Estimating early retirement with special early retirement offers*

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Abstract
This paper analyses retirement behavior in Sweden during the 1990ies with focus on voluntary early retirement. It is observed in data that a non-negligible fraction of early retirees receive higher occupational pension benefits than regulated in the collectively agreed contracts. This is consistent with "buy-outs", also called early retirement pensions, where employers offer employees more generous pension programs if they agree on early retirement. Neglecting such offers produces biased estimates of the individuals' responses to financial incentives in the retirement decision. The available register data is limited such that access to early retirement pensions are only indirectly recorded for early retirees, and not recorded at all for non-retirees. This creates an error-in-variables problem in the retirement equation and also a sample-selection problem in the access-to early retirement pension equation. We propose an estimation strategy where the retirement decision and the accesses to early pension are estimated in a simultaneous equation system, yielding unbiased estimates of the model parameters. We apply the model using detailed Swedish register data. Our results indicate that the marginal effects in retirement probability w.r.t. a change in social security wealth and its accrual is less pronounced if early retirement pensions are accounted for. Further, we illustrate that the early retirement probabilities would decrease by 10-30 percent if early retirement pensions were absent.

Keywords: Retirement, early retirement pension, golden handshakes, occupational pension, demand for old workers.
JEL Classification: J14, J21

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1 Introduction

The well-known development of the demographic structure will in the near future put serious financial pressures on the western world's possibilities to supply welfare services. This effect is reinforced by the increased tendency of early withdrawal from the labor force. It is therefore important to understand and analyze a) the main forces that drive individuals' decision to retire from the labor market, b) how public policy can affect these incentives, and c) firms' decisions to hire and lay off (offer early retirement to) older workers. There is a long list of authors focusing on (a) and (b) (cf., e.g., Gruber and Wise, 2005, and the references therein), while (c) have received less attention until recently, mainly because of lacking ideal data. Feldtein (1976, 1978), Topel (1984) and Hutchens (1999) are often mentioned as pioneers in adopting the employer's influence into individuals' retirement decision. The employee act as in a labor supply model, and decide, given the attributes of the alternatives, whether to retire. The employer can to some extent determine the alternatives' attributes. Some new papers (cf. Behaghel et al., 2005, Acemoglu and Angrist, 2001, Hakola and Uusitalo, 2005) study how lay off costs or hiring reductions targeted towards certain groups (e.g. old workers) affect labor demand.

In this paper we analyze early retirement with a special focus on the effects of early retirement pensions. Early retirement pensions (also known as "golden handshakes") are offered by the employers to employees close to normal retirement age. As these programs may have strong impacts on the individuals' financial incentives to retire early, they need to be taken into account when analyzing individual retirement behavior. Although the programs have important policy implications they have received limited attention in the economic literature (exceptions being Wadensjö and Sjögren (2000), Fölster et al. (2001), and Eklöf and Hallberg (2004)). Early retirement programs exist in the US but in a somewhat different shape. In the US there are "early retirement windows", which are special incentives (cash bonuses, improvement in or accelerated eligibility for pension benefits, and/or health insurance continuation), beyond those in a firm's pension plan, to retire at a particular time (Brown, 2002). There are some case studies – perhaps less general – that examine these programs, both in the US and in Sweden, that typically focus on specific (large) employers.

In Sweden, these early retirement pensions usually operate through the occupational pension plans, which complement the public pension system.[1] The information on how these pensions are set up is however rather limited, since they are not regulated in detail in the occupational pension schemes. There may be strong incentives for the firms to offer such programs to the older employees if these are associated with high pension premium rates. In fact, some of the occupational pension agreements in Sweden have age progressive premium rates implying that individual close to retirement are more costly than younger employees, *ceteris paribus*.

The methodological contribution of this paper is that we construct an empirical model that allows for partially unobserved access to early retirement programs. The difficulty here is that the individuals' access to these offers is only observed *ex post* if the offer is accepted. That is, for individuals that do not retire, we can not observe whether they had access to an early retirement program, and we can not construct their financial incentives to retire. As the observability of the financial incentives is correlated with the error term in the retirement decision equation, we have an error-in-variable problem. If we could instrument this variable, e.g. with its expected value, we could solve the problem. However, it is problematic to obtain such unbiased estimate of this expectation as the observed offers among the early retirees are contaminated by self-selection. Hence, we also have a sample-selection problem. However, by focusing on the system of equations determining the retirement decision and the access to early retirement pension, we can identify and estimate the relevant structural parameters.

We use detailed longitudinal register income data on individuals during 1992-2000. One complicating factor is that data is not complete w.r.t. early retirement pensions. First, we can only infer indirectly if a retired individual did accept an early retirement pension by comparing the observed annual benefits to the benefits stipulated in the relevant agreement. Based on this comparison we can model the financial incentives faced by retired individual. Second, for non-retired individuals we can not observe whether she has access to an offer or not, i.e. we do not observe the relevant incentives that the individual faced in the decision between "Work" and "Retire". However, by integrating over the possible outcomes of financial incentives, we can construct an unconditional expectation of the probability to stay at work and thus produce unbiased estimates of structural parameters.

[1] There are principally four main occupational pension schemes, which cover four parts of the labor market. The pension plans are discussed in Section 2.

Ignoring early retirement pensions altogether hence creates measurement errors in economic incentives for retirement. The implication is that models which do not account for these special offers may overestimate the effects of economic incentives as one tries to fit a model with relatively weak financial incentives to outcomes determined by strong incentives.

Furthermore, data shows that early retirees almost exclusively finance their consumption using withdrawals from the occupational pension plans only whereas the public pension is not withdrawn until age 65 (Eklöf and Hallberg, 2004). Such mixtures of pension benefits should be accounted for when calculating the stream of benefits. Analysts commonly use simplifying assumptions to restrict the number of available alternatives for the individual; the individuals are assumed to claim benefits from all available sources from the first day of retirement. In this paper we allow the construction of financial incentives to reflect that individual tend to claim benefits sequentially rather the simultaneously.

The process of early retirement can be separated into two parts; a health-induced early retirement via disability insurance, and a voluntary early retirement using the available old age pension plans. We consider these two routes to retirement to be distinct and mutually exclusive. However, this is not an obvious choice. For example, Palme and Svensson (2004) combines the two type of exists into a single model using Swedish data. Our main argument is that disability insurance is increasingly directed towards individuals with severe health issues that reduce their working capacity. Hence, this type of retirement should not be considered voluntary from the individual's perspective and the analysis calls for high quality information about the individual's health status. Second, in order to account for early retirement pensions, we need a more complex model, which would be difficult to combine with other routes into retirement. Hence, for the sake of simplicity, we have chosen to focus on retirement via old age pension only.

In Section 2 we present the main rules and legislation for the income security systems targeted at the elderly. In particular, we discuss the institutional background to an early retirement pension through the occupational pension system. Section 3 gives evidence regarding the importance of different exits among elderly, including labor market exits through unemployment, sickness, and disability insurance. Section 4 we discuss the individual retirement choice with focus on the old-age pension. Section 5 presents the data. The identification of early retirement program offers given these data is discussed. Section 6 describes the estimation sample. Section 7 introduces an econometric model of early retirement, which accounts for early retirement program offers. In Section 8 we present the empirical results and Section 9 concludes the paper.

2 Institutional setting

The income security system in Sweden consists of two main parts; the old age pension programs (public old age pensions and the occupational pensions as agreed upon by the unions and employers' associations) and the social (income) security programs (sickness, disability, and unemployment insurance). This analysis deals with the exits via the old age pension system. For a more general treatment of all possible routes, including sickness, disability, and unemployment insurance, cf., e.g., Palme & Svensson (2004) or Hallberg (2003). As the empirical analysis is limited to 1992-2000, we focus on the pension systems in effect during that time that period. [2]

Public old-age pension (OAP)

During the 1990s Sweden's national old-age pension consisted of the basic part and the supplementary part. All Swedish citizens and all persons residing in Sweden were entitled to the basic pension. It provided roughly the same amount regardless of previous earnings, but was reduced if the individual had resided in Sweden for less than 40 years or had Swedish work history less than 30 years. The pension benefits are approximately 60% of average earnings during the best 15 years below the social security ceiling of 7.5 basic amounts (BA).[3] The normal retirement age is 65, but benefits can be claimed in advance or postponed with an actuarial adjustment. It is possible to withdraw old-age pensions early starting at the age of 60 (the age was raised to 61 in 1998), or postpone receipt until the age of 70. Early withdrawal meant actuarial adjustment of 0.5% per month. It was also possible to claim the early part-time retirement pension (abolished by the end of 2000).

Occupational pension

The Swedish labor market is highly unionized which implies that the collective pension agreements between labor unions and the employers organization covers almost 95 per cent of

[2] Sweden has implemented a new national old age pension system. This was approved in the parliament in June 1998, and the first payments under the new system were made in January 2001, i.e. after the time period covered by the empirical part of this paper.
[3] The BA was until 1999 decided for one year at a time by the Swedish Parliament, following closely the consumer price index. Since 1999, the BA was renamed the price base amount, and has since been linked 100% to price moments. In 1999 1 BA was 36400 SEK, appr. 3640 €.

the labor force. There are basically four distinct occupational pension plans, covering different sectors of the labor market (short name of agreement): blue-collar workers in the private sector (SAF-LO), white-collar workers in the private sector (SAF-PTK), central government employees (PA-91), and local government employees (PA-KL). [4, 5]

Although some important differences exist across the sector specific agreements they are fairly similar in structure as to how benefits are defined. The usual case is to define benefits as a function of the previous sector specific earnings, the years of service, and retirement age. The motives of the occupational pensions are to compensate income losses above the social security ceiling that the national public pension system does not cover. For that reason, the occupational pension benefit rates are fairly low (about 10%) in the income intervals where the public pension system is active.

Except for private sector blue-collars, the occupational pension agreements allow for early withdrawal of benefits. There are some differences over time and sectors, but in general the occupational pension benefits allow for withdrawal from age 60. The future benefit levels are actuarially adjusted to account for the longer pay-out time. If the individual retires before the normal retirement age, the replacement rate in the income segment below 7.5 BA is 65 percent until the individual reaches the mandatory retirement age.

The agreement for blue-collars does not allow for early withdrawal of occupational pension before the age of 65. Hence, for blue collar workers there is no "vehicle" for early retirement program offers. However, blue collars still have the possibility to retire early making use of the public pension system. In the empirical analysis blue collars are included, but not allowed to receive early retirement programs.

As a result of the negotiated occupational pensions the normal retirement age actually varies across the Swedish labor market. Some groups in the Swedish labor market – particularly in the state and local government sectors – have a lower normal retirement age through

[4] There are a number of minor pension schemes for smaller “sub-unions” across the labor market. However, these alternative pension plans are generally only minor modifications of the main agreements. Hence, in the analysis we abstract from these sub-agreements.

[5] There have been changes in the occupational pensions for blue collar workers and local government employees during the study period. In 1996 the STP plan was renegotiated and became SAF-LO, which is a defined contribution (DC) plan. The earliest withdrawal is now possible at age 55 (according to transition rules the earliest withdrawal age is at age 60). STP is flexible with regards to period of payment; it can be made as a life long annuity or paid during a shorter period. A new pension agreement for local government employees, PFA-98, was renegotiated in 1998. Compared to the earlier system, it is organized more in the direction of a DC plan. In the estimation we will make the simplification that the occupcational pensions for blue collar workers and local government employees follows their old pension agreements.

their occupational agreements. These professions collect fulltime benefits without actuarial adjustment due to early withdrawal until the normal retirement age in the national old age pension system is reached.[6] Additional details about these occupational pension systems are given in Appendix.

Early retirement pension

The employer has the right to terminate an employment at the normal retirement age. The employer also has to formally agree to early retirement through the occupational pension. However, if an employer wants to lay off an employee before his or hers normal retirement age the situation is different. By virtue of seniority at the current employer, an old employees usually holds employment security enforced by law ("first-in last-out" rule). Therefore the employer must generally lay off the younger employees first. The employer needs to motivate why the first-in-first-out procedure is not applicable. However, the employer and the employee have the possibility to agree on other retirement conditions than the ones given by the standard occupational pension agreements. This early retirement pension can be used as a tool for the employer to persuade the employee to leave her employment before normal retirement age, which usually would mean that the employer gives the employee stronger incentives to retire than according to the standard agreements.

The level of compensation in an early retirement programs is negotiable and varies across individual agreements, but some guidance is given by the complementary rule in the tax deduction rules for corporate profits. The complementary rule regulates how much an employer can deduct from firm profits due to pension payments. Presumably, one condition in the early retirement pension is that the individual is not "punished" later in life due the early retirement. Hence, the early retirement pensions compensate for future losses in pension benefit levels after normal pension age of 65 due to early withdrawal.

However, the early retirement pensions are individually designed and the exact conditions of the contracts are not known. Anecdotal evidence and the observations in the data indicate that the supplementary tax rule for companies is a reasonable proxy for the actual indi-

[6] This group includes firemen, security service, some cultural professionals, etc.

vidual contracts. Although it is likely that there are various types of contracts across individuals we use this system to approximate the early retirement pension. [7]

3 Many ways out of the labor market into retirement

Below we present the importance of various routes out of the labor force for elderly in Sweden, including unemployment, sickness insurance, and disability insurance. We show that the timing of occupational pension and national old age pension withdrawals is of importance for early retirement. We also show that a substantial share of early pensioners who retire early with occupational pension obtain rather high pension benefits via their occupational pension agreements. These are higher than what the standard agreement stipulates.

Early withdrawal from the labor market in Sweden is substantial. The mandatory retirement age is 65, but, as reported in Hallberg (2003), only about one third of those whose income from work is their main income source at age 60 work steadily until the age of 65, before starting collecting public old age pension benefits. Figure 1 shows the hazard of leaving work in one year by age group in the period 1993-2000. The major outflows before age 60 were unemployment (UI), sickness and disability (DI+SI). At ages 60-64, however, occupational pension becomes the most frequent way to exit. On average 6 (12) percent exited via this route at age 60 (64). One can note that very few exited work via the public old age pension system (OAP). At age 65 about 70 percent exit work to retirement via OAP.

[7] See Appendix for exact details about replacement rates in an early retirement program. After the age 65, the same conditions apply as if as if the individual retired at age 65 i.e. there are no actuarial adjustments in the benefits above age 65.

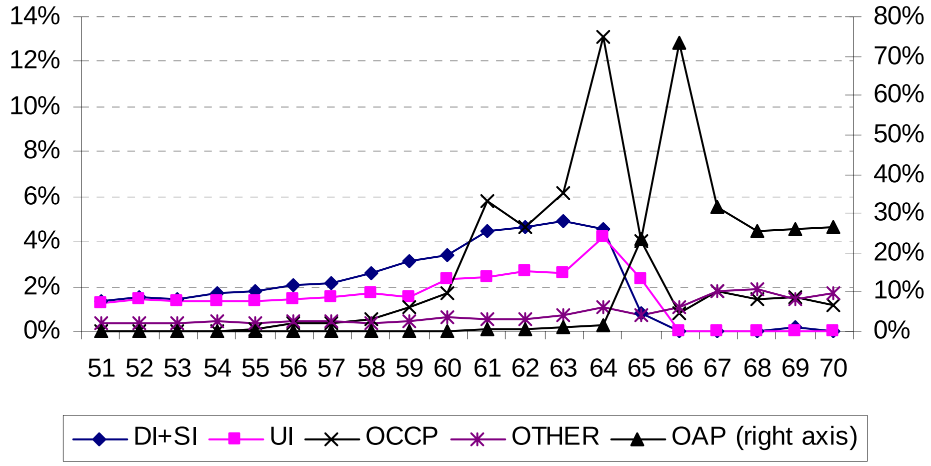

Figure 1 The hazard of leaving work and having an alternative income source (percent), 1993-2000 (*Source*: Own calcualtions from the LINDA data-base[8])

Table 1 presents the sample shares of individuals aged 55-59 and 60-64 (in 1992-2000) that receive their main income (more than 50 per cent of total income) from various sources. The most important unearned sources (beside income from work) are disability insurance (both age groups), unemployment benefits (55-59), and occupational pension benefits (60-64). It is notable that the share of individuals having public old age pension as their main income is very low in all labor market sectors. Instead, the disability insurance scheme, occupational pension and unemployment iinsurance seem to be more frequent sources of main income.

[8] LINDA is described in Section 4.

Table 1 Main source of income, by sector and age, percent, 1992-2000

Aged 55-59

	Blue collar **SAF-LO**	White collar **SAF-PTK**	Central gov. employees **PA-91**	Local gov. employees **PA-KL**	**OTHER**	**Total**
Work	65.16	76.27	74.96	74.77	72.77	73.05
Disability insurance	16.25	8.55	10.03	10.68	5.60	11.21
Public pension	0.00	0.00	0.00	0.00	0.00	0.00
Occupational pension	0.24	0.93	2.71	0.47	9.16	0.88
Sickness insurance	2.91	2.70	2.14	2.73	2.29	2.68
Unemployment insurance	5.88	4.84	3.79	3.53	2.04	4.49
Private pensions	0.46	0.60	0.28	0.32	2.04	0.43
Capital	2.91	2.04	1.42	2.10	1.78	2.18
Transfers	2.20	0.61	0.92	1.56	0.00	1.33
Inconclusive	3.98	3.46	3.74	3.84	4.33	3.75
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Aged 60-64

	SAF-LO	**SAF-PTK**	**PA-91**	**PA-KL**	**OTHER**	**Total**
Work	38.61	50.03	43.22	46.76	41.17	44.71
Disability insurance	33.05	16.86	19.36	21.64	12.35	23.47
Public pension	2.65	2.22	1.09	1.24	4.46	1.90
Occupational pension	2.10	9.53	21.54	11.67	15.27	9.58
Sickness insurance	2.17	1.92	1.24	2.23	0.34	2.00
Unemployment insurance	7.34	6.13	3.55	2.81	1.54	5.07
Private pensions	0.77	1.47	0.54	0.69	4.46	0.91
Capital	3.46	2.68	1.89	3.25	5.83	3.01
Transfers	2.29	0.76	0.75	1.64	0.00	1.49
Inconclusive	7.56	8.40	6.81	8.06	14.58	7.87
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Note. 'Inconclusive' category; those with no income or with no income above 50 percent of total income, and those with part-time pension as main source of income. ‘Work’ includes income from active business, but not sickness insurance, parental leave etc. ‘Transfers’ includes different housing allowances, and social assistance. *Source*: Own calcualtions from the LINDA data-base.

There are notable differences across the four labor market sectors. For example, blue collar workers in the private sector do not collect occupational pension benefits close to normal retirement age (60-64) in the same extent as the other groups. Only 2 per cent of the blue collar workers receive their main income from occupational pension, whereas the corresponding shares for white collars and local government employees are about 10 per cent and over 20 per cent for central government employees. This is explained by the fact that blue collar workers in the private sector, before the new agreement in 1996, generally can not collect occupational pension benefits before age 65. After 1996 early withdrawals can be made from age 55, but it is not likely that many will do so since their occupational pension is too small to alone finance early retirement. Blue collar workers are on the other hand more likely to collect disability insurance compared to the other groups. This is especially notable in the age group 60-64 where 33 per cent of the blue collar workers have their main income from disability insurance, whereas the shares of other groups range from 17 to 22 per cent. It can also be noted that blue collar workers in the private sector have a smaller share of workers compared to the other groups.

Among elderly, unemployment is also a pathway to permanent retirement. As evidenced by the Labor Force Surveys (SCB, 2002), unemployment spells are typically much longer for elderly compared to younger workers. Few of the older workers hence find re-employment after an unemployment spell. The results in Table 1 also suggest that the share of unemployed is higher in the private sector (blue and white collar) compared to the share in the public sector (central and local gov.)

Some of the differences in observed behavior across the labor market sectors may be explained by the institutional differences between the sectors. As discussed in Section 2, each sector has its own separate occupational pension plan, with distinct rules with respect to, e.g., early retirement eligibility and replacement rates. Before 1996, blue collar workers did not have the possibility of an early withdrawal of pension according to their occupational pension plan, which the three other sectors have had during this period. Instead we see many blue collar workers with disability pension. One reasonable interpretation is that blue collar workers, in lack of early retirement via occupational pension, become 'early retired' through the health-related insurance systems.

Another important implication of data is– if we just relied on the standard agreement text for occupational pensions – that the effects of economic incentives on retirement might very well be over-estimated. Figure 2 allows for a direct comparison of data with prevailing rules. This shows the observed replacement ratio (as a funciton of the pension qualifying wage), as well as what can be considered the upper and lower bounds of "standard" occupational pension given an individuals age and sector, etc. [9] We have also marked out the highest

[9] The benefit and the qualifying wage are expressed in units of Basic amounts (BA). The upper limit is calculated without actuarial adjustment and the lower with full actuarial adjustments due to early withdrawal. The actuarial adjustment is made with the assumption that individuals retire at earliest possible retirement age according to their particular collective agreement. We exclude those with a simultaneous withdrawal of either old age pension or disability insurance, or have work incomes.

tax-deductible pension (as a ratio of qualifying income), i.e., the complementary rule in the income-tax legislation.

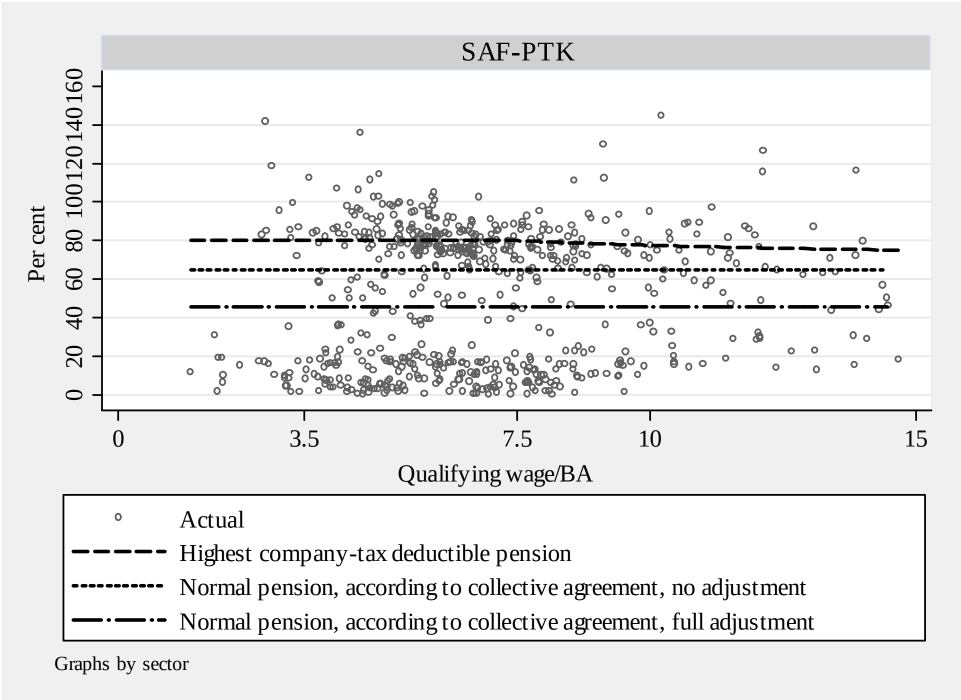

Figure 2 Observed and calculated pension replacement ratios for early retires; white collar workers in the private sector (*Source:* LINDA)

Interestingly, the agreements for white collar workers are clearly best described by the complementary rule, and not at all by standard agreement rules. Between the two bands that mark out the highest and lowest possible replacement rate according to the standard agreement, very few observations appear. The level for the standard benefit would clearly underestimate what is observed in data. For central government employees (not shown) there is instead an accumulation of observations on the upper bound of the "standard" occupational pension (no actuarial adjustment). Their agreements made also these quite well off but perhaps not as well as the white collar workers. Also for many in this group we would be at risk of underestimating their true benefit.[10]

4 Early retirement

In this section we present the model describing the exit from the labor force into retirement. Early retirement via the disability insurance system is sometimes included in the retirement decision. We argue that disability retirement is driven by health factors rather than economic

[10] Replacement rates for the local government employees have a much higher spread. For this group it is hence harder to say whether the benefits actually follow the standard agreement text or not.

incentives. This is especially true since the early 1990ies when disability insurance eligibility due to labor market reasons was abolished. In this paper we focus on early retirement via the "voluntary" systems only, that is the collective agreed occupational pension and public pension systems.

Retirement at normal retirement age is undisputedly the most common exit from the labor market. However, it is hard to find any economic motives for this behavior. Here, we consider retirement at normal retirement age as a social norm less influenced by economic incentives. On the other hand, individuals that do retire before normal retirement have potentially responded to economic incentives. Therefore, we do not set out to model retirement at normal retirement age, but focus on the decision to retire early.

Considering the voluntary decision to retire via the collective agreed occupational (or public) pension systems, there are three typical types of models in the economic literature. In the lifetime budget constraint approach (Burtless and Hausman, 1978; Hausman and Wise, 1980; Burtless, 1986), the individual faces a discontinuous, or kinked, lifetime budget constraint. The lifetime budget constraint is analogous to the standard labor-leisure budget constraint, with annual hours replaced by years of labor force participation, and annual earnings replaced by cumulative lifetime compensation. The slope is interpreted as the "price" of retiring one year earlier and is a function of the accrual rate (i.e. the rise in retirement income entitlement caused by continuing to work for one more year). The kinks are produced by changes in the accrual rates caused by the conditions in the pension schemes. The optimal age of retirement is then determined by a utility function defined over years of work and cumulative compensation. The individual is assumed to know with certainty the opportunities that are available to her even in the distant future.

In the option value approach (Lazear and Moore, 1988; Stock and Wise, 1990; Börsch-Supan, 1999; Blundell et al, 2002), the individual calculates, for each potential retirement year, the difference in expected lifetime utility from retiring that year and some other year – given the conditions of the pension schemes – in order to find the optimal age of retirement. The option value at age *t* (of postponing retirement to some later age) is the difference between expected lifetime utility from retiring at the optimal age of retirement and expected lifetime utility from retiring at age *t*. The individual is assumed to update the option value in the light of new information (such as unexpected changes in the pension schemes), which may result in changes in the accrual rate.

In the hazard model approach (Diamond and Hausman, 1984; Hausman and Wise, 1985; Siddiqui, 1997; Röed and Haugen, 2003; Bütler et al, 2004), the individual reacts to changes in current and one-period ahead social security wealth. This is a reduced form technique, which has been used to capture the net effects of changes in social security wealth and other variables on retirement. The hazard model approach is not as forward looking as the lifetime budget constraint approach. It does, however, allow for continuous updating of information as individuals grow older. That is, for an individual who is still active at age *t*, the probability of retiring at age *t*+1 is typically modeled in terms of annual wage earnings, private pension accruals, health status, etc., until age *t* as well as in terms of changes in these variables from *t* to *t*+1, while effects of changes occurring after t+1 are not considered.

In our final choice of model we argue that, although the option value model is the theoretically most intuitive model, the computational complexity might cover the objective of this paper to analyze the effects of early retirement pensions. Instead we use the third option and model early retirement via old age pension as reduced forms similar to the hazard model approach.

In the old age retirement model we are focusing on the relation between pension benefits and retirement behavior. The model includes, along with individual characteristics as controls, the discounted values of future net benefits and pension wealth accruals. These measures are standard in the literature but for clarity the definitions are given below. The net present value of the future pension benefits after tax (NPV) is defined as

$$NPV_{it} = \sum_{s=t}^{T} \left(1+\rho_{is}\right)^{t-s} B_i(s,r) \tag{1}$$

where $B(s,r)$ denotes the pension benefits after tax received in period s if retiring in period r ($B(s,r)=0$ for $s<r$) and ρ_{it} is the time, age, and gender specific discount rate accounting for survival rates and an exogenous time preference discount component of 3 per cent annually. In the analysis, we adopt a simplified tax system including only year specific state and local taxes. The after tax pension benefits for the public and the standard collective agreements, $B(s,r)$, are derived from the individual's income history and the conditions in the

relevant pension contracts as discussed in section 2.[11] The modeling of access to early retirement pensions is discussed below.

The net present value accrual ACC_{it} measures the discounted increase in NPV when postponing retirement one year,

$$ACC_{it} = \frac{1}{1+\rho_{it+1}} NPV_{i,t+1} - NPV_{it} \tag{2}$$

Depending on the actuarial adjustments with respect to the timing of the claims, the accrual can be positive as well as negative. Delaying benefit claims generally increases the benefits during the payout periods, i.e., $B(t,r+1) \geq B(t,r)$ for $t \geq r+1$, but simultaneously reduces the number of years the benefits are received. The net effect on the accrual varies across individuals and time and can take positive as well as negative values.

As the net present value reflects an income effect we would expect it to be positively correlated with the probability to retire, whereas the accrual measures a relative price effect it would be associated with a negative correlation. However, both net present value and its accrual are functions of the wage rate via the earnings history; in general both the NPV and the ACC are positively correlated (in absolute values) to the wage rate. Kruger and Pischke (1992) and Coile and Gruber (2000), among others, note that social security wealth (our net present value) and its accrual are a non-linear functions of past earnings, and unobserved retirement propensities may very well be correlated with earnings levels. This means that we may have an endogenous variable problem; if high wage rates signal strong preferences for work, we might see negative correlation between NPV and retirement probability. In order to control for the wage rate we could include it as a control variable, or rescale the net present value and its accrual by the wage rate. Unfortunately, we do not have direct access to the wage rate. In this analysis we will adopt the latter approach and define

$$\begin{aligned} NPV_{it}^{Q} &= NPV_{it} / Q_{it} \\ ACC_{it}^{Q} &= ACC_{it} / Q_{it} \end{aligned} \tag{3}$$

[11] The benefit level is defined as a function of qualifying wage, retirement age, present age (if retired), and the number of service years (entitlement years) within relevant occupational sector. From data we can observe neither the qualifying wage nor the number of service years perfectly, which means that they had to be estimated. We estimate the qualifying wage as the five-year mean of individual taxable income prior to the year of the first occupational pension withdrawal. We have chosen to assign the maximum number of service years, which is 30 years for all sectors, to everyone in the sample.

where Q_{it} denotes the average after tax annual income over the five years predating retirement. An alternative rational behind this specification is that individuals relate after tax pension wealth to after tax annual earnings. The rescaled measures will have the interpretation of wealth in terms of annual earnings, i.e., $NPV_{it} = 10$ would mean that the individual has 10 after tax annual earnings in after tax pension wealth.

The individual's choice to retire is assumed to be given by the discrete choice model

$$\begin{aligned} &y_{it} = 1 \text{ if } y_{it}^{*} = \mathbf{x}_{it}'\beta + \varepsilon_{it} > 0 \\ &y_{it} = 0 \text{ otherwise} \end{aligned} \tag{4}$$

where $y_{it} = 1$ indicates that the individual exit into retirement in period t, $\mathbf{x}_{it}$ is a vector of individual characteristics including rescaled net present values and accruals with weights β and ε_{it} reflects unobserved variables influencing the retirement decision.

The retirement via old-age pension model includes financial incentives which are derived from the future stream of pension benefits. As discussed in Section 6.2, the old-age benefits are generally determined by the public old-age pension and the collective agreement occupational pension systems. However, we also indicated the incidence of individual contracts between the employer and the employee close to normal retirement age, denoted as early retirement pension. This type of pension is not available to all individuals at all times, but it is the outcome of an unobserved negotiation process between the employee and the employer. As this type of early retirement pension can be very important for the individual's economic incentives to retire early, it should be included in the model. Ideally, we would like to construct a structural model describing the process that determines which individuals that receive an early retirement pension and the level of the early retirement pension benefits. However, that is not possible with the data at hand and we are forced to retreat to a reduced form capturing the main individual variables in the process. Here we assume that the probability of receiving an early retirement pension is determined as a discrete choice model such that

$$\begin{aligned} &v_{it} = 1 \text{ if } v_{it}^{*} = \mathbf{w}_{it}'\delta + \xi_{it} > 0 \\ &v_{it} = 0 \text{ otherwise} \end{aligned} \tag{5}$$

where $v_{it} = 1$ indicates that the individual has access to an early retirement pension, $\mathbf{w}_{it}$ denotes a vector of individual characteristics with weights δ, and ξ_{it} represents unobserved variables reflecting the probability to receive an offer.[12] There are some econometric complications as the early retirement pension is only indirectly observable for those who have retired. These problems and the proposed solutions are discussed in Section 7.

5 Data

This section describes the data used in the estimation of the retirement decision. We use the Longitudinal INdividual DAta set (LINDA), which is a register-based longitudinal data set drawn from income registers and population censuses (for a detailed description of LINDA, see Edin et al, 2000). It consists of a large panel of individuals, about 300,000 individuals annually, or about 3% of the population, representative of the overall population from 1960 to 2000. The data base also contains information on all family members of a sampled individual, as long as they remain in the household. We use sampled individuals only.

We limited the analysis to the age group 60-64. The argument for this is that very few actually start to claim their occupational pension before age 60, and not many continue work (without withdrawing pensions) after the age of 65 (see Section 3).[13] Hence, the large part of the early retirement via old-age pension is located in the age groups 60-64. Further, we define the risk group as those who were classified as working at least one preceding year[14] (has work or active business incomes summing to at least 1 BA), and did not claim any public, private, or occupational old age pension, or disability insurance in that year. Therefore, the preceding year serves as a qualifying period, meaning that the first claim can be observed in 1993.

The dependent variable indicates the individual’s first year of retirement. The year of retirement is the first year with an occupational pension claim, which is defined as the year in which occupational pension is paid out given that none was received in the preceding year. To avoid the usual problems with annual data of the type we employ, we do not measure income

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[12] As the accrual value of social security wealth includes also its future value there is an issue on the indivudal’s expectation of future access to early retirement programs. In this analysis we assume that an individual do not anticipate to receive an offer next year.

[13] The decision whether or not to retire is assumed to be taken and executed in the same calendar year.

[14] Data show that retirement is definitive. According to Hallberg (2003), the transition rate back to work among male workers aged 60-64 was 0.1 percent for disability insurance and 0.4 percent for occupational pension. One can note that conditioning on longer work history does not change the risk group, and therefore not the estimates very much.

with data from the transition year (to retirement) in our study. [15] Instead, incomes are measured in the first and the third year of a three-year panel, centered on the transition year. This implies that the first year of occupational pension claim must be observed no later than the second to last year before the panel ends, i.e., in 1999.

In addition to the variables measuring the economic incentives discussed below, we control for educational level, sex, age, calendar year, if the individual is born in Sweden, the individual's marital status, and if applicable, the spouse's labor market status. It is reasonable to believe that the subset of workers – mostly white collar workers in the private sector – that continue working longer than others, is a quite selective group in terms of health, productivity, and quality at the work place. The included controls capture at least partly such heterogeneity. Further, results in the literature (e.g. Blau, 1998) indice that spouses tend to coordinate and retire at the same time. In order to take full account of the household decision to retire, we would need a much more complicated model than what is feasible here. Hence, we are forced to use the spouse's lagged labor market status in the individual's decision to retire so that we do not create complicating simultaneity problems. Here, we define the spouse's labor market status by checking the income from work. If this is less than 1 basic amount, the spouse is considered not working.

For the calculation of economic incentives, it is crucial that each person's labor market sector affiliation can be identified in order to correctly implement the relevant collective agreement occupational pension plan. Sector affiliation is however not coded for all groups, so it has to be estimated for parts of the sample. In this process we use all individuals aged 50 years or more in the data set. After dropping a minor share of individuals with inconsistent income records, we observe 33 704 men and 41 383 women that are 50+ during 1992-2000. Sector affiliation is determined in a series of steps. For each retired individual with occupational pension benefits, we can observe the source of the pension payments. That is, we know from which collective agreement occupational pension the individual receives her benefits. This information is than used to classify the individuals into appropriate labor market sectors.[16] If the individual did not retire within the observed periods, we can not observe directly the sector affiliation through the occupational pension pay-outs. In that case we use additional

[15] Since individuals may change status any time during the year there is a high possibility that, with the annual structure of the data, the registered income from the transition year is difficult to use. It may be difficult to differentiate work on a part-time basis from work part-of-the-year.
[16] To avoid unnecessary complications, individuals that receive benefits from more than one occupational pension source are dropped.

information in the data on labor market affiliation. All employed individuals are coded in data as employed in the private, central, or local government sector. For individuals in the central or local government sector, and who do not retire before the end of the panel, we use this register information directly to code sector affiliation.[17] For employed in the private sector, this is not possible since these could be either white or blue collar workers. For this group, predictions from a logit equation are used to determine white collar or blue collar sector affiliation.[18]

A definition of early retirement program offers

In the available data, the same variable contains both ‘normal’ occupational pension benefit originating from the collective agreement, and early retirement pensions (ERP). Hence, there is no explicit information whether an individual has received an early retirement pension or not.

The strategy we pursue is to rely on how the observed pension benefit corresponds to standard conditions in the applicable occupational pension contract. We then make the assumption that benefits that exceed a certain threshold value constitute an accepted early retirement program. We define an early retirement program as having an occupational pension benefit above that given by the standard agreement for the occupational pension in question, also considering the early retirement option which exists in the programs (see Appendix for details about the rules). It may be the case that we observe an occupational pension withdrawal at an earlier age than what is stipulated in the agreements as early retirement age. In those cases we also code this as having a private agreement pension with the employer.

In the agreement text, all benefit levels are regulated as factors of the qualifying wage, retirement age, present age (if retired), and the number of service years within relevant occupational sector. We cannot observe the qualifying wage or the number service years perfectly in data. This means that they have to be estimated. The qualifying wage is estimated by the mean of taxable incomes during the last five years prior to the year of the first occupational pension withdrawal. Further, since we want to avoid the risk of overstating the replacement

[17] This code says in which sector most of the income was earned in a particular year. We backlag this value from the last year of the panel to every year in order to have only one value per individual.

[18] The prediction equation is estimated on those observed retired as either white collar workers or blue collar workers. Explanatory variables in that prediction model are taxable income, gender, education, and industry, and interactions. The reported measure of fit is high (given the particular uniform random draw, the ratio of “correct” predictions was about 75 percent). As a sensitivity check, we compared the register information on sector code with the actual pension source among those we observe as retired, and found a very good correspondence between these measures.

rates in our calculations, we have chosen to assign the maximum number of service years, which is 30 years for all sectors, to everyone in the sample (see Eklöf and Hallberg, 2004).

6 Estimation sample description

Table 2 gives the retirement status and early retirement program status in the estimation samples. The definition of an early retirement program is that the observed pension benefit (from occupational pension plans only) exceeds the standard agreement including actuarial adjustments for early withdrawal. This is a quite generous definition of early retirement programs as small measurement errors in the benefits generated by the standard agreement could be falsely interpreted as a program. The exit rates to retirement by age group shows for example that about 2.6 per cent exit to retirement at age 60. At age 64 this increases to almost 30 percent for women and 10.4 percent for men.

Table 2 Number of exits into retirement by age (percent)

A. Exit rates from work		
	Males	Females
Age	Retired	Retired
60	2.6	2.7
61	8.9	9.1
62	7.5	8.6
63	6.2	9.2
64	10.4	29.5
Total	6.6	10.2
B. Share of retired with early retirement pensions		
60	38.2	28.8
61	34.3	32.1
62	32.1	26.2
63	38.9	25.8
64	34.6	19.8
Total	35	25
C. Share of retirees with early retirement pension by sector		
Central	28.4	22.9
White collar	46.1	35.8
Local gov.	28.7	23.7
Blue collar	0	0

The share of retired individuals with *observed* access to an early retirement program is higher for males compared to women. For men it is quite stable over age and varies between

30 and 40 per cent, while it for women declines from slightly less than 30 percent at age 60 to 20 percent at age 64. The fractions of observed access to early retirement programs are moreover highest for white collar workers.

Table 3 Net present value of future pension benefits (NPV) with early retirement pension and standard agreement among the retired, by sector (sample means)

Sector	*NPV, early retirement pension (in 1999 SEK)*	*NPV, standard pension (in 1999 SEK)*	*Rescaled NPV, early retirement pension*	*Rescaled NPV, standard pension*
Central	1 644 000	1 441 000	11.0	9.6
White collar	1 726 000	1 552 000	10.8	9.7
Local gov.	1 409 000	1 184 000	11.9	10.0
Blue collar		935 000		8.3

Note: in 1999 SEK, 1 BA was 36,400 SEK, approx. 3640 Euro.

Table 3 present the sample averages of the net present values of future pension benefits with early retirement pensions and standard collective agreement occupational pensions. We also present the rescaled versions where the net present values are scaled by the after tax pensionable income. Note that the net present values are based on after tax benefits. The results indicate that, for central government employees, the average net present value of the early retirement pension is about 1 644 000 SEK (in 1999 price level) compared to 1 441 000 SEK for the standard pension. In terms of pensionable income, this represents about 11 and 9.6 years of after tax annual incomes, respectively. Table 5 and Table 6 in Appendix present descriptive statistics of the estimation samples.

7 Econometric analysis

We model the decision between remaining at work or retire as a discrete choice. As the observed transitions from retirement to work are negligible in practice, we consider retirement as an absorbing state. In the analysis we focus on voluntary early retirement. Consequently, we consider individuals that have not reached their "normal" retirement age, i.e. the risk group for "early retirees". The stylized facts indicate that early retirement programs are important for this group. We argue that the effects of economic incentives on the retirement decision can not be consistently estimated unless these programs are explicitly accounted for in the estimations. One complicating factor is that early retirement programs are only partially observed in the data; one can only infer existence of a program for individuals who has retired. This complicates the situation as the dependent variable in eq. (5) becomes only partially observable, and some of the independent variables in eq. (4) are measured with error and correlated to the error term. The proposed model is similar to the bivariate probit models with partial observability proposed by Abowd and Farber (1982) and Poirier (1982), but here we have the additional problem that also the independent variables are partially observed.

In eq. (4), the problem is that $\mathbf{x}_{it}$ is observed with error for non-retirees, i.e. when $\varepsilon_{it} < -\mathbf{x}'_{it}\beta$. This implies that we have an endogenous variable problem since the measurement error in $\mathbf{x}_{it}$ is related to the error term ε_{it}. Furthermore, since the accessibility of early retirement program is observed for retirees only, this implies that the data is censored w.r.t. v_{it} and we have a sample selection problem in eq. (5).

Assume that the utility parameters are not affected by the access of an early retirement pension. Let $\mathbf{x}_{it} = v_{it}\mathbf{x}_{it}^{ERP} + (1-v_{it})\mathbf{x}_{it}^{STD}$ where the superscript ERP refers to variables relevant if the individual has access to an early retirement pension and STD refers to the standard contracts. Then we can construct a system of simultaneous equations as

$$\begin{cases} y_{it}^{*} = \left(v_{it}\mathbf{x}_{it}^{ERP} + (1-v_{it})\mathbf{x}_{it}^{STD}\right)'\beta + \varepsilon_{it} \\ v_{it}^{*} = \mathbf{w}'_{it}\delta + \xi_{it} \end{cases} \tag{6}$$

where the simultaneity stems from that $\mathbf{x}_{it}$ is a function of v_{it} and v_{it} is only observed if $y_{it} = 1$, i.e. if $\left(v_{it}\mathbf{x}_{it}^{ERP} + (1-v_{it})\mathbf{x}_{it}^{STD}\right)'\beta + \varepsilon_{it} > 0$. The probability to observe the event $\left(y_{it}, v_{it}\right)$ is thus

$$\Pr\left(y_{it}, v_{it}\right) = \int_{\underline{\xi}_{it}}^{\overline{\xi}_{it}} \int_{\underline{\varepsilon}_{it}}^{\overline{\varepsilon}_{it}} f\left(\varepsilon, \xi\right) d\varepsilon d\xi \tag{7}$$

where $f(\varepsilon, \xi)$ denotes the joint density of $(\varepsilon_{it}, \xi_{it})$ and with integration limits defined as

$$\begin{aligned} \overline{\varepsilon}_{it} &= \begin{cases} \left(v_{it}\mathbf{x}_{it}^{ERP} + (1-v_{it})\mathbf{x}_{it}^{STD}\right)'\beta & \text{if } y_{it} = 1 \\ \infty & \text{otherwise.} \end{cases} \\ \underline{\varepsilon}_{it} &= \begin{cases} -\infty & \text{if } y_{it} = 1 \\ \left(v_{it}\mathbf{x}_{it}^{ERP} + (1-v_{it})\mathbf{x}_{it}^{STD}\right)'\beta & \text{otherwise.} \end{cases} \end{aligned} \tag{8}$$

and

$$\overline{\xi}_{it} = \begin{cases} \mathbf{w}'_{it}\delta & \text{if } v_{it} = 1 \\ \infty & \text{otherwise.} \end{cases}$$
$$\underline{\xi}_{it} = \begin{cases} -\infty & \text{if } v_{it} = 1 \\ \mathbf{w}'_{it}\delta & \text{otherwise.} \end{cases} \tag{9}$$

Furthermore, as the propensity to retire is potentially related to unobserved individual characteristics, we control for individual specific time invariant effects. Assuming that the unobserved time invariant individual effects are uncorrelated with the idiosyncratic random error and the observable independent variables allows us to estimate a random effect model. The probability to observe a sequence of outcomes $(\mathbf{y}_i, \mathbf{v}_i) = (y_{i1}, ..., y_{iT_i}, v_{i1}, ..., v_{iT_i})$ is

$$\Pr(\mathbf{y}_i, \mathbf{v}_i) = \int_{\underline{\xi}_{i1}}^{\overline{\xi}_{i1}} \cdots \int_{\underline{\xi}_{iT_i}}^{\overline{\xi}_{iT_i}} \int_{\underline{\varepsilon}_{i1}}^{\overline{\varepsilon}_{i1}} \cdots \int_{\underline{\varepsilon}_{iT_i}}^{\overline{\varepsilon}_{iT_i}} f(\varepsilon_{i1}, ..., \varepsilon_{iT_i}, \xi_{i1}, ..., \xi_{iT_i}) d\varepsilon_{iT_i} ... d\xi_{i1} \tag{10}$$

Let $\varepsilon_{it} = u_i + e_{it}$ where $u_i \sim iidN(0, \sigma_u^2)$ and $e_{it} \sim iidN(0,1)$. This implies that, conditional on u_i, ε_{it} is uncorrelated with ε_{is} for $t \neq s$. As $\mathbf{x}_{it}$ is observed only when $y_{it} = 1$ we join the outcomes $(y_{it}, v_{it}) = (0,0)$ and $(y_{it}, v_{it}) = (0,1)$. The probability conditional on u_i can thus be written as

$$\begin{aligned} \Pr(\mathbf{y}_i, \mathbf{v}_i \mid u_i) = \prod_{t=1}^{T_i} \Bigg[& \Phi\left(\mathbf{x}_{it}^{ERP\prime}\beta + u_i, \mathbf{w}'_{it}\delta, \rho\right)^{y_{it}v_{it}} \left\{\Phi\left(\mathbf{x}_{it}^{STD\prime}\beta + u_i, \infty, \rho\right) - \Phi\left(\mathbf{x}_{it}^{STD\prime}\beta + u_i, \mathbf{w}'_{it}\delta, \rho\right)\right\}^{y_{it}(1-v_{it})} \\ & \times \left\{1 - \Phi\left(\mathbf{x}_{it}^{ERP\prime}\beta + u_i, \mathbf{w}'_{it}\delta, \rho\right) - \left[\Phi\left(\mathbf{x}_{it}^{STD\prime}\beta + u_i, \infty, \rho\right) - \Phi\left(\mathbf{x}_{it}^{STD\prime}\beta + u_i, \mathbf{w}'_{it}\delta, \rho\right)\right]\right\}^{1-y_{it}} \Bigg] \end{aligned} \tag{11}$$

Integrating over u_i gives the unconditional probabilities as

$$\Pr(\mathbf{y}_i, \mathbf{v}_i) = \int_{-\infty}^{\infty} \Pr(\mathbf{y}_i, \mathbf{v}_i \mid u) f_u(u) du \tag{12}$$

which can be rewritten on a form suitable for numerical integration routines (e.g. Gauss-Hermite quadrature) as

$$\Pr(\mathbf{y}_i, \mathbf{v}_i) = \int_{-\infty}^{\infty} \exp(-r^2) g(r) dr \quad \text{where } g(r) = \frac{1}{\sqrt{\pi}} \Pr\left(\mathbf{y}_i, \mathbf{v}_i \mid \sqrt{2\sigma^2} r\right) \tag{13}$$

In general we assume that $(\varepsilon_{it}, \xi_{it})$ is bivariate normal with unit variance and correlation ρ. However, as this is much more computationally burdensome, we also estimate models where we assume that $\rho = 0$, which implies that the cumulative densities in eq. (11) simplifies to products of univariate cumulative densities.

In the empirical analysis we also report marginal effects on relevant probabilities w.r.t. a small change in any of the variables included in $\mathbf{x}$ or $\mathbf{w}$. When considering the marginal effects of changes in $\mathbf{x}$, we focus on their impact on the conditional probability to retire without an early retirement pension, i.e. $ME_{\mathbf{x}|v=0} = \partial \Pr(y=1 | v=0) / \partial \mathbf{x}$. The motivation is that this is the measure reported in studies that ignore the early retirement pensions. The unconditional marginal effects $ME_{\mathbf{x}} = \partial \Pr(y=1) / \partial \mathbf{x}$ are reported in the text for some key variables. The conditional marginal effect can be derived as

$$\begin{aligned} ME_{\mathbf{x}|v=0} &= \frac{\partial \Pr(y=1|v=0)}{\partial \mathbf{x}} = \frac{\partial}{\partial \mathbf{x}}\left(\frac{\Pr(y=1, v=0)}{\Pr(y=1, v=0) + \Pr(y=0, v=0)} \right) \\ &= \frac{\partial}{\partial \mathbf{x}}\left(\frac{\int_{-\infty}^{\mathbf{x}^{STD}{}'\beta} \int_{\mathbf{w}'\delta}^{\infty} \Phi(\varepsilon, \xi, \rho)\, d\xi\, d\varepsilon}{\int_{-\infty}^{\mathbf{x}^{STD}{}'\beta} \int_{\mathbf{w}'\delta}^{\infty} \Phi(\varepsilon, \xi, \rho)\, d\xi\, d\varepsilon + \int_{\mathbf{x}^{STD}{}'\beta}^{\infty} \int_{\mathbf{w}'\delta}^{\infty} \Phi(\varepsilon, \xi, \rho)\, d\xi\, d\varepsilon} \right) \\ &= \frac{\partial}{\partial \mathbf{x}}\left(\frac{\int_{-\infty}^{\mathbf{x}^{STD}{}'\beta} \int_{\mathbf{w}'\delta}^{\infty} \Phi(\varepsilon, \xi, \rho)\, d\xi\, d\varepsilon}{\int_{-\infty}^{\infty} \int_{\mathbf{w}'\delta}^{\infty} \Phi(\varepsilon, \xi, \rho)\, d\xi\, d\varepsilon} \right) \end{aligned} \quad (14)$$

Allowing for individual random effects introduces a third integral over the individual random effects where the individual effect would enter the integration limits for ε (see eq. (11) and eq. (12)). The marginal effects in the access-to-early retirement pension equation w.r.t. the independent variables are calculated in the same way. In the empirical analysis we have calculated the marginal effects using numerical derivatives and report the average marginal effect over individuals. Whenever the correlation is set to zero, the marginal effects can be simplified including only univariate cumulative distribution functions.

8 Estimation results

The model is estimated using maximum likelihood on the extended sample discussed above. In Table 4, we present results from two distinct estimation strategies. In columns (a) and (c), we present reduced form estimates when using the “standard approach”, that is neglecting the existence of early retirement pensions. In columns (b) and (d) we present estimates based on the strategy outlined above where we account for early retirement pensions. In the table, we present estimates, standard errors (SE), and average conditional marginal effects [ME]. The upper panel presents the estimates of the coefficients in the retirement decision equation (4). The lower panel refers to the access-to-early retirement pension in equation (5). Other alternative specifications are presented in appendix.

The key results in Table 4 are in line with intuition. An increase in net present value of future benefits in terms of net annual incomes, NPV/Q, is associated with an increased probability of early retirement. The coefficients are significant for females, but insignificant for males. The estimated marginal effects indicates that, for females, an additional annual wage in social security wealth would increase the probability to retire by 0.04 units. As the average probability to retire is about 0.1, this corresponds to a 40 per cent increase in retirement probabilities. For males, the corresponding increase is 6 per cent (insignificant).

An increase in the net accruals in terms of the net qualifying wage is associated with a decrease in probability of retirement as expected. Here, the estimated marginal effects indicate that individuals are much more responsive to changes in the accrual rate than to the net present values. However, one should note that the model is estimated under the assumption that individuals consider early retirement pensions as one-time offers, which might explain the large marginal effects.

Further, early retirement probability is increasing in educational level. This is perhaps a counter-intuitive result, but one should recall that higher education may be negatively correlated with the social security wealth in terms of annual incomes as the pension benefits do not cover high incomes at the same rate as lower incomes. Household composition clearly affects the retirement probability. First, married individuals are less prone to retire than singles. Second, married individuals with non-working spouses are more prone to retire than married individuals with working spouses. The net effect on retirement probabilities of being married to a non-working spouse is about the same as of being single. There are no significant effects of being born abroad for females on the retirement probability although the estimates are generally negative.

In the discussion above, we emphasize the potential bias that results if one fails to account for the access to early retirement pension and its impact on financial incentives. The biases are present in Table 4. Comparing the estimates of the marginal effects w.r.t. the financial incentives, we observe that the effects are inflated in the specifications where we ignore early retirement pensions (columns (a) and (c)). The effect varies across coefficients and sex, but there is a clear pattern that the marginal effects of financial incentives are reduced if early retirement programs are accounted for. The estimated marginal effects of an increase in social security wealth are about 10 (females) to 30 (males) per cent higher if early retirement programs are not accounted for. The corresponding increase w.r.t. accruals are 30 and 40 percent, respectively.

Regarding the access to early retirement pensions, we observe that a higher (before tax) wage rate is weakly but significantly (for females) associated with higher probabilities. Education is positively correlated with access probabilities. Again, being born abroad seems to have no measurable effect on access to early retirement pensions. However, female white collars and local government employees have significantly higher probabilities to have access to an early retirement pensions compared to the reference group of central government employees. However, for males no such differences are detectable. Note that blue collars are by construction excluded from the possibility to have access to an early retirement pension.

Finally, all models indicate that individual variation is significant compared to the idiosyncratic shocks. The standard deviation of the individual random effect is about 3.2 for females and 1.3-1.7 for males. The correlation between the idiosyncratic shocks in the retirement and early retirement pension equations differs between males and females. For females, the correlation is substantial and negative, which means that females associated with negative errors in the retirement equation (less prone to retire) are simultaneously associated with positive errors in the accessibility equation (more probable of receiving an offer). This could be interpreted as that employers give offers to those females that are not otherwise likely to retire. As the correlation is positive for males, the reverse holds, i.e., employers target the males that have a high unobserved likelihood of retiring.

Table 4 Maximum likelihood estimates of retirement and access-to-early retirement pension coefficients

	Males		Females	
	(a) No early ret. pens.	(b) Early ret. pens.	(c) No early ret. pens.	(d) Early ret. pens.
Retire = 1				
Constant	-5.318***	-6.567***	-16.182***	-16.033***
	(0.658)	(0.917)	(0.998)	(1.036)
	[-0.444]	[-0.377]	[-0.928]	[-0.856]
NPV/Q	0.090*	0.103	0.753***	0.725***
(after tax)	(0.051)	(0.066)	(0.080)	(0.075)
	[0.008]	[0.006]	[0.043]	[0.039]
ACCl/Q	-3.234***	-3.315***	-3.962***	-3.189***
(after tax)	(0.326)	(0.403)	(0.512)	(0.412)
	[-0.270]	[-0.191]	[-0.228]	[-0.171]
College	0.411***	0.408***	1.012***	0.864***
	(0.082)	(0.100)	(0.111)	(0.126)
	[0.034]	[0.023]	[0.058]	[0.046]
University	0.839***	0.947***	0.998***	0.778***
	(0.117)	(0.153)	(0.127)	(0.152)
	[0.070]	[0.055]	[0.057]	[0.042]
Married/Cohab.	-0.171**	-0.224**	-0.561***	-0.598***
	(0.071)	(0.096)	(0.124)	(0.132)
	[-0.014]	[-0.013]	[-0.032]	[-0.032]
Spouse not working	0.205***	0.252***	0.442***	0.440***
	(0.067)	(0.089)	(0.101)	(0.107)
	[0.017]	[0.015]	[0.025]	[0.024]
Born abroad	-0.387***	-0.367**	-0.342	-0.237
	(0.145)	(0.180)	(0.223)	(0.271)
	[-0.032]	[-0.021]	[-0.020]	[-0.013]
Access to early retirement pension = 1				
Constant		-2.052***		-1.779***
		(0.108)		(0.140)
		[-0.148]		[-0.239]
Annual wage in BA		0.013		0.027*
(before tax)		(0.008)		(0.015)
		[0.001]		[0.004]
College		0.147**		0.193***
		(0.063)		(0.063)
		[0.011]		[0.026]
University		0.204***		0.261***
		(0.075)		(0.076)
		[0.015]		[0.035]
Born abroad		-0.149		-0.026
		(0.135)		(0.139)
		[-0.011]		[-0.003]
White collars		0.031		0.147*
		(0.061)		(0.080)
		[0.002]		[0.020]
Local gov. empl.		0.068		0.146*
		(0.097)		(0.080)
		[0.005]		[0.020]
Blue collar				
SE(u_i)	1.339***	1.729***	3.282***	3.206***
	(0.178)	(0.225)	(0.195)	(0.198)
Correlation		0.331*		-0.621***
		(0.195)		(0.141)
lnL	-4425.763	-5222.325	-5603.400	-6652.784
Ind	8381	8381	8170	8170
Obs	20579	20579	20425	20425
Par	19	37	19	37

Standard errors in parenthesis ( ). Conditional marginal effects in brackets [ ].

With these estimates at hand we can go one step further and assess the early retirement pensions' impact on total retirement hazards. The model gives for each individual the estimated probabilities associated the four distinct outcomes (y_{it}, v_{it}) for $y_{it} = \{0,1\}$ and $v_{it} = \{0,1\}$. Although we can not observe some of these outcomes, we can construct estimates of their probabilities. For example, the total probability of retirement is the sum of the probabilities of retiring with and without early retirement pensions. We can also calculate the probability to retire if there were no early retirement pensions as the retirement probability conditional on no early retirement pension. Note that this is not the same as estimating a model without taking the existence of early retirement pensions into account. In appendix we present tables that represent the average probability mass in each category by age, year, and sector. Here we present some selected key results.

Each panel in Figure 3 presents three graphs illustrating the observed average retirement hazard in the sample, the average predicted retirement hazard, and the average predicted retirement hazard conditional on no early retirement pensions by age. For each individual we average the probabilities over 100 random draws from the distribution of the individual random effect. The predictions are then averaged over individuals by age (or year) to produce the average predicted hazards.

For comparisons, we also include the observed hazard rates in the sample. However, one should note that the average observed and predicted hazards can not be compared directly as the observed hazards are based on a selected sample of individuals that remain in the sample. That is, individuals that are observed to retire are dropped from the observed sample and thus do not influence hazards at later periods, whereas there is no corresponding deletion of individuals with high predicted hazards. In order to create a fully comparable measure between the predicted and observed hazards, we would need to randomly delete observations from the predicted sample based on predicted hazards, but this is not done here. Consequently, the average predicted hazards should be upward biased estimates of the observed counterparts, and there should be a non-decreasing trend in the differences over time and age. However, as we also include time dummies in the model, these trends can be broken occasionally.

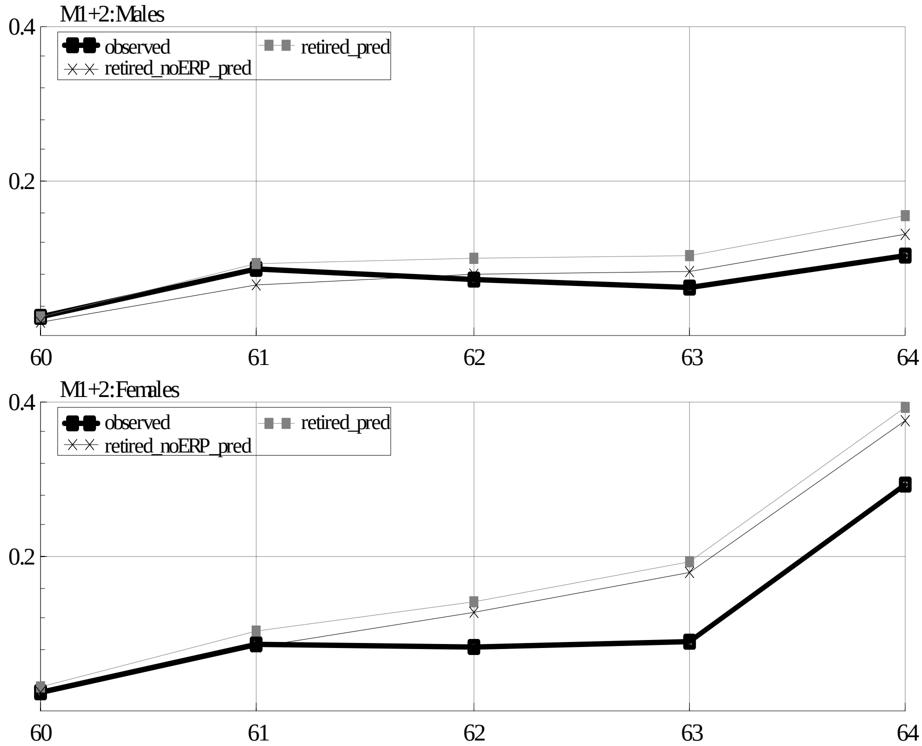

Figure 3 Average retirement hazards, observed, predicted with and without early retirement pensions, by age and gender.

Figure 3 presents the predicted and observed hazards by age. As discussed, the observed hazards lie above the observed ones, and the differences are generally increasing in age. The main message that can be drawn is the relative importance of the early retirement pensions on retirement hazards. For males, the retirement hazard with no early retirement pensions is about 15 to 30 per cent lower and decreasing in age, whereas for females the difference decreases from 20 to 3 per cent by age.

In Figure 4 we present the hazards averaged by year. The general conclusion stands in that the observed hazards are below the predicted ones, and the hazard with no early retirement pension is about 14 to 25 per cent below the hazard with early retirement pensions. The peak in all hazard rates in 1997 can potentially be explained by the fact that in this year, the central government announced that all government agencies would become responsible for the early retirement pension offer they granted. This implied a sharp increase in the number of early retirement pensions being granted just before the change went into effect (Wadensjö & Sjögren, 2000).

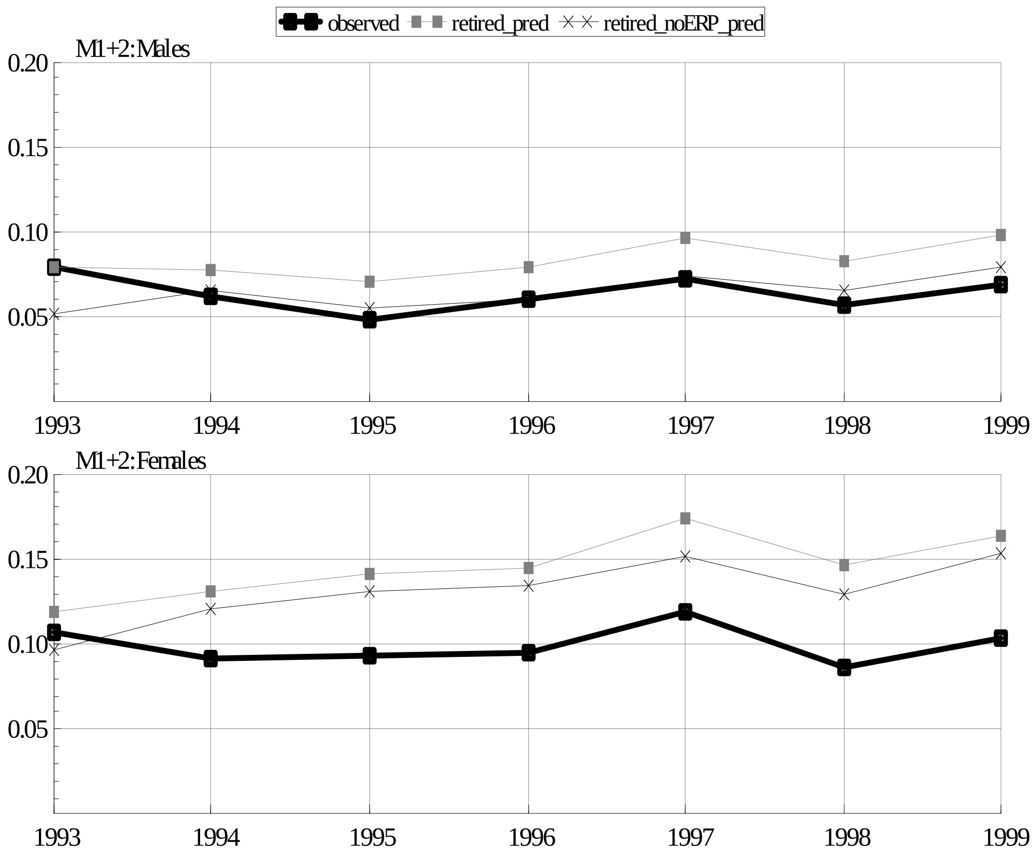

Figure 4 Average retirement hazards, observed, predicted with and without early retirement pensions, by year and gender.

This exercise indicates the importance of early retirement pension on aggregate retirement behavior. The average early retirement probability would have be reduced by about 5 to 25 per cent depending on age and year.

9 Conclusions

Individuals' responses to financial incentives when deciding on retirement are key factors when designing an efficient pension system. Previous studies have used the individual variation in financial incentives caused by the public and occupational pension systems. These previous studies have primarily used the information contained in the legislation and agreements to construct individual specific financial incentives. We argue that this is not the full story. Empirical, as well as anecdotal evidence indicate that, the group of individuals that is most likely to respond to financial incentives i.e. early retires, may have significantly stronger incentives than stipulated in the contracts. This is caused by individual agreements offered by the employer in order to persuade the employee to leave her employment and enter early retirement. Neglecting these offers may severely impede the estimated responses to financial incentives in the retirement decision.

In this paper we emphasize the importance of accounting for early retirement pensions when analyzing retirement hazards as functions of financial incentives. We adopt a simple reduced form approach focusing on financial incentives such as net present values of future pension benefit streams and accruals. We propose an estimation strategy that handles the problems of partial observability of early retirement pensions, in that they are only indirectly recorded for early retirees and not recorded for non-retirees. Our estimation strategy includes a system of equations determining the retirement and access-to-early retirement pension probabilities simultaneously.

There may be several reasons for employers to produce early retirement pension offers. First, in some collective agreement occupational pension systems, the pension premiums paid by the employer are linked to the current wage rate of the employee. The systems are generally constructed as defined benefit systems such that benefits are linked to the wage rate close to retirement. This implies that the additional life-long benefits generated by a wage increase close to retirement needs to be finance over just a few years. Consequently, the premiums may increase rapidly by age, causing a reduced demand for older labor force. Second, in times of distress, employers may find it more preferable to offer older employees early retirement than lay off younger employees as it would be forced to by the seniority rules.

Our empirical results indicate that the estimated marginal effects on retirement probabilities are positive w.r.t. net present values of future pension benefits and negative w.r.t accrual, all in line with previous studies and intuition. However, neglecting the existence of early retirement pension yields a bias away from zero in these marginal effects of about 10 to 30 per cent for net present values and 30 to 40 per cent for accruals. This would result in a severe over-estimation of individuals' responsiveness to financial incentives and may lead to erroneous recommendations to policy makers.

Our model also enables us to estimate the importance of early retirement pensions with respect to early retirement hazards. The results indicate that early retirement hazards would be reduced by 15-25 per cent each year if no early retirement pensions where issued. As the effects of early retirement pensions on retirement behavior is non-negligible and the motives for early retirement pensions most likely stem from the construction of the financial part of the collective agreement occupational pension systems, this emphasize the need for new debate on the preferable construction of these systems and their links to the public pension system.

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Appendix

Rules

A brief overview of main features of the occupational pension plans (SAF-LO, SAF-PTK, PA-91, and PA-KL) and early retirement programs, is presented below.[19]

- Blue collar workers in private sector (SAF-LO). Before 1996, the pension plan of private sector blue-collar workers included a pension benefit of 10 per cent of the earnings below 7.5 BA. Above that threshold there were no pension rights. The benefits were based on average earnings five years prior to the retirement date. A worker did not have the option to withdraw occupational pension benefits before normal retirement age of 65. Full benefits were received if the individual had 30 years or more of employment; otherwise they were proportionally reduced.
- White collar workers in private sector (SAF-PTK). Benefits based on average earnings during last year at employment. Full benefits if more than 30 years of employment, otherwise proportionally reduced. Claims can be made from age 55 through age 70, with normal retirement age 65. At normal retirement age, the benefits amounts to 10% of the qualifying (pensionable) wage up to 7.5 BA, 65% between 7.5 and 20 BA, 32.5% between 20 and 30 BA. If retirement age is less than 65, the benefit level is 65% up to 7.5 BA, and then the same as above until age 65 is reached. If retirement age is less than 65, benefits are reduced by approximately 6% per year predating age 65. Postponed retirement claim is awarded with an actuarial increase.
- Central government employees (PA-91). Benefits based on average earnings during last five years at employment. Full benefits if more than 30 years of employment, otherwise proportionally reduced. The normal retirement age is 65, earliest age is 60, oldest 70. Some subgroups have a lower mandatory retirement age. If mandatory retirement age is 65, the benefits amounts to 10% of the qualifying (pensionable) wage up to 7.5 BA, 65% between 7.5 and 20 BA, 32.5% between 20 and 30 BA. If retirement age is less than 65, the benefit level is 101% up to 1 BA, 65% between 1 and 20 BA, and then the same as above until age 65 is reached. These benefits are then reduced by 0.4% per each month of early retirement. If retirement age is less than 65, benefits af-

[19] See Svenska Arbetsgivareföreningen (1994), Arbetsgivarverket (2000), Svenska kommunalarbetareförbundet (1994), and SPP (2006). On top of the ordinary scheme described here, all occupational systems also have a contribution defined part as well. We will in our study not go into any detail about these, since they are relatively small in comparison to the ordinary pension.

ter 65 are also reduced (by 2.6% per month of early retirement for earnings below 7.5 BA, and 0.4% for earnings above 7.5 BA). If claims are postponed after age 65, benefits are increased by 0.5% per month.

- Local government employees (PA-KL). The pension benefits are fully coordinated with the social security system including the national old age pension plans. Full benefits if more than 30 years of employment, otherwise benefits are proportionally reduced. Several subgroups have a lower mandatory retirement age (in parenthesis): the normal retirement is 65 (60), earliest age for withdrawal is 60 (57). The benefits are based on the average income of the best 5 years of the 7 years predating retirement. The benefits amounts to 95% of earnings below 1 BA, 78.5% for earnings from 1 to 2.5 BA, 60% for 2.5 to 3.5 BA, 64% for 3.5 to 7.5 BA, 65% for 7.5 to 20 BA, and 32.5% for 20-30 BA. Early withdrawals are adjusted depending on mandatory retirement age and the number of months of early claim. Withdrawal can be postponed after age 65, although not longer than until age 67, with a 0.1% increase in the benefit level per month of late withdrawal.
- Early retirement pension is assumed to follow the complementary rule. This states, that the firm can deduct full pension costs up to 80% of the pensionable earnings below 7.5 BA, 70% between 7.5 and 20 BA, and 40% between 20 and 30 BA. This rule will be used for calculating the benefits in early retirement programs. Applies to age group 60-64.

Tables and figures

Table 5 Sample descriptives, males (UPDATE WITH INFORMATIVE LABELS)

	T	Missing	Mean	Std	Min	Max
year	20595	0	1996.179	2.021	1993	1999
bkon	20595	0	1	0	1	1
bald	20595	0	60.584	1.374	59	63
oap	20595	0	368.199	5456.126	0	146921.094
di	20595	0	888.185	9925.467	0	205530.109
work	20595	0	217708.128	174099.600	0	13909569
low_educ	20595	0	0.436	0.496	0	1
mid_educ	20595	0	0.378	0.485	0	1
high_edu	20595	0	0.186	0.389	0	1
female	20595	0	0	0	0	0
isectnum	20595	0	2.695	1.068	1	4
married	20595	0	0.764	0.425	0	1
cohabit	20595	0	0.014	0.119	0	1
spouse	20595	0	0.778	0.415	0	1
spouse_retired	20595	0	0.225	0.418	0	1
qualw	20594	1	6.631	3.312		
golden	20595	0	0.022	0.148	0	1
golden_l	20595	0	0.033	0.178	0	1
retired	20595	0	0.065	0.246	0	1
sectnum	20595	0	80.403	60.192	1	127
born_abr	20595	0	0.045	0.208	0	1
qualw_net	20589	6	4.254	1.738		
NPV_ERP	20589	6	41.124	17.576		
NPV_TJP	20589	6	37.385	15.578		
NPV_WORK	20589	6	45.118	16.218		
INC_ERP	20589	6	2.910	1.168		
INC_TJP	20589	6	2.331	0.915		
INC_WORK	20594	1	6.631	3.312		
ACC_ERP	20589	6	-4.222	3.682		
ACC_TJP	20589	6	-1.242	0.878		
NPV_ERP_Q	20579	16	9.569	1.327		
NPV_TJP_Q	20579	16	8.720	0.732		
NPV_WORK_Q	20579	16	10.712	0.875		
INC_ERP_Q	20579	16	0.685	0.150		
INC_TJP_Q	20579	16	0.548	0.070		
INC_WORK_Q	20579	16	1.526	0.095		
ACC_ERP_Q	20579	16	-0.932	0.724		
ACC_TJP_Q	20579	16	-0.276	0.145		
age	20595	0	61.584	1.374	60	64

Table 6 Sample descriptives, females (UPDATE WITH INFORMATIVE LABELS)

	T	Missing	Mean	Std	Min	Max
year	20436	0	1996.127	2.021	1993	1999
bkon	20436	0	2	0	2	2
bald	20436	0	60.657	1.387	59	63
oap	20436	0	201.413	3321.152	0	122246.305
di	20436	0	1441.499	10708.823	0	207097.391
work	20436	0	150319.171	79431.354	0	1254873.375
low_educ	20436	0	0.379	0.485	0	1
mid_educ	20436	0	0.394	0.489	0	1
high_edu	20436	0	0.227	0.419	0	1
female	20436	0	1	0	1	1
isectnum	20436	0	2.748	0.849	1	4
married	20436	0	0.728	0.445	0	1
cohabit	20436	0	0.009	0.096	0	1
spouse	20436	0	0.737	0.440	0	1
spouse_retired	20436	0	0.402	0.490	0	1
qualw	20436	0	4.591	1.864	0	33.311
golden	20436	0	0.025	0.156	0	1
golden_l	20436	0	0.035	0.184	0	1
retired	20436	0	0.100	0.300	0	1
sectnum	20436	0	68.342	62.005	1	127
born_abr	20436	0	0.036	0.187	0	1
qualw_net	20434	2	3.091	1.129	0	16.812
NPV_ERP	20434	2	36.054	13.481	0	127.474
NPV_TJP	20434	2	31.565	11.497	0	115.648
NPV_WORK	20434	2	38.650	13.277	0	135.664
INC_ERP	20434	2	2.349	0.925	0	6.312
INC_TJP	20434	2	1.831	0.666	0	5.383
INC_WORK	20436	0	4.591	1.864	0	33.311
ACC_ERP	20434	2	-3.051	2.493	-19.680	16.761
ACC_TJP	20434	2	-0.707	0.566	-7.852	0
NPV_ERP_Q	20425	11	11.680	1.320	5.479	15.280
NPV_TJP_Q	20425	11	10.260	0.740	6.608	13.674
NPV_WORK_Q	20425	11	12.614	0.984	3.957	16.211
INC_ERP_Q	20425	11	0.754	0.114	0.042	0.851
INC_TJP_Q	20425	11	0.598	0.088	0.213	0.915
INC_WORK_Q	20425	11	1.475	0.050	1.360	2.122
ACC_ERP_Q	20425	11	-0.936	0.604	-2.631	1.084
ACC_TJP_Q	20425	11	-0.218	0.129	-0.858	-0.012
age	20436	0	61.657	1.387	60	64

Table 4c. Maximum likelihood estimates (PRELIMINARY), before tax annual benefits and wages (golden_l)

	Females		Males	
	(a) No early ret. prg.	(b) Early ret. prg.	(c) No early ret. prg.	(d) Early ret. prg.
Retired=1				
Constant	-15.260***	-17.773***	-6.128***	-11.490***
	(0.978)	(1.255)	(0.864)	(1.399)
	[-0.277]	[-0.210]	[-0.215]	[-0.133]
SSW/Q	0.836***	0.966***	0.228***	0.613***
	(0.079)	(0.094)	(0.078)	(0.114)
	[0.015]	[0.011]	[0.008]	[0.007]
Accrual/Q	-2.944***	-1.628***	-4.072***	-3.069***
	(0.492)	(0.219)	(0.515)	(0.474)
	[-0.053]	[-0.019]	[-0.143]	[-0.036]
College	1.056***	0.999***	0.518***	0.592***
	(0.118)	(0.136)	(0.097)	(0.135)
	[0.019]	[0.012]	[0.018]	[0.007]
University	1.126***	1.192***	1.130***	1.354***
	(0.132)	(0.162)	(0.155)	(0.200)
	[0.020]	[0.014]	[0.040]	[0.016]
Married	-0.623***	-0.750***	-0.143*	-0.178
	(0.125)	(0.143)	(0.082)	(0.130)
	[-0.011]	[-0.009]	[-0.005]	[-0.002]
Spouse not working	0.477***	0.465***	0.218***	0.260**
	(0.105)	(0.115)	(0.076)	(0.117)
	[0.009]	[0.005]	[0.008]	[0.003]
Access to early retirement program=1				
Constant		-1.144***		-1.435***
		(0.143)		(0.117)
		[-0.061]		[-0.005]
Qualifying wage		0.025*		-0.002
		(0.013)		(0.006)
		[0.001]		[-0.000]
College		0.209***		0.105*
		(0.058)		(0.057)
		[0.011]		[0.000]
University		0.190***		0.077
		(0.071)		(0.065)
		[0.010]		[0.000]
White collars		-0.325***		-0.427***
		(0.076)		(0.051)
		[-0.017]		[-0.001]
Local gov. empl.		-0.131*		0.051
		(0.073)		(0.075)
		[-0.007]		[0.000]
Blue collars		-5.196***		-5.327***
		(0.000)		(0.000)
		[-0.275]		[-0.018]
SE(u_i)	3.008***	3.300***	-1.624***	-2.439***
	(0.178)	(0.216)	(0.217)	(0.258)
lnL	-5607.578	-6747.871	-4418.639	-5207.715
Ind	8171	8171	8385	8385
Obs	20427	20427	20584	20584
#Par	35	35	35	35

DEP:retired golden_l. SE(Hessian) in (), marginal effects in []. Using 10 Gauss-Hermite abscissas

Table 4b. Maximum likelihood estimates (PRELIMINARY), after tax annual benefits and wages (golden_l)

	Females		Males	
	(a) No early ret. prg.	(b) Early ret. prg.	(c) No early ret. prg	(d) Early ret. prg.
Retire = 1				
Constant	-15.574***	-17.285***	-5.356***	-8.823***
	(1.006)	(1.243)	(0.651)	(1.216)
	[-0.269]	[-0.197]	[-0.211]	[-0.119]
SSW/annual wage	0.836***	0.889***	0.180***	0.332***
(after tax)	(0.081)	(0.092)	(0.053)	(0.086)
	[0.014]	[0.010]	[0.007]	[0.004]
Accrual/annual wage	-2.816***	-1.578***	-3.670***	-3.019***
(after tax)	(0.500)	(0.208)	(0.397)	(0.453)
	[-0.049]	[-0.018]	[-0.144]	[-0.041]
College	1.049***	0.994***	0.429***	0.523***
	(0.115)	(0.134)	(0.086)	(0.134)
	[0.018]	[0.011]	[0.017]	[0.007]
University	1.028***	1.010***	0.870***	1.141***
	(0.131)	(0.160)	(0.120)	(0.199)
	[0.018]	[0.011]	[0.034]	[0.015]
Married/Cohab.	-0.573***	-0.683***	-0.184**	-0.287**
	(0.124)	(0.143)	(0.076)	(0.124)
	[-0.010]	[-0.008]	[-0.007]	[-0.004]
Spouse not working	0.444***	0.469***	0.211***	0.292***
	(0.102)	(0.117)	(0.071)	(0.111)
	[0.008]	[0.005]	[0.008]	[0.004]
Born abroad	-0.308	-0.211	-0.383**	-0.257
	(0.221)	(0.341)	(0.152)	(0.221)
	[-0.005]	[-0.002]	[-0.015]	[-0.003]
Access to early retirement program = 1				
Constant		-1.114***		-1.501***
		(0.147)		(0.124)
		[-0.064]		[-0.007]
Wage (before tax)		0.038**		0.021***
		(0.015)		(0.007)
		[0.002]		[0.000]
College		0.199***		0.099*
		(0.060)		(0.059)
		[0.011]		[0.000]
University		0.175**		0.079
		(0.074)		(0.068)
		[0.010]		[0.000]
Born abroad		-0.057		-0.158
		(0.141)		(0.127)
		[-0.003]		[-0.001]
White collars		-0.317***		-0.417***
		(0.078)		(0.053)
		[-0.018]		[-0.002]
Local gov. empl.		-0.097		0.183**
		(0.075)		(0.076)
		[-0.006]		[0.001]
Blue collar		-5.303		-5.324
		(209.715)		(209.716)
		[-0.306]		[-0.023]
SE(u_i)	3.127***	3.387***	-1.477***	-2.284***
	(0.180)	(0.227)	(0.185)	(0.286)
lnL	-5609.668	-6748.659	-4411.883	-5201.175
Ind	8170	8170	8381	8381
Obs	20425	20425	20579	20579

DEP:retired golden_l. SE(Hessian) in (), marginal effects in []. Using 10 Gauss-Hermite abscissas

Table 7 Average estimated probabilities by year, All

Average probabilities, All, All

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.038	0.061	0.837	0.063
1994	0.018	0.086	0.872	0.024
1995	0.022	0.085	0.866	0.027
1996	0.021	0.091	0.865	0.023
1997	0.034	0.099	0.831	0.035
1998	0.027	0.087	0.852	0.033
1999	0.024	0.106	0.847	0.024

Average probabilities, All, Central

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.064	0.076	0.806	0.054
1994	0.029	0.104	0.850	0.018
1995	0.034	0.097	0.850	0.019
1996	0.034	0.105	0.846	0.016
1997	0.049	0.114	0.814	0.023
1998	0.040	0.103	0.834	0.024
1999	0.033	0.122	0.829	0.016

Average probabilities, All, White

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.059	0.079	0.798	0.064
1994	0.028	0.109	0.840	0.023
1995	0.032	0.096	0.846	0.026
1996	0.033	0.098	0.847	0.022
1997	0.045	0.109	0.817	0.029
1998	0.037	0.101	0.833	0.029
1999	0.034	0.124	0.820	0.023

Average probabilities, All, Local

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.046	0.073	0.765	0.116
1994	0.023	0.107	0.826	0.044
1995	0.026	0.109	0.815	0.049
1996	0.023	0.114	0.822	0.041
1997	0.041	0.117	0.776	0.066
1998	0.032	0.100	0.808	0.060
1999	0.026	0.123	0.810	0.041

Average probabilities, All, Blue

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.000	0.024	0.976	0.000
1994	0.000	0.032	0.968	0.000
1995	0.000	0.034	0.966	0.000
1996	0.000	0.039	0.961	0.000
1997	0.000	0.047	0.953	0.000
1998	0.000	0.035	0.965	0.000
1999	0.000	0.039	0.961	0.000

Table 8 Average estimated probabilities by year, Males

Average probabilities, Male, All

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.033	0.046	0.895	0.026
1994	0.016	0.062	0.913	0.010
1995	0.019	0.051	0.916	0.013
1996	0.023	0.057	0.906	0.014
1997	0.026	0.069	0.891	0.014
1998	0.022	0.062	0.903	0.014
1999	0.023	0.075	0.888	0.014

Average probabilities, Male, Central

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.064	0.069	0.839	0.028
1994	0.029	0.088	0.873	0.009
1995	0.036	0.076	0.877	0.011
1996	0.040	0.083	0.864	0.013
1997	0.044	0.097	0.846	0.013
1998	0.036	0.086	0.863	0.015
1999	0.037	0.097	0.855	0.011

Average probabilities, Male, White

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.057	0.070	0.837	0.037
1994	0.027	0.090	0.870	0.014
1995	0.031	0.071	0.880	0.018
1996	0.036	0.076	0.871	0.018
1997	0.039	0.089	0.857	0.016
1998	0.033	0.083	0.868	0.016
1999	0.034	0.099	0.849	0.017

Average probabilities, Male, Local

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.038	0.048	0.851	0.062
1994	0.020	0.068	0.888	0.024
1995	0.022	0.054	0.892	0.033
1996	0.025	0.055	0.885	0.035
1997	0.029	0.071	0.866	0.034
1998	0.023	0.061	0.887	0.030
1999	0.026	0.075	0.869	0.030

Average probabilities, Male, Blue

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.000	0.019	0.981	0.000
1994	0.000	0.026	0.974	0.000
1995	0.000	0.022	0.978	0.000
1996	0.000	0.024	0.976	0.000
1997	0.000	0.031	0.969	0.000
1998	0.000	0.024	0.976	0.000
1999	0.000	0.028	0.972	0.000

Table 9 Average estimated probabilities by year, Females

Average probabilities, Female, All

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.044	0.076	0.781	0.100
1994	0.020	0.110	0.832	0.038
1995	0.024	0.118	0.818	0.040
1996	0.020	0.125	0.824	0.032
1997	0.043	0.129	0.771	0.057
1998	0.033	0.113	0.800	0.054
1999	0.024	0.139	0.803	0.034

Average probabilities, Female, Central

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.064	0.086	0.763	0.087
1994	0.028	0.125	0.818	0.029
1995	0.031	0.126	0.815	0.028
1996	0.025	0.133	0.821	0.021
1997	0.054	0.135	0.774	0.036
1998	0.044	0.122	0.800	0.034
1999	0.029	0.149	0.800	0.021

Average probabilities, Female, White

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.062	0.097	0.728	0.113
1994	0.030	0.148	0.780	0.043
1995	0.033	0.147	0.778	0.042
1996	0.027	0.144	0.797	0.032
1997	0.058	0.151	0.735	0.055
1998	0.045	0.137	0.766	0.052
1999	0.032	0.169	0.765	0.033

Average probabilities, Female, Local

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.049	0.081	0.738	0.132
1994	0.024	0.119	0.807	0.050
1995	0.027	0.126	0.792	0.054
1996	0.022	0.133	0.802	0.043
1997	0.046	0.133	0.745	0.076
1998	0.035	0.114	0.780	0.071
1999	0.025	0.140	0.789	0.045

Average probabilities, Female, Blue

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
1993	0.000	0.035	0.965	0.000
1994	0.000	0.046	0.954	0.000
1995	0.000	0.059	0.941	0.000
1996	0.000	0.069	0.931	0.000
1997	0.000	0.082	0.918	0.000
1998	0.000	0.061	0.939	0.000
1999	0.000	0.064	0.936	0.000

Table 10 Average estimated probabilities by age, All

Average probabilities, All, All

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.009	0.020	0.956	0.015
61	0.030	0.069	0.868	0.033
62	0.026	0.096	0.846	0.032
63	0.028	0.120	0.811	0.041
64	0.058	0.220	0.663	0.059

Average probabilities, All, Central

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.018	0.034	0.941	0.007
61	0.051	0.103	0.830	0.016
62	0.044	0.127	0.809	0.021
63	0.044	0.137	0.782	0.037
64	0.067	0.207	0.649	0.077

Average probabilities, All, White

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.017	0.026	0.947	0.009
61	0.048	0.092	0.837	0.022
62	0.039	0.125	0.807	0.028
63	0.038	0.149	0.768	0.045
64	0.066	0.244	0.610	0.080

Average probabilities, All, Local

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.005	0.019	0.943	0.033
61	0.026	0.068	0.838	0.068
62	0.028	0.108	0.803	0.061
63	0.036	0.148	0.748	0.068
64	0.089	0.288	0.543	0.081

Average probabilities, All, Blue

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.000	0.004	0.996	0.000
61	0.000	0.022	0.978	0.000
62	0.000	0.033	0.967	0.000
63	0.000	0.044	0.956	0.000
64	0.000	0.106	0.894	0.000

Table 11 Average estimated probabilities by age, Males

Average probabilities, Male, All

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.010	0.017	0.969	0.004
61	0.029	0.064	0.898	0.010
62	0.024	0.076	0.889	0.012
63	0.025	0.077	0.875	0.022
64	0.040	0.115	0.800	0.045

Average probabilities, Male, Central

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.018	0.032	0.949	0.001
61	0.050	0.102	0.844	0.003
62	0.045	0.113	0.834	0.008
63	0.049	0.104	0.823	0.024
64	0.066	0.126	0.737	0.070

Average probabilities, Male, White

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.016	0.022	0.959	0.003
61	0.047	0.084	0.861	0.008
62	0.038	0.108	0.840	0.014
63	0.039	0.114	0.814	0.033
64	0.060	0.173	0.695	0.072

Average probabilities, Male, Local

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.005	0.016	0.963	0.016
61	0.026	0.062	0.878	0.034
62	0.025	0.078	0.866	0.031
63	0.032	0.080	0.842	0.045
64	0.068	0.121	0.739	0.072

Average probabilities, Male, Blue

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.000	0.004	0.996	0.000
61	0.000	0.022	0.978	0.000
62	0.000	0.028	0.972	0.000
63	0.000	0.030	0.970	0.000
64	0.000	0.057	0.943	0.000

Table 12 Average estimated probabilities by age, Females

Average probabilities, Female, All

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.008	0.023	0.941	0.027
61	0.030	0.075	0.838	0.057
62	0.028	0.116	0.803	0.053
63	0.031	0.161	0.750	0.059
64	0.074	0.317	0.537	0.071

Average probabilities, Female, Central

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.018	0.038	0.930	0.015
61	0.052	0.103	0.812	0.032
62	0.042	0.144	0.777	0.036
63	0.037	0.177	0.733	0.052
64	0.068	0.307	0.541	0.085

Average probabilities, Female, White

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.018	0.036	0.923	0.023
61	0.052	0.107	0.791	0.049
62	0.042	0.161	0.742	0.056
63	0.037	0.214	0.681	0.068
64	0.078	0.379	0.447	0.096

Average probabilities, Female, Local

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.005	0.020	0.936	0.039
61	0.026	0.070	0.824	0.080
62	0.028	0.118	0.784	0.070
63	0.037	0.169	0.718	0.076
64	0.095	0.336	0.486	0.083

Average probabilities, Female, Blue

	(Ret,ERP)	(No Ret,ERP)	(No Ret,No ERP)	(Ret,No ERP)
60	0.000	0.004	0.996	0.000
61	0.000	0.022	0.978	0.000
62	0.000	0.043	0.957	0.000
63	0.000	0.072	0.928	0.000
64	0.000	0.203	0.797	0.000