25 April 2000

Family Labour Supply when the Husband is Eligible for Early Retirement

by

Erik Hernæs[1] and Steinar Strøm[2]

Abstract

When the husband works in the private sector in Norway the take-up rate of early retirement during the first twelve months after becoming eligible (once during 1993 and 1994) was around 40 percent. If the husband works in the public sector the corresponding take up rate was around 25 percent. A model with forward-looking and utility maximising married couples, where the husband only is eligible for early retirement, has been estimated on these data. The estimated model has been used to predict the labour supply responses of the husband and wife when pensions are taxed as wage earnings.

Taxing early benefits as labour earnings induces a substantial decline in retirement and a substantial shift towards full-time work among males. Females tend to decrease their labour supply a little. An additional 10 per cent cut in the pre-tax pension income has a positive impact on full-time work among both spouses, but the effect is a magnitude smaller than the effect obtained by changing taxation.

Husbands in poor households tend to increase their labour supply more than husbands in rich households. Poor households are also more negatively hit in terms of loss in expected household welfare than the rich households.

Key words: Early retirement, married couples, microeconometrics

JEL classification: D10, J22, J26.

Acknowledgement: The authors wish to thank Fredrik Haugen, Ole J. Røgeberg and Jia Zhiyang for their assistance in organising data, constructing tax and pension functions, and for programming. We also wish to thank Rolf Aaberge, Ugo Colombino and John K. Dagsvik for their comments and criticism to earlier versions of the paper. We also thank participants at the IIPF Conference in Moscow in August 1999 and participants at the CIRJE Conference in Tokyo in September 1999 for constructive comments. Financial support from the Research Council of Norway is gratefully acknowledged. Part of the paper was written when Steinar Strøm was visiting ICER, Torino. ICER is gratefully acknowledged for providing financial support and excellent working conditions.

[1] The Ragnar Frisch Centre for Economic Research, Oslo

[2] Department of Economics, University of Oslo, communication to steinar.strom@econ.uio.no

1. Introduction

As in many other OECD countries, labour force participation of Norwegian males above the age of 60 has gone down over a number of years (Wadensjø, 1996). Part of this decline can be explained by the introduction of early retirement programs. Early retirement programs may thus have made male labour supply more elastic than it was some years earlier. In contrast to male participation the female labour force participation has increased over the last two decades by 15 percentage points, although it is still below the male level (Statistics Norway, 1996). This will increase the accrued pension rights of females of retirement age in the years to come.

Because most men and women are married or cohabiting it could be important to account for the fact that observed behaviour in the labour market may be due to joint decisions by married couples. This will also be important when early retirement decisions are analysed. The purpose of our paper is to analyse this aspect of labour supply in the context of family labour supply. Because the early retirement age in Norway is the same across gender and because of the age difference between married men and women, only families where the husband is eligible for early retirement are included in our sample.

The decision of the husband to retire early is modelled as the outcome of a joint labour supply decision made by the couple. As a consequence of this we will be able to simulate how the labour supply of both spouses may be affected by changes in the budget constraints, for example by a change in tax and pension rules.

Empirical studies of retirement behaviour in a household context are rare. Most of the studies have focused on patterns of family retirement, like "wife first", "joint retirement" and "husband first", see Henretta and O'Rand (1983) for an early contribution. A more recent study is Zveimüller *et al.* (1996) who estimate a bivariate probit model on Austrian data. The probability for a married man and woman to retire is assumed to depend on Social Security characteristics of both spouses and on individual characteristics. The model allows for correlation of unobserved normally distributed variables across gender. A main finding in their study is that husbands react to changes in wives' legal minimum retirement age but not vice versa. The model is static in the sense that only current incomes in the period studied affect the retirement decision. No earnings history is observed which implies that the pension income has to be estimated based on the observations of pension income among those who have retired and who also report the retirement benefits in the survey. Taxation is not accounted for. Dates of retirement are not observed so the focus is on husbands' and wives' retirement probabilities at a given point in time, rather than on the age of

withdrawing from the labour force. Eligibility, specified as a dummy, enters the set of covariates in the bivariate probit.

Other recent studies are Gustman and Steinmaier (1994) who find that the wife's retirement has a notable effect on the husband's propensity to retire, but not vice versa, and Baker (1999) who finds that the propensity to retire among males is around 5-10 percentage points higher when the wife is eligible for a supplementary pension.

Blau (1997) estimates the impact of Social Security benefits on the labour force behaviour of older married couples in the U.S. He distinguishes between a spouse benefit and retired worker benefit. A spouse receives the larger of the two. If the spouse benefit is the largest, then this may create a work-disincentive for the one who receives, typically the wife. His main findings is that the spouse benefit has a negative, but small, impact on the labour supply of the wives, and a positive, but small, impact on the labour supply of the husbands.

Another vein of research is the option value approach of Stock and Wise (1990). The focus is on a pension plan in a large firm and the study is thus not directed to the effects of the Social Security benefits on retirement, as in the cases referred to above. These firm pension plans offered the employees a bonus if they worked until a certain age, otherwise the bonus was lost. The option value model of Stock and Wise (*op. cit.*) is a simplified and myopic, sub-optimal, version of a dynamic programming model, but considerably less complex to estimate. A problem with their analysis is the fact that one cannot ignore the possibility that workers, in their data set salesmen, who retire early from the considered firm may start to work for other firms.

Like Stock and Wise (*op. cit.*) we study the propensity to retire early by exploiting the observations generated by the introduction of a company-specific, early retirement program in 1989. In 1988 unions and employers negotiated an early retirement scheme, covering a substantial proportion of the employees. Eligibility has been extended in several steps since 1989. The scheme now covers the whole public sector (40 per cent of all employees in 1992) and private companies employing about 43 per cent of all employees in the private sector with an age limit of 62. Self-employed are not included. (NOU, 1994 and NOU, 1998). From January 1, 1989 the early retirement age was lowered from 67 to 66, from January 1,1990 to 65, from October 1, 1993 to 64, from October 1, 1997 to 63 and from March 1, 1998 to 62. In contrast to Stock and Wise (*op. cit.*) in our study retirement is an absorbing state. During the observation period analysed here (1992-1995), there was no option to combine work and early retirement. Furthermore, married couples are identified, which allows for an analysis of the joint decision of labour supply among married couples. As already mentioned our study is limited to the analysis of labour supply

among married couples where the husband only is eligible for early retirement. Because of the age difference between husband and wives, there are a negligible number of cases where both spouses became eligible for early retirement during our observation period.

We have limited our study to labour market behaviour the first twelve months after the husband became eligible for early retirement. This eligibility could occur during 1993 and 1994 and these two years are our estimation period. We also observe the individuals during 1992, which we call history, and throughout 1995, which we call future. Note that the year starts when the husband becomes eligible and consequently the calendar date of the start of the observation year will vary across households with the age of the husband.

Because the choice to retire during the first twelve months after eligibility is assumed to exclude the possibility of going back to work in the future, we allow the individuals to take this irreversibility into account when they make their choices. Thus, here we differ from the previous studies referred to above, with the exception of Stock and Wise (*op. cit.*) Moreover in contrast to these other studies we observe

- the exact dates of retirement,
- the working history which implies that we can calculate the retirement benefits from pension rules,
- tax rules which differ considerably between earnings and retirement benefits.

Furthermore, we estimate a structural model in the sense that preferences can be separated from the budget constraints and we may thus be able to use the estimated model to simulate the impact on retirement of changes in the budget sets.

The paper is organised as follows. In Section 2 we describe the model and the choice of functional forms. In Section 3 we give estimates and predictions while in Section 4 we report the outcome of a policy simulation. In this simulation the tax rules operating on pension income is replaced by the less generous tax rules related to wage income. Conclusions are drawn in Section 5. In the Appendix we describe the institutional setting, data sources, the sample and the variables used in the analysis, including the tax rules.

2. The model and functional forms

The states

Feasible states are given in the following table:

Table 1. Feasible states

States	Male	Female
1	Full-time work	Full-time work
2	Part-time work	Part-time work
3	Delayed retirement	
4	Immediate retirement	
5		Out of the labour force

In most data sets hours of work are either observed in broad categories or the observations are contaminated with severe measurement errors. Moreover, jobs are typically offered with a fixed number of hours. Therefore we let hours of work be represented by two values only, full-time work equal to 46x37.5 hours a year (1725 hours) and part-time work which is set to half of this annual load.

Immediate retirement means that the male takes up retirement during the first two months after he became eligible, whereas delayed retirement means that he does so during the subsequent 10 months.

In explaining the choices made by the couple we allow the utility maximising couple to take into account that if the male has chosen immediate or delayed retirement, only retirement is a feasible state next year. Thus, retirement is an absorbing state. Therefore, if in period t the male occupies states 1 or 2, then states 1,2 and 4 are feasible for him also the next period (t+1). If the male is in state 3 or 4 in period t, only state 4 is feasible in period t+1.

The reasons why it could be of interest to leave options open for flexible choices in the next period are:

- retirement benefits may rise for government employee; pension is related to last year,
- income in the year preceding retirement may increase due to seniority rules,
- labour income may rise next year,
- tax and pension rules may change.

The labour attachment of the female the first year puts no limitation on her choice set the following year.

The Model

Let $U_{ij}(t)$ be the instantaneous utility in period t when the husband occupies state i and the wife occupies state j. As analysts we are not able to observe preferences and thus from our point of view they are random. We will assume that the random instantaneous utility is given by

$$U_{ij}(t) = u_{ij}(t) + \varepsilon_{ij}(t), \qquad (1)$$

where $u_{ij}(t)$ is the deterministic part of the utility function and $\varepsilon_{ij}(t)$ is the random part, which is assumed to be extreme value distributed (IID across states and households) with location parameter η, equal to 0.57777 (Eulers constant), and standard deviation σ.

Let W_{ij} be the decision function that the households employ when making their choices with respect to labour market attachments in period t, given that the choices in period t may restrict the possible choices in period t+1. We will assume that at the start of period the households know the random component of utility, but that the future component is not known. As common in stochastic dynamic choice models, we assume that the households know U_{ij} and consider only the expected value in period t+1. Thus, W_{ij} may be written

$$W_{ij} = U_{ij}(t) + \gamma E\left[\max(U_{ks(ij)}(t+1)\right], \qquad (2)$$

where γ is the discount factor and where ks(ij) means the feasible alternatives in period t+1 when the household chooses (ij) in period t.

If the husband chooses states 1 or 2 in period t (no matter what the wife chooses), then the choice set available in period t+1, denoted S_1, is given by

$$S_1=\{(1,1),(1,2),(1,5),(2,1),(2,2),(2,5),(4,1),(4,2),(4,5)\}.$$

Let

$$Y_1(t+1) = \max_{(k,s)\in S_1}(U_{ks}(t+1)) \qquad (3)$$

then $Y_1(t+1)$ is extreme value distributed (Ben-Akiva and Lerman (1985)) with expectation given by

$$E[Y_1(t+1)] = \frac{1}{\sigma}\ln\Big(\sum_{i=1,2,4}\sum_{j=1,2,5}\exp(\sigma u_{ij}(t+1))\Big) + \frac{\eta}{\sigma} \tag{4}$$

Similarly, if the husband chooses state 3 or 4 in period t, the choice set available in period t+1 is

$$S_2=\{4,1),(4,2),(4,5)\}.$$

By letting $Y_2(t+1) = \max_{ks\in S_2}(U_{ks}(t+1))$, we get

$$E[Y_2(t+1)] = \frac{1}{\sigma}\ln\Big(\sum_{j=1,2,5}\exp(\sigma u_{4j}(t+1))\Big) + \frac{\eta}{\sigma} \tag{5}$$

The household decision function can thus be written as

$$W_{ij} = w_{ij} + \varepsilon_{ij} \tag{6}$$

where

$$\begin{aligned} w_{ij} &= u_{ij}(t) + \gamma E[Y_1(t+1)]; \quad for\ i=1,2;\ j=1,2,5 \\ w_{ij} &= u_{ij}(t) + \gamma E[Y_2(t+1)]; \quad for\ i=3,4;\ j=1,2,5. \end{aligned} \tag{7}$$

Under the assumption of utility maximisation the probability that state (i,j) is chosen is given by

(8)

$$\varphi_{ij} \equiv \Pr(W_{ij} \geq W_{ks}, \forall(k,s) \in (1,2,3,4)\times(1,2,5)) = \frac{\exp(\sigma w_{ij})}{\sum_{k=1,2,3,4}\sum_{s=1,2,5}\exp(\sigma w_{ks})};\ i=1,2,3,4;\ j=1,2,5.$$

Let

$$v_{ij} = \sigma u_{ij},$$
$$y_1 = \sum_{i=1,2,4} \sum_{j=1,2,5} \exp(v_{ij}(t+1)),$$
$$y_2 = \sum_{j=1,2,5} \exp(v_{4j}(t+1)).$$

The choice probabilities can then be written:

$$\varphi_{ij} = \frac{y_1^{\gamma} \exp(v_{ij}(t))}{y_1^{\gamma} \sum_{k=1,2} \sum_{s=1,2,5} \exp(v_{ks}(t)) + y_2^{\gamma} \sum_{k=3,4} \sum_{s=1,2,5} \exp(v_{ks}(t))}; \; for \; i = 1,2; j = 1,2,5. \quad (9)$$

and

$$\varphi_{ij} = \frac{y_2^{\gamma} \exp(v_{ij}(t))}{y_1^{\gamma} \sum_{k=1,2} \sum_{s=1,2,5} \exp(v_{ks}(t)) + y_2^{\gamma} \sum_{k=3,4} \sum_{s=1,2,5} \exp(v_{ks}(t))}; \; for \; i = 3,4, \; j = 1,2,5. \quad (10)$$

From (9) and (10) we observe that if γ=0, then the choice probabilities become equal to probabilities in a static multinomial logit model, i.e. with the deterministic part of the utility function in the first period only appearing in the choice probabilities.

From $v_{ij}= \sigma u_{ij}$ and (9) and (10) we observe that the scale parameters of the utility function, i.e. the parameters that enter u_{ij} in a linear way, cannot be recovered from data. The shape parameters, however, can be identified.

The specification of functional forms

The deterministic function v_{ij} will be specified as a Box-Cox transformation of disposable household income and leisure, i.e.

$$v_{ij} = \alpha \frac{C_{ij}^{\alpha_1} - 1}{\alpha_1} + \beta_1 \frac{L_{Mi}^{\beta_{11}} - 1}{\beta_{11}} + \beta_2 \frac{L_{Fj}^{\beta_{22}} - 1}{\beta_{22}} + \beta_3 \frac{L^{\beta_{33}} - 1}{\beta_{33}}, \quad (11)$$

Here is

$$C_{ij} = r_i + r_j - T(r_i, r_j) - C_{0.}$$

r_k is gross income when the husband/wife is in state k. $T(r_i,r_j)$ is the tax paid by the couple. C_0 is a reference disposable income level set equal to the basic pension in the years of observations, which is considered to be equal to the subsistence level.

L_{Mi} and L_{Fj} are leisure for the husband and wife respectively. The discrete leisure values are set out in Table 2.

Table 2. Leisure across states

States	L_{Mi}	L_{Fj}
1	1-[37.5x46+8x365]/8760	1-[37.5x46+8x365]/8760
2	1-[37.5x23+8x365]/8760	1-[37.5x23+8x365]/8760
3	1-[37.5x23+8x365]/8760	1-[8x365]/8760
4	1-[8x365]/8760	
5		

We deduct 8 hours sleep a day and measure leisure relative to total number of hours a year.

L is common leisure and is defined as

$$L = \min\left[L_{Mi}, L_{Fj}\right] \qquad (12)$$

The scale parameters of the v-functions are α, β_1, β_2 and $\beta_{3.}$ The shape parameters are α_1, β_{11}, β_{22} and β_{33}. If all of these shape parameters are equal to 1, then the v-function is linear in disposable income and leisure. If the shape parameters all go to zero, then the v-function becomes a log-linear function of disposable income and leisure.

The scale parameters, except for α, are all assumed to depend on observed covariates. Let A_k denote the age of spouse k and let Z_k denote the education level of spouse k. We will assume that

$$\beta_1 = b_{10} + b_1 Z_M;$$
$$\beta_2 = b_{20} + b_2 Z_F; \qquad (13)$$
$$\beta_3 = b_{30} + b_{31}(A_M - A_F) + b_{32}(A_M - A_F)^2$$

3. Estimates and predictions

To estimate the model we need to assess the income in states not occupied by the individuals. Potential retirement benefits follow from earnings histories (which are observed) and are predicted using all details of the rules. Moreover, because retirement is an absorbing state, we need potential earnings in period t+1 only for persons who worked in period t.

We have the choice of either estimating earnings functions and predict earnings, or using the observed values. The observed values reflect how earnings are affected by observed and unobserved covariates. We believe that individuals know the current stochastic component of their earnings function, while the analyst does not. Moreover, there are good reasons to expect the stochastic components to be serially correlated. We have therefore decided to use the observed earnings as much as possible. This means that we have used the observed earnings of an individual in the history window (1992) and/or in the observation window (1993/1994) to predict his or her earnings in the states of full time work and part time work. If we have observations of income in only one of these states, we predict the income in say part time work by dividing the observed income in full time work by 2. For women who are observed to be out of the labour force, we have to predict income based on the estimated earnings function described in the Appendix, Section 2.

Gross income when the husband is in the state of delayed retirement is assumed to be the income as full time worker for half a year and pension income for the other half.

Because the first twelve months after eligibility do not necessarily coincide with a calendar year, we have to employ the tax rules from different calendar years. In the Appendix, Section 3, we show the tax structure for wage and pension income for one selected year, 1994. In the calculation of disposable income all details of the tax structure are accounted for.

We have chosen to divide the sample in two parts according to whether the husband works in the private or the public sector. The arguments for doing this are:

- Because pensions are related to the earnings the very last year of working, government employees have incentives to postpone retirement, given that the income is not falling. We thus expect the bias for the present to be less in the public sector than in the private sector. That is, we expect γ to be higher among those working in the public sector than among those working in the private sector.
- Persons who have been working in the private sector may have had a more strenuous working history and they will thus be more inclined to immediate retirement than those working in the public sector. We thus expect the leisure term for the male to be of greater importance for the retirement decision if he is working in the private sector than if working in the public sector.

The estimates are set out in Table 3. In interpreting the results we should keep in mind that the scale parameters of the utility function, u_{ij}, cannot be identified. Therefore the estimates of the scale parameters do not imply anything about the shape say, the concavity of the utility function. However, they give correct information about the sign of the marginal utilities, and they can also be used to estimate the marginal rates of substitution between consumption and leisure. The estimates can also be used to perform policy simulation and to report the impact from these simulations on the choice probabilities.

In the estimations shown in Table 3 we have assumed that all the shape coefficients are the same and this common shape coefficient is denoted α_1. Test of this and other assumptions are reported in Jia (2000).

Table 3. Estimates

		Husband in private sector		Husband in public sector	
Variables	Coefficients	Estimates	t-values	Estimates	t-values
Shape	α_1	0.695	15.8	0.752	20.3
Discounting	γ	0.813	8.2	0.893	10.5
Consumption	α	3.271	34.0	2.966	34.0
Male leisure	β_1:				
Constant	b_{10}	0.761	3.7	-1.918	-7.9
Education	b_{11}	0.152	2.3	0.300	4.6
Female leisure	β_2:				
Constant	b_{20}	5.188	16.7	5.146	20.9
Education	b_{21}	0.300	2.5	0.103	1.1
Common leisure	β_3:				
Constant	b_{30}	1.244	5.8	1.900	9.0
(A_M-A_F)	b_{31}	-0.159	-3.0	-0.142	-3.8
$(A_M-A_F)^2$	b_{32}	0.004	0.9	0.004	2.0
Observations		2195		3334	
Log-likelihood		-4412		-6364	

The shape coefficient is estimated to be nearly the same across the husband's sector affiliation. The estimates are around 0.70, which is slightly above the value found in psychophysical experiments, Stevens (1975).

The point-estimates of the discount factors, the γ-s, imply a bias for the present in both sectors, with a stronger bias in the private sector (as expected). The point-estimates imply a rate of interest of 23 percent if the husband works in the private sector and 12 percent if he works in the public sector. However, it should be emphasised that γ is not found to be significantly different from 1 in either of the sectors. Because γ is found to be significantly different from zero a static model is rejected.

Marginal utility of leisure is estimated to increase with education for the husband as well as for the wife[3]. If the husband works in the private sector, then education is estimated to have a stronger positive impact on the marginal rate of

[3] Note that education also has an impact on behaviour through earnings. The higher the education level is, the higher is earnings. Thus education will have two opposing effects on labour supply.

substitution between disposable income and male leisure compared to if he works in the private sector.

As alluded to above, we find that the marginal rate of substitution between disposable income and male leisure is more leisure biased if the husband works in the private sector.

The marginal utility of common leisure is estimated to decrease with the age difference between the spouses. It should be noted that for some values of male education level and difference in age between spouses, the marginal utility of male leisure is negative when the husband works in the public sector. Taken at face value, this indicates that for some, but rather few in the sample, there is a bias for being work addicts. To prevent them for having an unrealistic high working load there must be some rationing of offered jobs with long hours in the market.

In Table 4 we report how well the model predict the states chosen by the married couples. For each couple the model is used in stochastic simulations to predict their choice. Probabilities are calculated as the average over households.

Table 4. The average of predicted probabilities across households and observed fractions

State specification			Husband in private sector		Husband in public sector	
States	Husband	Wife	Obs. fractions	Model predicts .	Obs. fractions	Model predicts
11	Full-time	Full-time	0.1317	0.1870	0.2024	0.2706
12	Full-time	Part-time	0.1786	0.0992	0.2183	0.1413
15	Full- time	Out of labour force	0.2178	0.2387	0.2396	0.2555
21	Part-time	Full-time	0.0087	0.0238	0.0156	0.0327
22	Part-time	Part-time	0.0187	0.0113	0.0333	0.0179
25	Part-time	Out of labour force	0.0241	0.0167	0.0297	0.0221
31	Delayed retirement	Full-time	0.0487	0.0755	0.0459	0.0616
32	Delayed retirement	Part-time	0.651	0.0412	0.0633	0.0369
35	Delayed retirement	Out of labour force	0.0907	0.0932	0.0618	0.0689
41	Immediate retirement	Full-time	0.0506	0.0667	0.0192	0.0243
42	Immediate Retirement	Part-time	0.0651	0.0344	0.0276	0.0141
45	Immediate Retirement	Out of labour force	0.1002	0.1125	0.0435	0.0540

We observe that the model tends to overestimate the number of couples that choose full time work for both spouses and underestimate the combination of full time work for the man and part time work for the female. Apparently, there are some problems with modelling the behaviour of the females in these rather old cohorts. However, the most important issue in our paper is to model the behaviour of married males who are eligible for early retirement. To focus more on how well the model predicts the behaviour of males we have calculated the marginal probabilities of the husband's choices in the labour market. In Table 5 we have lumped the states of delayed and

immediate retirement into one category called retirement. As is demonstrated in Table 5 the marginal probabilities of the husband's choices are rather precisely predicted.

Table 5. Marginal choice probabilities of the husband's choice

Marginal states	Husband works in private sector		Husband works in public sector	
	Observed	Model	Observed	Model
Full time work	0.5281	0.5177	0.6603	0.6674
Part time work	0.0515	0.0518	0.0786	0.0727
Retirement	0.4204	0.4235	0.2613	0.2598

We will end this section with addressing the question of the importance of accounting for the forward-looking behaviour in explaining the labour market choices of married men who are eligible for early retirement. As alluded to above, the justification for accounting for the future implications of current choices in explaining current choices is that the decision to retire early is an irreversible act. Yet, one could ask whether a model with forward-looking behaviour (as modelled above) performs better than a model that ignores this aspect, and if so, how much better. Thus, in Table 6 we report the estimates of a model without forward-looking behaviour (Model A), which is the same model as the one estimated above, with the exception that γ is set equal to zero. Model A is a static multi-nominal logit model covering the labour supply choices of married couples. To facilitate comparisons we repeat the estimates and predictions based on the forward-looking model (to this end called Model B).

Table 6. Estimates of models without forward-looking behaviour (Model A) and with (Model B)

Coeff-icients	Husband in private sector				Husband in public sector			
	Model A		Model B		Model A		Model B	
	est.	t-val	est	t-val	est	t-val	est	t-val
α_1	0.791	18.1	0.695	15.8	0.804	21.2	0.752	20.3
γ	-	-	0.813	8.2	-	-	0.893	10.5
α	3.327	28.6	3.271	34.0	2.901	32.1	2.966	34.0
b_{10}	0.668	2.5	0.761	3.7	-2.885	-8.6	-1.918	-7.9
b_{11}	-0.137	-1.4	0.152	2.3	-0.357	-0.3	0.300	4.6
b_{20}	5.535	17.1	5.188	16.7	5.186	20.4	5.146	20.9
b_{21}	0.408	3.2	0.300	2.5	0.139	1.5	0.103	1.1
b_{30}	1.382	5.5	1.244	5.8	2.494	9.8	1.900	9.0
b_{31}	-0.240	-3.4	-0.159	-3.0	-0.348	-5.9	-0.142	-3.8
b_{32}	0.004	0.8	0.004	0.9	0.009	2.1	0.004	2.0
Obser-vations	2195		2195		3334		3334	
Log-like-lihood	-4492		-4412		-6553		-6364	

We observe that estimates are fairly equal, with some exceptions. Model A implies a higher estimate of the shape coefficient, α_1. In Model A the marginal utility of disposable household income (as well as the marginal utility of leisure) is estimated to decline less with the relevant arguments than in Model B. Moreover, the scale coefficients attached to the marginal utility of male leisure are quite different in the two models. We also note that the log-likelihood is higher in model B than in Model A. In Table 7 we report the predictions of the marginal choice probabilities of the males, based on the two models. We observe that while the forward-looking model (Model B) is right on target, the static Model A predicts the observed fractions rather badly!

Thus, we conclude that the forward-looking model, Model B, performs much better than the static Model A. Therefore, Model B will used to simulate how policy changes affect labour supply, and, in particular, the propensity of the male to retire early. The results are presented in the next section.

Table 7. Prediction of marginal probabilities for males based on a model without forward-looking behaviour (model A) and with (model B)

States	Husband works in private sector			Husband works in public sector		
	Observed	Model A	Model B	Observed	Model A	Model B
Full time	0.5281	0.4549	0.5177	0.6603	0.5755	0.6674
Part time	0.0515	0.0374	0.0518	0.0786	0.0515	0.0727
Retirement	0.4204	0.5077	0.4235	0.2613	0.3730	0.2598

4. Policy Simulations

In order to illustrate the magnitude of the estimated relationship and the corresponding impact of potential policy changes, we have performed two simulations with the model. In the first simulation, called Policy 1, pensions are taxed like labour earnings. In the second simulation, Policy 2, pension is taxed like labour earnings, and in addition pre-tax pension is reduced by 10 per cent. The results in terms of how the marginal choice probabilities are affected by the policy changes that are set out in Table 8.

Table 8. Marginal choice probabilities for husband and wife, percent

	Husband works in private sector			Husband works in public sector		
Husband	Model	Policy 1	Policy 2	Model	Policy 1	Policy 2
Full-time	52.49	84.05	86.28	66.74	77.87	81.13
Part-time	5.18	7.02	7.24	7.27	8.66	9.06
Delayed retirement	21.35	2.65	1.73	9.25	4.36	2.87
Immed. retirement	20.98	6.27	4.75	16.74	9.11	6.93
Sum	100.0	100.0	100.0	100.0	100.0	100.0
Wife	Model B	Policy 1	Policy 2	Model B	Policy 1	Policy 2
Full-time	35.28	34.74	34.88	38.93	37.64	37.97
Part-time	18.61	17.69	17.73	21.02	19.76	19.84
Out of labour force	46.11	47.57	47.39	40.06	42.59	42.19
Sum	100.0	100.0	100.0	100.0	100.0	100.0

First, we observe that replacing the actual tax rules related to pension income by the tax function related to wage income (Policy 1) is predicted to have a rather strong impact on male labour supply. The marginal probabilities of choosing full-time work among males working in the private sector is predicted to increase by as much as 32 percentage points. Consequently, the probability of choosing early retirement is predicted to very low values. If the males work in the public sector the effect is weaker, but still strong. From the Appendix, Section 3, we note that the taxes paid by those who retire are very much lower at low incomes than for wage earners. Thus,

introducing Policy 1 worsens the alternative of early retirement to a large extent, in particular among those with low pensions.

Given that Policy 1 has been introduced cutting pensions by 10 percent has only a modest, but positive impact on male labour supply.

The impact on the labour supply of the wife is negative, but numerically rather weak. This decline in female labour supply is due to increased labour supply among their male spouses, and consequently higher income. Because of the negative income effect in the estimated labour supply probabilities, female labour supply goes down.

In what follows we will examine how the marginal choice probabilities of the male are affected by the policy change. Let $\varphi_{i.}$(**Pol r**) denote the marginal choice probability for the male under Policy regime r; r=1,2 and i=1,2,3,4, and let $\varphi_{i.}$(**b**) denote these marginal choice probabilities **b**efore the policy change. Furthermore let R denote the disposable income of the household in the history window. In Table 9 below we give the result of regressing log [$\varphi_{i.}$(**Pol r**)/ $\varphi_{i.}$(**b**)] against log R.

Similar calculations can be done for females. We show the estimates and t-values of the slope coefficient and for males only.

Table 9. The relationship between log [$\varphi_{i.}$(Pol r)/ $\varphi_{i.}$(b)] and log R

	Husband works in the private sector				Husband works in the public sector			
Husband	Pol 1/b		Pol 2/b		Pol 1/b		Pol 2/ b	
	Estimate	t-value	Estimate	t.-value	estimate	t-value	Estimate	t-value
Full-time	-0.271	-17.2	-0.282	-16.6	-0.037	-12.3	-0.037	- 9.7
Part-time	-0.236	-15.8	-0.247	-15.3	-0.021	- 8.2	-0.020	- 6.4
Delayed retirement	-0.129	-5.8	-0.166	-7.0	0.105	14.2	0.098	12.2
Immediate retirement	-0.288	-11.6	-0.346	-12.9	0.074	8.2	0.054	5.9

The coefficients imply that in the public sector males with the low pre-policy household income increase their labour supply more and reduce their inclination to retire more than males in households with high income.In the private sector the negative coefficients for all transitions is due to the fact that when running the regressions of the log odds ratio of marginal probabilites we do not account for the

fact that transitions probabilities should sum to unity. Numerically, the coefficient for Full-time work dominates, and the interpretation also for the private sector is that low-income households show the strongest response to policy changes in increasing their labour supply.

From the model it follows that the expected consumer surplus for an household, denoted CS, is given by

$$CS = \frac{1}{\sigma} \ln \sum_{k=1,2,3,4} \sum_{s=1,2,5} y_k^{\gamma} \exp(v_{ks}(t)) \qquad (14)$$

where $y_1=y_2=\Sigma_{k=1,2,4}\Sigma_{s=1,2,5} \exp(v_{ks}(t+1))$ and $y_3=y_4=\Sigma_{s=1,2,5} \exp(v_{4s}(t+1))$.

Let CS(**Pol r**) denote the expected consumer surplus under policy regime r, r=1,2 and let CS(**b**) denote the surplus before the policy change. To check how the loss in consumer surplus from introducing the change in the budget constraints is distributed across households, we have regressed σ[CS(**Pol r**)-CS(**b**)] against household income, R, for the period prior to estimation. The results of these four regressions are given in Table 10. Because the change in taxation of pension income hits the lower income groups harder than the higher income groups, we will expect that the loss in expected consumer surplus is higher for the lower income households than for the higher income households.

Note that because there is a loss for all households CS(**Pol r**)-CS(**b**) will be negative. If households with lower prior income lose more than households with higher income, then we would expect that the coefficient in front of log household income is positive. [4]

Table 10. The relationship between the change in expected consumer surplus, σ[CS(Pol r)-CS(b)], and the log of household income, R, prior to estimation. t-values in parentheses

	Husband in private sector		Husband in public sector	
Policy regime	Intercept	Slope	Intercept	Slope

[4] Because we limit the discussion of the regression results to the sign of the slope, we do not need to employ cardinal utilites.

Policy 1	-3.8661	0.3865	-0.7583	0.0166
	(-10.9)	(13.9)	(-11.7)	(3.2)
Policy 2	-4.1640	0.4061	-0.8047	0.0129
	(-11.1)	(13.7)	(-10.4)	(2.1)

These results confirm the conjecture that the poor households will suffer more from the consider change in tax rules and pensions than the rich. Thus, the policy experiments considered here imply that a higher labour force participation can be achieved by changing tax and pension rules but at the expense of a less even distribution of household welfare. Therefore one has to make the familiar trade off between efficiency and equity. It should be noted that equity here is related to the distribution of household income prior to estimation and hence also prior to the policy experiments. The r- square coefficients related to the regressions in Table 10 are rather low, which indicate that prior household income is only one variable among a possible large number of variables that can explain the heterogeneity in the distribution of CS.

5. Conclusion

When the husband works in the private sector the take-up rate of early retirement during the first twelve months after becoming eligible (once during 1993 and 1994) was around 40 percent. If the husband works in the public sector the corresponding take up rate was around 25 percent. A model with forward-looking and utility maximising married couples has been estimated on these data. The estimated model has been used in stochastic simulations to predict the outcome of taxing pensions as wage earnings and to cut pensions by 10 percent.

Taxing pensions as labour earnings induced a substantial decline in immediate and delayed retirement and a substantial shift towards full-time work among males. Female labour supply is nearly not affected, but females tend to decrease their labour supply a little. An additional 10 per cent cut in the pre-tax pension income has a positive impact on full-time work among both spouses, but the effect is a magnitude smaller than the effect obtained by changing taxation. Husbands in poor households tend to increase their labour supply more than husbands in rich households. Poor households are also more negatively affected in terms of loss in expected household welfare than the rich households.

References

Aaberge, Rolf, Colombino,Ugo and Strøm, Steinar: "Labour supply in Italy: An empirical analysis of joint household decisions, with taxes and quantity constraints", *Journal of Applied Econometrics*, 14, 1999

Baker, Michael "The Retirement Behavior of Married Couples: Evidence from Spouse's Allowance" NBER Working Paper No. 7138, 1999

Ben - Akiva, M. and S.R. Lerman (1985), *Discrete Choice Analysis, Theory and Application to Travel Demand*, The MIT Press, Cambridge, Massachusetts, London, England

Blau, David H.: Social Security and the labor supply of older married couples, Labour Economics 4, December, 1997, 373-418

Gustman, Alan, L. and Thomas Steinmeier: Retirement in a family context: A structural model for husband and wives, Working paper no 4629, NBER, Cambridge, MA, Jan, 1994

Haugen, Fredrik: Insentivvirkninger av skatte- og pensjonsregler, Master Thesis, Department of Economics, University of Oslo, 2000 (in Norwegian only)

Henretta, John, C. and Angela M. O'Rand: Joint retirement in the dual worker family, Social Forces, 62, 504-520, 1983.

Hernæs, Erik, Sollie, Marte and Strøm, Steinar "Early Retirement and Economic Incentives", *Scandinavian Journal of Economics*, Vol 102, No 3, 2000

Jia Zhiyang: *Family labor supply when the husband is eligible for AFP*, Master Thesis, Department of Economics, University of Oslo, 2000

NOU "Fra arbeid til pensjon" Norges offentlige utredninger 1994:2 (in Norwegian only)

NOU " Fleksibel pensjonering" Norges offentlige utredninger 1998:19 (in Norwegian only)

Røgeberg, Ole, J.: Married Men and Early Retirement Under the AFP Scheme, Master Thesis, Department of Economics, University of Oslo, 2000

Statistics Norway "Labour Market Statistics 1995", Official Statistics of Norway, C 325, Oslo-Kongsvinger: 1996 (Dual Norwegian and English text)

Stevens, S.S.: *Psychophysics: Introduction to its perceptual neural and social prospects,* Wiley, New York, 1975

Stock, James and Wise, David E.: "Pensions, the Option Value of Work, and Retirement" *Econometrica* 58, 5: 1151-1180, 1990

Zveimüller, Josef, Winter-Ebmer, Rudolf and Falkinger, Josef: "Retirement of spouses and social security reform" *European Economic Review* 40: 449-472, 1996

Wadensjø, Eskil (ed.) *Leaving the Labour Market Early in the Welfare State* North-Holland Elsevier, 1996. (Part 2 of Wadensjø, Eskil (ed.) *The Nordic Labour Markets in the 1990s* North-Holland Elsevier, 1996)

Appendix

.

1. Institutional Setting

In 1988 employers and unions negotiated an early retirement scheme (AFP). Under this scheme, persons working for employers who are participating (today about 43 % of private employees and all employees of central and local government) and meeting individual requirement could retire at an earlier age than the ordinary 67. From January 1 1989, the AFP age was 66. It was lowered to 65 from January 1 1990, to 64 from October 1 1993, to 63 on from October 1 1997 and to 62 from March 1 1998. The pension level was as it would have been from age 67 according to the public pension system, had the person continued till that age in the job they held at the time of early retirement.

The backbone of the retirement system in Norway is a mandatory, defined benefit public pension system, covering all permanent residents, established in its current form in 1967. Because we study the retirement decision given accumulated rights, the description below focuses on the regulations determining the benefits. Regarding the financing of the system, we will just mention that contributions to the system are levied on employers and employees as percentages of total earnings and on self-employed as a percentage of their income, as part of the income tax system. Although there is a central pension fund, it is not required that this fund should meet future net expected obligations, and the system is based on yearly contributions from the government.

The benefits consist of two main components. One component is a minimum pension, paid to all persons who are permanently residing in the country. With less than 40 years of residence, the pension is reduced proportionally. This reduction mainly applies to immigrants, of which there are very few in the sample, and we will not pay any attention to this feature of the system in the following. The other main component is an earnings based pension.

A crucial parameter in the system, used for defining contributions as well as benefits, is the basic pension. The basic pension in most of 1994 was NOK 38 080. There were small adjustments during the observation period, and these were

accounted for when calculating potential pensions on the basis of the basic pension. The earnings based pension in the private sector depends on the basic pension and the individual earnings history in several ways. Each year, earnings exceeding the basic pension is divided by the basic pension to give pension 'points' for that year. Earnings above 12 times the basic pension do not give points, and earnings between 6 and 12 times the basic pension (8 and 12 times for earnings before 1992) are reduced to one third before calculating points. The yearly points are then multiplied by 0.45 (points obtained after 1992 are multiplied by 0.42) and the average yearly points over the 20 best years are calculated. These points multiplied by the basic pension give the earnings based component, and adding the basic pension gives the total public pension. If a person has had less than 40 years with earnings above the basic pension, the earnings based pension is reduced proportionally.

The public pension system also has a number of additional regulations, which we will only briefly recount here. Firstly, since we are still in the process of phasing in the public pension system, a special 'overcompensation' program is in operation for persons born before 1928. Secondly, there is a supplementary pension for those without any earnings based pension component, giving a minimum pension level of 1.605 times the basic pension. This means that income below 2.344 times the minimum pension does not influence the public pension. Thirdly, there is co-ordination of the pensions for married couples, mainly reducing their joint pension compared to the sum for two single persons. All of these features have been taken into account when we calculated potential pension.

Keeping 1994 regulations constant, the maximum future pension level will be 3.94 times the basic pension (G), NOK 180 080 (as of April 1st, 1 USD is approximately NOK 8.30). This pension level requires 20 year with earnings of at least NOK 456 960 and another 20 years with earnings of at least NOK 38 080. Although there is a re-distributive effect of the tax system also for pre-retirement earnings, this effect is much stronger after retirement. For pre-retirement earnings up to around NOK 100 000, after-tax pension is actually higher than after-tax earnings. Also, the after-tax public pension curve is fairly flat, implying a strong re-distributive effect. The replacement level implied by the public pension curve falls from one at an income level of 2.344 G (below that level income does not influence the public

pension). At earnings just giving the maximum pension, the replacement level is between 0.3 and 0.4.

State and local government employees have alternative pensions, co-ordinated so that benefits will be the maximum of the public and the government pension. The government pension is calculated in much the same way as the public pension, but with some important distinctions. First, it is based on the earnings level immediately prior to retirement and not on the previous earnings history. Secondly, the reduction in accrued pension points starts at 8 times the basic pension, allowing the maximum employer-based public sector pension to be 6.16 times the basic pension in the public system, giving a replacement ratio at that level of 0.51. In addition, there are employer based and private, additional pensions (tax deductible and widespread).

There are also special tax rules, which apply to retirement benefits. These are briefly described below, but all details are given in Haugen (2000). In the early retirement program a tax-free lump-sum amount was given to those who retired from a job in the private sector. In the government sector a higher, but taxed lump-sum amount was awarded.

2. Data Sources

The basis for the analysis is register files held by Statistics Norway. The files are all based on a personal identification number that allows linking of files with different kinds of information and covering different periods in time.

For the present study, we used register files covering the entire population and spanning the period 1992-95. The information of interest in the register files is:

Demographic variables

- Date of birth
- Gender
- Marital status and the identification number of spouse
- Educational qualifications

From the labour market authorities

- Start- and stop-dates for any periods of registered unemployment
- As reported by employer:
    - Start- and stop-dates for spells of employment, with identification of employer
    - Job-type (Full-/Part-time)
    - Industry

From the tax-files

- Wage-earnings
- Earnings from other sources

From the social security authorities

- The complete series of earned public pension points since 1967
- Start dates for early retirement with information on whether the individual received private or public pension
- Received benefits from the early retirement scheme

For more details about data sources, see Røgeberg (1999).

3. Sample, States, and Economic Attributes

General

The data sets used here cover the whole population over the period 1992-1995, and give detailed information on employment, earnings and benefits (pension incomes) of various types, gender, age (also birth date), marital status, educational attainment, place of residence and local rate of unemployment. There is information about the month in which the retirement option becomes available and the month in which it is taken out. During the observation period, there was in general not an option to combine work and pension. There is also information on the level of

earnings and on all the components of the pensions once they are taken out. Direct information on the potential pension, covering also those who are eligible but who do not immediately take out, are only partly available, although the main components are covered. The available information on potential pension is accrued rights in the public pension system. This also forms the basis for potential early retirement pensions. Even if there is no direct information on accrued rights in the public sector pension system (covering only public sector employees, and not to be confused with the public pension which covers all residents) we know their latest job and assume this was their permanent position. Nor is there direct information on accrued rights in employer-based pensions in the private sector or private pensions.

Limiting the analysis to persons eligible for early retirement ensures that the option is actually open for the persons in the sample, but does also limit the risk group. In addition to being employed by companies that are covered, there are individual limits on working hours and work experience. This means that employees of companies not covered, typically small companies in the private sector, persons with short labour market careers and self-employed are excluded. From a modelling point of view, this is a reasonable limitation, since the incentives will be different for employees in very small companies and for self-employed, calling for a different modelling approach. Still, the early retirement scheme (AFP) covers employees of more than half the labour force. A substantial proportion is still in the labour force at age 64, in 1990 about 60 per cent of the males and 40 per cent of females (Statistics Norway, *op. cit.*). The analysis therefore covers an important phase in the transition from work to retirement.

The data set is restricted to cover households in which the husband becomes eligible for early retirement during 1993 or 1994, and in which the wife does not qualify during this period. Because the husband is on the average about three years older than the wife, this is the most common situation for married couples. In about 80 per cent of the selected households the wife is too young to qualify, and in only 4 per cent of the households she is 67 and receiving old-age pension. The rest of the wives do not qualify for early retirement either because they do not work in an early retirement (AFP) company or does not qualify on the basis of personal labour market attachment or history.

In the present study, we analyse retirement behaviour of married men who became eligible for the early retirement scheme (AFP) during 1993 or 1994 and labour supply of their wives, who are required not to qualify. Since the scheme is employer-based, we identify employers where some of the employees took out early retirement and identify all other employees in those companies. With this procedure, we may miss some companies, but are certain that those companies that are identified are participating.

Early Retirement Companies

The early retirement scheme (AFP) operates on a company level, covering most of the private and the whole public sector. In order to identify the companies participating in the early retirement scheme, we made a list of individuals who were registered as recipients of early retirement benefits in at least one of the years 1993-1995 without having been registered as such the previous year. We then found their work-records from the previous year, and, including only those individuals with a single work-record in order to avoid misidentification, made a list of all the companies involved. Though a company may be comprised of several firms, and though not all firms in a single company necessarily have to introduce the early retirement scheme in concert, the conditions where this ”common-policy” assumption does not hold are rather rare and the rule holds as an approximation. Whereas the companies thus identified can safely be assumed to be included in the AFP, there may be companies not identified, simply because no employees took out AFP during the observation period. This is a special problem with small companies in the private sector.

Of the roughly 1.9 million individuals registered with at least one work record in the records of the labour market authorities in 1993-94, approximately 56% were registered with a work record in one of the companies our procedure identified as participating in the AFP-scheme. Because the proportion of the labour force working in AFP-participating companies has been increasing, this compares quite well with the official estimate of 60%.

Eligibility, Take-up Date and Cohorts

In the AFP companies all employees attaining the required age were selected as eligible if they

- had been employed in the company the last 3 years or been employed in another company also operating the AFP scheme the last 5 year,
- had earnings at a level at least corresponding to the basic pension (G) when AFP is taken up,
- had earnings at least equal to the basic pension the year before,
- had an average proportion between earnings and the basic pension of at least 1 in the 10 best years after the age of 50 and
- had at least 10 years in which earnings were at least twice the basic pension.

Persons meeting individual criteria while working in companies covered by the scheme became eligible from the month after they turn the required age. With information on birth date, we are therefore able to identify exactly the date of eligibility.

The observation period is 1992-1995. In order to observe earnings prior to retirement eligibility and whether retirement is taken out, we use the birth cohorts of 1928-1930 and observe retirement outcome during 1993-95 of persons becoming eligible 1993-94.

This gives a three-year window for observation of early retirement, within which persons became eligible (provided they meet the other requirements) from the first of the month after the required birthday. On October 1, 1993, the eligibility age was lowered from 65 to 64 years. Hence, between January 1 and September 30 1993, persons born between these dates in 1928 met the age requirement (65). These are the oldest persons in the data set and they became 67 during the same period in 1995, so that early retirement behaviour can be observed during a two-year period from the time of eligibility until age 67.

On October 1 1993, a whole new age cohort met the age requirement, comprised of the remainder of the 1928 birth cohort (born after September 30) and those in the 1929 cohort born up to October 1. Those born in 1928 after October 1 became 67 during 1995, giving an observation window increasing from 2 years for the

oldest to 2 years and 3 months for the youngest. Those born in 1929 before October 1 became 67 after 1995, so that the observation window is limited by the end of the observation period, giving an observation window increasing from 2 years and 3 months until 2 year and 9 months.

During the remainder of 1993, the rest of the persons in the 1929 birth cohort met the age requirement. For the oldest persons in this age group the observation window before ordinary retirement is 2 years and 3 months. The observation window then tapers off until 2 years for the youngest in the 1929 cohort. For persons in the 1930 cohort the observation window is 2 years for the oldest and 1 year for the youngest.

The data sets thus gives us observation windows varying from 2 years and 9 months, to 1 year, with a truncation at 2 years.

Couples

A data set of couples was then created, comprising men eligible for early retirement during 1993 or 1994 who were married to an identified wife not eligible for early retirement during the same period. We started by identifying all males who had at least one work-record in one of the early retirement identified companies. We then proceeded to remove

- Those with a spell of unemployment at some time in the period 1992-95
- Those non-eligible due to age
- Those with a work and earnings history not meeting the AFP requirements
- Those who did not work in an early retirement company the year before they would otherwise have become eligible for early retirement
- Those not ”reciprocally married” to an identified person. Either because they were
    - Not married
    - Registered as married, but missing the identification number of a spouse
    - Registered as married, but the identification number of their spouse was not found in the register files (dead, too old or other)
    - Not ”reciprocally married” (Individual A registered as married to B, but B registered as married to C or to no-one at all)

To this set of men with identified wives we affixed information on wage earnings, types of job (full-/part-time, industry, private/public), age, educational level, pension-rights and work history, and created a data set consisting of couples.

Retirement Behaviour

The AFP Take-up Profile

Figure A.1 shows the distribution of waiting times between eligibility and start of AFP. On October 1 1993 a whole new cohort became eligible, and we have therefore split the sample. Panels A shows the waiting time for those who become eligible during the first three quarters of 1993, panel B waiting times for those qualifying in the last quarter of 1993, and panel C waiting times for those qualifying during 1994. The period of time we can observe an individual varies with his eligibility date, and we chose a one-year cut-off point after eligibility in order to have a one-year observation period of retirement outcome for all who qualify during 1993 or 1994. The total take-up rate for the sample when using a one-year cut-off point is 30.8 per cent. After two years (for those observed that long) the take-up rate is 40.6 per cent.

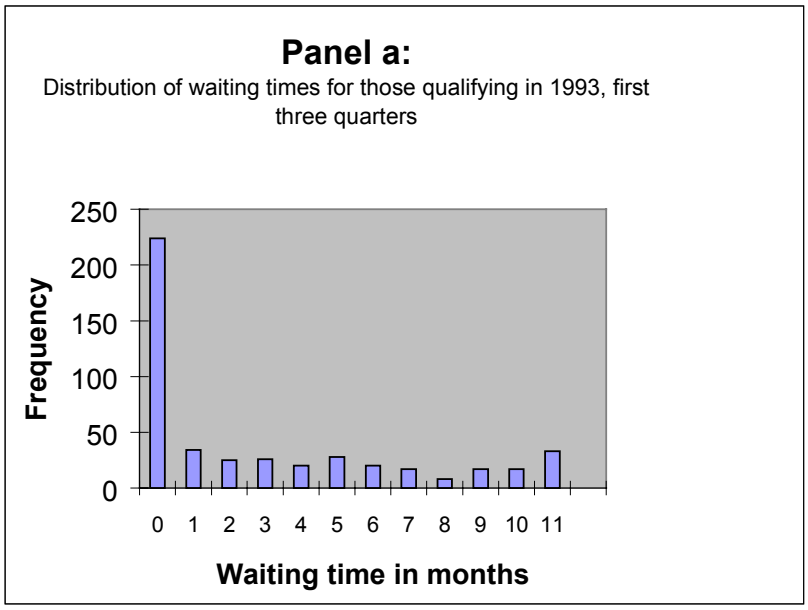
In panel A we note a rather sharp fall in take-up after the first month. The pattern in panel B is much less clear, probably because a rather "untidy" cohort then were thrust into eligibility. Due to reduction in the age limit from 65 to 64 taking effect 1 October 1993, a whole cohort became eligible on 1 October 1993. It may well be that people plan retirement a long time ahead, and will not immediately react when becoming eligible one year before they had initially planned. As time goes by, plans are adjusted and the effects diminish. There is also a spike after one year (not shown in Figure A.1, which only cover the observation period), much more markedly after the lowering of the retirement age 1 October 1993 and remaining throughout 1994. Part of the reason for this may be that for individuals who are in the public sector and who qualify for the more generous public pension type, the public pension does not start before age 65. If they take out early retirement from age 64, they therefore receive pension of the private type until they turn 65, at which age they begin to receive public pension. Thus, retiring at 64 (possible from 1 October 1993) means

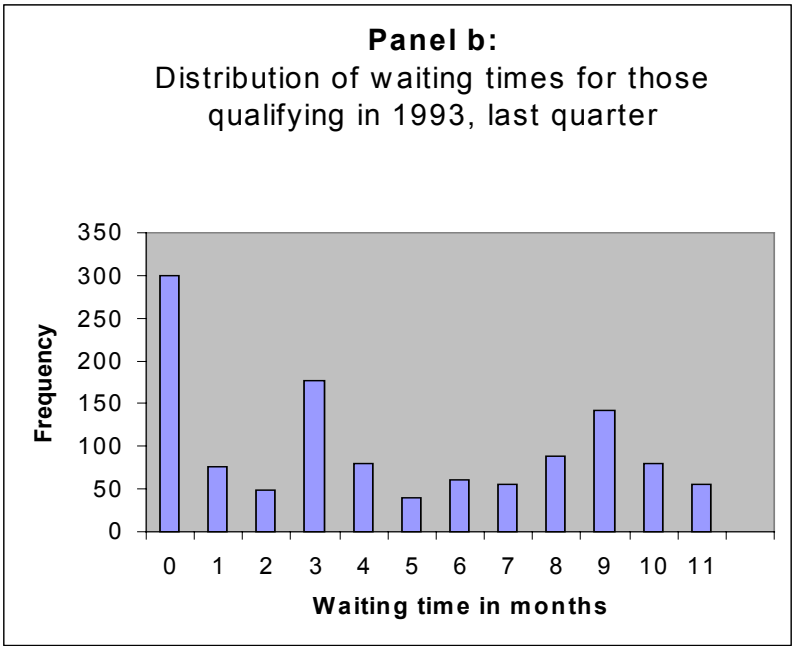
they will have to endure a sharper dip in 'income the first year of their retirement', then would be the case if they waited one year. Factors such as liquidity constraints and myopia may combine to make this problematic.

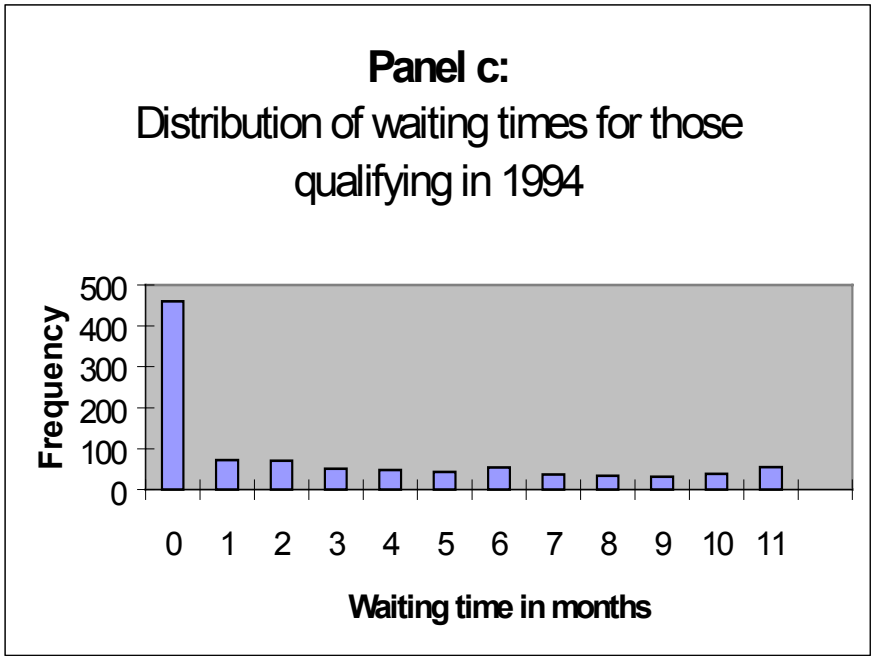
Although the one-year spike is much sharper among public employees after 1 October 1993, there is a spike also among private employees. This may be because our procedure for the classification of companies into private and public is imperfect, but it may also be that this is a compound phenomenon.

The spike also occurs among those qualifying during 1993, at age 65, indicating that also a "birthday effect" will be in operation. Some individuals may use special occasions such as their birthday or the coming of a new year as an occasion for implementing major, planned changes, perhaps as a personal strategy against procrastination or as a way of making an already special day take on added significance.

Figure A.1. Distribution of Waiting Times Between Eligibility and Start of AFP







Retirement Alternatives and Combination with Work

For two major reasons, we assume that people who are in the period of their working life that we are studying here, do not consider major changes in job or hours worked other than those related to retirement. First, there are transaction costs, like training, attached to a change of job. Secondly, the labour supply literature amply demonstrates

that there are indeed not always jobs with a continuum of working hours available, and that people are rationed with respect to offered hours in the market, see Aaberge et al (1999). The changes related to retirement occur to a large extent because a previously unavailable option has become available, and we assume that other changes in job or earnings than these we will not occur. Hence, we assume that persons will choose among a set of discrete alternatives. Figures A.2 and A.3 below show changes in average income before and after AFP eligibility, for those who take AFP and those who do not. As within-year dates for income are unreliable, we have chosen calendar year as the time unit.

Figure A.2. Mean couple income by source for couples where husband took up early retirement within one year of becoming eligible

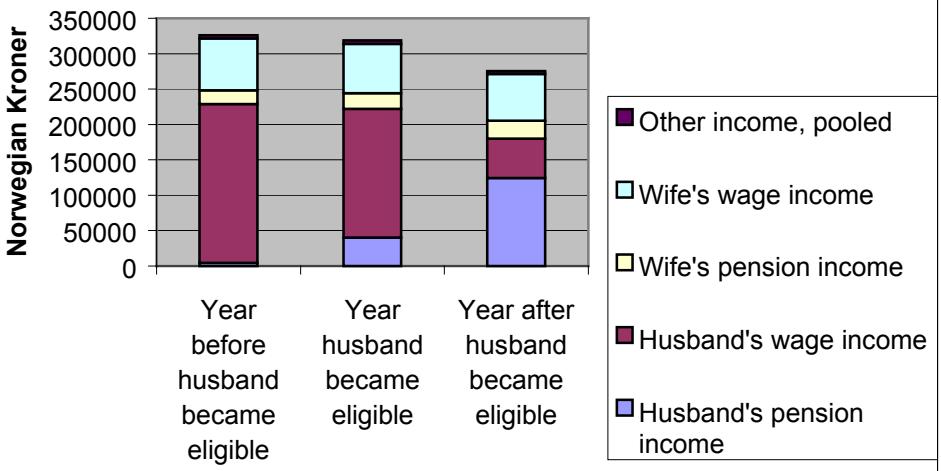
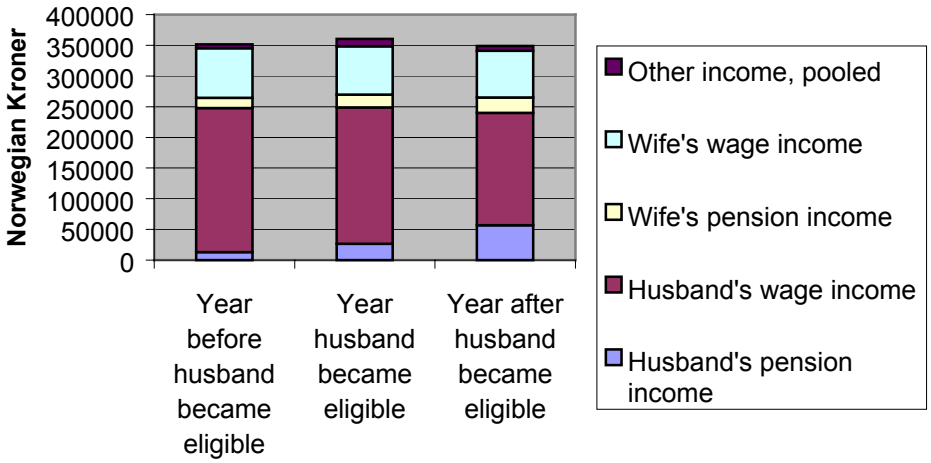


Figure A.3. Mean couple income by source for couples where husband did not take up early retirement within one year of becoming eligible



As expected, average income does not change much if the husband does not retire. If he does retire, his pension does not compensate for the fall in earnings, and the couples' total income falls. The wife's average earnings are largely unaffected.

Destination States and Economic Attributes in the Alternatives

Based on the sharp drop in AFP take-up after the first months, we have chosen to split retirement into immediate and delayed retirement. We also include a state for part-time work. The destination states for those who qualify are set out in Table A.1 below, which include also the principles for pre-tax economic characterisation of the states. The procedures for calculating after-tax income ('consumption') are described in the final section.

Table A.1 Destination States for Eligible Males

Destination state	Classification principles for destination state		Principles for pre-tax potential income over next 12 months	Frequency observed in our sample
	Waiting time between eligibility and start of AFP	Weekly hours worked in the job held in the year eligibility occurs		
1. Full-time work	More than 12 months (including no AFP)	30 or more	Predicted earnings, see below	5358
2. Part-time work	More than 12 months (including no AFP)	4-29 (in the job held in the year eligibility occurs)	Predicted earnings, see below	635
3. Delayed retirement	2-12 months	-	6 months earnings (see below) followed by 6 months pension	1500
4. Immediate retirement	0-1 months	-	Predicted pension (see below)	1170

Table A.2 Destination States for Wives of Eligible Males

Destination state	Classification principles for destination state	Principles for pre-tax potential income over next 12 months	Frequency observed in our sample
	Weekly hours worked		
1. Full-time work	30 or more (in the job held in the year eligibility occurs	Predicted earnings, see below	1934
2. Part-time work	4-29 (in the job held in the year eligibility occurs)	Predicted earnings, see below	2659
5. Out of labour force		Benefits	4070

Full-time Work and Part-time Work

There are two alternatives for predicting potential earnings in the two states part-time and full-time work

1. Use observed earnings last calendar year, and increase or reduce proportionally to obtain potential full-time earnings for part-timers and vice versa
2. Predict on the basis of an earnings function estimated on observed earnings last year.

In the first alternative we assume that if people continue to work at the same level without taking out any pension, they earn as much as they did last year, and if they move to part-time from full-time or the other way round, they face proportional increases/reductions.

In the second alternative, we remove transitory fluctuations and measurement errors in earnings, but also permanent individual variation apart from what is captured by covariates like education, gender, industry, weekly hours group. If permanent individual variation is more important than measurement errors and transitory fluctuations, alternative 1 is best. In this version, alternative 1 was chosen, with the exception of estimating the potential earnings of females who were observed to be out of the labour force.

Gross annual labour income, r, if working full-time or part-time is predicted from the estimated annual income function given below:

$$\ln r = X\lambda + \tau$$

where τ is a normal distributed error term. The covariates entering the X-vector are:

1) Working full time=1, Working part-time=0,
2) Age,
3) Education, with 15 years of education or more as a reference category, otherwise three categories: less than 8 years of education, less than 10 years of education, less than 15 years of education,
4) Working in private sector=1, =0 otherwise,
5) Number of years before the observation period with less than full-time work.

Immediate Retirement

Potential pension following eligibility is calculated according to rules applied to an earnings history. Details are given in Haugen (2000), see also Hernæs *et al.* (2000).

The pension level is calculated in several steps. We start by calculating potential public pension on the basis of accumulated rights, which are registered. Although this is only a part of the total pension rights it is strongly correlated with full pension. Also, since we assume that people may receive private or public pension according to the sector they work in the year they become eligible, we implicitly assume that those working in the public sector have done so for a period of time long enough for them to qualify for public pensions.

Delayed Retirement

Based on the observed take-up profile, we predict 6 more months of work and 6 months of retirement within the year we are modelling.

Out of Labour Force

Wife's income when she is out the labour force is either zero or equal to the capital income and/or government transfer allocated to her.

Tax rules

On average pension incomes are taxed at somewhat lower rates than labour income. The tax structure is progressive, but marginal tax rates are not uniformly increasing with income. Thus, the tax rules imply non-convex budget sets. In the estimation of the model all details of the tax structure are accounted for. A detailed description of the tax rules is given in Haugen (2000). As an illustration we show the tax rules for 1994.

Table A.3. Tax rules, 1994. All amounts in NOK 1000

Pensions		Earnings	
Income	Tax	Income	Tax
0-120	0	0-42	0
120-140	0.44Y-53	42-140	0.302Y-13
140-199	0.55Y-68	140-252	0.358Y-21
199-252	0.31Y-21		
252-263	0.405Y-44	252-263	0.453Y-45
263-	0.447Y-55	263-	0.495Y-56

We observe that the marginal tax rates on pensions are note uniformly increasing with income, which indicates that the budget is non-convex.