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.

Keywords: family labor supply, retirement, econometric models, policy simulations
JEL classification: D10, H55, J26

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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 et al (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 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 a 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 incomes 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 income 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) was introduced in 1989, in which persons who worked in companies participating (by now two thirds of the labor force) and meeting individual labor market requirements, were allowed to retire earlier than the statutory 67. There was no loss in pension, as pension rights accrual was projected to age 67 and made effective when early retirement was taken out. The age of eligibility has gradually been reduced, by now it is 62. Pension and taxation rules are described in Appendix 2.

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. 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. Data are described in more detail in Appendix 3.
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 5529 couples, 770 couples were observed in state (1,1), 1024 couples were observed in state (1,0), 1428 couples were observed in state (0,1) and 2307 couples were observed in state (0,0). Figure 3.1 shows the distribution of the couples over the states.

![Distribution of sample couples over states](image)

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. In estimating these earnings function we account for possible selection bias. Leisure is predicted as the observed leisure related to full time work.
- 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
\[ U_m(i,j) = \alpha_m \frac{C_{ij}^\lambda - 1}{\lambda} + \beta_m \frac{L_{mi}^\lambda - 1}{\lambda} + \kappa_m y_m D + \epsilon_{mij}; \]

\[ U_f(i,j) = \alpha_f \frac{C_{ij}^\lambda - 1}{\lambda} + \beta_f \frac{L_{fj}^\lambda - 1}{\lambda} + \epsilon_{fij} \]

where,

- \( U_{kij} \) = utility of spouse \( k \), the husband is in state \( i \) and the wife is in state \( j \); \( i,j=0,1 \) and \( k=m,f \),
- Consumption \( C_{ij} \) and leisure \( L_{mi} \) and \( L_{fj} \) are defined above,
- \( \beta_k = \beta_{k0} + \beta_{k1} \text{Age}_k \), \( k=m,f \),
- \( \epsilon_{kij} \) is an extreme value distributed random variable,
- \( D=1 \) if the husband worked in the private sector before retirement, \( =0 \) otherwise.

From the specification of the utility function we observe that the shape coefficient, \( \lambda \), 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).

\[ y^*_m = v_m(1,y_f) - v_m(0,y_f) + \epsilon_m, \text{ where } \epsilon_m = \epsilon_m(1) - \epsilon_m(0), \]

\[ y^*_f = v_f(y_m,1) - v_f(y_m,0) + \epsilon_f, \text{ where } \epsilon_f = \epsilon_f(1) - \epsilon_f(0). \]

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).

\[ y^*_m = v_m(1,y_f) - v_m(0,y_f) + \epsilon_m, \text{ where } \epsilon_m = \epsilon_m(1) - \epsilon_m(0), \]

\[ y^*_f = v_f(y_m,1) - v_f(y_m,0) + \epsilon_f, \text{ where } \epsilon_f = \epsilon_f(1) - \epsilon_f(0). \]

\[ y^*_i = 1 \text{ if } y^*_i > 0 \quad i = m,f \]

\[ 0 \text{ otherwise} \]
\(e_m\) and \(e_f\) are logistic distributed with correlation \(\rho\) 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 \textit{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.

<table>
<thead>
<tr>
<th>Husband</th>
<th>Wife</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Works, (y_f=0)</td>
</tr>
<tr>
<td>Works, (y_m=0)</td>
<td>(v_m(0,0), v_f(0,0))</td>
</tr>
<tr>
<td>Retired, (y_m=1)</td>
<td>(v_m(1,0), v_f(1,0))</td>
</tr>
</tbody>
</table>

\textit{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

\[
U_m(i, j) > U_m(1-i, j) \quad \text{and} \quad U_f(i, j) > U_f(1-i, 1-j) \quad i, j = 0,1
\]

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 \((i,j; \quad i,j = 0,1)\).

For example:

\[
\begin{align*}
Pr(1,1) &= Pr(e_m > (v_m(0,1) - v_m(1,1)) \land e_f > (v_f(1,0) - v_f(1,1))) \\
-\frac{1}{2} Pr((v_m(0,0) - v_m(1,0)) > e_m > (v_m(0,1) - v_m(1,1))^4(v_f(1,0) - v_f(1,1)) > e_f > (v_f(0,0) - v_f(0,1))) \\
+\frac{1}{4} Pr((v_m(0,0) - v_m(1,0)) > e_m > (v_m(0,1) - v_m(1,1))^4(v_f(1,0) - v_f(1,1)) > e_f > (v_f(0,0) - v_f(0,1))) \\
+\frac{1}{4} Pr((v_m(0,1) - v_m(1,1)) > e_m > (v_m(0,0) - v_m(1,0))^4(v_f(0,0) - v_f(0,1)) > e_f > (v_f(1,0) - v_f(1,1)))
\end{align*}
\]

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:

\[(3) \quad U(i,j) = v_{ij} + e_{ij} \text{ for } i,j=0,1;\]

where,

\[(4) \quad v_{ij} = \frac{\alpha C_{ij} - 1}{\lambda} + \beta_1 \frac{L_{mi} - 1}{\lambda} + \beta_2 \frac{L_{mj} - 1}{\lambda}\]
\( \epsilon_{ij} \) is an extreme value distributed random variable. The \( \epsilon_{ij} \)'s are assumed to be IID (independent and identical distributed) across states and households with a location parameter \( \eta \) and a scale parameter \( \sigma \).

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

\[
P(i, j) = \frac{e^{\sigma_{W_{ij}}}}{\sum_{k} \sum_{s} e^{\sigma_{W_{ks}}}}; i, j = 1,0.
\]

**

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, \( \lambda \), is identified. The scale coefficients of the utility functions are not because \( \sigma \) are absorbed in these scale coefficients. In the Stackelberg version of the game models \( \beta_{mf} \) is identified but \( \beta_{fm} \) 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>
<thead>
<tr>
<th>Coef</th>
<th>Variable</th>
<th>Nash</th>
<th>t-value</th>
<th>Stackelberg (male leader)</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_f$</td>
<td>Consumption female</td>
<td>6.7240</td>
<td>29.5484</td>
<td>6.7441</td>
<td>28.4669</td>
</tr>
<tr>
<td>$\alpha_m$</td>
<td>Consumption male</td>
<td>1.5628</td>
<td>13.9742</td>
<td>1.5749</td>
<td>11.3234</td>
</tr>
<tr>
<td>$\beta_{f0}$</td>
<td>Female leisure: Constant</td>
<td>-6.3922</td>
<td>-2.5266</td>
<td>-6.4952</td>
<td>-2.5690</td>
</tr>
<tr>
<td>$\beta_{f1}$</td>
<td>Female leisure: Linear in age</td>
<td>0.6687</td>
<td>16.7239</td>
<td>0.6662</td>
<td>16.6602</td>
</tr>
<tr>
<td>$\beta_{m0}$</td>
<td>Male leisure: Constant</td>
<td>79.5999</td>
<td>4.3505</td>
<td>80.4955</td>
<td>4.3963</td>
</tr>
<tr>
<td>$\beta_{m1}$</td>
<td>Male leisure: Linear in age</td>
<td>-1.2758</td>
<td>-4.4960</td>
<td>-1.2899</td>
<td>-4.5426</td>
</tr>
<tr>
<td>$\beta_{mf}$</td>
<td>Female leisure in male utility</td>
<td>NA</td>
<td>NA</td>
<td>9.1758</td>
<td>2.8198</td>
</tr>
<tr>
<td>$\kappa_m$</td>
<td>Male sector parameter</td>
<td>0.6952</td>
<td>11.8682</td>
<td>0.6942</td>
<td>11.7800</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>Shape parameter</td>
<td>0.7520</td>
<td>32.3518</td>
<td>0.7412</td>
<td>30.7543</td>
</tr>
<tr>
<td>$R$</td>
<td>Proxy of correlation$^1$</td>
<td>0.9707</td>
<td>13.2717</td>
<td>0.9771</td>
<td>13.4117</td>
</tr>
<tr>
<td></td>
<td>Observations</td>
<td>5529.</td>
<td>5529.</td>
<td>5529.</td>
<td>5529.</td>
</tr>
<tr>
<td></td>
<td>Log-likelihood</td>
<td>-6129.15</td>
<td>-6124.91</td>
<td>-6129.15</td>
<td>-6124.91</td>
</tr>
</tbody>
</table>

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 $\lambda$ is somewhat above 0.5, a value that has been suggested in psychophysical experiments, Stevens (1976). 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.

$^1$ The correlation $\rho$ can be calculated from the formula: $\rho = \frac{3(R-1)}{\pi^2}$. 
From the estimate of the deterministic part of the utility function we observe that.

- the marginal utility of disposable income is rather sharply determined, it is significantly different from zero, and I decreases with the level of disposable income
- the marginal utility of female leisure in the female’s utility function is significantly positive for all age levels of the female,
- the marginal utility of male leisure in the male’s utility function is positive for an age level below 63,
- 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 in the public sector the pension gets higher when the person reaches the age of 65. Until age 65 also government employees follow private sector rules, which usually give a lower pension than the government pension they receive from age 65. Thus a person working in the public sector will avoid a sharp dip in disposable income by postponing retirement to the age of 65 (one year). In addition, a yearly early retirement lump is not received from 65 by government employees who take out early retirement before age 65 (this is indeed a strange rule). Moreover, 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. The latter may interact with the leisure term in the male’s utility function and thus affect how the male’s marginal utility of leisure varies with age.

We observe that we do not find any significant 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>
<thead>
<tr>
<th>Coef</th>
<th>Variable</th>
<th>Estimate</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>Consumption</td>
<td>3.1782</td>
<td>25.7016</td>
</tr>
<tr>
<td>$\beta_{f0}$</td>
<td>Female leisure: Constant</td>
<td>-24.3317</td>
<td>-10.2826</td>
</tr>
<tr>
<td>$\beta_{fi}$</td>
<td>Female leisure: Linear in age</td>
<td>0.6900</td>
<td>17.5654</td>
</tr>
<tr>
<td>$\beta_{mo}$</td>
<td>Male leisure: Constant</td>
<td>141.6500</td>
<td>7.6685</td>
</tr>
<tr>
<td>$\beta_{mi}$</td>
<td>Male leisure: Linear in age</td>
<td>-2.2034</td>
<td>-7.6864</td>
</tr>
<tr>
<td>$\kappa_m$</td>
<td>Male sector parameter</td>
<td>0.8015</td>
<td>13.7639</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>Shape parameter</td>
<td>0.8509</td>
<td>20.5515</td>
</tr>
<tr>
<td></td>
<td>Observations</td>
<td>5529</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Log-likelihood</td>
<td>-6374.56</td>
<td></td>
</tr>
</tbody>
</table>

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 slightly above the shape parameter of the game models. We also note that a Cobb-Douglas structure of the utility function ($\lambda=0$) is strongly rejected.

As in the game models 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 34 or more. The marginal utility of leisure for men aged 64 or more is negative, but as in the previous model the propensity to retire early if working in the private sector is quite strong and may interact with the leisure term.

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

<table>
<thead>
<tr>
<th></th>
<th>Obs</th>
<th>Nash</th>
<th>Stackelberg (man leader)</th>
<th>Joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>State (1,1)</td>
<td>0.1393</td>
<td>0.1602</td>
<td>0.1601</td>
<td>0.1655</td>
</tr>
<tr>
<td>State (1,0)</td>
<td>0.1852</td>
<td>0.1829</td>
<td>0.1831</td>
<td>0.1806</td>
</tr>
<tr>
<td>State (0,1)</td>
<td>0.2583</td>
<td>0.2947</td>
<td>0.2948</td>
<td>0.2970</td>
</tr>
<tr>
<td>State (0,0)</td>
<td>0.4173</td>
<td>0.3622</td>
<td>0.3620</td>
<td>0.3569</td>
</tr>
<tr>
<td>Male retire</td>
<td>0.32448</td>
<td>0.3431</td>
<td>0.3432</td>
<td>0.3461</td>
</tr>
<tr>
<td>Male work</td>
<td>0.67552</td>
<td>0.6569</td>
<td>0.6568</td>
<td>0.6539</td>
</tr>
<tr>
<td>Female does not work</td>
<td>0.39754</td>
<td>0.4549</td>
<td>0.4550</td>
<td>0.4625</td>
</tr>
<tr>
<td>Female work</td>
<td>0.60246</td>
<td>0.5451</td>
<td>0.5450</td>
<td>0.5375</td>
</tr>
</tbody>
</table>

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 32.5% percent of the males have decided to retire at the eligibility date, while the three models predict that slightly more, around 34.3-34.6%, will retire early.
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, pensions 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

<table>
<thead>
<tr>
<th></th>
<th>Nash Model</th>
<th>Policy</th>
<th>Stackelberg man leader</th>
<th>Joint Model</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>State (1,1)</td>
<td>0.160</td>
<td>0.138</td>
<td>0.160</td>
<td>0.165</td>
<td>0.125</td>
</tr>
<tr>
<td>State (1,0)</td>
<td>0.183</td>
<td>0.156</td>
<td>0.183</td>
<td>0.181</td>
<td>0.129</td>
</tr>
<tr>
<td>State (0,1)</td>
<td>0.295</td>
<td>0.315</td>
<td>0.295</td>
<td>0.297</td>
<td>0.336</td>
</tr>
<tr>
<td>State (0,0)</td>
<td>0.362</td>
<td>0.391</td>
<td>0.362</td>
<td>0.356</td>
<td>0.401</td>
</tr>
<tr>
<td>Male retire</td>
<td>0.343</td>
<td>0.294</td>
<td>0.343</td>
<td>0.346</td>
<td>0.254</td>
</tr>
<tr>
<td>Male work</td>
<td>0.657</td>
<td>0.706</td>
<td>0.657</td>
<td>0.654</td>
<td>0.746</td>
</tr>
<tr>
<td>Female not work</td>
<td>0.455</td>
<td>0.453</td>
<td>0.455</td>
<td>0.463</td>
<td>0.461</td>
</tr>
<tr>
<td>Female work</td>
<td>0.545</td>
<td>0.547</td>
<td>0.545</td>
<td>0.537</td>
<td>0.539</td>
</tr>
</tbody>
</table>

As seen from Table 4.4, the tax system strongly favors retirement, as Making the taxation of pensions less generous and equal to the taxation of labor income therefore reduces early retirement substantially. We also observe that although the three models had almost the same prediction of within-sample frequencies, the game models and the joint utility model differ considerably with regard to the prediction of a change in policy rules. Based on the game models the predicted reduction in the marginal probability of male retirement averages around 5 percentage points, while in the joint utility case the average reduction amounts to as much as nearly 10 percentage points.

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

In our simulations, female labor supply is nearly unaffected by the policy change. This is the same across models. Thus, the considered change in the taxation of pension incomes clearly increases labor supply among the elderly men, without affecting their wives’ labor
supply, and is thus 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. Estimates of the utility functions following from Nash equilibrium differ very little from the estimates derived from a Stackelberg game with husband as the leader. 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 is rather similar across models. Estimates also indicate that the marginal utility of consumption decreases slightly more with consumption in the game models compared to in the joint utility case. This latter result may explain why the joint utility model is more sensitive to changes in disposable income than the game 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.

Although the three models do not differ with regards to how within-sample fractions are predicted, they differ considerably with respect to the prediction of choice probabilities generated by a change in taxation. All simulations indicate that the lenient taxation of pension income strongly favors early retirement. Taxing pension income by the rules of earning reduces on average the marginal probability of male retirement by 5 percentage points in the game models and by as much as 10 percentage points in the joint utility model. In all three models female labor supply is not affected by this policy change.

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 in line with previous research, for instance Blau (1997) and Zweimüller (1996).
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(Appendices to be inserted in a later version)