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## Retirement patterns during the Swedish pension fund

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*Department of Economics*

# Retirement patterns during the Swedish pension reform

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RETIREMENT PATTERNS DURING THE SWEDISH  
PENSION REFORM

ERIK GLANS

# Retirement patterns during the Swedish pension reform \*

Erik Glans †

November 2008

## Abstract

The Swedish pension reform of 1999-2003 provides an opportunity to study whether and how important economic incentives are for the timing of retirement. The new pension system provides a much closer link between contributions and benefits than the former system. I study whether the reform has led to delayed retirement by examining the retirement patterns of elderly Swedish workers that were differentially affected by the reform. I use duration analysis with annual data from the LINDA database. Discrete time proportional hazard models are estimated. The results show a remarkable decline in the retirement hazard among latter born cohorts, who were more affected by the reform. This implies that retirement is delayed. Most of the decline occurs among public sector employees.

**Keywords:** Retirement, Labour supply, Pension Reform  
**EconLit Subject Descriptors:** H550, J260

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# 1 Introduction

A new Swedish pension system was enacted in 1999, affecting individuals born 1938 and later. Pensions in the new plan are largely determined by lifetime earnings and provide greater incentives for individuals to delay their exit from the labor force. Benefits in the preexisting pension system were only weakly linked to lifetime earnings and provided much higher minimum pensions. This paper is an attempt to test the hypothesis that the pension reform has made people delay their retirement. The LINDA database containing register data on a random sample of about three percent of the Swedish population is used. I estimate differences in the retirement patterns of affected and unaffected cohorts using the complementary log-log model which corresponds to a proportional hazard model in discrete time. I control for education, permanent income, sector specific labour demand in the private sector using economic sentiment indicators, and regional labour demand using regional growth data.

Identification of the reform effect is provided in part by the fact that the reform is being phased in gradually based on individuals' year of birth: The proportion of one's pension provided by the new system is greater the later one was born. The removal of specific thresholds of the old system also provides identification. By exploiting the fact that successively younger cohorts were less affected by rules regarding the minimum number of worked years, it is possible to identify some of the effect of the reform. The old system of supplementary pension (ATP) required 30 years or more of work experience for full pension eligibility, whereas the new system has no such requirement.

Estimates indicate that latter born cohorts postpone retirement, but there is no evidence that the gradual abolition of the 30 year rule is making people postpone retirement. In fact, some results suggest the opposite: Even though individuals belonging to cohorts born later had stronger incentives to continue working after having reached 30 years of work experience, individuals with long work experience within this group actually tended to retire earlier than others. This result seems to be driven in part by the fact that the fraction of females with full ATP (30 years of work experience) increased over time and they are more prone to retire early than males. It may also be driven by stricter rules for disability insurance, which induced individuals with long work experience to retire early through other routes.

The structure of the paper is as follows: Section 2 introduces some earlier literature, section 3 summarizes the reform studied, and section 4 describes the data sources and definitions used. Section 5 discusses the estimation sample and possible biases, section 6 provides some descriptive statistics on the data, and section 7 describes the model and interpretation of estimation coefficients. Estimation results are presented in section 8, while sections 9 and 10 discuss the reliability of

the results with respect both to econometric concerns and confounding reforms. Section 11 concludes.

## 2 Previous literature

As far as I am aware, no comprehensive evaluation of the Swedish pension reform has been undertaken to date. However, the link between retirement timing and economic incentives have been thoroughly studied both in Sweden and internationally. Burtless (1986) studied the impact of benefit increases in US social security in 1969 and 1972. Using data from the Retirement History Survey (RHS), he finds that the increase in benefits of about 20 percent cannot be the main explanation for the subsequent increase in early retirement. Similar results are found by French (2005) using data from the Panel Study of Income Dynamics in the US, covering the period 1968-1997. Using simulations he estimates that a 20 percent reduction in social security benefits would lead only to a delay of retirement by three months. On the other hand, he finds that the social security earnings test is more important in shaping retirement behavior; An elimination of the test would increase the time remaining in the labour force by a full year. Sevak (2002) estimate the wealth elasticity of retirement using difference-in-difference estimation on data from the Health and Retirement Study (HRS) of the US. This is done by exploiting the fact that individuals with defined contribution plans had more to gain from appreciation in equity prices of the late 1990s. The results are that a \$50,000 exogenous increase in wealth leads to a two percent increase in the retirement probability of 55-60 yearolds.

The exogenous source of variation used by Krueger and Pischke (1992) is the US Social Security act of 1977 that reduced the social security wealth of individuals born between 1917 and 1921 as compared to those born earlier. Analyzing data from the Current Population Survey, the authors find very little evidence to support the hypothesis that reduced social security benefits delay retirement, claiming that less than a sixth of the reduction in labour force participation of the 1970's and 80's could be attributed to the reform.

Retirement of blue collar workers under the old Swedish pension system has been studied by Karlstrom et al. (2004). They estimate a dynamic programming model using a restricted sample of individuals in the LINDA database, and predict behavior under hypothetical reforms by simulation. They find that the reform does affect retirement timing in the expected way, but results vary greatly depending on the assumptions made about the variability of preferences over time.

One should not forget that retirement is influenced both by employer and employee preferences. Eklöf and Hallberg (2006) study the importance of employer retirement offers providing benefits beyond the regular pensions. Also using LINDA

data, they estimate that these offers increase the probability of early retirement in the order of 10 to 30 percent. Hakola and Uusitalo (2005) provide very strong evidence for the hypothesis that making unemployment pensions more expensive for firms reduced the risk of unemployment near the retirement age.

Many studies are plagued by sampling issues, small data sets of poor quality, and endogeneity problems. In order to accurately assess the importance of economic incentives for retirement behavior, one requires some exogenous source of variation in incentives with differential effects on the population, and ideally data covering a reasonably long period. This paper has both an exogenous source of large variations in benefits, and makes use of excellent quality register data for a representative sample of the population over a long period of time.

### 3 The reform

This section gives a broad description of the pension reform and the difference between the old and the new pension plans. More detailed information on pension benefit structures and regulations can be found in Ministry of Health and Social Affairs and the National Social Insurance Board (2003), Palmer (2000), Sundén (2006), and Sundén (2000) <sup>1</sup>.

#### 3.1 The former pension plan

The former public pension plan was introduced in 1960. It consisted of guaranteed pensions (*folkpension*), and the public pension supplement (ATP, *allmän tilläggspension*). This pension plan will be referred to as the ATP plan throughout the paper. Public pensions above the guaranteed level were based on the average of the highest 15 years of earnings, or if one had worked less than that, simply the average. In order to receive a full pension, one had to have earned pension points during at least 30 years. Individuals with three years or less of earnings did not qualify at all. Income above a cap of 7.5 basic price amounts <sup>2</sup> (BPA) did not contribute to ATP pension rights. For individuals with less than the required number of years with earned points, the supplementary pension was reduced by a factor:

$$\frac{\text{Years Worked}}{\text{Years Required}} \tag{1}$$

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<sup>1</sup>The most accurate information about the reforms can be found by consulting the legal texts. More general descriptions in Swedish can be found in The Swedish social insurance administration, Ministry of Health and Social Affairs (2005), Statens offentliga utredningar (1994) and Wadensjö and Sjögren (2005).

<sup>2</sup>The basic price amount is 40,300 SEK in 2007, approximately 4,430 €.

Provided they had 30 years of ATP points, individual could only increase their ATP pension through continued work if their real annual income exceeded the average of the highest 15 years of earnings, and then by an amount proportional to the increase in that mean and only if the ceiling of 7.5 BPA had not been reached. There was, however, an early withdrawal penalty of 0,5 percent per month before the age of 65, and the pension was credited with 0,7 percent for every month withdrawal was delayed after that age. Most early retirees in the ATP plan chose to finance early retirement from other sources, such as occupational pensions, and made withdrawals from their ATP first at the age of 65, thus avoiding the penalty. The ATP plan coexisted with minimum guarantee levels, several income tested special supplements and tax breaks for people with low incomes, and occupational pensions, which meant that the marginal effect of delayed retirement on social security wealth was very low.

Calculations of the incentives for early retirement in the old pension system can be found in Palme and Svensson (1997), who include the effects of income taxes and housing benefits. They conclude that incentives for continued work were in general rather low, in particular for individuals eligible for disability insurance. They find that the actuarial adjustments for early and late retirement were not sufficient to compensate the expected lost benefits due to delayed withdrawals.

In the early 90's the pension system as a whole was underfinanced and deemed fiscally unsustainable. It was also recognized that it had detrimental effects on labour supply. A new pension system was decided upon with the explicit aim of providing a closer link between lifetime earnings and pension benefits, SOU(1994:20).

## 3.2 Implementation of the new system

In the new plan 16 percent of annual income up to 7.5 basic income amounts (BIA) <sup>3</sup> are credited to notional individual accounts. 2.5 percent of earnings are paid into fully funded premium pension accounts. Delayed retirement increases the pension by shortening the expected benefit period. Pensions are calculated on the basis of expected survival of one's birth cohort, and are adjusted if there is a deficit in the system. The new rules were not in full force until 2003, although the law regulating them was passed in 1998, and parliament decided upon the broad outline of the new rules as early as 1994. The most important rules regarding pension rights entered into force in 1999. The earliest possible age for withdrawal of public pensions was increased from 60 to 61 for those born 1938 and later in

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<sup>3</sup>In the new system pensions are income indexed rather than price indexed. The basic income amount, as calculated by Statistics Sweden and based on average labour earnings in the working population was 45,900 SEK in 2007. The basic price amount, BPA, follows the consumer price index and was 40,300 SEK in 2007.



1998. The first allocation of the fully funded individual premium savings accounts was in year 2000. Income indexation of benefits replaced price indexation in 2002.

The fraction of pensions provided from the two systems depends on the year of birth. Those born before 1938 are unaffected by the reform. Those born in 1938 receive 4/20th of their pension from the new plan. For each year of birth beyond this point an additional 1/20th is provided by the new system. Those born in 1954 and later gain their whole pension from the new system.

## 4 Data and definitions

I use a data from the LINDA database, a panel data-set consisting of a representative random sample of approximately three percent of the Swedish population. It is based on calendar year register data mainly from the tax authorities. I use a subsample consisting of individuals born 1936 to 1942 aged 60 to 64 that are observed between the years 1996 to 2005. The observation frequency is annual. The number of individuals, observations, and retirement events for two different samples (described below) are shown in Table 1.

Table 1: Total observations

Sample:	Disabled censored out	Disabled included as retired
Observations	62022	64388
Individuals	15951	16477
Retirement events	5153	7519

Retirement is broadly defined to be the state an individual is in when he or she is gaining most of her income from pensions. I assume that unemployed individuals in the sample are looking for work and therefore I include them in the labour force, even though some of these people in practice may no longer be willing to work. An individual is defined to be in retirement when labour and active self employment income falls short of the value of 1.75 basic price amounts (BPA) in 2006 <sup>4</sup> in constant wages, and pension income exceeds 1.75 BPA. This threshold is slightly higher than that used by for instance Hallberg (2008) and is chosen to be slightly below the minimum guaranteed pension level in the new system. An individual is also defined to be retired if all other income except pension income is zero, even if retirement income is below 1.75 BPA. This definition means that part time retirees are counted as still being in the labour force. If the individual did not earn any

<sup>4</sup>A BPA was 39,700 SEK in 2006. The choice between using the basic income amount or the basic price amount is arbitrary, but the BIA is not used because it has only been calculated since 2001.

pension income the year before, retirement is defined to occur in the same year as this income pattern is observed. This pattern is indicative of retirement at the turn of the year. If on the other hand the individual earned some pension income the year before, that year is determined to be the year of entry into retirement. A wage index rather than price index is used to deflate income to avoid the possibility that more individuals are categorized as working because of rising wages even though their work hours may have been unchanged. Since real wages have been increasing throughout the sample period, this avoids overestimation of the fraction retired in earlier born cohorts as compared to latter born ones.

Income not only includes pure salaries, but also temporary sick-leave benefits, parental leave benefits and unemployment benefits, since these are all benefits that at least to some degree require participation in the labour force, and are included in pension qualifying income. Table 2 shows two fictional examples of the typical income pattern for individuals and how retirement is defined on the basis of this pattern. Income is measured in basic price amounts, the last columns shows which observations are included in the estimation sample.

Table 2: Examples of data using the definition of retirement

Age	Labour income	Pension income	Retirement	Retired	Estimation sample
Example 1					
60	5,4	0	0	0	1
61	5,6	0	0	0	1
62	0	4,8	1	1	1
63	0	4,6	0	1	0
64	0	4,4	0	1	0
Example 2					
60	7,5	0	0	0	1
61	6,9	2,3	0	0	1
62	4,2	3,4	1	0	1
63	0,4	6,1	0	1	0
64	0	5,4	0	1	0

A large fraction of those leaving the labour force do so with disability benefits. If disability is caused by exogenous factors the disabled should be censored. In practice it has been a common view historically that disability benefits are a rather regular early retirement path for individuals who were not fully disabled. Prior to 1997 benefits could be paid out for labour market reasons in combination with some form of disability. Individuals receiving disability benefits are treated as censored in the main analysis. The appendix provides corresponding results from the equivalent analysis but where individuals with disability benefits are treated

as retired.

Individuals with zero income are also censored, since many of these have probably left the country without registering their emigration. Still, some may be homemakers or housewives that are in effect retired and living off personal savings. This fact introduces some degree of error in the analysis, and it means that the proportion retired is probably somewhat understated. A robustness check where individuals with no income are assumed to be retired shows only small differences compared to the results using the baseline definition.

The sampling period is the calendar year, so the data do not fit the model perfectly; Instead of measuring hazards at age  $a$ , we only have data from the year individuals have their  $a$ 'th birthday. This can be problematic since individuals born later in the year are less likely to retire in the year of their birthday as compared to those born earlier in the same year. The inclusion of month of birth dummy variables should remedy this problem. In effect, the baseline hazard estimated in this case is defined over age in both years and months under the assumption of a constant 'month' baseline hazard function that is independent of age in years. The other covariates used are marital status, level of education, sex, county level economic growth and a proxy of permanent income. The proxy is mean real income at the age 50-55. ten quantile dummies are used to allow for a non-linear relationship between retirement timing and permanent income. Several dummies are dropped in order to avoid collinearity. The reference group is those unmarried males born in June of 1937 with a university degree and where applicable, were in the 6th income decile of mean income of the whole sample at the age 50-55. The estimates should be interpreted in reference to this baseline category.

Data on education is missing for a small number of individuals, these missing values are replaced by predicted values as described in the appendix. Missing data is very uncommon, and the bias in standard errors resulting from this prediction is negligible.

## 5 Sampling

Because ordinary retirement status is inferred from annual income, being retired in a particular year is assumed to imply that the individual entered retirement the year before, unless it is evident on the basis of the income pattern that retirement occurred at the turn of the year (as is the case in example 1 of Table 2). The risk set consists of individuals who were in the labour force the year before: They have to have had labour related income above 1.75 BPA in the previous year. Because information prior to and after retirement is required in order to determine whether the event occurred that year, the first and last observation for each individual must be deleted from the sample, and only those with at least three consecutive years

of observation are included. Data on disability benefits on the other hand can be used to identify disability in the same year. Income data from the year of death is not used.

The sample includes those born between 1936 to 1942 having their 60'th to 64'th between 1996 to 2005. The age 64 category is missing for those born in 1942 since their 64th birthday is in 2006.

The self employed are usually excluded from retirement studies, which is unfortunate because it leads to sample selection bias and less generality in terms of the population covered. One reason for their exclusion is that observed income in any given year does not necessarily correspond to work undertaken in the same year, often because of tax deferrals. Data on tax deferrals is only available for the last few years in the LINDA database. Still, the self employed are included in the current study for the following reasons: Judging from the years when data is available, only about half of those who are ever self employed ever make use of tax deferral possibilities, and most of the tax deferrals that are quite small. Many who defer tax also pay tax on previously deferred income of similar amounts, meaning that net taxes are little different from what they would have been in the absence of this option. Most importantly, legislation stipulates that all deferred tax be paid in the year during which self employment activity ceases. Furthermore, even if measurement error in the dependent variable arises, this only leads to larger standard errors as long as self employment behaviour is not systematic. Excluding the self employed is a worse option because it leads to sample selection bias since many older workers leave the labour force only to continue working as self employed, and will lead to an underestimation of the true retirement age.

## 6 Descriptive Statistics

Although the individuals of interest are in the age category of 60 to 64-yearolds, one should be aware that a substantial fraction of the population has already left the labour force already at the age of 60. Labour force status at this age is shown in Table 3. The cohort size has increased over time because of rising birthrates.

What are those that are not working doing? About 70 percent of them became disabled before the age of 60. Of the remaining 30 percent, about half are retired and about half have no income at all. Some of the individuals with zero income have probably left the country without registering with the public authorities. Some are probably housewives or homemakers that have temporarily or permanently left the labour force. What is the source of income for those already retired? Most are getting income from occupational pension schemes and some are making withdrawals from private pension saving schemes. It also seems that many of them have some labour income, but often insufficient to support a household. Table 4

Table 3: Sampled individuals in and outside the labour force (the risk set) at age 60, disabled censored, total and shares in percent

Year of birth	Not in labour force	In labour force	% in labour force	Total
1936	883	1,855	67,8	2,738
1937	928	1,962	67,9	2,890
1938	885	2,155	70,9	3,040
1939	886	2,270	71,9	3,156
1940	897	2,229	71,3	3,126
1941	885	2,340	72,6	3,225
1942	917	2,721	74,8	3,638
Total	6,281	15,532	71,2	21,813

shows the fractions on full disability benefits by age and cohort. These are as a proportion of the entire sample. The proportion disabled appears to be falling for those aged 60 and is substantially lower for those born 1942 relative to others.

Table 4: Percent fully disabled by cohort and age

	60	61	62	63	64
1936	20.5	24.0	25.8	26.9	26.5
1937	20.8	22.7	24.6	27.2	28.0
1938	17.6	19.4	22.6	24.6	26.8
1939	17.6	20.2	23.0	26.1	27.0
1940	19.1	21.2	24.3	25.7	27.4
1941	18.3	21.3	23.0	24.8	26.8
1942	15.9	17.4	19.8	22.1	.

Table 5 shows the proportion of individuals with full ATP, i.e 30 years of pension qualifying income by age and cohort separately for females and males. These figures are excluding the disabled. Note that the proportion of females with full ATP has been growing rapidly in line with increased labour force participation rates of the post-war period, whereas the rates for males has been permanently high.

Table 6 shows retirement rates for the samples where the disabled are treated as censored. Table 16 in the Appendix shows the equivalent for the sample where the disabled are treated as retirees. Note that retirement rates fall over cohorts, in particular for those aged 60 and 63. The different trends over age categories suggests that the proportionality assumption of the proportional hazard model may not be satisfied.

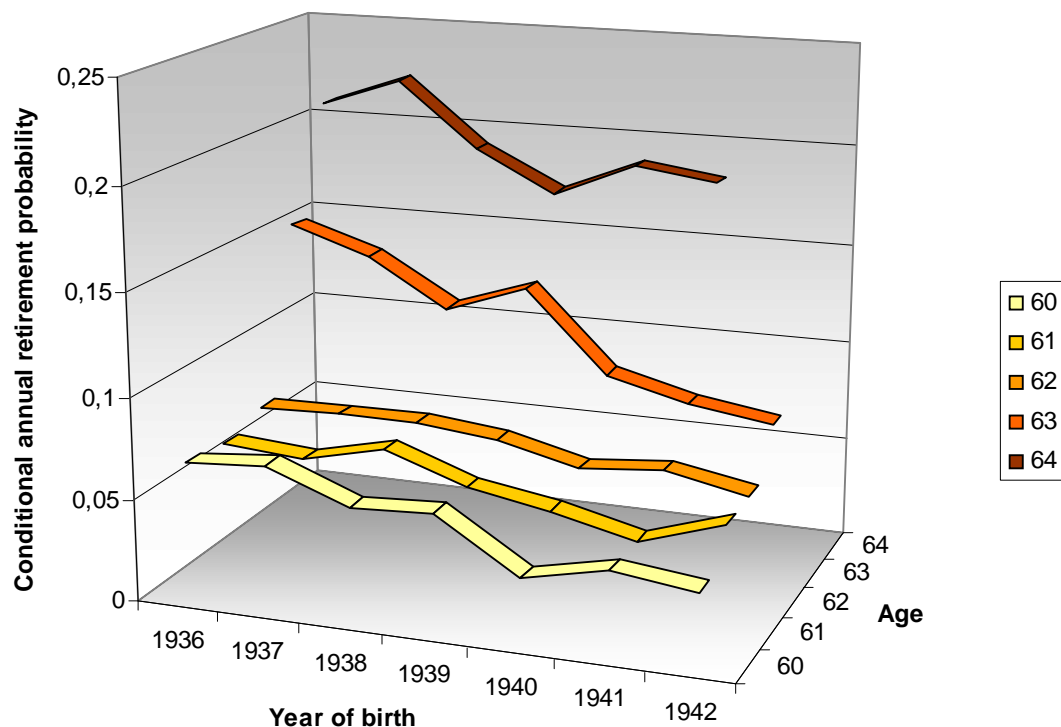
Table 5: Percent females and males with full ATP by cohort and age, disabled excluded

Females	60	61	62	63	64
1936	43.5	47.5	52.1	57.0	61.1
1937	42.0	47.3	53.0	59.0	63.5
1938	53.6	59.6	63.1	68.1	73.1
1939	63.0	69.0	73.2	76.5	78.4
1940	65.7	70.8	75.9	80.3	83.2
1941	73.3	77.8	81.6	85.3	88.0
1942	80.6	83.7	86.6	89.5	.
Males	60	61	62	63	64
1936	94.2	94.7	95.2	95.6	95.6
1937	93.7	94.2	94.1	94.9	94.9
1938	94.0	94.6	95.6	95.6	95.5
1939	94.9	95.7	96.7	97.6	98.1
1940	96.3	96.4	96.7	96.8	96.7
1941	96.5	96.5	97.0	97.6	97.4
1942	95.8	95.9	96.4	96.6	.

Table 6: Retirement rate by age and year of birth: In percent, disabled censored

	60	61	62	63	64
1936	6.7	6.4	7.0	15.4	20.9
1937	7.0	6.1	7.1	14.1	22.3
1938	5.5	7.0	7.1	11.8	19.1
1939	5.7	5.6	6.7	13.2	17.1
1940	3.1	4.9	5.7	9.2	18.8
1941	4.0	3.9	6.1	8.2	18.2
1942	3.5	5.3	5.3	7.6	.
Total	5.0	5.5	6.3	11.0	19.3

Figure 1: Retirement rate by year of birth and age when the disabled are censored. A graph of the figures in Table 6.



The unconditional proportions of retired individuals over time by age category are shown in figures 2 and 3 for samples where the disabled are excluded and treated as retired respectively. These proportions are calculated without regard to prior labour force participation. Note that there was a gradual trend in fewer retired individuals when the disabled are included whereas non-disability retirement started to drop first after most people presumably became aware of the new pension rules around the year 2000 when they received information about the premium pension choices to be made.

Means of some covariates are shown in Table 7. The last column shows the CPI deflated value of mean non-zero income of the individuals between the age 50-55 measured in basic price amounts (BPA) of 2006.

Figure 2: Proportion retired over time by age category, disabled excluded

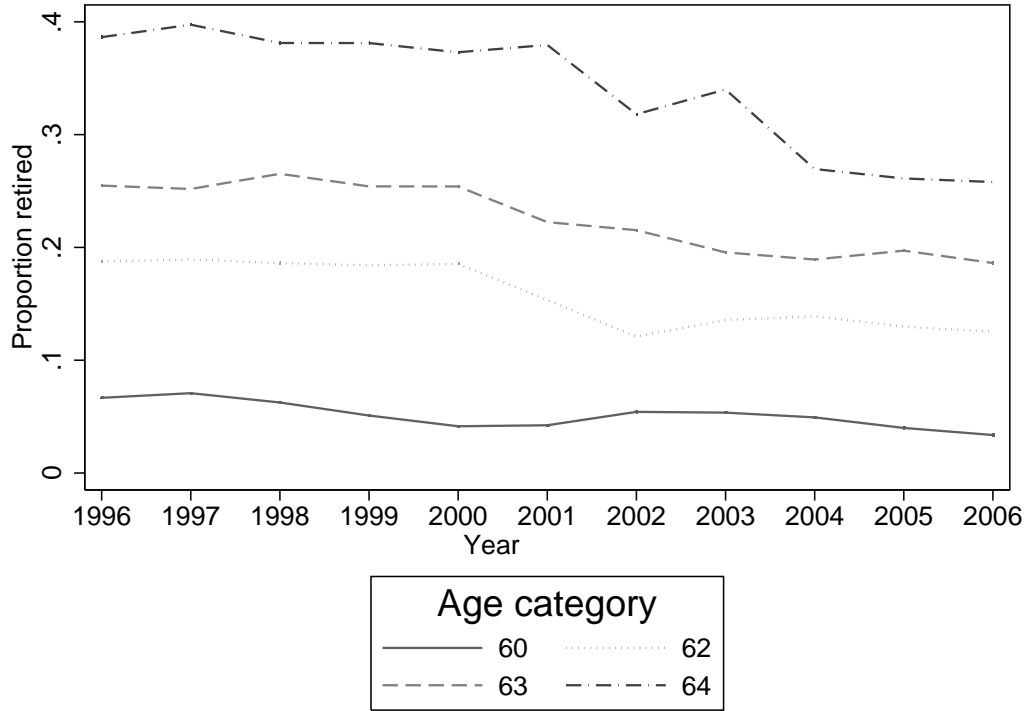
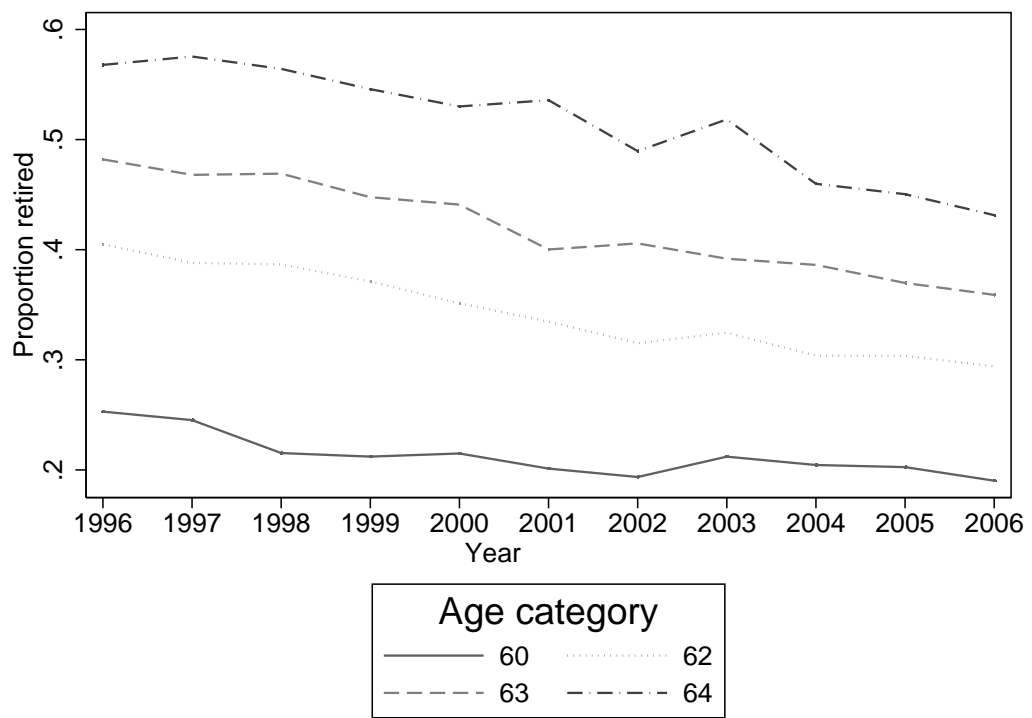


Table 7: Means by year of birth

Year of birth	Prop. female	Prop. married	Lag real income in BPA of 2006
1936	0.526	0.690	4.865
1937	0.512	0.683	5.011
1938	0.497	0.677	5.072
1939	0.517	0.667	4.993
1940	0.492	0.646	4.926
1941	0.512	0.644	5.072
1942	0.473	0.646	5.191
Mean	0.504	0.664	5.020



Figure 3: Proportion retired over time by age category, disabled retired



## 7 The model

The discrete-time transition model is used, for details see Sueyoshi (1995). The model is not directly derived from any underlying structural model of utility maximization. Rather, it is based on the assumption that there is an underlying baseline hazard of retirement for any given age common to the population, and that individual characteristics or other variables such as changed incentives affect this hazard proportionally across all age categories. The reason for choosing the survival analysis approach rather than a utility based option value or dynamic programming model is because the latter are based on loose assumptions regarding rational individual behaviour and makes identification of the reform effect based on exogenous variation more difficult. The difference in difference estimator in the survival analysis setting is attractive because it requires rather weak assumptions for identification.

It is important to distinguish between the underlying continuous time model and its discretized counterpart as observed in the data at hand. This distinction is made by using  $a$  to denote age in year intervals, and  $t$  to denote continuous time age within the interval.

Let  $Z$  be a deterministic index function reflecting the propensity to retire in continuous time:

$$Z(t)_a = h_a(t) + \mathbf{X}\beta \quad (2)$$

Where  $h_a(t)$  is an unknown continuous time dependent function at age  $a$ , defined over  $(0,1]$ , where 0 is the start of the time interval at age  $a$  and 1 is the end. Without loss of generality we can assume an arbitrary non negative continuous time baseline hazard function  $\lambda_a^B(t)$  such that

$$h_a(t) = \ln \int_0^t \lambda_a^B(s) ds \quad (3)$$

Assume a proportional hazard model:

$$\lambda_a(t, X, \beta) = \lambda_a^B(t) \exp(\mathbf{X}\beta) \quad (4)$$

Let  $A_0$  be initial age. The conditional probability, or discrete time hazard is then given by:

$$\begin{aligned} P [y_{ia} = 1 \mid y_{i(a-k)} = 0, \forall k = A_0, \dots, a-1] \\ = 1 - \exp(-\exp((h(1)_a + \mathbf{X}_i\beta))) \end{aligned} \quad (5)$$

This corresponds to the complementary log-log model, which can be easily estimated using maximum likelihood. Left censoring is not a problem since the starting age of all spells is assumed to be the same for all individuals. The spells are not defined over clock-time from some predefined starting point, they are defined over age, and are conditional on the individual working at some point between age 59-63.

The estimates have the interpretation as the effect of changes in the covariates on the relative risk in continuous time:

$$\beta_k = \frac{\partial \ln \lambda(t; \beta, X)}{\partial x_k} \quad (6)$$

For small changes in the covariate, the coefficient is a good approximation of the proportional effect on the hazard. For dummy variables switching from 0 to 1, the percentage effect on the hazard is given by

$$100(e^\beta - 1) \quad (7)$$

Continuous time hazard is not a very intuitive concept, so it may be more interesting to interpret the parameters in terms of annual conditional survival probabilities. The marginal effect on the retirement probability conditional on the individual being in the labour force the year before for coefficients on 0 - 1 dummy variables as compared to the baseline group is given by:

$$P_1 - P_0 = e^{-e^{h(1)}} - e^{-e^{h(1)}e^\beta} \quad (8)$$

Since the error variance is normalized in this binary model, the scale of the coefficients is actually unidentified.

## 8 Results

### 8.1 Difference-in-difference estimates

Baseline model estimates are presented in Table 8. The first column shows the difference in retirement hazards between cohorts without controls. There is a clear large and statistically significant downward trend in retirement between the cohorts. This pattern persists when controlling for education and decile dummies for real lag mean labour related income between age 50-55 as is shown in column 2. These estimates show that high income earners, the less educated, females and married individuals retire earlier than the reference group. Post-graduates and low income earners stay longer in the labour force. County level economic growth is also controlled for but the estimate is small and insignificant.

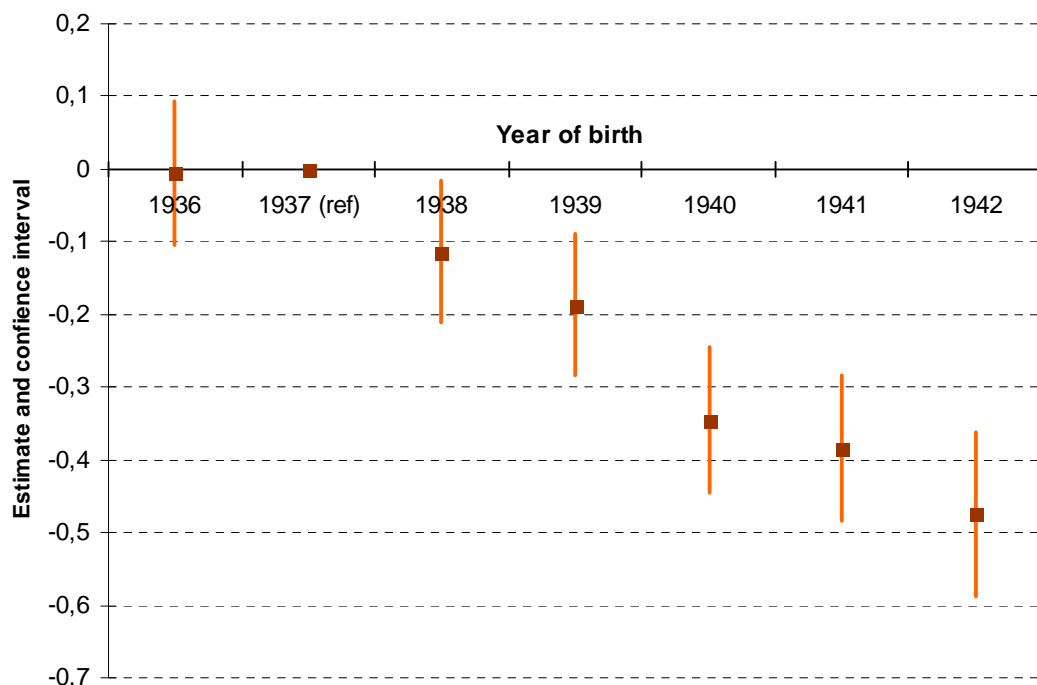
The third column of Table 8 contains the difference-in-difference estimates in which a dummy for the equivalent of full pension eligibility (30 years of work experience) is interacted with the year of birth dummy variables. The estimates for those with 30 years of work experience born both in 1940 and 1942 are positive, large and statistically significant, which indicates that those with long work experience of latter born cohorts are relatively less prone to delay retirement than those born earlier. This is in opposition to the hypothesis that workers expecting a higher proportion of pensions from the old system were more inclined to retire once having reached the 30 year requirement. The estimates are at odds with the prediction that those more affected by the reform and have reached the equivalent of full ATP are retiring earlier than those less affected by the reform, since the new system provides greater incentives for continued work beyond this threshold. This result seems to be driven by a switch from disability insurance to regular retirement as a result of more stringent benefit rules in the disability insurance scheme. If the disabled are treated as censored (results shown in the appendix) the interaction terms are insignificant and close to zero. Since employees with long work experience often are at higher risk for work disability, it is plausible that more stringent benefits rules has gradually made these individuals choose early retirement instead, despite the financial cost of such a choice.

The last column of Table 8 contains similar estimates where the dummy includes only those who have earned above the ceiling of 7.5 BPA for at least fifteen years and have in total worked 30 years or more. These people had the maximum possible public pension in the old system, but could still increase their pension in the new system. The estimates show that despite facing greater incentives to delay retirement, those born in 1942 among this group were more prone to retire early than those born earlier. Again, this is opposite to what one would expect on the basis of incentives in the public pension system. The results may also be explained by the wealth effect of the reform. Individuals with different initial pension wealth may respond differently to a reduction in expected pension wealth. The lower the initial wealth, the stronger is the effect of a pension wealth reduction on retirement timing. Indeed, if log lagged income interacted with year of birth is included (see Table 9)<sup>5</sup>, it is clear that later cohorts, in particular those born 1940 and 1942 are more responsive to lagged income in their retirement behaviour than earlier born ones, and that this cancels out some of the effect from the full ATP dummies. These become statistically insignificant but are still positive and rather large. This canceling effect is most likely because long work experience is associated with higher social security wealth.

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<sup>5</sup>Recall that missing data is replaced by fitted values, so the sample is unchanged

Figure 4: 95 % Confidence intervals of year of birth coefficients, from the estimation of the retirement hazard, disabled censored. Estimates corresponding to column two of Table 8.



## 8.2 Controlling for labour demand

It is difficult to establish how much of the changing pattern of retirement is caused by labour supply effects of the reform rather than contemporaneous changes in labour demand. In fact, most of the increase of labour supply seems to be within the public sector as can be seen by comparing column 1 of Table 10 containing estimates of those previously since the age of 59 were employed in research, teaching, childcare, public administration and health care and column 2 containing estimates for those ever employed in the private sector (these categories are imperfect, see the appendix for details). It is possible to proxy for labour demand for a subset of the private sector using industry specific sentiment indicators from survey data collected by the National Institute of Economic Research (the indicator data is incomplete, see the appendix for details). Controlling for sector economic sentiment does not change other coefficient estimates very much (The difference between estimates in columns two and three are mostly due to the sample being slightly

Table 8: Complementary log-log estimation of the retirement hazard: standard errors in parentheses

	(1)	(2)	Full ATP	Maximum ATP
Born 1936	-0.008 (0.050)	-0.005 (0.050)	-0.024 (0.100)	0.005 (0.054)
Born 1938	-0.119 (0.050)	-0.115 (0.050)	-0.208 (0.108)	-0.140 (0.054)
Born 1939	-0.168 (0.050)	-0.187 (0.050)	-0.185 (0.114)	-0.169 (0.053)
Born 1940	-0.349 (0.051)	-0.345 (0.051)	-0.750 (0.143)	-0.365 (0.056)
Born 1941	-0.368 (0.051)	-0.385 (0.051)	-0.549 (0.143)	-0.392 (0.055)
Born 1942	-0.468 (0.057)	-0.474 (0.057)	-0.909 (0.196)	-0.572 (0.064)
Married		0.135 (0.031)	0.143 (0.031)	0.132 (0.031)
Female		0.353 (0.034)	0.395 (0.034)	0.367 (0.034)
Regional GDP		-0.004 (0.006)	-0.004 (0.006)	-0.004 (0.006)
Primary education less than 9 years		-0.231 (0.037)	-0.232 (0.037)	-0.228 (0.037)
9 years primary education		-0.189 (0.060)	-0.186 (0.060)	-0.187 (0.060)
Graduate		-0.130 (0.037)	-0.134 (0.037)	-0.138 (0.037)
Post graduate		-1.175 (0.156)	-1.176 (0.156)	-1.203 (0.156)
0 lag income		-0.972 (0.450)	-0.757 (0.451)	-0.969 (0.450)
10% lag income		-0.666 (0.114)	-0.563 (0.116)	-0.664 (0.114)
20% lag income		-0.308 (0.072)	-0.251 (0.072)	-0.314 (0.072)
30% lag income		-0.097 (0.063)	-0.061 (0.064)	-0.104 (0.063)
40% lag income		-0.150 (0.063)	-0.120 (0.063)	-0.155 (0.063)
50% lag income		-0.089 (0.062)	-0.081 (0.062)	-0.092 (0.062)
70% lag income		0.207 (0.059)	0.203 (0.059)	0.209 (0.059)
80% lag income		0.173 (0.060)	0.160 (0.060)	0.174 (0.060)
90% lag income		0.233 (0.060)	0.220 (0.060)	0.210 (0.061)
100% lag income		0.412 (0.061)	0.402 (0.061)	0.281 (0.079)
Full/Maximum ATP dummy			0.123 (0.083)	0.095 (0.115)
Full/Maximum ATP born 1936			0.024 (0.116)	-0.088 (0.150)
Full/Maximum ATP born 1938			0.108 (0.122)	0.178 (0.143)
Full/Maximum ATP born 1939			-0.016 (0.127)	-0.131 (0.148)
Full/Maximum ATP born 1940			0.438 (0.154)	0.144 (0.147)
Full/Maximum ATP born 1941			0.159 (0.153)	0.032 (0.145)
Full/Maximum ATP born 1942			0.443 (0.205)	0.509 (0.147)
N	62022	62022	62022	62022
<b>Controls:</b>				
Age and month of birth	Yes	Yes	Yes	Yes

Table 9: Complementary log-log estimation of the retirement hazard, varying income effect: Disabled censored, standard errors in parentheses

Full ATP dummy	0.189 (0.090)
Full ATP born 1936	-0.040 (0.130)
Full ATP born 1938	-0.004 (0.132)
Full ATP born 1939	-0.013 (0.138)
Full ATP born 1940	0.315 (0.163)
Full ATP born 1941	0.153 (0.163)
Full ATP born 1942	0.250 (0.213)
Lag log income born 1936	0.433 (0.094)
Lag log income born 1937	0.301 (0.084)
Lag log income born 1938	0.542 (0.080)
Lag log income born 1939	0.287 (0.083)
Lag log income born 1940	0.588 (0.090)
Lag log income born 1941	0.331 (0.083)
Lag log income born 1942	0.706 (0.094)
Born 1936	-0.199 (0.190)
Born 1938	-0.535 (0.185)
Born 1939	-0.169 (0.188)
Born 1940	-1.135 (0.214)
Born 1941	-0.603 (0.204)
Born 1942	-1.440 (0.256)
Married	0.147 (0.031)
Female	0.392 (0.033)
Regional GDP	-0.003 (0.006)
Primary education less than 9 years	-0.095 (0.044)
9 years primary education	-0.057 (0.064)
High School	0.134 (0.036)
Post graduate	-1.069 (0.155)
N	62022
<b>Controls:</b>	
Age and month of birth	Yes

different). Note however that the estimate on the sentiment indicator, which is a measure from -100 to 100 is relatively large and statistically significant. A 50 point change in the indicator is not uncommon for which the estimate implies an approximate proportional hazard effect of about 20 percent.

### **8.3 Controlling for trends by sex, sector and permanent income**

It is clear that there are separate trends in retirement hazard for men and women and different sectors. Table 11 shows that by far the largest delay of retirement occurs among public sector employees, and that after controlling for sector, and cohort specific effects of log lagged income, there is no clear differential trend among males or females, although females on average retire earlier. Public sector employees go from being more prone to retire early to being much less prone to do so as compared to the reference group (private sector employees). Some of the difference between the public and private sector is probably due to different changes in occupational pension schemes. This will be a subject of further research.



Table 10: Complementary log-log estimation of the retirement hazard, by sector:  
Disabled censored, standard errors in parentheses

	Public sector	Private sector	Controlling for sentiment
Married	0.283 (0.048)	0.018 (0.042)	-0.019 (0.047)
Female	0.302 (0.059)	0.350 (0.046)	0.287 (0.053)
Primary education less than 9 years	-0.013 (0.077)	-0.172 (0.063)	-0.289 (0.071)
9 years primary education	0.052 (0.107)	-0.219 (0.088)	-0.402 (0.103)
High School	0.110 (0.058)	0.024 (0.055)	-0.064 (0.062)
Post graduate	-0.943 (0.198)	-0.585 (0.263)	-0.351 (0.283)
Regional GDP	-0.001 (0.008)	-0.005 (0.008)	0.004 (0.009)
Born 1936	0.006 (0.074)	-0.019 (0.072)	-0.020 (0.081)
Born 1938	-0.182 (0.075)	-0.058 (0.069)	-0.089 (0.078)
Born 1939	-0.209 (0.074)	-0.168 (0.070)	-0.218 (0.079)
Born 1940	-0.665 (0.081)	-0.128 (0.070)	-0.140 (0.079)
Born 1941	-0.722 (0.080)	-0.200 (0.070)	-0.134 (0.078)
Born 1942	-0.924 (0.094)	-0.231 (0.076)	-0.189 (0.086)
0 lag income	-1.180 (0.712)	-0.473 (0.581)	-0.217 (0.584)
10% lag income	-0.783 (0.203)	-0.600 (0.167)	-0.508 (0.182)
20% lag income	-0.115 (0.105)	-0.505 (0.110)	-0.390 (0.122)
30% lag income	0.024 (0.094)	-0.263 (0.096)	-0.205 (0.107)
40% lag income	0.140 (0.092)	-0.493 (0.097)	-0.484 (0.111)
50% lag income	0.032 (0.093)	-0.192 (0.090)	-0.201 (0.102)
70% lag income	0.240 (0.099)	0.193 (0.077)	0.204 (0.086)
80% lag income	0.229 (0.098)	0.148 (0.078)	0.137 (0.088)
90% lag income	0.129 (0.101)	0.278 (0.077)	0.268 (0.087)
100% lag income	-0.099 (0.124)	0.496 (0.076)	0.430 (0.086)
Sector sentiment			-0.004 (0.001)
N	24464	33719	27491
<b>Controls:</b>			
Age and month of birth	Yes	Yes	Yes

Table 11: Complementary log-log estimation of the retirement hazard with varying trends; Disabled censored, standard errors in parentheses

Married	0.151 (0.031)
Regional GDP	-0.002 (0.006)
Born 1936	0.146 (0.254)
Born 1938	-0.171 (0.248)
Born 1939	0.019 (0.248)
Born 1940	-0.663 (0.274)
Born 1941	-0.008 (0.260)
Born 1942	-0.786 (0.308)
Full ATP dummy	0.289 (0.094)
Full ATP born 1936	-0.152 (0.138)
Full ATP born 1938	-0.100 (0.138)
Full ATP born 1939	-0.066 (0.143)
Full ATP born 1940	0.194 (0.167)
Full ATP born 1941	0.013 (0.167)
Full ATP born 1942	0.102 (0.216)
Female	0.560 (0.087)
female born 1936	-0.355 (0.126)
female born 1938	-0.272 (0.122)
female born 1939	-0.115 (0.120)
female born 1940	-0.124 (0.125)
female born 1941	-0.194 (0.123)
female born 1942	-0.177 (0.134)
In public sector	0.220 (0.066)
in public sector born 1936	0.199 (0.102)
in public sector born 1938	0.021 (0.100)
in public sector born 1939	-0.013 (0.099)
in public sector born 1940	-0.450 (0.106)
in public sector born 1941	-0.499 (0.106)
in public sector born 1942	-0.578 (0.120)
N	62022
<b>Controls:</b>	
Age, month of birth and education	Yes
Cohort specific lag income	Yes

## 8.4 Interpretation of the estimates

Even though the coefficient estimates are not identified to scale, it may be of interest to interpret the estimates in terms of annual conditional retirement probabilities. This is the difference in the probability of retirement conditional on being in the labour force between different individuals. Table 12 shows the difference in annual conditional retirement probabilities for various groups in relation the baseline reference group for the model where the disabled are censored (The second column of Table 8). The coefficient of -0.47 for those born in 1942 is equivalent to a 37.7 percent lower conditional retirement probability as compared to the reference group born in 1937. The 95 percent confidence interval as calculated by the delta method is (-44.8, -30.8) percent. For individuals still working at the age of 64 the point estimate is equivalent to a 5.6 percent lower retirement probability which can be compared to the reference group probability of 15.66 percent. As the table shows, post graduates have a much lower retirement probability than others, whereas females on average have a higher retirement probability.

Table 12: Percent difference from reference group in annual conditional retirement probability

	Coefficient estimate	Age 60	Age 62	Age 64
Baseline Probability		3.96	5.15	15.66
Born 1936	-0.01	-0.02	-0.03	-0.08
Born 1938	-0.11	-0.42	-0.54	-1.57
Born 1942	-0.47	-1.48	-1.91	-5.60
Married	0.13	0.55	0.72	2.03
Female	0.35	1.63	2.10	5.87
Post Grad.	-1.04	-2.54	-3.30	-9.82

In terms of expected survival time, the coefficient estimate of -0.47 on the 1942 cohort dummy indicates a delay in retirement by approximately 3.3 months compared to the reference group within the censored observation age of 60-64. The effect appears to be rather small because relatively few of those who worked at 59 retire before 64. One can extend the age horizon on the basis of observed retirement rates among those born in 1937 until the age of 68 (the final year of observation for this cohort). The comparable survival function for those born in 1942 can be predicted using the estimated lower hazard for this cohort. The prediction suggests that the retirement delay within the censored age span of 60-68 is almost a year, 11.4 months to be exact. This estimate is valid for the reference population, i.e males in the 6th income decile with a university degree. The proportionality assumption and absence of individual heterogeneity is required for the validity of

the estimate. The proportionality assumption probably does not hold for ages over 65 however, so the estimate should be interpreted with some caution. Since 65 is a generally accepted retirement age in Sweden, it is likely that behaviour is different at that age as compared to behaviour in the 60-64 age span.

## 9 Discussion

The most important assumptions underlying identification are those concerning the definition of retirement, exogeneity of censoring, omitted variables, forward looking behaviour of workers, endogeneity in the work experience variable, repeated spells, general equilibrium effects, and the importance of the 30-year rule in relation to other changes in the reform. Using price indexation instead of wage indexation does not change the results substantially. Neither does reducing the income threshold from 1.75 to 1 BPA. The assumption that censoring due to death, migration, or zero income is random is unlikely to be satisfied. It is probable that those people who are of poor health may be less inclined to continue working. Estimating the models under the assumption of immediate retirement at death or emigration yields similar results to those reported, however.

The timing of the implementation of the new pension plan is a concern. The data covers the period 1996 to 2005, but the new system was not in full force until 2003. The estimator will be misleading as an indicator of the long term consequences of the reform for retirement behaviour if individuals did not adjust their behaviour as soon as the changes were decided upon. It could be that many individuals were ill informed about the consequences of the reform for their pension from 1996 to the end of 2002, or simply did not choose to adjust their behavior until the policies were implemented. Indeed, there is still a large degree of ignorance as to the workings of the new pension system. Rational individuals should decide upon labour force participation based on the expected rules of the future. If this is not the case, it is too early to evaluate the full effect of the reform. It is probable that most individuals became more aware of the reform in the year 2000 when it first became possible to allocate individual premium pension savings.

A concern exists regarding the implementation of the ATP system. The plan was implemented in 1960 and this was the first year in which it was possible to earn ATP points. Thus, younger cohorts have had more time to earn the points at any given age than those born earlier. This is the main reason for restricting the data to observations after 1996 and the sample to only those born from 1936. People born in that year were twenty-four years old in 1960 and had had 36 years to reach full ATP points in 1996 when they were sixty years old. This makes comparison to individuals born ten years later difficult. There is likely to be heavier selection of individuals with strong preferences for work into the category with full ATP among

those born early on. Provided that preference for work is positively correlated with late retirement, this is likely to bias the hazard of the earlier born cohorts with full ATP downward, and in comparison bias the hazard of latter born groups with full ATP upward. The bias is thus, under reasonable assumptions, in the direction opposite to the hypothesis being tested. Naturally, if there is a tendency among those with a long work history in early life to retire early rather than later, the opposite will be true.

There is a more fundamental problem with the indicator of 30 years of work experience. It is subject to severe endogeneity because a higher hazard of retirement lowers the probability of reaching 30 years of work experience. However, the difference-in-difference estimator need not be biased, because the reform effect is identified from the combination of the 30-year work experience variable and year of birth, which is exogenous. The main assumption required for identification is that aside from the effect of the reform, the pattern of retirement behavior among those with more than 30 years of work experience is similar irrespective of birth year, once controlling for fixed cohort effects, and the included covariates. Omitted variables are a potential source of bias. The most important omitted variable in the estimation is time, which cannot be controlled for because it is collinear with age and year of birth. It is likely that changed economic circumstances, changed demography, and other reforms may have affected the groups differently. To the extent that the included controls do not capture these changes, the estimators may be biased. Section 10 covers some of the main changes happening at the time of the reform.

Repeated spells are not much of an issue because very few individuals return to the labour force after retirement or censoring. In the few cases that they do these are treated as new spells. Last and not least, labour force participation is the result of choices made by employers and employees alike. At least in the short term, increased labour supply among the elderly may reduce offered wages, counteracting the effect of the reform on labour force participation. The estimates only capture the reform effect net of general equilibrium effects. It is probable that these general equilibrium effects lead to an underestimation of the true reform effect on retirement behaviour.

## 10 Concurrent reforms

A wide variety of changes have occurred that may have influenced retirement behaviour. This section describes some of these and their implications for the reliability of the results.

## 10.1 Occupational pensions and other agreements

Occupational pensions complicate the matter, for more details see Wadensjö and Sjögren (2005). Most occupational pension plans were changed around the same time as the state pension reform, and in a similar way. Table 13 summarizes the changes:

Table 13: Changes in occupational pensions

Sector	Year of change to defined contribution	Cohorts affected
Private sector Blue collar workers	1996	1932-1967 mix of old and new plan 1968- only new plan
Private sector White collar workers	2006	1979 and later
Government employees	2003	born before 1942 unaffected
Local government employees	1998 (2000)	born from 1938 earning < 7,5 BPA

Note: This is just a rough summary of multiple reforms with many exceptions. Please see the references for further details.

All the old occupational pension schemes had a 30 year limit for full benefit eligibility corresponding to the public system. All of the plans have changed to a greater or lesser degree from a defined benefit to defined contribution system (in some instances only for earnings below 7.5 BPA). However, as the table shows these changes only affected some cohorts, and were enacted at different times for different occupations. With respect to the estimation sample, defined benefit schemes with the 30 year rule remains in place for central government and private sector white collar workers. There are graduated rules similar to the pension reform for private sector blue collar workers. The occupational pensions for low income local government employees born from 1938 switched to a defined contribution system in 1998, but in practice took effect only after year 2000. High income public sector employees are still covered by a defined benefit scheme. The former local government occupational pension scheme was very generous to early retirees and it is likely that some of the drop in the retirement hazard can be attributed to this reform. This will be a subject of further research.

## 10.2 Disability insurance

Changes in the public disability insurance complicate matters since, as Palme and Svensson (1997) make clear, it has been a common path for the elderly into retirement, particularly among private sector blue collar workers. Between the years 1970 to 1997 it was possible for individuals nearing retirement age to receive dis-

ability benefits partly for labour market reasons. Between 1972 to 1991 it was possible to receive benefits solely for labour market reasons, even if one was in good health. It is likely that changes in disability insurance had spillover effects into early retirement, or into other means of leaving the labour force. Table 14 summarizes the major changes to disability insurance (förtidspension) since 1970, which is a summary from Wadensjö and Sjögren (2005). The reform of 2003 is a serious issue for identification; if it had a differential effect on people with different work histories it could severely bias the results. Consider first the model where the disabled are censored. It is likely the case that less educated workers, who have spent a longer part of their life working in more physically demanding occupations, are more likely to retire through the disability insurance path. This would imply that the risk group of retirement through other means increased as a result of stricter rules in 2003. The extent to which these individuals who would have left the labour force through disability insurance choose to continue working, or instead retire, determines the spillover effect of the disability insurance reforms into the hazard of retirement. It is plausible that these individuals had a relatively higher risk of retirement, which would increase the overall hazard for individuals in 2003 and 2004. Because individuals from the older cohorts were already beyond the age of 65 at this point and thus unaffected by the changes to disability insurance, (which only applies to those under this age), this will bias the results in the direction opposite to the hypothesis. In a parallel fashion, older cohorts will have had more opportunities to leave the labour force through disability insurance, and their risk group will thus contain fewer high risk individuals, meaning that the estimated hazard for this group is lower than it otherwise would have been. This conclusion holds under the assumption that there is a positive correlation between the risks for disability insurance and other forms of retirement, and that there was no anticipatory behaviour in advance of the disability insurance reforms.

Table 14: Changes to disability insurance

Year	Change
1991	Benefits due solely to labour market reasons no longer applied, medical reasons also required.
1993	New scale for the degree of benefits (a quarter, half, three quarters instead of half, two thirds). Benefits reduced by 2 percent.
1995	Periodic review of eligibility instead of permanent eligibility once granted.
1997	Eligibility on medical grounds only.
1999	Slightly more lenient benefit rules, close to full disability rather than complete disability.
2003	Separate rules for those over 29 years of age. Temporary sickness benefits requiring acceptance of any proposed rehabilitation treatment.

## 11 Conclusions

The switch to a defined contribution public pension system has made continued work more rewarding than before in terms of future public pension benefits, in particular after having reached 30 years of work experience. This paper has examined whether people more affected by this reform have continued working longer. The results show that, controlling for education, lagged income and other demographic factors, those born after 1940 are noticeably less inclined to retire between the age 60 to 64, conditional on still being in the labour force at this age. Discrete time proportional hazard estimates indicate that the log-hazard rate among those born in 1942 is about 0.47 points lower than the reference group born in 1937. This corresponds to an average conditional probability of retirement in the 60-64 age range that is more than a third lower than for the reference group unaffected by the reform. Since the absolute scale of this effect is unidentified, the exact magnitude of the difference is uncertain. Nevertheless, the change appears to be large in both absolute and relative terms, and is by a large margin statistically significant. The effect holds even after counting the disabled as retired. On the other hand, the results show that those whose marginal return from work in terms of pensions has



increased the most, i.e those individuals with 30 years of work experience, have not delayed retirement more than previously. Neither does the expected effect show up when I compare individuals with maximum pensions to those who could still increase their pension in the in the former ATP plan. This is probably due in part to the introduction of stricter disability benefits, differential reform effects depending on social security wealth, and changes to the ratio of males to females within the group of individuals with full ATP eligibility.

The reduction in retirement hazard seems mainly to have occurred in the public sector. Private sector employees show much less variation between cohorts. This may be because occupational pension plans for local government employees in the sample have also switched to defined contribution, whereas many other employee categories maintained defined benefit occupational pension plans. The results also indicate that a high permanent income seems to lead to earlier retirement for those more affected by the reform than those unaffected. This is line with the fact that the marginal benefits of continued work were lowest for low income earners in the former pension system.

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## 12 Appendix

### 12.1 Regressions

#### 12.1.1 Limited sample

Table 15 shows regression results for the sample where individuals who have ever been self employed are excluded (The sum of real active self employment income from 1995 to 2006 exceeds two basic price amounts). The regressions also exclude individuals who have ever belonged to occupational categories with special early retirement benefits. These are people employed in the financial sector, in defence, firefighting, dancing and other artistic activities, and flight services (the most narrow category that includes air-traffic controllers). In these regressions the disabled are censored out of the data.

#### 12.1.2 Disabled retired

Table 16 shows retirement rates by age and year of birth where the disabled are treated as retired.

Tables 17, 18, 19, 20 and 21 contain results from regressions that are replications of those presented in the main article except for the fact that the disabled are included as retired instead of being censored.

Table 22 contains the results of regressions identical to those of Table 15 except for the fact that the disabled are counted as retired.

Table 15: Complementary log-log estimation of the retirement hazard, limited sample: Disabled retired standard errors in parentheses

	Limited sample	Limited sample
Born 1936	0.024 (0.053)	0.017 (0.103)
Born 1938	-0.095 (0.053)	-0.162 (0.112)
Born 1939	-0.156 (0.053)	-0.181 (0.118)
Born 1940	-0.336 (0.055)	-0.816 (0.152)
Born 1941	-0.384 (0.054)	-0.556 (0.149)
Born 1942	-0.506 (0.062)	-0.984 (0.217)
Married	0.169 (0.033)	0.178 (0.033)
Female	0.323 (0.036)	0.360 (0.037)
Regional GDP	-0.002 (0.006)	-0.002 (0.006)
Primary education less than 9 years	-0.089 (0.047)	-0.087 (0.047)
9 years primary education	-0.117 (0.070)	-0.111 (0.070)
High School	0.135 (0.040)	0.139 (0.040)
Post graduate	-0.975 (0.171)	-0.973 (0.171)
0 lag income	-0.875 (0.450)	-0.664 (0.452)
10% lag income	-0.628 (0.129)	-0.525 (0.131)
20% lag income	-0.214 (0.076)	-0.155 (0.077)
30% lag income	-0.018 (0.067)	0.017 (0.068)
40% lag income	-0.093 (0.066)	-0.063 (0.067)
50% lag income	-0.066 (0.066)	-0.059 (0.066)
70% lag income	0.216 (0.063)	0.214 (0.063)
80% lag income	0.196 (0.063)	0.183 (0.063)
90% lag income	0.267 (0.063)	0.255 (0.063)
100% lag income	0.386 (0.066)	0.376 (0.066)
Full ATP dummy		0.595 (0.211)
Full ATP born 1936		-0.486 (0.227)
Full ATP born 1937		-0.494 (0.227)
Full ATP born 1938		-0.416 (0.231)
Full ATP born 1939		-0.477 (0.234)
Full ATP born 1940		0.035 (0.253)
Full ATP born 1941		-0.320 (0.251)
N	55326	55326
<b>Controls:</b>		
Age and month of birth	Yes	Yes

Table 16: Retirement rate by age and year of birth. In percent, disabled retired

	60	61	62	63	64
1936	9.5	11.4	9.8	17.4	23.7
1937	11.1	9.2	10.0	18.2	26.1
1938	8.3	9.7	12.0	15.1	23.3
1939	8.2	9.2	10.9	17.9	19.6
1940	6.1	8.2	10.2	11.6	22.0
1941	7.6	7.8	9.2	11.2	21.4
1942	6.4	7.9	8.8	11.2	.
Total	8.0	8.9	10.1	14.3	22.5

Table 17: Complementary log-log estimation of the retirement hazard: Disabled retired, standard errors in parentheses

Born 1936	-0.043 (0.043)	-0.042 (0.043)	-0.021 (0.083)
Born 1938	-0.096 (0.042)	-0.092 (0.042)	-0.090 (0.086)
Born 1939	-0.136 (0.042)	-0.145 (0.042)	-0.054 (0.091)
Born 1940	-0.285 (0.043)	-0.278 (0.043)	-0.293 (0.100)
Born 1941	-0.285 (0.042)	-0.288 (0.042)	-0.163 (0.102)
Born 1942	-0.372 (0.046)	-0.362 (0.046)	-0.429 (0.129)
Married		0.060 (0.025)	0.065 (0.025)
Female		0.242 (0.027)	0.272 (0.028)
Regional GDP		-0.011 (0.005)	-0.011 (0.005)
Primary education less than 9 years		0.054 (0.037)	0.055 (0.037)
9 years primary education		0.050 (0.053)	0.056 (0.053)
High School		0.164 (0.032)	0.166 (0.032)
Post graduate		-1.027 (0.144)	-1.025 (0.144)
0 lag income		-0.351 (0.270)	-0.256 (0.272)
10% lag income		-0.328 (0.081)	-0.276 (0.082)
20% lag income		-0.119 (0.055)	-0.086 (0.056)
30% lag income		-0.008 (0.051)	0.017 (0.051)
40% lag income		-0.055 (0.050)	-0.036 (0.050)
50% lag income		-0.052 (0.050)	-0.047 (0.050)
70% lag income		0.110 (0.049)	0.108 (0.049)
80% lag income		0.091 (0.049)	0.084 (0.049)
90% lag income		0.103 (0.050)	0.095 (0.050)
100% lag income		0.153 (0.052)	0.148 (0.052)
Full ATP dummy			0.179 (0.070)
Full ATP born 1936			-0.028 (0.097)
Full ATP born 1938			-0.016 (0.099)
Full ATP born 1939			-0.131 (0.102)
Full ATP born 1940			-0.009 (0.111)
Full ATP born 1941			-0.174 (0.112)
Full ATP born 1942			0.038 (0.138)
N	64388	64388	64388
<b>Controls:</b>			
Age and month of birth	Yes	Yes	Yes



Table 18: Complementary log-log estimation of the retirement hazard, varying income effect: Disabled retired, standard errors in parentheses

Full ATP dummy	0.202 (0.076)
Full ATP born 1936	-0.109 (0.110)
Full ATP born 1938	-0.078 (0.108)
Full ATP born 1939	-0.123 (0.112)
Full ATP born 1940	-0.057 (0.120)
Full ATP born 1941	-0.107 (0.122)
Full ATP born 1942	-0.022 (0.146)
Lag log income born 1936	0.284 (0.081)
Lag log income born 1937	0.127 (0.071)
Lag log income born 1938	0.262 (0.068)
Lag log income born 1939	0.106 (0.069)
Lag log income born 1940	0.241 (0.073)
Lag log income born 1941	0.017 (0.065)
Lag log income born 1942	0.253 (0.071)
Born 1936	-0.220 (0.160)
Born 1938	-0.266 (0.152)
Born 1939	-0.029 (0.152)
Born 1940	-0.442 (0.162)
Born 1941	-0.050 (0.154)
Born 1942	-0.587 (0.179)
Married	0.067 (0.025)
Female	0.274 (0.027)
Regional GDP	-0.011 (0.005)
Primary education less than 9 years	0.063 (0.036)
9 years primary education	0.056 (0.052)
High School	0.167 (0.031)
Post graduate	-1.044 (0.144)
N	64388
<b>Controls:</b>	
Age and month of birth	Yes

Table 19: Complementary log-log estimation of the retirement hazard, maximum ATP dummy: Disabled retired, standard errors in parentheses

Maximum ATP lagged	0.086 (0.098)
Maximum ATP born 1936	-0.022 (0.140)
Maximum ATP born 1938	0.141 (0.133)
Maximum ATP born 1939	-0.087 (0.135)
Maximum ATP born 1940	0.054 (0.137)
Maximum ATP born 1941	-0.085 (0.135)
Maximum ATP born 1942	0.312 (0.133)
Born 1936	-0.040 (0.045)
Born 1938	-0.110 (0.044)
Born 1939	-0.133 (0.044)
Born 1940	-0.289 (0.045)
Born 1941	-0.283 (0.045)
Born 1942	-0.416 (0.050)
Married	0.059 (0.025)
Female	0.188 (0.025)
Regional GDP	-0.010 (0.005)
Primary education less than 9 years	-0.002 (0.035)
9 years primary education	0.006 (0.052)
High School	0.122 (0.031)
Post graduate	-1.048 (0.144)
N	64388
<b>Controls:</b>	
Age and month of birth	Yes

Table 20: Complementary log-log estimation of the retirement hazard, by sector:  
Disabled retired, standard errors in parentheses

	Public sector	Private sector	Controlling for sentiment
Married	0.207 (0.040)	-0.021 (0.035)	-0.049 (0.039)
Female	0.247 (0.050)	0.224 (0.038)	0.188 (0.044)
Primary education less than 9 years	0.066 (0.063)	0.040 (0.055)	-0.039 (0.062)
9 years primary education	0.024 (0.091)	-0.015 (0.074)	-0.112 (0.084)
High School	0.140 (0.049)	0.099 (0.050)	0.041 (0.056)
Post graduate	-0.950 (0.179)	-0.616 (0.254)	-0.369 (0.273)
Regional GDP	-0.010 (0.007)	-0.011 (0.006)	-0.002 (0.007)
Born 1936	0.005 (0.064)	-0.105 (0.060)	-0.110 (0.068)
Born 1938	-0.116 (0.064)	-0.094 (0.058)	-0.109 (0.065)
Born 1939	-0.183 (0.064)	-0.140 (0.058)	-0.166 (0.065)
Born 1940	-0.479 (0.067)	-0.183 (0.059)	-0.184 (0.066)
Born 1941	-0.551 (0.067)	-0.197 (0.058)	-0.156 (0.064)
Born 1942	-0.679 (0.075)	-0.240 (0.062)	-0.221 (0.070)
0 lag income	-0.567 (0.452)	-0.053 (0.382)	0.070 (0.414)
10% lag income	-0.364 (0.144)	-0.300 (0.118)	-0.246 (0.130)
20% lag income	0.060 (0.086)	-0.289 (0.083)	-0.224 (0.092)
30% lag income	0.138 (0.078)	-0.178 (0.075)	-0.126 (0.083)
40% lag income	0.222 (0.077)	-0.332 (0.074)	-0.339 (0.084)
50% lag income	0.085 (0.078)	-0.164 (0.071)	-0.182 (0.080)
70% lag income	0.173 (0.086)	0.073 (0.063)	0.077 (0.070)
80% lag income	0.217 (0.084)	0.022 (0.064)	-0.011 (0.071)
90% lag income	0.063 (0.088)	0.129 (0.064)	0.110 (0.071)
100% lag income	-0.199 (0.110)	0.208 (0.064)	0.155 (0.072)
Sector sentiment			-0.003 (0.001)
N	25364	34933	28486
<b>Controls:</b>			
Age and month of birth	Yes	Yes	Yes

Table 21: Complementary log-log estimation of the retirement hazard, varying trends interactions: Disabled retired, standard errors in parentheses

Married	0.070 (0.025)
Regional GDP	-0.011 (0.005)
Born 1936	-0.068 (0.212)
Born 1938	-0.031 (0.201)
Born 1939	0.139 (0.199)
Born 1940	-0.129 (0.210)
Born 1941	0.413 (0.198)
Born 1942	-0.164 (0.220)
Full ATP dummy	0.282 (0.079)
Full ATP born 1936	-0.170 (0.117)
Full ATP born 1938	-0.147 (0.114)
Full ATP born 1939	-0.176 (0.117)
Full ATP born 1940	-0.149 (0.125)
Full ATP born 1941	-0.228 (0.126)
Full ATP born 1942	-0.135 (0.149)
Female	0.399 (0.073)
female born 1936	-0.230 (0.108)
female born 1938	-0.200 (0.102)
female born 1939	-0.094 (0.100)
female born 1940	-0.093 (0.103)
female born 1941	-0.177 (0.101)
female born 1942	-0.096 (0.107)
In public sector	0.160 (0.056)
in public sector born 1936	0.217 (0.087)
in public sector born 1938	0.058 (0.084)
in public sector born 1939	-0.049 (0.083)
in public sector born 1940	-0.297 (0.087)
in public sector born 1941	-0.384 (0.087)
in public sector born 1942	-0.457 (0.095)
N	64388
<b>Controls:</b>	
Age, month of birth and education	Yes
Cohort specific lag income	Yes

Table 22: Complementary log-log estimation of the retirement hazard, limited sample: Disabled retired, standard errors in parentheses

	Limited sample	Limited sample
Born 1936	-0.024 (0.045)	-0.002 (0.086)
Born 1938	-0.074 (0.044)	-0.054 (0.089)
Born 1939	-0.128 (0.044)	-0.073 (0.094)
Born 1940	-0.261 (0.045)	-0.323 (0.104)
Born 1941	-0.285 (0.045)	-0.166 (0.106)
Born 1942	-0.376 (0.049)	-0.422 (0.136)
Married	0.087 (0.027)	0.092 (0.027)
Female	0.191 (0.029)	0.220 (0.030)
Regional GDP	-0.011 (0.005)	-0.011 (0.005)
Primary education less than 9 years	0.058 (0.039)	0.058 (0.039)
9 years primary education	0.028 (0.056)	0.034 (0.056)
High School	0.166 (0.034)	0.168 (0.034)
Post graduate	-0.948 (0.156)	-0.948 (0.156)
0 lag income	-0.338 (0.280)	-0.239 (0.282)
10% lag income	-0.226 (0.088)	-0.170 (0.090)
20% lag income	-0.019 (0.058)	0.018 (0.059)
30% lag income	0.070 (0.053)	0.097 (0.054)
40% lag income	0.002 (0.053)	0.022 (0.053)
50% lag income	-0.030 (0.053)	-0.025 (0.053)
70% lag income	0.109 (0.052)	0.108 (0.052)
80% lag income	0.110 (0.052)	0.103 (0.052)
90% lag income	0.124 (0.053)	0.116 (0.053)
100% lag income	0.116 (0.056)	0.112 (0.056)
Full ATP dummy		0.187 (0.129)
Full ATP born 1936		-0.046 (0.147)
Full ATP born 1937		-0.016 (0.146)
Full ATP born 1938		-0.055 (0.148)
Full ATP born 1939		-0.103 (0.150)
Full ATP born 1940		0.033 (0.157)
Full ATP born 1941		-0.183 (0.158)
N	57553	57553
<b>Controls:</b>		
Age and month of birth	Yes	Yes

## 12.2 Definitions

This section describes variables used in the analysis and how they are defined using LINDA data.

**Labour related income:** Work income including benefits plus sickness benefits, unemployment benefits, adult education benefits (ttjlon tjlon) but excluding partial pension (pdel delpens), insurance compensation due to work related accidents (tagstfa agstfa). Income earned on ships (tsjo insjo) and active self employment income in sole proprietorships (nakte) and trading partnerships (nakthb) are added.

From 2005:  $ttjlon - parbliv - tagstfa + nakte + nakthb - tinkrse$

2003-2004:  $ttjlon - pdel - parbliv - tagstfa + nakte + nakthb - tinkrse$

between 1998 and 2002:  $ttjlon - pdel - parbliv - tagstfa + nakte + nakthb$

1997:  $ttjlon - pdel - parbliv - tagstfa + tsjo + nakte + nakthb$

From 1993 to 1996:  $ttjlon - pdel - parbliv - tagstfa + tsjo + nakt$

**Pension income:** Taxable and tax free pension income as defined by Statistics Sweden in the LINDA database. It includes disability insurance until 2003, and disability insurance payments are added to the variable from that point for consistency. The variable includes public pensions, occupational pensions, pension payments from previous employers, work injury benefits and withdrawals from private pension funds.

**Disability** After 2003 bgarse and binkrse codes. Prior to this tpekod fpekod batpe bfpe.

**Regional growth:** Gross regional product from Statistics Sweden, measured in percent.

**Lag income** Mean of non-zero or non-missing values of work related income as defined by Statistics Sweden (carb) while aged 50-55, divided by the deflated BPA of 2006. 10 quantile dummies are created for the relative position on the income scale over the entire sample.

**Full ATP** Pension points from the pension register, including points for care of young children, are used to determine the total number of years of earned points for individuals in the sample. Missing values are assumed to mean that no points were earned during the year.

**Sectors** Sector is determined using SNI codes, These are based on survey data collected from firms and organizations by Statistics Sweden. A three year lag, or otherwise the latest observed code is used for each individual.

The public sector is meant to include researchers, teachers, and employees in the health care sector. The first two digits of the SNI codes 73, 75, 80 and 85 are included.

The private sector includes all other sectors.

### **12.2.1 Sector economic sentiment**

Time series of the economic sentiment indicators are calculated by the National Institute of Economic Research. For each industry a figure is calculated based on the answers to a number of survey questions regarding order intake, order stock, profit margins, etc. The fraction of answers suggesting improvements or declines are weighed such that the total indicator value lies between -100 implying declines for all companies in respect to all survey questions and 100 implying the opposite.

## **12.3 Missing values**

Missing values of education are predicted from a ordered logit regression on covariates; year of birth, sex interacted with year of birth, dummies for quantiles of mean income at age 50-55, month of birth and county of residence from the entire population of 50 to 72 yearolds from 1998 to 2006. Similar predictions are made for income at the age of 50-55.

Data on economic sentiment is missing for some sectors (mainly services) prior to 2003. The missing values are replaced by the mean private sector economic sentiment indicator. Between 20 to 23 percent of the economic sentiment indicator observations from 1996 to 2002 are replaced in this manner.

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