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ABSTRACT

This paper investigates to what extent the 1998 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 1927 and 1950 and observe their retirement behavior during 1991–2012. The data show that the reform changed the incentives to remain in the labor force ambiguously: although it induced an income effect towards later retirement through lower replacement levels, it also implied a lower price on leaving the labor market under some assumptions. 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, which should be interpreted with caution, 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, retirement behavior in Sweden has changed in different phases. 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 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. 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, but 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, e.g., 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 reform of the old-age public pension system decided in 1998 and the sequence of reforms of the disability insurance program. 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 sequence of reforms of the disability insurance (DI), the most important one in 2008, implied stricter eligibility rules – after the 2008 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, i.e., primarily the 1998 major reform of the old-age pension system and the stricter eligibility rules in the DI program. 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, or a combination of these changes related to the replacement of industrial blue-collar jobs with jobs primarily in the service sector.[4]

In this paper we focus on studying the role of the 1998 reform of the public old-age pension system in explaining the recent changes in retirement behavior in Sweden. We do three things. First, we present a detailed description of how the pathways to retirement have changed in recent decades. 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. The economic incentives may be affected by the generosity in the system, through an income effect, and by the change in benefits from continued work, through a price effect. We capture these dimensions by looking 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 been affected by the policy changes 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 include the native population born in Sweden between 1927 and 1950 and draw a sample of 10 percent of the population for computational reasons. We exclude all immigrants since it is difficult to accurately calculate their pension benefits.

[4] See Johansson, Laun and Palme, 2017, for a description of how the development in health relates to retirements and Laun and Palme, 2020, for an overview on how all the listed changes may relate to changes in retirement.

We have access to the full pension accrual history for the entire population, 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. Annual earnings data allow us to define the age at which an individual leaves the labor force and the age at which an individual starts to claim public pension.

In addition to quantifying the already well-known fact that labor force participation among elderly workers in Sweden has increased in recent years, our analysis on how the retirement behavior has changed highlights three important results. First, that an increasing share of workers retire through the old-age pension rather than the disability insurance path. Second, that there is an increasing variance in the distribution of the public pension claiming age. Third, that the average gap between the age of labor force exit and the age of benefit claiming is shrinking.

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 following the reform, which, to the extent that leisure time is a normal good, creates an income effect towards later exit from the labor force. In addition, 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 the age of labor force exit. 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. The actuarial adjustment related to pension claiming in the post-reform system, taking place through the adjustment of the annuity divisor and the income indexing of the account balance, is smaller than in the pre-reform system, which had a substantial actuarial adjustment for early or late pension claiming.

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 exit, or whether we assume that these decisions are independent. Under the assumption that the labor market withdrawal and pension claiming decisions go hand in hand, the post-reform pension system in fact offers weaker incentives to remain in the labor force, through the price effect, than the pre-reform system. This is due to the strong actuarial reduction in the pre-reform pension system, that implied a substantial gain from delaying pension claiming. 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, we elaborate with the alternative assumption 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 a lower implicit tax on working an additional year, i.e., stronger incentives to stay in the labor force, as a result of the reform.

We use the incentive measures to analyze retirement behavior at ages 61–64 during 1991–2012. We present three models using different assumptions on the relationship between pension claiming age and labor force withdrawal age. 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, while the coefficient estimates for the ITAX measure have the expected, positive, sign in most specifications. In a simulation exercise we show, however, that using these estimates still yields rather small potential effects of the pension reform on labor force participation of older workers.

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 analyzes the implications for the cohorts transitioning into the post-reform pension system. Section 6 presents the econometric model for analyzing retirement behavior and the regression results. Finally, Section 7 concludes.

2. Sweden's Social Insurance System

Economic incentives to remain in the labor force in old ages can be affected by public policy through, e.g., the public old-age pension system, the disability insurance program and by income taxes. In this section we give a short overview of the most important systems affecting older workers as well as the main reforms that have been implemented in recent years.[5]

2.1 Public Old-age Pension Systems

The compulsory old-age pension system consists of two main parts: the Occupational pension programs and the Public pension programs. The Occupational pensions are based on agreements between the trade unions and the employers' confederations and are compulsory for the entire labor market covered by central agreements. There are four main programs: one for central government employee, one for local government employees, and one each for blue- and white-collar workers in the private sector, respectively. The Occupational pensions are most important for replacing income above the social security ceiling, i.e., for high income earners.[6]

In this paper, we disregard the occupational pension schemes and focus on the Public old-age pension system.[7] In 1998, the Swedish parliament decided on a major reform of this 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 increased by 5 percentage points 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.[8] The basis for the accrual of pension wealth is the pension qualifying income (PGI). It amounts to the

[5] For a schematic overview of all changes in Sweden's income security systems that may have affected labor force participation among older workers, see Figure 10.3 in Laun and Palme (2021).

[6] The rules for these programs are described in more detail in Palme and Svensson (1999 and 2004) and in Johansson, Laun and Palme (2016). Hagen and Elinder (2018) as well as Hagen (2018) give overviews of the occupational programs.

[7] We disregard the occupational pension schemes since we are unable to accurately calculate the benefits and since we want to focus on the major reform of the public old-age pension system.

[8] 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 (see Palme and Svensson, 1999). In 2018 the level of the *PBA* was 45,500 SEK (about 4,000 € or 5,000 US$). In 1995, the *Increased Price Basic Amount* was introduced. The increased *PBA* is only slightly higher

annual earnings of the individual, reduced by the common pension fee (*allmän pensionsavgift*).[9] In addition to labor earnings, also income from certain income security programs is included in the pension qualifying income. For the pension qualifying income, incomes above 0.423 *Price Basic Amounts (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 *Income Basic Amounts (IBAs)* since 2001.[10]

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 one, the *Basic pension* (*Folkpension*), is unrelated to the insured individuals' previous earnings. For a singled pensioner this pension amounts to 96 percent of a *PBA* and is reduced to 78.5 percent of a *PBA* for a married pensioner.

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*.[11] 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 turned 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 percent for each month of delayed withdrawal.[12] In 1998 the age of early withdrawal was changed to age 61, affecting the cohorts born in 1938 and later, i.e., the same cohorts that that were affected by the stepwise implementation of the post-reform pension system.

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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 (Pension Qualifying Income) for all permanently living in Sweden between age 16 and 64.

[9] The common pension fee was introduced in 1998 and amounted to 6.95 percent. Since 2000, the common pension fee is 7 percent of the pension qualifying income.

[10] Since the pension qualifying income is annual earnings minus the common pension fee, the ceiling is around 8.07 base amounts in terms of annual earnings.

[11] Since 1995 the increased *PBA* is being used.

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

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 benefits that is financed through the general state budget and indexed by the *Consumer Price Index (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. 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. Of these, 10.21 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 an income 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.[13]

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 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.

When the individual decides to claim benefits, the account balance is divided by the so-called *annuity divisor* to get the size of the annual pension benefit at the date of pension claiming. 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 pension claiming into account.[14] In this context it is important to point out that this actuarial adjustment does not vary with, for example, gender and educational attainment, which is the case for many private pension programs.

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 (based on own calculations). 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

[13] 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.

[14] The calculation of the annuity divisor implies that the individual receives future interest rate payments on the social security wealth in advance, in order to smooth the pension payments across all retirement years.

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.[15]

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, Sundén and Söderlind, 2007, for a more detailed overview of the Premium Pension). 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 benefits remain in the fund chosen by the insured individual.

2.2 The Disability Insurance Program

The disability insurance (DI) program replaces forgone earnings due to a lasting impaired work capacity. 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, later older than age 60) and rights for older workers to receive DI benefits for labor market reasons. These reforms were reversed in the 1990s. The eligibility to DI benefits 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 more lenient 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 DI 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 best three out of the last five to eight years of the annual pension qualifying income before the worker became eligible to DI.

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 were combined into one central

[15] See the *Orange Report* 2016 for a description.

[16] Since October 1, 2015, the benefit level is 64.7 percent of assumed income.

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 the local social insurance offices gradually applying 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 sickness insurance (SI) 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 1 shows the development of DI prevalence and incidence between 1980 and 2015 for males and females, respectively. The most striking result in Figure 1 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. The decline follows the more stringent eligibility rules following the reforms of the DI system in 2003 and 2008, and coincides with the gradual changes in implementation of the rules at the Swedish Social Insurance Agency.

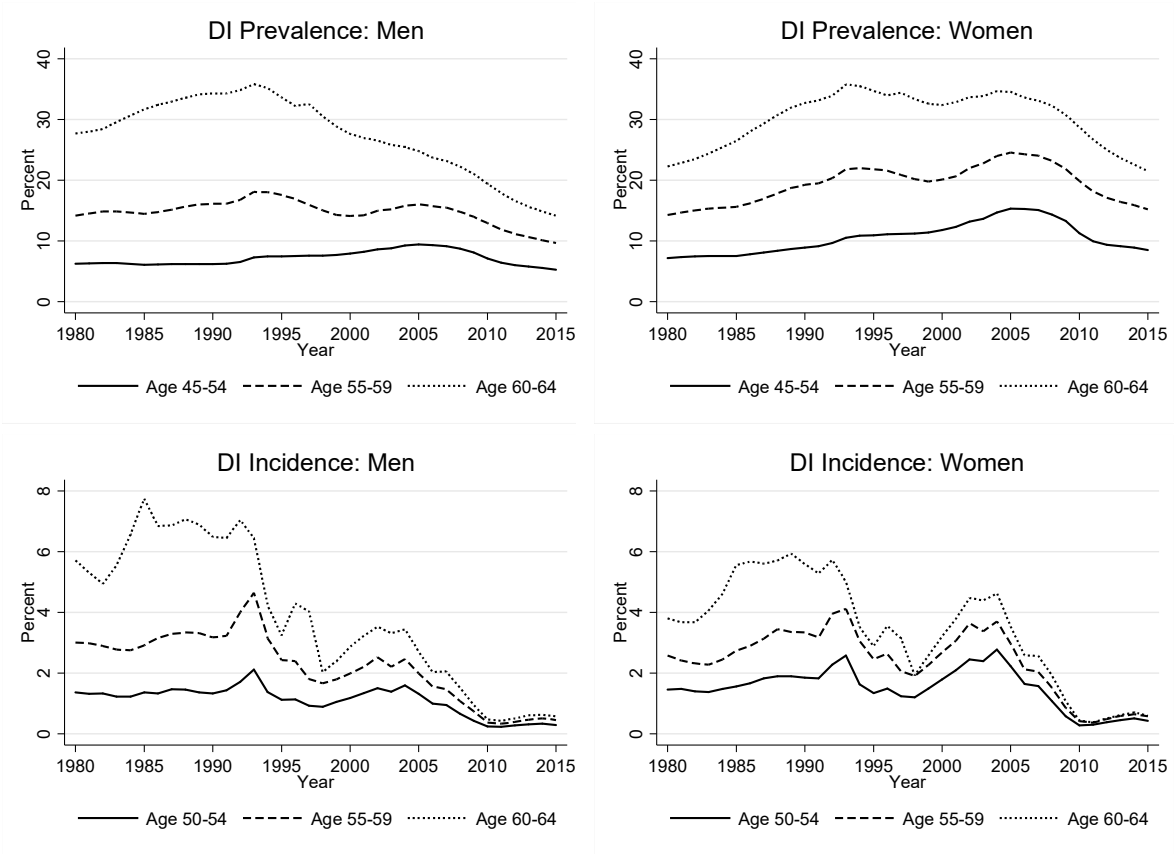

Figure 1. Upper panels: Share of the population receiving DI in different age groups. Lower panels: Share of DI entry in different age groups. Males and Females.
Source: Swedish Social Insurance Agency.

2.3 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. Depending on ongoing collective agreements in some sectors of the labor market, the reform was not fully implemented until 2003.

Age 65 remains, despite the changes in the legislation described above, the "landmark age" for retirement in Sweden. Calculations for replacement levels depart, in most cases, from retirement at age 65. Workers older than age 65 are still not covered by the unemployment insurance or the compulsory sick pay insurance program. Age 65 is also the age that NDC benefits for disability recipients are converted into an annuity.

2.4 Income Taxes

Main changes to the Swedish income tax system during this period 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 (see, e.g., Laun, 2017). 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 are 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 1927 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 1991 and 2012. Date of retirement for an individual is defined as the last observed year *before* the individual has labor earnings below 1 *PBA*.[17] 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.

Table 1. Descriptive statistics for non-retired workers born 1927–1950 at ages 50–70 (10 percent random sample of the population).

	Total	Males	Females
Birth year	1940.36	1940.42	1940.30
Age	59.31	59.24	59.37
Male	0.499	1	0
Married	0.648	0.661	0.635
Education			
Low	0.372	0.391	0.353
Medium	0.490	0.475	0.505
High	0.138	0.134	0.142
Number of observations	3,570,269	1,782,432	1,787,837
Unique individuals	216,581	109,328	107,253

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 are recorded, which implies that as earnings records they are top coded.

Figure 2 shows the pension points earned per year on average for cohorts born in 1930, 1935, 1940, 1945 and 1950 for males and females, respectively.[18] The graphs reveal some real earnings growth rate across cohorts. For females, the growth in earnings is larger and more evenly spread over the

[17] Palme and Svensson (2004) evaluate different measures of retirement in administrative data and conclude that a measure based on earnings for labor is more suitable than a measure based on the main income source when assessing full-time retirement. Eyjólfsdóttir et al. (2019) evaluate different measures of retirement in administrative and survey data and conclude that defining retirement as the year after the last observation of receiving at least the PBA from employment, followed by at least 2 years of non-employment, well resembles measures of retirement in survey data.
[18] As described in Section 2, pension points are capped at 6.5 *PBA*s before 2001 and 6.5 *IBA*s since 2001. In the figure, we capped pension points at 6.5 *PBA*s in all years to enhance comparability over time.

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.

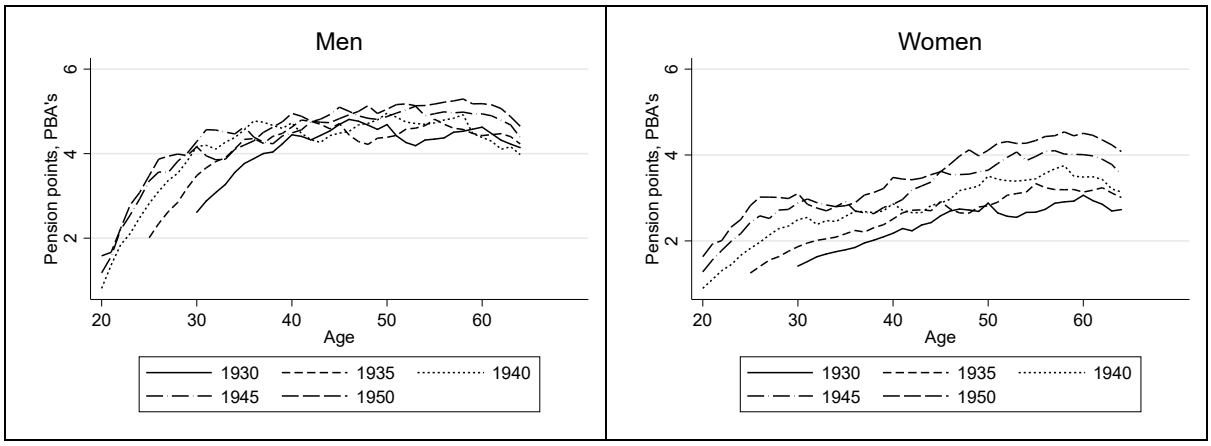

Figure 2. Earnings histories by cohort.
Source: Own calculations from individual data provided by the Swedish Pensions Agency.

3.3 The Pension Calculator

We use the pension accrual information from the Swedish Pensions Agency to calculate the old-age pension at each potential retirement age between 50 and 70, until the person retires. To disregard changes in composition regarding marital status, we assign values for single pensioners to all individuals. We disregard the occupational pensions, for two reasons: we are unable to accurately calculate the benefits from the occupational pension schemes and we want to focus on the reforms of the public old-age pension system. We focus on gross earnings from old-age public pension and disregard income taxes. Since there was a large reform to income taxation in 1991, our analysis period begins in 1991. When calculating the future stream of benefits, we use age, year and gender-specific mortality rates provided by Statistics Sweden.[19] We include both rules for the income-related public pension program and for guaranteed pension benefits in the calculations.

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 3 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 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.

[19] 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. We also do not account for the balancing mechanism, since it is difficult for the individual to foresee events, or developments that would activate this mechanism. We observe the annual account balance for the premium pension, but assign the same rules for pension withdrawal for this part as for the income pension. We do not account for transition rules primarily affecting the initial cohorts in the post-reform system.

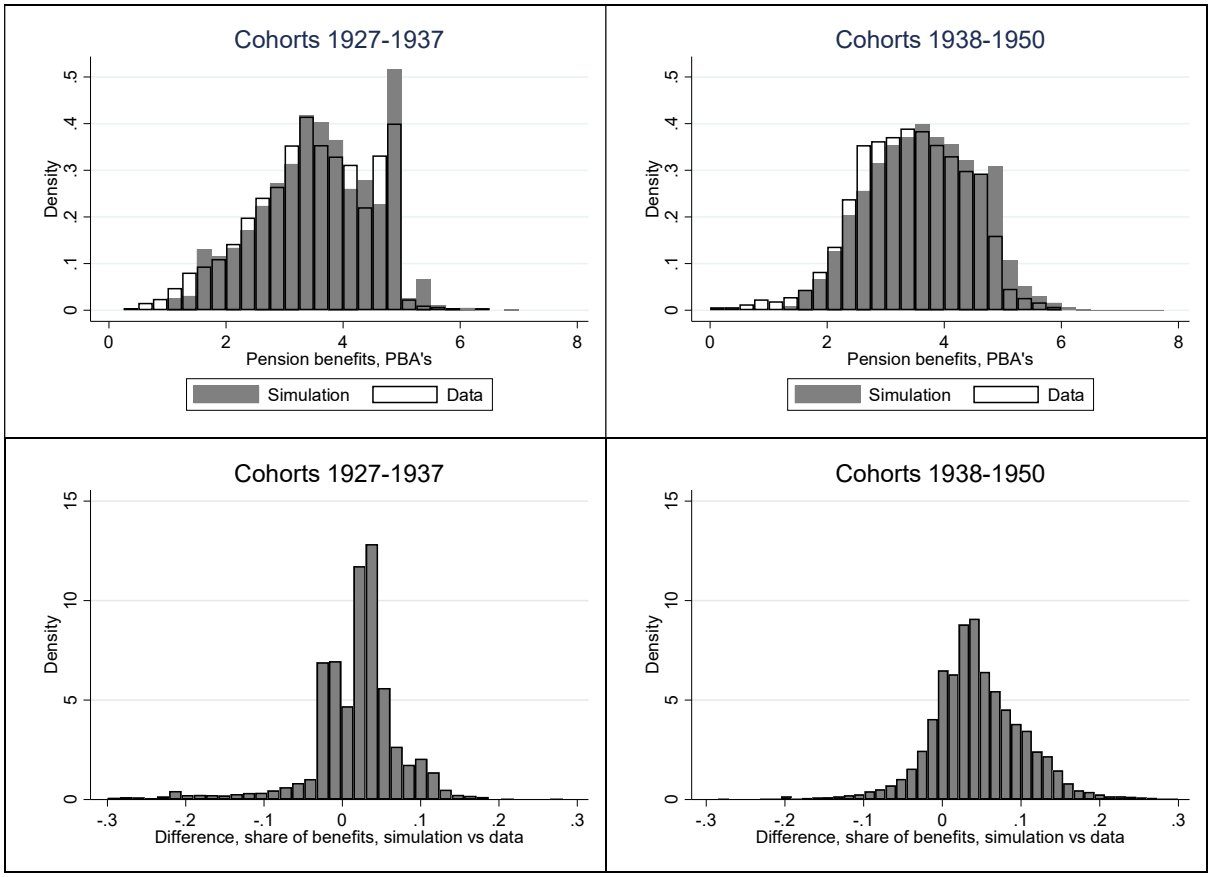

Figure 3. Upper panels: predicted versus observed pension benefits for those born before and after 1938, respectively. Lower panels: distribution of percentage differences between predicted and observed pension benefits.

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 4 shows how the hazard rate of retirement in different ages has changed during 1991–2012. The left panel shows the estimates for males and the right one for females.[20] The figure shows that the retirement hazard has decreased in all ages between 61 and 64 compared to the 1990s. 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-year-olds.

[20] Throughout this paper we treat retirement as an absorbing state.

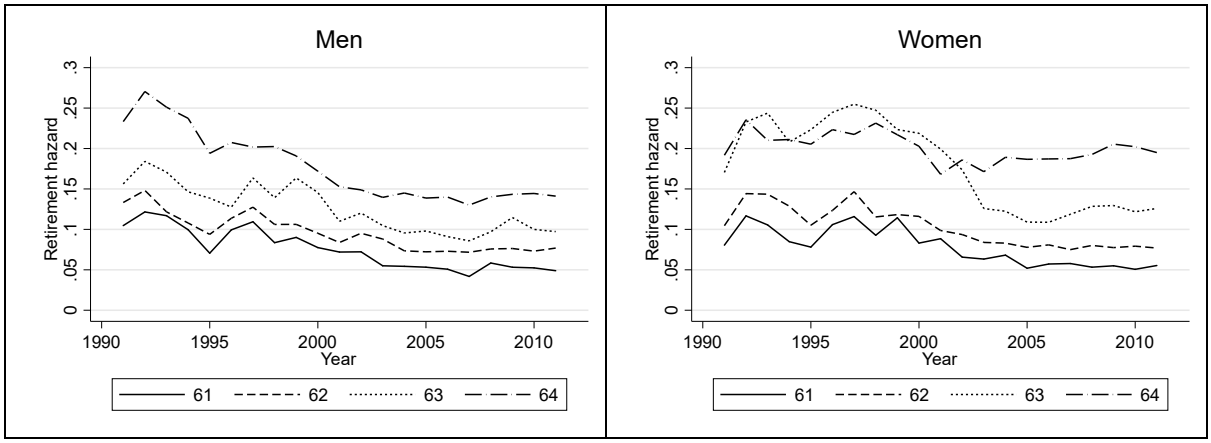

Figure 4. Changes in the hazard rates for leaving the labor force by age and gender 1985–2012.

Figure 5 breaks down the retirement hazards by educational attainments and shows average retirement hazards at age 61–64 during 1991–2012 in three groups by the maximum educational attainment achieved: compulsory education only (Low), vocational or secondary schooling (Medium), and, finally, college or university education (High). Figure 5 shows quite different outcomes for males, in the left panel, and females, in the right panel. For males, there is a much lower *level* of the retirement hazard for the high-education group throughout the entire period. 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.

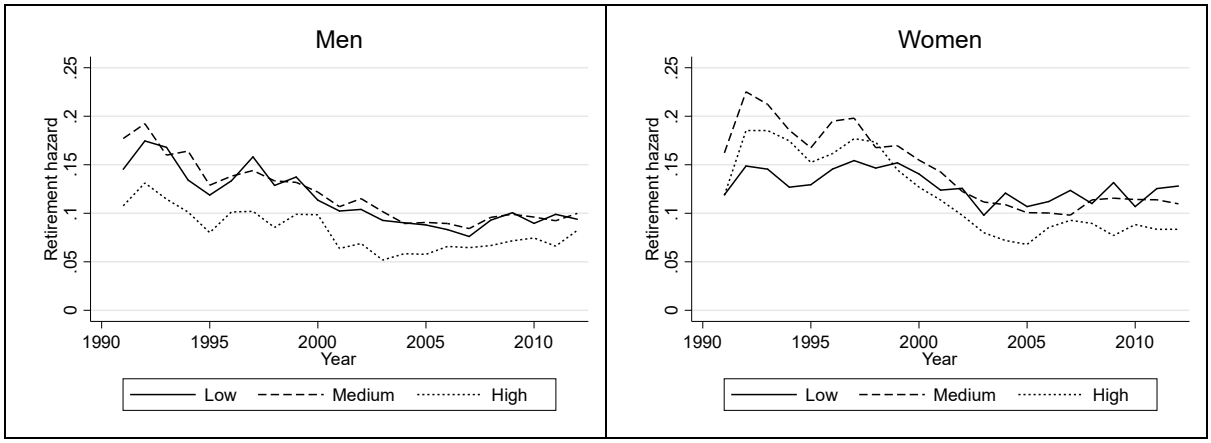

Figure 5. Changes in the average hazard rates for leaving the labor force between age 61 and 64 by educational attainments 1985–2012. Males and females, respectively.

4.2 Pathways to Retirement

The two main pathways to retirement in Sweden are through the old-age pension system or the disability insurance (DI) program. Figure 6 shows the share leaving through DI across birth cohorts in

our sample for males and females, respectively.[21] 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.

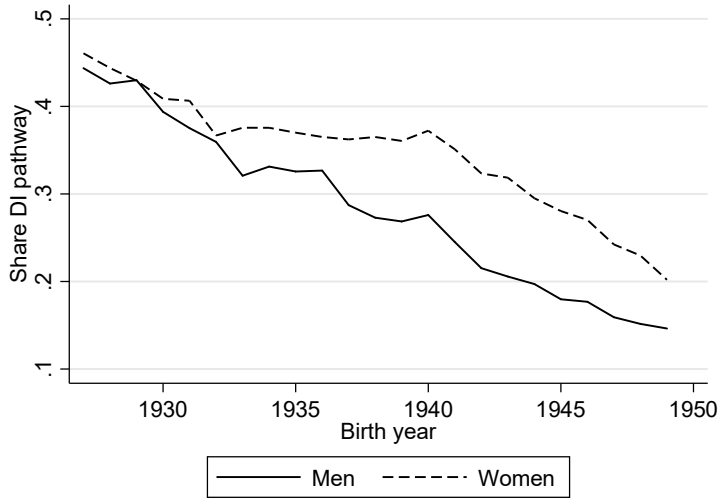

Figure 6. Changes in the probabilities to leave the labor force through the disability pathway across birth cohort by gender.

Figure 7 breaks down the development shown in Figure 6 by the three groups of educational attainments. The probability of retiring through the DI program is markedly higher among low educated. For males, 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.

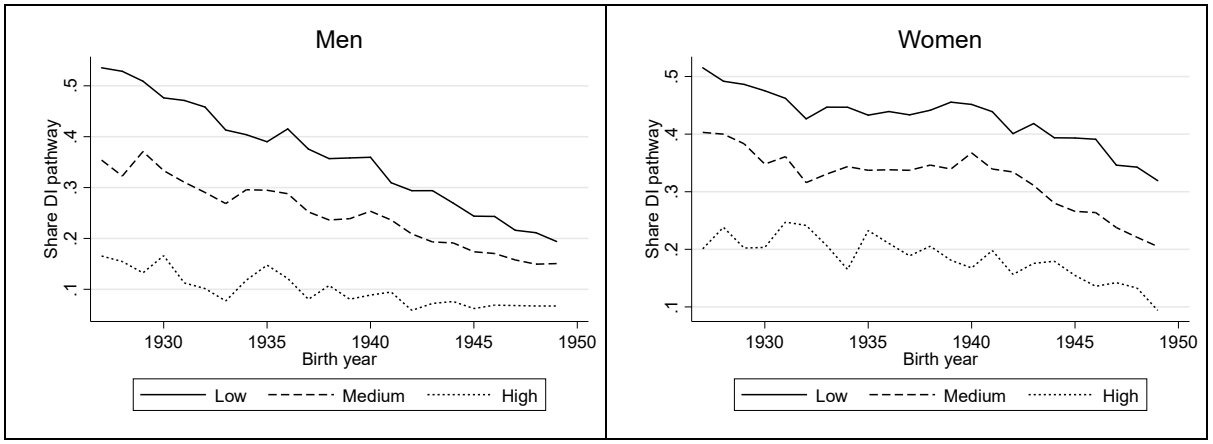

Figure 7. Changes in the probabilities to leave the labor force through the disability pathway across birth cohort by gender.

[21] 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.

4.3 Retirement and Claiming of Benefits

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 primarily linked to when the worker started to claim benefits from the system. In the post-reform system, the size of the benefit is determined by *both* the date at which the worker stops contributing to the system, i.e., stops working, which affects the balance of the individual account, and by when he or she starts to claim benefits, through the annuity divisor and the indexing of the account balance. This means that the economic incentives for the worker to delay the date of pension claiming after the exit from the labor force may be stronger 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 8 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.

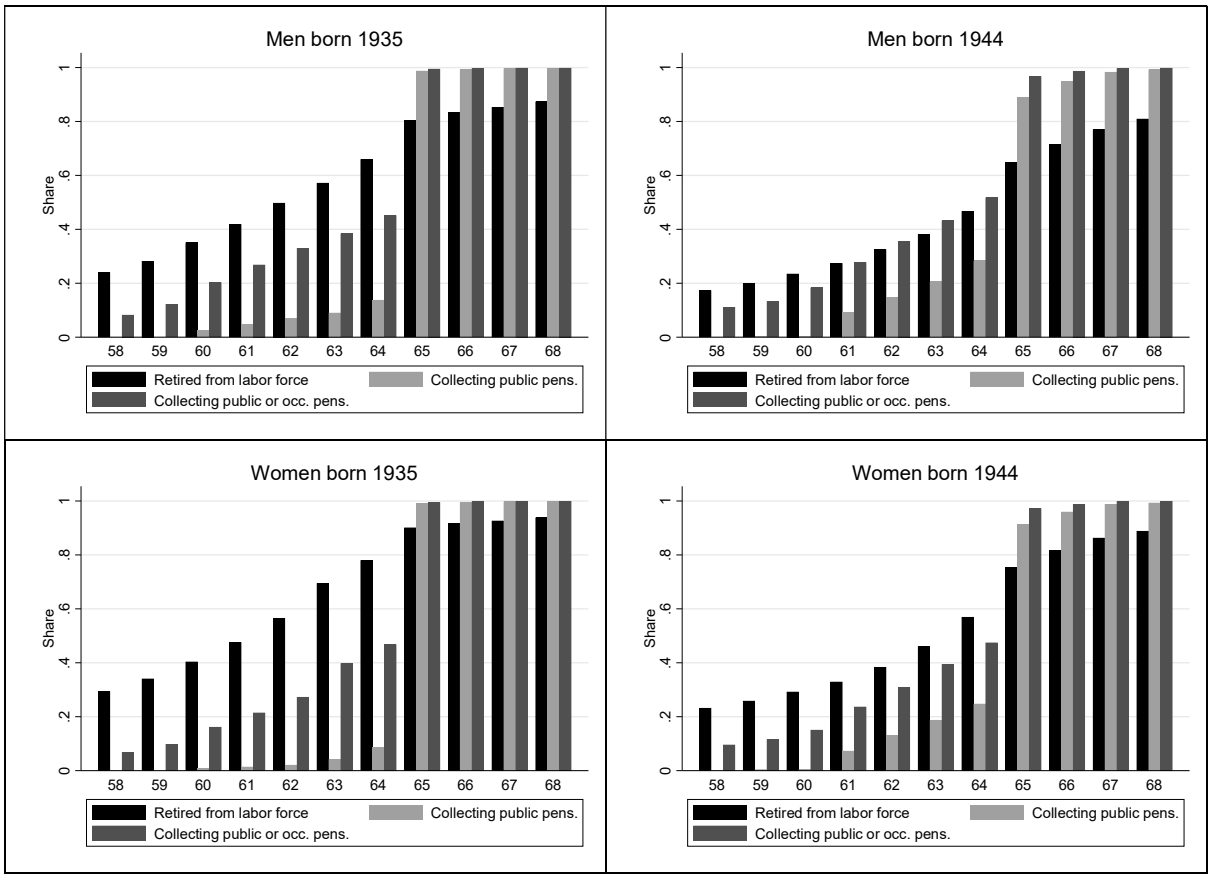

Figure 8. Share retired from the labor force, share collecting public old-age pension benefits and share collecting public old-age pension or occupational pension benefits at different ages by year of birth (1935 or 1944) and gender.

Figure 8 displays several interesting differences between the two birth cohorts. First of all, it is obvious that the norm of retiring at age 65 has become less salient in the 1944 cohort. By comparing the bars for retirement and pension claiming, it is also apparent that a much larger share retired without claiming old-age pension benefits in the 1935 cohort than in the 1944 one.[22] 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 9 extends the analysis in Figure 8 by showing how the four possible permutations of employment and pension claiming by age have changed across the cohorts born in 1935 and 1944 for males and females, respectively. In these figures, pension includes both public and occupational pension. By comparing the 1935 and 1944 cohorts and adding the "Work + No pension" and the "Work + pension" categories, it is apparent that the share of workers that remain in the labor force has increased markedly. It can also be seen that the share of workers that both work and receive pension has increased considerably. Finally, the shrinking of the category "No work + no pension" between the 1935 and the 1944 cohorts reflects the smaller gap between retirement and claiming of benefits in the younger cohort.

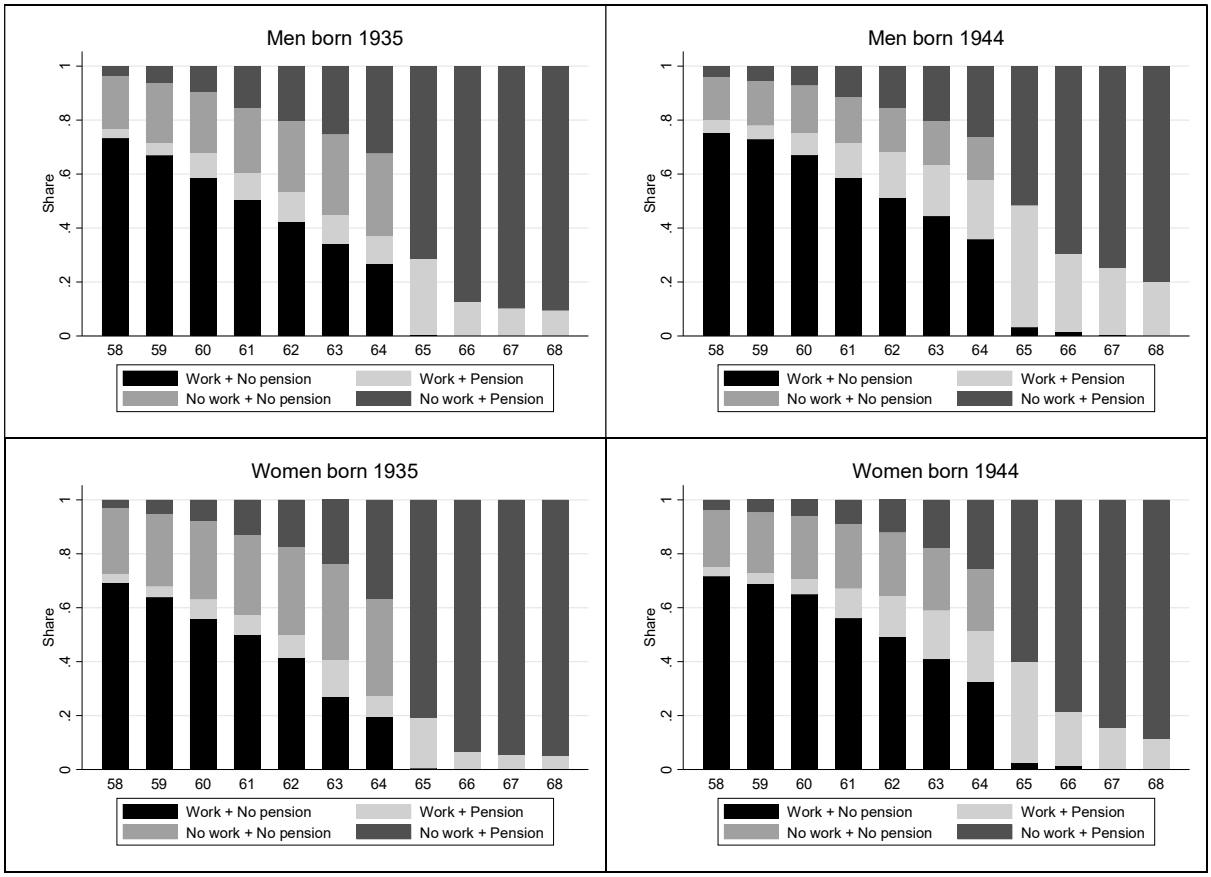

Figure 9. Changes in the four possible permutations of employment and pension claiming by age across the cohorts born in 1930, 1935, 1940 and 1945 by gender.

Note: Pension claiming includes both public and occupational pension.

[22] This is also noted by Ossowicki (2019), who analyses the heterogeneity of the group retiring before and after age 65.

To sum up, our key findings on changes in retirement behavior so far is: (i) an overall delay in retirement; (ii) changes in the pathways of labor force exit; (iii) an increasing variance in the distribution of the public pension claiming age; and (iv) a closing of the average gap between retirement and claiming of benefits from the public old-age pension system.

5. Economic Incentives to Remain in the Labor Force

This section first describes how the incentive measures are calculated. It then shows how they have changed as a result of the pension reform across cohorts.

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 (the old-age pension or the disability insurance pathway) 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. Although the individual will receive fewer pension benefit payments, which will decrease the social security wealth, delaying retirement may increase the benefit levels through the actuarial adjustment and other rules for how the size of the benefits is determined in the pension system. These adjustments will, however, depend on which pathway out of the labor force that the insured individual takes. The actuarial adjustments for early withdrawal will be smaller if the worker leaves the labor force through the disability insurance program. For a particular exit path, *k,* out from the labor force, we define the benefit accrual measure as:

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

i.e., it measures the percentage change in the social security wealth of staying one additional year in the labor force conditional on leaving the labor force by using exit path *k.*

The overall *benefit accrual* measure can be obtained by averaging over all exit paths using the probabilities for each path, 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.*

This formulation gives us a way to translate policy changes affecting the probabilities of different exit paths, e.g., more stringent eligibility rules in the disability insurance, into the incentive measures. Stricter rules in the disability insurance means a lower probability of a pathway with lower benefit accrual and therefore stronger incentives for the worker to stay in the labor force.

From this measure we can obtain the following expression for the *implicit tax rate* on remaining at the labor market:[23]

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

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 labor earnings net of payroll taxes during that additional year $\big(W_{t+1}(i)(1-PT_{t+1})\big)$. 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 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 begin by showing how the predicted incentives to retire have changed across the cohorts born between 1938 and 1949 who transition into the new pension system. 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. For cohorts transitioning into the new pension system, born 1938–1953, 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.

Pension reforms can change two aspects of the economic incentives to remain in the labor force. First, by changing the *level* of the social security wealth, i.e., an income effect. Second, by affecting the *change* in the social security wealth from staying additional time at the labor market, i.e., a price effect capturing 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.

[23] The term *tax* may appear misleading for the post-reform NDC system in Sweden, since it is technically separated from the government budget. However, for example, for workers with earnings above the social security ceiling marginal contributions do not qualify for additional benefits and the system therefore works as a tax.

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 age of labor market withdrawal and the age when the individual starts to claim public pension benefits. We therefore present results from two different cases. In the first one, we assume that the individual starts to claim public 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 claim public pension benefits at age 65.

Figure 10 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 four 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 10 measure the overall generosity of the income security program, related to the *income effect* in the incentives to stay in the labor force described above. The lower ones show 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 10 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 10 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 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 10, reveal 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 cohorts 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 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, which created a price effect towards earlier retirement. However, taken together, as a result of the stepwise implementation, our calculations reveal that the latter effect was quite small before the 1945 birth cohort in the system facing the workers in our data.

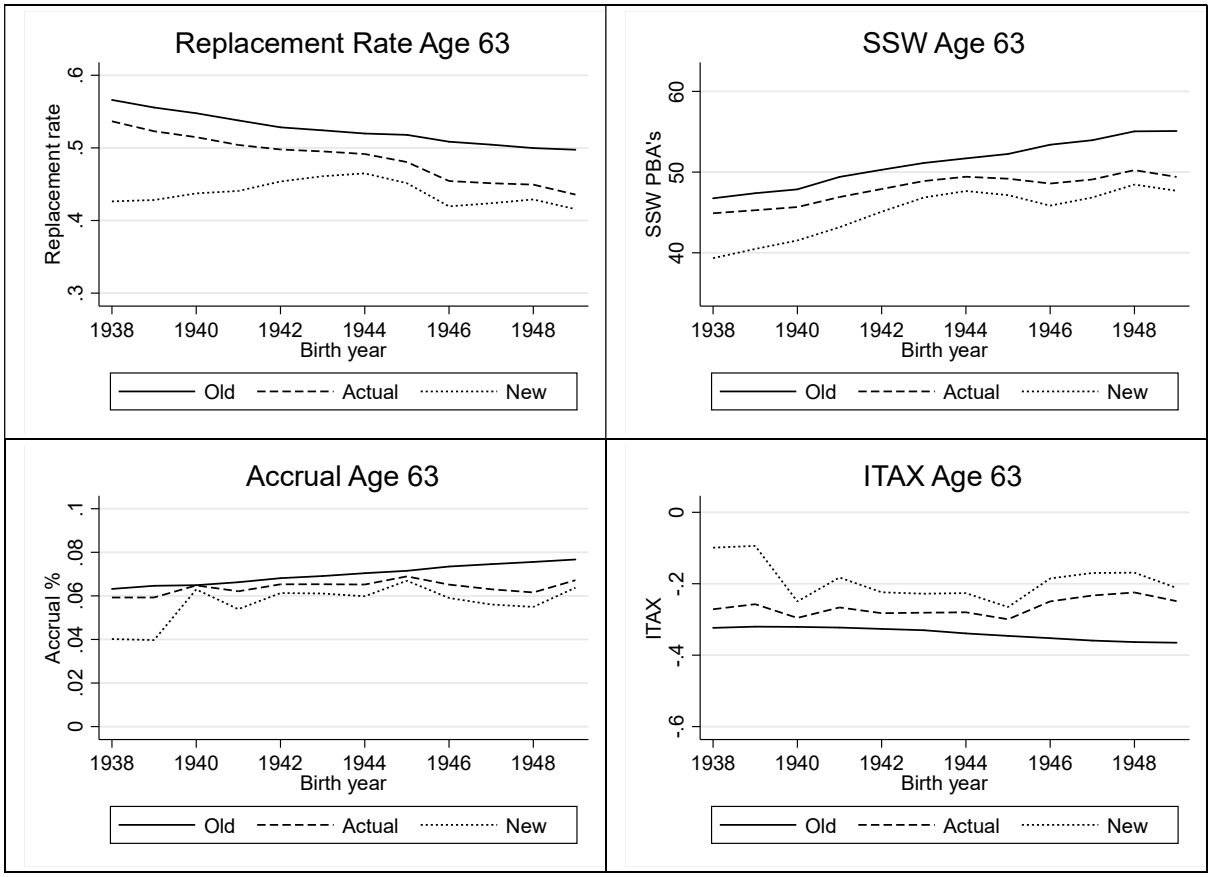

Figure 10. Changes in four measures of economic incentives to retire across birth cohorts. Calculations restricted to the public old-age pension system only. The worker is assumed to start claim benefits as soon as he or she retires.

Figure 11 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 10, it is evident that the results on the replacement levels and social security wealth are very similar. However, the ones on benefit accrual and the implicit tax rate are very different. In the results shown in Figure 11, the rates of benefit accrual are much higher and the tax rates much lower in the new system compared to the old system. This is an important and surprising result: whether or not the major pension reform implied a higher or lower price to remain in the labor force depends on to what extent we view the age of labor market withdrawal and age of pension claiming as separable. If we view the pension claiming age as fixed to age 65, the pension reform implied stronger incentives to stay in the labor force, both from an income and a price effect.

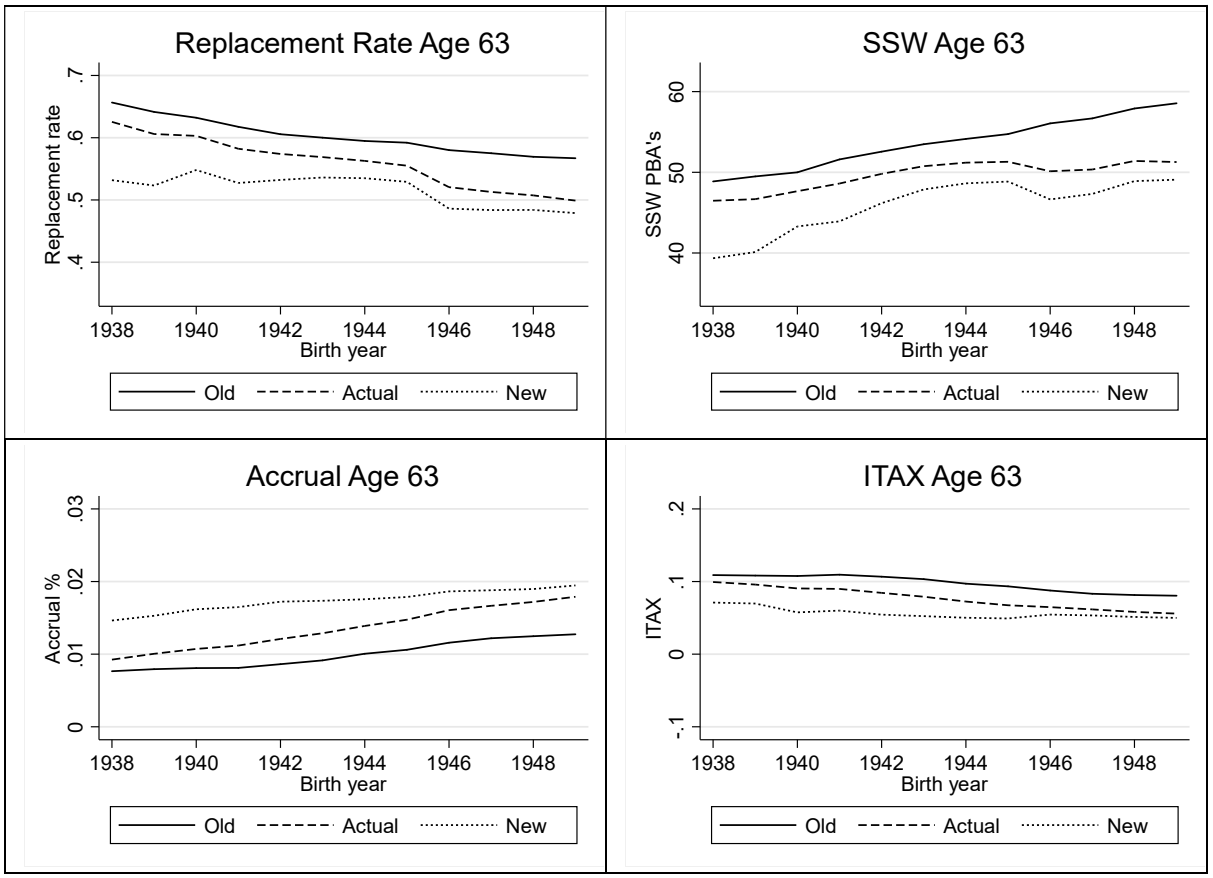

Figure 11. Changes in four measures of economic incentives to retire across birth cohorts under the assumption that the individual retires at age 63 and starts to claim old-age pension benefits at age 65. Calculations restricted to the public old-age pension system only.

As we described in Section 4.2, a large share of those who retired between age 61 and 64 retired through the disability insurance pathway rather than the old-age pension one. In Figure 12 we present the incentive measures resulting from a weighted average between the actual incentives from the public old-age pension system (presented in Figure 10 under the assumption that retirement and benefit accrual coincides) and the actual 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, according to data from the Social Insurance Agency. The figure also shows the development of the four economic incentive measures for the old-age pension and the DI systems, respectively. Note that the cohorts born before 1938 are fully in the pre-reform system, whereas those born in 1938 or later are gradually phased in to the post-reform system.

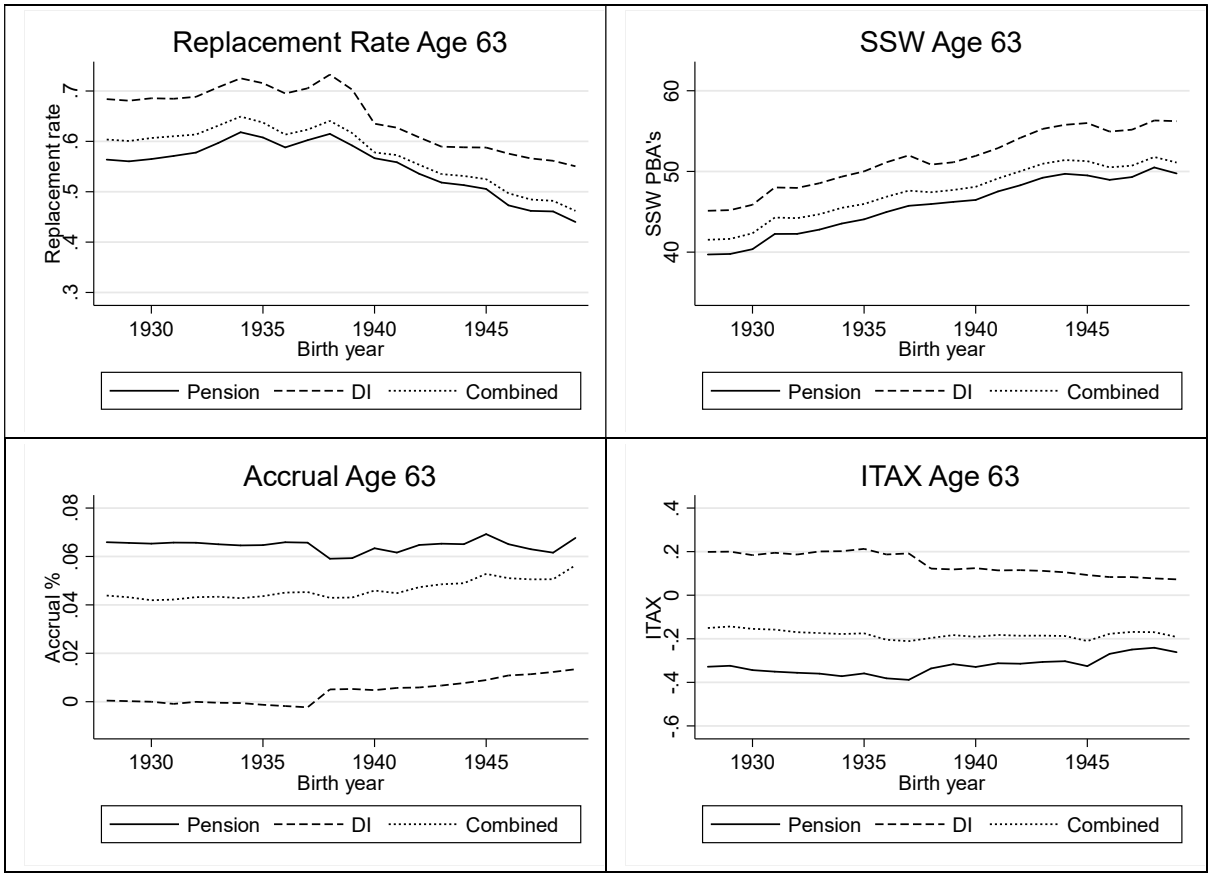

Figure 12. Changes in four measures of economic incentives to retire across birth cohorts. Calculations of the weighted average between the old-age pension and the DI path out of the labor force.

As expected, the upper panels of Figure 12 show that the DI system is more generous than the old-age pension system. The downward trend for the replacement rate and the upward trend for the social security wealth can be attributed to economic growth across cohorts. The lower panels in Figure 12 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. For the DI system considered separately, there is a tax, rather than a subsidy as for the old-age pension system, on remaining in the labor force. 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.

To sum up, the three results that stand out as most important from those obtained in this section are (i) that the reform of the public pension system implied an unambiguous income effect towards delayed retirement; (ii) under the assumption that retirement and benefit withdrawal happens simultaneously, there is a decrease in the price of leaving the labor market as a result of the reform; (iii) under the assumption that all start to claim their pension benefits at age 65, the reform instead implied that the average price increased for leaving the labor force.

6. The impact of economic incentives on retirement behavior

6.1 Empirical Specification

In this section, we present estimates on the effect of the economic incentives on retirement behavior from econometric models. 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 employed, defined as having labor income above 1 *PBA*, at age 60. Individuals remain in the estimation sample until they retire or, if they die during the period of observation, they are censored at the date of death. 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 saw in Section 4, most of the changes in the labor force participation in recent years can be attributed to the age group 60–64.

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.[24]

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. A disadvantage with this approach is that a simple, quadratic function is unlikely to capture the complex relation between age and labor force exit and that the unmeasured relation between age and retirement, unrelated to economic incentives, may be spuriously correlated to the incentive measures. Second, we use a set of dummy variables for each age. A problem with this approach is over-fitting, i.e., that the dummy-variable specification is not fully separable from the economic incentives measures, which, in turn, would lead to that the effect of economic incentives on retirement behavior would be underestimated.

We also consider three different specifications with regards to other covariates, represented by the *X* vector in equation (7). In the first one we do not include any additional confounders in the model. In the second specification, we control for differences related to over-all economic resources by including controls for average earnings from the five years preceding retirement (quadratic), indicators for education level, marital status, whether the partner is retired and socio-economic status (self-employed/blue-collar/white-collar workers). Finally, in the third specification, we also include a full set of calendar year dummies. These variables control for unobservable changes across years that affect retirement behavior. There are many candidates for such variables: changes in health and conditions on the labor market, including work environments, for the cohorts included in the analysis are probably the most important ones.

In the first specification, the identification of the effect of economic incentives comes from three main sources. First, through differences that has to do with individual levels of contributions to the pension

[24] An important limitation of our empirical specification is that we disregard joint retirement decisions between spouses as well as the possibility that the retirement decision of one spouse may be affected by the incentives attributed to the other spouse's pension program. For a recent study on joint retirement in Sweden, see Selin (2017).

schemes, or income security programs. Second, although workers may have similar levels of contributions across the life cycle, 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 and years that are attributed to institutional changes. The most important of these changes during the period under study is of course the 1998 reform of Sweden's public old-age pension program. In the second specification, the identifying variation is restricted to the second and third sources of variation listed above, i.e., variations in how contributions are transformed into benefits and institutional changes across cohorts. Finally, in the third specification we also include year dummies, restricting the variation in the incentive measures to between individuals in the same year and, in the specification with age dummies, the same age. In total, the two alternative specifications for the age controls and the three different variants for including other covariates yields six different specifications.

As highlighted in Section 5.2, 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 from the labor force. 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.

The first model choice 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, weaker economic incentives to remain in 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 ways. In the first model, we calculate separate incentive measures for the DI and the old-age pension paths, respectively, and use them to create a measure of the sum of old age pension and DI 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, according to official data from the Swedish Social Insurance Agency. In the second model, 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. For these estimates, we use the incentive measures calculated on the old-age pension scheme only (see Figure 12 for the development of the combined incentives measure and the incentives from the public pension system only).

In the third model, we address the problem of different assumptions regarding the timing of retirement and claiming of old-age pension benefits. We restrict the sample to those who retire through the old-age pension path, i.e., the same sample as in Panel B, and use the incentive measures assuming that they start to claim their benefits at age 65 (see Figure 11 for the development of the actual incentives under this assumption).[25]

[25] A limitation of the model is that we do not consider joint retirement of spouses. See Klerby, Larsson and Palmer (2013 and 2020) for an empirical analysis of that using Swedish data.

6.2 Econometric Estimates

Table 2 shows the main results. The panels A, B and C show the results from each of the three models discussed in Section 6.1. Panel A shows the results when we include both pathways out from the labor force. In Panel B we consider the old-age pension path only and the calculations of the incentive measures are restricted to the old-age pension scheme. Finally, in Panel C, we consider the pension path only, as in Panel B, but we use the incentive measures under the assumption that the individual starts to claim his or her old-age pension benefits at age 65. The six columns show the results from the six different specifications discussed in Section 6.1. 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. Columns 1 and 2 include no controls for observable characteristics other than gender and age; columns 3 and 4 also include controls for observable characteristics, and in columns 5 and 6 we include a full set of dummy variables for each year of observation.

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

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: All pathways weighted by probabilities						
SSW	–0.0035***	–0.0035***	–0.0014***	–0.0014***	–0.0003**	–0.0003**
	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
ITAX	–0.0375***	–0.0375***	0.0164***	0.0163***	0.0082**	0.0082**
	(0.0033)	(0.0033)	(0.0040)	(0.0040)	(0.0039)	(0.0039)
Obs	439,762	439,762	439,761	439,761	439,761	439,761
Panel B: Old-age pension path only						
SSW	–0.0018***	–0.0018***	–0.0018***	–0.0018***	–0.0004***	–0.0004***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ITAX	0.0038**	0.0038**	0.0111***	0.0111***	0.0294***	0.0293***
	(0.0019)	(0.0019)	(0.0022)	(0.0022)	(0.0023)	(0.0023)
Obs	422,884	422,884	422,884	422,884	422,884	422,884
Panel C: Claiming of benefits fixed at age 65						
SSW	–0.0015**	–0.0015***	–0.0009***	–0.0009***	–0.0004***	–0.0004***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ITAX	0.161***	0.161***	0.168***	0.168***	0.0684***	0.0684***
	(0.0085)	(0.0085)	(0.0087)	(0.0087)	(0.0096)	(0.0096)
Obs	410,630	410,630	410,630	410,630	410,630	410,630
Quadratic age	X	-	X	-	X	-
Age dummies	-	X	-	X	-	X
Other Xs	-	-	X	X	X	X
Year dummies	-	-	-	-	X	X

As we 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 Johansson, Laun 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 expected positive sign in all specifications except the first two ones in Panel A. Throughout, pairwise comparisons of the results from the two alternative age control specifications show that there are very small differences between them. These results suggests that the relatively short age interval under study is well approximated by a quadratic polynomial.

There is no unambiguous way to select a preferred specification based on the differences in the results for the different models revealed in Table 2. The magnitudes of the coefficient estimates for the ITAX variable are, however, in general larger for the specifications shown in Panel C, where the withdrawal of the pension benefits is fixed to start at age 65. This is in particular true for the specifications shown in columns 1 through 4. These results make sense, since, as shown in Figures 10 and 11, the change in the price of leaving the labor force as a result of the reform is much larger in this specification. However, when including year/cohort dummies, such as in the specifications shown in columns 5 and 6, this variation is not included and the estimates are closer to the ones shown in Panels A and B. We will further discuss the size of the estimated coefficients in the next section, where we simulate the potential employment responses based on these results.

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 6 in Table 2. Column 1 in Table 3 shows the results for the entire sample for sake of comparison; columns 2 and 3 the results by gender; finally, the last three columns the results for three education groups, respectively. The first group is restricted to those with a maximum educational attainment of compulsory education only; the second one to those with vocational or secondary education; and the third groups to university or college graduates.

The heterogeneity analysis in Panel A shows, interestingly, that the negative sign for the SSW coefficient estimates can be attributed to the male sub-sample. The estimates for females are, as predicted from theory, positive. The coefficient for women is also larger than for men in Panel B. A possible background to these results is that males are to a larger extent guided by norms at the labor market in their retirement behavior, while females, who our descriptive analysis shows have a larger variance in when they exit the labor market, react more strongly on economic incentives. The pattern for the male-female differences in the estimates of the ITAX coefficients is harder to interpret: for the results in Panels A and B the estimates are stronger for females, while the reverse is true for Panel C. Finally, the heterogeneity analysis with respect to educational attainment gives less clear results.

Table 3. Coefficient estimates for the SSW and ITAX measures by gender and maximum education level achieved.

	(1)	(2)	(3)	(4)	(5) Education	(6)
	All	Men	Women	Low	Medium	High
Panel A: All pathways weighted by probabilities						
SSW	–0.0003**	–0.0005***	0.0011***	–0.0003	–0.0003	0.0000
	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
ITAX	0.0082**	–0.0058	0.0215***	0.0105	0.0128**	–0.0018
	(0.0039)	(0.0051)	(0.0064)	(0.0064)	(0.0057)	(0.0113)
Observations	439,761	230,300	209,461	142,270	222,126	75,365
Panel B: Old-age pension path only						
SSW	–0.0004***	0.0003***	0.0010***	–0.0001	–0.0001	–0.0006***
	(0.0000)	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
ITAX	0.0293***	0.0194***	0.0692***	0.0378***	0.0375***	0.0014
	(0.0023)	(0.0028)	(0.0040)	(0.0038)	(0.0037)	(0.0064)
Observations	422,884	223,157	199,727	133,774	214,205	74,905
Panel C: Claiming of benefits fixed at age 65						
SSW	–0.0004***	–0.0001	–0.0002	–0.0005***	–0.0004***	–0.0003*
	(0.0000)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0002)
ITAX	0.0684***	0.225***	0.173***	0.0416***	0.0835***	0.114***
	(0.0096)	(0.0165)	(0.0140)	(0.0161)	(0.0143)	(0.0236)
Observations	410,630	218,289	192,341	128,272	208,819	73,539
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

6.3 Simulation Results

The main research question of this paper is to assess to what extent the reform of the public old-age pension system has contributed to the marked increase in labor force participation in recent decades. To get insight into this question we use our econometric estimates and predict the counterfactual outcomes on retirement hazards for the pure pre- and post-reform systems for the four one-year age groups aged 61 through 64 for the period 2002 to 2012. For the sake of comparison, we also predict the outcome for the actual system, where the transition rules are applied. A limitation of this exercise is that we failed to identify an income effect in the estimates from all our econometric models and we, as consequence, set the income effect to zero in the predictions. This restricts us from assessing the possibility that the lower replacement levels in the post-reform system led to delayed retirement and limit the analysis to the effect to the change in the incentives coming from the implicit tax on staying in the labor force among older workers.

As we showed in Figure 10 in Section 5, the calculated change in the implicit tax measure showed that the tax actually *increased* marginally when we only considered the public old-age pension system and assumed that the worker started to claim benefits in the same year as he or she decided to exit from the labor force. Furthermore, Figure 12 showed that the combined measure changed very little. This means that the models shown in Panels A and B in Table 2, could not be used in order to capture an

increased labor force participation among older workers, as we observe in the data. However, which is revealed in Figure 11, if we fixate the age at which the worker starts to claim his or her pension benefits to age 65, the implicit tax on remaining in the labor force actually decreased as a result of the reform. This allows us to use the model corresponding to the estimates in Panel C to predict an "upper bound" for the increase in labor force participation among elderly as a result of the reform and predicted from our estimated models.

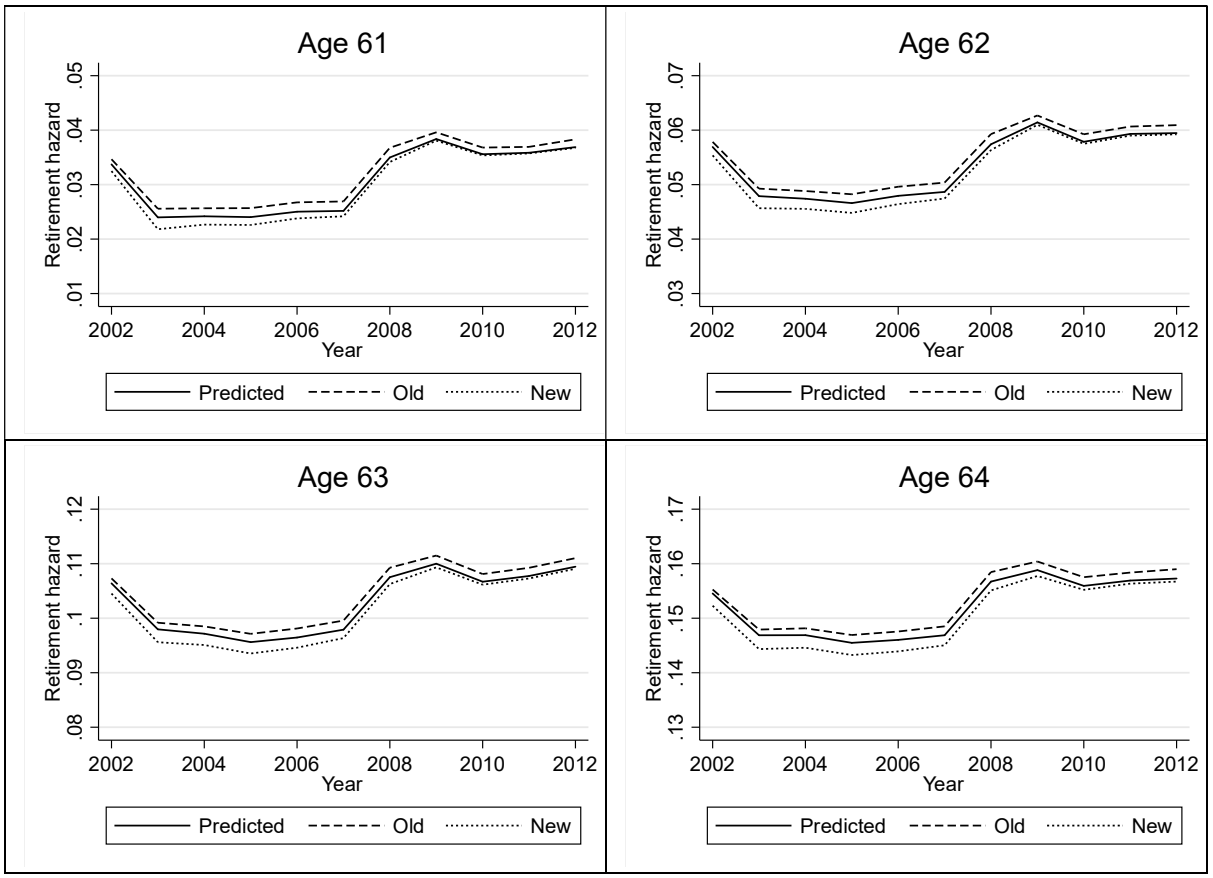

Figure 13. Simulated retirement hazards for old-age pension system only. Pre-reform (Old), post-reform (New) and actual system taking the transition rules into account (Predicted).

The results in Figure 13 show, as expected, that the post-reform public pension system generated a lower retirement hazard in all age groups and throughout 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 14 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 14 we went back to Figure 4 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, was assigned to 20 percent to the new system and that the share gradually increased to 40 percent for those born in 1942. The corresponding cohorts in 2012, born between 1948 and 1953, are assigned between 70 and 95 percent to the post reform system.

It is apparent from these graphs that 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 the relevant birth cohorts were on average covered to 85 percent by the new system, the observed increase in labor force participation is more than 10 percent higher than in the initial year 2002. Still, the prediction from our model suggests an increased labor force participation by less than 1 percent. Our estimates do not 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.

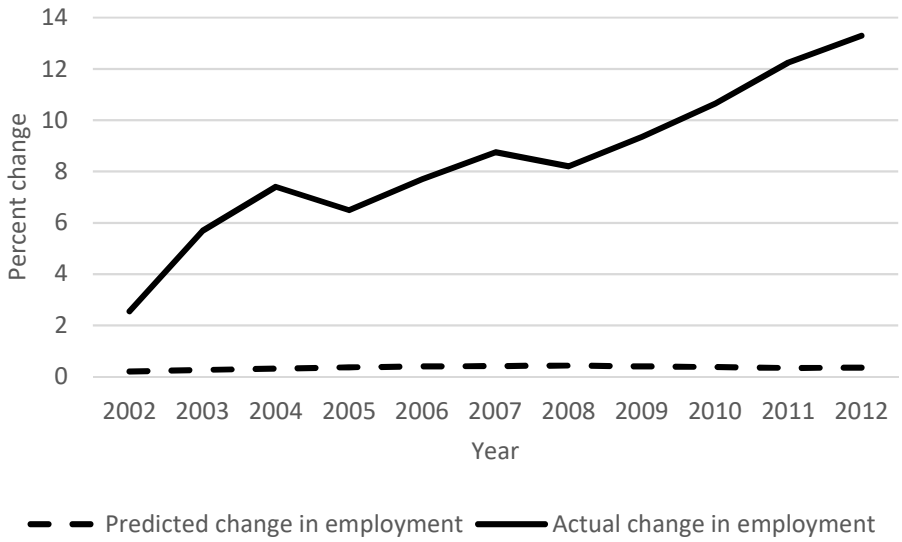

Figure 14. Actual average change in labor force participation in the age group 60–64 along with predicted changes from our econometric estimates 2002–2012.

These estimates contradict the strong effects of the 1998 pension reform on retirement behaviour suggested by Laun and Wallenius (2015). There are, however, several methodological differences between the present study and the Laun and Wallenius one. A limitation of our study is that we were not able to estimate an income effect from the social security system on retirement behaviour and we were, consequently, not able to include the effect of the lower replacement levels in the post-reform system in the simulations. Since Laun and Wallenius did not estimate the parameters in their life-cycle model they avoided this problem and could include this important effect in their simulations. Another difference between the studies is that Laun and Wallenius did only consider the case of a full implementation of the new system, rather than the gradual implementation across cohorts as in the present study. This, of course, magnified the already large difference between the simulation results of the two studies.

7. Conclusions

This study consists of three main parts. In the first part, we describe changes in retirement behavior and how the workers have changed their pathways to retirement with respect to their main income sources after retirement. In the second part, we show how the incentives to remain in the labor force for older workers have changed across birth cohorts around the time of the major 1998 public pension reform. Finally, we estimate various econometric models and try to disentangle the role of economic incentives induced by the pension reform to explain the great increase in labor force participation of older workers.

In the first part, we concluded that, in addition to the general increase in labor force participation among worker older than age 55, there have been three main changes in the retirement behavior in the recent decades: (i) an increasing share retiring through the old-age pension, rather than the disability insurance, pathway; (ii) an increasing variance in the age of the public pension claiming of workers; and (iii) a decreasing average gap between the age of labor force withdrawal and the age at which the retirees start to claim public pension benefits.

In the second part, we showed that the SSW measure and, as a result, the replacement rates from the public old-age pension system unambiguously decreased as a result of the major pension reform, which, provided that leisure is a normal good, would strengthen the incentives to remain in the labor force. Our results for the implicit tax to remain in the labor force were, on the other hand, ambiguous. Assuming that the retirees started to claim the benefits immediately after they exited from the labor market, we showed that there is a slightly lower tax in the pre-reform system. However, when restricting benefit withdrawal to age 65, the results suggest a small decrease in the implicit tax on remaining in the labor force after the reform.

Finally, the estimates from the econometric models show that we failed to identify an income effect, since all coefficient estimates for the SSW measure have the unexpected sign in the main estimates shown in Table 2. The coefficient estimates for the implicit tax to remain in the labor force turned out to have the expected positive sign in most specifications, suggesting that the workers in our sample may have acted on this type of economic incentive in their retirement behavior. However, when we used these estimates in the model where we restrict the withdrawal of the pension benefits to age 65, it turned out that we could only explain a minor part of the recent increase in labor force participation among older workers with changes in this incentive measure.

Although our results could not give a definite answer to the main research question posed in this study, i.e., to what extent the reform of the public old-age pension system could explain the recent increase in labor force participation among older workers in Sweden, we still believe that some things can be learned from them to get a better sense of the role of different effects at work. To us, the perhaps most interesting, and surprising, result obtained in this study is that the tax on remaining in the labor force (measured by ITAX) actually increased slightly as a result of the reform, since one of the main motives behind the reform was to make the pension more actuarially fair.

Our results from the econometric model also allowed us to rule out that changes in the tax of remaining in the labor force attributed to the delay retirement behaviour observed in the data under the assumption that the insured individuals are restricted to withdraw their pension benefits at age 65 – the only case when the tax *decreased* as a result of the reform. The simulation exercise shown in Section 6.3 suggests that the changes in the tax on remaining in the labor force under this assumption were not large enough to generate any considerable changes in employment among elderly.

Taken together, our results thus suggest that the only conceivable channel through which the increase in labor force participation could be attributed to changes in economic incentive to remain employed induced by the pension reform is through an income effect from the less generous post-reform system. Unfortunately – since we were unable to identify the income effect in our econometric model, which were revealed by the unexpected signs of the parameter estimates for the income effect – we were unable to assess empirical importance of this potential mechanism.

Previous studies, e. g. Laun and Palme (2020), suggest that eligibility rules in the Disability Insurance affect labor force participation, beyond what can be captured in our measures of economic incentive, and that improvements in health may also have been important. To assess the importance of these changes in relation to a potential income effect through the pension reform remain as an important topic for future research.

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