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RETIREMENT IN NON-COOPERATIVE AND COOPERATIVE FAMILIES*

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Abstract

Models that allow for non-cooperative as well as cooperative behavior of families are estimated on data from Norway in 1993 and 1994. The husband is eligible for early retirement while the wife is not. The models aim at explaining labor supply behavior of married couples the first twelve months after the husband became eligible for early retirement. Estimates and predictions derived from the different models are compared. Yet, no definite conclusion is reached with respect to what model is best at explaining the observed behavior. The models are employed to simulate the impacts on labor supply of taxing pension income the same way as labor income. We find that that this change of the tax system may reduce the propensity to retire early considerably.

JEL Classification: D10, H55, J26.

Keywords: Family labor supply, retirement, econometric models, policy simulations.

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1. Introduction

Empirical studies of retirement behavior in a household context are rare. In Zveimuller et al (1999) a bi-variate probit model is estimated on Austrian data. The probability for a married couple to retire is assumed to depend on Social Security characteristics of both spouses as well as on individual characteristics. 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 labor force. Eligibility, specified as a dummy, is included in the set of covariates. Other recent studies are Gustman and Steinmeier (2000), Blau (1997) Baker (1999), Hernæs and Strøm (2000). Lately, there have been retirement studies that explicitly model family behavior as the outcome of non-cooperative behavior, Hiedeman (1998) and Falkinger et al (1996).

In the present paper we specify a non-cooperative model and we follow Kooreman (1994) in calculating Nash and Stackelberg-equilibrium. In Kooreman (1994) linear reaction functions are derived from the utility function of the spouses, while in our model the utility functions as well as the reaction functions are non-linear functions of disposable income and leisure. Moreover, we also specify a model where the spouses have a joint utility function.

The statutory age of retirement in Norway is 67 years. However, in negotiations between the employers and employees associations in 1988, a voluntary and subsidized early retirement program (AFP) was introduced for the 66-year-old workers. Since then, the program has gradually been extended, and it now covers workers aged 62-66. For a worker to be eligible, two conditions have to be fulfilled. First, there are requirements with regard to the workers previous work experience (at least 10 years of work experience since the age of 50). Secondly, it is required that the firm in which the would-be retiree is employed is part of the of the central tariff agreements.

This early retirement program can be considered to approximate a natural experiment, and for three reasons. First, the introduction, and later expansion, of the program was not anticipated by the workers. Secondly, the eligibility rules require a long-term commitment to the firm (at least three years of work experience in the firm, or five years in an AFP-affiliated firm). Finally, the program gives the firms strong disincentives with hiring workers who are approaching the early retirement age.

The models are estimated on Norwegian data from 1992-1995. We restrict the sample to households where the husband is eligible to early retirement according to the early retirement program that was introduced in 1989. In contrast to the studies referred to above we observe the exact date of retirement and we also observe all details of the budgets sets, including pension benefits and taxes paid. The estimates of the different models are compared with respect to how well the different models predict observed labor market attachments. We conclude that the models give quite similar results, with a few but important exceptions. The models are also employed to simulate the impacts on the labor supply of the families of replacing the rather generous taxation of pension benefits with the taxation of earnings for all kinds of income. It is shown that this policy change has a strong and negative impact on the propensity to retire early.

In Section 2 we describe briefly the institutional setting in Norway. Section 3 presents the model and results are given in Section 4. Section 5 concludes.

2. Institutional settings and data

The institutional settings are described in detail in Hernæs et al (2000). Briefly summed up, an early retirement scheme (AFP) came into effect in Norway in 1989, as part of the national wage settlements of 1988. This program allows retirement before age 67, when ordinary old age pension can be received. The AFP age was 66 from 1 January 1989, 65 from 1 January 1990, 64 from 1 October 1993, 63 from October 1 1997 and 62 from March 1 1998.

The AFP program covers all government employees (of local and central government), and private sector employees of companies that have joined the program, in total about 60 per cent of the labor force. Participation is voluntary on the part of the company, but will usually be a part of the agreement with the union. Self-employed and private employees of companies not participating are not covered. There are also individual requirements for being eligible for AFP, as only those are eligible who

- 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 become 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.

Although the AFP program is a negotiated agreement, the benefits received are the same as in the ordinary old age pension system. Private employees receive an AFP pension equal to the ordinary public old age pension, based on their actual earnings history and a projection of earnings from AFP take-up and up to age 67. This pension is also the pension they will receive from age 67, so that there is no penalty on early retirement. A detailed explanation of the how this pension is calculated is given by Hernæs and Strøm (2000). It varies between 9 000 USD and 23 000 USD, (exchange rates early in 2001 at 8.7 NOK per USD). Income above 69 000 USD does not count towards the pension. The system is therefore strongly re-distributive.

The AFP pension for (local and central) government employees is the same as for private employees up to age 65, when it becomes equal to the old age pension for public sector employees. Over the observation period, this latter pension equaled about 2/3 of income up to 46 000 USD and 2/9 of income between 46 000 USD and 69 000 USD. The details can be found in Hernæs and Strøm (2000).

Pensions for private employees are financed partly by a state subsidy of 40 per cent from age 64 and partly by the employers. In some industries the company of the incumbent pays 10 per cent of the pension whereas the rest is paid from pooled contributions levied according to the wage sum of the company. In other industries the company of the incumbent pays directly. Pensions for government employees are paid directly by the government.

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 is awarded.

The empirical 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. Details about the data sources can be found in Hernæs and Strøm (2000).

For the present study, we used register files covering the entire population and spanning the period 1992-95. The data sets give detailed information on employment (including identification of the employer), earnings and benefits (also pension income) 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 not an option to combine work and pension.

The earnings history is available from 1967 in the form of on accrued rights in the public sector pension system, via year-by-year total pension-accruing income and pension points in the public pension system. This is the basis for predicting potential public pension. There is no identification of the income source, so we do not know whether the income gives right to other pensions than the public. Hence, there is no direct information on accrued rights in employer-based pensions in the private sector or private pensions, but these benefits are highly correlated with public pension benefits (Hernæs et al, 2000).

The sample used in this study consists of all married couples in which the husband qualified during 1993 and 1994 and in which the wife did not qualify. Since the observation period is 1992-1995, we have for all persons in the sample, a one-year period prior to eligibility to identify labor market history and a one-year period after eligibility to observe behavior. Administrative data provide information on current earnings and potential pension, as well as the exact date of eligibility and actual take-up date.

3. The models

3.1 The sample, the choice set and the economic attributes in the alternatives

In the present study, the husband is allowed to choose between working (state 0) and early retirement (state 1), whereas the wife can choose between working (state 0) and not working (state 1). As noted above the wife is not eligible for early retirement. Thus for her, "not working" does not include retirement.

Of the 5773 couples, 747 couples were observed in state (1,1), 1010 couples were observed in state (1,0), 1574 couples were observed in state (0,1) and 2442 couples were observed in state (0,0). Figure 3.1 shows the distribution of the couples over the states.

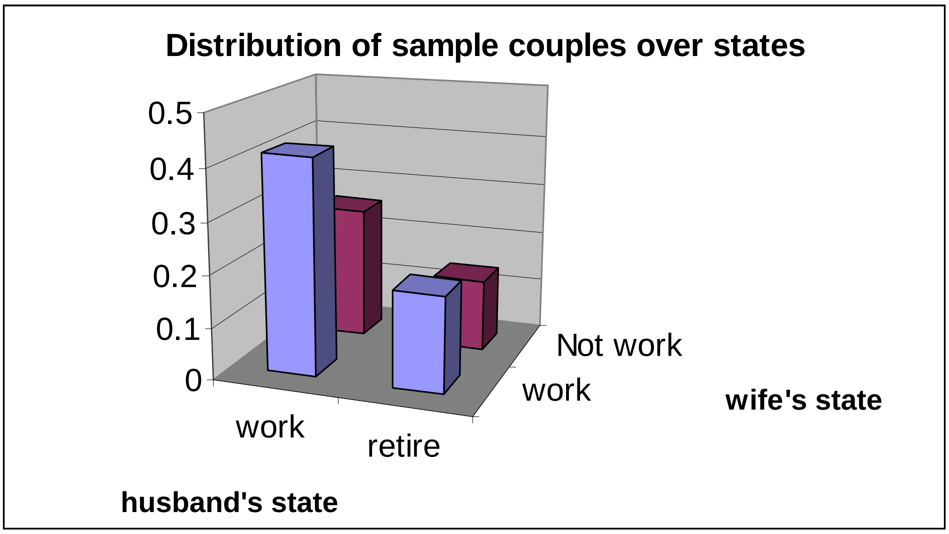

Figure 3.1 Distribution of sample couples over states

We assume that individuals, alternatively cooperative households, will select the opportunity set that yields highest utility in the sets of feasible opportunities. The attractiveness, or the utility, of an alternative is evaluated in terms of attribute values. These attribute values are disposable income and leisure.

Disposable income, C_{ij}, is equal to after-tax income when the husband is in state i and the wife is in state j. Thus $C_{ij} = r_{Mi} + r_{Fj} - T(r_{Mi}, r_{Fj})\ ; i, j = 0,1;$ where r_{Mi} is the gross income when husband is in state i , and r_{Fj} is the gross income when wife is in state j, and T(.) is the tax function. On average, pension income is taxed at somewhat lower rates than labor income. The unit of tax calculation is the couple, not the individual, which means that the taxes paid by the couple depends on both members' states of the household. The marginal tax rates are not uniformly increasing with income and therefore the tax rules imply non-convex budget sets. In the estimation of the model, all details of the tax structure are accounted for.

Leisure, L_k, k=F,M, is defined as one minus the ratio of hours of work to total annual hours. Thus, when the husband is retired or the wife is not working, L_k=1.

Because the individual can be observed in one state only, we can observe the gross income of the individual only in that state. In order to model different possible outcomes, we need to impute or simulate the gross income also in those states in which the individual is not observed. We have done the following:

- If the husband or the wife is observed working in the current period or in the year prior to the date of the husband's eligibility, then working are characterized by their observed earnings and leisure.
- If the wife is observed to be out of the labor force the current and the previous period, then working is characterized by predicted earnings based on a log earnings function estimated on earnings data among those women working full time. Leisure is predicted as leisure consistent with the working load related to the earnings that are assigned to the women. The estimated log earnings function is given in Appendix 2.
- For the husband, potential pension following eligibility is calculated according to rules applied to his earnings history. Details about pension rules are set out Appendix 2 and in Haugen (2000).

3.2 The game models: Separate utility functions for husband and wife

First, we assume that husband and wife has his/her own utility function. Second, we assume that they both benefit from total disposable income, but allow them to have different marginal utility of disposable income. Third, we assume that both parties know with certainty their own preferences as well as the preferences of their spouse. Finally, as econometricians we do not know the preferences of the household and thus we have to deal with random utilities.

We assume that the deterministic part of the utility function is a Box-Cox transformation of household consumption and the leisure of the spouses. The random variable is assumed to be extreme value distributed. We thus have

$$U_m(i,j) = \alpha_m \frac{C_{ij}^{\lambda}-1}{\lambda} + \beta_m \frac{L_{mi}^{\lambda}-1}{\lambda} + \varepsilon_{mij}$$

(1)

$$U_f(i,j) = \alpha_f \frac{C_{ij}^{\lambda}-1}{\lambda} + \beta_f \frac{L_{mi}^{\lambda}-1}{\lambda} + \varepsilon_{fij}$$

where,

- U_{kij} = utility of spouse k, the husband is in state i and the wife in state j; i,j=0,1 and k=m,f,
- Consumption C_{ij} and leisure L_{mi} and L_{fj} are defined above,
- $\beta_k = \beta_{k0} + \beta_{k1}Age_k + \kappa D_m$; k= m, f,
- D_m =1 if the husband worked in the private sector before retirement, =0 otherwise,
- ε_{kij} is an extreme value distributed random variable which may be correlated across spouses; k= m, f.

From the specification of the utility function we observe that the shape coefficient, λ, is assumed to be the same for both spouses, while all scale coefficients are allowed to vary.

Let y_k denote the decision variable for spouse k, k=m,f. y_k= 0 implies that spouse k works, and y_k=1 means that the spouse has retired /is out of the labor force. Thus, there will be a one-to-one correspondence between the variables in the utility function and these two decision variables. Consequently we can express the utility function in terms of these two variables.

Let $v_k(y_m,y_f)$ denote the non-random components of the utility functions of the spouses specified in (1). Furthermore, let y_m^* and y_f^* be the two reaction functions of the husband and wife, respectively. These two functions are defined in (2).

$$y_m^* = v_m(1,y_f) - v_m(0,y_f) + e_m, \text{ where } e_m = \varepsilon_m(1) - \varepsilon_m(0),$$

(2)

$$y_f^* = v_f(y_m,1) - v_m(y_m,0) + e_f, \text{ where } e_f = \varepsilon_f(1) - \varepsilon_f(0).$$

The decision of the spouse comes into the reaction function of the others. The problem becomes a simultaneous model with discrete endogenous variables (endogenous dummy variables):

$$(3)\qquad \begin{cases} y_m^* = v_m(1, y_f) - v_m(0, y_f) + e_m, \text{ where } e_m = \varepsilon_m(1) - \varepsilon_m(0), \\ y_f^* = v_f(y_m, 1) - v_m(y_m, 0) + e_f, \text{ where } e_f = \varepsilon_f(1) - \varepsilon_f(0). \\ y_i = 1 \text{ if } y_i^* > 0 \quad i = m, f \\ \ 0 \text{ otherwise} \end{cases}$$

e_m and e_f are logistic distributed with correlation ρ across spouses.

In general this model is very difficult to estimate (Heckman, 1978). However, by letting the decision variables, i.e. the endogenous dummy variables, be determined in a game between the two parties it is possible to estimate the model and to identify the parameters of the utility functions. We will employ the method used in Kooreman (1994) to describe the *equilibrium outcomes* of the different games. Kooreman analyses a labor supply model embedded in a game theoretic setting with linear reaction functions. Here we allow for non-linear reaction functions.

In the game discussed here, husband and wife can take one of two actions, working or not working. The pay-off is his/her utility function: $U_k(i,j)=v_k(i,j)+e_k$; k=m,f;i,j=0,1.

The deterministic part of the pay-off matrix is given in the table below.

	Wife		
Husband		Works, y_f=0	Home, y_f=1
	Works, y_m=0	$v_m(0,0)$, $v_f(0,0)$	$v_m(0,1)$, $v_f(0,1)$
	Retired, y_m=1	$v_m(1,0)$, $v_f(1,0)$	$v_m(1,1)$, $v_f(1,1)$

Nash Equilibrium

Each player is assumed to maximize his/her utility function, given the action of the other player. Both players then adjust their actions until their decisions are mutually consistent. Or mathematically, choice (*i,j*) is a Nash equilibrium (NE) if

$$U_m(i,j) > U_m(1-i,j) \quad and \quad U_f(i,j) > U_f(i,1-j) \quad i,j = 0,1$$

There may be situations with more than one NE or no NE at all.

So we make the following assumptions:

1. If there is only one NE, the household will choose it.
2. If there is more than one NE, we assume the household pick any one of them by random.
3. If there is no NE, we assume each available choice is chosen with equal probability.

As shown in Table A.1 in Appendix 1, we can specify the NE corresponding to each of the sixteen possible combinations. From this we can calculate the probability of the household choosing (*i,j; i,j =0,1*).

For example:

$$\begin{aligned}
\Pr(1,1) &= \Pr(e_m > (v_m(0,1) - v_m(1,1)) \;\wedge e_f > (v_f(1,0) - v_f(1,1))) \\
&-\frac{1}{2}\Pr((v_m(0,0) - v_m(1,0)) > e_m > (v_m(0,1) - v_m(1,1))\wedge(v_f(1,0) - v_f(1,1)) > e_f > (v_f(0,0) - v_f(0,1))) \\
&+\frac{1}{4}\Pr((v_m(0,0) - v_m(1,0)) > e_m > (v_m(0,1) - v_m(1,1))\wedge(v_f(1,0) - v_f(1,1)) > e_f > (v_f(0,0) - v_f(0,1))) \\
&+\frac{1}{4}\Pr((v_m(0,1) - v_m(1,1)) > e_m > (v_m(0,0) - v_m(1,0))\wedge(v_f(0,0) - v_f(0,1)) > e_f > (v_f(1,0) - v_f(1,1)))
\end{aligned}$$

And then the likelihood function follows.

Stackelberg Equilibrium

Instead of the symmetric Nash-game we can assume that the roles of husband and wife are asymmetric, i.e. one of them is assumed to be the leader, the other acts as a follower. Then we have a Stackelberg-Game. Here, we only consider the case of male leadership.

It is easy to see that Stackelberg equilibrium always exists and that it is unique. Table A.2 in Appendix 1 shows the probability of the couple choosing state (i,j). Similar to the case of Nash Equilibrium, we can construct the likelihood function.

Notice that neither Nash-Equilibrium nor Stackelberg-Equilibrium is generally Pareto optimal. Kooreman (1994) tried to estimate a model implying Pareto-optimality of observed outcomes. With a very simple structure, i.e. linear reaction functions, he was not able to get convergence. We have not tried to estimate a model that implies Pareto-optimality.

3.3 Joint utility for the couple; cooperative households

One possible way to account for cooperative behavior is to assume that the couple has one joint utility function. Or, equivalently family decisions are made in a cooperative setting. In this case we assume the following random utility function:

(4) $U(i,j)=v_{ij}+\varepsilon_{ij}$ for i,j=0,1;

where,

$$(5) \quad v_{ij} = \alpha \frac{C_{ij}^{\lambda} - 1}{\lambda} + \beta_m \frac{L_{mi}^{\lambda} - 1}{\lambda} + \beta_f \frac{L_{fj}^{\lambda} - 1}{\lambda}$$

As above $\beta_k = \beta_{k0} + \beta_{k1}Age_k + \kappa D_m$, k=m,f. ε_{ij} is an extreme value distributed random variable. The ε_{ij}'s are assumed to be IID (independent and identical distributed) across states and households with a location parameter η and a scale parameter σ.

Under the assumption of utility maximization, the probability that state (i,j) is chosen by the decision maker (household) is:

$$P(i,j) = \Pr(U(i,j) \geq U(k,s), \ \forall \ \ (k,s) \in (1,0)\times(1,0)) .$$

Then we have

$$(6) \quad P(i,j) = \frac{e^{\sigma w_{ij}}}{\sum_k \sum_s e^{\sigma w_{ks}}}; \ i,j = 1,0.$$

**

Notice that in all of the models presented above, in the game model as well as in the joint utility model, the shape parameter of the utility function, λ, is identified. The scale coefficients of the utility functions are not because σ are absorbed in these scale coefficients. In the Stackelberg version of the game models β_{mf} is identified but β_{fm} is not.

4. The estimations and policy simulation

The models are estimated by maximum likelihood. The estimation results for the game-theoretic models are given in Table 4.1.

Table 4.1 Estimates of Nash and Stackelberg Model

		Nash		Stackelberg (male leader)	
Coef	Variable	Estimate	t-value	Estimate	t-value
α_f	Consumption female	3.8644	18.6486	4.0315	19.3550
α_m	Consumption male	0.3919	2.6157	0.1879	0.9291
β_{f10}	Female leisure: Constant	-27.5672	-12.6423	-27.7172	-12.8015
β_{f11}	Female leisure: Linear in age	0.7141	21.1842	0.7102	21.2330
β_{m10}	Male leisure: Constant	42.4446	2.5165	43.5676	2.5662
β_{m11}	Male leisure: Linear in age	-0.7297	-2.7909	-0.7477	-2.8410
κ_m	Male sector parameter	3.2741	11.4202	3.3048	11.4604
β_{mf}	Female leisure in male utility	NA	NA	7.1733	1.8658
λ	Shape parameter	0.3779	7.5425	0.3229	6.3729
R	Proxy of correlation[3]	1.2953	19.5457	1.3177	20.0790
	Observations	5773		5773	
	Log-likelihood	-7025.42		-7014.63	

We observe that the estimates of these two game models are quite similar. According to the log-likelihood values they cannot be distinguished from each other.

The shape coefficient is estimated to be significantly below 1, which means that the utility function is quasi-concave. The estimate of λ is somewhat above 0.5, a value that has been suggested in psychophysical experiments, Stevens (1975). We note that the shape coefficient is significantly different from zero, which implies that the utility function is significantly different from a Cobb-Douglas utility function.

From the estimate of the deterministic part of the utility function we observe that

- the marginal utilities of disposable income is significantly different from zero in the Nash-game, but the male's marginal utility of disposable income is not significantly different from zero in the Stackelberg-game,

[3] The correlation ρ can be calculated from the formula: $\rho=3(R-1)/\pi^2$

- in both games the marginal utility of female leisure in the female's utility function is significantly positive for females aged 39 and above,
- in both games the marginal utility of male leisure in the male's utility function is positive for an age level below 63 if he works in the private sector, and 58 if he works in the public sector. Thus the propensity to retire early is clearly stronger for persons working in the private sector than for persons working in the public sector. This result may be due to the fact that many of the men who belong to the cohorts studied here and who have worked in the private sector, mainly in the manufacturing sector, may have had so strenuous working history that they retire at the earliest date.
- there is a significantly positive correlation of the unobserved variables in the utility functions of the spouses.

4.2 *Joint utility model*

The estimation results are given in Table 4.2

Table 4.2 Estimates of joint utility model

Coef	Variable	Estimate	t-value
α	Consumption	1.9638	13.3334
β_{f0}	Female leisure: Constant	-35.5618	-17.3890
β_{f1}	Female leisure: Linear in age	0.7179	21.0936
β_{mo}	Male leisure: Constant	76.3884	4.5531
β_{m1}	Male leisure: Linear in age	-1.2311	-4.7295
κ_m	Male sector parameter	3.9966	13.9558
λ	Shape parameter	0.3785	4.6216
	Observations	5773	
	Log-likelihood	-7140.10	

Again, the shape parameter is estimated to be significantly below 1, which means that the utility function is quasi-concave. We note that the shape parameter in the joint utility function is estimated to be the same as in the game models. We also note that a Cobb-Douglas structure of the utility function (λ=0) is strongly rejected.

The marginal utility of consumption is rather sharply determined and it is significantly different from zero. The marginal utility of leisure is positive for women aged 49 or more. The marginal utility of leisure for men working in the private sector (public sector) aged 64 (62) or more is negative. As in the game-models the propensity to retire early if working in the private sector is higher compared to men working in the public sector.

Judging from the value of the log-likelihood it is not possible to distinguish between the game models and the joint utility model.

4.3 *Observed versus predicted proportion*

Based on the estimates of the three models, we can calculate the average probability of choosing each state across the couples. Table 4.3 shows the observed proportions as well as the predicted average probabilities and average marginal probabilities.

Table 4.3 The observed proportions vs predicted probabilities

	Obs	Nash	Stackelberg (man leader)	Joint
State (1,1)	0.1294	0.1462	0.1547	0.1581
State (1,0)	0.1750	0.1748	0.1675	0.1657
State (0,1)	0.2727	0.3298	0.3162	0.3139
State (0,0)	0.4230	0.3492	0.3616	0.3623
Male retire	0.3044	0.3210	0.3222	0.3237
Male work	0.6957	0.6790	0.6778	0.6763
Female does not work	0.4021	0.4760	0.4710	0.4720
Female work	0.5980	0.5241	0.5290	0.5280

All three models are quite similar with respect to how well they predict the within-sample fractions. Of most interest here is the marginal probability of male retirement. We observe that 30.4% percent of the males have decided to retire at the eligibility date, while the three models predict that slightly more, around 32.1-32.3%, will retire early.

We notice that we predict the labour market situation of the wife less well than the labour market situation of the husband. This may be because for males we are modeling the adjustment right after a new option has become available. For the wife, we are modeling the labor market situation following from choices over a life-time. The economic incentives incorporated are primarily related to the current situation, and may therefore be insufficient to explain the wife's labor market situation.

Policy simulation

In order to illustrate the magnitude of the estimated relationship and the corresponding impact of potential policy changes, we have performed a policy simulation using the models. In the simulation, pension benefits are taxed the same way as labor earnings.

Table 4.4 below shows how the average choice probabilities (the approximation of the fractions) across the sample are affected by the policy changes and how the marginal probabilities across gender are affected.

Table 4.4 Choice Probabilities in policy simulations

	Nash		Stackelberg man leader		Joint	
	Model	Policy	Model	Policy	Model	Policy
State (1,1)	0.146	0.108	0.155	0.129	0.158	0.132
State (1,0)	0.175	0.147	0.168	0.179	0.166	0.173
State (0,1)	0.330	0.361	0.316	0.324	0.314	0.328
State (0,0)	0.349	0.384	0.362	0.368	0.362	0.367
Male retire	0.321	0.255	0.322	0.308	0.324	0.305
Male work	0.679	0.746	0.678	0.692	0.676	0.695
Female not work	0.476	0.469	0.471	0.454	0.472	0.461
Female work	0.524	0.531	0.529	0.546	0.528	0.539

As seen from Table 4.4, the tax system favors retirement. Therefore, making the taxation of pension benefits less generous, and equal to the taxation of labor income, reduces early retirement. We also observe that although the three models had almost the same prediction of within-sample frequencies, the Nash-game model and the joint utility model differ considerably with regard to the prediction of a change in policy rules. The Stackelberg- game model gives policy predictions in line with the joint utility model. Based on the Nash- game model the predicted reduction in the marginal probability of male retirement averages around 7 percentage points, while in the joint utility case the average reduction amounts to 2 percentage points.

These results indicate that the current tax system favors retirement and that a change in the tax rules may have a positive impact on male labor supply among those males who are eligible for early retirement.

In our simulations, female labor supply does not change much due to the shift in policy. If anything, a slight increase in labor supply is predicted. This is the same across models. Thus, the considered change in the taxation of pension incomes clearly increases labor supply among the elderly men eligible for early retirement, with a modest but positive impact on their wives' labor supply. Thus, the considered change in tax rules is a good policy candidate if one wants to counteract the negative effects on labor supply implied by the early retirement programs.

5. Conclusions

The paper makes a first attempt to compare game-theoretic and joint utility models of early retirement and labor force participation for married couples, using detailed Norwegian micro data. It is not straightforward to compare the estimates of the game model with the estimates of the joint utility function, but the estimates indicate that the marginal utility of leisure and the shape coefficient is rather similar across models. In all three models the shape parameter is found to be significantly different from 1 and from 0, the former means that the utility functions are quasi-concave and the latter implies that a Cobb-Douglas structure of the utility function is strongly rejected.

The three models do not differ to any great extent with regards to how within-sample fractions are predicted. However, they differ slightly more with respect to the prediction of choice probabilities generated by a change in taxation. All simulations indicate that the lenient taxation of pension income favors early retirement. Taxing pension income by the rules of earning reduces on average the marginal probability of male retirement by 2 percentage points in joint utility model and by as much as 7 percentage points in the Nash-game model. In all three models female labor supply is predicted to increase slightly.

It should be noted that the results in this paper are based only on observations of couples in which only the husband qualifies for early retirement. A topic for further research will be to estimate the models on observations of couples over a period in which both spouses qualify. The indication of a positive correlation in retirement behavior is found previous research, for instance Blau (1997) and Zweimüller (1996).

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Appendix 1. Nash and Stackelberg equilibrium

Table A.1 Nash equilibrium (NE)

	$U_m(1,1)-U_m(0,1)>0$ $U_m(1,0)-U_m(0,0)>0$	$U_m(1,1)-U_m(0,1)>0$ $U_m(1,0)-U_m(0,0)<0$	$U_m(1,1)-U_m(0,1)<0$ $U_m(1,0)-U_m(0,0)>0$	$U_m(1,1)-U_m(0,1)<0$ $U_m(1,0)-U_m(0,0)<0$
$U_f(1,1)-U_f(1,0)>0$ $U_f(0,1)-U_f(0,0)>0$	(1,1)	(1,1)	(0,1)	(0,1)
$U_f(1,1)-U_f(1,0)>0$ $U_f(0,1)-U_f(0,0)<0$	(1,1)	(1,1) or (0,0)	No pure NE	(0,0)
$U_f(1,1)-U_f(1,0)<0$ $U_f(0,1)-U_f(0,0)>0$	(1,0)	No pure NE	(1,0) or (0,1)	(0,1)
$U_f(1,1)-U_f(1,0)<0$ $U_f(0,1)-U_f(0,0)<0$	(1,0)	(0,0)	(1,0)	(0,0)

Table A.2 Stackelberg equlibrium (SE)

$y_f(1)=1$ $y_f(0)=1$	$e_f> \max[v_f(1,0)-v_f(1,1), v_f(0,0)-v_f(0,1)]$	$e_m>v_m(0,0)-v_m(1,0)$ $e_m<v_m(0,0)-v_m(1,0)$	(1,1) is SE (0,1) is SE
$y_f(1)=1$ $y_f(0)=0$	$v_f(0,0)-v_f(0,1) > e_f > v_f(1,0)-v_f(1,1)$	$e_m>v_m(0,0)-v_m(1,1)$ $e_m<v_m(0,0)-v_m(1,1)$	(1,1) is SE (0,0) is SE
$y_f(1)=0$ $y_f(0)=1$	$v_f(1,0)-v_f(1,1) < e_f < v_f(1,0)-v_f(1,1)$	$e_m>v_m(1,0)-v_m(0,1)$ $e_m<v_m(1,0)-v_m(0,1)$	(0,1) is SE (1,0) is SE
$y_f(1)=0$ $y_f(0)=0$	$e_f< \min[v_f(0,0)-v_f(0,1), v_f(0,1)-v_f(1,1)]$	$e_m>v_m(0,0)-v_m(1,0)$ $e_m<v_m(0,0)-v_m(1,0)$	(1,0) is SE (0,0) is SE

Appendix 2. Female earnings function

If the wife is observed to be out of the labor force the current and the previous period, then gross annual labour income, w , is predicted from the estimated annual income function given below:

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

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

1) Constant term ,
2) Age,
3) Education, with 15 years of education or more as a reference category, otherwise three categories: less than 7 years of education, less than 9 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 (DOWN).

The estimation result given in the following table:

Table A.4 Estimates of wage regression

		Estimate	Std.dev	t-value	Prob.
1)	C	12.3833	0.0587	211.0120	[.000]
2)	AGE	-0.0018	0.0010	-1.7650	[.078]
3)	LESS THAN 7YEARS	-0.3034	0.0164	-18.5053	[.000]
	LESS THAN 9 YEARS	-0.2111	0.0103	-20.5112	[.000]
	LESS THAN 15 YEARS	-0.1353	0.0158	-8.5536	[.000]
4)	PRIVATE SECTOR	0.0292	0.0093	3.1433	[.002]
5)	DOWN	0.0067	0.0015	4.5644	[.000]
	R square	30.5%			
	Adjusted R square	30.3%			