Family Labor Supply and Proposed Tax Reforms in the Netherlands[1]

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Abstract

This paper presents a discrete choice static neo-classical labor supply model for married or cohabiting couples in the Netherlands. The model simultaneously explains the participation decision and the desired number of hours worked. Due to its discrete nature, institutional details of the tax system can be fully incorporated. The model is estimated using Dutch cross-section data. The results are used to simulate the first order labor supply effects of several proposed reforms of the Dutch income tax system. In particular, it is shown that some of the proposed reforms would have a negative effect on the number of married females who prefer a small part-time job. This pitfall is avoided in the proposal that has gone to Parliament.

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1. Introduction

This paper aims at analyzing the effects of the proposed reform of the income tax rules in the Netherlands on labor supply of married or cohabiting couples. Static neo-classical models of labor supply which can be used to analyze tax reforms have been used by, for example, Hausman (1985), Hausman and Ruud (1984) and Moffitt (1986, 1990a). These models are fully structural, in the sense that they completely identify preferences of leisure versus consumption. They allow, in principle, for an analysis of the effects on labor supply of any permanent change in the tax rules. Moreover, participation and hours worked are jointly treated as the outcome of the same utility maximization problem. This means that the effects on participation and the effects on hours worked can be jointly analyzed. This makes these models a useful tool for policy analysis - in spite of apparent drawbacks such as their static nature.[1]

In the traditional Hausman (1985) model for individual labor supply, and in the labor supply model for married couples in Hausman and Ruud (1984), the budget set is piece-wise linear and convex. The utility maximization problem can be solved from the first order conditions using Lagrange multipliers. Using the dual approach, the empirical models in these articles use an explicit expression for the labor supply function and the indirect utility function. An easy algorithm to find the solution is available, which is guaranteed to converge if preferences are quasi-concave (see Blomquist, 1983). This approach has been applied fruitfully to analyze labor supply in many countries. See, for example, all six studies in Moffitt (1990b). Still, it has some drawbacks. First, solving the model becomes substantially more complicated if the budget set is not convex or piece-wise linear. In practice, this is an important limitation, due to, for example, fixed costs, benefits, tax allowances depending on whether the partner works or not, thresholds in social security premiums, etc. To account for non-convexities, either a restrictive functional form has to be used which allows for explicit expressions for both the direct and the indirect utility function, or *ad hoc* features are added to the model, for example explaining the choice between working and not working.

Second, quasi-concavity of preferences has to be imposed *a priori*. Together with

[1] See Blundell (1994) and Card (1994) for surveys of labour supply models in a dynamic (life cycle) context, and Heckman (1993) for a critical discussion of the state of this art.

functional form assumptions on the utility function, this implies that prior restrictions are imposed. For restrictive functional forms (such as a linear labor supply curve) this may mean that elasticities are to a large extent driven by these assumptions, instead of being the outcome of the estimations. See the discussion in MaCurdy et al. (1990).

These drawbacks can be overcome by approximating the choice set by a finite subset of its points. For example, the assumption that an individual can choose any number of working hours on the interval [0,80] (with corresponding net incomes), can be replaced by the assumption that the individual can only choose from {0,4,8,12,...,80} (with corresponding net incomes). The choice set then consists of 21 points instead of a continuum of points. The utility maximum can be obtained by comparing the 21 values of the (direct) utility function. This simply boils down to finding the maximum of 21 values. It does not require first order conditions, etc., and it does not rely on convexity or piece-wise linearity of the budget set or quasi-concavity of preferences. Models for individual labor supply with discrete choice sets have been used by, for example, Dickens and Lundberg (1993), Tummers and Woittiez (1991), and van Soest et al. (1990).

A discrete choice labor supply model for couples, with a stochastic specification similar to that of a multinomial logit model, has been introduced by van Soest (1995). Further refinements of this model, for example allowing for fixed costs of working, and using information on actual as well as desired hours of work, have been introduced in some subsequent papers, see for example Callan and van Soest (1996) and Euwals and van Soest (1999).

This discrete choice framework with multinomial logit type errors is also the basis of the current paper. We assume that the two spouses have a common utility function. We use a direct quadratic translog utility function, with arguments family income, leisure of the husband, and leisure of the wife. We allow for preference variation across households. This is achieved by making several parameters of the utility function dependent on characteristics such as age and family composition. We include separate error terms in the values of the utility function at all points of the choice set, with the same specification as in the multinomial logit model.

To explain why there are relatively few people with a part-time job, we incorporate fixed costs of work. These fixed costs are again allowed to depend upon observed and unobserved characteristics of the family and its members. We allow for different fixed costs functions for husbands and wives. The fixed costs are fully integrated in the structural model:

they are subtracted from family income of workers, and thus enter the utility function through income. Increasing fixed costs will lower the income if working, and will thus make not working relatively more attractive compared to working - assuming that utility increases with income.

We assume that before tax hourly wage rates do not vary with hours worked. This assumption is maintained in most of the neo-classical labor supply models, though there are exceptions, such as Moffitt (1984), Tummers and Woittiez (1991), and Ilmakunnas and Pudney (1990). Thus each individual has a unique before tax wage rate. Together with hours worked and the tax system, the before tax wage rate determines net earnings. A common problem in labor supply models with non-workers is that wage rates of non-workers are not observed. To account for this, a wage equation is estimated, and wage predictions are constructed for non-workers. Due to the non-linear nature of the labor supply model, however, replacing wage rates by their predictions leads to inconsistent estimates, even if the wage predictions themselves are unbiased. To account for this, wage rate prediction errors are explicitly incorporated in the model, as additional unobserved error terms.

The labor supply model is based upon the assumption that individuals or couples maximize (joint) utility, and thus aims at estimating preferences of those who supply labor. It is therefore estimated using information on desired hours of work, so that deviations between desired and actual hours of work - due to, for example, involuntary unemployment or a lack of part-time jobs - are allowed for.

The model is estimated with data from the 1995 wave of the Netherlands' Socio-Economic Panel, which, at least for our purposes, is representative for the Dutch population. To account for the various unobserved error terms, the model is estimated with smooth simulated maximum likelihood: the likelihood function is replaced by an approximation based upon simulation, and the simulated approximation of the likelihood is maximized. The estimator is asymptotically equivalent to exact maximum likelihood.

The results are used to set up a micro-simulation model for analyzing the sensitivity of labor supply for financial incentives. First, participation rates and average hours worked are computed on the basis of the estimates and the actual wages and tax rules. Second, the simulation is repeated for different alternative scenarios. Increasing all wage rates of husbands or wives by the same percentage leads to estimates of own and cross wage elasticities of both spouses. The focus of the simulations is the analysis of labor supply effects of changing the income tax rules. Proposals for substantial revisions of the tax system,

including detailed plans for changing the income tax rules, have recently been published by the Dutch government (Ministry of Finance, 1997). These plans have played a major role in the recent policy debate at the time of the general elections of 1998. Currently, a revised and more specific version of these plans is proposed by the government (Ministry of Finance, 1999). The proposals suggest, for example, to change tax free allowances and marginal tax rates in such a way that the income difference between working and not working would increase. This should help to stimulate participation and improve the working of the labor market. Moreover, several measures have been proposed which change the tax treatment of two earner versus one earner families. For women whose husband works full-time, the current system creates a disincentive to work part-time or full-time, and thus it stimulates non-participation of married females. On the other hand, due to special treatment of married women who earn less than about one third of the annual minimum wage for a full-time job, the current system does not create a disincentive for married women to work only a few hours per week.

This feature is not shared by the original reform proposals, which therefore makes small part-time jobs less attractive. Our discrete choice framework is particularly convenient to analyze the effects of this type of changes, since it allows us to take account of the complete structure of the tax system. We disentangle the effect on the number of people who want small part-time jobs, large part-time jobs, and full-time jobs, and also look at the consequences for total labor supply. We will show that the original reform proposals would imply smaller numbers of married women who want a small part-time job. We will also show how this is repaired in the final version of the tax reform proposal which has gone to parliament.

The structure of this paper is as follows. Section 2 describes the data. The labor supply model is discussed in Section 3. Section 4 discusses the results and the labor supply elasticities. Section 5 briefly describes the actual (1998) tax system with the proposed reforms which we want to analyze. Section 6 discusses the outcomes of our analysis of the labor supply effects of this reform. Section 7 concludes.

2. Data

The data are drawn from the Dutch Socio-Economic Panel (SEP). This is a panel consisting of about 5,000 households, which is representative for the Dutch population excluding people living in nursing homes, etc. We have used the wave drawn in May 1995. We focus on married or cohabiting couples in the age group 16-64. We classify the individuals into four groups according to their labor market state: not available (NA), voluntarily unemployed, involuntarily unemployed, and employed. The category NA consists of students, persons receiving full-time disability benefits, persons receiving pensions or other retirement benefits, and persons in mandatory military service. Labor supply of people in this category is not explained by our model. Their spouse's labor supply behavior, however, is analyzed. This explains why the numbers of men and women in the SEP sample used in the analysis are different: 1948 men, 2069 women.

The group of employed individuals includes everybody with a paid job who is not in the category NA. It includes those with a part-time job looking for additional work. On the other hand, it excludes, for example, students with a job of one day per week, who are in category NA. The distinction between involuntary and voluntary unemployment is based upon sample information on search behavior. The requirement for involuntary unemployment is that an individual claims to be seriously looking for work, or has applied for a job at least once in the past two months. For people in involuntary unemployment, desired hours of work are positive, for those in voluntary unemployment, they are zero.

Earnings in the SEP are measured as gross earnings in the year 1994, retrieved from the respondents' tax files. These earnings can only be used to compute an hourly wage rate for the job held at the time in the survey in May 1995 for people who have not changed jobs in 1994 or from January 1995 until May 1995. For those who did change jobs in that period, earnings are set to missing.

The sample contains information on actual as well as desired hours worked. Desired hours of workers are based upon the survey question "How many hours per week would you like to work, for your current hourly wage?" In SEP 1995, this is only asked if respondents are considering to change jobs, however. For those who are not looking for another job, it is assumed that desired hours are equal to actual hours. Job searchers are simply asked how many hours they would like to work.

Table 1 presents some sample characteristics for the men and women in our sample.

Since we have excluded students and disabled people and focus on couples, the employment and unemployment rates cannot be compared to the commonly published figures. The sample participation rate of men is quite large, and involuntary unemployment is very low. Non-participation among married women in the Netherlands is still substantial, but has fallen substantially during the past two decades. The positive differences between means of desired and actual hours are due to involuntary unemployment.

Table 1: Variable Definitions and Sample Means

		Men	Women
Age		41.1	40.0
Education level			
D edl1	dummy primary education	7.3%	14.0%
D edl2	dummy lower vocational	18.1%	27.1%
D edl3	dummy intermediate level	47.6%	40.3%
D edl4	dummy higher vocational	17.9%	13.9%
D edl5	dummy university degree	6.7%	1.9%
D edl6	dummy other/unknown	2.4%	2.7%
Gross wage rate (Dfl. per hour)		31.51	23.64
Actual number of hours worked (per week)		39.63	14.13
Desired number of hours worked (per week)		40.05	15.37
Labor market status	employed	93.7%	59.2%
	involuntarily unemployed	2.6%	6.4%
	voluntarily unemployed	3.7%	34.4%
Nch0-18	number of children	1.16	1.08
	number of children younger than 18		
D ch0-5	dummy children younger than 6	27.3%	25.5%
Child allowance		49.56	46.77
Total number of observations		1948	2069

Note: Means of dummy variables are presented as sample percentages. Married and cohabiting people only (age group 16-64). Those who are not available for the labor market (students, disabled, retired) are excluded.

3. Model

We present a static neo-classical structural labor supply model. The framework is similar to that of van Soest (1995). We only consider people with a spouse (married or cohabiting). They are assumed to maximize a joint utility function for the couple, taking account of their own and their spouse's leisure, and of family income.

Utility

We specify a direct utility function in which utility depends on one's own working hours (h), on total net income (y), and on working hours of the partner (hp). Net income includes asset income, the partner's income and child allowances, but earnings of other household members are excluded. The assumption that total income enters the utility function rather than the separate incomes of both spouses, is common in the standard family labor supply model, and is usually referred to as income pooling (see Blundell and MaCurdy, 1999, p. 1660). The underlying assumption is that consumption of the two spouses only depends on their total income, not on the two incomes separately. This assumption has been criticized in the literature, and models have been developed in which this assumption has been relaxed, but these models require additional data for identification (such as consumption expenditure on a privately consumed commodity). See the discussion in Blundell and MaCurdy (1999, p. 1661-1663), for example. Extending the model in this direction is beyond the purpose of the current paper.

The model would be consistent with utility maximization in a life cycle framework with intertemporally additive preference if y could be replaced by total expenditures (see Blundell and Walker, 1986). Due to lack of data on consumption expenditures, however, we could not do this.

We take the direct utility function quadratic in logarithms:[2]

$$U(v) = v'Av + b'v, \qquad v = (\log y, \log(80-h), \log(80-hp))' \tag{1}$$

Without any restrictions on the parameters, this utility function is locally second order

[2] For notational convenience, the index for the household is dropped.

flexible. In principle there is no reason to prefer this utility function to any other direct utility function with the same (or larger) flexibility. We impose parameter restrictions to guarantee that utility decreases with h and hp and increases with income.[3] We do not impose quasi-concavity of preferences, and thus avoid the critique by MaCurdy et al. (1990).

The time endowment is fixed and set equal to 80 hours per week.[4] We follow the bulk of the labor supply literature, in which the difference between the time endowment and hours worked is usually called leisure time, but actually comprises an aggregate of all time use categories except for paid work.

A is a 3x3 matrix of unknown parameters and b is a three-dimensional vector. We assume that b_2 and b_3 depend on individual or household characteristics, i.e. we allow for variation of preferences across the sample through observed characteristics: $b_k = X'\beta_k$, k=2,3, where X are observed characteristics (age of husband and wife, number of children, dummy for the presence of children younger than 6). We also included unobserved characteristics (reflecting unobserved heterogeneity of preferences), but the variance of the corresponding error term was estimated to be zero.

Husband and wife are assumed to maximize the same utility function, although, of course, in our notation, hours (h) of one spouse are hours of the partner (hp) for the other. The labor supply decision is thus modeled at the household level, as in, for example, Hausman and Ruud (1984) and van Soest (1995). A more general framework would be a game theoretic model with different utility functions for the two spouses (see Kooreman and Kapteyn, 1990, for example). The intra household decision making process, however, is beyond the purpose of the current paper.

Constraints

The answer to the question: "how many hours would you like to work?" is based upon utility maximization under constraints. An obvious constraint is the budget restriction: to each choice of the number of working hours of husband and wife corresponds a different net

[3] Vlasblom (1998) avoids this by using a CES utility function. This function, however, has fewer parameters and is therefore not second order locally flexible without parameter restrictions.

[4] We experimented with different time endowments but this led to smaller values of the likelihood.

income. Moreover, we assume that respondents take the actual working hours of their partner as given.

To determine net income as a function of working hours, the following is required: net earnings, earnings of the partner, other household income (child benefits, asset income), potential unemployment assistance and other social security benefits. Income of the partner and other household income are usually observed. To determine net own earnings for each number of working hours, we assume that the gross hourly wage rate does not depend on hours worked (see Section 1). For workers with observed wage rate, we can then compute net earnings for each possible number of working hours. For non-workers, we need to predict the before tax wage rate. For this purpose, we have estimated wage equations for males and females, accounting for selection bias in the usual way (see Heckman, 1979). The estimates of the wage equation are then used to predict the wages of non-workers. Because the labor supply model is nonlinear in wages, it is necessary to take the wage rate prediction errors into account for consistent estimation of the labor supply model.

To determine social security benefits in case of working few or zero hours, we incorporate the basic system of unemployment assistance only. This is relatively easy to model: according to the Dutch social security system, all families are entitled to financial assistance if family income falls below the minimum standard of living, which depends on age, marital status and family composition (we ignore the fact that these unemployment assistance benefits are means tested). We do not model unemployment insurance benefits. This is difficult to model due to lack of data and due to the static nature of our framework - unemployment insurance benefits are of temporary nature. Following van Soest (1995), the budget constraint under which the individual maximizes utility will be approximated by a finite number of points. There is some discussion in the literature on how to choose the number of points. Earlier studies such as Moffitt (1986) and Ilmakunnas and Pudney (1990) have used only three points for each individual (not working, working full-time, and working part-time). This has computational advantages. Moreover, hours distributions are usually of a peaked nature, and using few points might reduce the potential bias due to rounding errors made by people reporting their hours of work. On the other hand, using few points introduces rounding errors as well, since observed hours are rounded off to one of the few points. More importantly for our purposes, the more points are included, the more detail of the budget set will be captured. This becomes particularly relevant if, due to tax and benefits rules, the budget set is non-convex and irregular. On the other hand, where irregularities in the budget

sets occur typically depends on income and not on hours. Due to variation in wage rates, therefore, choosing fixed hours points may lead to missing the irregularities for some people, but will include them for others with different wages. Thus for the aggregate results, working with very many points does not seem necessary. We therefore will work with more than just a few points, and analyze the sensitivity of the results for the chosen number of points.

In the benchmark model, we take multiples of 6 hours and work with 10 possible numbers of hours worked for each individual: 0,6,..,54. For given hours of the partner, each choice of h corresponds to some net family income y_j (j=0,...,9), where j=0 corresponds to 0 hours, j=1 corresponds to 6 hours, etc. In the sensitivity analysis, we will also discuss results based upon hours intervals of 4 or 8 hours.

The vectors appearing in the utility function are denoted by v_j:

$$v_j = (\log y_j, \log(80-6j), \log(80-hp))' \quad (j=0,...,9),$$

where hp denotes given actual hours worked by the partner. Maximizing utility - for given actual hours of the partner - now boils down to choosing the best point out of a set of ten points. First order conditions etc. are not required; the choice is discrete.

Error terms

The utility function in (1) does not give room for an error term. We introduce error terms as follows:

$$u(v_j) = U(v_j) + \varepsilon_j$$

We assume that the ε_j are iid and follow an extreme value distribution. When he or she answers the desired hours question, the individual is assumed to choose $j \in \{0,...,9\}$ such that $u(v_j)$ is maximized. Due to the ε_j, this is not always the same j for which $U(v_j)$ is optimal. The ε_j can be interpreted as alternative specific utilities, or as errors in evaluating each alternative. They play a role similar to the optimization errors in the Hausman (1985) model. As explained above, the empirical model we present does not allow for random preferences. Incorporating random preferences by adding an error term to the parameters of the utility

function did not improve the model significantly.

Due to the assumption on the distribution of the ε_j, the resulting model is very similar to the multinomial logit model. The probability that an individual chooses alternative j, conditional on the wage, potential benefits, exogenous variables, and the partner's number of hours worked, is given by:

$$P[j] = \exp\{U(v_j)\} / \sum_{k=0}^{9} \exp\{U(v_k)\} \qquad (j = 0,\ldots,9).$$

$P[j]$ increases with $U(v_j)$. Since U is increasing in income, the utility of working increases with the (before and after tax) wage rate. On the other hand, the utility of non-participation does not vary with the wage rate. As a consequence, the participation probability increases with the wage. On the other hand, the participation probability decreases with the benefits level: a higher benefits level increases $U(v_0)$ but does not affect utility values of the alternatives where working hours are so large that benefit income is zero.

Fixed costs of working

The model described so far appears to underpredict the number of non-workers substantially. A possible explanation is that there are fixed costs for working. In other words, there is an extra gain to not working compared to all the other possibilities, which makes not working relatively more attractive than working few hours per week. The level of the fixed costs may depend on individual and household characteristics Z. We model them loglinearly: $\log FC_k = Z'\alpha_k$, k=2 (husband) and k=3 (wife).[5] In computing the values of the utility function, we now replace $\log y_j$ by $\log y_j - \log FC_2$ if according to this alternative the husband works, by $\log y_j - \log FC_3$ if only the wife works, and by $\log y_j - \log FC_2 - \log FC_3$ if, for alternative j, both $h>0$ and $hp>0$. Since U is increasing with income, positive fixed costs decrease the utility of working but do not affect the utility of not working. They thus make working less attractive, and decrease the probability of participation.

Fixed costs are not incorporated in van Soest (1995), who, instead, uses disutilities of part-time jobs to model the lack of part-time jobs. The fixed costs approach is more in line with economic models of labor supply. It was introduced earlier in this framework by Euwals

[5] We also added an unobserved heterogeneity term here, but (like random preferences added to b_2 and b_3) this did not significantly improve the model.

and van Soest (1999) and Callan and van Soest (1996). Its should be noted that we do not have any information on fixed costs in the data, and the fixed costs variables in the model are latent, unobserved variables. They comprise the various types of fixed costs that can play a role, such as the costs of child care, commuting costs, etc., but may also capture other disincentives for paid work, such as search effort, etc. We cannot distinguish between the various sources of fixed costs.

An alternative explanation for the lack of part-time jobs is to model the availability of part-time jobs using job offer probabilities. This implies that the choice set varies across households, with a common probability distribution for all households in the sample. This approach is followed by Dickens and Lundberg (1993), Woittiez and Tummers (1991) and van Soest et al. (1990).

Estimation

We estimate the model using all observations in the sample except those who are not available for the labor market (NA, see Section 2). For those in voluntary unemployment, desired hours are zero; for those who work or are involuntarily unemployed, desired hours are positive.

Due to the multinomial logit nature of the model, estimation by maximum likelihood would be straightforward if all wages were observed. As explained above, unobserved wages are replaced by predictions. Prediction errors will be substantial and should properly be taken into account. This can be achieved by integrating out the disturbance term of the wage equation in the likelihood. This, however, becomes computationally burdensome, particularly if the wage of a working spouse is unobserved and the unknown error term is bivariate. Instead, we approximate the integral by a simulated mean. For each individual whose wage is unknown, we take R draws from the distribution of the error term(s) in the wage equation(s), and compute the average of the R likelihood values, conditional upon the drawn error. This estimator is a special case of smooth simulated maximum likelihood. It is asymptotically equivalent to maximum likelihood, provided that R tends to infinity at a fast enough rate with the number of observations. See, for instance, Hajivassiliou and Ruud (1994). The results we present are based upon R=10. In the sensitivity analysis, we also looked at R=5.

4. Results

The model fits the data reasonably well, in the sense that predicted participation rates and predicted average hours worked by men and women according to the model, are very similar to the sample participation rates and the sample averages of hours worked. On the other hand, the model is not able to reproduce the hours distribution completely. In particular, it does not predict the bunching of hours at 40 hours per week. This is a common problem with fitting this type of model to data on weekly hours worked (see Euwals and van Soest, 1999, for example).

The parameter estimates are shown in Table 2. The upper panel refers to the terms in the utility function.[6] An index *m* denotes the husband and *f* denotes the wife. The coefficients on the squared leisure terms and the interaction terms of leisure and income cannot be interpreted separately. Together, they determine the elasticities of hours worked, which will be discussed below.

A positive coefficient on an interaction of one of the exogenous variables with leisure (i.e., one of the β-s in b_2 and b_3) implies a positive effect on the marginal utility of leisure, and thus a negative effect on labor supply. For example, the significantly positive coefficient on log(80-h_f) nch0-18 implies that the wife's marginal utility of leisure increases with the number of children. This means that children reduce the wife's desired hours. On the other hand, the coefficient on log(80-h_m) nch0-18 is negative, implying that the husband's desired hours increase with the number of children. The presence of young children (age 0-5) reduces labor supply of both spouses significantly, though the effect is stronger for women than for men. For both spouses, age is significant, and the age pattern of desired hours is decreasing, particularly for older individuals.

[6] The coefficient of $(\log y)^2$ was insignificant and imprecise, and we therefore set it to zero.

Table 2: Estimation Results

Utility Function[a]	estimate	t-value
Log(80 - h_m)^2	-2.910	-14.3
Log(80 - h_f)^2	-3.174	- 7.9
Log(y) log(80 – h_m)	0.845	7.5
Log(y) log(80 – h_f)	-0.297	-2.2
Log(80 – h_f) log(80 - h_m)	0.832	7.6
Log(y)	4.457	3.0
Log(80 - h_m)	83.658	4.4
Log(80 - h_m) log(age$_m$)	-43.549	-4.2
Log(80 - h_m) log(age$_m$)^2	6.114	4.3
Log(80 - h_m) nch0-18	-0.255	-2.7
Log(80 - h_m) d ch0-5	0.663	2.6
Log(80 - h_f)	121.933	6.8
Log(80 - h_f) log(age$_f$)	-58.738	-5.8
Log(80 - h_f) log(age$_f$)^2	9.020	6.4
Log(80 - h_f) nch0-18	1.482	11.0
Log(80 - h_f) d ch0-5	1.999	5.6
Fixed costs men[b]		
Constant	-1.308	-3.8
Log(age$_m$)	0.421	4.8
Nch0-18	-0.071	-2.8
d ch0-5	0.082	1.2
d edl2$_m$	-0.148	-3.1
d edl3$_m$	-0.103	-2.4
d edl4$_m$	0.047	0.9
d edl5$_m$	0.077	1.3
d edl6$_m$	0.105	1.5
Fixed costs women[b]		
Constant	0.008	0.1
Log(age$_f$)	0.047	1.2
Nch0-18	-0.022	-2.8
d ch0-5	0.068	3.0
d edl2$_f$	0.006	0.4
d edl3$_f$	-0.052	-3.0
d edl4$_f$	-0.099	-4.3
d edl5$_f$	-0.196	-2.9
d edl6$_f$	0.028	0.6

Notes:

[a] The utility function in (1) can be written as W'δ, where W is the vector of regressors in the top panel of the table (first column). The second and third column of the top panel give the estimates of δ and their t-values. See Table 1 for definitions of the variables.

[b] As explained in the text, logFC_k=Z'α_k, k=2 (husband) and k=3 (wife).

Fixed costs of working depend on the presence of children and on age and education

level of husband and wife. Estimated fixed costs appear to be positive for all individuals in the sample. For women, fixed costs decrease significantly with education level. As explained in the previous section, the fixed costs in our model may comprise any (monetary or nonmonetary) disincentive for working. The result on education level may suggest that fixed costs should indeed be interpreted in a broad sense: they may also reflect immaterial or psychological costs or benefits. Women with high education level may find it rewarding to have a (relatively attractive) job, which partly compensates their material fixed costs. Still, also for women with a university degree, fixed costs remain significantly positive. For men, the education level pattern is less clear: some educational dummies are significant, but the pattern is not monotonic. While age of the woman does not change her fixed costs significantly, fixed costs of men do increase with age. As expected, fixed costs for females increase significantly if there are young children. Surprisingly, however, the presence of older children has the opposite effect, and is significant for both men and women.

Elasticities

The estimates do not directly reveal the sensitivity of labor supply for the wage rates. For this purpose, simulations are necessary to compute elasticities. The elasticities vary across the sample. Since we want to use the model for policy analysis, we are interested in aggregate elasticities. We define the (own or cross) wage elasticity of labor supply of some given group of people (husbands or wives) as the percentage change in total desired hours of that group if all before tax wage rates (of husbands or wives) in that group rise by 1%. Although this comes close to some definitions used elsewhere, it is not the same. Many studies only consider the elasticities for the average ("representative") family. In a highly nonlinear model like ours, these elasticities are not very informative for the consequences of wage changes for a heterogeneous population. Others consider average elasticities instead of elasticities of the average, thus giving more weight to people with lower desired hours. Moreover, some people look at elasticities of hours worked conditional upon participation. We take full account of the (positive) impact of the wage rate on the participation decision (with desired hours equal to zero for non-participants). Actually, most of the sensitivity of labor supply for wage rates is, according to our results, driven by changes in the decision to participate. Finally, elasticity calculations vary with the way in which the tax system is accounted for. We change all gross wage rates by 1% and leave the tax system unaffected. The way in which net wage rates

change is endogenous. On average, they will change by slightly less than 1%, due to the progressive nature of the tax rules.

For men, we find a positive own wage elasticity of 0.082. For women, the estimate is 0.705. This is well in line with another recent finding for the Netherlands given by Vlasblom (1998), who finds an elasticity of 0.59 for married women, using a similar methodology. On the other hand, Grift (1998) finds much larger elasticities for married women, with values between 2 and 3. She uses the same data as Vlasblom (1998) but a very different type of model (a censored regression model, with endogenous after tax wage rates instrumented). Theeuwes (1988) already pointed at the vast range of the empirical findings of labor supply elasticities for the Netherlands, which is not out of line with findings in other countries (see Killingsworth and Heckman, 1986).

We find cross wage elasticities of -0.064 for men and -0.358 for women. Thus, if all wage rates of both men and women would rise, we would predict a very small positive change for labor supply of men (0.082-0.064=0.018%) and a positive change of 0.347% for women.

We have also looked at elasticities for several subpopulations. Of particular interest from a policy point of view is labor supply of the low educated women, since their participation rates are lower and their unemployment rates are higher than for other women. In general, we find that the supply of labor for the low educated is more sensitive for wage rate changes than for the high educated. For example, for low educated married women, we find an own wage elasticity of 0.928, compared to 0.705 for the whole population of married women. Their cross-wage elasticity is –0.430, compared to -0.358 for all married women.

Sensitivity check

We have checked the precision of our estimates in two different ways. First, we have computed confidence intervals, maintaining the assumption that the model is correctly specified. The methodology is the same as in van Soest (1995): we have drawn parameters from the estimated (normal) asymptotic distribution of the estimator, and have computed the elasticities for a large number of drawn parameter vectors. This gives the estimated distribution of the estimates of the elasticities.

For the own wage elasticities of all men and women, we find 90% confidence intervals of [0.069; 0.101] and [0.671; 0.739], respectively. For the cross wage elasticities, the

confidence intervals are [-0.070; -0.061] and [-0.396; -0.319]. These results suggest that the estimates are quite precise.[7]

Second, we have re-estimated the model after changing certain features of its specification. Of particular interest, for example, is the robustness of the results for the number of points in the discrete choice set. While the estimates in Table 2 are based upon hours intervals of length 6 (h=0,6,…,54), we have also estimated the model for 4 (h=0,...,56) and 8 (h=0,...,56) hours intervals. This has some effect on the elasticities, but the effect is not dramatic. See Table 3.

Table 3: Sensitivity analysis

Parameters in the estimation	Parameters in the simulation	Men		Women	
		Wage man +10%	Wage woman +10%	Wage man +10%	Wage woman +10%
IL=6, *R*=10	*IL*=6, *R*=10	0.82	-0.64	-3.58	7.05
IL=4, *R*=10	*IL*=6, *R*=10	1.01	-0.67	-3.84	8.47
IL=8, *R*=10	*IL*=6, *R*=10	0.62	-0.62	-3.37	6.60
IL=6, *R*=50	*IL*=6, *R*=10	0.84	-0.63	-3.61	7.12
IL=6, *R*=10	*IL*=4, *R*=10	0.69	-0.64	-3.21	6.48
IL=6, *R*=10	*IL*=8, *R*=10	0.90	-0.70	-3.92	7.56
IL=6, *R*=10	*IL*=6, *R*=50	0.83	-0.64	-3.58	7.05

Note: *IL* = interval length:
IL = 4 means *h* is chosen from {0,4,8,…,56};
IL = 6 means *h* is chosen from {0,6,12,…,54};
IL = 8 means *h* is chosen from {0,8,16,…,56}.
R = number of draws per observation.

Again, Table 3 shows that the elasticities do not change much. Moreover, we have changed *R*, the number of draws per observation used in our simulated maximum likelihood estimation. In the fourth row of Table 3, we present the results based upon using *R*=50 draws

[7] These intervals are based upon 100 draws of the parameter vectors. Very similar confidence

for each observation. These are very close to the results for R=10. It suggests that R=10 is enough to get reliable estimates, in spite of the theoretical result that consistency of the simulated maximum likelihood estimator requires that R tends to infinity with the number of observations. This was also found in other studies using similar models (van Soest, 1995, for example).

We have also investigated the sensitivity of the results for changing the same parameters (interval length, number of draws) in the simulations needed to compute the elasticities instead of in the estimations. See the bottom panel of Table 3. We find that the elasticities are somewhat sensitive to the length of the hours interval, but not to the number of draws. All in all, we can conclude that our results are reasonably robust for the considered details of the specification. Still, the range of the elasticities in Table 3 exceeds the confidence intervals for the benchmark model reported above. This suggests that such confidence intervals – which take the model specification as given – tend to underestimate the uncertainty of the policy relevant outcomes.

5. Income Tax Reforms

We first describe the main features of the current Dutch income tax system for married couples (with or without children). The exact numbers refer to 1998. Next, we discuss three government proposals for reforms. The first two are drawn from a Ministry of Finance document preparing a revision of the tax system as a whole. The third one is the proposal which was sent to parliament, and which – with some minor adjustments – will soon be introduced. We do not discuss deductibles, health insurance premiums, employee's insurances, etc., since these are not incorporated in the empirical model. We also do not discuss rules for elderly people, retirement income, lone parents, singles, etc., since this is irrelevant for the sample at hand.

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intervals are obtained using the delta method.

Actual income tax rules

There is individual taxation for the two spouses: each spouse is taxed for his or her own income. Since the revision in 1990, there are four tax brackets, with marginal rates 0%, 36.35%,[8] 50%, and 60%. The second and third brackets are of fixed length (Dfl 47,000 and Dfl 56,000). The length of the first (tax free) bracket, however, depends upon earnings of the spouse. If both spouses work and both earn more than Dfl 8,600, then the tax free amount for each spouse is Dfl 8,600. If the wife has no own income, the husband's tax free amount is Dfl 16,800, i.e. the wife's allowance is largely transferred to the husband. If the husband earns more than Dfl 8,600, but the wife earns less than Dfl 8,600, the wife can (and, in general, will) transfer her allowance to the husband, so that her own tax free amount is Dfl 400 and her husband's allowance will be Dfl 16,800. The same rules apply if husband and wife are interchanged.

These rules to determine the tax free bracket give the income tax rules some feature of a joint system. The transfer possibility creates a disincentive for the woman to earn more than Dfl 8,600 if the husband's earnings are high. This is revealed by the solid curves in Figures 1 and 2, which depict net family income as a function of the wife's hours of work. The before tax hourly wage rate of the wife is set equal to 150% of the minimum wage rate. The husband’s earnings are equal to the minimum wage for a full-time worker (Figure 1) or three times the minimum wage of a full-time worker (Figure 2). The dip in both solid curves is reached when the wife's earnings attain the maximum transfer threshold. The dip is more serious for the case where the husband's earnings are larger, since in that case the difference between the wife's and the husband's marginal income tax rates is largest.

"Taxes in the 21st century: an explorative analysis"

In the report "Taxes in the 21st century: an explorative analysis" (Ministry of Finance, 1997), the main ideas are sketched for a complete reform of many features of the Dutch tax system. The proposals refer to increasing taxes on polluting activities, changing some of the VAT rates, a completely different system of taxing ownership of and revenues from financial assets, and reducing taxes on labor. The latter should mainly be achieved through a revision

[8] This also includes premiums for national insurances.

of the income tax rules. The report contains 21 proposals for income tax revisions. Many of these do not have far reaching consequences for marginal tax rates on earnings. Some only involve small changes in marginal rates or bracket lengths, and leave the system of tax free amounts unaffected.[9] In some others, the tax free amounts are replaced by tax cuts.[10] The third type of changes in the proposal is the most radical: the tax free brackets are abolished for two earner families.[11] In all basic proposals, additional tax revenues are used to lower the marginal tax rates, so that the revision as a whole (also accounting for changes in other taxes) would be revenue neutral if there were no behavioral effects. Apart from that, proposals are discussed in which tax revenues are lowered, and the government reduces the tax burden to stimulate the working of the labor market.

In the current paper, we will focus on the basic (revenue neutral) versions of the second and third type of income tax reform. We will refer to them as Reforms A and B, respectively. Reform A, replacing tax free amounts by tax cuts, with adjustment of marginal tax rates, is similar to the proposal which made it into parliament (see below). Reform B, abolishing tax free amounts and not replacing them by tax cuts, implies the largest changes compared to the current system. This reform provides a good illustration of how our model can be used to answer the question how sensitive labor supply can be to major changes in the income tax rules.

According to Reform A, the tax cut for the earner in a one earner family would become Dfl 6,282. As soon as there is a second earner, however, this would go down to Dfl 3,211, even if the second earner has very low earnings. (The second earner would also have a tax cut of Dfl. 3,211, at maximum.) Thus the possibility of transfer for incomes below some positive threshold disappears. This would change the disincentive to earn more than Dfl 8,600 into a disincentive to earn anything at all, and might thus discourage women with full-time working husbands from accepting a job with only few hours per week.

Figures 1, 2 and 3 illustrate this.[12] The dotted lines in Figures 1 and 2 refer to the

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[9] This holds for the proposals discussed in option 1 in Ministry of Finance (1997).

[10] This is the basic version of option 2 in Ministry of Finance (1997).

[11] This is the basic version of option 3 in Ministry of Finance (1997).

[12] The proposal also implies that the first tax band is extended by Dfl 5,000, while the marginal tax rates for the three taxed income bands will be reduced to 34.1%, 43.9% and 56.2%.

revised system. Figure 3 shows the difference in net income between the revised and the actual system in more detail, for the two values of the husband's earnings in Figures 1 and 2. For full-time working women (with full-time working husbands), the revision would be an improvement. This is in line with the government's intention that the revision should lower taxes on labor. For women with a small part-time job of only a few hours per week, however, the effect of Reform A on household income would be negative.

Figure 1 Reform A : after tax family income as a function of the hours worked by the wife. The husband earns the minimum wage.

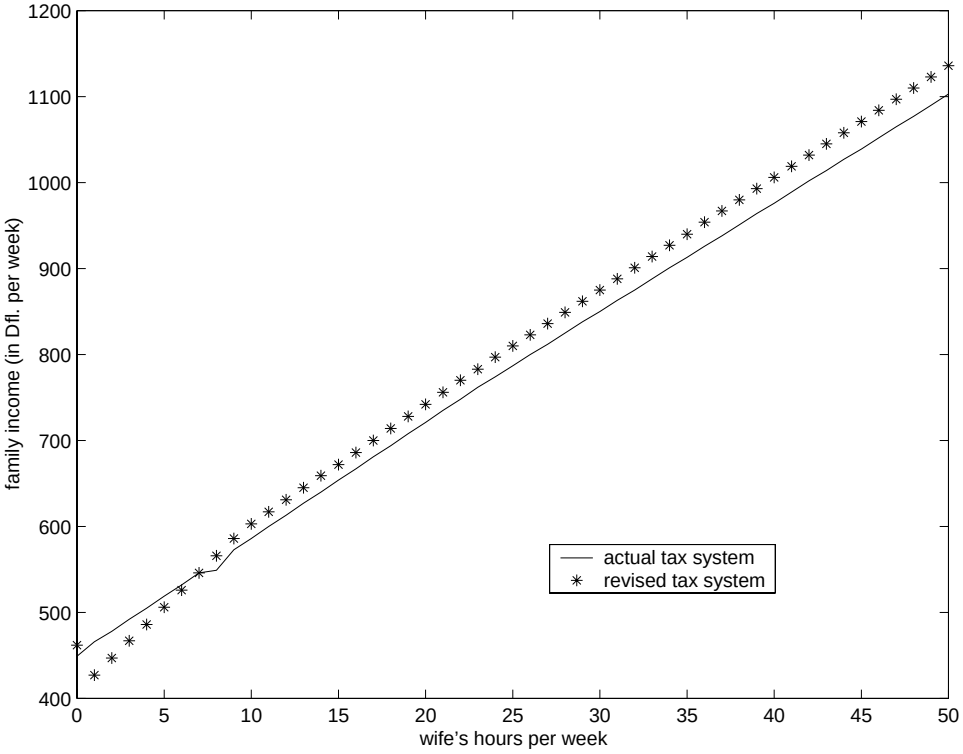


Figure 2 Reform A: after tax family income as a function of the hours worked by the wife. The husband earns three times the minimum wage.

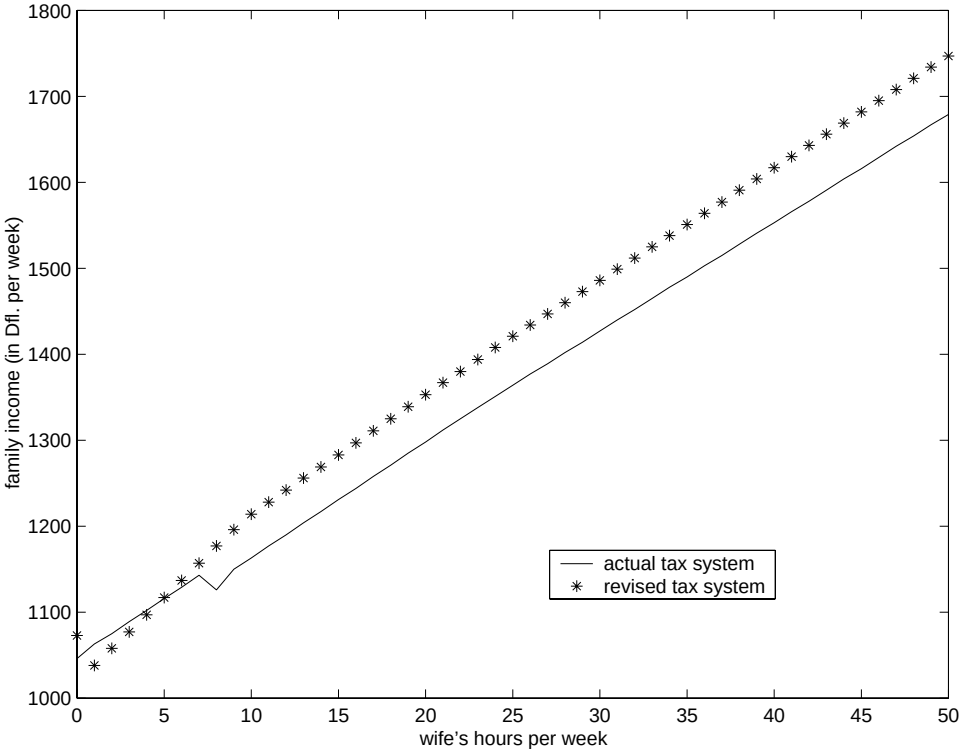
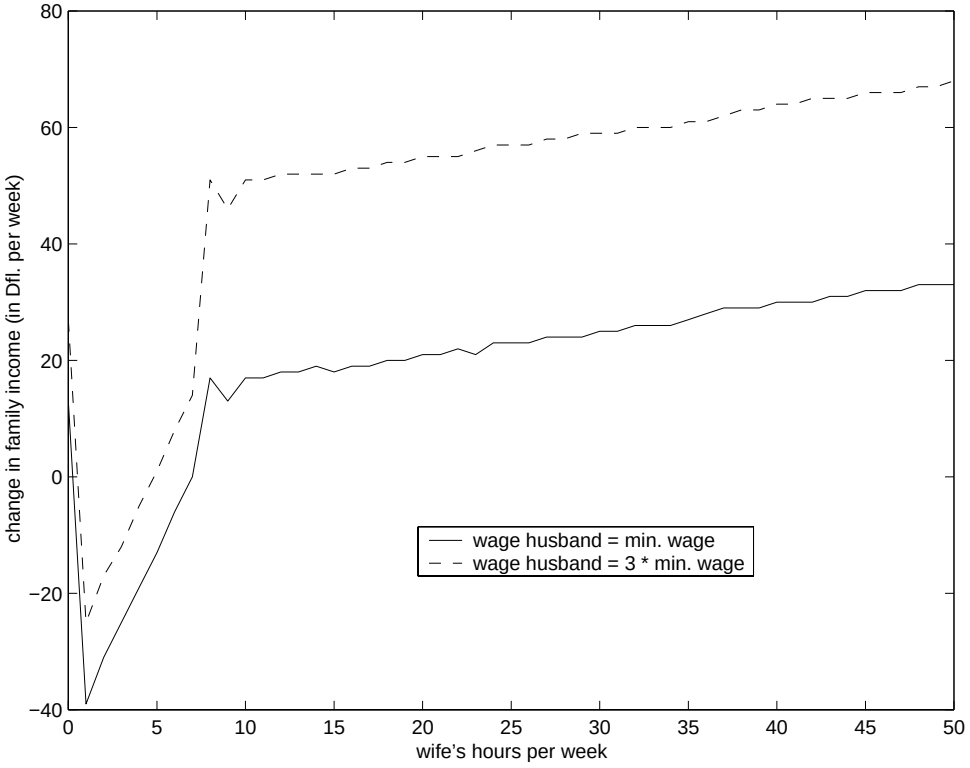


Figure 3 Reform A: difference between family incomes based on actual and revised tax system as a function of the hours worked by the wife.



The figures obviously can only illustrate the effects of the tax reform for a few reference families, and do not show for how many people such incentives are relevant. We have checked for each two earners family in our sample, how family income would change at different combinations of working hours of husband and wife.[13] If the husband has a full-time job (38 hours per week) and the wife does not work, family income would increase by about 2.35%, on average. If the wife works 8 hours, the average increase would be the same. If the wife works less than 8 hours, the average increase would be smaller or even negative (-0.64% at 4 hours). If the wife works more than 8 hours per week, the average increase in family income would be larger (3.09% at 20 hours, 3.30% at 38 hours.) For part-time working husbands, similar patterns are found. Thus we can conclude that this reform would make small part-time jobs less attractive compared to both not working and to working more hours.

The government was aware of this problem, and announced in its 1997 report that it might be necessary to repair this in some way (without indicating how). We will show in the next subsection that the final proposal that went to parliament indeed solves the problem. Our analysis will show what the (negative) labor supply effects would be if the problem would not be repaired. In particular, women with a small part-time job are overrepresented in the health sector. In this sector, many women work about one day per week or less, helping out in private households with elderly, ill, or handicaped people. These women earn so little that they can transfer their tax free amount to their husband in the current system. The Ministry of Health was concerned that many of these women would withdraw from the labor market if this reform would be implemented.

According to Reform B, the tax free amount for a one earner family would become Dfl 9,500. As soon as there is a second earner however, this would go down to zero, even if the second earner has very low earnings. Thus the possibility of transfer for incomes below some positive threshold disappears. This would change the disincentive to earn more than Dfl 8,600 in the current system into a disincentive to earn anything at all, and would thus discourage women with full-time working husbands from accepting a small part-time job.

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[13] These are unweighted averages over all two-earner families, not accounting for their actual or predicted hours worked. The reason to do this for two earner families only is that the results depend on wages. Extending the exercise to all sample families using simulated wages for the non-workers gives very similar results. We only look at direct income effects through the income tax system, ignoring effects through other revisions in the tax system, second order effects, etc.

Figure 4 Reform B: difference between family incomes based on actual and revised tax system as a function of the hours worked by the wife.

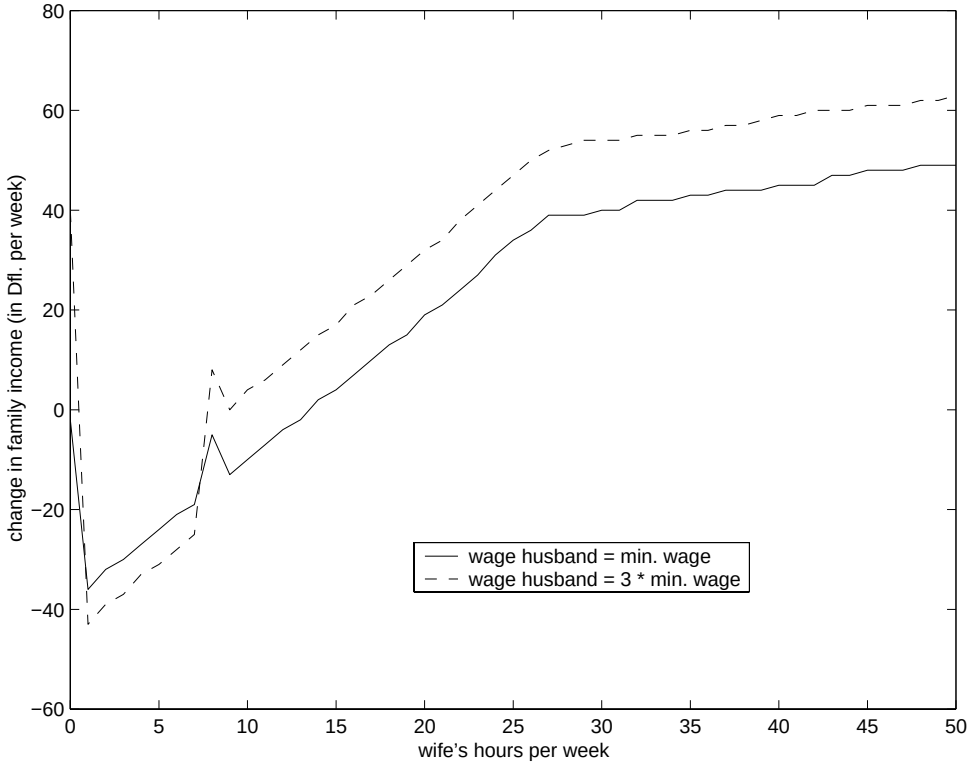

Figure 4 illustrates this. This figure is constructed in the same way as Figure 3.[14] The effects are qualitatively similar to those of Reform A. They lead to an improvement for full-time working women (with full-time working husbands), as intended by the government, but to a negative income effect for women with a small part-time job. The disincentives for women to work few hours per week are much larger in Reform B than in Reform A, however. Computed in the same way as for Reform A, if the husband works full-time (38 hours), family income would increase by 4.05% on average if the wife does not work, and by only 0.07% if she works 8 hours per week. It would fall if the wife works less than 8 hours (-2.07% at 4 hours), and would increase by more than 0.07% if she worked more hours (by 2.81% at 20 hours, and by 3.66 at 38 hours, on average). In absolute rather than relative terms, the average family income would rise by about Dfl 38 per week if the husband works

[14] To save space, the analogs to Figures 1 and 2 are not presented here. These are available upon request.

full-time and the wife does not. The average increase would be larger than this if the wife works more than 20 hours per week. We thus conclude that this reform would create much larger disincentives for many more part-time workers than Reform A.

"The Tax Plan for 2001"

The government has recently submitted the revized version of its tax reform plans to parliament (Ministry of Finance, 1999). The income tax reform in this revized proposal is of the same type as Reform B: Tax allowances are replaced by tax cuts. Marginal rates, thresholds, etc. have been adjusted, and about Dfl 6 billion will be spent to reduce taxes on labor and improve the working of the labor market.[15] Moreover, and important for our analysis, the treatment of second earners has changed. The plan (which we refer to as Reform C) is illustrated in Figure 5 (which is comparable to Figures 3 and 4). Instead of immediately losing the one earner tax cut, reform C has effectively no specific one-earner tax advantage. The tax cut applies to each individual separately, even if the individual does not work.[16] Figure 5 shows that there is no difference between the income effects for women who do not work and women who work few hours. Positive effects for married women with larger jobs, however, can be much larger.

This is confirmed by similar calculations as for the other reforms. The average percentage changes if the husband works full-time are 5.0% if the wife does not work, 4.61% if she works four hours, 5.2% if she works 8 hours, 5.8% if she works 20 hours, and 5.9% if she works full-time. Average absolute changes are larger the more hours the wife works. Thus even for women who work very few hours per week, the reform does not create a serious incentive to stop working. It does create an incentive to work more hours. Thus in the reform submitted to parliament (which, with some minor adjustments, has been accepted and will soon be introduced), the anomalies in the preliminary proposals (Reforms A and B) have been removed.

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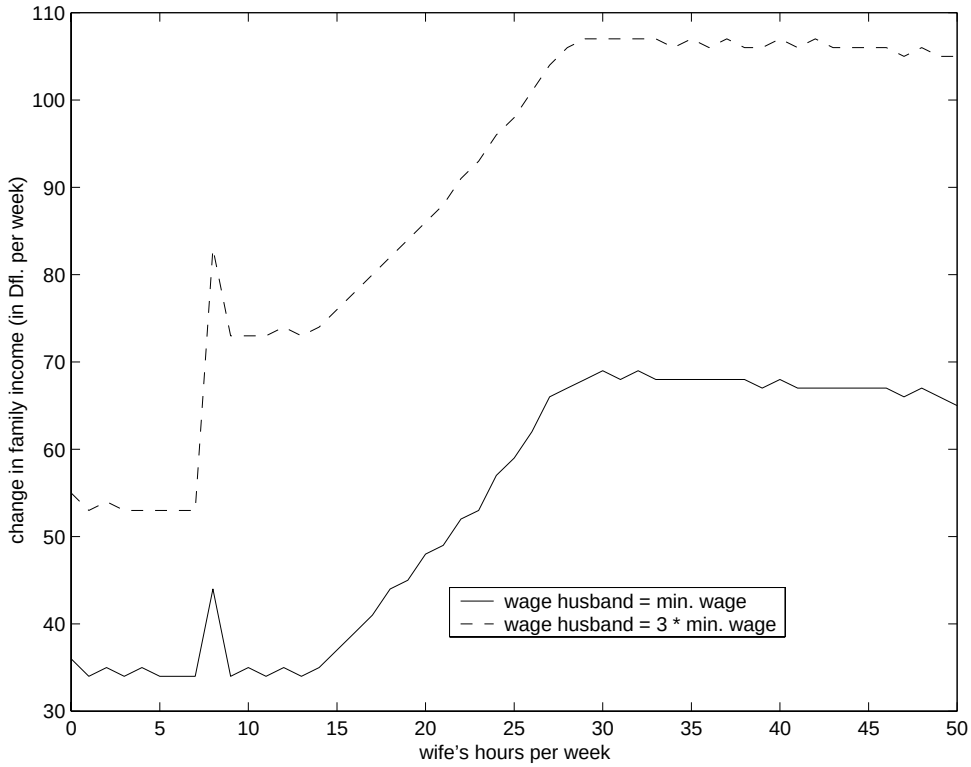
15 In the proposal there are four tax brackets with marginal rates 32.9%, 36.85%, 42%, and 52%. The lengths of the brackets are respectively 32,000, 22,000, and 48,000.

16 More precisely: the partner who earns the lowest income always receives a standard tax cut of Dfl. 3321 in case the spouse's tax bill exceeds than Dfl. 3321. (If the spouse pays less than Dfl. 3321 then the tax cut for the partner is equal to this tax amount). If the tax amount that should be paid by the partner becomes negative, then the govern-

Figure 5 Reform C: difference between family incomes based on actual and revised tax system as a function of the hours worked by the wife.



6. Tax Reforms and Labor Supply

In this section we analyze the first order labor supply effects of the tax reform proposals described above. Our structural model is particularly useful to do this, since it accounts for the complete structure of the tax system, including nonconvexities such as the kinks in the current tax system in Figures 1 and 2. Moreover, the model predicts the effects on participation as well as the effects on the distribution of hours worked.

The way in which the effects are predicted is very similar to the method of computing the elasticities in Section 4. Using the parameter estimates, we first predict labor supply using the actual tax rules (the benchmark scenario). We then repeat the simulation using the tax rules according to each of the proposed reforms. Comparing with the benchmark scenario

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ment pays this amount to the partner.

gives the predicted changes. We assume that the reforms do not change the before tax wage rates. Thus general equilibrium effects are not taken into account: we consider the first order effects only. Our results can in principle serve as input for a macro-economic general equilibrium type of model based upon micro foundations.[17]

The results are presented in Table 4. For men, the effects are in line with the intentions of the reform. Men usually work full-time, and each of the three reforms is favorable for after tax earnings in full-time jobs. Thus labor supply effects for married men are always positive. In terms of participation, the largest effect is obtained for Reform C (the reform which will be introduced): a rise by 0.44 %-points. On the other hand, Reforms A and B would lead to somewhat larger increases in average desired hours (0.57% or 0.40% versus 0.35% according to Reform C). The reason is that reform C would mainly stimulate larger part-time jobs, while the number of men preferring full-time work would hardly change. All the effects for married men are rather small, due to their small labor supply elasticities (cf. Section 4).

For married women, the effects are generally much larger, in line with the fact that women's labor supply is more sensitive for financial incentives than men's. Reforms A and B would both create negative incentives for small part-time jobs. For Reform B, this effect would be quite strong, as could be expected from Figure 4: the number of married women who want to work less than 20 hours per week would be reduced by -4.06 %-points (from 32.1% to 28.0%), and this would dominate the positive effects on participation due to the increasing incentive to take up a larger part-time job or a full-time job. Thus reform B would reduce the participation rate. On the other hand, it would still increase the number of hours worked (taking zeros due to non-participation into account), since it would induce working women to work more hours.

The effects of Reform A would be much less dramatic. The percentage of married women preferring a job of less than 20 hours per week would fall slightly from 32.05% to 31.54%. This is mainly because fewer women want to work one day or less. The number of women who want to work about two days per week, would increase. About 1.29%-points more women would prefer a job of at least 20 hours per week. These two changes taken together imply that participation would rise by 0.78%-points. Labor supply of married women

[17] An example of such a model in the Netherlands is MIMIC, which is one of the main models used for policy analysis. See Gelauff and Graafland (1994).

measured in hours would increase by about 3%.

The most important results from a practical point of view are those for Reform C, which, with some minor adjustments, will soon be introduced. As explained in the previous section, this reform does not induce negative incentives for small part-time jobs. Still, the positive incentives increase with hours worked (as shown by the curves in Figure 5). As a consequence, the number of small part-time jobs will still be reduced, and the number of larger part-time jobs will increase substantially. This explains the result of comparing the effects of Reforms A and C: both lead to about the same reduction in small part-time jobs. The main difference between the two is that Reform C leads to a larger increase in the number of women who want a part-time job of more than 20 hours, and thus to a larger increase in participation and average hours worked.

Table 4. Effects of the tax reforms

	Men			Women		
Reform	A	B	C	A	B	C
Participation (in %-points)	0.20	0.20	0.44	0.78	-2.02	1.48
average hours (in %)	0.58	0.40	0.35	3.01	2.11	4.01
parttime, < 20 hours (in %-points)	-0.18	-0.37	-0.15	-0.51	-4.06	-0.57
parttime, ≥ 20 hours (in %-points)	-0.20	0.20	0.60	0.72	1.07	1.38
full-time (in %-points)	0.59	0.37	-0.02	0.57	0.98	0.68

Notes: (1) average hours are computed including the zeros of non-participants;
(2) A, B, C: Reforms A, B and C described in Section 5; Reforms A and B are drawn from Ministry of Finance (1997), Reform C is the proposal in Ministry of Finance (1999) which is submitted to parliament.

We thus conclude that the aggregate effects of any of these reforms on labor supply will be positive, as intended by the government. But the effects are not uniform for all workers, and for some groups, negative effects are found. This implies that the reforms may lead to undesirable effects in some sectors of the labor market where these groups are strongly represented, such as the health sector. This would have been a particularly serious problem with the most far reaching reform, reform B. The problem would potentially exist in Reform A, but appears to play a minor role. The problem is removed in Reform C, the revised proposal that has gone to parliament.

7. Conclusions

We have constructed a discrete choice structural labor supply model which is able to capture features of household labor supply behavior that are important from a policy point of view. The model accounts for the full structure of the tax rules; it simultaneously captures the participation decision and the decision on hours worked, by allowing for fixed costs of work; it appropriately accounts for missing information on wage rates. It does not impose quasi-concavity of preferences and thus avoids the MaCurdy critique that elasticities are largely determined *a priori*. We have estimated the model using Dutch data, and the elasticities we have found are well in line with other recent findings, and are robust for changes in the specification. The usefulness of our approach is illustrated by our analysis of the possible first order labor supply effects of three recently proposed tax reforms. Although these reforms would have a positive effect on total labor supply, some of them would also imply a negative incentive for married women with a part-time job, and would therefore reduce the number of women who want to work less than 20 hours per week. This could have distortionary effects on segments of the labor market where women with a small part-time job are strongly represented, such as a large part of the health sector. We show that this risk would be substantial for one of the proposed reforms, but is much smaller for the reform that made it into parliament and (with some small changes) will soon be introduced. Our model predicts that this reform may lead to a small negative effect on the number of women who want to work less than 20 hours, but will lead to much larger increases in supply of larger part-time and full-time jobs.

Although we hope to have shown that our discrete choice framework has clear advantages compared to the traditional neo-classical static labor supply model, we also have to admit that it has some limitations. These limitations are very similar to those of the traditional model. First, the model is static and is not consistent with a life cycle framework. It could be embedded in a life cycle model with data on consumption expenditures on savings, but to make it a useful tool for policy analysis, it should then also be enriched with a model explaining intertemporal substitution and the impact of taxes on the marginal utility of life-time leisure. To our knowledge, no attempt has yet been made to analyze the impact of taxes in a complete life cycle framework. This seems an enormous task requiring much better (panel) data than the data we have used in the current paper.

Another limitation is the way in which we treat hours restrictions and involuntary

unemployment. Although considering desired hours instead of actual hours can be seen as a step in the right direction, it is far from the ideal model. A simultaneous structural model for preferences and hours restrictions could be seen as the ultimate goal. Again, however, we know of no study attaining this goal, although a study like Ilmakunnas and Pudney (1990) seems a promising step towards this.

Even within the static framework without demand side or institutional restrictions, a more general framework could be exploited. We have assumed joint utility maximization of husband and wife. A more general alternative is the bargaining framework with separate utility functions for husband and wife, who then attain some game theoretic equilibrium allocation (see, for example, Kooreman and Kapteyn, 1990). Another way of extending the model is to disaggregate what we call "leisure" into a number of different categories of time allocation (see Apps and Rees, 1996). Similarly, what we call consumption could be disaggregated in several categories of commodities. Although some work on these types of extensions have been done, and has shown that ignoring them can lead to biased labor supply estimates, using these models for analysis of tax policies etc. still seems a hardly explored research area. Provided that rich enough data become available, extending the discrete choice framework in these directions could be a promising direction of future research.

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