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Abstract
The focus of this paper is to analyse why a large fraction of single elderly people choose to retire early. A structural model directly based on the individual decision of labour supply is estimated on a sample of singles, where singles are defined as those who are living alone. We find that income and health are important determinants of the retirement decision. Furthermore, we find substantial gender differences in the retirement pattern. Healthy single women value retirement more than healthy single men and are willing to reduce their disposable income to 74 per cent of their previous income while men are willing to reduce the income to 81 per cent. Men's retirement decision is mainly influenced by income and health, whereas women's retirement decision is also affected by education and unemployment experience.

Keywords: retirement, gender differences, singles, panel data, option value
JEL: C23, J14, J16, J26

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1. Introduction

Many OECD countries are facing an increasing proportion of elderly people. In the future, more individuals will be retired and at the same time fewer individuals will be in the labour force. The increased retirement programme participation and the future financial burden connected with this development have generated widespread interest in the retirement issue; cf. e.g. Gruber and Wise (1997) who present results from analyses of retirement in 11 industrialised countries.

Despite the large amount of literature on retirement, very few studies consider the retirement of singles. The lack of attention to singles' retirement patterns is somewhat surprising, since knowledge about single men's and women's retirement patterns is important when designing future retirement schemes and since a large proportion of older people are singles and an even larger proportion will be singles in the future. In the United States for example, about 35% of women and 25% of men aged 60-64 are unmarried and in the UK the figures are 28% and 19% for the 55-64 years of age, respectively,[1] and there is a general declining tendency in the marriage rate and an increasing share of individuals are divorced.[2] Furthermore, the retirement pattern of singles is likely to differ from the pattern of couples, because singles may be exposed to different economic incentives and they may have different preferences for, e.g., leisure. Another distinct trend in the labour market, which is likely to affect the future inflow to retirement, is the narrowing of the gender gap in labour force participation over the last three decades. The gender composition of the older part of the labour force will change in the future, as a result of increasing female labour force participation (see e.g. Perracchi and Welch (1994)).

The gender gap in labour force participation is, in general, smaller for singles than for couples. As an example, the employment rate of singles in the EU is, on average, 58% for men and 50% for women, aged 50-64, whereas the employment rate is 65% and 38% for married men and women

1 U.S Census Bureau (2000), and U.S. Census Bureau, International Database (1991)
2 EUROSTAT (1997a).

respectively.[3] Futhermore, some studies, e.g. Ruhm (1996), find that unmarried men and women with work experience have the same probability of working. Johnson and Skinner (1986) find that labour supply is affected strongly by marital separation in terms of higher participation rates for women. These and other previous studies concerning singles mostly deal with middle aged people and only a few studies examine single elderly people's retirement decision. Two studies (Hanoch and Honig (1983) and Honig (1985)) find evidence suggesting that characteristics influencing the retirement of single women are not much different from those of married men. A Norwegian study by Dahl et al. (2003) finds that being single appears to increase the probability of early exit for men and that the opposite seems to be the case for women.

The aim of this paper is to analyse why a large fraction of single elderly people choose early retirement instead of staying in the labour force until reaching the official pension age. In this study we focus, in particular, on gender differences in the retirement behaviour among singles. If gender differences exist, are the differences in retirement due to differences in, e.g., financial circumstances or due to differences in preferences for retirement? To disentangle the different explanations we formulate a structural model for single men and women directly based on the individual decision to retire. In our framework the decision is based on financial conditions, health status, unemployment, and education. Considering gender differences, singles provide a particularly useful case since one can directly estimate the value of retirement/leisure and thereby investigate whether there are gender differences in the preferences for leisure. In contrast, when analysing couples, the value of retirement/leisure for husbands and wives may be influenced by the fact that the decision is likely to be a joint decision (which may be a result of bargaining within the household). Therefore, it can be difficult to attribute differences in observed retirement behaviour of husbands and wives to gender differences in preferences for retirement.

3 EUROSTAT (1997b).

The basis of the empirical analysis is a 10 per cent longitudinal sample of single men and women in Denmark, including information on a large number of demographic, educational, income, health, labour market and retirement variables for the period 1981-97. The advantages of these data are twofold, first the data are register-based, which makes it possible to involve a large part of the population, and second, historical information is registered with a high degree of reliability. The paper concentrates on the very popular public financed Early-Retirement Pay (ERP) scheme, which is available to individuals aged 60 to 66. In the sample period the economic incentives in this retirement scheme were changed. This within-sample change, helps identify the parameters of the model. The main result from the estimations indicates the existence of gender differences in the retirement behaviour of singles, and that income and health are important determinants of the retirement decision. Healthy women value retirement more than healthy men and are willing to reduce the disposable income to 74 per cent of their previous income while men are willing to reduce their income to 81 per cent. For singles with worse health, the gender differences are much smaller. Men's retirement decision is mainly influenced by income and health, whereas women's retirement decision is also affected by education and unemployment experience.

The paper is organised in seven sections. Section 2 summarises some of the previous studies of retirement behaviour. In Section 3, a description of the ERP system in Denmark is given. In Section 4, the economic and econometric model is presented, and Section 5 gives a description of the data and the construction of the variables applied in the model. Section 6 contains the estimations and the results. Finally, Section 7 contains concluding remarks.

2. Previous Evidence of Retirement

The growing interest in retirement issues and the access to micro data have resulted in a large number of empirical studies of individual retirement behaviour. The methodology used for

estimating individual's choice of retirement comprises both reduced form models and structural models. The reduced form models are based on well-known statistical models such as the duration model, Blau (1994), and probit models, Meghir & Whitehouse (1997). A number of different structural models of retirement have been estimated, for example by Berkovec & Stern (1991), Rust (1989,1990), Rust & Phelan (1997), Gustman & Steinmeier (1986), Sickles and Taubman (1986), Stock & Wise (1990), Lumsdaine, Stock & Wise (1990), Kerkhofs et al. (1999), and Blundell et al. (2002). The choice of method has been widely discussed in this literature, but without a final conclusion. It depends on the type of data, the complexity of the problem and the abilities of the model to predict. See, e.g. Lumsdaine and Mitchell (1999) for a review of different structural retirement models.

Even though all the empirical analyses referred to above are based on different data sets and different methods, the results reveal some common features. All the analyses suggest that financial circumstances affect the retirement decision. In addition, low education, spells of unemployment, and poor health are found to be associated with early retirement in all analyses where these issues are considered.

The studies of retirement behaviour have so far mainly concentrated on the behaviour of men. Among the very few studies that actually consider women's retirement patterns are Pozzebon and Mitchell (1989), and Vistnes (1994). Both studies focus on retirement by married women and take the husband's labour market status as exogenous. In Pozzebon and Mitchell (1989) the decision to retire does not seem to be affected by either the financial circumstances or retirement age of the husband. However, Vistnes (1994) finds the opposite results, namely that higher earnings and a working husband increase the probability of the wife continuing to work. Moreover, Pozzebon and Mitchell (1989) find that the age difference between husband and wife and the husband's state of health appear to be important determinants of the wife's retirement age.

Only a few studies, to our knowledge, analyse retirement of singles. Mastrogiacomo, Alessie, and Lindeboom (2002) estimate retirement models for singles and married couples. They focus on the relative importance of differences in behavioural responses of the different types of households to financial incentives. They find that singles would have a stronger tendency to stay in the labour force if they had the retirement options available to couples. They do not estimate separate models for men and women. Hanoch and Honig (1983), and Honig (1985) find evidence suggesting that characteristics influencing the retirement of single women are not much different from those of married men. A Norwegian study by Dahl et al. (2003) analyses early retirement for men and women focussing on different family characteristics. The results indicate that single women are less likely to retire early compared to single men.

The other strand of the literature examines joint retirement decisions of married couples; e.g. Blau and Riphahn (1999), Gustman and Steinmeier (2000) and Christensen and Datta Gupta (1998). Blau and Riphahn (1999) employ a reduced form model, while the two other studies use a structural model. In all the studies strong cross spouse effects on the retirement pattern are found, i.e. that the probability of retirement increases if the spouse is not working. However, Gustman and Steinmeier (2000) find that women are less sensitive to the retirement of the spouse than men are. Blau and Riphahn (1999) find that responses to wages and benefits, in general, are greater for women. In Christensen and Datta Gupta (1998), husbands are found to have at least as strong preferences for leisure as wives have. These studies indicate the importance of modelling couples' retirement jointly.

Empirical studies of retirement in Denmark include analyses applying reduced-form models, e.g. Pedersen and Smith (1992, 1995), and structural models by e.g. Bingley and Lanot (1996), and Bingley, Datta Gupta, and Pedersen (2001). The main findings are that educational attainment, spells of unemployment, and illness have a significant impact on the retirement age.

To sum up, the empirical evidence about female retirement that emerges from previous studies suggests that the effects of the determinants of women's retirement choice might be different than for men. However, most of the previous studies of women's retirement patterns are based on highly selective and relatively small data sets. Only a few empirical studies have examined the retirement behaviour of singles, and none of them focus on gender differences.

3. Early-Retirement Pay in Denmark

This section contains a description of the main features of the Danish Early-Retirement Pay (ERP) scheme, which is the basis for the economic model of retirement. The ERP system was introduced in 1979 as part of a public programme to reduce unemployment and to make it possible for worn-out workers to retire. In practice ERP has functioned as a reduction in the pension age, not only for worn-out workers but for a broad section of the older labour force. Eligibility for the ERP programme requires membership of an unemployment insurance fund[4] for at least 20 years of the previous 25 years,[5] and both unemployed and employed individuals may enter the scheme from the age of 60 to 66. Although, the membership contributions for unemployment insurance funds is quite high (on average EUR 486 per year, in 1995), still about 80 per cent of the labour force are members, and for the age group 40-60 almost 90 per cent are members; see Parsons, Tranæs and Lilleør (2003) for further details.

The basic amount of the ERP benefit is equivalent to unemployment benefits, which amounts to 90 per cent of the final wage earned, subject to a ceiling. In 1998 the maximum sum was EUR. 18,726 per year. This means that the ERP benefit for a university graduate will typically be 45 per

4 Membership of an unemployment insurance fund is voluntary in Denmark.

5 Before March 1992 the condition was at least 10 years' membership of an unemployment insurance fund within the last 15 years. To ensure that the conditions for eligibility for the ERP-programme after March 1992 were unchanged for persons who already were members of an unemployment insurance fund before March 1992, the requirement for eligibility for these people was still at least 10 years' membership within the last 15 years.

cent of the earlier wage income, whereas for a textile worker, the benefit amounts to about 83 per cent.[6] After a maximum of 2.5 years on the ERP scheme, the amount of retirement benefit decreases to a maximum 80 per cent of the unemployment benefit (82 per cent after 1993). If an individual is unemployed before joining the ERP, the duration of the maximum payment period is shortened, such that after a maximum 2.5 years on unemployment benefits or on ERP, the amount of retirement benefit decreases.

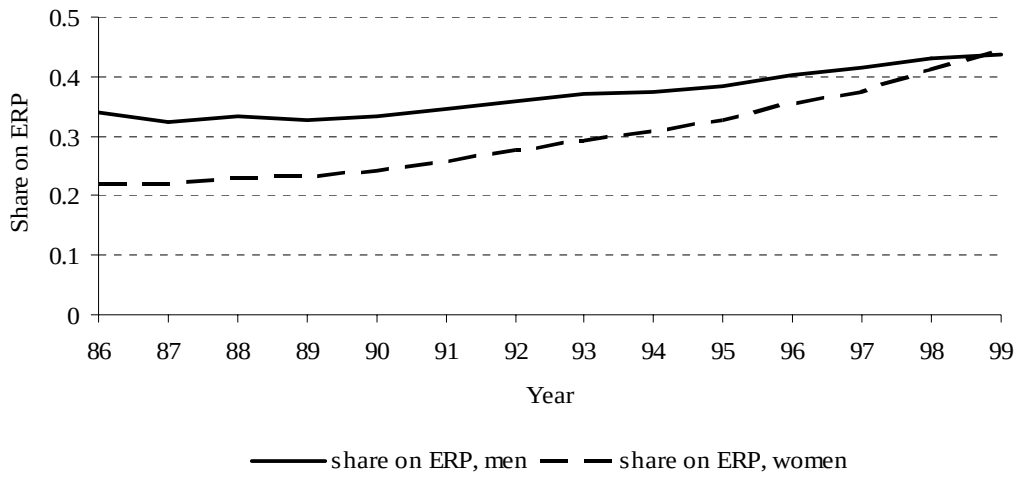

Fig. 1. The share of men and women, 60-66 years of age, on Early-Retirement Pay, 1986-1999.
Source: DfA's (Direktoratet for Arbejdsløshedsforsikring) Annual Report , (1999), and Statistics Denmark's, homepage: www.dst.dk.

In figure 1, the share of the population aged 60-66 on the ERP scheme is shown for men and women, respectively, for the period 1986-1999. The share of 60-66 year-olds on the ERP is in most of the period higher for men than for women, but in 1999, 44 per cent of both men and women in the relevant age group were in receipt of ERP. The reason why the share on ERP is lower for women than for men prior to 1999 is mainly because fewer women were eligible for ERP. If only people who are entitled to ERP are included, the share of people on ERP amounted to 68 per cent in

6 The Directorate of Unemployment Insurance, in Danish: Direktoratet for Arbejdsløshedsforsikring (1994).

1998.[7]

In 1992, postponing retirement to the age of 63 was made financially rewarding to encourage later retirement, such that, if a person postpones retirement to the age of 63, the payment will be a maximum 100 per cent of the unemployment benefit until the age of 67. The behaviour responses to the reform of ERP in 1992 were that more individuals retired at age 63. The distribution of the retirement age for men and women receiving ERP in 1991 and 1997 is shown in figure 2. Both before and after the reform the majority retire as soon as they become eligible. However, after the reform the second largest group is the 63-year-olds, including 16 per cent of men and 10 per cent of women who join the ERP scheme in 1997. This figure suggests that financial conditions play a role in the retirement decision.

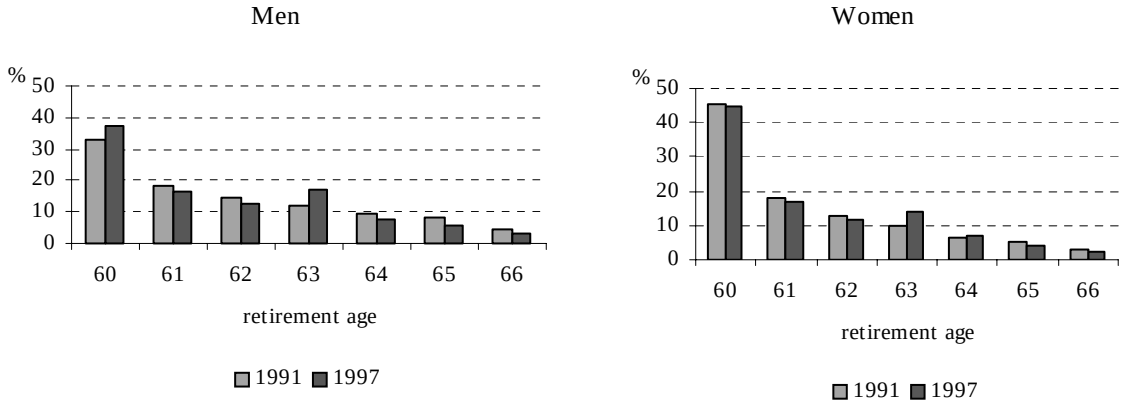

Fig. 2. Distribution of the entry age for men and women joining the ERP scheme in 1991 and 1997. Source: Statistics Denmark (1999)

In addition to the payment from the ERP, individuals may receive income from two other sources. First, individuals on the ERP scheme are allowed to work up to 200 hours per year without a deduction in the ERP payment, after which the payment is reduced. However, a survey (DfA, 1994)

7 Source: The Directorate of Unemployment Insurance. In Danish: Direktoratet for Arbejdsløshedsforsikring (1999).

shows that very few persons work after retiring with the ERP. The second potential source of income is from private pension funds. If an individual receives a regular income from a private pension scheme, the payment from ERP is reduced. The survey indicates that for individuals retiring in 1994, about 8 per cent have this additional income.[8]

When modelling the retirement decision, we regard the ERP as the only 'route' to early retirement. The reason for this is that this 'route' is almost the only option for early retirement. For individuals aged 60-67 the other exit route from the Danish labour market is the Social Disability Pension (*førtidspension*), but in contrast to the ERP, the Social Disability Pension is not a voluntary option. The difference in eligibility between the two early retirement schemes is that the ERP is an option for individuals who are able to work, whereas the purpose of the Social Disability Pension is to provide an income for individuals who are unable to work either because of health reasons or due to social reasons.[9] In general, the benefit from the Social Disability Pension scheme for the age group 60-66 is lower than the benefit from ERP. Table 1 shows the distribution of retirement on different exit routes for persons who are eligible for ERP and who actually retired before the age of 67. About 94 per cent of both men and women retired on the ERP scheme.

Table 1.
Exit routes for persons who are eligible for ERP and who actually retired before the age of 67

	Men		Women	
	Percent	Obs.	Percent	Obs.
Early-Retirement Pay	93.9	8182	93.6	4891
Social Pension	3.7	325	4.6	240
Others	2.4	205	1.9	97

Source: The Institute of Local Government Studies' Longitudinal Register.

8 Unfortunately, no information is available from register data or other official statistics about membership of private pension funds. For the sample period analysed it seems that very few persons are members and those who are, are, to a high degree, academics.

9 Declaration of eligibility for social disability pension is made by social workers in the local municipality.

Finally, unemployment is often considered to be an exit route even though people who are unemployed are still in the labour force. Membership of an unemployment insurance fund ensures unemployment benefit during unemployment. From the age of 60, it is possible to receive unemployment benefits for a maximum of 2½ years. Unemployment benefits amounts to 90 per cent of the last wage earned subject to a ceiling. An important feature of the ERP system is that the ERP benefit is equivalent to the unemployment benefits. This implies that there are no (financial) reasons for using unemployment as a retirement scheme if the ERP programme is available. Furthermore, entering the ERP scheme may be attractive because the individuals are no longer obliged to search for a new job, which is a criterion for receiving unemployment benefits (for a further description of the exit routes, cf. e.g. Pedersen and Smith (1996)).

4. The Model

The model choice is the Option value model introduced by Stock and Wise (1990), which focuses on the value of retaining the option to retire at a later date. As this model not only compares the expected present value of retiring now with postponing retirement for one year, but also compares it with all future years, the model takes the option of retiring into account, which means that an individual, who does not retire, retains the option of retiring later. If the option value is positive, the person continues to work; otherwise, he retires.

The option value model is an alternative approach to dynamic programming. The model is directly based on a utility function as in a dynamic programming model, but the solution is based on the principles of optimal stopping. In the option value model individuals compare the maximum expected present values of future utilities from current retirement versus each potential future age, where in contrast, the expected value of the maximum current versus future options are compared in dynamic programming. The difference in the probability of retirement under the two rules depends

on the variance of the random components. If all future values are known with certainty then the two rules are equivalent. The two models differ to the extent that the variance of the unknown component is large relative to the predictable differences in the values of income and retirement benefits across ages.[10] An advantage of using optimal stopping is that it is easier to incorporate serial correlation in the unobserved process, which is rarely done in a dynamic programming model. Furthermore, the implementation of the option value model is less complex than the implementation of the dynamic programming rule. A comparison of the two principles, which is found in Lumsdaine, Stock & Wise (1990), shows that the two models produce almost the same estimates, and that they are equivalent concerning predictions. The option value model has recently been used in a number of retirement studies (see, e.g. Gruber and Wise (1997)).

The retirement choice is modelled as a discrete choice between participating in the labour force or retiring with ERP. The time horizon in the model is the age range 60-66, which is motivated by the fact that the ERP programme is only available for the 60-66 age group. If the individual has retired with ERP, return to the labour market is not possible in the model.[11] The Old-Age Pension takes over from the age of 67, and the benefit received from here is the same for all persons independently of having received ERP benefit. Therefore, we assume that the decision to retire on ERP does not influence utility beyond the age of 67. As in most of the existing literature this model is based on one important simplifying assumption: the savings process is not modelled explicitly but is only considered in a static way, where interest rates on savings are included in income.

In the original model by Stock and Wise (1990) it is assumed that the factors mainly influencing the retirement decision are income in the labour force and payment from the ERP programme. In addition, the model contains two latent individual effects. In our analysis, we have extended the

10 Stock and Wise (1990)

11 Very few people return to the labour force after having received ERP. For instance, in 1991 less than 2 per cent returned to the labour force (Statistics Denmark, 1993, Efterretninger 1993:14 table 10).

model by including characteristics such as health, education and unemployment directly. In the original model these factors are implicitly described as latent individual effects. By including these factors directly in the utility function, we may be able to reduce the unobserved heterogeneity between individuals and to examine how these factors affect the retirement pattern.[12]

Unfortunately, including health and unemployment directly in the model normally gives rise to an endogeneity problem. In this set-up we assume that unemployment for individuals entitled to ERP is involuntary unemployment, since there is no financial reason for using unemployment as a retirement scheme (see section 2 for further details). Therefore, we treat unemployment as an exogenous variable. A proxy for health in the previous year is used as the explanatory variable; however, we admit that this might not be sufficient to avoid all endogeneity problems.

The model is formulated as a discrete choice model in discrete time with a finite horizon. An individual at age *t* remains in the labour force for (s-t) years (where s>t) receives an income Y_s at age *s*.[13] If retiring at age *r*, the retirement benefit will be $B_s(r)$ at age *s*. As stated earlier, this payment depends on the age of retirement. Let X_s be an *l* * 1-vector of other variables that may potentially influence the decision to retire. The utility of being in the labour force, *U*, and the utility of being on the ERP programme, *W*, at age *s* are given by:

$$\begin{aligned} U(Y_s, X_s, \varpi_s) &= Y_s^{\gamma} + \alpha_U' X_s + \varpi_s \\ W(B_s(r), X_s, \xi_s) &= (kB_s(r))^{\gamma} + \alpha_W' X_s + \xi_s. \end{aligned} \tag{1}$$

The parameter γ is associated with income and measures risk aversion. The parameter *k* in the utility function is interpreted as the instantaneous utility of retirement (leisure). Abstracting from

12 The utility of the individual observed characteristics is assumed to be additive separable, in line with Stock and Wise's model which includes additive separable unobserved individual characteristics.

13 s is an index running from t to 66.

the random terms and the *X* variables, 1*/k* measures the fraction by which an individual is willing to reduce income if entering into retirement. α_U and α_W are *l**1-vectors of parameters, which measure the effect of the explanatory variables on utility in the labour force and on retirement. The difference α ' $\alpha_U - \alpha_W$ measures the net effect on the retirement decision.

The terms ϖ_s and ξ_s are individual specific random variables or latent variables that might reflect preferences for work. These terms are assumed to be independent of *X*, *Y* and *B* and may be correlated over time. We have made an additional assumption on the process of the individual error term which is a difference to the original model. In Stock & Wise (1990), the error term is assumed to follow an auto regressive process, while in this paper the error structure is assumed to follow the frequently used specification with an individual specific effect[14] (see Appendix A.2 for further details). This hinges on the fact that we have seven periods instead of two as in the original model and far more individuals in the sample. In order to get a computationally feasible model, we assume the more simple structure of the error term.

In deciding whether or not to retire, it is assumed that the individual weighs the utility that he or she will receive from future income, which is discounted to age *t* at a constant rate of time preference β. The present utility value if retiring at age $r \geq t$ is given by:

$$V_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} U_s(Y_s, X_s, \varpi_s) + \sum_{s=r}^{66} \beta^{s-t} W_s(B_s(r), X_s, \xi_s) \quad t = 60,\ldots,66, r = t,\ldots,66, r \geq t. \tag{2}$$

The expected gain evaluated at age t from postponing retirement until age r is given by:

$$G_t(r) = E(V_t(r) \mid I_t) - E(V_t(t) \mid I_t) \tag{3}$$

14 Equicorrelation implies that the random term contains an individual effect as in panel data.

where $E(\cdot \mid I_t)$ is the conditional mean given information available to the agent at time t. Let r^* be the age that gives the maximum gain. An individual will postpone retirement if:

$$G_t(r_t^*) = E(V_t(r_t^*) \mid I_t) - E(V_t(t) \mid I_t) = \max_{r \in (t,t+1,\ldots,66)} G_t(r) \geq 0 \quad (4)$$

Based on the gain function, the likelihood function can be derived (see Appendix A.2) and the estimates are found by using maximum likelihood estimation.

5. The Data

The sample used in this analysis is drawn from the Institute of Local Government Studies' longitudinal register, which contains a random sample of 10 per cent of men and women over the age 15 in Denmark. The sample covers the period 1981-1997.[15] The data set contains information about a large number of demographic, educational, income and labour market variables, as well as information about the frequency of contacts with doctors to capture the influence of health (dating from 1988-97).

The variables in the sample are collected on an annual basis. For the most part they are collected at the beginning of January, and to ensure that the individual characteristics are measured before the retirement decision, the explanatory variables are lagged one year. The individual retirement decision is therefore analysed for the years 1989-97. A further description of the sample and definitions of the explanatory variables included is given in Appendix A.1. The following variables

15 Information about individuals is collected from a number of registers in Statistics Denmark that are mainly based on different administrative registers used by various public authorities. Statistics Denmark then makes these data available for statistical and research purposes.

are included in the estimations: labour market income (defined as the total amount of earnings, unemployment benefit and sickness benefit an individual receives during a year), labour market experience, unemployment,[16] an indicator for living outside the Copenhagen metropolitan area, educational groups, and a health measure.

The individual frequency of doctor consultations over a year is used to proxy health.[17] It is the only health measure available in our data set. A self-reported health measure used in other studies might be more preferable because it captures how a person regards his/her own health, which might not necessarily correspond to the number of consultations. However, we find that the frequency of doctor consultations, especially in our context, has some clear advantages that makes it useful as a health indicator. First, the use of doctors covers the entire population. Second, the Danish Public Health Insurance system (of which all Danish citizens are members) meets the cost of a consultation, which implies that no economic considerations (except for time costs and other opportunity costs) influence the decision to consult a doctor. Finally, the panel structure of the data makes it possible to focus on differences over time in the number of consultations, which can provide knowledge about changing health conditions.

In this analysis we focus on singles, which are defined as adults living alone. They turn out to be a fairly large group among those eligible for ERP: 1/3 of all eligible women were singles while 1/6 of all men were singles. The sample analysed consists of single men and women who are eligible for ERP, and comprises 4,246 observations on men and 4,906 on women. Persons are observed each year until the first year of retirement. Summary statistics of the sample are shown in table 2 for

16 The administrative unemployment register contains information about the individual degree of unemployment on a weekly basis. At the end of the year, these data are compiled into a composite measure: the annual individual unemployment rate. Individuals are classified as unemployed if they are without a job but are looking for work. For insured individuals, the weekly degree of unemployment is measured by comparing the number of unemployed hours with the number of insured hours.

17 The categories of contacts in the measure include consultation, visit to patients, consultation by phone with/without consultation/visit, renewal of prescriptions, basic treatments, social medical cooperation, and certificates.

men and women, where the sample for men and women is further divided into individuals in the labour force and on the ERP scheme. Individuals are included each year while they are in the labour force. Persons who retire to the ERP are only observed for a single year in this group.

Table 2.
Mean and standard errors for single men and women aged 60-66 in the labour force or on the ERP scheme, 1989-97

	Men					Women				
	Labour force		ERP*			Labour force		ERP*		
	Mean	Std. dev.	Mean	Std. dev.	Two-sample t-test[1]	Mean	Std. dev.	Mean	Std. dev.	Two-sample t-test[1]
Labour market income (in DKK 1000)**	203.2	83.9	167.3	57.7	16.0	184.8	51.7	160.3	44.9	16.7
Years of experience	25.95	5.8	23.21	6.5	12.8	22.41	6.7	20.44	6.8	9.4
Unemployment (%)	13.28	29.4	29.3	39.0	-12.9	10.13	26.2	21.09	35.2	-10.7
0-3 consultations	0.65	0.4	0.60	0.5	3.0	0.50	0.5	0.48	0.5	1.3
4-10 consultations	0.26	0.4	0.28	0.5	-1.3	0.36	0.5	0.36	0.5	0.0
> 11 consultations	0.10	0.3	0.11	0.3	-0.9	0.14	0.3	0.16	0.4	-1.8
Outside Copenhagen	0.48	0.5	0.6	0.5	-7.2	0.42	0.5	0.54	0.5	-7.7
Education:										
Unskilled	0.47	0.5	0.52	0.5	-2.9	0.46	0.5	0.56	0.5	-6.4
Vocational education	0.39	0.5	0.41	0.5	-1.2	0.33	0.5	0.31	0.5	1.4
Short-term further education	0.04	0.2	0.03	0.2	1.6	0.08	0.3	0.04	0.2	5.6
Intermediate or long-term further education	0.1	0.3	0.04	0.2	7.6	0.13	0.3	0.08	0.3	5.5
Observations	3,029		1,217			3,435		1,471		

Source: The Institute of Local Government Studies' Longitudinal Register.
Note: All characteristics are lagged one year.
*People entering the ERP scheme are only observed until their first year of retirement.
** Annual labour market income is deflated to 1989 prices.
[1] The two-sample t-test tests whether the two samples come from distributions with the same mean.

Summary statistics of the variables included in the estimations are shown in table 2 for men and women, separately. From these statistics it is obvious that there are differences in the observed characteristics between sexes. Men have, on average, a higher labour market income and more

years of labour market experience than women. With respect to health, women have, on average, more visits to the doctor than men. As an example, 15 percent of women and 9 per cent of men visit the doctor more than 10 times per year. Table 2 also shows significant differences between persons in labour force and persons on early retirement. Lagged annual labour market income, and labour market experience is significantly lower for men and women retiring on ERP than for people remaining in the labour force. The rate of unemployment is substantially higher for individuals who retired on ERP; for men, the rate of unemployment was, on average, 29 per cent during the year before retiring; for women it was about 21 per cent.[18]

On average the number of doctor consultations is higher for women and men joining the ERP scheme. Both men and women living in the provinces are more inclined to join the ERP scheme than individuals living in the Copenhagen metropolitan area. Among the educational groups it is seen that especially unskilled men and women join the ERP scheme, which is probably due to a higher replacement rate for low-educated people compared to highly-educated people.

In the model described in the previous section, the dependent variable is a binary variable indicating whether or not an individual retires. Since the explanatory variables in the model include expectations of prospective income, health status, and unemployment status, assumptions must be made about how the expectations are formed (for further detail see appendix A.3).

6 Estimation and Results

In this section we present the estimated parameters of the Option Value Model. Three versions of the model are estimated for each gender. We start by estimating the specification used by Stock and Wise (1990), where only income matters for the retirement behaviour. In the second specification,

18 This is in line with the result obtained by e.g. Meghir and Whitehouse (1997), who find that previous labour-market attachment has a significant impact on the retirement age.

we allow health to affect the value of retirement.[19] In the last specification we control for individual characteristics such as education, region of residence and individual unemployment. These characteristics are assumed to affect the retirement behaviour as described in section 4.[20]

Table 3.
Estimation results of the Option Value Model for men. (The parameters refer to the probability of staying in the labour force).

	(1)		(2)		(3)	
	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.
γ	0.87**	0.09	0.88**	0.08	0.79**	0.08
k	1.39**	0.04	1.35**	0.04	1.23**	0.06
k*(4-10 consult.)	-	-	0.11	0.07	0.11	0.07
k*(>11 consult.)	-	-	0.22**	0.11	0.19*	0.11
ρ	0.31**	0.03	0.31**	0.03	0.31**	0.03
$\sigma^2_\varepsilon/10$	4.29**	1.89	4.36**	1.93	2.72**	1.14
Voc. Education	-	-	-	-	-0.16	1.19
Short-term further educ.	-	-	-	-	-0.09	2.75
Intermediate or long-term further education	-	-	-	-	-3.57	2.66
Living outside Copenhagen	-	-	-	-	-2.50*	1.31
Unemp. 1-50	-	-	-	-	-3.25	2.02
Unemp. 51-100	-	-	-	-	-1.97	2.00
# of observations	3,022		3,022		3,022	
# of individuals	1,360		1,360		1,360	
Log-likelihood	-1708.8		-1706.4		-1699.2	

Note: **Statistically significant at the 5 per cent level, * significant at the 10 per cent level.
The reference group has 0-3 consultations within a year, no formal educational qualifications, and full-time employment.

The parameters in the Option Value Model consist of parameters entering the utility function: γ, which describes the amount of risk aversion, k, which is the value of retirement, and β, the rate of time preference. Besides these basic entities of the model, some extra parameters are included related to observed and unobserved characteristics. The observed characteristics in the model

19 This is done by interacting the k-parameter with dummies for different numbers of doctor consultations.

20 Alternatively, these variables could have been included in the model in a similar way to health. However, since our primary focus is on health we chose not to do so.

consist of the individual characteristics discussed in section 5. The parameters of the unobserved component are ρ and σ^2_ε, where ρ measures the serial correlation and σ^2_ε the variance of the unobserved heterogeneity. Simulations of the model show that the likelihood function is almost a flat function of the discount rate β. Hence, the estimation is performed with β fixed at 0.94.[21] The estimation results for men and women are shown in tables 3 and 4.

Table 4.
Estimation results of the Option Value Model for women. (The parameters refer to the probability of staying in the labour force).

	(1)		(2)		(3)	
	Coeff.	Std.err.	Coeff.	Std.err.	Coeff.	Std.err.
γ	0.88**	0.07	0.87**	0.07	0.85**	0.06
k	1.37**	0.02	1.34**	0.03	1.35**	0.04
k*(4-10 consult.)	-	-	0.04	0.04	0.03	0.04
k*(>11 consult.)	-	-	0.11**	0.05	0.11**	0.05
ρ	0.29**	0.03	0.27**	0.03	0.30**	0.03
$\sigma^2_\varepsilon/10$	3.11**	1.11	3.12**	1.11	2.57**	0.89
Voc. Education	-	-	-	-	2.45*	1.33
Short-term further educ.	-	-	-	-	6.10**	2.73
Intermediate or long-term further education	-	-	-	-	0.60	1.54
Living outside Copenhagen	-	-	-	-	-2.94**	1.35
Unemp. 1-50	-	-	-	-	-3.08*	1.80
Unemp. 51-100	-	-	-	-	2.11	1.95
# of observations	3637		3637		3637	
# of individuals	1644		1644		1644	
Log-likelihood	-2003.5		-2001.2		-1985.7	

Note: **Statistically significant at the 5 per cent level, * significant at the 10 per cent level.
The reference group has 0-3 consultations within a year, no formal educational qualifications, and full-time employment.

In general, the estimation results seem reasonable and confirm our a priori expectations. To examine the goodness of fit of the model we compare the actual and predicted probabilities of retirement for different age groups (see appendix A.4 for model (3)). The analyses suggest that the

21 The model has been estimated with different values of β. The results of these estimations show that the remaining parameters do not vary much, see Danø et al. (1998).

model fits the data satisfactorily. Furthermore, we investigate whether the model is robust to changes in the financial incentives, by comparing the model's ability to predict before and after the reform in 1992. The analysis shows that the model is able to capture the change in incentives, which indicates that the model is well specified.

The essential parameter in the Option Value Model is *k*, which measures the value of retirement (leisure). 1/*k* as a percentage is the percentage to which men/women, on average, are willing to reduce the income they earned when working in order to retire. For the simple specification, model (1), which is almost identical to the model in Stock and Wise (1990), the estimation results are in the same range as those found in Stock and Wise (1990), except for ρ and *k*, which are lower in this analysis. The difference in *k* may be explained by either singles behaving differently, or by the fact that we use disposable income instead of gross income. The standard errors are relatively small for the parameters of the utility function, while the standard errors for the demographics are larger, in particular for the sample of men. In this model there are almost no differences in how single men and women value leisure. The estimated value of *k* is 1.39 and 1.37 for men and women, respectively, which indicates that men and women, on average, are willing to reduce income to 72 and 73 per cent. However, a formal test for whether all the parameters are the same for men and women is strongly rejected.[22]

In model (2) where health dummies are interacting with *k*, we find that health, measured as the number of visits to the doctor, has an impact on the value of retirement. Persons with more than 11 doctor consultations are willing to accept a larger decrease in income in order to retire than persons with a fewer number of consultations. One possible explanation is that hard physical or psychological work is associated with a greater risk of bad health as well as a greater probability of retiring early. If this is the case, the estimated health effect may, in part, reflect an effect of present

[22] The likelihood ratio test gives a $\chi^2(4)$ statistic of 50.9.

working conditions

In model (3), which is the preferred specification,[23] we control for various observed individual characteristics such as education, region and unemployment. Also in this model we test whether men and women have the same set of parameters. This test is performed as a likelihood ratio test and is strongly rejected, which suggests that there are gender differences in retirement behaviour. In this model, single men with less than 4 doctor visits will accept a reduction in their income to 81 per cent of previous income in order to retire, while healthy women will reduce their income to 74 per cent[24]. Single men with more than 11 doctor visits are willing to reduce income to 70 per cent of the previous income, while the similar number for women is 68 per cent. This indicates that worse health increases the willingness to reduce income in order to retire and that the gender differences are much smaller for individuals with bad health. Whether there actually is a significant difference of course also depends on whether the measure of health can be compared for men and women. From table 2 in section 3, we see that the distribution of the number of doctor consultations diverge between men and women. Women have, on average, more visits to the doctor, and a larger proportion of women visit the doctor more than 11 times during a year. It does not necessarily reflect that women are in worse health than men, but rather that women behave differently.

In the following we briefly discuss the remaining parameters. The estimates of γ (risk aversion) indicate that the utility function is a concave function of income for both men and women, which implies that the increase in utility from a marginal increase in income is lower for people with high incomes than for people with low incomes. Since it is presumed that not all individual heterogeneity is captured by the explanatory variables included, unobserved heterogeneity is included in the model (see section 4 for a further description). The estimations confirm that unobserved heterogeneity is very important in this model. The estimate of σ^2 of the latent process indicates a

[23] A likelihood ratio test indicates that model (3) cannot be reduced to model (1) or model (2).
[24] A two sample test for whether there exists a difference between healthy men and women was tested to be significant at the 10 per cent level.

huge variance of the unobserved shock for both genders, which means that the retirement decision is strongly influenced by the unobserved components. The estimate of ρ of the latent process is significant for both genders, stressing the importance of allowing for serial correlation over time in the unobserved heterogeneity.

In the third specification we also control for education, region of residence and unemployment. One effect of including these controls is that we are able to reduce the variance of the unobserved component. For both men and women the estimate of the standard deviation decreases substantially. However, it does not seem to have a major impact on the serial correlation of the unobserved component. The educational dummies are insignificant for single men, but significant for single women. Skilled women and women with short further education seem to postpone retirement. Surprisingly, we do not find any significant impact of having a long further education. However, the fact that we ignore private pension schemes may affect this estimate, since it is primarily individuals with long further education who have these schemes. A possible explanation for the very different impact of education for men and women is that women, in contrast, to men tend to be concentrated within fewer fields of education, primarily related to health, teaching and office work. These types of education do, to a large extent, tend to lead to particular jobs. This means that women's education may serve as a proxy for the actual job type.

As the data analysis also suggested, the estimate of living outside the Copenhagen metropolitan area shows that both men and women in the provinces are more likely to retire early than those living in Copenhagen. The effect is largest for women. The effect of being unemployed seems to hasten retirement, but is only significant for women. Besides the direct effect of unemployment (that unemployment is a path to retirement), we find strong evidence of an indirect effect through the low income that follows with unemployment.

To summarise the results, we find an indication for gender differences in the retirement

behaviour of single men and women, and that for both single men and women future income is an important determinant of the retirement decision. The results from the most flexible model indicate that healthy single women value retirement more than healthy single men, while the gender differences are smaller for individuals with worse health. Whereas the value of the retirement decision of men is mainly determined by income and health, women's retirement decision is also affected by education and unemployment experience.

7. Conclusion

Like many other OECD countries, Denmark is facing an increasing proportion of elderly people and an expected increase in retirement programme participation. Changes in the composition of the labour force and in the patterns of household composition may have implications for future retirement. The gender composition of the older work force will change as a result of a sharp increase in women's labour force participation. Furthermore, there is a tendency toward a decline in the marriage rate and there is an increasing share of divorced individuals. To examine how these changes affect the future inflow to retirement schemes, knowledge is needed about the retirement patterns of men and women living alone.

As in most other OECD countries, a considerable proportion of elderly people in Denmark are living alone and an even larger proportion is expected to be single in the future. We have chosen to focus on single men and women's retirement behaviour only, since the retirement pattern of singles is likely to differ from the pattern of couples in terms of different economic incentives and different preferences for, e.g., leisure than couples. Our study is one of the first to analyse the retirement behaviour of singles.

Our objective was to study gender differences in the early retirement behaviour of singles. To do so, we estimated a structural model of retirement based on the option value of staying in the

labour force. The model is estimated for single men and women separately, using Danish register data. The results suggest that there exist gender differences in the retirement behaviour of single men and women. For both single men and women, future income and health are important determinants of the retirement decision, but healthy women value retirement more than healthy men. Whereas the retirement decision of men is mainly determined by income and health, women's retirement decision is also affected by education and unemployment experience.

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References

Baltagi, B.H., 1995, Econometric Analysis of Panel Data, (John Wiley and Sons Ltd, England).

Berkovec, J. and S. Stern, 1991, Job Exit Behavior of Older Men. Econometrica Vol. 59, No. 1, 189-210.

Bingley, P. & Datta Gupta, N. and P. J. Pedersen, 2001, The Effects of Pension Programme Incentives on Retirement Behavior in Denmark, CLS Working Papers 01-8, Aarhus School of Business, Centre for Labour Market and Social Research.

Bingley, P. and G. Lanot, 1996, Danish Private Sector Wage Policies and Male Retirement Decisions, Memo, Centre for Labour Market and Social Research, Denmark.

Blau, D., 1994, Labor Force Dynamics of Older Men, Econometrica Vol. 62, No. 1, 117-156.

Blau, D. and R. Riphahn, 1999, Labour force transitions of older married couples in Germany,

Labour Economics 6, 229-251.
Blundell, R., Duncan, A., and C. Meghir, 1998, Estimating Labor Supply Responses using Tax Reforms, Econometrica, Vol. 66, No. 4, 827-861.
Blundell, R., Meghir, C. and S. Smith, 2002, Pension Incentives and the Pattern of Early Retirement, The Economic Journal, 112, C153-C170.
Christensen, B.J and N. Datta Gupta, 1998, A Dynamic Programming Model of the Retirement Behaviour of Married Couples, Forthcoming, Journal of Applied Econometrics.
Dahl, S-Å, Nilsen, Ø.A. and K. Vaage, 2003, Gender Differences in Early Retirement Behaviour, European Sociological Review, Vol 19 No. 2, 179-198.
Danø, A.M., Ejrnæs, M. and L. Husted, 1998, Gender Differences in Retirement Behaviour, AKF Memo, Institute of Local Government Studies, Denmark.
Direktoratet for Arbejdsløshedsforsikring, 1994, Efterlønssatsundersøgelse 1992, Denmark.
Direktoratet for Arbejdsløshedsforsikring, 1999 Annual Report, Denmark.
Direktoratet for Arbejdsløshedsforsikring, 2000, Homepage:www.dfa.dk, Efterløn og overgangs-ydelsesstatistik.
EUROSTAT, 1997a, Labour Force Survey.
EUROSTAT, 1997b, Statistics in Focus, Population and Social Conditions, 1997-14.
Gruber, J. and D. Wise, 1997, Social Security Programs and Retirement around the World, NBER Working Paper 6134, National Bureau of Economic Research.
Gruber, J. and D. Wise, (eds.), 1999, Social Security Programs and Retirement around the World, The University of Chicago Press.
Gustman, A.L. and T.L Steinmeier, 1986, A Structual Model, Econometrica, Vol. 54, No. 3, 555-584.
Gustman, A.L. and T.L. Steinmeier, 2000, Retirement in Dual-Career Families: A Structural Model, Journal of Labor Economics 18(3), 503-45.
Hanoch, G. and M. Honig, 1983, Retirement, Wages, and Labor Supply of the Elderly, Journal of Labor Economics Vol. 1, No. 2,131-151.
Heckman, J., 1979, Sample Bias as a Specification Error, Econometrica, Vol. 47, No. 1, 153-162.
Honig, M., 1985, Partial Retirement among Women, Journal of Human Resources 20(4): 613-21.
Johnson, W.R. and J. Skinner, 1986, Labor Supply and Marital Separation. The American Economic Review, Vol. 76, No. 3, 455-469.
Kerkhofs, M., M. Lindeboom and J. Theeuwes, 1999, Retirement, Financial Incentives and Health, Labour Economics 6, 203-227.
Lumsdaine, R.L. and O.S. Mitchell, 1999, New Developments in the Economic Analysis of Retirement, in: O. Ashenfelter and D. Card, eds., Handbook of Labor Economics, Vol. 3: 3261-3307.
Lumsdaine, R., J. Stock and D. Wise, 1990, Three Models of Retirement: Computational Complexity versus Predictive Validity, NBER Working Paper 3558, National Bureau of Economic Research.
Mastrogiacomo, M., R. Alessie and M. Lindeboom, 2002, Retirement Behaviour of Dutch Elderly Households: Diversity in Retirement Patterns across Different Household Types, Tinbergen Institute Discussion Papers 02-073/3, Tinbergen Institute.
Meghir, C. and E. Whitehouse, 1997, Labour Market Transitions and Retirement of Men in the UK, Journal of Econometrics 79, 327-354.
Parsons, D.O., T. Tranæs, and H.B. Lilleør, 2003, Voluntary Public Unemployment Insurance, George Washington University, mimeo.
Pedersen, P.J. and N. Smith, 1992, A Duration Analysis of the Decision to Retire Early, Working Paper 1992-2, Centre for Labour Economics, University of Aarhus and Aarhus School of

Business.
Pedersen, P.J. N. and Smith, 1995, The Retirement Decision, in: G.B. Mogensen, ed., Work Incentives in the Danish Welfare State, Rockwool Foundation Research Unit, Aarhus University Press, 80-113.
Pedersen, P.J. and N. Smith, 1996, Early Exit in the Danish Labour Market - The Development in the Recent Years, in: E. Wadensjö, ed., The Nordic Labour Markets in the 1990's, Vol. II. Elsevier Science B.V.
Perrachi, F. F. and Welch, 1994, Trends in Labor Force Transitions of Older Men and Women, Journal of Labor Economics, Vol. 12, No. 2, 210-242.
Pozzebon, S. and O.S. Mitchell, 1989, Married Women's Retirement Behaviour, Journal of Population Economics, 2(1), 39-53.
Ruhm, C.J., 1996, Gender Differences in Employment Behavior During Late Middle Age, The Journals of Gerontology, Vol. 51B, No. 1, S11-S17.
Rust, J., 1989, A Dynamic Programming Model of Retirement Behaviour, In D. A. Wise, ed., The Economics of Aging, 359-398. University of Chicago Press, Chicago.
Rust, J., 1990, Behaviour of Male Workers at the End of the Life Cycle: An Empirical Analysis of States and Controls, in D. A. Wise, ed., Issues in the Economics of Aging, 317-379, University of Chicago Press, Chicago.
Rust, J. and C. Phelan, 1997, How Social Security and Medicare Affect Retirement Behavior in a World of Incomplete Markets, Econometrica, Vol. 65, No. 4, 781-831.
Sickles, R.C. and P. Taubman, 1986, An Analysis of the Health and Retirement Status of the Elderly, Econometrica, Vol. 54 No. 6, 1339-1356.
Statistics Denmark, 1993, Statistiske Efterretninger 1993:14.
Statistics Denmark, 1999, Statistiske Efterretninger, Arbejdsmarked 1999:37.
Statistics Denmark, 2003, Statistikbanken.dk
Stock, J. and D. Wise, 1990, Pension, the Option Value of Work and Retirement, Econometrica, Vol. 58 No. 5, 1151-1180.
Wallace, R.B. and A.R. Herzog, 1995, Overview of the Health Measures in the Health and Retirement Study, Journal of Human Resources, 30(0), Supplement.
Vistnes, J.P., 1994, An Empirical Analysis of Married Women's Retirement Decisions. National Tax Journal, 47(1), pp. 135-55.
U.S. Census Bureau, 1991, International Data Base, http://www.census.gov/cgi-bin/ipc/idbsprd .
U.S. Census Bureau, 2000, http://www.census.gov/population/socdemo/hh-fam/p20-537/2000/tabA1.pdf

Appendix A.1. Description of the Sample and Definitions of Explanatory Variables Included in the Estimations

A.1.1 The Sample

The sample consists of singles, who are single over the whole sample period. Singles are defined as adults living alone. The condition for a person to retire on the ERP scheme is membership of an unemployment insurance fund for at least 20 years. Due to the fact that we only have observations going back to 1981, the sample is restricted to individuals who have been full members of an unemployment insurance fund and in the labour force for a minimum of five years before the age of 60. Furthermore, part-time workers are excluded. By limiting our sample, the majority of the individuals who are not entitled to the ERP scheme are excluded. However, there may still be a small number of individuals in the sample who are not entitled to join the ERP. The sub-sample is illustrated in figure A.1. Only observations in area A for individuals who have the option of entering the ERP scheme are used in the estimation of the retirement model. In 1989 the age of individuals in the sample is at most 60 and in 1997 at least 60. Thus, the individuals are aged between 60 and 66 at the end of the period. In particular, we analyse a sub-sample of 3,022 observations on men and a sub-sample of 3,637 observations on women in the period 1989-97.

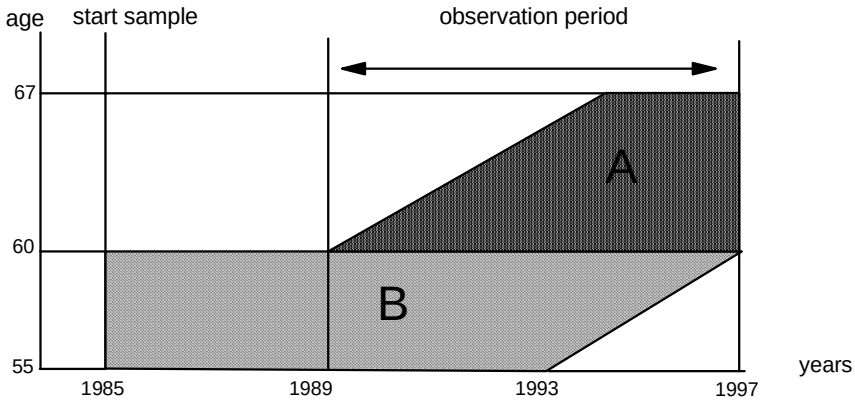

Fig. A.1. Description of the sub-sample

Sample B, see figure A.1, is used for the estimation of the labour force income. This sample consists of individuals between 55 and 59 years of age who are full-time insured in an unemployment insurance fund and who have been in the labour force for a minimum of five years before the year observed. The sample contains 8,590 observations for men and 9,870 observations for women.

A.1.2 Definitions of Explanatory Variables included in the Estimations

Table A.1
Definitions of variables

Variable name	Definition
Labour market income	Total amount of earnings, unemployment benefits, and sickness benefits an individual receives during a year
Unemployment	Annual individual unemployment rate, per cent
Unemplsq	Unemployment rate squared, per cent
Experience	Labour market experience in years
Expsq	Labour market experience in years squared
Trend84	Time trend for the period 1984-89
Trend89	Time trend for the period 1989-97
Time8997	An indicator variable taking the value one if year 1989-97
Unemp0	An indicator variable taking the value one if the unemployment rate is 0%
Unemp1-50	An indicator variable taking the value one if the unemployment rate is 1-50%
Unemp51-100	An indicator variable taking the value one if the unemployment rate is 51-100%
Living outside Copenhagen	An indicator variable taking the value one if the person is living outside the Copenhagen metropolitan area
0-3 consultations	0-3 doctor consultations within a year
4-10 consultations	4-10 doctor consultations within a year
> 11 consultations	More than 11 doctor consultations within a year
Unskilled	An indicator variable taking the value one if the person has no formal qualifications
Vocational education	An indicator variable taking the value one if the person has a vocational education (e.g. education ranging from clerical training to training as carpenters, plumbers etc.).
Short-term further Education	An indicator variable taking the value one if the person has a short-term further education (e.g. college trained nurse).
Intermediate or long-term further education	An indicator variable taking the value one if the person has an intermediate or long-term further education (e.g. school teacher, Bachelor degree or Master's degree).

Appendix A.2

The individual regards all the terms in the gain function as deterministic, but the econometrician will perceive the latent variable v_{it} as a stochastic variable. We need to assume a probability

distribution on ν_{it}, and assume that ν_{it} is normal $\nu_{it} \sim N(0,\sigma^2)$.

The probability of staying in the labour force, on which the likelihood function is based, turns out to be a distribution function of a multi-normal distribution. In order to simplify the problem, the random term is assumed to be equicorrelated, which implies that the individual effect is given by

$$v_{it} = \mu_i + \varepsilon_{it} \quad for\ i = 1...N,\ t = 60 \ldots 66$$

where $\varepsilon_{it} \sim iidN(0,\sigma_\varepsilon^2)$ and $\mu_i \sim iidN(0,\sigma_\mu^2)$ are mutually independent. By conditioning on the individual specific effect the likelihood function is reduced to a one-dimensional integral.

In order to obtain an agreement between the statistical model and the economic model, the variance of μ is defined by

$$\rho = \frac{\sigma_\mu^2}{\sigma_\mu^2 + \sigma_\varepsilon^2}.$$

Appendix A.3 Prospective income, health and unemployment status

To be able to construct expected future income, expected individual income is modelled. Since non-labour market income may constitute a considerable part of gross income for the elderly, this information is explicitly used in the estimation of future income. Here, income is assumed to consist of one part that depends on labour market status (wage earnings, unemployment benefit, retirement benefit, and sickness benefit[25]) and one part that is unaffected by labour-market status (return on assets, etc.). In the rest of our paper the latter is referred to as unearned income.

25 Income from private pension schemes is not included because information is not available in the register data. For our sample, the group of individuals with a private pension scheme are mostly individuals with an intermediate or long-term further education.

First, labour-market income is estimated separately. In our framework, annual labour market income is defined as the total amount of earnings, unemployment benefits and sickness benefits an individual receives during a year. Since a substantial part of labour market income arises from earnings, a Mincer-type model is applied. Labour market income is explained by labour market experience in years, labour market experience squared, the annual amount of unemployment, unemployment squared, a time trend, and an individual fixed effect. The individual fixed effect contains all-time invariant individual characteristics, e.g. education.

The labour market income is estimated by the following model,

$$\ln y_{it} = \alpha + \beta x_{it} + \mu_i + f_t + \varepsilon_{it} \qquad i = 1,\ldots N \qquad t = 85,\ldots,97$$

$\ln y_{it}$ is the log of total labour market income and x_{it} contains the explanatory variables. μ_i is a time-invariant individual specific term and the time trend f_t is modelled as a piecewise linear trend with a kink point in 1989.[26] This type of wage model normally gives rise to sample selection bias, due to the fact that wages are only observed if individuals are employed. In order to avoid this problem, two different approaches are used.[27] First, labour market income is used instead of earnings. Second, the model is estimated on a sub-sample limited to individuals between 55 and 59 who are in the labour force (sub-sample B in figure A.1). By limiting the sample to individuals less than 60, we avoid some of the people leaving the sample due to retirement (selection). The disadvantage of this approach is that we impose the same income relation for 55-59 year-olds as for 60-66 year-olds.

Assuming that the individuals form expectations according to the model, predicted income can be used as expected income.[28] But to obtain a good prediction of future income, estimates of fixed

26 The piecewise linear trend is included to capture a high inflation rate in the eighties and a lower inflation rate after 1989.

27 An alternative method to deal with the sample selection problem is using the Heckman approach (cf. Heckman, 1979).

28 This assumption is made in a number of models based on expectations, e.g. Bingley and Lanot (1996), Rust and Phelan (1997) and Stock and Wise (1990).

effects are needed. Therefore, the estimation is performed by fixed effect estimation for unbalanced panels (cf. Baltagi, 1995, pp.11-13). The model is transformed into deviations from individual means. Estimation of this specification gives consistent estimates of β and from $\hat{\beta}$ we can get consistent estimates of μ_i (which now includes the constant term, α). Thus

$$\hat{\mu}_i = \overline{\ln y_i} - \hat{\beta}\overline{x_i} - (\overline{\hat{f}_t})_i$$

The estimation results are reported in table A.2[29].

Table A.2
Estimation results of the income model

	Men		Women	
	Estimate	Std. err.	Estimate	Std. err.
Unemployment/100	-0.617	0.019	-0.322	0.018
Unempsq/100^2	0.181	0.018	-0.014	0.018
Experience	0.039	0.005	0.047	0.003
Expsq*10	-0.0001	0.00009	-0.0003	0.0005
Trend85	0.017	0.002	0.027	0.002
Trend89	-0.009	0.002	-0.006	0.002
Time8997	0.160	0.011	0.190	0.008
R^2	0.45		0.44	
Number of obs.	8591		9871	

Note: The R^2 does not include individual fixed effects.

The expected labour market income depends on expectations of future unemployment and labour market experience. In this context, expectations about future labour market status are based on a conservative point of view. An individual who has a certain amount of unemployment expects the same amount of unemployment in the following years, e.g. a person who is unemployed six months during a year expects to be unemployed six months in the following year. This assumption seems reasonable concerning unemployment. About 96 per cent of men and women who are not

29 We have tried to estimate the model with time dummies instead of a piecewise linear trend and used a first difference estimation. However, this does not change the results substantially.

unemployed during the year are full-time employed the year after. 42 per cent of men and 45 per cent of women who are unemployed 1-50 per cent of the year stay in the same interval of unemployment the year after. Finally, 76 per cent of both men and women who are unemployed more than 50 per cent of the year, are also unemployed more than 50 per cent the year after.

Given the expectations of unemployment, the expected total labour market experience is easily found by simply assuming that an extra year in the labour force results in one extra year of labour market experience minus the expected rate of unemployment.

Based on the estimates and expectations about future unemployment and labour market experience, for each individual in the sample we can determine the expected future labour market income that is conditioned on remaining in the labour force. The expected income on the ERP scheme mainly consists of ERP benefit. The ERP payment is determined according to how the ERP is regulated and is based on wage income and age of retirement.[30]

From labour market income, retirement benefit, and unearned income,[31] it is possible to calculate the estimated gross income conditioned on remaining in the labour force or retiring. Since disposable income is clearly more relevant than gross income when calculating the economic consequences of retirement, disposable income is determined from gross income according to the Danish tax system (for further details cf. Danø et al., 1998).

The expectations about future health conditions are formed similarly to the expectations about future unemployment rates. It is assumed that the individuals expect that their future status of health remains the same as their present status of health, meaning that an individual with good health expects good health also in the future. This assumption seems to be in accordance with the data,

30 The calculation of the expected future income on the ERP scheme for each individual is based on the observed historical development of maximum ERP benefit.

31 Unearned income here is calculated as gross income minus the sum of labour market income and retirement benefit. Unearned income is expected not to depend on labour market status. We assume that the individuals have perfect expectations of their future unearned income.

where we find no effect of labour market status on health and no deterioration of health in the age range.

Appendix A.4. Comparison of Predicted and Actual Retirement Behaviour

The fit of the estimated models is evaluated by comparing predicted and actual retirement rates.[32] The retirement rates are shown in table A.3, for different age groups for single men and women. The predicted retirement rates appear to be relatively close to the actual rates for the youngest age groups, and especially women, but seem to over-predict the retirement rates for persons who are more than 62 years of age. This hinges on the fact that we have relatively few observations for these age groups.

Table A.3.
Predicted and actual retirement rates by age for men and women (as a percentage)

	Men			Women		
Age	Obs.	Actual	Predicted	Obs.	Actual	Predicted
60	1360	36.2	31.9	1644	35.2	31.7
61	721	30.2	29.8	877	29.8	29.2
62	411	23.1	27.7	502	22.3	24.9
63	262	27.5	35.1	307	35.2	38.8
64	143	31.5	35.9	154	26.0	37.5
65	75	28.0	35.8	96	27.1	38.5
66	39	15.4	36.9	49	22.4	44.7

Note: The retirement rates are computed for the estimated models with individual characteristics included in the specification. Note that age is used neither in the wage equation nor in the retirement model.

In 1992 the economic incentives in the ERP scheme were changed to make postponing retirement more attractive. This within-sample change in the ERP scheme, gives us an opportunity to see whether people actually changed behaviour as a result of the reform and whether our model is actually capable of describing this change in retirement behaviour. To illustrate the effect of the

32 The predictions are made as in ordinary probit models. The individual effect is set to zero.

reform we have divided our sample into two, one containing observations on individuals in the years 1989 to 1992, and another part which contains observations on individuals for the period 1993 to 1997.

The actual and the predicted age-specific retirement probabilities are shown in table A.4 for men and women, respectively. The expected result of the reform is that the age-specific retirement probabilities for those who are 60-62 years of age should be lower after the reform, whereas they should be higher for those who are 63 to 66 years of age. It could be expected that, in particular, the probabilities for those who are 62 and 63 would be affected because here a small change in retirement age has a large influence on future income, making the probabilities for those who are 62 much lower after the reform and the probabilities for those who are 63 much higher. Because of the way our data is constructed, the individuals in the 1989-1992 sample are no older than 62 years, which means that it is only possible to compare the age-specific retirement probabilities of people who are 60-62 years of age before and after the reform.

It is evident that the reform actually changed the retirement behaviour. The retirement probabilities falls for those who are younger than 62 and especially for those who are 62. This is the case for both men and women, but especially for women. Our model seems to capture this change in behaviour, even though it under estimates the effect.

Table A.4.
Predicted and actual retirement rates by age for men and women, before and after the 1992 reform (per cent)

Men	1989-92			1993-97		
Age	Obs.	Act.	Pred	Obs.	Act.	Pred
60	448	35.3	35.3	912	36.6	30.8
61	181	35.9	33.0	540	28.3	29.1
62	57	17.5	36.7	354	24.0	29.3
63	--	--	--	262	27.5	32.5
64	--	--	--	143	31.5	33.4
65	--	--	--	75	28.0	35.0
66	--	--	--	39	15.4	34.4
Women						
Age	Obs.	Act.	Pred.	Obs.	Act.	Pred.
60	502	38.8	36.4	1142	33.6	30.3
61	196	30.6	34.5	681	29.5	28.5
62	61	29.5	36.7	441	21.3	27.1
63	--	--	--	307	35.2	33.9
64	--	--	--	154	26.0	32.3
65	--	--	--	96	27.1	34.7
66	--	--	--	49	22.4	38.2