 euro (measured in 2012 prices) change in the utility difference between retiring at a given age compared to retiring at the optimal age on the probability of retiring. The effect of a one standard deviation change in the option value measure is given in square brackets below the coefficients. In addition, all results are presented in a second version of the tables (1b, 2b and 3b), where the coefficients are presented as the estimated response to a one percent change in the utility value of delaying retirement by one year.

Table 1a shows the results from eight different specifications. The first column shows the results when we alongside the option value measure for retirement incentives and a linear age variable have included dummy variables for each health quintile, with the first quintile, those with worse health status, being the excluded category. As expected, there is a negative sign on the coefficient estimate for the option value measure. Thanks to an exceptionally large sample size the precision of the estimate is impressively high and the estimate is highly significant. The magnitude of the estimate suggests that a 10,000 euro increase in the inclusive option value measure would lead to a 0.12 percentage point reduction in the retirement rate. The estimates also shows that those in the highest health quintile are on average about 1.6 percentage points less likely to exit the labor force compared to the quintile group with worse health status.

The second column in Table 1a reports results from a specification where the linear age variable has been replaced by a more flexible specification with age dummies for each one-year age group. The results seem to be quite robust to this change. The coefficient estimate changes from -0.0012 to -0.0020, a change on the fourth decimal. The specification shown in

columns three and four corresponds to those in the first and second columns, but we now also include controls for a number of demographic characteristics. The result for the inclusive option value measure in the specification in the fourth column does not change much compared to the one in column two. However, the estimate in the third column is substantially smaller in absolute value compared to the corresponding one in column one. The estimates for the demographic variables show for example that women on average retire earlier, since they have an about 0.5 percentage point higher retirement rate than men. The estimates of the dummy variables for the different education levels indicate large differences in the timing of the exit from the labor market between different educational groups: the group with college or university education has on average an about 1.1 percentage point lower retirement rate compared to those with compulsory education only.

The models shown in the fifth through the eighth columns of Table 1a correspond to the ones shown in the first four columns with the difference that the dummy variables for the five health quintiles are replaced by a linear variable in the health indexed used for constructing the quintile groups. The estimates of the inclusive option value measure for these alternative specifications are very similar to the corresponding original ones.

To sum up, the results from the eight specifications shown in Table 1a all give negative and significant estimates of the inclusive option value measure, i.e., estimates show that economic incentives matter for the timing of the exit from the labor market. The preferred specification, which includes the most flexible specification in age and health differences together with controls for demographic variables shown in the fourth column, suggests that a 10,000 euro change in the inclusive option value would lead to a 0.15 percent change in the retirement rate. Since the average retirement rate is 5.19 percent in the age group under study, this implies that retirement would change by 2.9 percent. Table 1a also shows that a one standard deviation change in the option value would translate into a 1.34 percent lower retirement rate. The result in Table 1b for this specification shows that a one percent increase in the option value would lead to a 3.15 percentage point reduction in the retirement rate.

Table 1a. Effect of Inclusive OV on Retirement

	Specification							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OV Inclusive	-0.0012*** (0.0000) [-0.0118]	-0.0020*** (0.0000) [-0.0176]	-0.0006*** (0.0000) [-0.0057]	-0.0015*** (0.0000) [-0.0133]	-0.0012*** (0.0000) [-0.0118]	-0.0020*** (0.0000) [-0.0177]	-0.0006*** (0.0000) [-0.0059]	-0.0015*** (0.0000) [-0.0134]
Health Quint 2 (Second lowest)	-0.0105*** (0.0001)	-0.0109*** (0.0001)	-0.0105*** (0.0001)	-0.0109*** (0.0001)				
Health Quint 3	-0.0137*** (0.0001)	-0.0142*** (0.0001)	-0.0138*** (0.0001)	-0.0142*** (0.0001)				
Health Quint 4	-0.0153*** (0.0001)	-0.0158*** (0.0001)	-0.0154*** (0.0001)	-0.0159*** (0.0001)				
Health Quint 5 (Highest)	-0.0159*** (0.0001)	-0.0164*** (0.0001)	-0.0161*** (0.0001)	-0.0165*** (0.0001)				
Health Index					-0.0002*** (0.0000)	-0.0002*** (0.0000)	-0.0002*** (0.0000)	-0.0002*** (0.0000)
Age	0.0070*** (0.0000)		0.0071*** (0.0000)		0.0070*** (0.0000)		0.0071*** (0.0000)	
Age Dummies		Included		Included		Included		Included
Female			0.0048*** (0.0001)	0.0040*** (0.0001)			0.0046*** (0.0001)	0.0038*** (0.0001)
Married			0.0072*** (0.0001)	0.0070*** (0.0001)			0.0071*** (0.0001)	0.0069*** (0.0001)
Spouse works			-0.0162*** (0.0001)	-0.0149*** (0.0001)			-0.0162*** (0.0001)	-0.0149*** (0.0001)
Sector Dummies			Included	Included			Included	Included
2 years high school			-0.0016*** (0.0001)	-0.0012*** (0.0001)			-0.0016*** (0.0001)	-0.0012*** (0.0001)
3 years high school			-0.0052*** (0.0001)	-0.0044*** (0.0001)			-0.0052*** (0.0001)	-0.0044*** (0.0001)
College			-0.0109*** (0.0001)	-0.0092*** (0.0001)			-0.0109*** (0.0001)	-0.0092*** (0.0001)
Observations	11,575,057	11,575,057	11,575,057	11,575,057	11,575,057	11,575,057	11,575,057	11,575,057
Mean Ret. Rate	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519	0.0519
Mean of OV	7.2557	7.2557	7.2557	7.2557	7.2557	7.2557	7.2557	7.2557
Std. Dev. of OV	6.9829	6.9829	6.9829	6.9829	6.9829	6.9829	6.9829	6.9829

Standard errors in parentheses, clustered by individual. *** p<0.01, ** p<0.05, * p<0.1

Table 1b. Effect of % Gain in Inclusive OV on Retirement

	Specification			
	(1)	(2)	(3)	(4)
% Gain in OV	-0.0104***	-0.0444***	0.0043***	-0.0315***
	(0.0003)	(0.0005)	(0.0003)	(0.0005)
Linear Age	X		X	
Age Dummies		X		X
Health Quintiles	X	X	X	X
Other Xs			X	X
Observations	11,575,057	11,575,057	11,575,057	11,575,057
Mean Ret. Rate	0.0519	0.0519	0.0519	0.0519
Mean of % Gain in OV	0.3145	0.3145	0.3145	0.3145
Std. Dev. of % Gain in OV	0.3311	0.3311	0.3311	0.3311

Standard errors in parentheses, clustered by individual. *** p<0.01, ** p<0.05, * p<0.1

Table 2a and 2b show the same results as in Table 1a and 1b, but the sample is now divided by health quintile. For obvious reasons, we now only include the health index linearly as a control variable. The results reveal that the group with worse health status, the first quintile, reacts strongest on economic incentives. The coefficient estimates decrease monotonically across the five groups. However, if one relates the estimates to the average retirement rates in the groups, it can be seen that the percentage change is very similar in all groups. This is true also for the results of the response to the percentage change in the option value presented in Table 2b.

Table 2c and 2d present the results corresponding to results displayed in table 2a and 2b but in which we instead have estimated a more restrictive model. Here the heterogeneous effects are estimated by adding an interaction between the option value and the linear health index to the regression model. In contrast to table 2a and 2b, the marginal effects are decreasing with the level of health. Although statistically significant, the magnitude of the estimated heterogeneous effect is small.

Table 2a. Effect of Inclusive OV on Retirement by Health Quintile

	Obs	Mean Ret. Rate	Mean of OV	Std. Dev. of OV	Specification (1)	(2)	(3)	(4)
OV: Quintile 1 (Worst Health)	1,700,751	0.0814	5.7588	5.9693	-0.0022*** (0.0001) [-0.0144]	-0.0034*** (0.0001) [-0.0216]	-0.0010*** (0.0001) [-0.0068]	-0.0024*** (0.0001) [-0.0154]
OV: Quintile 2	2,254,529	0.0568	6.6553	6.4598	-0.0016*** (0.0000) [-0.0136]	-0.0025*** (0.0000) [-0.0201]	-0.0008*** (0.0000) [-0.0068]	-0.0019*** (0.0000) [-0.0150]
OV: Quintile 3	2,477,592	0.0476	7.3671	6.9350	-0.0011*** (0.0000) [-0.0112]	-0.0018*** (0.0000) [-0.0168]	-0.0005*** (0.0000) [-0.0052]	-0.0014*** (0.0000) [-0.0126]
OV: Quintile 4	2,560,048	0.0426	7.9134	7.3947	-0.0008*** (0.0000) [-0.0091]	-0.0014*** (0.0000) [-0.0140]	-0.0004*** (0.0000) [-0.0043]	-0.0011*** (0.0000) [-0.0110]
OV: Quintile 5 (Best Health)	2,582,137	0.0414	8.0067	7.4514	-0.0007*** (0.0000) [-0.0081]	-0.0012*** (0.0000) [-0.0128]	-0.0003*** (0.0000) [-0.0035]	-0.0009*** (0.0000) [-0.0098]
Linear Age					X		X	
Age Dummies						X		X
Other Xs							X	X

Table 2b. Effect of % Gain in Inclusive OV on Retirement by Health Quintile

	Obs	Mean Ret. Rate	Mean % OV	Std. Dev. % OV	Specification (1)	(2)	(3)	(4)
OV: Quintile 1 (Worst Health)	1,700,751	0.0814	0.2474	0.2764	-0.0196*** (0.0013)	-0.0700*** (0.0017)	0.0070*** (0.0012)	-0.0453*** (0.0017)
OV: Quintile 2	2,254,529	0.0568	0.2865	0.3026	-0.0162*** (0.0009)	-0.0579*** (0.0012)	0.0034*** (0.0008)	-0.0404*** (0.0012)
OV: Quintile 3	2,477,592	0.0476	0.3189	0.3284	-0.0091*** (0.0007)	-0.0420*** (0.0010)	0.0049*** (0.0006)	-0.0296*** (0.0009)
OV: Quintile 4	2,560,048	0.0426	0.3445	0.3541	-0.0047*** (0.0006)	-0.0312*** (0.0008)	0.0050*** (0.0005)	-0.0230*** (0.0008)
OV: Quintile 5 (Best Health)	2,582,137	0.0414	0.3489	0.3574	-0.0031*** (0.0006)	-0.0278*** (0.0009)	0.0058*** (0.0005)	-0.0200*** (0.0008)
Linear Age					X		X	
Age Dummies						X		X
Other Xs							X	X

Table 2c. Effect of Inclusive OV on Retirement with Health Index Interaction

	Specification			
	(1)	(2)	(3)	(4)
OV	-0.0003*** (2.44e-05) [-0.0026]	-0.0012*** (2.59e-05) [-0.0104]	0.0003*** (2.30e-05) [0.0029]	-0.0007*** (2.53e-05) [-0.0063]
OV*Health Index	-1.86e-05*** (4.42e-07)	-1.58e-05*** (4.33e-07)	-1.76e-05*** (4.06e-07)	-1.53e-05*** (4.05e-07)
Health Index	-0.000149*** (2.28e-06)	-0.000164*** (2.43e-06)	-0.000156*** (2.20e-06)	-0.000169*** (2.35e-06)
Linear Age	X		X	
Age Dummies		X		X
Other Xs			X	X
Observations	11,575,057	11,575,057	11,575,057	11,575,057
Mean Ret. Rate	0.0519	0.0519	0.0519	0.0519
Mean of OV	7.2557	7.2557	7.2557	7.2557
Std. Dev. of OV	6.9829	6.9829	6.9829	6.9829

Table 2d. Effect of % Gain in Inclusive OV on Retirement with Health Index Interaction

	Specification			
	(1)	(2)	(3)	(4)
OV	0.0131*** (0.0005)	-0.0239*** (0.0006)	0.0254*** (0.0005)	-0.0121*** (0.0006)
OV*Health Index	-0.0005*** (9.75e-06)	-0.0004*** (9.95e-06)	-0.0004*** (8.66e-06)	-0.0004*** (9.11e-06)
Health Index	-0.0002*** (2.22e-06)	-0.0002*** (2.39e-06)	-0.0002*** (2.12e-06)	-0.0002*** (2.29e-06)
Linear Age	X		X	
Age Dummies		X		X
Other Xs			X	X
Observations	11,575,057	11,575,057	11,575,057	11,575,057
Mean Ret. Rate	0.0519	0.0519	0.0519	0.0519
Mean of OV	0.3145	0.3145	0.3145	0.3145
Std. Dev. of OV	0.3311	0.3311	0.3311	0.3311

Table 3a and 3b show the results when the sample is divided in four groups by educational attainment. The first group includes individuals that have not obtained any education beyond the compulsory level; the second group consists of those with vocational education in addition to compulsory schooling; the third group those who graduated from an academic track in their secondary education; and, finally, the fourth group are those with college or university education. The specifications corresponds to the first four ones in Table 1a, i.e., all specifications includes dummy variable for health quintiles; the specifications in the first and third columns includes linear controls for age, while those in the second and fourth columns

uses age dummies; the specifications in the third and fourth columns include controls for the demographic characteristics shown in Table 1b.

Although the estimates vary somewhat between the four different specifications it seems that the low education groups reacts more strongly on economic incentives in their retirement behavior. This result emerges more clearly if one compares the lowest and the highest education groups. The coefficient estimates for the inclusive option value measure is significantly larger in all specifications for the low education group.

Table 3a. Effect of Inclusive OV on Retirement by Education Group

	Obs	Mean Ret. Rate	Mean of OV	Std. Dev. of OV	Specification (1)	(2)	(3)	(4)
OV: < High School	2,634,666	0.0709	4.4487	4.5582	-0.0019*** (0.0001) [-0.0109]	-0.0042*** (0.0001) [-0.0226]	-0.0011*** (0.0001) [-0.0062]	-0.0036*** (0.0001) [-0.0195]
OV: 2 Years High School	3,541,791	0.0519	5.9837	5.1799	-0.0015*** (0.0000) [-0.0104]	-0.0034*** (0.0000) [-0.0222]	-0.0015*** (0.0000) [-0.0105]	-0.0037*** (0.0000) [-0.0243]
OV: 3 Years High School	3,104,564	0.0455	8.4283	7.0607	-0.0003*** (0.0000) [-0.0029]	-0.0008*** (0.0000) [-0.0070]	-0.0002*** (0.0000) [-0.0023]	-0.0008*** (0.0000) [-0.0069]
OV: College	2,294,036	0.0385	10.8562	9.3225	-0.0003*** (0.0000) [-0.0035]	-0.0005*** (0.0000) [-0.0066]	-0.0002*** (0.0000) [-0.0032]	-0.0005*** (0.0000) [-0.0066]
Linear Age					X		X	
Age Dummies						X		X
Health Quintiles					X	X	X	X
Other Xs							X	X

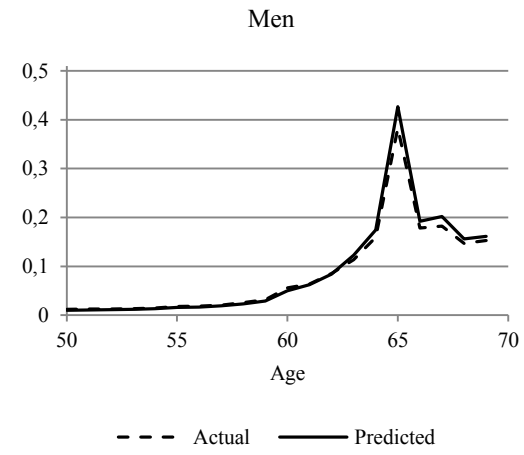
Table 3b. Effect of % Gain in Inclusive OV on Retirement by Education Group

	Obs	Mean Ret. Rate	Mean of % OV	Std. Dev. of % OV	Specification (1)	(2)	(3)	(4)
OV: < High School	2,634,666	0.0709	0.1988	0.2176	-0.0173*** (0.0013)	-0.1000*** (0.0016)	0.0059*** (0.0013)	-0.0828*** (0.0016)
OV: 2 Years High School	3,541,791	0.0519	0.2709	0.2552	-0.0086*** (0.0007)	-0.0751*** (0.0010)	-0.0063*** (0.0008)	-0.0812*** (0.0010)
OV: 3 Years High School	3,104,564	0.0455	0.3693	0.3493	0.0065*** (0.0005)	-0.0159*** (0.0006)	0.0080*** (0.0005)	-0.0153*** (0.0007)
OV: College	2,294,036	0.0385	0.4408	0.4414	0.0063*** (0.0003)	-0.0062*** (0.0006)	0.0060*** (0.0003)	-0.0064*** (0.0005)
Linear Age					X		X	
Age Dummies						X		X
Health Quintiles					X	X	X	X
Other Xs							X	X

4.2 The model fit

To evaluate the model we use the preferred specification, shown in the fourth columns in Tables 1, 2 and 3. Figure 13 shows the results when this model is used to predict the retirement rates by age and compare it with the actual retirement pattern. Figure 13a and 13b compare the hazard rates by age for males and females, respectively, and Figures 13c and 13d show the corresponding results for the cumulative distribution function.

From these figures it can be seen that the model underestimates retirement in relatively early ages and overestimates it in later ages for men. The opposite is true for women. Overall, however, it is apparent that the model gives a very good prediction of the actual outcome.



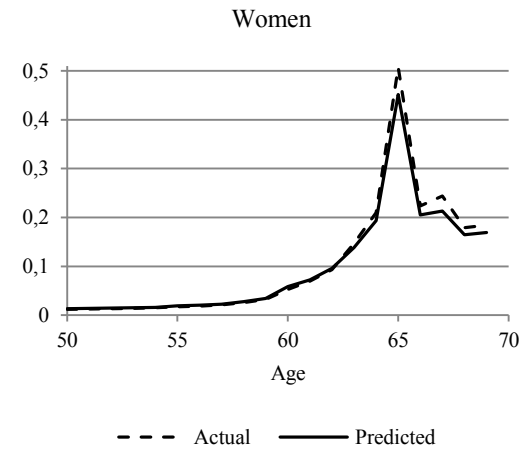
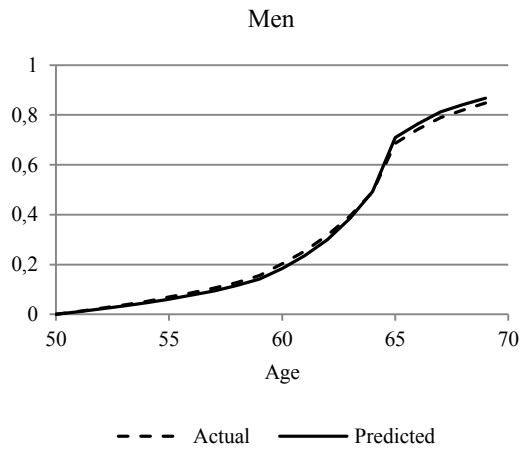


Figure 13a and 13b. Actual and predicted retirement hazard rates



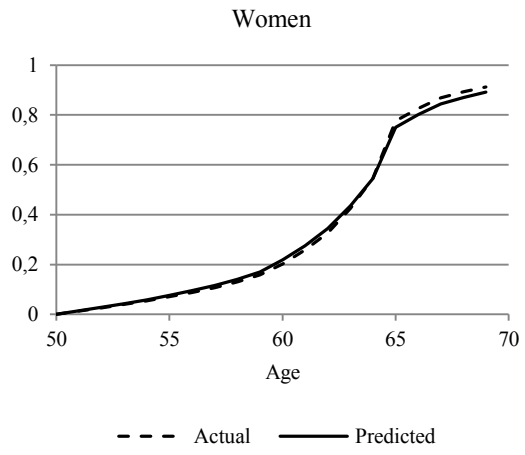
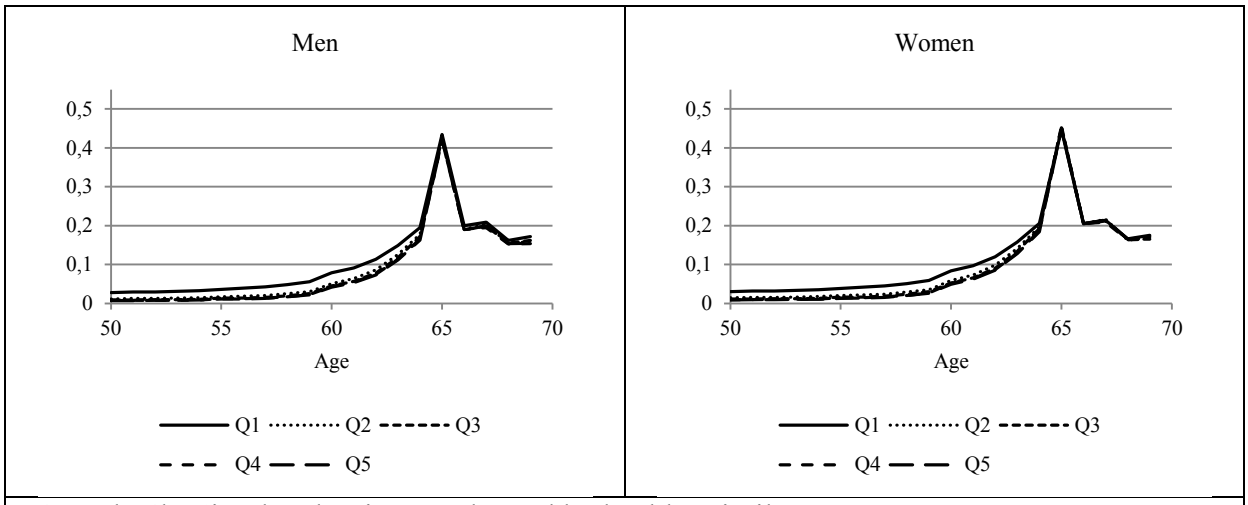


Figure 13c and 13d. Actual and predicted cumulative retirement hazard rates

4.3 Descriptive key results in graphical form

Figure 14 shows the results of Tables 2 and 3 graphically. Figures 14a and 14b show the predicted retirement hazards by age for the five health quintiles, for males and females, respectively. It can be seen that the largest difference in retirement behavior is between the first quintile, those with worse health status, compared to the other four groups. This is true for both males and females.

Figures 14c and 14d show the differences in predicted retirement hazards between the four groups with different educational attainments. In general, it can be seen that the differences between groups with different educational attainments are somewhat larger compared to those between the quintile groups with different health status.



14a and 14b. Simulated retirement hazard by health quintile

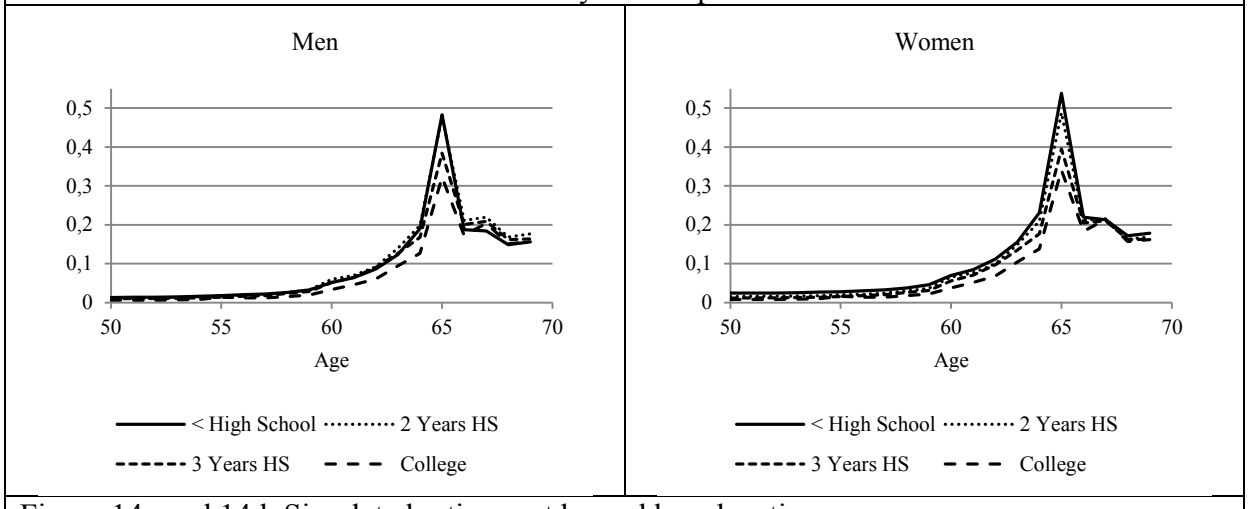


Figure 14c and 14d. Simulated retirement hazard by education group

5. Implications of changes in DI eligibility stringency

A key motivation for the study of how economic incentives affect retirement behavior is that it has implications for how screening stringency in the disability insurance program affects labor force participation rates among older workers. If an older worker is denied DI, an alternative is to claim old-age pension, which is a less generous exit path given actuarial reductions for early withdrawal. We use our estimated preferred model (Table 1a Column 4) to simulate the difference in retirement behavior in our sample under the hypothetical policy regime that *all* workers were eligible for the DI pathway – regardless of health status – compared to the regime where *no one* was eligible, i.e., if only the old-age pension path is available. The driving force behind the observed differences is purely that the insured individuals are affected by economic incentives in their decision on when to leave the labor force.

Figure 15 shows the cumulative retirement hazards for these two policy simulations for males and females, respectively. As a summary of the effects of the policy simulations, Figure 16 shows the expected remaining number years of work between age 50 and 69 of the two hypothetical policy regimes compared to the actual state. As expected, the cumulative hazard function for the policy regime where all workers are eligible to DI are everywhere below the corresponding regime with no DI. As can be seen in the summary measure in Figure 16, the simulated difference between the expected lengths of the work life is 0.82 years, or a 5.9 percent prolonging of the work life after age 50, for men and 0.75 years, or 5.6 percent for women.

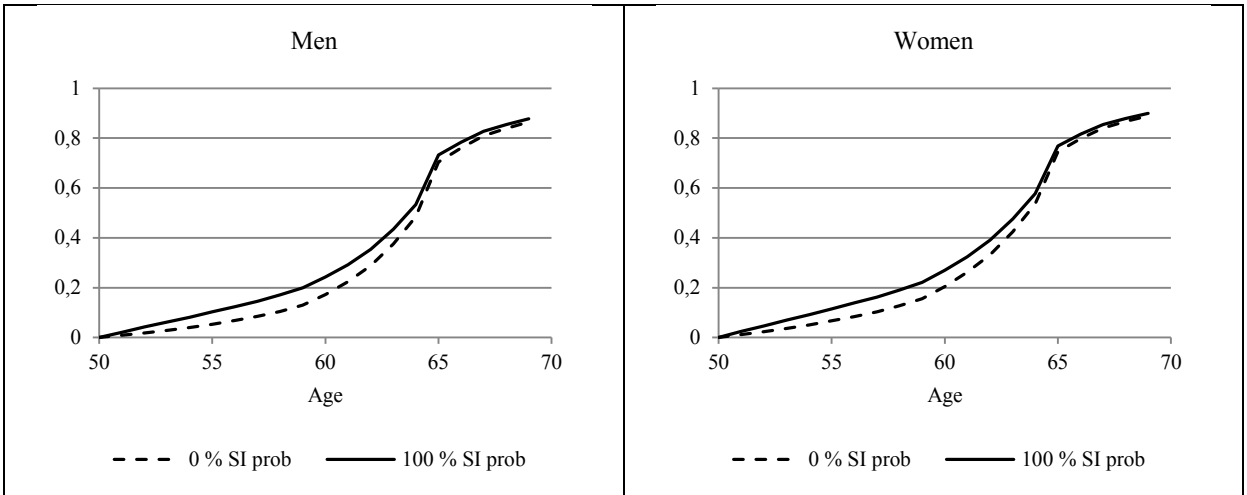
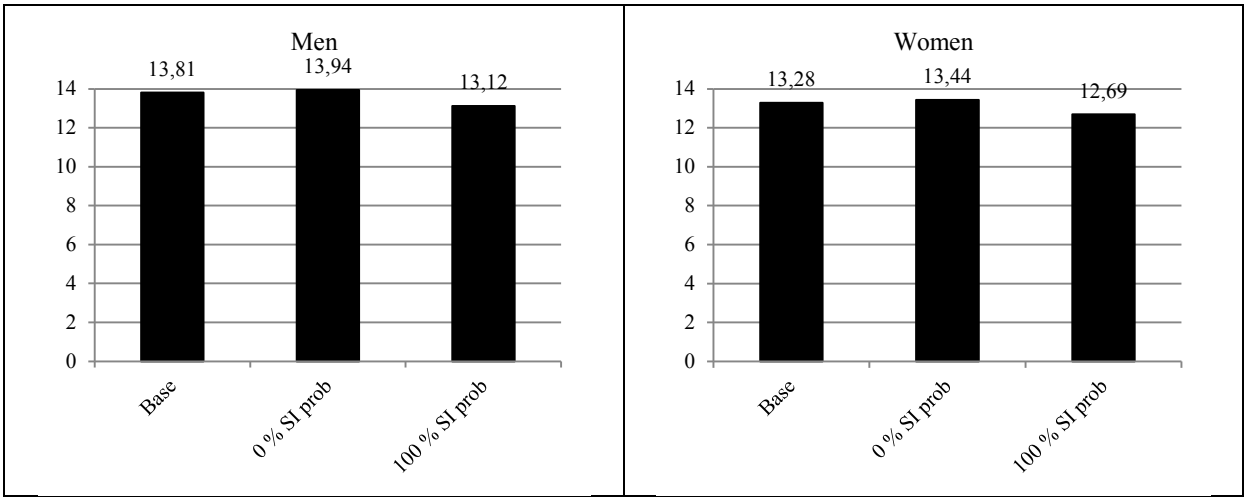


Figure 15. Cumulative retirement hazard from simulations with 0 % and 100 % SI probability



Figures 16. Expected years of work between age 50 and age 69, base case and various simulations

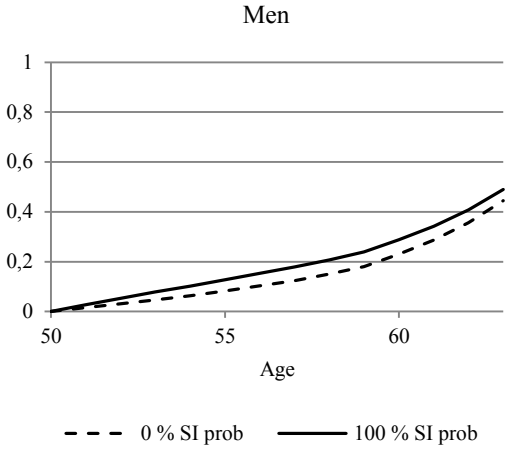
The Disability Insurance is not a relevant exit path from the labor force for a quite large share of the population. This implies that the simulations shown above overestimate the effect though economic incentives of every relevant policy reform altering the DI screening stringency and should therefore be interpreted as an "upper bound" for possible effects of such reforms. However, the problem is that we do not know the size of the group for which DI is a relevant exit path depending on screening stringency. In addition, the group for whom it is a relevant exit path differs from those for which it is not on several observable as well as unobservable characteristics.

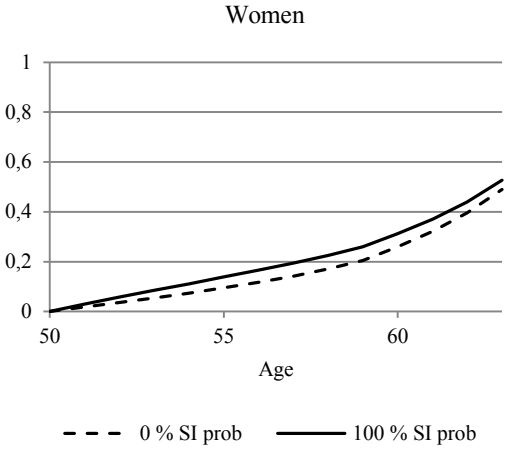
The most restrictive definition of the group for which the Disability Insurance is a relevant exit path is to include only those who we observe use the DI pathway for exit from the labor force. As an alternative simulation strategy, we therefore repeat the simulations reported above on the sub-sample of individuals that we observe retiring through the Disability

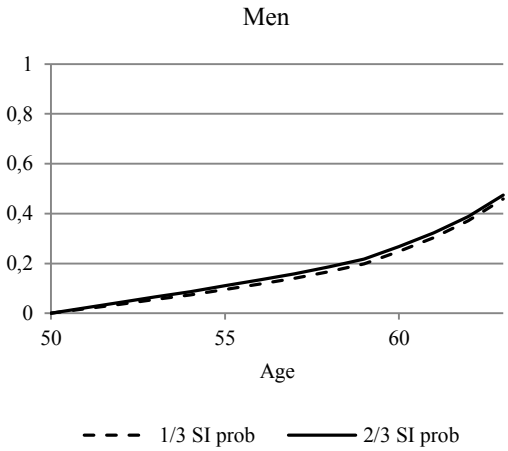
Insurance path separately. The economic incentives for retirement facing these individuals may differ from what we observe in the entire sample. These differences may generate differences in the result of the simulation. However, since we use the same estimated models as in the simulations reported above, possible heterogeneity parameters reflecting sensitivity to economic incentives in retirement behavior between the two samples is not taken into account.

Figure 17 shows the cumulative distribution functions for the subsample of DI recipients under different regimes of DI acceptance probabilities. The graphs stop at age 63, i.e., at the age when the individuals consider retiring at age 64, which is the oldest age for DI eligibility. In addition to the simulation where we shut down the DI option – i.e., zero probability of DI acceptance – and the simulation where everybody is eligible for DI, we also consider the cases where one third (1/3) and two thirds (2/3) of the group is eligible for DI. As expected, the differences between the simulations with zero probability versus 100 percent probabilities, shown in the two upper panels of Figure 17 are much larger than the simulation of two thirds versus on third DI probabilities, shown in the two lower panels of Figure 17.

As a summary measure for the simulations, Figure 18 shows the simulated expected remaining time in the labor force at age 50 under the different policy regimes described above. Comparing the results shown in Figure 18 with the corresponding ones for the entire sample shown in Figure 16, it can be seen that the simulated expected duration of the remaining work life is considerably shorter for those retiring through the DI program. This reflects the fact that these individuals on average have an inferior health status and lower educational attainments than the rest of the sample. However, comparing the simulated differences between the policy regimes in Figure 18 with those in Figure 16 suggest that the policy response is quite similar in the two samples. This suggests that differences in economic incentives in retiring through the DI path do not drive the observed differences in retirement ages.







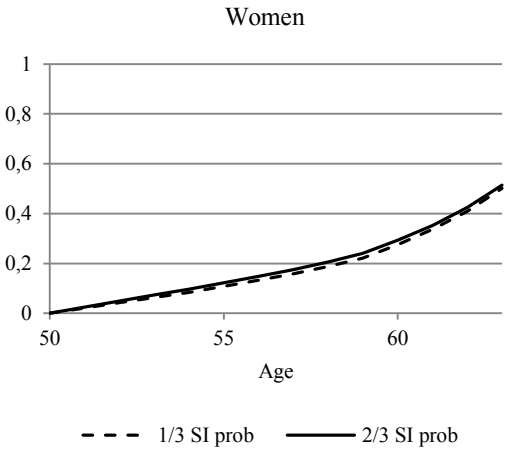
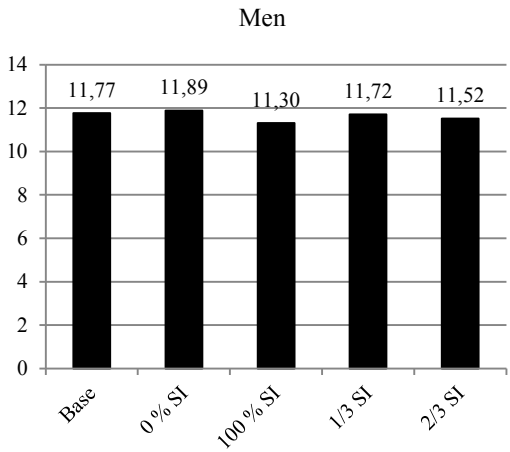


Figure 17. Cumulative hazard functions for different DI probabilities. Males and females, respectively.



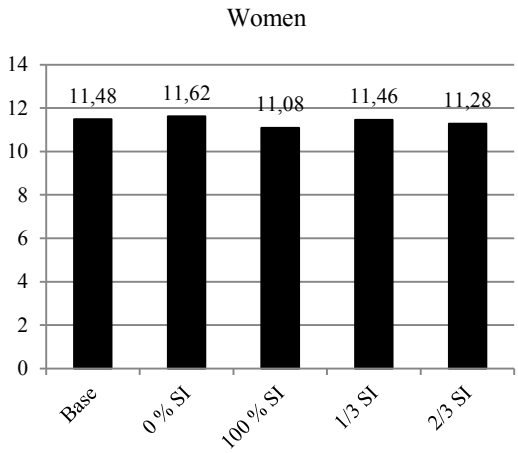


Figure 18. Expected number of years in of remaining work life at age 50 under different DI acceptance probabilities.

6. Conclusions

In this paper we first estimate an econometric model for the choice between staying in the labor market and leaving it for older workers in Sweden. We consider the economic incentives of two different exit paths from the labor force: the old-age pension path and a composite path consisting of other income security programs, where the DI program is the most important. We then simulate the effect if the probability of being admitted DI is changed from zero to 100 percent. The behavioral response to these changes comes through how the individuals in the sample respond to economic incentives in their retirement decision.

We find that the option value of retirement has a statistically significant impact on retirement behavior, i.e., economic incentives generated by income taxes and the income security system significantly affects the timing of the exit from the labor market. We also find that there are statistically significant differences between different population groups. The quintile group with the most inferior health status reacts stronger on economic incentives and the strength of the reaction seems to decrease monotonically with health. The difference is even larger between groups with different educational attainments. People with lower education are more sensitive to economic incentives in their retirement behavior.

The simulation exercises, however, show that the effects of economic incentives, through changes in the stringency of DI admittance, overall are quite small. Going from 0 to 100 percent DI admittance probability in the male population would increase the expected number of years in the labor force at age 50 from 13.17 to 13.93 years.

In Jönsson, Palme and Svensson (2012) it was shown that changes in the rules for DI eligibility in the long run gave very sizeable effects on labor force participation. Also, Figure 2 in Section 2.2 of this paper shows that employment in the age group 60-64 increased from around 50 in the year 2000 to almost 70 percent in 2012. Our results suggest that such huge changes could not have been driven by economic incentives alone. Other factors such as social norms, credit constraints and changes in population health may also have been important.

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Appendix: Sweden's occupational pensions, income taxes and housing allowances

A1. Occupational pensions

A1.1. The central government sector

The employees in the central government sector included in our sample are covered by two different pension agreements. Those born before 1943 are covered by the PA-91 act and the cohorts born from 1943 are covered by the PA-03 act. PA-03 replaced PA-91 in 2003. The pension age in both agreements is 65, but pension can be claimed from age 60 under PA-91 and from age 61 under PA-03 with an actuarial reduction in benefits. Pension withdrawal can also be delayed with an actuarial increase in benefits.

PA-91 includes a defined benefit pension and a supplementary defined contribution pension. The defined benefit pension in PA-91 is based on the average earnings up to 30 increased price base amounts during the five years preceding retirement. The pension from age 65 is 10 percent of the pensionable income below 7.5 increased price base amounts, 65 percent of the pensionable income between 7.5 and 20 increased price base amounts and 32.5 percent of the pensionable income between 20 and 30 increased price base amounts. For each month of early withdrawal, benefits on the pensionable income below 7.5 increased price base amounts are reduced by 2.6 percent and benefits on the pensionable income between 7.5 and 30 price base amounts are reduced by 0.4 percent. For each month of delayed withdrawal benefits at all levels are increased by 0.4 percent. The pension below age 65 is 101 percent of the pensionable income below one increased price base amount, 65 percent of the pensionable income between one and 20 increased price base amounts and 32.5 percent of the pensionable income between 20 and 30 increased price base amounts. In addition, benefits below age 65 are reduced by 0.4 percent for each month of early withdrawal. Benefits are also reduced proportionally if the number of contribution years from age 28 is less than 30.

The contributions for the supplementary defined contribution pension in PA-91 amounted to 1.5 percent of the pensionable income from January 1991 to March 1994 and to 1.7 percent from April 1995. Pension rights are collected between age 28 and age 65 and are accounted for also during years with disability benefits and early withdrawal of pension benefits. The

defined contribution pension can be withdrawn life-long or as a temporary pension. Pension rights collected under PA-91 are accounted for also for cohorts born after 1942.

PA-03 consists of two defined contribution pensions and one defined benefits pension. The first defined contribution pension in PA-03 is the individual pension. The premium amounted to 2.3 percent of annual income during 2003-2007 and 2.5 percent from 2008 for income up to 30 income base amounts. Pension rights are collected between age 23 and age 65 and are accounted for also during years with disability benefits and early withdrawal of pension benefits. The individual pension can be collected from age 61 and is paid out life-long.

The second defined contribution pension in PA-03 is the supplementary pension. The premium amounted to 1.9 percent of annual income during 2003 and 2.0 percent since 2004 for income up to 30 income base amounts. Pension rights were collected between age 28 and 65 until 2007 and between age 23 and 65 since 2008. The supplementary pension is paid out life-long or as a temporary pension.

The defined benefits pension in PA-03 is based on the pensionable income, calculated as the average income during the five years preceding retirement. In the long run the defined benefits pension from age 65 will only be provided for individuals with income above 7.5 income base amounts and will amount to 60 percent of the pensionable income between 7.5 and 20 income base amounts and 30 percent of the pensionable income between 20 and 30 income base amounts. Cohorts born between 1943 and 1972 are covered by transitional rules, however. For the cohorts born between 1943 and 1958, included in this paper, pension benefits amount to between 6.3 percent for the youngest cohort to 9.5 percent for the oldest cohort on the income below 7.5 income base amounts, between 62.60 percent for the youngest cohort and 64.85 percent for the oldest cohort on the pensionable income between 7.5 and 20 income base amounts and between 30.9 percent for the youngest cohort and 32.4 percent for the oldest cohort on the pensionable income between 20 and 30 income base amounts. Benefits are reduced proportionally if the number of contribution years from age 28 is less than 30.

Individuals on disability benefits are also granted supplementary benefits from the state occupational pension plan from the retirement age up to age 65. The supplementary disability benefits amounted to 21 percent on income up to 7.5 increased price base amounts, 81 percent

on income between 7.5 and 20 increased price base amounts and 40.5 percent on income between 20 and 30 increased price base amounts between 2001 and 2007. From 2008, the supplementary disability benefits amount to 15 percent on income up to 7.5 increased price base amounts, 75 percent on income between 7.5 and 20 increased price base amounts and 37.5 percent on income between 20 and 30 increased price base amounts.

A1.2. White-collar workers in the private sector

Private sector white-collar workers born before 1979 are covered by the ITP2 occupational pension plan. The scheme consists of a defined benefit pension and a defined contribution pension. The pension age is 65 but pension can be withdrawn early from age 55 and delayed until age 70. For each month of early or delayed withdrawal, benefits are adjusted according to the pension funds actuarially calculated guidelines.

The pensionable income under the defined benefit plan is the annual income up to 30 income base amounts in the year before retirement. The occupational pension is 10 percent of the pensionable income below 7.5 income base amounts, 65 percent of the pensionable income between 7.5 and 20 income base amounts and 32.5 percent of the pensionable income between 20 and 30 income base amounts. Benefits are reduced proportionally if the number of contribution years from age 28 is less than 30.

The contributions for the supplementary defined contribution pension in ITP2 amounted to 2 percent of the pensionable income from 1977. Pension rights are collected between age 28 and 65. If the individual retires before age 65 but after age 62, pension rights are accounted for until age 65 based on the pensionable income at the time of retirement. The supplementary defined contribution pension is paid out life-long or as a temporary pension.

Individuals on disability benefits are also granted supplementary benefits from the state occupational pension plan from the retirement age up to age 65. The supplementary disability benefits amount to 15 percent on income up to 7.5 increased price base amounts, 65 percent on income between 7.5 and 20 increased price base amounts and 32.5 percent on income between 20 and 30 increased price base amounts.

A1.3. The municipality sector

Cohorts in the municipality sector born before 1938 are covered by the PA-KL agreement. The pension points (P) for the defined benefit pension in PA-KL are the average earnings

during the best five years of the seven years preceding retirement up to 30 increased price base amounts divided by the increased price base amount. Gross pension points are calculated according to the following formula:

- 0.785*P+0.1750 if pension points are between 1 and 2.5 increased price base amounts;
- 0.6*P+0.6375 if pension points are between 2.5 and 3.5 increased price base amounts;
- 0.64*P+0.4975 if pension points are between 3.5 and 7.5 increased price base amounts;
- 0.65*P+0.4225 if pension points are between 7.5 and 20 increased price base amounts;
- 0.325*P+6.9225 if pension points are between 20 and 30 increased price base amounts.

Gross pension points are reduced proportionally if the number of contribution years from age 28 is less than 30. The supplementary occupational pension from PA-KL is the difference between gross pension points and the pension payments from the public pension system. The pension age is 65 but benefits can be claimed from age 60 with an actuarial reduction. The reduction is 0.3 percent per month if claimed at age 64, 0.304 percent per month if claimed at age 63, 0.339 percent per month if claimed at age 62, 0.379 percent per month if claimed at age 61 and 0.395 percent per month if claimed at age 60. Benefits are increased by 0.1 percent for each month of delayed withdrawal up to age 67.

Cohorts in the municipality sector born from 1938 onwards were covered by the PFA98 and PFA01 agreements until 1 January 2006. These agreements consist of a defined contribution pension scheme for all workers and a supplementary defined benefit scheme for workers with earnings above 7.5 income base amounts. Under the defined contribution pension scheme, the premium amounts to 4.5 percent of annual earnings up to 7.5 income base amounts and 2.1 percent of annual earnings between 7.5 and 30 income base amounts. Pension rights are collected between age 28 and 65. Pension could be withdrawn early from age 61 and delayed to age 67.

The supplementary defined benefit scheme in PFA98 and PFA01 was based on the pensionable income, calculated as the average earnings during the best five years of the seven years preceding retirement up to 30 increased price base amounts. The supplementary pension amounts to 62.5 percent on pensionable income between 7.5 and 20 income base amounts and to 31.25 percent on pensionable income between 20 and 30 income base amounts. Benefits can be withdrawn early from age 61 and delayed until age 67, with a reduction in benefits of 0.4 percent per month of early withdrawal and an increase in benefits of 0.4 percent per

month of delayed withdrawal. Benefits are reduced proportionally if the number of contribution years from age 28 is less than 30.

Since 1 January 2006 workers in the municipality sector are covered by the agreement KAP-KL, consisting of a defined contribution pension scheme and a supplementary defined benefits scheme. The premium for the defined contribution pension is 4 percent of annual earnings up to 30 income base amounts during 2006 and 2007, 4.25 percent during 2008 and 2009 and 4.5 percent from 2010 onwards. For workers born between 1938 and 1943, however, the premium is the same as in the PFA agreements, described above.

The pensionable income in the supplementary defined benefits scheme in KAP-KL is again calculated as the average earnings during the best five years of the seven years preceding retirement up to 30 increased price base amounts. For cohorts born until 1946, the supplementary pension is the same as under the PFA agreements, amounting to 62.5 percent on earnings between 7.5 and 20 income base amounts and to 31.25 percent on pensionable income between 20 and 30 income base amounts. For successive cohorts benefits are gradually reduced to a level of 55 percent on earnings between 7.5 and 20 income base amounts and to 27.5 percent for earnings between 20 and 30 income base amounts, for cohorts born in 1967 or later. Benefits can be withdrawn early from age 61 and delayed until age 67, with a reduction in benefits of 0.4 percent per month of early withdrawal and an increase in benefits of 0.4 percent per month of delayed withdrawal. Benefits are reduced proportionally if the number of contribution years from age 28 is less than 30.

A1.4. Blue-collar workers in the private sector

Since 1996, blue-collar workers in the private sector are covered by the SAF-LO agreement, which is a defined contribution scheme. Before then, workers were covered by the STP plan, which is a defined benefits scheme. Cohorts born after 1968 are fully covered by the SAF-LO agreement, whereas cohorts born between 1932 and 1968 are subject to special transitional rules between the two schemes. The premium under the SAF-LO agreement was 2 percent of annual earnings before year 2000 and is 3.5 percent on annual earnings from 2000 onwards. Pension rights are collected between age 21 and 65. Pension can be collected from age 55.

The transitional rules for cohorts born between 1932 and 1968 are somewhat complicated and we have not been able to find any documents explaining these rules. We only had these rules

explained to us by an employee at AMF Pension, administering the pension payments. For these cohorts, the pension wealth in 1996 was determined by the defined benefit pension under the STP plan based on the average income from all years from age 28 until 1995. This pension wealth was brought along to the defined contribution STP plan. From 1996, individuals collected new pension points according to the STP rules. Since the transitional rules are rather unclear, we simplify our calculations by assuming that pension rights for the defined contribution plan SAF-LO was collected between ages 21 and 65 with a premium of 2 percent before year 2000 and 3.5 percent from year 2000 onwards.

A2. The income tax system

Individuals pay income taxes on earnings, public pension, sickness-, unemployment- and disability benefits and occupational pension. This is accounted for in the option value calculations. Individuals pay municipal income tax on the income, net of a basic deduction. If income exceeds a certain break point, individuals also pay a state income tax. In 2007, an earned income tax credit was introduced, which is also accounted for in the calculations.

The basic deduction is based on the total income (I) and is calculated according to the following formula, expressed in price base amounts:

- 0.423 if $I \leq 0.99$
- $0.423+(I-0.99)*0.2$ if $0.99 < I \leq 2.72$
- 0.77 if $2.72 < I \leq 3.11$
- $0.77-(I-3.11)*0.1$ if $3.11 < I \leq 7.88$
- 0.293 if $7.88 < I$

The municipality income tax varies across municipalities and may change over time. In this paper, we do not take the municipality of residence into account but apply the average municipality income tax rate in each year for all individuals. The state income tax has two thresholds. Above the first threshold, the state income tax is 20 percent and above the second threshold, the state income tax is 25 percent. These brackets have changed over time. Table A1 presents the average municipality income tax and the two thresholds in the state income tax during the period 2001–2008, which is the period under study.

Table A1. Average municipality income tax rate and income thresholds for state income tax, 2001–2008

	Average municipality income tax	Income threshold 20 % state income tax	Income threshold 25 % state income tax
2001	0.3053	271,500	411,100
2002	0.3052	290,100	430,900
2003	0.3117	301,000	447,200
2004	0.3151	308,800	458,900
2005	0.3160	313,000	465,200
2006	0.3160	317,700	472,300
2007	0.3155	328,600	488,600
2008	0.3144	340,900	507,100

The earned income tax credit applied to earnings but not to income from public pension or public transfers such as disability benefits. The tax credit was a function of earned income (E), the basic deduction (BD) and the municipality income tax rate (T). Furthermore, there was an age discontinuity in the tax credit schedule. Individuals who had turned 65 at the beginning of the tax year received a substantially larger tax credit, roughly amounting to twice the size of the tax credit for individuals below age 65. The formulas for the earned income tax credit in 2007 and 2008, accounted for in this paper, are presented below.

For individuals below age 65, the earned income tax credit in 2007, expressed in price base amounts, was:

- $(E-BD)*T$ if $E \leq 0.79$
- $(0.79+(E-0.79)*0.2-BD)*T$ if $0.79 < E \leq 2.72$
- $(1.176-BD)*T$ if $2.72 < E$

For individuals below age 65, the earned income tax credit in 2008, expressed in price base amounts, was:

- $(E-BD)*T$ if $E \leq 0.91$
- $(0.91+(E-0.91)*0.2-BD)*T$ if $0.91 < E \leq 2.72$
- $(1.272+(E-2.72)*0.033-BD)*T$ if $2.72 < E \leq 7$
- $(1.413-BD)*T$ if $7 < E$

For individuals above age 65, the earned income tax credit in 2007, expressed in price base amounts, was:

- (E-BD)*T if E≤1.59
- (1.59+(E-1.59)*0.2-BD)*T if 1.59<E≤2.72
- (1.816-BD)*T if 2.72<E

For individuals above age 65, the earned income tax credit in 2008, expressed in price base amounts, was:

- (E-BD)*T if E≤1.79
- (1.79+(E-1.79)*0.2-BD)*T if 1.79<E≤2.72
- (1.976+(E-2.72)*0.033-BD)*T if 2.72<E≤7
- (2.117-BD)*T if 7<E

A3. Means-tested benefits

A3.1. Housing supplement

Individuals collecting public pension benefits or disability benefits can be granted a means-tested housing supplement if their income is low. The maximum housing supplement is 93 percent of the housing cost up to SEK 5,000 per month for singles, which is SEK 55,800 per year. For married individuals, the housing supplement is lower. The first step in the calculation of the housing supplement is to determine the individuals so-called "reduction income". It is the sum of public pension benefits, disability benefits and capital income, 80 percent of occupational income, 50 percent of earned income and 15 percent of the wealth exceeding 100,000 SEK, minus 2.17 price base amounts. The reduction income is based on gross income, before tax. The housing supplement is then calculated as the maximum housing supplement minus 62 percent of the reduction income up to 44,500 SEK and 50 percent of the reduction income exceeding 44,500 SEK.

A3.2. Special housing supplement and old-age support

Individuals with very low income can also be granted special housing supplement or old-age support. The rules are very similar. The calculation is based on the total net income, including housing supplement. The special housing supplement or old-age support equals 1.3546 price base amounts plus the housing cost of maximum 6,200 SEK per month minus net income.