Pension Reform, Incentives to Retire and Retirement Behavior: Empirical Evidence from Swedish Micro-data

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Abstract

This paper investigates to what extent the 1998 major reform of Sweden's public old-age pension system contributed to the increase in extensive margin labor supply among older workers seen in the country in recent decades. We use a large data set containing all males and females born in Sweden between 1922 and 1950 and observe their retirement behavior during 1985–2014. We use an econometric model in which the economic incentives to stay in the labor market are measured by Social Security Wealth, defined at each hypothetical retirement age, and a variable measuring the implicit tax, imposed by the income security system, on staying in the labor force. The point estimates from our econometric model suggest that at most a small part of the increase in labor force participation of the elderly can be attributed to the pension reform.

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1. Introduction

In recent decades, several aspects of retirement behavior in Sweden has changed. For males aged 60–64, labor force participation decreased by more than 30 percentage points between the mid-1960s to the late 1990s: from around 85 percent to about 55 percent. Since then, there has, however, been a reversed trend and in 2017 the labor force participation in this age group was close to 80 percent, only marginally smaller than in the early 1960s (see, e.g., Laun and Palme, 2020). Due to the general trend of female labor force participation, the downturn in the employment rate from the 1960s to the late 1990s has been absent for females although the upsurge in labor force participation of older women since then has been largely parallel to the development for men in this age group (see Laun and Palme, 2020).

The recent increase in labor force participation rates among older workers coincided with several policy changes affecting the incentives to stay in the labor force. The most important ones are the major reform of the old-age public pension system decided in 1998, which was gradually implemented since then, and the major reform of the Disability Insurance program in 2008. The reform of the old-age pension system implied a transformation from a defined benefit (DB) pay-as-you-go system to a notional defined contribution (NDC) system with a stronger link between the paid contributions to the scheme and the expected benefits. The new system was gradually implemented for the cohorts born between 1938 and 1953. The reform of the Disability Insurance (DI) in 2008 implied much stricter eligibility rules – after the reform the work capacity must be permanently lost due to health reasons – and a stronger emphasis on rehabilitation programs for workers facing health problems.

An unresolved research question is to what extent the development towards a later exit from the labor market can be attributed to the policy changes that altered the incentives for remaining employed. The alternative explanation is that the development is driven by changes in the labor force, or the labor market in general, such as improvements in the physical work environment, the general health status of the work force, the educational attainments of the workers (see Laun and Palme, 2020, for a detailed description of these changes), or a combination of these three changes related to the replacement of industrial blue-collar jobs with jobs primarily in the service sector.

In this paper, we do three things to shed light on this important research question. First, we give a detailed description of the series of policy changes that have affected the incentives to remain in the labor force for older workers. The emphasis is on the great reform of the public old-age pension system decided in 1998 and gradually implemented starting with the cohort born in 1938. We also describe the series of reforms of Sweden's DI system initiated in 1991 with the abolition of the right for workers older than age 60 to be eligible to DI for labor market reasons. Second, we describe how the economic incentives to stay in the labor force have changed as a result of the 1998 reform of the public old-age pension system. We look at how the implicit Social Security Wealth (SSW) as well as the implicit tax on staying an additional year in the labor force from the pension and income security system (ITAX) have changed across birth cohorts. Finally, we estimate an econometric model for retirement choice. Our policy variables in this model are the SSW and ITAX measures used in the descriptive analysis.

We use a large data set including information from several Swedish administrative registers, linked together using a unique personal identification number. We focus on the native population born in Sweden between 1922 and 1950. We exclude all immigrants since it is difficult to accurately calculate their pension benefits. For computational purposes, we draw a sample of 10 percent of the population. The data sources we use include the full pension accrual for the entire population, provided by the Swedish Pensions Agency, back to the introduction of Sweden's first supplementary

pension scheme (ATP) in 1960. The individual pension accrual histories enable us to calculate individual measures of economic incentives to stay in the labor force. Data from the LOUISE database compiled by Statistics Sweden also allow us to evaluate the accuracy of our pension calculator, since this data include the annual pension benefit amounts actually paid out to the retirees. Annual earnings data from the LOUISE database allow us to define the date of retirement and the date of pension withdrawal. The LOUISE database also includes socioeconomic information at the individual level.

Our descriptive analysis on how the incentives to remain in the labor force changed as a result of the 1998 pension reform unambiguously shows that the average SSW decreased as a result of the reform, creating an income effect towards later exit from the labor force. Our analysis also shows that the series of reforms of Sweden's DI system implying gradually stricter eligibility rules reinforced the trend towards a lower SSW. This result follows from the fact that the compensation levels in the old-age pension system are in general lower than in the DI system and that SSW is measured as a weighted average from the old-age pension and DI pathways out from the labor force.

Our results on how the ITAX measure changed in the 1998 pension reform highlight the importance of the assumption we make about the relationship between pension claiming age and labor force withdrawal age. A fundamental difference between the pre- and post-reform pension system is that the actuarial adjustment in the pre-reform system was primarily linked to when the worker started to claim benefits, independently of when he or she stopped working. In the post-reform Notional Defined Contribution (NDC) scheme, the accrual of pension wealth continues until the worker stops contributing to the system through payroll taxes, i.e., stops working. There is also a smaller actuarial adjustment linked to the pension claiming age in the new system, through the adjustment of the annuity divisor and the income indexing of the account balance.

These differences between the pre- and post-reform system implies that the size of the ITAX measure depends on whether we assume that the worker starts to claim public pension at the age of labor force withdrawal, or whether we assume that these decisions are independent. Since we can observe that many workers in the pre-reform system started to claim pension at age 65 while exiting the labor force earlier than that, our preferable alternative assumption is that all workers start to claim pension at age 65 independently of the age at labor force withdrawal. Under this assumption, our results unambiguously indicate stronger incentives to stay in the labor force as a result of the reform. On the other hand, assuming that pension claiming goes hand in hand with labor force withdrawal implies a change towards weaker incentives to stay in the labor force in the post-reform pension system.

Our econometric analysis includes six different specifications representing different permutations of age controls, variables controlling for observable characteristics as well as dummy variables for years. In addition to that, we present four sets of results using different assumptions on the relationship between pension claiming age and labor force withdrawal age. We analyze retirement behavior at ages 61–64 during 1991–2012. As in previous research on retirement behavior using Swedish data (see, e.g., Palme and Svensson, 2004, or Johansson, Laun and Palme, 2016), our results reflect difficulties in identifying income effects in retirement behavior, since our estimates have unexpected signs in all different specifications. We encountered similar problems with the coefficient estimates for the ITAX variable: only the specification when the pension claiming age was fixed to age 65 yields expected signs on the coefficients.

The rest of the paper is organized as follows. Section 2 describes the pre- and post-reform public old-age pension systems and other relevant institutions for older workers. Section 3 presents the data used in the study and Section 4 describes the patterns of retirement behavior during the observation period. Section 5 describes the measures of economic incentives and the econometric model used in

the empirical analysis. Section 6 first shows the results from the descriptive analysis and then those from the econometric model. Finally, Section 7 concludes.

2. Sweden's Social Insurance System

Figure 1, which was originally published in Laun and Palme (2021), shows the main changes in public old-age pensions, Disability Insurance programs and income taxes affecting incentives to exit from the labor market.

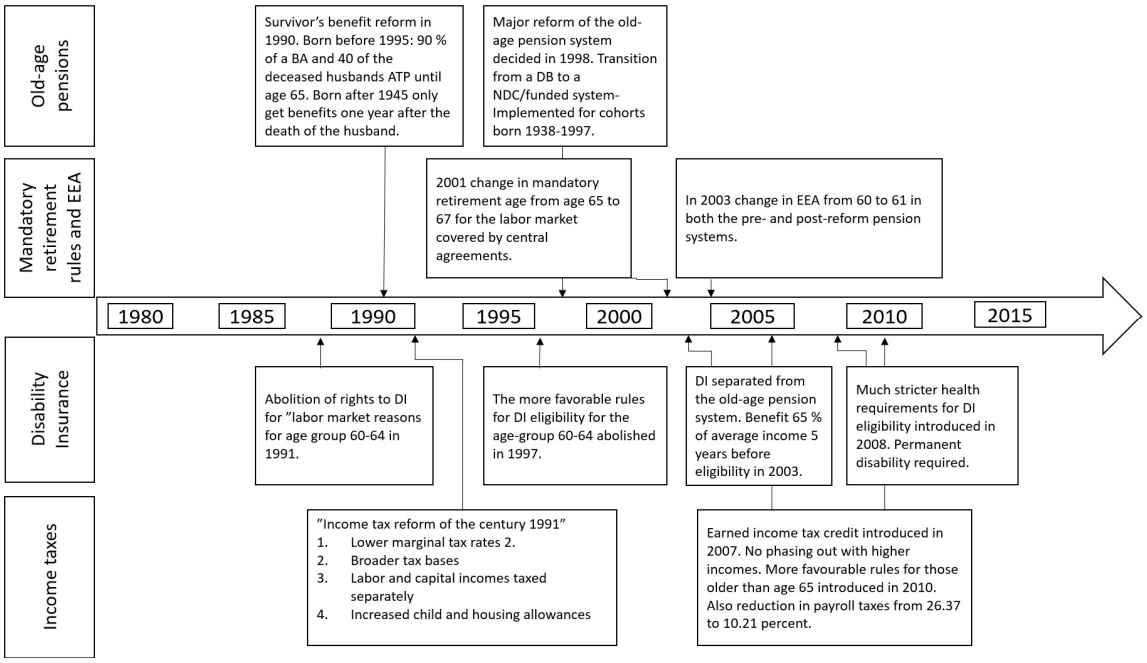


Figure 1. Major institutional changes affecting incentives to exit from the labor market between 1980 and 2015.
Source: Laun and Palme (2021).

2.1 Old-age Pension Systems

In 1998 the Swedish parliament decided on a major reform of the public old-age pension system. This reform replaced the old Defined Benefit (DB) plan by a scheme consisting of a pay-as-you-go (PAYG) Notional Defined Contribution (NDC) scheme and a fully funded scheme, where people can choose between a large number of privately managed funds.

Those born in 1938 were the first ones to be assigned to the post-reform public pension system. This cohort was in the post-reform system by 20 percent and by 80 percent in the pre-reform system. After the 1938 cohort the share in the post-reform system was increased by 5 percent per cohort, implying that those born in 1954 are fully covered by the post-reform pension system.

Different types of *Basic Amounts* are used to index a large part of the Swedish income security system. The *Price Basic Amount (PBA)* is politically decided but follows the Consumer Price Index (CPI) very closely. It has deviated from the CPI on a few notable occasions.[3] In 2018 the level of the *PBA* was

[3] The first time was between November 1980 and November 1982, when the *PBA* was linked to a price index that to a lesser extent reflected changes in oil and electricity prices than the CPI. The second time was when price changes due to the 16 percent devaluation of the Swedish currency in 1982 was not fully accounted for in the *PBA* (see Palme and Svensson, 1999).

45,500 SEK.[4] In 1995, the *Increased Price Basic Amount* was introduced. The increased PBA is only slightly higher than the regular *PBA*, at 46 500 SEK in 2018. In 2001, the *Income Basic Amount* (*IBA*) was introduced*,* which is indexed by the Income index rather than the price level. The Income index measures the percentage change in the average income from labor for all permanently living in Sweden between age 16 and 64.[5]

The basis for the accrual of pension wealth is the pension qualifying income (PGI). It amounts to the annual earnings of the individual, reduced by the common pension fee (*allmän pensionsavgift*). The common pension fee was introduced in 1998 and amounted to 6.95 percent in 1998 and 1999. Since 2000, the common pension fee is 7 percent of the pension qualifying income. In addition to labor earnings, also income from certain income security programs are included in the pension qualifying income. For the pension qualifying income, incomes above 0.423 *PBAs* and below the social security ceiling of 7.5 basic amounts are recorded. The social security ceiling was 7.5 *PBAs* between 1960 and 1994, 7.5 increased *PBAs* between 1995 and 2000, and is 7.5 *IBAs* since 2001.

2.1.1 The Pre-reform Public Old-age Pension System

The pre-reform public old-age pension system consisted of two main parts. The first part, the *Basic pension* (*Folkpension*) is unrelated to the insured individuals' previous earnings. For a singled pensioner this pension amounts to 96 percent of a *Price Basic Amount* (*PBA*)[6] and is reduced to 78.5 percent of a *PBA* for a married pensioner.[7]

The second main part of the pre-reform public pension system is a supplementary pension (*Allmän tilläggspension, ATP*). This part is related to the retirees' previous earnings. The size of the benefit is determined by equation (1):

$$Y_i = 0.6 \cdot AP_i \cdot min\left(\frac{N_i}{30}, 1\right) \cdot PBA, \qquad (1)$$

where *AP* is the average pension points obtained by averaging the pension points of the 15 best years of the insured individual's earnings history. The pension points are obtained from dividing the individual's pension qualifying income by the *PBA*.[8] Earnings below 1 *PBA* and above the social security ceiling are not counted. *N* is the number of years the individual has positive pension points, i.e., contributed to finance the pension scheme. The expression $min\left(\frac{N_i}{30}, 1\right)$ implies that the benefit is linearly reduced if the individual contributes less than 30 years to the system.

In addition to these two main parts, the pre-reform public pension system also includes a *Special Supplement* (*Pensionstillskott*). The Special Supplement was introduced in 1969 and given to those with no or very low supplementary pension. It is decreased on a 1:1 basis with the supplementary pension (*ATP*). The level of the Special Supplement increased slightly at a few occasions and amounted to 0.569 *PBA*s from 2001 for old-age pensioners. For people on disability insurance, the Special Supplement increased to almost the double amount in 1976. Since 2001 the special supplement for disability beneficiaries has amounted to 1.129 *PBA*s.

Until 1997 all benefits from the pre-reform public old-age pension system could be claimed from the month the insured individual turns age 60, with a life-long actuarial adjustment of 0.5 percent for each month of early withdrawal relative to age 65. After age 65, there was an actuarial addition of 0.7

[4] About 4,000 € or 5,000 US$ in 2018.
[5] Formally, the Income index is based on the sum of labor income qualifying for old-age pension, i.e., labor income above 42.3 percent of a *BA,* divided by the number of individuals with a positive pension qualifying income from labor.
[6] *Prisbasbeloppet* in Swedish.
[7] To abstain from changes in composition regarding marital status, we assign values for single pensioners to all individuals.
[8] Since 1995 the increased *PBA* is being used.

percent for each month of delayed withdrawal.[9] In 1998 the age of early withdrawal was changed to age 61.

An important feature of the pre-reform old-age pension system are the special rules during the phasing-in of the program. Labor earnings for the income related part of the system was recorded for the first time in 1960. Those born in 1914 or earlier only required 20 years of contributions to receive full benefits and the benefits were linearly reduced by the factor $\frac{N}{20}$, where *N* is the number of years of contribution if the worker contributed less than 20 years. For each birth cohort between those born in 1914 and 1924 one year of contributions were added to this requirement. This means that for the 1915 birth cohort 21 years of contributions were needed. The 1924 cohort was the first one to meet the requirement of 30 years of contributions.[10] These special rules implied that the cohorts until those born in 1924 had to claim their benefits at age 65 or later to receive full benefits. Claiming before 65 reduced the pension benefits by 1/30th per year of early claiming in addition of the actuarial adjustment of 0.5 percent per month of early claiming described above.

2.1.2 The Post-Reform Public Old-age Pension System

The post-reform public pension system consists of three main parts. The first part is a guaranteed benefit level (*Garantipension*) for those with no, or low, income related benefit that is financed through the general state budget and indexed by the *CPI*. The benefit level is independent of the insured individual's previous contributions to the pension scheme. In 2020 the monthly benefit was set to a maximum of 8,597 SEK (about 833 € or 980 US$) for single pensioners and to 7,690 SEK (about 745 € or 877 US$) for married.

The second and third parts of the post-reform system are financed through employers' and employees' contributions. The part of these contributions devoted to the pension system is set to 18.5 percent of the pension qualifying income.[11] Of these 18.5 percentage points, 11.5 is paid as an employer's and 7 as an employee's contribution; 16.0 percentage points, or 86.5 percent, are devoted to a pay-as-you-go NDC scheme and 2.5 percentage points, or 13.5 percent, to a fully funded scheme.

The NDC system is based on individual notional accounts. The benefits are proportional to the pension qualifying income below the social security ceiling of 7.5 basic amounts. The transition in 2001 from indexing the social security ceiling with a wage index (IBA) rather than a price index (PBA) is important, since it prevents the income related part of the pay-as-you-go pension from "fading out" with economic growth. The change becomes more and more important over time, as the *PBA* and the *IBA* diverge. In 2018, the social security ceiling of 7.5 *IBA*s amounts to 10.3 *PBA*s.[12]

Another important part of the post-reform pension system is that also historic pension contributions are indexed by an income index. All individual contributions recorded since 1960 are included in the individual accounts, and annually multiplied by the change in the income index. Inheritance gains from deceased individuals are allocated proportionally to still active persons in the same age cohort

[9] Until 1988, the actuarial addition beyond age 65 was 0.5 percent.

[10] Since labor earnings were recorded from age 16 and the first year this was done was in 1960, one could claim the system was not fully matured until the cohort born in 1944 reached the normal retirement age at age 65 in 2009. This means that the ATP system was abolished before it was fully implemented.

[11] Since the pension qualifying income is annual earnings reduced by the common pension fee, the actual contribution is only 17.21 percent of annual earnings.

[12] The same social security ceiling applies when calculating the pension points in the pre-reform system. However, since the IBA was introduced in 2001, it matters more for contributions to the post-reform system.

proportionally to the size of their account balance (see Orange Report, 2017). The accounts are also reduced by a factor corresponding to the administrative cost of the pension system.[13]

When the individual decides to retire, the account balance is divided by the so-called *annuity divisor* to get the size of the annual pension benefit at the date of retirement. The annuity divisor is a function of an interest rate, which is set to 1.6 percent, and the life expectancy at the age of retirement. The annuity divisor is calculated for all retirement ages at the time the cohort turns 65. If the individual retires before age 65, a preliminary annuity divisor is being used and then recalculated when he or she turns 65. The annuity divisor is a form of actuarial adjustment since it takes the age at retirement into account.

For the cohorts born in 1938–1953, the change of the annuity divisor implies an actuarial adjustment of between 0.26 and 0.36 per month delay in pension claiming from age 62 to age 70. Earlier cohorts face a slightly larger gain in postponing pension claiming, and the gain also increases with the pension claiming age. These actuarial adjustments for pension claiming that comes from the change of the annuity divisor in the post-reform system are, however, substantially lower than the actuarial adjustment of 0.5 percent per month before age 65 and 0.7 percent per month above age 65 in the pre-reform system.

For each year during retirement, the benefit is changed following the *adjustment indexation.* At the turn of the year, the benefits are adjusted with the factor $\frac{I_t/I_{t-1}}{1.016}$, where I_t is the income index of the coming year and I_{t-1} corresponds to the past year. If there is a growth rate at exactly 1.6 percent there is no adjustment. If the real wage sum grows faster than 1.6 percent, there is a real growth rate in the benefit levels. However, if the growth rate is smaller, there will be a real decrease in the benefit levels.

Since the contribution to the NDC scheme is fixed to 16.0 percent of the pension qualifying income, there is an uninsurable risk for the system to get financial problems, primarily related to unexpected changes in life expectancies or a smaller labor force. To handle these risks, the pension scheme includes a special "balancing mechanism" that lowers the benefits proportionally in order to reach balance in expected incomes and liabilities of the NDC system.[14] We do not account for the balancing mechanism in our pension calculator, since it is difficult for the individual to foresee events, or developments that would activate this mechanism.

In the third part of the post-reform public pension system, the fully funded Premium Pension (PPM), the insured individual is able to choose between almost 850 different funds (see Palme et al., 2007, for a more detailed overview of the Premium Pension). When the system was introduced in the year 2000, all fund managers with an active business in Sweden were allowed to participate in the system. However, since then, somewhat stricter rules for participation have been implemented.

The system contains a default fund for those who do not make an "active choice" of fund manager. When the system was introduced, about 68 percent avoided the default alternative by choosing a different a fund manager. However, since then, the share of those who make an active choice has decreased and today almost 50 percent of the insured individuals have their savings in the default fund managed by the pension authorities.

The annual benefits from the fully funded part of the public pension are calculated using an annuity divisor specific to the premium pension. The advance rate is currently set to 1.75 percent, where 0.1 percent is reserved to cover administrative costs for the Swedish Pensions Agency. The premium pension can be drawn as a traditional insurance, where the fund shares are sold at the date of retirement and managed by the Swedish Pension Agency, or as a fund insurance, where the pension

[13] Since inheritance gains and administrative costs are small and difficult to predict in advance for an individual making her retirement decision, we do not include these features in our pension calculator.
[14] See the *Orange Report* 2016 for a description.

benefits remain in the fund chosen by the insured individual. We do not separately model the premium pension but assign also the fully funded part to the rules for the NDC scheme since individuals cannot foresee the future stock market development at the age of retirement.

2.1.3 Implementation of the Reform and Transition Rules

The first cohort to be affected by the new pension system were those born in 1938. Their pension benefits are calculated as a weighted average of the benefits they would receive in the old and the new system with the weights 80 and 20 percent, respectively. For every cohort born after 1938, the weight for the new system was increased by 5 percentage points until those born in 1954, who are 100 percent in the new system.

In addition to the smooth implementation of the new pension system, the reform also contained an important transition rule for the first birth cohorts affected by the reform. This transition rule implied that, since the first decision on a new public old-age pension system were taken by the parliament in 1995, all insured workers were guaranteed the public pension they were entitled to by the end of the year 1994 if they would have retired in the month they turned 65. The difference between this amount and what they get after the reform is given to the retiree as a *Guarantee supplement*.

This does not, however, mean that they reached the same benefit level as they would have had under the pre-reform pension system. Remember that the supplementary pension under the pre-reform system was linearly reduced by the number of years less than 30 that the individual had reported positive pension points. In 1994, those born in 1938, the first cohort affected by the reform, turned 56. This means that their benefits could have been more reduced by the rule of 30 years of contribution than it would have been at age 65 and it could also have been reduced by the fact that some of their best years of earnings could have still been ahead of them.

The features of the *Guarantee supplement* described above implied that the levels of the benefits decreased over the birth cohorts to fade out for the cohorts born by the end of the age groups affected by the transition rules. The *Guarantee supplement* implies that the difference, in both the benefit levels and how they change if the worker decides to stay in the labor force an additional year, between the pre- and the post-reform pension systems are smaller for the cohorts born close to the cut-off point than for younger cohorts.

2.2 Mandatory Retirement and Occupational Pension

2.2.1 Mandatory Retirement

Most of Sweden's labor market is covered by central agreements between trade unions and employers' confederations. These include agreements on retirement ages and in most cases the mandatory retirement age was 65. This was also supported in the labor market legislation. Workers older than age 65 were not covered by employment security legislation and were exempted from seniority rules. In addition, they were not covered by the unemployment insurance (UI), disability insurance (DI) or the compulsory sick pay insurance. Central and local government employees automatically lost their jobs at age 65. Exceptions from this rule were permitted for one year only.

A new legislation implemented in 2001 postponed the mandatory retirement age to 67, meaning that those aged between 65 and 67 were now covered by the employment security legislation. The special rules for central and local government employees were also adjusted to age 67. However, the rules for the income security programs remained at age 65 also after the reform. Depending on ongoing collective agreements in some sectors of the labor market, the reform was not fully implemented until 2003.

2.2.2 Occupational Pension

The central agreements between trade unions and employers' confederations also include occupational pension. The rules for these programs are described in detail in Palme and Svensson (1999 and 2004). Although the programs have converged considerably in recent years and there are some variations between occupations, they can be categorized into four main groups based on the sector of employment. In the private sector, there is one program for white collar workers and one for blue collar workers, respectively. In the public sector there is one program for state employees and one for employees in local public sectors.[15]

The occupational pensions are financed through an employers' contribution and consists of a defined contribution (fully funded) and a defined benefit (pay-as-you-go) part. They constitute a complement to the public pension system. This means that they compensate a much lower share of earnings below the social security ceiling but constitute the main compensation for earnings above the ceiling. Thereby, they extend the social security ceiling from the public pension system and are the main income source for retired high-income earners.

We have decided to leave out the occupational pensions out from this study. Although they are important income sources for retirees, in particular for high income earners, and consequently, in many cases, decisive for the economic incentives to stay in the labor force, we have two main reasons for doing this. First, since we are not able to observe which occupational pension program each individual is assigned to it is impossible to accurately calculate benefits at each hypothetical retirement age. Second, since the focus of this paper is on the labor supply response to the reforms of the public old-age pension system, we have put the main emphasis to model these changes as accurately as possible.

2.3 The Disability Insurance Program

The Disability Insurance program replaces forgone earnings due to a lasting impaired work capacity. Since 1980 there has been several changes of the program. A series of reforms that gradually made the eligibility rules more generous were implemented in the 1970s. The most important changes were the introduction of special eligibility rules for older workers (initially older than age 63) and rights for older workers to receive Disability Insurance for labor market reasons. These reforms were reversed in the 1990s. The eligibility to DI for long-term unemployed workers older than age 60 were abolished in 1991. Six year later, in 1997, the special eligibility rules were completely abolished. This meant that workers older than age 60 no longer had lower medical eligibility rules, had to participate in rehabilitation programs and were covered by the same requirements for taking suitable jobs and accepting geographical mobility as younger workers (see Karlström, Palme and Svensson, 2008, for a detailed description of the reform and its effects on employment).

Before 2003, the Disability Insurance program was a part of the public old-age pension system. Like the old-age pension, it consisted of a basic and an income related supplementary part. In 2003, following the reform of the Swedish pension system, the DI program became independent of the public old-age pension system. The benefits were calculated as 64 percent of the "assumed income" below the social security ceiling.[16] The "assumed income" is the average of the five to eight best years of the annual pension qualifying income before the worker became eligible to DI.

[15] See Selin (2016) for an analysis of changes to the occupational pension scheme for local government workers.
[16] Since October 1, 2015, the benefit level is 64.7 percent of assumed income.

The reform in 2003 also included changes in the eligibility rules for DI. The most important change was that the DI benefit was no longer permanent; eligibility would be reconsidered every 5th year. The Disability insurance program for those younger than age 30 changed name to "Activity support" (*Aktivitetsersättning*) and the recipients were automatically required to reapply for benefits when they turned 30. In addition, rehabilitation programs in collaboration with The Public Employment Service were initiated. In 2005, the local Social Insurance Agencies where combined into one central authority. In relation to that, the Social Insurance Agency made an effort to increase the equivalence of the assessment of work capacity across Swedish regions. As shown in Laun and Palme (2020), this appears to have led to that the local social insurance offices have gradually applied stricter eligibility rules for disability insurance.

In 2008 the government implemented a new reform of the DI system. The most important element of the new eligibility rules was that the person applying for DI had to show that his or her ability to work was permanently lost. For obvious reasons, this change implied that the threshold for receiving DI increased significantly. Simultaneously, the rules for the sick pay insurance program, which replaces foregone earnings from temporary health problems, was changed so that the maximum spell length was limited to one year. The reform also implied a much more structured rehabilitation program (*Rehabiliteringskedjan*) that was imposed very early on in a sickness spell.

Figure 2 shows the development of DI prevalence and incidence between 1980 and 2011 for males and females, respectively. The most striking result in Figure 2 is the sharp drop in DI entry from the late 1980s to today. The analysis in Jönsson, Palme and Svensson (2012) indicates that changed eligibility criteria during the 1980s and 1990s clearly affected program caseloads and may also have had an impact on labor force participation. However, for our purposes the most interesting change is the decline in DI entry since 2005. It is apparent that the background to the decline is the more stringent eligibility rules following the reforms of the DI system in 2003 and 2008, and the gradual changes in implementation of the rules at the Swedish Social Insurance Agency.

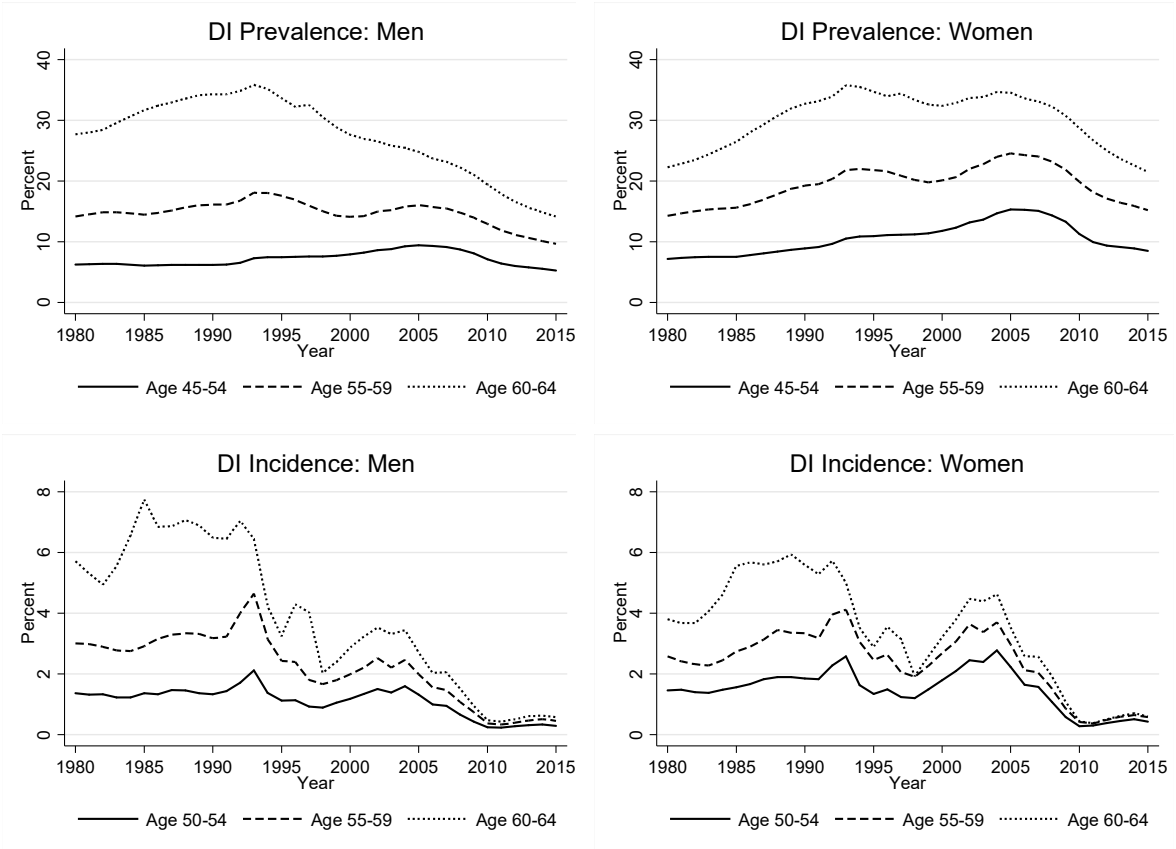


Figure 2. Upper panels: Share of the population receiving DI in different age groups. Lower panels: Share of DI entry in different age groups. Males and Females.
Source: Swedish Social Insurance Agency.

2.4 Income Taxes

Figure 1 describes the main changes to the Swedish income tax system. These include the 1991 income tax reform – "The tax reform of the century" (see Agell, Englund and Södersten, 1996, or Björklund, Palme and Svensson, 1995, for an overview) – and the introduction and expansions of earned income tax credit schemes from 2007 onwards. In this paper, we calculate the incentives to retire in terms of pre-tax pension benefits. Therefore, we do not discuss the changes to the income tax system in any depth. One reason for not taking taxes into account is that applying the annual tax scheme on the entire future pension benefit stream would mean that small tax changes could get a large impact on financial incentives. We do not think that individuals may be fully aware of the actual tax system nor that they believe that the current system will last until the individual dies. Nevertheless, since the change in 1991 was so substantial, in our regression framework we will only use data on retirement from 1991 onwards.

3. Data

3.1 Data Sources and Sample Selection

We use administrative individual-level data that is linked together through a unique personal identification number. The most important register, provided by the Swedish Pensions Agency, contains the full pension accrual histories back to the introduction of the supplementary pension system (ATP) in 1960 for all insured individuals in the population. This includes the pension points used to calculate the benefits in the pre-reform pension system, recorded for both the pre-reform cohorts up until those born in 1937 and the cohorts 1938–1953 who transitioned into the post-reform pension system. It also includes the pension qualifying income, used to calculate the pension accrual in the post-reform public pension system, recorded for all post-reform cohorts born in 1938 or later.

We also use the LOUISE/SYS register, provided by Statistics Sweden, covering the full population from 1985 to 2014. It contains annual earnings from tax records from 1985 and annual public transfers from different systems from 1990. It also contains information about gender, age, education level and marital status. The advantage with tax data compared to those obtained from the Swedish Pensions Agency is that they also contain data for labor incomes above the social security ceiling. We observe individuals until age 64 between 1985 and 1989, until age 65 between 1990 and 2000, and until age 74 from 2001 onwards.

We include individuals born in Sweden between 1922 and 1950 who are observed in the registers, i.e., permanently living in Sweden. We exclude all immigrants since it is difficult to accurately calculate their pension benefits. For computational purposes, we draw a random sample covering 10 percent of the population. The different registers allow us to observe labor market outcomes between 1985 and 2014 and we include individuals in ages 50–70. Date of retirement for an individual is defined as the last observed year *before* the individual has labor earnings below 1 *PBA*. Date of pension claiming is defined as the first year with positive old-age pension from the public pension system. Table 1 provides descriptive statistics for the 10 percent random sample of the population. About 50 percent are men, and 65 percent are married. The education level is quite low for these cohorts, with only 13

percent having at least 3 years college education. The majority, 51 percent, has a high school education.

	Total	Males	Females
Birth year	1939.64	1939.73	1939.54
Age	59.45	59.37	59.52
Male	0.498	1	0
Married	0.648	0.662	0.635
Education			
Low	0.354	0.380	0.329
Medium	0.512	0.489	0.534
High	0.134	0.131	0.137
Number of observations	3,742,817	1,863,739	1,879,078
Unique individuals	260,984	130,742	130,242

Table 1. Descriptive statistics.

In the regressions, we analyze retirement behavior between ages 61 and 64 during 1991–2012 for the cohorts born between 1927 and 1950. We condition the estimation sample to those being in the labor force, defined as having labor income above 1 *PBA*, at age 60. Individuals remain in the estimation sample until they retire. We start in 1991 because of the major income tax reform implemented that year. We end in 2012 to allow at least two years with no earnings following the last year in which we define a retirement hazard. We have three main motives for focusing on the age group 61–64. First, age 61 is the early eligibility age in the post-reform pension system, and age 65 was the mandatory retirement age until 2001. Thus, individuals are likely to be unable to respond to financial incentives below or above these age thresholds in the years they apply. Second, we only observe retirement behavior above age 65 from 2001 onwards. Finally, as we will see in Section 4, most of the changes in the labor force participation in recent years can be attributed to the age group 60-64.

3.2 Pension Accrual Histories

The longitudinal pension accrual data are of key importance for our ability to calculate the measures of economic incentives to remain in the labor force. A strength of our data set is that we are able to observe pension accrual registered by the National Pension Agency back to 1960, when the pre-reform old-age pension system (ATP) was implemented, for all individuals in the population. However, as explained in Section 2 only earnings below the social security ceiling at 7.5 *IBA*s is recorded, which implies that as earnings records they are top coded.

Figure 3 shows the pension points earned per year on average for cohorts born in 1922, 1930, 1938, 1948 and 1953 for males and females, respectively.[17] The graphs reveal some real earnings growth rate across cohorts. For females, the growth in earnings is larger and more evenly spread over the work life. The larger real wage growth among females partly reflects a relative growth in hours of work compared to males for those in the labor force across cohorts.

[17] As described in Section 2, pension points are capped at 6.5 *PBB*s before 2001 and 6.5 *IBB*s since 2001. In the figure, we capped pension points at 6.5 *PBB*s in all years to enhance comparability over time.

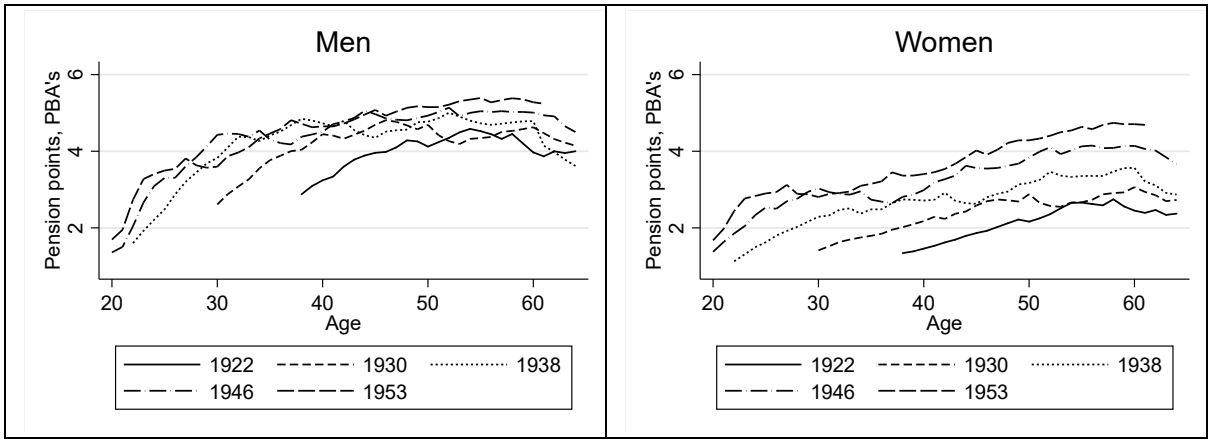


Figure 3. Earnings histories by cohort.
Source: Own calculations from individual data provided by the Swedish Pensions Agency.

3.3 Evaluation of the Pension Calculator

The LOUISE/SYS database compiled by Statistics Sweden includes the actual pension benefits paid out to the retirees. This enables us to evaluate the accuracy of our pension calculator. The upper two panels in Figure 4 shows the distribution of the observed pension benefits two years after retirement along with the distribution of the predicted benefits. The upper left panel shows the outcomes for those born before 1938, i.e., those who were 100 percent under the pre-reform pension system, and the upper right panel shows the outcomes for those born after 1938 and who were partially covered by the post-reform pension system. The two lower panels show the distribution of the percentage difference between the predicted and the actual pension outcomes for the two cohort groups, respectively. Reassuringly, the deviations seem to be symmetrically distributed around zero with comparatively small variations.

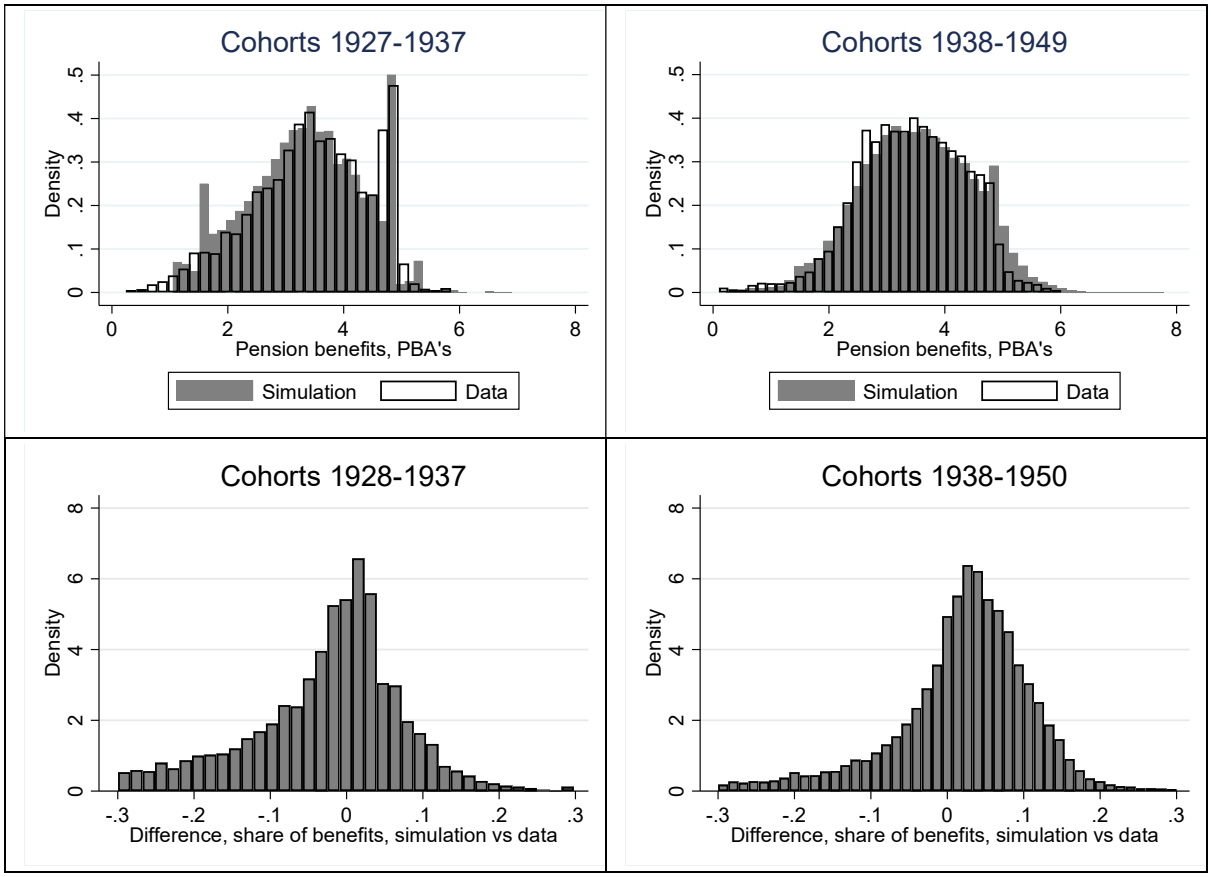


Figure 4. Upper panels: predicted versus observed pension benefits for those born before and after 1938, respectively. Lower panels: distribution of percentage differences between observed and predicted pension benefits.

Source: Own calculations from individual data provided by the Swedish Pensions Agency.

4. Retirement Behavior

4.1 Timing of Exit from the Labor Force

Figure 5 shows labor force participation rates according to the Swedish Labor Force Survey (LFS) between 1980 and 2015 for the age groups 55–59, 60–64 and 65–69 for males and females, respectively. The graphs reveal that most of the changes in labor force participation rates have been in the age group 60–64. For males in this group the labor force participation has increased from about 55 percent in the late 1990s to 75 percent in 2015 and for women the corresponding increase is from 45 to 65 percent. There is a similar development for the age group 55–59, but the changes are much smaller. Finally, the age group 65–69 shows a marked increase in labor force participation in recent years for both men and women, although from a very low initial level of labor force participation.

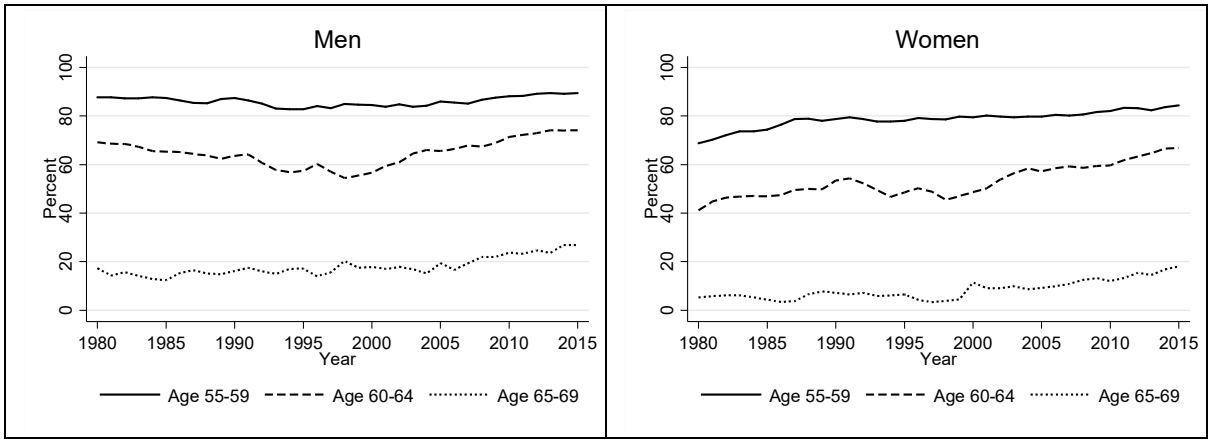


Figure 5. Development of labor force participation (LFP) rates between 1980 and 2015 for the age groups 55–59, 60–64 and 65–69. Males and Females, respectively.
Source: Labor Force Surveys, Statistics Sweden.

Another way to study the change in labor force participation of elderly workers is to look at the expected retirement age. Figure 6 shows the average retirement age for all men and women who retired from the labor force between ages 55 and 68 in the cohorts born between 1935 and 1945. Retirement is defined in the last observed year with earnings above 1 PBA before having labor income below 1 PBA. The results show that the expected retirement age has increased by about 1.5 years for males – from around age 62.0 to age 63.5 – and by about 1.3 year – from around 62.0 to 63.3 – for females across the 11 birth cohorts considered.

Figure 6. Changes in the average retirement age across cohorts born between 1935 and 1943 and retiring between ages 55 and 68, by gender.

To get a better sense of how retirement has changed in different age groups, Figure 7 reveals how the hazard rate of retirement in different ages has changed across the years included in our sample. The left panel shows the estimates for males and the right one for females. The figure shows that the retirement hazard has decreased in all ages between 61 and 64. The change for men is largest in the age group where retirement has been most prevalent, i.e., among 64-year-olds, while the largest change for females has taken place among the 63-yeear-olds.

Figure 7. Changes in the hazard rates for leaving the labor force by age and gender 1985–2012.

Figure 8 breaks down the retirement hazards by educational attainments and shows average retirement hazard 1985–2013 in three groups by educational attainment: compulsory education only (Low), vocational or secondary schooling (Middle), and, finally, college or university education (High). The results for males are shown in the left panel and the ones for females in the right. Figure 8 shows quite different outcomes for males and females. For males, there is a much lower *level* of the retirement hazard for the high-education group throughout the entire period 1985-2013. The decline in retirement hazards seems, however, to be equally shared between all education groups. For females, the differences between the education groups are overall smaller, although the *change* in retirement behavior towards the end of the period seems to be largest in the highly educated group.

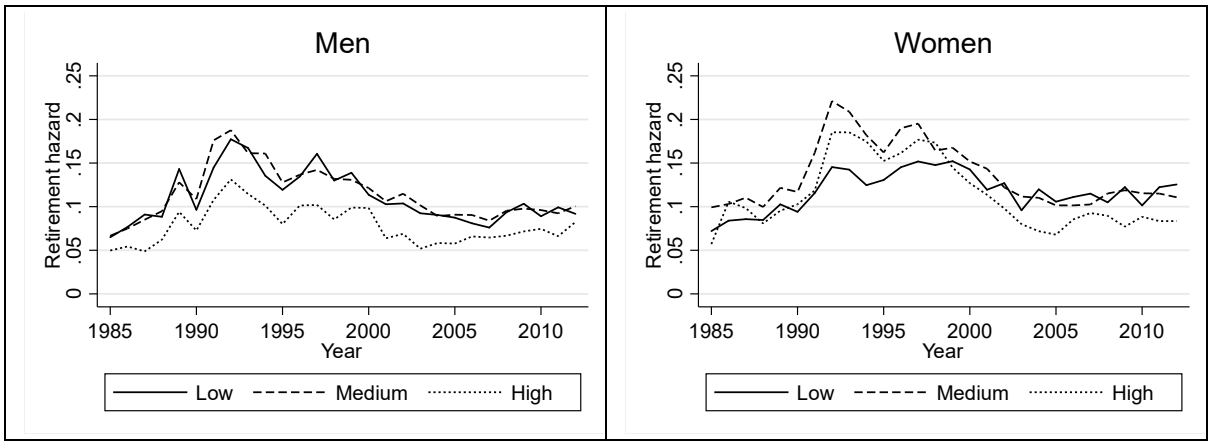


Figure 8. Changes in the average hazard rates for leaving the labor force between age 61 and 64 by educational attainments 1985–2013. Males and females, respectively.

4.2 Pathways to Retirement

The two main pathways to retirement in Sweden is through the old-age pension system or the Disability Insurance (DI) program. Figure 9 shows the share leaving through DI across birth cohorts in

our sample for males and females, respectively.[18] The graphs reveal a dramatic change. For males and females born in 1930, about 40 percent left the labor force through the disability insurance. The corresponding share for males born in 1949 was only about 15 percent and for females 20 percent.

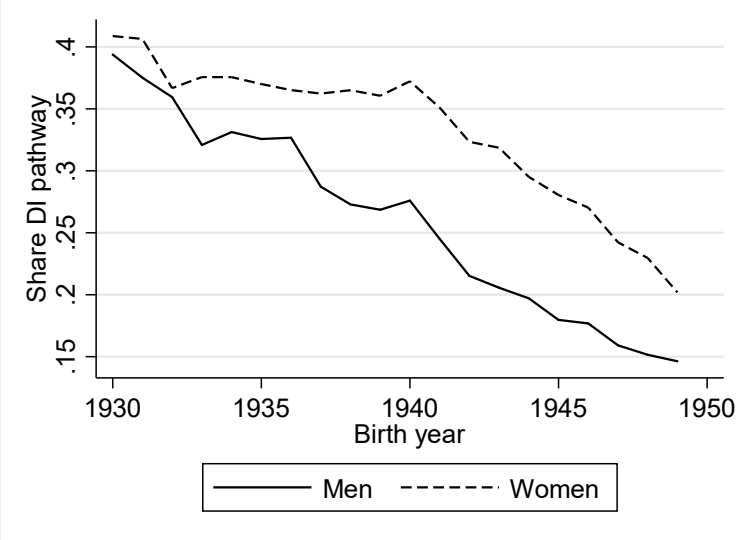


Figure 9. Changes in the probabilities to leave the labor force through the disability pathway across birth cohort by gender.

Figure 10 breaks down the development shown in Figure 9 by the three groups of educational attainments. The probability of retiring through the DI program is markedly higher among low educated. For males, Figure 10 shows that the largest decrease in the share retiring through DI can be attributed to the low educated. This is not the case for females where the development has been largely parallel in all three education groups.

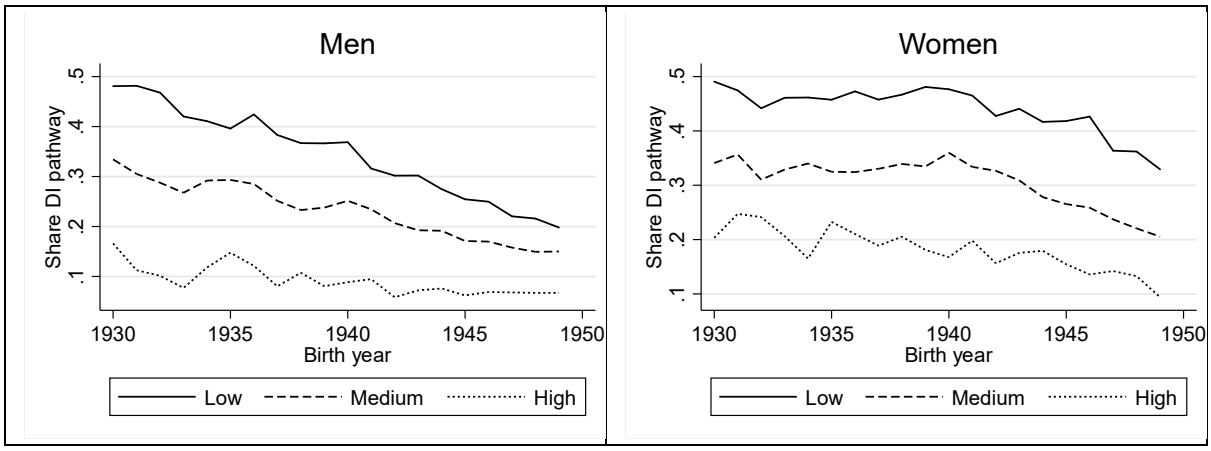


Figure 10. Changes in the probabilities to leave the labor force through the disability pathway across birth cohort by gender.

4.3 Retirement and Claiming of Benefits

[18] Each year between retirement and age 65, we record the largest income source of old-age pension or disability benefits. Pathway is defined by the largest income source an individual has for most of those years. Individuals leaving the labor force at age 65 or older are assigned the old-age pension pathway, since DI eligibility ceases at age 65.

As we explained in Section 2, an important difference between the pre- and the post-reform old-age pension system is the construction of the actuarial adjustment. In the pre-reform system, the adjustment was linked to when the worker started to claim benefits from the system and independent of when the worker stopped contributing to the system through employers' contributions. In the post-reform system it is determined *both* by the data at which the worker stops contributing to the system, i.e. stops working, which affects the balance of the individual account, as well as when he or she starts to claim benefits, which affects the size of the benefits both through the annuity divisor and through the indexing of the account balance. This means that it may be a stronger economic incentive for the worker to delay the date of pension claiming after the exit from the labor force in the pre-reform system. If people act on these stronger incentives, it may have created a larger gap between the date of retirement and the date they started to claim benefits in the pre-reform system.

To investigate to what extent this is the case, Figure 11 compares the share retired in the 1935 and 1944 cohorts, the share collecting public pension and, finally, the share collecting public and/or occupational pension benefits at different ages. Since those born in 1938 were the first to be included in the post-reform old-age pension system, the 1935 cohort was completely in the pre-reform system, while the 1944 cohort is in the pre- and post-reform systems by equal shares.

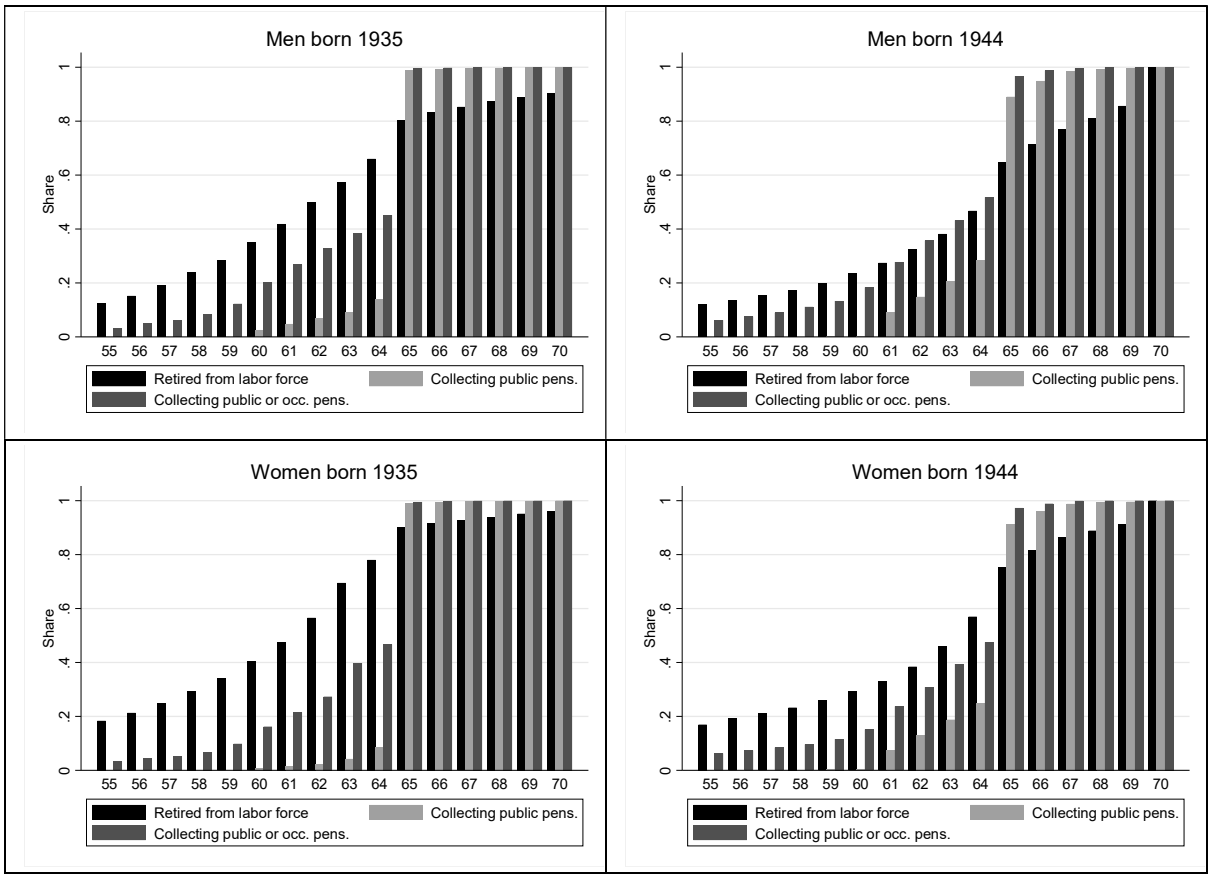
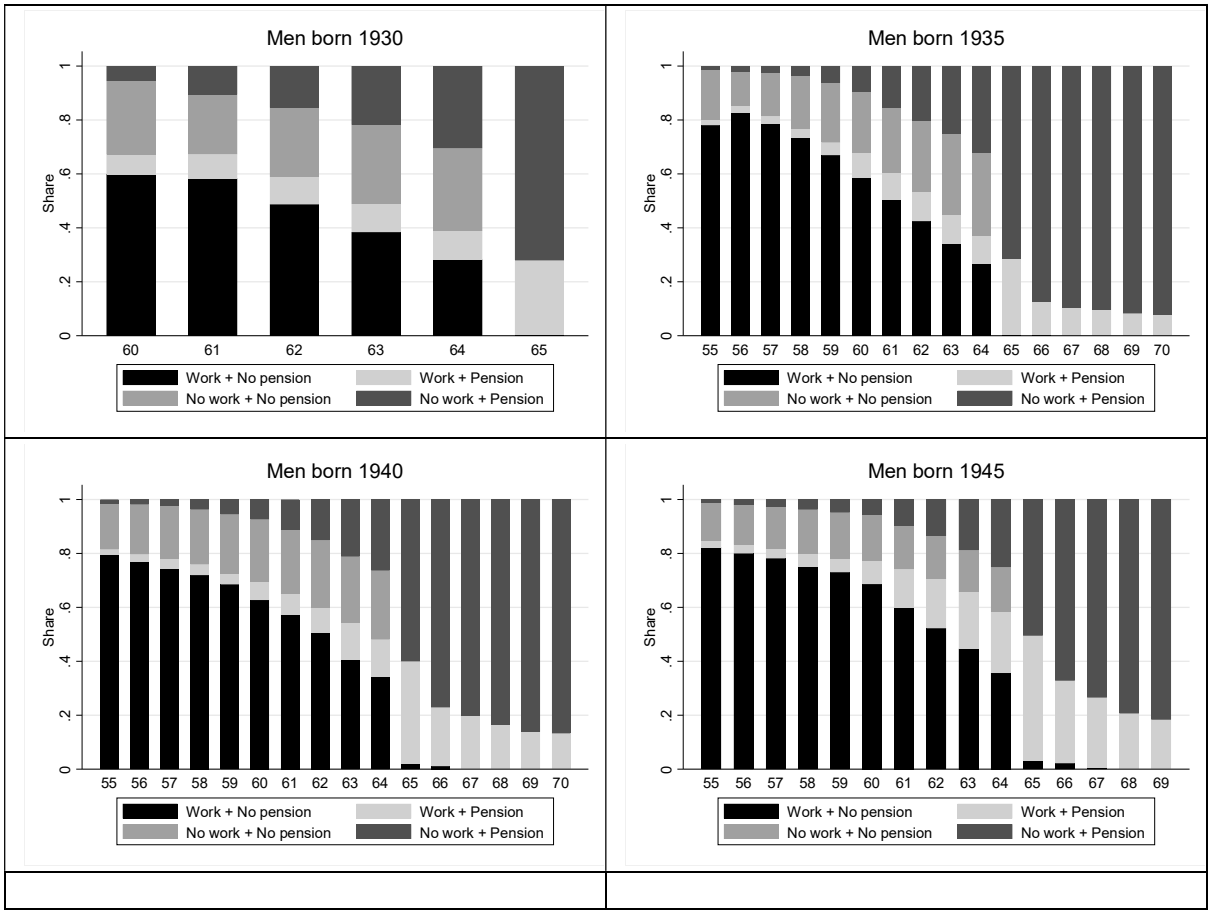


Figure 11. Changes share retired, share collecting public old-age pension benefits and shares collecting public old-age pension or occupational pension benefits at different ages by year of birth (1935 or 1944) and gender.

Figure 11 displays several interesting differences between the two birth cohorts. By comparing the bars for retirement and pension claiming, it is apparent that a much larger share retired without claiming old-age pension benefits in the 1935 cohort than in the 1944 one. A very small share, only around 10 percent, claimed benefits from the public old-age pension system in the 1935 cohort before

age 65. On the other hand, almost all started to claim their benefits at age 65. In the 1944 cohort the age of benefit claiming is much more spread out across the ages.

Figure 12 extends the analysis in Figure 11 by showing how the four possible permutations of employment and pension claiming by age have changed across the cohorts born in 1930, 1935, 1940 and 1945 for males and females, respectively. By comparing the 1935 and 1945 cohorts, it is apparent that the share of workers that remain in the labor force has increased markedly. Comparing the situation at age 64 we see that only about 25 percent of the males in the 1940 cohort work, while the corresponding number is 50 percent in the 1945 cohort. At the same time, the share who receive old-age pension before age 65 has increased. Thus, if one would have used the date when people start to receive their pension benefits as date of retirement one would have gotten a less dramatic picture of changes in retirement behavior.



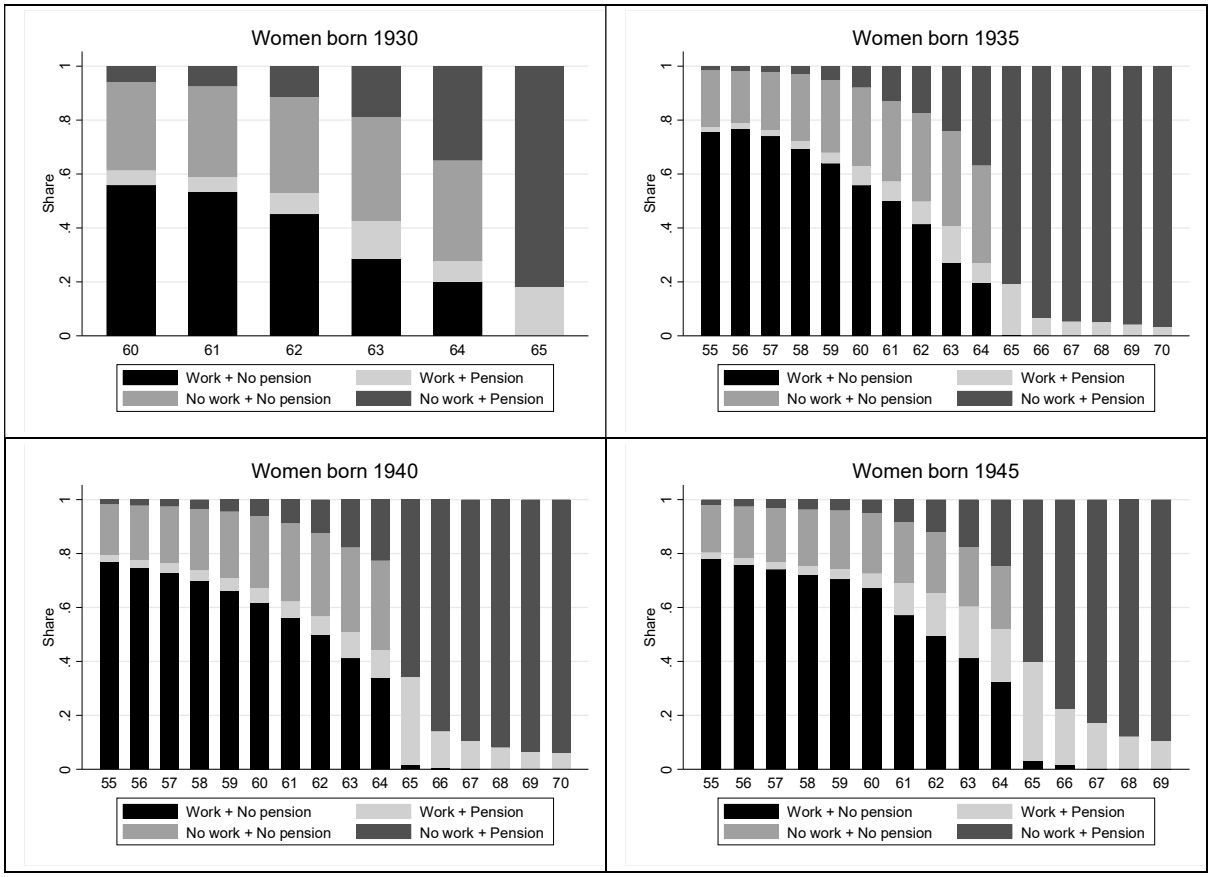


Figure 12. Changes in the four possible permutations of employment and pension claiming by age across the cohorts born in 1930, 1935, 1940 and 1945 by gender.

Finally, Figure 13 combines our analysis of the changes in retirement behavior in Section 4.1 with that of changes in how the workers leave the labor force and summarizes our key findings so far: the delayed retirement, the change in the pathways of labor force exit and the closing of the average gap between retirement and claiming of benefits from the public old-age pension system. It shows the hazards for labor force exit at different ages for those born in 1935 and 1945, respectively. Again, the bars in the diagrams highlight the delayed retirement that have occurred between the two birth cohorts. It also shows that the composition of the income sources after retirement has changed markedly. Much fewer retire through the DI program in the 1945 cohort, but also much fewer who started to claim their occupational pension before age 65.

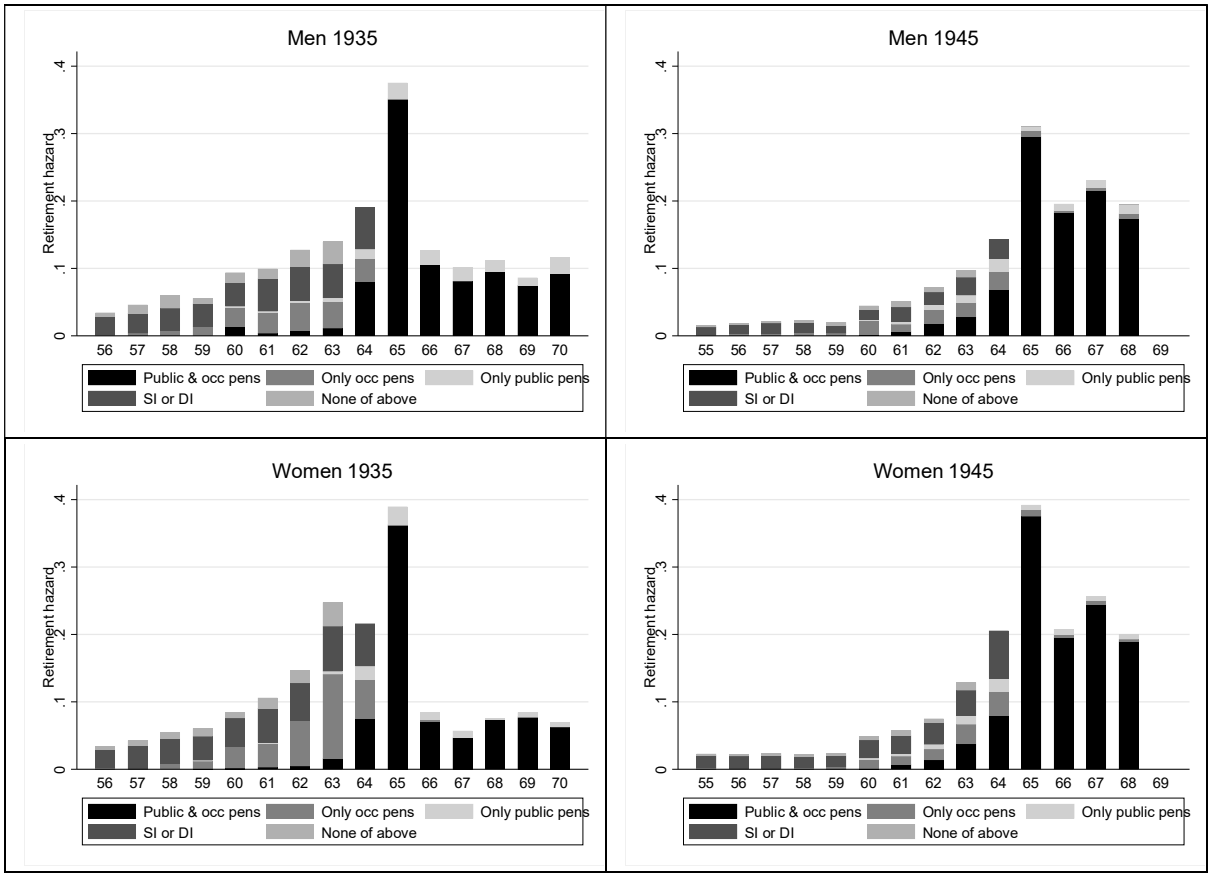


Figure 13. Retirement hazard by type of route for labor force exit.

4.4 Joint Spousal Retirement

Previous research has shown that spouses tend to coordinate their timing of exit from the labor force (see e.g. Schirle, 2008). In particular, Gustman and Steimeier (2000) finds that married men are more likely to retire if their wives are also retired, but that married women's retirement decision do not seem to depend on the labor market status of their husband. Blau (1998) finds that the joint retirement results can be referred to higher valuation of leisure time rather than economic incentives.

Figure 14 provides a preliminary check for the prevalence of joint retirement behavior in our data. The figure shows the distribution of differences in year of retirement between spouses for married males and females born in 1940, respectively. Two features of the distributions are apparent. First, that there is a "spike" for couples retiring in the same year. Second, that the male distribution is skewed to the left and the female distribution is skewed to the right. Since husbands are on average somewhat older their wives, both these features support that there is evidence of joint retirement in our data.

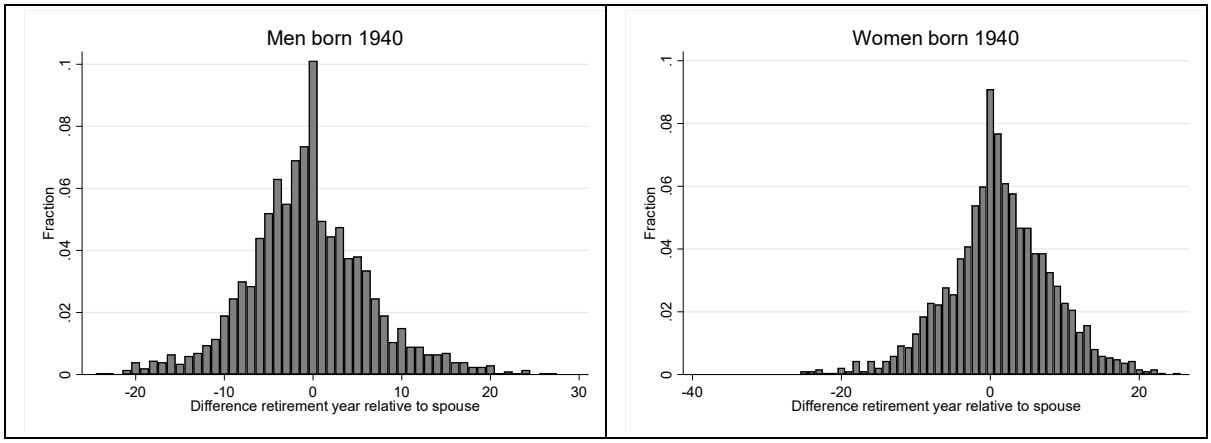


Figure 14. The distribution of the difference in date of retirement of spouses.

5. Modelling Retirement Behavior

5.1 Measuring Economic Incentives

The individual social security wealth at a particular time *t* is defined as the net present value of all future social security benefits. It will depend on individual *i*'s retirement age *R* and which pathway *k* of the income security system that the individual chooses to exit from the labor market, i.e.,

$$SSW_{k,t}(R,i) = \sum_{t=R}^{T} B_{k,t,a}\,(R,i)\sigma_{t,a}\beta^{a-R}, \qquad (3)$$

where *t* is an index for time and *a* for age; $B_{k,t,a}$ is the retirement benefit from source *k,* at time *t,* at age *a*, which is partly determined by the retirement age *R*; $\sigma_{t,a}$ is the survival probability in time *t* at age *a*; and finally, β is the discount factor.

Postponing retirement has two counteracting effects on the social security wealth. Delaying retirement increases the benefit levels, through the actuarial adjustment and other rules for how the size of the benefits is determined in the pension system. However, the individual will also receive fewer benefit payments, which will decrease the social security wealth. The net value of these effects is measured in the benefit accrual measure:

$$ACC_{k,t}(R,i) = (SSW_{k,t+1} - SSW_{k,t},)/\,SSW_{k,t}, \qquad (4)$$

for a particular exit path, *k,* out from the labor force. This measure could also be constructed as a weighted average for all exit routes combined, i.e.,

$$ACC_t(R,i) = \sum_{k=1}^{K} p_{k,i} ACC_{t,k}(R,i), \qquad (5)$$

where $p_{k,i}$ is the individual specific probability to exit the labor market through path *k.*

From this measure we can obtain the following expression for the *implicit tax rate* on remaining at the labor market:

$$ITAX_t(R,i) = -(ACC_t(R,i) - W_{t+1}(i)PT_{t+1})/\big(W_{t+1}(i)(1 - TAX_t(i))\big). \qquad (6)$$

This implies that the tax on continued work is calculated as the gain in social security wealth for working one additional year minus what the individual would have contributed to the pension system through the payroll tax on labor earnings ($W_{t+1}(i)PT_{t+1}$) as a share of net labor earnings during that additional year $\big(W_{t+1}(i)(1 - TAX_t(i))\big)$. The reversed sign is due to the fact that a tax by definition is a reduction in wealth, meaning that a negative change in wealth is a positive tax. All contributions

to the pension system through the payroll tax made before the hypothetical last year are regarded as sunk costs to the individual.

A negative tax rate tells us that the income security system works as a subsidy for continued work given the assumed discount rate. This implies that it is rational for the individual to remain in the labor force if he or she values work and leisure time equally. If the tax rate is positive, the individual will remain in the labor force if he or she values the future consumption of goods implied by the increase in social security wealth higher than his or her valuation of leisure.

5.2 Empirical Specification

We use the following reduced form specification:

$$R_{it} = \delta_0 + \delta_1 ITAX_{it} + \delta_2 SSW_{it} + \delta_3 AGE_{it} + \delta_5 X_{it} + \varepsilon_{it}, \qquad (7)$$

where *i* is an index for individual and *t* for year. The dependent variable, *R*, is an indicator variable taking the value 1 for leaving the labor force in year *t* – i.e., year *t* is the last year for which we observe individual *i* to be in the labor force – and 0 otherwise, *ITAX* measures the implicit tax for staying one additional year in the labor force, *SSW* is social security wealth, *AGE* is age, *X* are observable exogenous individual characteristics that affect the retirement decision and, finally, ε is a stochastic component representing individual unobserved characteristics affecting the retirement decision.

The motivation for including controls for the individuals' age is that there are several unobservables – such as unobserved aspects of health, institutions and conventions, or norms – at the labor market that are related to age as well as retirement behavior. If no controls for such factors are included in the specification, we would run the risk of getting a spurious correlation between the incentive measures and retirement.

We use two alternative specifications for the age controls. First, a quadratic function in age. The obvious disadvantage with this specification is that it is unlikely that the complex relation between age and labor force exit can be approximated by a simple, quadratic function. This means that the unmeasured relation between age and retirement, unrelated to economic incentives, may be spuriously correlated to the incentive measures. Second, a set of dummy variables for each year in the individuals' age of living. The obvious disadvantage with this approach is over-fitting, i.e., that the dummy-variable specification is correlated with unmeasured aspects of economic incentives, which, in turn, would lead to that the effect of economic incentive on retirement behavior would be underestimated.

In the first specification we do not include any additional confounders in the model. However, in the two additional ones, we have alternative specifications of the *X* vector in equation (7). In the first one, we include variables for life-time earnings. In the second one, we also include a full set of dummy variables for year of birth. These variables control for unobservable changes across cohorts that affect retirement behavior. There are many candidates for such variables: changes in health and conditions on the labor market, including work environments, are probably the most important ones.

In the first specification, including no additional controls, the identification of the effect of economic incentives comes through three main sources. First, through differences that has to do with individual levels of contributions to the pension schemes, or income security programs. Second, although workers may have similar levels of contributions, their benefit levels, and their economic incentives to retire, may differ as a result of how contributions are transformed into benefits. Third, variations across cohorts that are attributed to institutional changes. The most important of these changes during the period under study in this paper is of course the big reform of Sweden's public old-age pension program.

In the second specification, we try to control for differences related to over-all economic resources and restrict the identifying variation in data attributed to the second and third sources of variation listed above, i.e., how variations in how contributions are transformed into benefits and institutional changes across cohorts. Finally, in the third specification, we restrict the identification to within-cohort variation. This means that the identification is restricted to the second source listed above.

Another specification problem is related to the fact that we have no information on to what extent the individuals in the sample have access to the disability insurance, or other income security programs. As shown in Section 4, a large share of the population under study retires through the DI path. This program gives, on average, more generous benefit levels and, as a consequence, different economic incentives to leave the labor force. However, if we assign economic incentives that the individual does not have access to, and could not act on, we will underestimate the effects of economic incentives on retirement. Conversely, if we assign more generous economic incentives to those who retire through the DI path only, we will induce an endogeneity problem and over-estimate the effects of economic incentives.

We address the problem of different access to the DI path in two different ways. First, we restrict the analysis to those retiring through the old-age pension path. This means that we include all who retire through the DI path only until the year before they exit the labor market. We treat the observation as right censored starting at the year of labor force exit. Second, we calculate separate incentive measures for the DI and the old-age pension paths, respectively. In the next step, we calculate a common measure, defined as the sum of old age pension and the DI measures using year-specific weights for each of the two paths. The DI weights are given by the share of 60-64-year-olds receiving disability benefits in the specific year. Figure 15 shows these probabilities between 1991 and 2012.

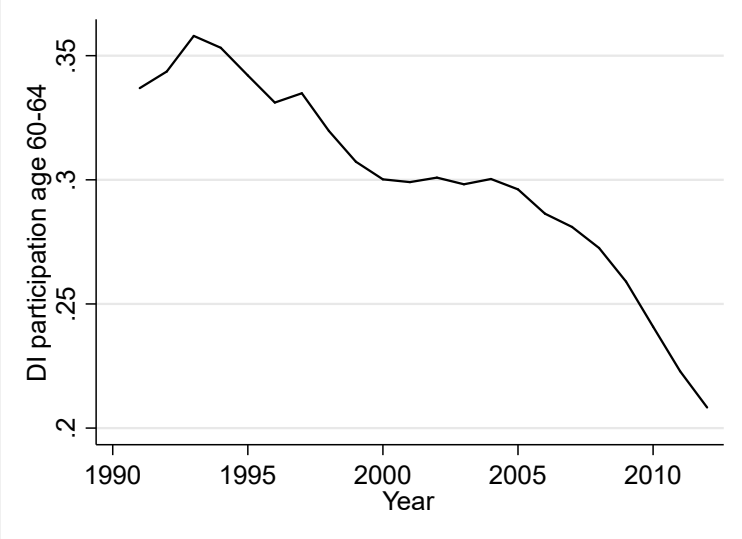


Figure 15. Share of workers aged 60–64 who receive disability benefits in Sweden between 1991 and 2012.
Source: Swedish Social Insurance Agency.

The identification of the reduced form retirement model (7) comes partly from individual differences in pensions and other income security benefits resulting from individual differences in earnings paths. However, it also comes from assignment to different pension programs. In particular, the large reform of Sweden's old-age pension program that was implemented gradually starting with the cohort born in 1938. This reform will identify differences in economic incentives across all cohorts included in the empirical analysis.

6. Results

This section consists of two sub-sections. In Sub-section 6.1, we describe how the different incentive measures have evolved over time through the different policy changes described in Section 2. In Sub-section 6.2, we present the estimates on the effect of the economic incentives on retirement behavior from the econometric models.

Following the discussion on different assumption on availability of different income security benefits, as well as assumptions regarding different strategies for timing of retirement and claiming of old-age pension benefits, we consider four different cases: (i) a weighted average of the old-age and the DI pathways based on the share aged 60–64 participating in the DI program; (ii) we restrict the sample to those who use the old-age pension path only, with no assumptions regarding on when they start to claim their old-age pension benefit; (iii) we restrict the sample to those who use the old-age pension path and, in addition, retire the same year as they start to claim their pension benefits; (iv) we, again, restrict the sample to those who retire through the old-age pension path, but we assume that they start to claim their benefits at age 65.

6.1 The Effect of the Pension Reform on Incentives to Remain in the Labor Force and on Retirement Behavior

To assess to what extent the policy reforms described in Section 2 are transformed into changes in incentives to retire, we start off this section by showing how the predicted incentives to retire have changed across the cohorts born between 1938 and 1949. This exercise will show what changes we would expect in the retirement behavior from the changes in economic incentives that have taken place across these cohorts. The most important reform of Sweden's income security programs in recent years – affecting the birth cohorts under study – is the 1998 reform of Sweden's old-age pension system. A main objective of the reform was to change the economic incentives to retire. For these cohorts, we have records of both the pension points and the pension qualifying income, allowing us to calculate the potential benefits from both the pre-reform system, the post-reform system and the actual system they face according to the transition rules for each cohort.

As we described in Section 2, pension systems and other income security programs can change two aspects of the economic incentives to remain in the labor force. First, through the *level* of the social security wealth that will be transformed into a certain replacement level when the worker is retired, i.e., an income effect. Second, the wealth *change* from staying additional time at the labor market, i.e., the price of the additional leisure time that an earlier retirement would imply. The pension reform is likely to have changed both these incentive components.

To highlight how the reform have changed the incentives we first calculate the incentives under three different policy regimes:

1. The pure pre-reform system.
2. The actual system, i.e., taking the staggered implementation of the post-reform system across cohorts into account.
3. The pure post-reform system.

Note that regimes 1 and 3 are hypothetical, while regime 2 corresponds to the regime that the workers actually face.

As described in Section 2, the actuarial adjustment in the pre-reform system was primarily linked to when the individual started to claim his or her benefits, while in the post-reform system it also

depends on when the person stops working and thereby contributing to the system. This implies that the difference in the incentives between the two systems is potentially dependent on the relation between the date of retirement and the date when the individual starts to claim his or her benefits. We therefore present results from two different cases. In the first one, we assume that the individual starts to claim pension benefits at age 63, the same year as he or she assumes to retire, while in the second case, the individual retires at age 63 and starts to receive benefits at age 65.

Figure 16 starts with the first case: when the worker is assumed to start to claim benefits as soon as he or she retires. The figure shows how the three different measures of economic incentives – the replacement rate, the social security wealth, the benefit accrual rate and the implicit tax rate on staying in the labor force through the pension system – at age 63 changed for the cohorts included in our empirical analysis. The upper two panels in Figure 16 measures the overall generosity of the income security program, related to the *income effect* in the incentives to stay in the labor force described above, and the lower ones how the benefit levels change by staying an additional year in employment, related to the *price effect* of retiring. The social security wealth is measured in *PBA*s, which, for the period under study, followed the CPI very closely.

The development in Figure 16 reveals several interesting features. First, it is apparent that the pre-reform system would have been more generous for all the cohorts included in the study. The graphs for the replacement levels and the social security wealth measure for the pre-reform system are everywhere above the ones for the post-reform system and the actual one. The rapidly increasing SSW measure for the pre-reform system also reflects the financial instability of this system, which was the main motivation for the 1998 pension reform. Second, there is a period effect, starting at the cohort born in 1946 reflecting the economic downturn following the financial crisis in 2009. The fact that only the slopes of the actual and the post-reform systems are affected reflects the differences in the indexing of the pre- and post-reform systems.

The lower panels of Figure 16 show two measures of how the price induced by the public old-age pension system of the extra leisure time of retiring at age 63 has changed across cohorts. The most striking result shown in these panels is that the benefit accrual rate is much lower in the post-reform system than in the pre-reform one. Taken together, the graphs for the actual policy regime shows that the accrual rate did not change much until the cohort born in 1945, after which it decreases marginally and, as a consequence, the implicit tax rate also increased.

The graphs for the ITAX measure, shown in the lower right panel of Figure 16, show that the tax rate is negative, implying an implicit subsidy of staying in the labor force, for all three policy regimes considered and all birth included in the graph. As noted above for the benefit accrual rate, it is apparent that the pre-reform system, primarily through the 0.5 percent life-long benefit reduction for each month of early withdrawal, implied a stronger subsidy to stay in the labor force compared to the post-reform system.

To sum up, under the assumption that the individual starts to claim benefits in the same year as he or she retires, the major reform of the public old-age pension scheme decided in 1998 seems to have had counteracting effects on the workers' incentives to stay in the labor force. On the one hand, the benefit levels were markedly reduced by the reform, which created an income effect towards later retirement. On the other hand, the tax on continued employment was increased in the new system. However, taken together, as a result of the stepwise implementation, our calculations reveal that the latter effect was very small before the 1945 birth cohort in the system facing the workers in our data.

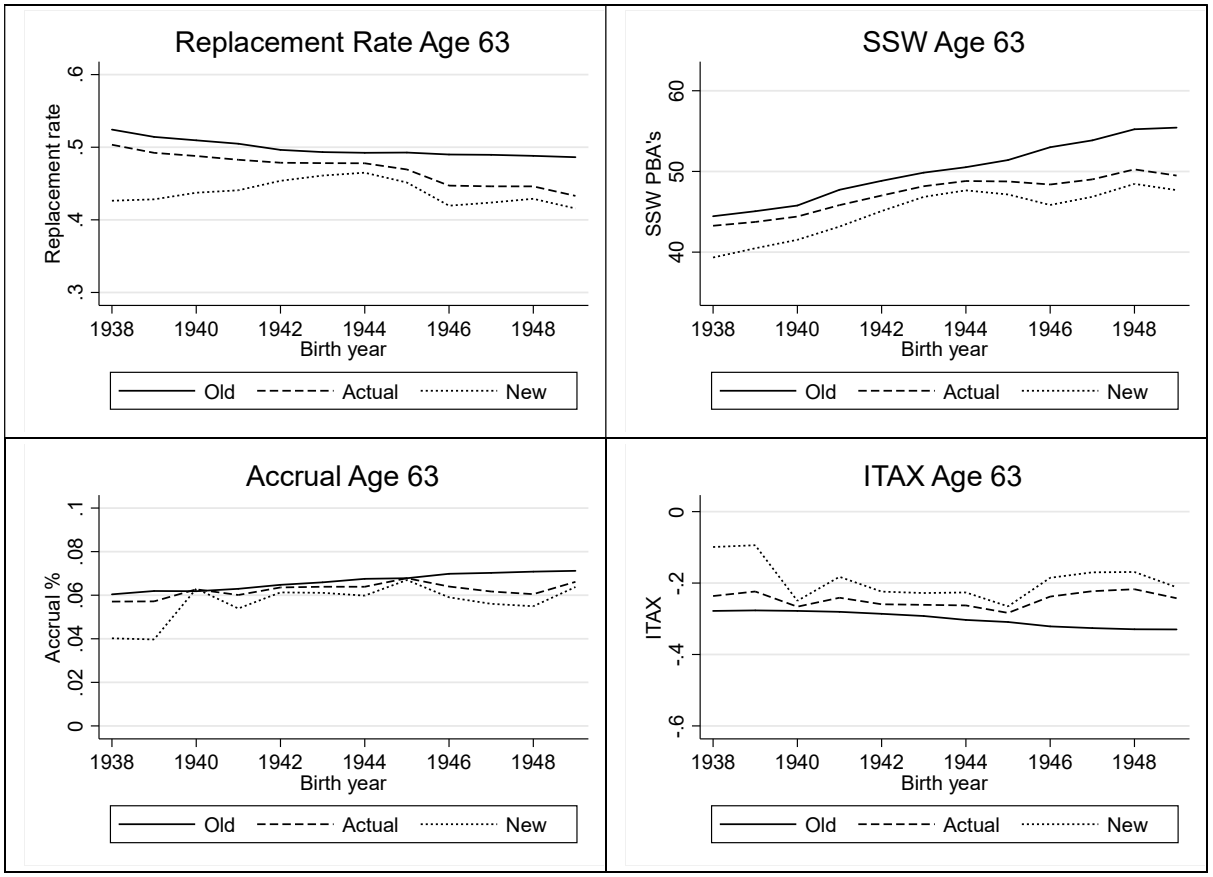


Figure 16. Changes in four measures of economic incentives to retire across birth cohorts. Calculations restricted to the public old-age pension system only.

Figure 17 shows the incentive measures at age 63 under the assumption that the individual starts to claim benefits at age 65. Comparing these results with those in Figure 16, it is evident that the results on the replacement levels and social security wealth are very similar. However, the results on benefit accrual and the implicit tax rate are very different. In the results shown in Figure 17, the rates of benefit accrual are much higher and the tax rates much lower in the new system, just as we expected from the discussion in Section 2.

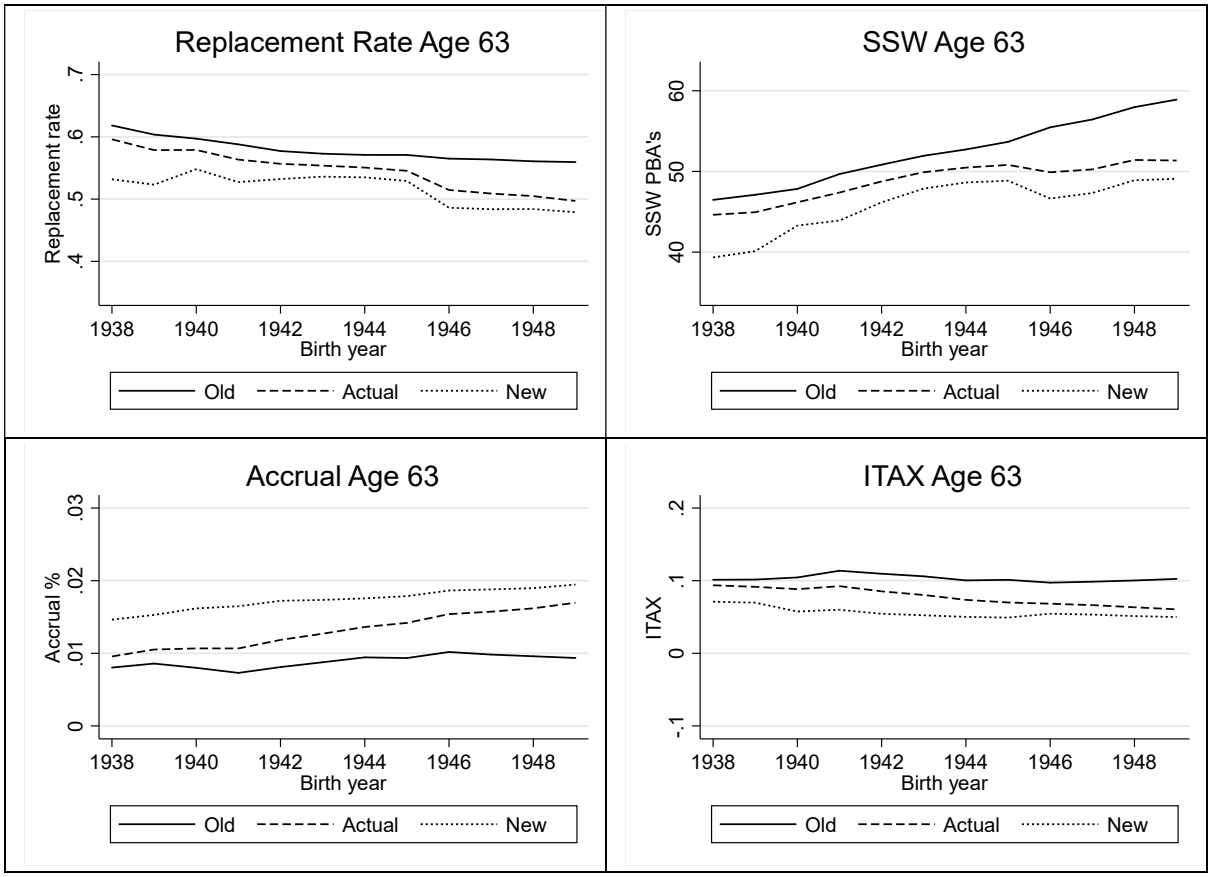


Figure 17. Changes in four measures of economic incentives to retire across birth cohorts under the assumption that the individual retires at age 63 and starts to claim old-age pension benefits at age 65. Calculations restricted to the public old-age pension system only.

As we described in Section 4, only a minority of those who retired between age 61 and 64, which is the window we study in our econometric analysis, retired through the old-age pension pathway. The majority used one or more insurance programs from Sweden's income security system. In Figure 17 we present the incentive measures resulting from a weighted average between the actual incentives from the public old-age pension system (presented in Figure 16) and the incentives calculated from the Swedish DI program for the cohorts born between 1926 and 1949. The weights used for the probability of being eligible for DI correspond to the share 60-64 year olds receiving DI in the specific year. The figure also shows the development of the four economic incentive measures for the old-age pension and the DI systems, respectively.

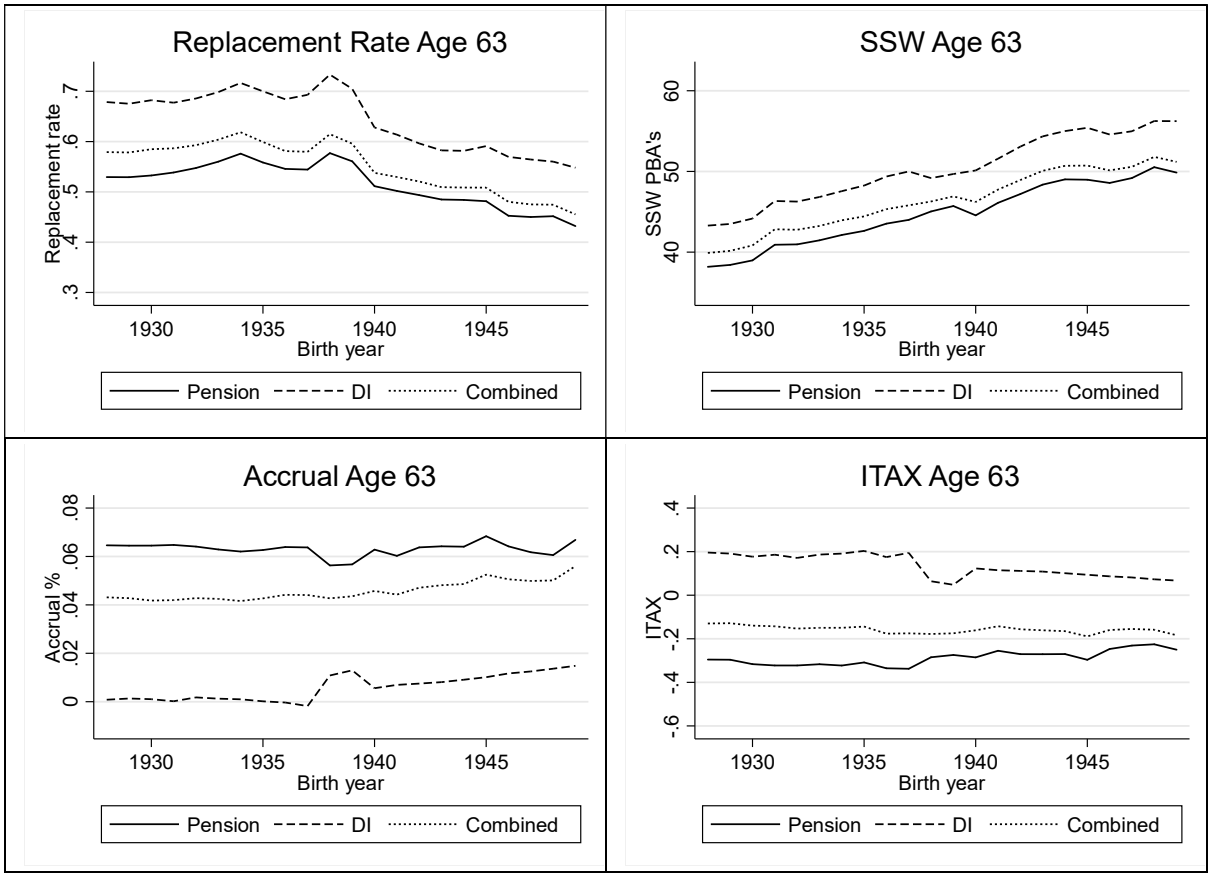


Figure 18. Changes in four measures of economic incentives to retire across birth cohorts. Calculations of the weighted average between the old-age pension and the DI path out of the labor force.

As expected, the upper panels of Figure 18 show that the DI system is more generous than the old-age pension one. The downward trend for the replacement rate and the upward one for the social security wealth can be attributed to economic growth across cohorts. The lower panels in Figure 18 show, again as expected, that the economic penalty on continued work from the DI system is larger than from the public old-age pension system. The panels also show that the penalties have decreased somewhat. This change can be attributed to the lower replacement rates in the DI program described in Section 2.

6.2. Econometric Estimates

As highlighted in the previous sub-section, measurement of the changes in the economic incentives to stay in the labor force induced by the income security programs depend critically on a number of choices for how we as researchers believe the workers perceive the economic incentives that they are facing. The most critical ones are the assumptions on whether or not the disability insurance pathway out of the labor force is an available option and to what extent the workers are able to separate the date they start to claim benefits from the old-age pension program from the date of retirement. Our strategy to account for this uncertainty is to be agnostic about the preferred specification and present results under different assumptions for how the incentives are perceived.

Table 2 shows the main results. This table consists of four panels labeled A through D. Panel A shows the results when we include both pathways out from the labor force. As described in Section 5.2, the incentive measures obtained are in this case calculated as weighted averages using the weights corresponding the observed DI participation rates in ages 60–64. In Panel B we consider the old-age

pension path only. For these estimates, we use the incentive measures calculated on the old-age pension scheme only. Individuals who leave the labor force through the DI pathway are censored at the year of exit from the labor force. In Panel C we restrict the sample, in addition to the restrictions made in Panel B, to those who start to claim their old-age pension to less than one year after their exit from the labor force. Finally, in Panel D, we again use the restrictions imposed for the specification corresponding to the results in Panel B, but now we calculate the incentives under the assumption that the individual starts to claim his or her old-age pension benefits at age 65.

Each of the six columns in Table 2 show the results from slightly different specifications. In Columns 1, 3 and 5 we use a quadratic control in age and in Columns 2, 4 and 6 a full set of age dummies. The first two columns report the results from specifications where we have not included any controls for observable characteristics other than for gender and age. In the specifications we show in columns 3 and 4 we also include controls for observable characteristics (average earnings from the five years preceding retirement, indicators for education level, marital status and indicators for county of living). Finally, in Columns 5 and 6 we also include a full set of dummy variables for each year of observation.

As we described in Section 5, the motivation for including controls for age is that several unobserved variables are likely to be correlated with both the probability leaving the labor force and individual age – such as health, age-related retirement rules as well as conventions and informal rules for the appropriate age to retire. A quadratic specification in age is likely to be a misspecification, while a full set of age-dummies are likely to result in over-fitting, since some unobserved features of the economic incentives are likely to be correlated with the age-dummies. By showing results from both specifications, we get an upper and lower bound for the true effect of the variables measuring economic incentives. Our motivation for including the year-dummies, as we do in the specifications shown in Columns 5 and 6, is to control for changes over time, such as, e.g., health improvements of business cycle effects on retirement.

As we also described in Section 5, to the extent that leisure is a normal good and that workers react on prices of leisure by the end of their work careers, we expect the sign for the coefficients on both SSW and the ITAX measures to be positive. However, as is apparent from the estimates shown in Table 2, the coefficient estimates for the SSW parameter are significantly below zero in all specifications. This result has repeatedly appeared in similar studies on Swedish data (see, e.g., Palme and Svensson, 2004, or Laun, Johansson and Palme, 2016). A likely background to this result is that we have not sufficiently controlled for preference heterogeneity, in particular preferences for work that may be positively correlated with SSW.

The estimates for the ITAX measure have the unexpected negative sign in Panels A through C, although not significantly different from zero in Panels B and C. Only in the specifications where we the retirees start to claim their old-age pension benefits at age 65 have the expected positive sign on the ITAX measure. One can view the sign of the coefficient estimates as a form of mis-specification test of our econometric model. It is, however, important to stress that such test necessarily implies that the alternative hypothesis is a joint one, since the unexpected signs on the ITAX variable may have other causes than the different principles for how it is calculated.

One interpretation of the unexpected signs on the ITAX coefficient in all specifications except the ones corresponding to the results shown in Panel D is, nevertheless, that the insured individual's perception of the economic incentives generated by the old-age pension system concur most closely with the specification shown in Panel D, i.e., that they view the incentives in the pension system as conditional on that they claim their benefits at age 65 independently of age at retirement. The results in Panel D

of Table 2 also shows that the coefficient estimates are quite stable in the different specifications. The ITAX measure has a positive sign in all specifications.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: All pathways weighted by probabilities						
SSW	–0.0032***	–0.0032***	–0.0020***	–0.0020***	–0.0004***	–0.0004***
	(5.43e-05)	(5.43e-05)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
ITAX	–0.0720***	–0.0721***	–0.0312***	–0.0313***	–0.0250***	–0.0251***
	(0.0038)	(0.0038)	(0.0044)	(0.0044)	(0.0044)	(0.0044)
Obs	439,762	439,762	439,761	439,761	439,761	439,761
Panel B: Old-age pension path only						
SSW	–0.0017***	–0.0017***	–0.0021***	–0.0021***	–0.0011***	–0.0011***
	(5.12e-05)	(5.12e-05)	(7.81e-05)	(7.81e-05)	(8.32e-05)	(8.32e-05)
ITAX	–0.0003	–0.0003	–0.0003	–0.0003	–0.0002	–0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Obs	422,986	422,986	422,986	422,986	422,986	422,986
Panel C: Sample restricted to those who claim benefits less than one year after retirement						
SSW	–0.0006***	–0.0006***	–0.0006***	–0.0006***	–0.0010***	–0.0010***
	(3.45e-05)	(3.45e-05)	(5.26e-05)	(5.26e-05)	(5.60e-05)	(5.60e-05)
ITAX	–3.63e-05	–3.76e-05	–5.33e-05	–5.45e-05	–5.30e-05	–5.43e-05
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Obs	398,498	398,498	398,498	398,498	398,498	398,498
Panel D: Claiming of benefits fixed at age 65						
SSW	–0.0004***	–0.0004***	–0.0002**	–0.0002**	–0.0002**	–0.0002**
	(5.49e-05)	(5.49e-05)	(9.68e-05)	(9.68e-05)	(9.81e-05)	(9.81e-05)
ITAX	0.0990***	0.0990***	0.0981***	0.0981***	0.129***	0.129***
	(0.0111)	(0.0111)	(0.0115)	(0.0115)	(0.0119)	(0.0119)
Obs	291,615	291,615	291,615	291,615	291,615	291,615
Quadratic age	X	-	X	-	X	-
Age dummies	-	X	-	X	-	X
Other Xs	-	-	X	X	X	X
Year dummies	-	-	-	-	X	X

Table 2. Main results from the econometric model. Panel A: all exit paths included. Panels B–D: only exits using the public old-age pension system considered.

Table 3 shows the heterogeneity in the estimates of the policy parameters between groups defined by gender and educational attainments. We have chosen to restrict the presentation to the specification shown in column 4 in Table 2. This specification includes year dummies and controls for observable characteristics. However, it turned out that the between group heterogeneity was very similar across specifications, making our choice of specification arbitrary. The first column in Table 3 shows the results for the entire sample for sake of comparison; the second and third columns the result by gender; finally, the last three columns the results for three education groups, respectively. The first group is restricted to those with compulsory education only; the second one to those with vocational or secondary education; and the third groups to university or college graduates.

Confining ourselves to look at the results from our preferred specification in Panel D, it is evident that the heterogeneity analysis shows that females and low educated respond more strongly to the ITAX measure. It is also apparent from the results that low educated seem to react more strongly on economic incentives, through the ITAX measure, than high educated. A possible explanation to the latter result is that the low and medium education groups are more dependent on the public old-age

pension system, which we have included in our incentive calculations, while the high educated are more dependent on the negotiated plans, which we have excluded.

	(1)	(2)	(3)	(4)	(5)	(6)
					Education	
	All	Men	Women	Low	Medium	High
Panel A: All pathways weighted by probabilities						
SSW	–0.0004***	–0.0006***	0.0004**	–0.0002	–0.0002	–0.0009***
	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0002)
ITAX	–0.0251***	–0.0361***	0.0011	–0.0164**	–0.0133**	–0.0975***
	(0.0044)	(0.0065)	(0.0065)	(0.0074)	(0.0063)	(0.0123)
Observations	439,761	231,079	208,682	128,636	234,578	76,547
Panel B: Old-age pension path only						
SSW	–0.0011***	–0.0003***	–0.0011***	–0.0010***	–0.0010***	–0.0011***
	(8.32e-05)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0002)
ITAX	–0.0002	–0.0002	0.0150***	0.0081***	–0.0001	–0.0006
	(0.0002)	(0.0002)	(0.0024)	(0.0027)	(0.0002)	(0.0007)
Observations	422,986	223,673	199,313	120,959	226,502	75,525
Panel C: Sample restricted to those who claim benefits less than one year after retirement						
SSW	–0.0010***	–0.0006***	–0.0013***	–0.0010***	–0.0010***	–0.0007***
	(5.60e-05)	(7.43e-05)	(0.0001)	(0.000142)	(8.26e-05)	(0.0001)
ITAX	–5.43e-05	–0.0001	0.0065***	0.0057***	–8.31e-05	–5.99e-05
	(0.0001)	(0.0001)	(0.0015)	(0.0019)	(0.0001)	(0.0004)
Observations	398,498	212,765	185,733	114,027	212,515	71,956
Panel D: Claiming of benefits fixed at age 65						
SSW	–0.0002**	0.0002	–0.0003**	–0.0002	2.60e-05	–0.0006***
	(9.81e-05)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
ITAX	0.129***	0.0874***	0.169***	0.162***	0.154***	0.0399*
	(0.0119)	(0.0151)	(0.0201)	(0.0257)	(0.0167)	(0.0223)
Observations	291,615	152,900	138,715	68,539	166,421	56,655
Quadratic age	-	-	-	-	-	-
Age dummies	X	X	X	X	X	X
Other Xs	X	X	X	X	X	X
Year dummies	X	X	X	X	X	X

Table 3. Coefficient estimates for the SSW and ITAX measures by gender and group of education level.

6.3 Simulation Results

To get a better sense for the implications of our results on the magnitudes for the effects of the 1998 reform of the public pension system on retirement behaviour, we predict the contra-factual outcomes on retirement hazards for the pure pre- and post-reform systems together with the predictions for the actual system where also the transition rules are used for the three one-year age groups aged 61 through 64 for the period 1999 to 2012. Interpreting the expected sign on the ITAX measure as a specification test, we confine ourselves with presenting the results from the simulations using the specification presented in Panel D in Table 2.

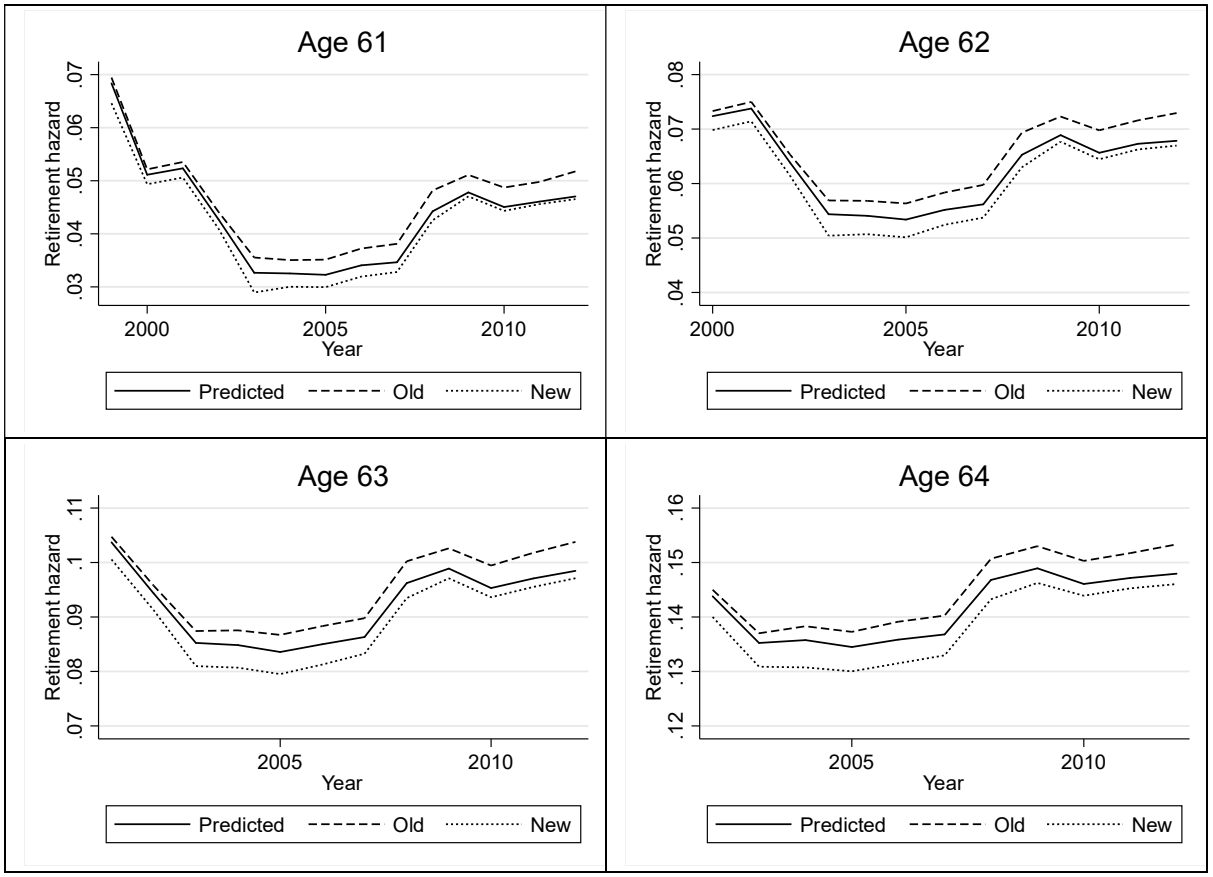


Figure 19. Simulated retirement hazards for old-age pension system only. Pre-reform (Old), post-reform (New) and actual system taking the transition rules into account (Predicted).

The results in Figure 19 show, as expected, that the post-reform public pension system generated a lower retirement hazard in all age groups and throughout, almost, the period under study than the pre-reform one, with the actual scheme constituting a weighted average of the two systems between these graphs. To gauge the significance of the magnitudes of the estimated effects in general and to assess the importance of the old-age pension reform in explaining the increase in labor force participation of older workers in Sweden in recent decades, we do a back-of-the-envelope analysis where we look at the predicted differences in labor force participation in the age group 60–64 between the pre-reform and the actual system. To do this, we simply add the additional employment in the one-year groups and average over the entire age group 60–64. Since it was not possible to claim old-age pension before age 61, we assume no effect of the old-age pension reform of those aged 60.

Figure 20 shows the results from this exercise. The dotted line shows the additional average labor force participation from implementing the new old-age pension system compared to continue using the pre-reform system. To obtain the data for the solid line in Figure 20 we went back to Figure 5 and plotted the change in labor force participation, averaged over males and females, between 2002 and 2012 in the age-group 60-64. In the beginning of the period, in 2002, those in the age-group 60-64 were born between 1938 and 1942. Recall that the first cohort, born in 1938, were assigned to 20 percent to the new system and that the share gradually increased to 40 percent for those born in 1942. For the corresponding cohorts in 2012, born between 1948 and 1953, are assigned between 75 and 100 percent to the post reform system.

As is apparent from these graphs, the change in labor force participation implied by the pension reform is very small compared to the large actual change experienced in recent years. In the last year covered by the graph, 2012, where in the relevant birth cohorts were on average covered to 85

percent by the new system, the observed increase labor force participation is more than percent higher than in the initial year 2002. Still, the prediction from our model suggest an increased labor force participation by only about 1 percent. We can therefore conclude that our estimates do suggest that a major part of the observed increase in labor force participation in the age group 60-64 can be attributed to the 1998 reform of the old-age pension system.

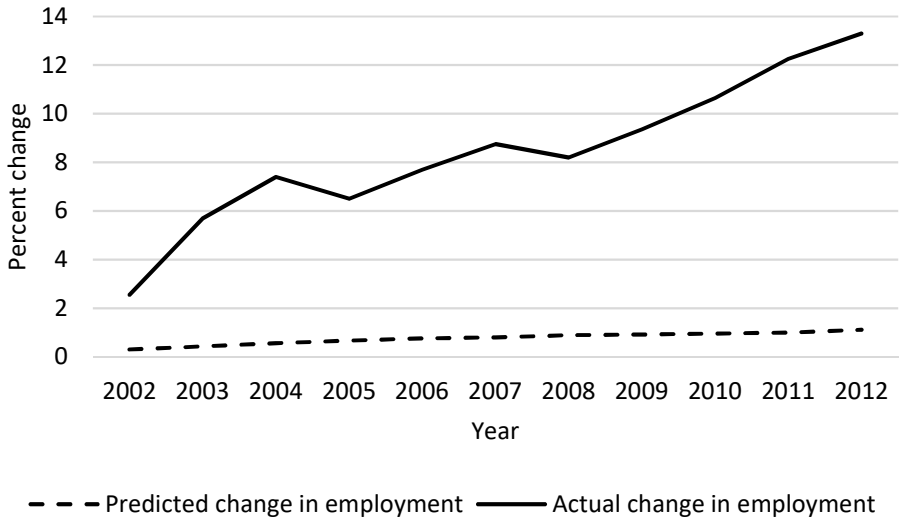


Figure 20. Actual average change in labor force participation in the age group 60-64 along with predicted changes from our econometric estimates 2002-2012.

7. Conclusions

In this paper, we have documented recent changes in retirement behavior in Sweden. The exit from the labor market has been delayed across groups of workers with different educational attainments, and overall labor force participation rates for both males and females in the age group 60–64 have increased by about 20 percentage points. This development has been accompanied with a rapid change in paths of exit from the labor market. The share that use the Disability Insurance, or other income security programs, as an initial financial source has decreased significantly and the share using the old-age pension path has increased. For those using the old-age pension path, the average time gap after they stop working until they start to claim pension benefits has decreased in recent decades. Although the average age when people start to claim old age pension has not changed much, there is a visible increased heterogeneity in this age, i.e., more people start to claim benefits earlier, but there is also an increase in the share who choose to delay their withdrawal.

The first step in the analysis of how the 1998 pension reform in Sweden affected the retirement behavior was to look into how the reform influenced the incentives to remain in the labor force for older workers. We found this influence to be ambiguous in two different ways. First, if defining the date of retirement as coinciding with the date the worker starts to claim benefits, we found that the tax on remaining in the labor force, as a result of transition rules and actuarial adjustments in the pre-reform system, actually increased as a result of the reform, while average pension wealth – the generosity in the scheme – decreased, creating an income effect towards delayed retirement. Second, if we regarded the date when the workers started to claim benefits in the pre-reform scheme to the

65th birthday, we found that the implicit tax on continued labor force participation through the social security system actually decreased as a result of the reform.

The results from the econometric models gave unexpected negative coefficient estimates for the Social Security Wealth variable in all specifications. A possible background to these estimates is that this variable is likely to be positively correlated with several omitted variables that are correlated with health and preferences for work. Moreover, the signs for the coefficient estimates on the ITAX variable, measuring the price of retiring in the current year rather than the next, have an unexpected negative sign in the three specifications giving a lower price of earlier retirement in the post-reform system. This is not surprising given the fact that our identification to a large extent explores variation in incentives across cohorts and the general trend towards later retirement shown in Section 4.

However, in the specification where we imposed the restriction that the old-age pension was claimed starting at age 65 we get expected positive signs on our estimates. Palme and Svensson (1999) shows that the realism in this assumption under the pre-reform pension system is reasonably high, since less than 10 percent deviated from the norm of claiming pension before age 65 in the 1990s. A possible interpretation of our estimation result is that that the individuals perceived the incentives in the pre-reform system as conditional on retiring at age 65 and acted on these incentives in their retirement behavior. For these reasons, we chose this specification for our simulation exercise to quantify the effects of the old-age pension reform on retirement behavior. When we used the results from the fourth specification in a simplified simulation exercise to investigate to what extent the old-age pension reform contributed to the major increase in labor force participation among older workers, we found that only small part of the change could be attributed to the reform.

Taken together, although our modelling framework included obvious limitations notably reflected in the fact that we were not able to identify an income effect, the empirical evidences suggest that the reform of the old-age pension system did not play a major role in the great increase of labor force participation of older workers in Sweden since the late 1990s. Previous research (see Laun and Palme, 2018, for an overview) have highlighted the role of the stricter rules for eligibility in the Disability Insurance as well as improved health among, primarily, older male workers. To extend the measurement of how the pension reform affected labor supply incentives by also consider how the reform interacted with negotiated occupational pension plans remains as a subject for further research.

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