Modeling Wages and Hours of Work

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ABSTRACT:
This paper consists of two parts. In the first part we introduce a wage model and in the second part we construct a household labor supply model. Both models are intended to be a part of the dynamic micro simulation model, Sesim, developed by the Ministry of Finance, Sweden. Hourly wage rates are explained by a random coefficient panel data model. To avoid the sample-selection problem a model explaining the probability of observing a wage rate is suggested. Labor supply of single- and two-adult households are modeled as a discrete choice problem. The household labor supply model is estimated assuming that preference for leisure and consumption can be described by a direct translog utility function. When constructing the households' budget sets the complete taxation scheme and the main social benefit programs are taken into account. The wage elasticities are estimated to about 0.3 for both females and males, irrespective of household type. However, the response to simulated reforms of the tax and transfer scheme differs between sex and household type.

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[1] The views expressed in the paper are the authors' and do not necessary represent those of our employer

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1 Introduction

This study is one part of the Sesim project[2], managed by the Ministry of Finance, Sweden. Sesim is a dynamic micro simulation model developed by the Swedish Ministry of Finance in collaboration with researchers from different universities.

One important concern of the Sesim project is to model household's earnings over their whole life cycle. We concentrate here on the earnings of individuals over seventeen and below the standard retirement age. The aim of the study is firstly to produce a wage model that provides us with a wage rate for those individuals who work, and secondly to construct a model that produces reliable estimates of the households' labor supply.

Empirical studies of labor supply are of interest for a variety of reasons. The results can be used to test the predictions and implications of theoretical models. They may provide information on the sign and magnitude of effects about which theoretical models make no *a priori* assumptions. The empirical results are also an important tool when evaluating proposed government policies. How progressive income taxation and transfer programs influence households' labor supply is always a controversial issue among economists and policy makers.

Labor supply models attempt to explain changes in labor market participation and hours of work in conjunction with the changes in the institutional features of labor markets. The success of these models must be judged according to their ability to explain and enhance our understanding of the changes in participation and hours of work. Moreover, alterations in wages in addition to policy-reforms provide the variation needed to explain these changes. (Blundell and MaCurdy (1998))

The motivation for this study is threefold: first, we want to provide Sesim with models explaining the labor supply and labor income of the households over their whole life cycle. Second, it is to understand the overall patterns in labor supply behavior. The influence of governmental programs on people's decisions of hours of work is often a critical consideration in the design of policies. The primary objective of many recent reforms in both tax and welfare programs has been to encourage participants to increase their work effort. Therefore, understanding labor supply behavior is crucial in formulating proposals that invoke work incentives. The third motivation is to try to explain the factors underlying the changes in employment patterns that have occurred in recent decades. The main trends in the Swedish labor market consist of a strong rise in the female labor force participation rate and a slight long run decline in both hours of work and participation rates of men.

The study is divided into two self-sufficient parts. In the first part hourly wage rates are explained by a random coefficient panel data model. To correct for possible self-selection bias, a structural model is suggested. The probability of having a wage in a given year depends on the labor force participation in the previous year, and a set of other observable individual characteristics. The unknown parameters are estimated by the maximum likelihood technique.

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[2] See www.sesim.org

In the second part of the study a household labor supply model is suggested. Preferences for consumption and leisure are described by a direct translog utility function. The household's labor supply is treated as a discrete choice problem. This approach is based on the principle that a household chooses the outcome that maximizes the utility gained from that choice. Special attention is given to the construction of a realistic and detailed budget set for each household in question.

The estimates are used to examine the participation and hours of work decisions of different types of households. Behavioral responses to changes in wages and income are assessed and the wage elasticities of the single- and two-adult households are estimated. The policy simulations that we implement here are the doubling of the amount of basic tax deductions and the abandoning of the progressive income tax. To properly evaluate the incentive effects of tax reforms we need to analyze the responses in different income brackets. Changes in the labor supply are not only due to changes in participation rates but also due to changes in hours worked among participants.

The empirical studies are in both cases carried out with the Linda database that is a rich representative data of the Swedish population. Since all information about different income types and taxes in Linda is based on registers it is possible to get reliable results from these models. It has earlier been shown that estimates of the parameters in labor supply models are very sensitive to measurement errors in economic variables (Ericson and Flood (1997)).

The outline of the paper is following. We start the discussion with the formulation of the wage equation. The data set that is used in the estimation is then introduced. We end the first part by discussing the results received. In the second part the framework and justification of the labor supply model is presented. We specify the labor supply model for different types of households. The database and descriptive statistics are introduced then. Finally, we present the results received from the estimations. The concluding section sums up the results and discusses the trends in participation and hours of work.

2 The Wage Model

The purpose of the wage model is to predict or simulate hourly wage rates for all agents in the dynamic micro simulation model Sesim. All information about the individuals in Sesim is generated by different models, or sometimes just by simple transition matrices. A consequence is that information about the characteristics of agents is meager. So, even though there might exist rich external data sources that could be used in explaining individuals' wage rates it is of no use if the same variables are not found in Sesim. This means that in estimation we have to restrict the explanatory variables to those that are compatible with the micro simulation model.

We begin with constructing a structural wage equation where the wage rate is modeled in conjunction with a separate dynamic discrete panel data model. In the empirical estimation a large panel data covering the period 1992 - 1996 is used. The data is described more fully after the specification of the wage model. We then discuss the estimation results of the structural wage equations.

3 The Empirical Specification of the Wage Model

An empirical issue when estimating labor supply models is to construct a wage variable for all those individuals who might participate in the labor force. The choice between working and not working is referred to as the participation decision. There are various difficulties associated with the procedure of predicting wage rates for those not participating in the labor force. Another problem arises because of the empirical definition of the wage rate variable. Typically, the data set used to estimate the parameters of interest does not contain a wage rate variable measured independently of hours of work. Commonly the wage rate is derived by dividing annual earnings by annual hours. This method usually leads to a downward bias in the estimated wage elasticity as long as there are measurement errors in the observed hours of work. Due to the definition of the wage rate, a spurious negative correlation between hours of work and the wage rate is created. This problem of the so-called division bias is recognized in the literature, see for example G. J. Borjas (1980) and P. Ericson (2000).

In this study the problem of division bias is avoided since the Linda data has an incremental data set for monthly wages and hours of duty. This additional data source provides us with reliable register based information of the two most important variables, the wage rate and hours of work. Monthly earnings are given in the data for everyone as if one were working full-time. Hourly wage rates are calculated by dividing monthly earnings by the "standard" full-time rate of 165 hours per month. Annual hours of work are then calculated by dividing the annual labor income by the wage rate. Hence, the definition of hours of work is based on paid hours, not on actual hours worked.

Yet another problem that may arise when predicting wages is selectivity. In the estimation we use a sub-sample of individuals participating in the labor force. The wage rate is missing on some of the observations in a systematic way, because it is unobserved for those who are not working. One solution to this sample-selectivity problem is to use a so-called Tobit model. The structural model for wage rates is based on the value of a latent variable, (D_{it}^* in our model), and the wage rate will be observed only when the latent variable exceeds a certain value (zero). The idea of a latent variable is that there is an underlying propensity to work that generates the observed state. (Long (1997))

We use a panel data model in explaining the hourly wage rates. The panel sample is taken from five years, from 1992 to 1996, so that every individual is followed for the whole period of time. The cross-section sample consists of 49 040 individuals who are 18 - 64 years old. In total, the panel sample involves 245 200 observations.

In the empirical specification of wages we allow for unobserved random effects specific to each person. To avoid the self-selection bias in predictions we build a structural wage model, specifically

$$W_{it} = \begin{cases} \beta' x_{it} + u_{it} + \alpha_i & if \;\; D_{it}^* > 0 \\ 0 & if \;\; D_{it}^* \le 0 \end{cases}$$

$$D_{it}^* = \begin{cases} \gamma' z_{it}^2 + \rho D_{i\,t-1} + v_{it} & if \;\; t > 1 \\ \delta' z_{it}^1 + v_{it} & if \;\; t = 1 \end{cases} \qquad \text{i = 1,...,N, and t = 1,...,5} \tag{3.1}$$

where $D_{it} =$ 1, if $D_{it}^* > 0$, and
$D_{it} =$ 0, otherwise.

In the first equation, W_{it} is the logarithm hourly wage-rate and $\boldsymbol{x}_{it}$ a vector of observed variables for the *i*th individual in period t. α_i is a stochastic variable capturing unobserved individual specific effects, which is assumed to be constant over time. These random effects are distributed normally by assumption. It is further assumed that the wage-rate, W_{it}, is observed only when D_{it}^* is positive.

To estimate the model, we further assume that the error terms are normally distributed so that $u_{it} \sim N(0, \sigma_u^2)$, $v_{it} \sim N(0, \sigma_v^2)$, and $\mathrm{cov}(u_{it}, v_{it}) = \sigma_{12}$. If the covariance between the error terms is zero there will be no problem with selection bias. However, the inclusion of the selection model might increase the efficiency when estimating the parameters in the wage equation.

The probability of observing a wage rate is modeled as a dynamic discrete panel data model. The distribution of D_{it}^* is assumed to differ between the first observation (t = 1) and the rest (t >1) of the observations. Since the error term is distributed normally, the equation for D_{it}^*

specifies a probit part of the model where $D_{it} = 1$ (if $D_{it}^* > 0$) and W_{it} is observed. $D_{it} = 1$ if a person is in the paid labor force and $D_{it} = 0$ if he or she is not.

The selection equation for the first observed year (t =1) is different from the rest (t >1), since we do not have information about the participation from the previous period when we estimate the first year. The variables used in both of the selection equations are the same, except that for the first year we cannot use the lagged value ($D_{i\,t-1}$). Instead, three additional interaction variables are included to the first year's selection equation. The common variables for both of the equations are age, age squared, number of children, and dummy variables for education, place of residence, and nationality. Since we estimate the wage rates for the whole sample simultaneously we need also dummy variables for being a male and if a person is cohabiting.

The wage equation is a function of age, age squared, education dummy variables, gender, and a random coefficient trying to capture unobservable individual specific characteristics. We are able to estimate the variance of the random coefficient that is assumed to be normally distributed.

The likelihood function of the model is given by

$$L = \prod_0 P(D_{it}^* \leq 0) \prod_1 f(W_{it} | D_{it}^* > 0) \; P(D_{it}^* > 0) \qquad (3.2)$$

where $\prod_0$ and $\prod_1$ stand for the product over those *i* for which $D_{it} = 0$ and $D_{it} = 1$, respectively, and $f(W_{it} \mid D_{it}^* > 0)$ denotes the conditional density of W_{it}, given $D_{it}^* > 0$.

The parameter estimates resulting from maximizing the likelihood function are given in Table 2 (in the Appendix). Later on, we will discuss the estimation results of the selection and wage equations.

4 The Data

In order to estimate the unknown parameters of the wage model described above we need a large panel data sample. The Linda data set is the most suitable for our interests. Linda[3] (Longitudinal Individual Data for Sweden) is a register-based longitudinal representative data of the Swedish population. The data consists of a large panel of individuals and their household members (since 1960). There is also an incremental register data for monthly

[3] LINDA is a joint endeavour between the Department of Economics at Uppsala University, The National Social Insurance Board (RFV), Statistics Sweden, and the Ministries of Finance and Labour.

wages and hours of duty (fraction of full-time working hours). This additional database contains information about all those who are working in the public sector and approximately half of those who are working in the private sector. In total, the panel database contains information of about 300 000 households annually, which constitutes a large sample for our purposes.

Here we have used five years of panel data drawn from 1992 to 1996. In selecting the sample we ensured that each individual is observed every year. The sample consists of both those who were not in employment and those individuals who were employed provided that they had recorded values as their monthly wages. This means that a part of those who were working in the private sector was excluded because of the unobservable monthly wages. Otherwise, the selections were made only on the basis of age, so that each individual would be in his or her working age during this period, meaning that the sample consists of individuals between 18 and 64. Observations that appeared to have excessive values as their hourly wage rates were excluded. The monetary values of the variables from the five years were deflated to represent the wage level in 1996[4].

An example of these statistics is shown in Table 1.1 (year 1992) and in Table 1.2 (year 1996) (in the Appendix). The sample consists of 49 040 individuals each being observed every year in question. 41 % of the individuals in the sample are males. About 75 % of persons in the sample are employed. Their mean hourly wage rate is 103.34 SEK and the annual hours of work is 1 432 on average (calculated as a mean value of all individuals in the sample).

Education is measured by four dummy variables corresponding to the highest obtained degree of education. The four classes for education are primary school (not more than 2 years of high-school education), high school degree (more than 2 years of high-school), bachelor's degree (not more than three years of education after high-school), and university degree (more than three years of education after high-school). The dummy variables for the place of residence is measured simply by reflecting the size of the city where the individuals are living, and the municipalities are divided into three groups according to the population (big cities, small towns, and countryside). Finally, nationality dummy variables have been used to code the individuals' native region. Four different classifications are used for native countries, the first represents the native Swedish, the second Nordic countries, the third Western countries, and the fourth refugee countries.

5 Results from The Wage Model

The structural wage equation has been estimated as explained above and the estimation results of the selection and the wage equations are shown in Table 2 (in the Appendix). Below we discuss the results in more detail.

In the wage equation the explanatory variables behave mostly in the expected way. The wage increases at a decreasing rate with age (indicating work experience). Also, the wage increases

[4] Årsgemomsnittet, supplied by Statistics Sweden.

as anticipated with the level of education and wages are higher for males than females. For the individual specific effect we estimated the standard deviation to be twice as high as the standard deviation of the classical error term, which indicates the relevance of a panel data model approach. We allowed for correlation between the wage and the selection models. The covariance between the error terms would thus signal a selection bias. It appears, though, that selection bias is not a problem here since the estimated covariance is not significantly different from zero.

The selection equation estimates for the first year (t =1) show that the probability of having a wage rate increases with age. Also, the bigger the city the individual is living in the higher this probability becomes. We notice also that there is a clear relationship between the level of the education and the probability that a wage rate is observed: the higher the education level, the higher the probability for a person to participate in the labor force. However, the number of children has an opposite effect on the likelihood to participate. Note further that having a foreign background decreases the likelihood of having a wage rate. The parameter estimate for gender variable reveals that males have a lower probability of having a wage rate. This is presumably a consequence of missing information about the wage rate for a large portion employed in the private sector where the males dominate.

Some of the parameter estimates do not differ significantly from zero. Out of the interaction variables: ”male*the highest education”, ”male*cohabiting”, and ”living in a big city*the highest education”, only the last one has a significant and negative effect on probability.

The other selection equation (t >1) shares the same signs in most cases with the first equation (t =1). Many of the estimated parameters, though, are not significantly different from zero. There is a significant and positive effect of having a wage rate in the current period if the person did have an observed value in the previous period. There is a clear indication that a person employed in a certain period has a very high probability of also being employed in the subsequent period. Age and a higher level of education also have significant and positive parameter estimates. There is an expected positive relationship between the level of education and the probability of having a wage rate. As with the first selection equation there is some indication that the probability varies with nationality and that the parameter estimate is negative and significant if the individual was emigrated from a refugee country. Finally, the probability of having a wage is lower for males than for females, which might be explained by the fact that half of the private sector employed are excluded from our sample and since we also deleted some observations that had excessive wage rate values.

Our aim was to construct a wage model that could provide us with trustworthy hourly wage rates for the individuals in the Sesim model. One way to explore this trustworthiness is to compare the wage rates produced by the model to the observed wages. We noticed that the predicted wage rates resulted in accurate values. The mean of the predicted hourly wage rate corresponded to the observed one. As a measure of ”goodness of fit” we obtained a value of 0.41. This coefficient of determination, R^2, is a summary measure that tells how well the sample regression line fits the data. Moreover, the model could capture the participation in the labor force very well. Even though we could only use a restricted number of characteristic variables in the prediction, the model was able to supply reliable measures of wage rates.

6 The Labor Supply Model

The empirical specification of the labor supply model is of great importance because of its critical impact on the estimation results. The most difficult problem is to construct a realistic model to represent the complex process of labor supply. There are a number of different factors which are important when describing and predicting the labor supply behavior; for example, the demand side restrictions, real wages, nonlabor income, socioeconomic factors, family composition, taxation and social benefits. Since we here concentrate on a cross-sectional analysis it is best to focus on the factors that are most relevant to short run decision making. Also, the accessible data set and computational restrictions set limits to the econometric model that might be successfully estimated.

In our basic framework we emphasize the separation of income into different categories and the correct representation of net income at all levels of gross income. The budget constraints are calculated realistically by taking taxes and the most important social benefit programs into account, and by trying to construct as complete a budget set as possible. The Swedish tax and transfer programs cause in many cases nonlinear and non-convex budget sets, which in turn can make the estimation more difficult.

Because the budget sets are complex and the number of possible working hours is restricted, we treat the labor supply decision as a discrete choice problem. We assume that individuals can choose their hours of work among seven different discrete working states, ranging from not working at all to a maximum of 3 000 hours of work annually. An important advantage of the discrete specification compared to the continuous is that the coherency conditions do not have to be imposed *a priori* (see more about coherency conditions in MaCurdy, Green, and Paarsch (1990) and Flood (1994)).

The labor supply model that is considered here is based on the neoclassical consumer demand theory. We define the household utility function with reference to consumption and leisure during a specified period of time, one year. The preferred leisure time is then symmetrical with the amount of chosen hours of work. Individuals make decisions over their hours of work (leisure time) and consumption by maximizing their utility subject to a specific budget constraint and the total time endowment.

The neoclassical model of labour supply is limited by its simplistic assumptions to workers who are free to vary the hours they work. In reality, the hours of work are not at the complete discretion of the worker. As some studies have reported (e.g. Sacklén (1996)) there are a group of workers who experience some form of rationing in their decisions on hours of work. Such constraints are, for example, technological and institutional ones, or constraints on hours worked imposed by employers. Unemployment is also regarded as a constraint on hours. An important group for whom this type of rationing may be a fair approximation consists of secondary workers in the households, particularly married women. Many potential second workers choose not to work. The hours restriction is relaxed here, since we can argue that workers can choose their hours freely by choosing between different jobs, at least in the long run. This can also be justified by the fact that there are part-time jobs available especially in the public sector. Though, there is still some rigidity in the labor market in Sweden. According to labor force surveys, a greater proportion of females would have been willing to work part-time had such jobs been available (For a further discussion of hours constraints in Sweden, see Sacklén (1996)).

The other restraining assumption of utility maximizing behavior concerns the budget constraints that the individuals face. People do not usually have a full knowledge about their budget sets. The tax and social transfer programs are so complex in most Western countries that most people do not know all the details of these programs and subsequently would not be able to adjust to each of them (discussed more in Klevmarken et al. (1995)). But it surely can be assumed that modest changes in taxation do have an influence on people's decisions about their hours of work.

Our aim is to construct a model that produces reliable estimates of the labor supply of single- and two-adult households. We have selected four samples to represent the different household types in the labor market. These groups are ”single mothers”, ”single females without children”, ”single males”, and ”cohabiting and married couples”. Note also that there are more assumptions and restrictions placed on the labor supply behavior when we examine the problem in a context where there is potentially more than one supplier of labor in the household.

In a two-adult household labor supply model we need to acknowledge the complex set of incentives that the workers face resulting from the full tax and social welfare programs. Actually, there exist alternative models of labor supply decision-making for cases where the suppliers are members of the same family, typically a household comprised of two working-age individuals. The standard neoclassical family labor supply model builds upon a joint utility function that has three arguments: the aggregate consumption, and the leisure time of both husband and wife. In this approach it is often assumed that the husband is a so-called primary worker and he is assumed to ignore the labor income of his wife. Or alternatively, the spouses are considered in a symmetrical way: one of the spouses can combine all sources of non-labor income into a single unearned income measure, which implies that the source of non-labor income is irrelevant to labor supply decisions within the family. Yet another approach is to find a solution to the two-adult decision problem within a collective labor supply model that seeks solutions from efficient bargaining theory. (Blundell and MaCurdy (1998))

We begin our account of the labor supply study by describing how the budget sets of the households are constructed. A model is then suggested to predict wages for those not participating in the labor force. The wage equation will be estimated separately for all of the different household types. The succeeding section introduces the framework that allows for an empirical specification of the labor supply model. In this study we apply the family labor supply model that treats spouses in a symmetrical way. The data set used to estimate the unknown parameters is described together with the descriptive statistics about the households. Resulting estimates of the labor supply model are then presented and interpreted. Finally, we will explore the effects of changes in wages and income to the labor supply of different households by using simulations.

6.1 The Budget Set

When trying to predict labor supply behavior it is essential to calculate the disposable income as accurately as possible. Thus we here consider the effects of abandoning the linear budget constraint of the neoclassical model and take a more realistic view of the constraints faced by the households. The budget sets are calculated realistically by taking the taxes and the most important social benefit programs into account. The budget set for a household can be written as:

$$C = C_h + C_w + B \qquad (6.1)$$

The individual components of the budget set are given as

$$C_i = W_i h_i + Y_i + V_i - t(I) \qquad i = h, w \qquad (6.2)$$

where C is the disposable income, W is wage per hour, h is hours of work, Y is taxable non-labor income, V is non-taxable transfers, and the function $t(I)$ determines the total amount of taxes after the deductions from the total of taxable income has been made. B indicates the three major transfer programs (separated from V) that are targeted to families: housing allowance, social assistance and the publicly subsidized child day-care fees.

The budget sets are evaluated at 7 and 49 discrete points of hours of work for single- and two-adult households, respectively. The budget sets comprise potential labor income with all the transfers the households are entitled to. For households with two spouses the variable is defined as the sum of each spouse's nonlabor and labor income.

The wage rate is observable in almost two thirds of the cases in the Linda data basis. By making use of actual before-tax wage rates for workers and predicted before-tax wage rates for non-working individuals, and also the information of all relevant details in the tax and transfer systems, the budget sets can be constructed for each household. In particular, the three major transfer programs, social welfare, housing allowance, and costs of child day-care (publicly subsidized), as well as the tax-system, have been considered in detail.

The rules determining eligibility for social welfare are based on a rather complicated system and they also differ across municipalities. Here we calculate a minimum level of disposable income to qualify for welfare, a so-called ”norm”, based on the information about the state average level. The amount of social assistance a family is entitled to is simply the difference between the norm and the household's disposable income.

Housing allowance is determined by nationwide rules and is mainly directed to families with children. The net household income, housing expenditures, the number of children, and the age of the parents determine the amount of the benefit the household is entitled to.

In labor supply studies the child day-care costs are typically embedded in child dummy variables in the estimated labor supply function. In addition to the effects of childcare costs, the dummy variables also capture the effects of the mother's preferences. Since it is not obvious how one should interpret these variables, an explicit recognition of childcare costs is favored. In practice, the child day-care payment schemes vary with place of residence (municipality), household's income, and the number and the age of the children (the rules in 1996). Therefore the different budget constraint that follows implies different approaches in modeling. Here, the emphasis is on the case where childcare costs depend on the number of hours worked and the number and ages of the children. We also simplify the rules and use a system based on the average cost for all the municipalities. One reason for considering the effects of the number and the age structure of children is that both the childcare costs and the mother's preferences may differ accordingly. (For a further discussion of the modeling of child day care in labor supply, see Ilmakunnas (1996))

In modeling a labor supply function we have to respect the practical problems originating from the tax and transfer schemes. Also, to be able to predict hours of work for each individual in the sample, a budget set has to be constructed even for those not participating in the labor force. One of the most common problems in estimating the labor supply function arises when the budget constraint is 'kinky' or nonlinear. Especially when we model consumer behavior such constraints arise from government tax and transfer programs. The income tax system in Sweden imposes non-linearities and the transfer programs impose additional non-convexities in the budget sets for the households. These non-convexities sometimes cause huge marginal effects mostly to the low-income households (so-called poverty traps). The kinked budget constraints create two difficulties that have several interesting aspects. One difficulty is that changes in tax and transfer schedules can have unexpected effects that can be exactly opposite in sign to those expected from economic theory. The second difficulty relates to the implications of kinked budget constraints for the estimation of utility functions. Such constraints make estimation quite difficult for reasons that are often closely related to the economic theory and to the nature of economic behavior of individuals (coherency conditions are discussed earlier in section 6, see also R. Moffit (1990)).

A proper calculation of the budget sets is necessary for both the estimation procedure and the simulation. The budget set for each household is calculated by using a static micro simulation model FASIT (Statistics Sweden and Ministry of Finance, Sweden). The budget set is then constructed for each individual with varying hours of work in order to derive the predicted values of possible behavioral responses to changes in economic variables. These changes can be tax and welfare policy changes or changes in the wage level. Any change in these implies a change in the budget set which in turn might cause a change in the economic behavior of an individual. One of the purposes of this study is to evaluate behavioral responses to wage effects. Estimated measures of sensitivity for wage changes are calculated by using a simulation method to find out the elasticity of labor supply with respect to the wage rate. We also want to examine the labor supply responses due to changes in income tax regulation. These effects of the reforms are also studied with a simulation method.

6.2 The Wage Predictions

In the empirical models of labor supply, one of the basic and most consequential explanatory variables[5] of a model is the hourly wage rate. The difficulty with the variable is that we do not have observations on the wage offers received by individuals who do not participate in the labor force. We have only observations on that part of the sample satisfying the reservation wage condition, which is by no means a random or representative selection. In the literature the problem is known as sample-selectivity bias. As a consequence, we cannot straightforwardly regress observed wages on the personal characteristics of those who work, when we make inferences about the complex distribution of wage rates. Hence the independent variables determining participation in the labor force exert an indirect influence through the participation rate on the mean of the observed wage distribution and other factors that influence the decision. (Deaton and Muellbauer (1980))

As already mentioned, the Linda database contains information about the monthly wages and (a percentage share of full) hours of duty. Thus we can calculate the hourly wage rates and hours of work by using this register information for those who work. The hourly wage rate is calculated by dividing the monthly wage by the standard full-time hours. The problem of missing observations on wage rates for those who are not working is solved by means of the Heckman (1979) approach. The method involves a two-stage procedure. In the first stage we estimate a probit model, where the dependent variable is zero if an individual does not work and one otherwise. Based on this probit-estimation, a correction term, the inverse of Mill's ratio, is constructed. This correction variable is then included in the second-stage OLS-estimation as an independent variable in the wage equation. (Flood (1994))

The wage predictions are calculated separately for all the household types and the predicted values are used for all those who did not have an observed value for the wage rate. In the estimations we could use a wide variety of individual characterizing variables. The explanatory variables used in estimating the probability of participation are age, age squared, number of children, regional unemployment rate, and dummy variables for education levels, place of residence, having young children (less than seven years old), and nationality. In wage predictions we mostly used the same explanatory variables, except that variables for number of children and the dummy variable for having young children were not used. The estimation results are shown in Tables 3.1 - 3.4 (in the Appendix).

6.3 The Empirical Specification of the Labor Supply Model

The econometric model used in this study follows closely the model in Flood, Hansen and Wahlberg (1999), also used in Van Soest (1995). The individuals make decisions over their consumption (C) and leisure time ($T- h$) by maximizing their utility subject to a budget

[5] A more detailed discussion about the importance of defining the variables used in the estimation of labor supply in Andersson, Flood and Hansen (1993).

constraint and the total time endowment (T). Preferences for consumption and leisure are described by a direct translog utility function, specifically for the single-headed households:

$$U(C,h) = \beta_C \log(C) + \beta_h \log(T-h) - \beta_{FC} DW + \beta_{CC} (\log(C))^2 + \beta_{hh} (\log(T-h))^2 + 2\beta_{Ch} \log(C) \log(T-h) \quad (6.3)$$

And for the two-adult households:

$$U(C,h_h,h_w) = \beta_C \log(C) + \beta_h \log(T-h_h) + \beta_w \log(T-h_w) - \beta_{FCw} DW_w - \beta_{FCh} DW_h + \beta_{CC} (\log(C))^2 + \beta_{hh} (\log(T-h_h))^2 + \beta_{ww} (\log(T-h_w))^2 + 2\beta_{Ch} \log(C) \log(T-h_h) + 2\beta_{Cw} \log(C) \log(T-h_w) + 2\beta_{hw} \log(T-h_h) \log(T-h_w) \quad (6.4)$$

The utility function is assumed to be increasing with consumption (C), and decreasing with respect to hours of work (h). For the case in which there are several potential earners in a household, the utility is assumed to be a function of three arguments: hours of work of husband, (h_h), hours of work of wife, (h_w), and family consumption, (C). Commodities are consumed jointly rather than separated into two bundles. Even if such a separation is possible in principle, the separate consumption bundles are usually unobservable, unlike the labor supply of each spouse. So, it seems that there is little point in separating the consumption. (Deaton and Muellbauer (1980))

The total time endowment (T) is set to 4 000 hours per year. Normally the full-time work is considered to be 2 080 hours per year (40 hours per week). The model explaining labor supply is treated as a discrete choice problem. For the single-headed households the model considers seven choices of hours of work: ranging from 0 to 3 000, in 500-hour steps. For the two-adult households there are now two individuals making the decision among the same amount of discrete choices, so that there are altogether 49 (= 7*7) different working states.

We make an assumption that if a person works, she must pay a fixed working cost, and if she does not work, she does not have to pay it. A fixed entry cost acts like a tax on working and reduces the probability to participate in the labor force. The fixed costs are incorporated in the utility function with a dummy variable (DW_i), so that it captures the effect of the cost only if the person is working. Since the utility is increasing with income, positive fixed costs decrease the utility of working but do not affect the utility of not working. The costs thus make working less attractive and decrease the probability of working.

Another assumption is related to decision-making within the family. We assume that the labor supply decisions are made jointly in two-adult households. We further assume that labor supply of spouses can have substitutability or complementary relationships between them. In practice, the leisure of husband and wife is substitutable when it comes to looking after children, while complementary when sharing the leisure time.

The flexible specification of the model in the equations (6.3) and (6.4) above allows for non-convexities in the budget sets that are unavoidable especially among the low-income households due to the social transfer programs. Moreover, when using a discrete choice approach in the neoclassical framework, there is no need to impose coherency conditions *a priori*. These conditions can be tested *ex post*. This is an advantage compared to the continuous choice model suggested by Burtless and Hausman (1978) which, according to the theory, necessarily presupposes certain parameter restrictions to the estimation method and therefore makes it impossible to test whether the coherency conditions are actually fulfilled. The coherency problem is further discussed in MaCurdy et al. (1990) and in Moffit (1990).

In order to estimate the labor supply model we need to specify the nature of heterogeneity in the households' preferences, and the stochastic disturbance. Preference variation across households through observed characteristics can be incorporated in the parameters (the β s below). Heterogeneity in the preferences for leisure in the two-adult household (for the single-headed households the formula is the same) is introduced as

$$\beta_h = \sum_{i=1}^{k} \beta_{hi} x_{hi} \text{ for husbands, and } \qquad \beta_w = \sum_{i=1}^{k} \beta_{wi} x_{wi} \text{ for wives} \tag{6.5}$$

where the $\boldsymbol{x}$-variables consist of observed household characteristics (in total there are k different characteristics): age, education and the number and the ages of the children. The intercept represents unobserved variables that affect preferences for leisure. The interpretation of this unobserved heterogeneity parameter is straightforward: the higher the value the higher the preference for leisure.

Adding an additive error term to the household utility function, assumed to be extreme value distributed, results in the conditional logit model. The contribution to the likelihood function for a given household becomes

$$L_h = \frac{\exp(U_{i'j'})}{\sum_{i,j} \exp(U_{ij})} \tag{6.6}$$

In the equation above i and j indicate hours of work for husband and wife, respectively, and L_h indicates a household (accordingly for the single-headed households). We assume that a household chooses the state for which the utility is the largest. The expression (6.6) denotes the probability that the utility in the observed state ($i'j'$) is the highest amongst all possible combinations of hours.

After specifying a functional form for utility, the parameters of this model can be estimated by the maximum likelihood (ML) technique. The main disadvantage of the discrete choice approach is the introduction of classification error in hours of work due to the discrete classification of hours. In the specification of measurement errors (or classification error in this case), we follow MaCurdy (1990) and Flood, Hansen, and Wahlberg (1999), and assume a multiplicative classification error. Let H_h and H_w denote observed hours and h_h and h_w optimal discrete hours. The multiplicative classification error specification is given as

$$H_i = h_i e^{\varepsilon_i} \qquad \text{with } \varepsilon \sim N(-½\sigma_i^2, \sigma_i^2) \qquad \text{for } i = h, w \tag{6.7}$$

Thus, zero hours are observed with certainty but when optimal hours are positive they differ from observed hours by a factor of proportionality. In presence of the classification errors, the contribution to the likelihood function is given by

$$L_h = \frac{\exp(U_{i'j'})}{\sum_{i,j} \exp(U_{ij})} * g_h * g_w \tag{6.8}$$

where g_h and g_w are densities for measurement error for the husband and wife.
The assumptions about the measurement error implies

$$g_i = \begin{cases} 1 & \text{if } H_i = 0 \text{ or } h_i = 0 \\ \frac{1}{\sigma_i}\phi\left(\frac{[\log(H_i) - \log(h_i)] + ½\sigma_i^2}{\sigma_i}\right) & \text{otherwise} \end{cases} \qquad \text{for } i = h, w \tag{6.9}$$

7 The Data and Descriptive Statistics

We will next examine in more detail the nature of the data and carefully describe the four different types of households with the help of descriptive statistics. The households differ from each other with respect to the head(s) of the family.

7.1 The Data

The available and accessible data set for our purposes is Linda (Longitudinal Individual Data for Sweden, by Statistics Sweden), a cross section data drawn from the year 1996. Linda is a register-based longitudinal representative data of the Swedish population. The data consists of a large panel of individuals and their household members (since 1960). There is also an incremental register data for monthly wages and hours of duty (fraction of full working hours). This information is available for all those in the panel who are working in the public sector and for about half of those who are working in the private sector. In total, the panel database contains information on about 300 000 individuals and on their household members annually, which constitutes a large sample size for each four groups of interest: single mothers, single females, single males, and two-adult households.

Since all the information about income and taxes in Linda is based on register data, it is possible to construct reliable measures for budget sets. It can be assumed that all the variables that are needed to define disposable income are important and that the estimated parameters will be sensitive to errors in these variables. Thus, the access to register-based information is a better guarantee for reliable results. Andersson, Hansen, and Flood (1993) have found that in surveys people usually underreport some crucial income components. Simulations in Ericson and Flood (1997) demonstrate that measurement errors in the independent variables can cause severely biased parameter estimates. In general, a proper treatment of complicated nonlinear budget constraints is essential in applied work, not only in order to estimate consistently the parameters of the labor supply function, but also from the point of view of policy analysis.

The problem with register based data sources is, however, that they do not contain as many variables useful for labor supply studies as does the survey data basis which usually includes observed values for working experience, for example. Hence, some of the variables of interest have to be imputed by various methods. Here we needed a measure of the housing costs for the households. The housing costs were imputed by a minimum distance method with the help of another database HINK (the Swedish Household Income Survey, supplied by Statistics Sweden) that contains a survey data for the variable in question.

Two-adult households are not directly observable in Linda. It is possible, though, to select these households according to the family characteristics, so that we could also get all relevant information for both of the spouses and also for their children. The sample of two-adult households in this study consists of those with a traditional family composition: two adults, a female and a male, and children under 18 years of age.

The explanatory variables that are used in wage predictions and in the labor supply model are created by effectively using the information supplied by the Linda data source. Education is measured by four dummy variables corresponding to the highest obtained degree: primary school, high school, bachelor's degree, and university degree. Place of residence is categorized to three classes according to the population of the town. We have also made classes for nationality according to the country an individual was born: Sweden, Nordic countries, Western countries, and so-called refugee countries. The regional unemployment rate was chosen for a variable to capture the differences in wage rate and in participation probability. To account for the effects of having children we have used variables for the number of children and a dummy variable for presence of a young child.

7.2 Descriptive Statistics

The four different household types were selected from the Linda database so that they would best represent the household type in interest and so that the heads of the households would be able to respond to the changes in the economic environment. Each household sample consists of both those who were voluntarily unemployed and those who were working and having observable values for monthly wages and hours of duty. Most of the latter were working in the public sector. The early-retired, full time students, long term unemployed, and those on parental leave were excluded from the samples. The hours of work were restricted to range from 0 to 3 000 hours per year in each sample. A more detailed description of the household samples is given below and the sample statistics of each household is presented in Tables 3.1 - 3.4 (in the Appendix).

The sample of single mothers consists of 10 533 mother-headed households of one to four children, while 58 % of these households had children under seven years old. In the sample 78 % of the single mothers were working, having 92.37 SEK as their mean hourly wage-rate. On average they worked 1 585 hours annually, their labor income being 148 489 SEK in the given year, 1996. The statistics of all relevant variables is given in Table 3.1. Of all the single-mother households in the sample, 16 % were receiving social assistance and 69 % housing allowance, whereas 21 % and 89 % of them, respectively, were actually eligible to these allowances according to their income measures and eligibility rules. The difference between these figures can be explained by a lack of information about eligibility and the possibilities to apply for those benefits. Also, as some earlier studies have indeed suggested, this might be due to the so-called stigma effect (Moffit (1983)). Certain former results indicate that there is evidence of a significant disutility associated with welfare participation (Kalb (1998), Flood, Hansen and Wahlberg (1999)).

The statistics corresponding to single female households is shown in Table 3.2. The sample of single females consists of women who live alone and have no children under the age of 18 living in the same household. 79 % of the single females in the total sample of 13 530 women were working and had 93.58 SEK as a mean hourly wage rate. The participating group worked 1 765 hours on average in the given year, their mean labor income being 168 055 SEK. In comparison with the sample of single mothers, the single females received much less social benefits. Only 7 % and 6 % of the households, respectively, were receiving social assistance and housing allowance, at least at some point of the year. And according to the eligibility rules and our calculations, 19 % and 10,5 %, respectively, were entitled to those benefits. Both of the allowances mentioned above are means-tested, and the eligibility depends also on the family composition.

The sample of single male households consists of those living alone and those who have children to take care of. There were 17 647 such households in the sample and about 5 % of those, 983 households, had 1 - 4 children. 69 % of the men in the sample were participating in the labor market having 105.80 SEK as a mean hourly wage rate. They worked on average 1 975 hours during the year and their labor income was 211 200 SEK. 10 % of the single male households were receiving social assistance and housing allowance, whereas 17 % and 27 %, respectively, were eligible for these benefits according to their budget sets. The sample statistics is shown in Table 3.3.

The sample of two-adult households consists of the traditional type of families, two adults, a male and a female, and possible children living with them. The families with 0 - 4 children are included in the sample. There are 33 440 families of that type altogether after the selections have been made. In order to focus on the central questions of the study, all the long term unemployed, students, and early-retired persons are excluded as well as those families who had a newborn baby. It seems that 85 % of the females and 82 % of the males in the household sample are working. The participation rates are in general higher than those of the single-headed households. The earlier studies indicate the same, for example Flood (1996). About 60 % of the chosen households have children and about half of those have children under seven years old. Only 4 % of the households in the sample are welfare participants and 13 % are receiving housing allowance. About 9 % of these households would have been eligible for social welfare according to our calculations. The sample statistics is shown in Table 3.4.

8 Results from the Labor Supply Model

We will now examine the results obtained from the labor supply model. First of all, the results of the structural wage model will be considered. Secondly, we carry out an analysis of the predictive power of the model. With the help of the results obtained we will also simulate the labor supply behavior of the different household types when changing the income taxation rules.

8.1 Wage Predictions

In order to predict the wage-rates for non-participants we first have to calculate wages for those participating in the labor force. We used the observed values for monthly wages to get a measure for a hourly wage rate for those who were working. Participation and hourly wage rate equations were then estimated simultaneously by the Heckman method to correct for possible sample-selection bias. Because selectivity may have an important effect on the parameters in the wage equation, we have used an estimate from the selectivity corrected regression to calculate the wages. The received predicted wage rates are then used in the labor supply model regressions with actual hourly wage rates for those who were working.

The results of these two procedures, the probit-model estimates for participation and the OLS-estimates for wage predictions are shown in Tables 4.1 - 4.5 (in the Appendix). The main explanatory variables behave in the expected way in most of the cases. The independent variables determining labor market participation and wage rates are age, education level, number and ages of children, nationality code, place of residence, and the regional unemployment rate (and ”Lambda” for correcting selection-bias in the wage equation).

The variables that are used in the estimations differ. We chose only those variables that appeared to be significant. Here we sum up the most general features of the estimation results.

A higher age and a higher level of education increase the probability of participation. Whereas having children decreases it, and further, having children under seven years old has an additional negative effect on the female participation. Similar conclusions have been replicated in other studies (e.g. Kalb (1998) and Ilmakunnas (1997)).

Foreign background, too, seems to have a negative effect on the probability to participate. In addition, the higher regional unemployment rate has a slight negative effect upon the probability in some cases.

The received estimation results from wage equations seem to be consistent with earlier studies. The wage rate estimates rise with education and age (interpreted as an indication of working experience). The effect of the level of education on wage is noticeable. Individuals who have a university degree earn about twenty percent more than persons with only a basic education. Finally, regional differences in wage rates seem to be quite significant. In bigger cities the wages tend to be higher. Nationality, too, seems to explain the wage level, having a slight negative effect on wage rates if a person comes from a refugee country.

8.2 Labor Supply Estimation Results

Labor supply was estimated by using imputed hourly wage rates (discussed in sections 6.2 and 8.1) for non-workers and observed wage rates for workers. Tables 5.1 - 5.4 (in the Appendix) present the parameter estimates of the utility function for different types of households. The model has been estimated with 7 and 49 labor supply points for single- and for two-adult households, respectively.

Even though it seems that we should have fewer discrete classes for labor supply (especially for the upper part of hours of work), recent studies have shown that this does not make much of a difference. A larger number of labor supply points might become more important if the data set consists of a larger number of part-time workers (van Soest (1995), Kalb (1998)).

The effects of different characteristics on the preference for leisure can be seen in the estimated values of parameters. To begin with, for the single-headed households, age has a significant effect on a single-adult's preference for leisure. For the youngest age group the effect is significant and positive in all three household types.

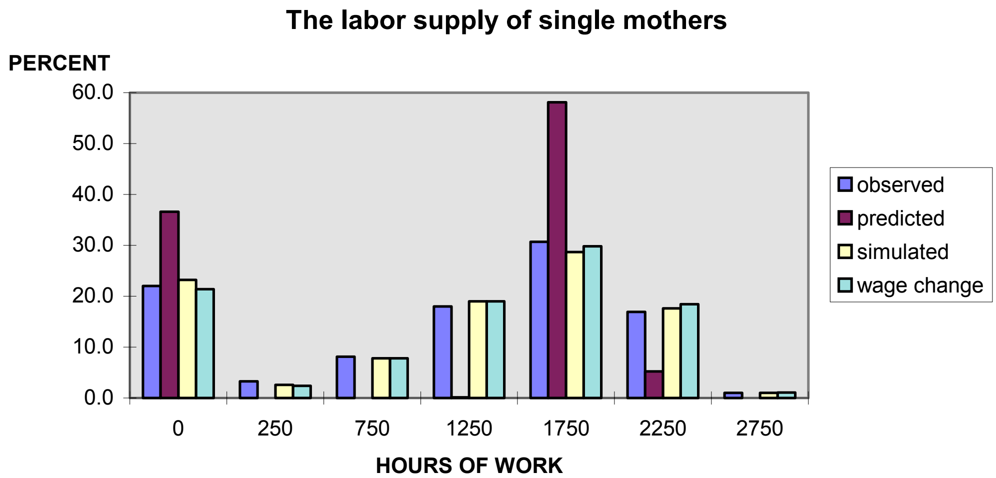
However, a highly educated person prefers less leisure compared to a person with a lower level of education. The effect is significant and negative for the upper education level compared to the lowest education level. For the two-adult households we compare the preference for leisure in the estimation with the highest education level and discover that the overall pattern is the same. The relation between the education level and the preference for leisure is negative. The reasoning is now reversed but in line with the results received from single adults.

The estimated parameters for the fixed costs of working appear to be positive for both single- and two-adult households in our study. Moreover, the effect is higher for males than for females. The fixed costs of working is thus likely to decrease the probability to participate in the labor force.

Another result is that all variables related to children have a significant positive effect on a mother's preference for leisure. There is a positive and significant effect when the number of children in the household increases, and especially if a mother has a child younger than seven years of age. The effect is similar for single mothers as for cohabiting and married mothers. The presence of children may reduce the likelihood to participate if it changes a parent's preferences between work and leisure. Children also bring about day care costs, which may further reduce the participation probability (discussed earlier in connection with budget sets, in section 6.1). For some reason the effect of the number of children is reversed for cohabiting and married males. This might be due to endogeneity in the decision of having a child. The probability of having a child increases with household's income which in turn increases with husband's hours of work.

Labor supply models attempt to explain changes in labor market participation and hours of work as a response to changes in the economic environment. The goodness of fit of a model can be judged according to its ability to predict the participation and hours of work of different households. To evaluate whether our model succeeded in this we have compared the distribution of predicted and simulated hours given by the model to the observed distribution.

The distribution of hours of work from the observed sample together with distributions obtained by the prediction and simulation are presented in Figures 8.1 - 8.5 (in the Appendix). The figures also show the effect of wage increase upon the hours of work distribution. We have increased the gross wage rates by 10% and simulated the effect to the hours of work for each household type (wage elasticities are examined in the next section). As an example, we show below the respective distributions for single mothers.



The figure above shows the distribution of hours of work of single mother households. Many females are used to work part-time as can be seen in the figure, and this is especially the case with the sample of single mothers (compare with others, Tables 8.2 - 8.5).

Table 6 (in the Appendix) shows the mean values for hours of work for each household type yielded by the methods described above. One can see that we are able to produce mean values by the model that are mostly very close to the observed mean.

The Figures 8.1-8.5 (in the Appendix), in turn, display the distribution of hours of work more explicitly. The model did not succeed in predicting the distribution of hours of work that well. There seem to be two peaks especially in the distribution of male labor supply when we predict the hours of work. In the female labor supply there is more variation in the predicted hours of work.

The results seen in Figures 8.1 - 8.5 summarize the overall fit of the model. A well-known problem with labor supply models is that the predicted hours distribution typically do not describe the observed hours distribution very well. There are various methods to improve the fit of these models. For example, unobserved heterogeneity in individuals' preferences for leisure can be captured by various methods. Also, dummy variables can be incorporated in the model to account for some specific effects.

One way of illustrating the implications of the results found here is to calculate the elasticities of wage and income. We will thus now examine the effects of changes in gross wage rates and in income taxes to the labor supply of different household types by using simulations.

9 Policy Simulations

Our model can be used to predict the labor supply response to policy measures that affect the budget sets of the households. A straightforward evaluation of an economic reform is to estimate the expected changes of hours of work for different types of households. The model constructed here allows the individuals to adjust their labor supply as a result of changes in their economic environment. The alteration of a decision variable may increase or decrease the hours of work supplied. Beforehand, it is difficult to see how a certain reform might affect the total labor supply.

The static neoclassical theory underlying the determinants of hours of work is well known. Its basic prediction is that an increase in the wage rate creates two opposing effects on the labor supply of the individual. The income effect, provided that leisure is normal, increases the demand for leisure, thus decreasing the number of hours supplied to the market, while the substitution effect makes the individual substitute away from leisure and toward hours of work.

The effects of tax change on hours of work can be similarly decomposed into income effect, measured by the income elasticity, and substitution effect, measured by the compensated wage effect. The income effect measures the change in hours of work caused by the change in income. When taxes decrease, we expect a decrease in hours of work since income has increased and one can afford more leisure. The substitution or compensated effect (or Slutsky effect) measures the effect of a tax change when we compensate the change in income due to the tax change. A fundamental result in the neoclassical model is that the substitution effect from a tax decrease is always positive. However, the total effect is indeterminate, and the question is whether the substitution or the income effect dominates. (Flood (1994))

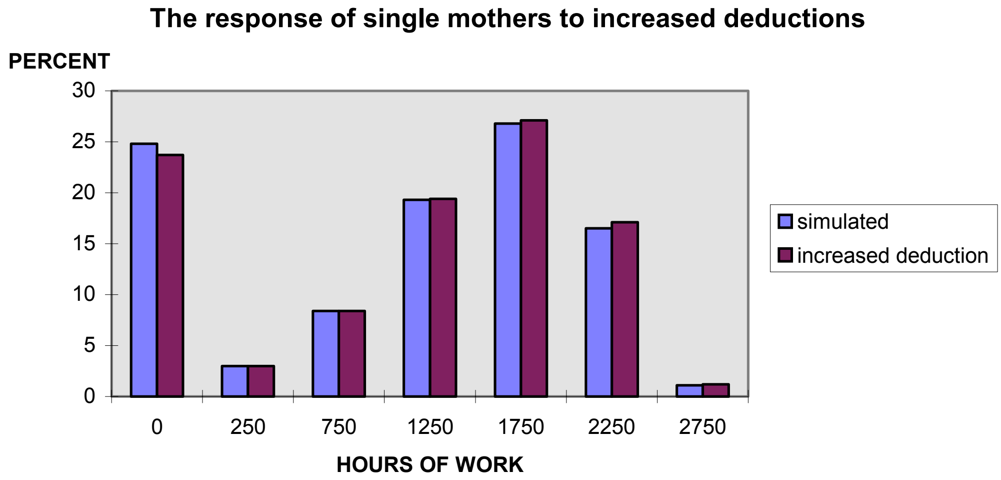
We have examined the sensitivity of the different household types to wage changes by using simulations. Wage rates are increased by 10 percent and the resulting changes in simulated hours of work have been calculated. The results in Table 7 (in the Appendix) imply that hours of work are quite insensitive to wage changes. Of course, the elasticity of wage on labor supply depends on the wage level. The average wage elasticities are positive but quite small for all cases. The average wage elasticities for the different households are 0.28 percent for cohabiting males, 0.30 for cohabiting females, 0.32 for single mothers, 0.34 for single females, and 0.34 for single males. For two-adult households we calculated only the own-wage elasticity.

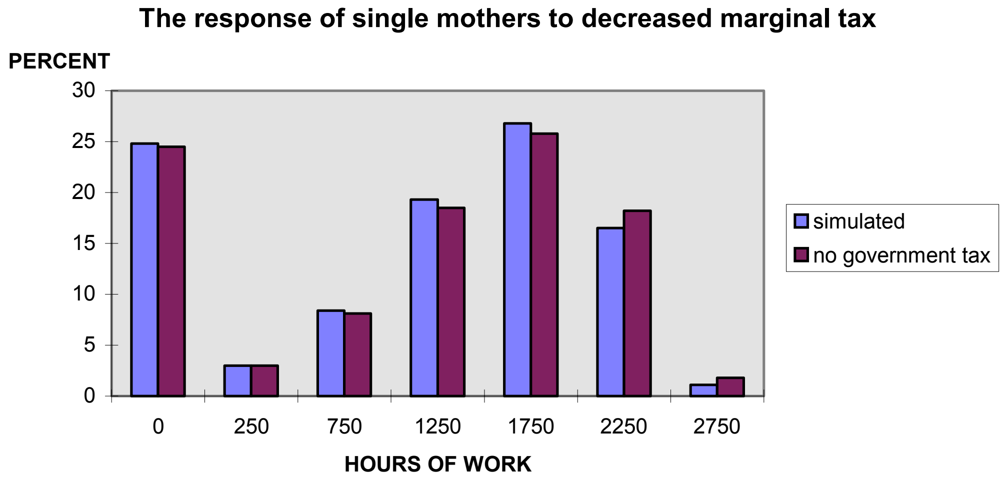
A typical feature in the analyses of wage elasticities is that females usually have a higher elasticity of wage than males. Here we cannot see the same pattern. Recent labor supply studies based on Swedish data give evidence of a diversity of results in estimated elasticities, just like the international studies do. The empirical results in Agell et al. (1995) revealed that for prime-aged cohabiting and married men the estimated income elasticities were ranging from -0.1 to 0 and compensated wage elasticities from 0.08 to 0.25. For cohabiting and married women the range of the results was wider. Income elasticities were found between -0.03 and 0.24 and compensated wage rate elasticities between 0.22 and 1.07.

We conducted two policy simulations that alter the income tax schedule. The idea here was to examine how the tax reforms affect the labor supply of two different types of households. First, we double the amount of deductions. That is, the threshold before paying any taxes is increased by a factor of two. Secondly, we completely abandon the progressive part of the taxation, i.e. the government taxes, which leads to a flat tax rate of about 30 %.

The behavioral response to these changes in the economic environment is tested with single mother and two-adult households. Figures 9.1 - 9.5 (in the Appendix) summarize the labor supply responses of these households comparing the results with the simulated hours of work. Here we take single mother households as an example of the labor supply responses to the pursued tax reforms.

Those most affected by the changes in taxation are expected to adjust their hours of work the most. The first policy reform (an increased amount of deductions) has the largest influence on those in the lowest segment of hours of work. According to the simulated responses it looks that the participation rate increases in each case, varying from 1.1 to 2.1 percentage points. The other reform (neglecting the progressive income tax) has the largest effect on those further up the income distribution, and again obtained results seem to support this. These tax reforms seem to produce an incentive to increase the supply of labor.





The total net effect of both tax reliefs appears to be clearly positive for each household type. Alleviation in the structure of income taxation produces incentive effects upon the labor supply of those in the higher income brackets. Some of those who were participating in the labor force before work more after the reform. Also, the participation rate increases somewhat in each case. Some individuals join the labor force as a result of these changes. These tax reforms may have, though, the opposite effect to those in the lower regions of hours of work. Both single and cohabiting females increase their hours of work as a result of the reforms. Married and cohabiting males increase their hours of work even more than females on average. Thus, the total net change in the hours of work is positive for all household types and for both sexes.

The results from these two policy simulations are also presented numerically in Table 8 (in the Appendix) where the mean net effects of the tax reforms to hours of work is shown for the different households. Typically, married women are believed to be more responsive to tax changes than other groups. One can see that the annual hours of work increase in all of the groups by a reasonable amount. The average increase in labor supply is 22 - 47 hours annually. Males increase their average hours of work almost twice as much as females when the tax deductions are doubled. The simulated responses due to the abandoning of the progressive income tax suggest that hours of work would increase even more. Again, males increase their hours of work more than females. Different studies show variation in results depending on the specification of a model, the econometric methods, and the data used.

The analysis of the participation in the labor force is the key to the evaluation of reforms. Further, to properly evaluate the impact of a policy reform requires a careful analysis of the balance between two groups: labor supply decisions of those individuals already participating and the labor supply decisions of those individuals who may be encouraged to enter by such a reform.

Changes in the tax rate alter the net wage and net labor income so that the income effect of tax changes will have an extra component compared with a change in wage. Whether labor supply curves are backward bending in practice and if so, for what kind of workers, are major empirical questions. They are of obvious practical relevance, for example, for analyzing the incentive effects of income taxation. Simulations of the tax reforms show that even a small number of individuals who were not participating in the labor force might have a considerable influence on the total labor supply and tax revenues if they are encouraged to participate due to such a reform.

10 Conclusions

In the first part of the study we constructed a wage model that predicts the hourly wage rates for those participating in the labor force. The wage rates are explained by a random coefficient panel data model. In the empirical estimation we used the longitudinal data, Linda, spanning five years, from 1992 to 1996. The model is intended to be a part of the dynamic micro simulation model Sesim.

In the second part we constructed a discrete choice structural labor supply model for single- and two-adult households. This approach has two important advantages compared to a continuous choice model. First, it allows for non-convexities in the budget set. Second, there is no need to impose coherency conditions *a priori*. The model accounts for the complete taxation scheme and the main social benefit programs with publicly subsidized child day-care. In addition, we have taken fixed costs of work into account.

We estimated the model using the Linda database. The wage elasticities for different household types were assessed by simulations. Evaluated at the sample average values the elasticities were found to range between 0.28 and 0.34. There did not seem to be a noticeable difference in the estimated elasticities between the household types or between the sexes. The results obtained are consistent with other recent findings.

Our model is able to capture simultaneously the participation decision and the decision on hours of work. The model is also capable of capturing important features in household labor supply behavior from a policy point of view. The usefulness of our approach was illustrated by applying it to analyze the possible labor supply effects of different reforms in tax schemes. We carried out two policy simulations, by pursuing new rules to income taxation. As we saw, these tax-reducing reforms have a positive effect on the aggregate labor supply for each household type. This implies a positive incentive effect at least on some groups in the labor market. Especially for males the labor supply responses to the tax decreasing reforms were found reasonably large.

To analyze the incentive effects of government tax and transfer programs, a detailed specification of individual responses in the econometric procedure is absolutely necessary. Changes in the labor supply are not only due to changes in participation rates but also to changes in hours worked among participants.

The average number of hours worked among the employed has declined during the past couple of decades, while the labor force participation rates have increased substantially among single and cohabiting women. These facts make it very important to examine the determinants of labor supply for both micro- and macroeconomic reasons.

Plans for future research involve a deeper analysis of the non-labor income of a household. The enlarging proportion of the non-labor income in the household's budget set has an effect on the participation and hours of work decisions. Capital income might have a much greater influence than ever before on households' labor supply decisions. An increasing share of a capital income in households' budget sets may significantly decrease the supplied hours of work and thus raises new challenges for governments whose aim is to increase the work effort of individuals.

In the future we might expect also that the static model is not necessarily consistent with a life cycle setting. Henceforth, for a better understanding of the choices made by labor suppliers and to make the model more useful as a tool for policy analysis, we need to widen our perspective to incorporate the whole life cycle. As we have noticed, persons employed in a certain period have a very high probability of being employed also in the subsequent period. Dynamic models permit for a more realistic view of labor supply behavior of individuals. In the long-run individuals can adjust their hours of work towards the optimal level.

11 Acknowledgments

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THE SAMPLE STATISTICS AND THE RESULTS OF THE WAGE MODEL (sections 4 and 5) TABLES 1.1 – 1.2 and 2.

Table 1.1
The sample statistics of the wage model (N=49 040).
Year 1992.

Variable	Mean	Minimum	Maximum
THE YEAR 1992			
Age	42	18	59
Number of children	0,73	0	9
Education, the highest			
- Primary school	0,63	0	1
- High school	0,08	0	1
- Bachelor's degree	0,14	0	1
- University degree	0,15	0	1
Place of residence			
- living in a big city	0,33	0	1
- living in a medium sized city	0,48	0	1
- living in countryside	0,19	0	1
Gender, male=1 / female=0	0,41	0	1
Cohabiting	0,62	0	1
Working	0,75	0	1
The hourly wage rate (SEK)	102,50	62,95	249,71
Working hours per year	1 390	0	7 874

Table 1.2.
The sample statistics of the wage model (N=49 040).
Year 1996.

Variable	Mean	Minimum	Maximum
THE YEAR 1996			
Age	46	22	63
Number of children	0,60	0	10
Education, the highest			
- Primary school	0,61	0	1
- High school	0,08	0	1
- Bachelor's degree	0,15	0	1
- University degree	0,16	0	1
Place of residence			
- living in a big city	0,33	0	1
- living in a medium sized city	0,48	0	1
- living in countryside	0,19	0	1
Gender, male=1 / female=0	0,41	0	1
Cohabiting	0,60	0	1
Working	0,75	0	1
The hourly wage rate (SEK)	103,34	54,55	248,88
Working hours per year	1 432	0	7 286

Table 2. The estimates of the wage model.

	Variable	Estimate	Std error
t > 1	Intercept	- 2,981	0,414
	Dummy for obs. Wage, t-1	4.811	0.0695
	Age	0.0534	0.0196
	Age Squared / 100	- 0.0791	0.0231
	Education, the highest		
	- High school	0.356	0.0225
	- Bachelor's-degree	0.680	0.0441
	- University	0.944	0.0593
	Place of residence		
	- Medium sized city	- 0.0487	0.0696
	- Countryside	0.126	0.0527
	Nationality		
	- from Nordic countries	- 0.0599	0.0819
	- from Western countries	- 0.301	0.187
	- from Refugee countries	- 0.502	0.101
	Cohabiting	0.0333	0.0648
	Male	- 0.215	0.0593
	Number of children	0.0251	0.0326
t = 1	Intercept	- 2.175	0.291
	Age	0.155	0.0158
	Age squared / 100	- 0.204	0.0201
	Education		
	- High school	0.379	0.0775
	- Bachelor's degree	0.913	0.0604
	- University degree	1.365	0.0795
	Place of residence		
	- Medium sized city	0.164	0.0561
	- Countryside	0.0783	0.0381
	Nationality		
	- from Nordic countries	- 0.397	0.0875
	- from Western countries	- 1.0109	0.109
	- from Refugee countries	- 1.237	0.0802
	Cohabiting	0.299	0.0573
	Male	- 0.413	0.0613
	Number of children	- 0.1005	0.0249
	Male * highest education	0.123	0.0995
	Male * cohabiting	0.196	0.0819
	Big city * highest education	- 0.281	0.103
Wage eq.	Intercept	3.963	0.0225
	Age	0.0201	0.00102
	Age Squared / 100	- 0.0181	0.00116
	Education, the highest		
	- High school	0.105	0.00837
	- Bachelor's degree	0.144	0.00599
	- University degree	0.383	0.00511
	Male	0.176	0.00479
	Std error of the random effect	0.169	0.00199
	Standard error	0.0676	0.000381
	Covariance	0.0301	0.0335

DESCRIPTIVE STATISTICS OF THE HOUSEHOLDS (section 7.2)
TABLES 3.1 – 3.4

Table 3. 1
Description of the sample of the Single mother households.
(N=10 533)

Variable	Mean
Age	36,5
Number of children	1,7
Education (the highest)	
- Primary school	66 %
- High school	7 %
- Bachelor's degree	16 %
- University degree	11 %
Place of residence	
- Big cities	38 %
- Medium sized cities	44 %
- Countryside	18 %
Nationality	
- Sweden	86 %
- Nordic countries	5 %
- Western countries	1 %
- Refugee countries	8 %
Working	78 %
Wage per hour SEK	92,37
Working hours (annual)	1 585
Labor income	148 489
Disposable income	145 492

Table 3. 2
Description of the sample of the Single female households.
(N=13 530)

Variable	Mean
Age	38,0
Number of children	0
Education (the highest)	
- Primary school	57 %
- High school	13 %
- Bachelor's degree	16 %
- University degree	14 %
Place of residence	
- Big cities	40 %
- Medium sized cities	44 %
- Countryside	16 %
Nationality	
- Sweden	89 %
- Nordic countries	4 %
- Western countries	2 %
- Refugee countries	5 %
Working	79 %
Wage per hour SEK	93,58
Working hours (annual)	1 765
Labor income	168 055
Disposable income	110 220

Table 3. 3
Description of the sample of the Single male households.
(N=17 647)

Variable	Mean
Age	36,0
Number of children	0,08
Education (the highest)	
- Primary school	61 %
- High-school	15 %
- Bachelor's degree	13 %
- University degree	11 %
Place of residence	
- Big cities	38 %
- Medium sized cities	44 %
- Countryside	18 %
Nationality	
- Sweden	87 %
- Nordic countries	4 %
- Western countries	2 %
- Refugee countries	7 %
Working	69 %
Wage per hour, SEK	105,80
Working hours (annual)	1 975
Labor income, SEK	211 200
Disposable income, SEK	119 572

Table 3. 4
Description of the sample of the Two-adult households.
(N=33 440)

Variable	Wife	Husband
Age	43,0	46,0
Number of children	1,44	1,44
Education (the highest)		
- Primary school	53 %	48 %
- High school	7 %	13 %
- Bachelor's degree	20 %	15 %
- University degree	20 %	24 %
Place of residence		
- Big cities	31 %	31 %
- Medium sized cities	49 %	49 %
- Countryside	20 %	20 %
Nationality		
- Sweden	86 %	87 %
- Nordic countries	4 %	3 %
- Western countries	2 %	2 %
- Refugee countries	8 %	8 %
Working	85 %	82 %
Wage per hour, SEK	98,44	128,57
Working hours (annual)	1 699	2 107
Labor income, SEK	144 564	224 160
Disposable income, SEK	123 636	168 794

THE RESULTS FROM THE PARTICIPATION AND WAGE EQUATIONS FOR EACH HOUSEHOLD (section 8.1)
TABLES 4.1 – 4.5

Table 4. 1
Estimated parameters of the probit model of
The labor force participation and the wage equation for
single mothers.
(N=10 533)

Variable	Estimate	Standard error
PARTICIPATION EQ.		
Intercept	- 4,074	0,280
Age	0,277	0,016
Age Squared / 100	- 0,339	0,021
Number of children	- 0,212	0,018
Dummy for young child	- 0,226	0,041
Education, the highest degree		
- Bachelor's degree	0,560	0,049
- University degree	0,594	0,060
Nationality		
- Western countries	- 0,789	0,139
- Refugee countries	- 1,213	0,047
WAGE EQUATION (log-wage)		
Intercept	4,287	0,062
Age	0,007	0,003
Age Squared / 100	- 0,004	0,004
Education, the highest degree		
- High school	0,024	0,007
- Bachelor's degree	0,076	0,006
- University degree	0,224	0,007
Place of residence		
- Living in a small city	- 0,027	0,004
- Living in countryside	- 0,033	0,005
Nationality		
- Refugee countries	- 0,047	0,014
Lambda	- 0,038	0,019
R^2	0,28	

Table 4.2
Estimated parameters of the probit model of the labor force participation and the wage equation for single females. (N=13 530)

Variable	Estimate	Standard error
PARTICIPATION EQ.		
Intercept	- 3,013	0,148
Age	0,220	0,007
Age Squared / 100	- 0,258	0,009
Education, the highest degree		
- High school degree	0,431	0,040
- Bachelor's degree	0,575	0,043
- University degree	0,708	0,050
Place of residence		
- Living in a big city	- 0,110	0,032
Nationality		
- Nordic Countries	- 0,378	0,062
- Western Countries	- 1,217	0,092
- Refugee Countries	- 1,309	0,052
Regional unemployment rate	- 0,031	0,010
WAGE EQUATION (log-wage)		
Intercept	3,885	0,043
Age	0,028	0,002
Age Squared / 100	- 0,028	0,002
Education, the highest degree		
- High school	0,048	0,006
- Bachelor's degree	0,096	0,006
- University degree	0,226	0,006
Place of residence		
- Living in a small city	- 0,049	0,016
- Living in countryside	- 0,051	0,004
Nationality		
- Refugee countries	- 0,055	0,005
Lambda	0,026	0,020
R^2	0,34	

Table 4.3
Estimated parameters of the probit model of the labor force participation and the wage equation for single males.
(N=17 647)

Variable	Estimate	Standard error
PARTICIPATION EQ.		
Intercept	- 2,646	0,104
Age	0,165	0,006
Age Squared / 100	- 0,196	0,007
Education, the highest degree		
- High school degree	0,300	0,030
- Bachelor's degree	0,637	0,035
- University degree	0,760	0,040
Nationality		
- Nordic Countries	- 0,466	0,053
- Western Countries	- 1,069	0,072
- Refugee Countries	- 1,211	0,041
WAGE EQUATION (log-wage)		
Intercept	3,867	0,057
Age	0,032	0,002
Age Squared / 100	- 0,034	0,003
Education, the highest degree		
- High school	0,053	0,007
- Bachelor's degree	0,101	0,009
- University degree	0,261	0,010
Nationality		
- Refugee countries	- 0,117	0,020
Lambda	0,021	0,025
R^2	0,25	

Table 4.4
Estimated parameters of the probit model of the labor force participation and the wage equation for cohabiting and married females.
(N=33 440)

Variable	Estimate	Standard error
PARTICIPATION EQ.		
Intercept	- 3,195	0,210
Age	0,228	0,010
Age Squared / 100	- 0,276	0,011
Number of children	- 0,125	0,011
Young child (under 7 years)	- 0,163	0,028
Education, the highest degree		
- High school degree	- 0,150	0,034
- Bachelor's degree	0,499	0,028
- University degree	0,668	0,030
Place of residence		
- Living in a big city	0,082	0,027
- Living in a small city	0,158	0,025
Nationality		
- Nordic Countries	- 0,223	0,046
- Western Countries	- 1,068	0,065
- Refugee Countries	- 1,601	0,029
WAGE EQUATION (log-wage)		
Intercept	4,108	0,038
Age	0,015	0,002
Age Squared / 100	- 0,014	0,002
Education, the highest degree		
- High school	0,060	0,007
- Bachelor's degree	0,108	0,003
- University degree	0,266	0,003
Place of residence		
- Living in a big city	0,054	0,003
- Living in a small city	0,012	0,003
Nationality		
- Refugee countries	- 0,069	0,012
Regional unemployment rate	- 0,003	0,001
Lambda	- 0,007	0,015
R^2	0,32	

Table 4.5
Estimated parameters of the probit model of the labor force participation and the wage equation for cohabiting and married males.
(N=33 440)

Variable	Estimate	Standard error
PARTICIPATION EQ.		
Intercept	- 1,451	0,207
Age	0,127	0,009
Age Squared / 100	- 0,162	0,010
Number of children	- 0,075	0,009
Education, the highest degree		
- High school degree	0,279	0,026
- Bachelor's degree	0,608	0,029
- University degree	0,801	0,026
Place of residence		
- Living in a big city	0,071	0,025
- Living in a small city	0,147	0,023
Nationality		
- Western Countries	- 0,774	0,056
- Refugee Countries	- 1,543	0,028
WAGE EQUATION (log-wage)		
Intercept	4,027	0,061
Age	0,026	0,002
Age Squared / 100	- 0,024	0,003
Education, the highest degree		
- High school	0,124	0,006
- Bachelor's degree	0,140	0,009
- University degree	0,341	0,010
Place of residence		
- Living in a big city	0,108	0,005
- Living in a small city	0,018	0,005
Nationality		
- Western Countries	- 0,051	0,018
- Refugee Countries	- 0,147	0,031
Regional unemployment rate	- 0,007	0,001
Lambda	- 0,038	0,037
R^2	0,29	

THE RESULTS FROM THE LABOR SUPPLY MODEL (section 8.2)
TABLES 5.1 – 5.4

Table 5.1
Estimated parameters of the labor supply model
for single mother households.
(N=10 533)

Variable	Coeff.	Estimate	Standard error
Intercept	β_{h0}	11,0622	0,258
Number of children	β_{h1}	0,527	0,0383
Dummy for young child	β_{h2}	1,555	0,132
Education, the highest degree			
- High school	β_{h3}	0,165	0,0835
- Bachelor's degree	β_{h4}	- 0,720	0,0836
- University degree	β_{h5}	- 0,891	0,0921
Age, dummy for each group			
- 18 - 27 years old	β_{h6}	2,078	0,155
- 28 - 33 years old	β_{h7}	0,529	0,124
- 34 - 39 years old	β_{h8}	0,0599	0,0778
- 40 - 45 years old	β_{h9}	- 0,176	0,235
Fixed costs of working	β_{FC}	2,792	0,0556
Consumption	β_{C}	4,622	0,760
Consumption squared	β_{CC}	0,999	0,297
Hours squared	β_{hh}	- 7,0436	0,143
Hours * consumption	β_{Ch}	- 1,00219	0,228
Classification error	ε	0,188	0,00141
Log of Likelihood Function		15458,63	

Table 5.2
Estimated parameters of the labor supply model for single female households.
(N=13 530)

Variable	Coeff.	Estimate	Standard error
Intercept	β_{h0}	9,198	0,112
Education, the highest degree			
- High school	β_{h1}	- 0,702	0,0343
- Bachelor's degree	β_{h2}	- 0,959	0,0642
- University degree	β_{h3}	- 1,152	0,0478
Age, dummy for each group			
- 18 - 24 years old	β_{h4}	1,706	0,0802
- 25 - 34 years old	β_{h5}	- 0,325	0,0278
- 35 - 44 years old	β_{h6}	- 0,627	0,0459
- 45 - 54 years old	β_{h7}	- 1,100	0,0437
Fixed costs of working	β_{FC}	3,769	0,0587
Consumption	β_{C}	2,371	0,0629
Consumption squared	β_{CC}	0,787	0,0222
Hours squared	β_{hh}	- 5,691	0,0911
Hours * consumption	β_{Ch}	0,0115	0,00252
Classification error	ε	0,148	0,00102
Log of Likelihood Function		15199,78	

Table 5.3
Estimated parameters of the labor supply model for single male households.
(N=17 647)

Variable	Coeff.	Estimate	Standard error
Intercept	β_{h0}	6,735	0,253
Education, the highest degree			
- High school	β_{h1}	- 0,424	0,0541
- Bachelor's degree	β_{h2}	- 0,826	0,0564
- University degree	β_{h3}	- 0,756	0,0656
Age, dummy for each group			
- 18 - 24 years old	β_{h4}	1,205	0,0700
- 25 - 34 years old	β_{h5}	- 0,401	0,0595
- 35 - 44 years old	β_{h6}	- 0,181	0,0656
- 45 - 54 years old	β_{h7}	- 0,398	0,0640
Fixed costs of working	β_{FC}	5,721	0,0819
Consumption	β_{C}	0,335	0,262
Consumption squared	β_{CC}	1,196	0,108
Hours squared	β_{hh}	- 6,257	0,137
Hours * consumption	β_{Ch}	0,445	0,117
Classification error	ε	0,120	0,000765
Log of Likelihood Function		17089,1	

Table 5.4
Estimated parameters of the labor supply model for two-adult households.
(N=34 440)

Variable	Coeff.	Estimate	Standard error
HUSBAND:			
Intercept	β_{h0}	6,314	0,1098
Number of children	β_{h1}	-0,0965	0,00712
Education, the highest degree			
- Primary school	β_{h2}	0,343	0,0214
- High school	β_{h3}	0,0638	0,0186
- Bachelor's degree	β_{h4}	- 0,243	0,0411
Age, dummy for each group			
- 18 - 33 years old	β_{h5}	- 0,731	0,0485
- 34 - 40 years old	β_{h6}	- 0,760	0,0365
- 41 - 47 years old	β_{h7}	- 0,628	0,0363
- 48 - 54 years old	β_{h8}	- 0,479	0,0352
Fixed costs of working	β_{FCh}	9,739	0,0774
WIFE:			
Intercept	β_{w0}	10,740	0,115
Number of children	β_{w1}	0,448	0,020
Education, the highest degree			
- Primary school	β_{w2}	0,941	0,0415
- High school	β_{w3}	1,411	0,0761
- Bachelor's degree	β_{w4}	0,384	0,0348
Age, dummy for each group			
- 18 - 33 years old	β_{w5}	0,469	0,0544
- 34 - 40 years old	β_{w6}	- 0,522	0,0593
- 41 - 47 years old	β_{w7}	- 1,143	0,0570
- 48 - 54 years old	β_{w8}	- 1,0593	0,0545
Fixed costs of working	β_{FCw}	3,699	0,0334
Consumption	β_{C}	- 0,514	0,0528
Consumption squared	β_{CC}	2,0277	0,0414
Husband's hours squared	β_{hh}	- 9,651	0,0848
Wife's hours squared	β_{ww}	- 8,513	0,0675
Husband's hours * consumption	β_{Ch}	0,667	0,0262
Wife's hours * consumption	β_{Cw}	- 0,0980	0,00579
Husband's hours * Wife's hours	β_{hw}	1,145	0,0264
Classification error, husband	ε_{h}	0,0838	0,000354
Classification error, wife	ε_{w}	0,132	0,000543
Log of Likelihood Function		44209,59	

THE ACTUAL, PREDICTED AND SIMULATED AVERAGE HOURS OF WORK FOR EACH HOUSEHOLD TYPE (section 8.2), TABLE 6

Table 6
The actual, predicted, and simulated hours of work for single- and two-headed households. And, an average hours of work after 10 % increase in wage rates.

SINGLE MOTHERS (N = 10 533)	VARIABLE	MEAN	MIN.	MAX.
	Actual annual working hours	1 236	0	2 960
	Predicted annual working hours	1 135	0	2 250
	Simulated working hours	1 230	0	2 750
	Simulated annual working hours due to the 10 % wage increase	1 269	0	2 750

SINGLE FEMALES (N = 13 530)	VARIABLE	MEAN	MIN.	MAX.
	Actual annual working hours	1 387	0	2 996
	Predicted annual working hours	1 461	0	2 250
	Simulated working hours	1 403	0	2 750
	Simulated annual working hours due to the 10 % wage increase	1 451	0	2 750

SINGLE MALES (N = 17 647)	VARIABLE	MEAN	MIN.	MAX.
	Actual annual working hours	1 362	0	3 000
	Predicted annual working hours	1 337	0	2 250
	Simulated working hours	1 367	0	2 750
	Simulated annual working hours due to the 10 % wage increase	1 414	0	2 750

COHABITING AND MARRIED FEMALES (N = 33 440)	VARIABLE	MEAN	MIN.	MAX.
	Actual annual working hours	1 460	0	3 000
	Predicted annual working hours	1 537	0	2 750
	Simulated working hours	1 455	0	2 750
	Simulated annual working hours due to the 10 % wage increase	1 499	0	2 750

COHABITING AND MARRIED MALES (N = 33 440)	VARIABLE	MEAN	MIN.	MAX.
	Actual annual working hours	1 763	0	3 000
	Predicted annual working hours	1 929	0	2 750
	Simulated working hours	1 764	0	2 750
	Simulated annual working hours due to the 10 % wage increase	1 814	0	2 750

THE ELASTICITY OF WAGE ON LABOR SUPPLY CALCULATED FOR EACH HOUSEHOLD TYPE, AND
THE RESULTS OF THE POLICY SIMULATIONS:
THE LABOR SUPPLY RESPONSE OF SINGLE MOTHERS AND TWO-ADULT HOUSEHOLDS TO TAX REFORMS (section 9)
TABLES 7 and 8

Table 7
The wage elasticities for different household types.
An average percentage change in hours of work as wage increases by 10 %.

HOUSEHOLD TYPE	WAGE ELASTICITY
SINGLE MOTHERS	0,317
SINGLE FEMALES	0,342
SINGLE MALES	0,344
COHABITING FEMALES	0,302
COHABITING MALES	0,283

Table 8
The Results from policy simulations.
The average change in hours of work after
- an increase in deductions
- relaxing the government tax

HOUSEHOLD TYPE	INCREASED DEDUCTIONS	DECREASED MARGINAL-TAX
SINGLE MOTHERS	+ 22	+ 31
COHABITING FEMALES	+ 24	+ 35
COHABITING MALES	+ 46	+ 47

THE DISTRIBUTION OF HOURS OF WORK FROM THE OBSERVED SAMPLE AND DISTRIBUTIONS OBTAINED BY PREDICTION AND SIMULATION. THE EFFECT OF A TEN PERCENT WAGE INCREASE TO THE DISTRIBUTION OF HOURS OF WORK (section 8)
FIGURES 8.1-8.5

Figure 8.1

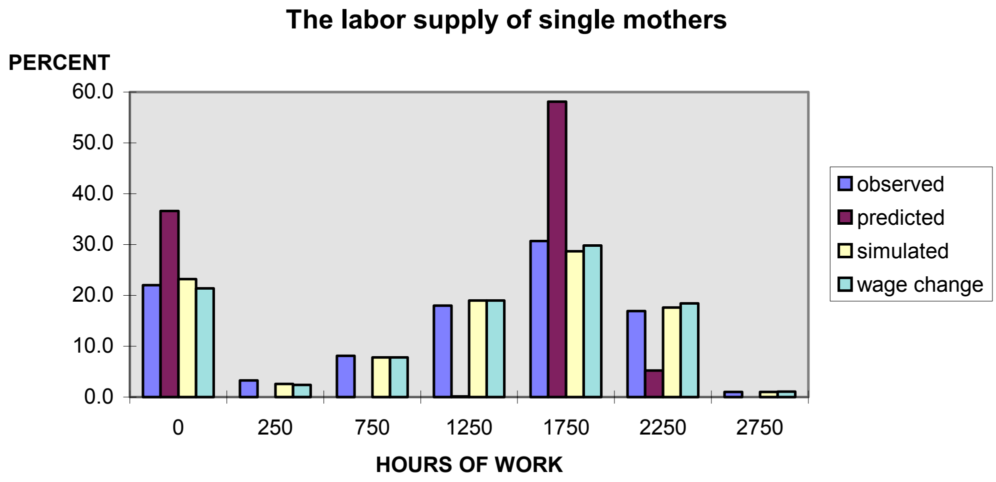


Figure 8.2

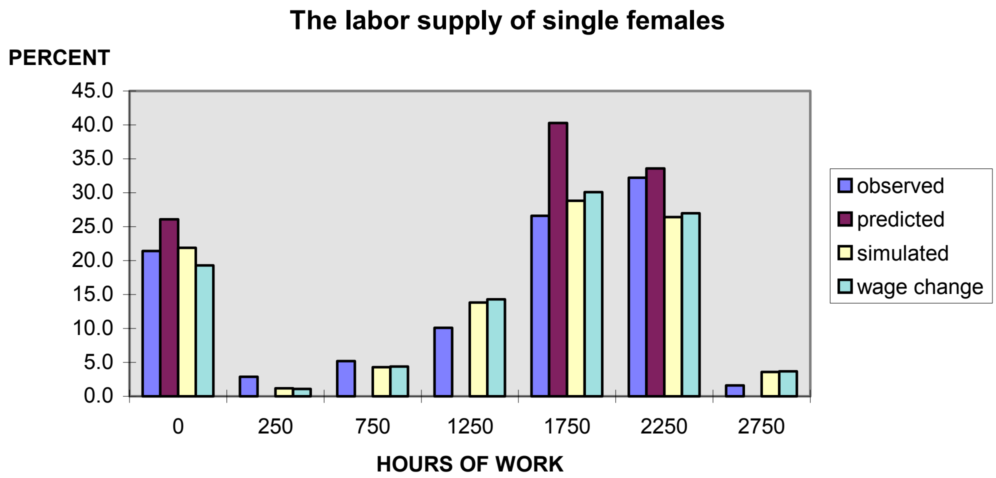


Figure 8.3

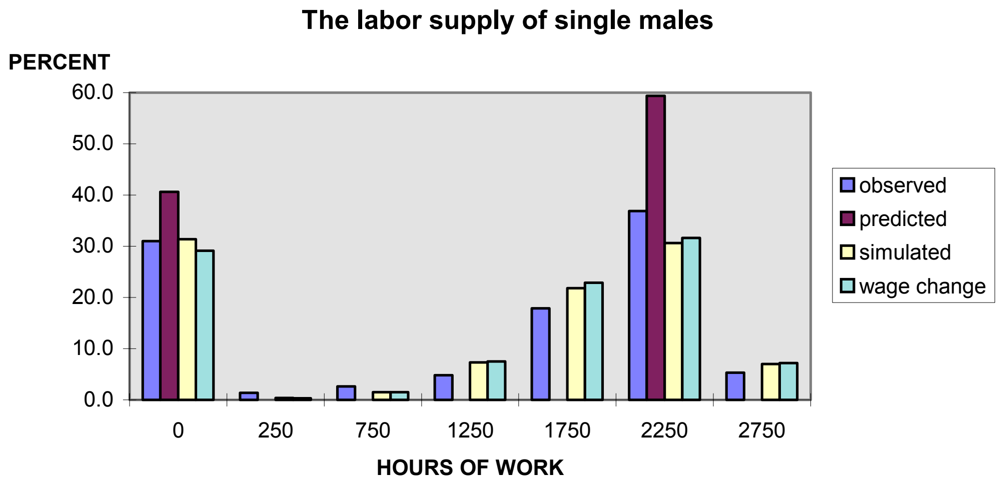


Figure 8.4

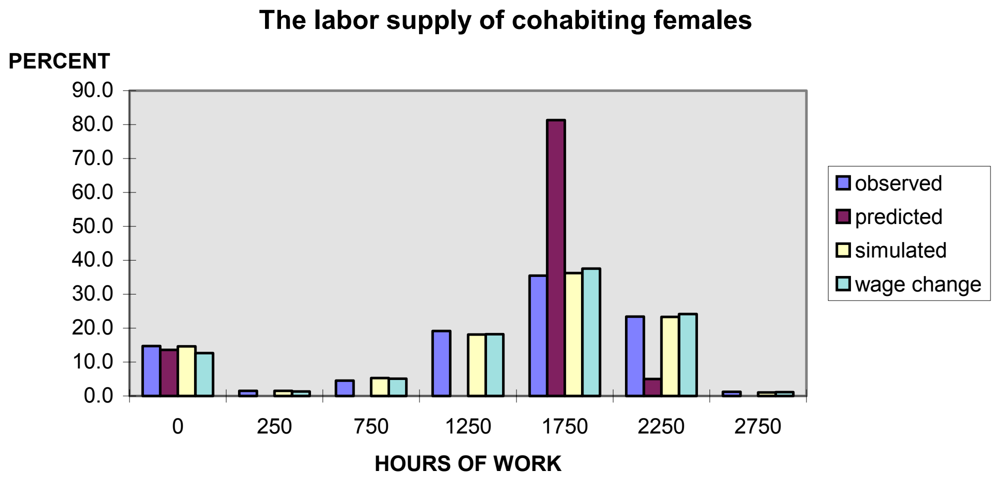
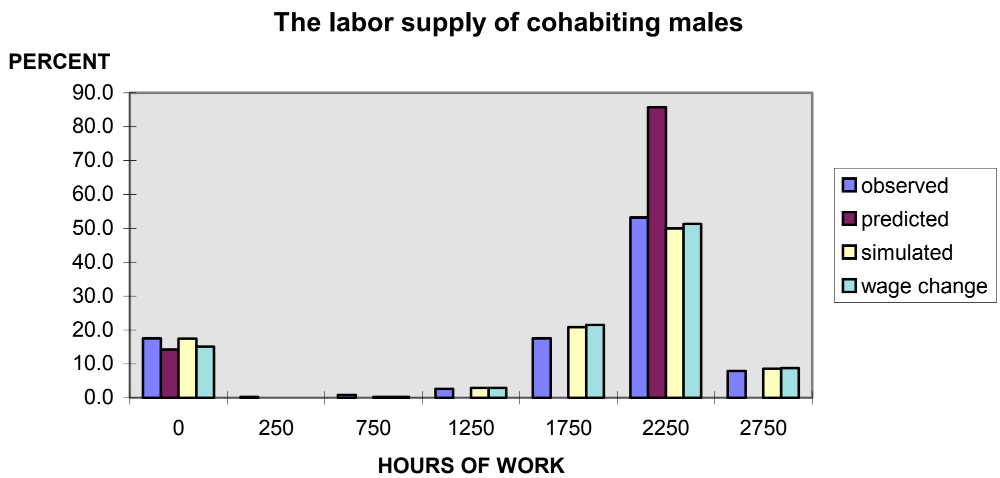


Figure 8.5



THE RESULTS FROM THE POLICY SIMULATIONS FOR SINGLE MOTHER AND TWO-ADULT HOUSEHOLDS (section 9)
FIGURES 9.1-9.6

Figure 9.1

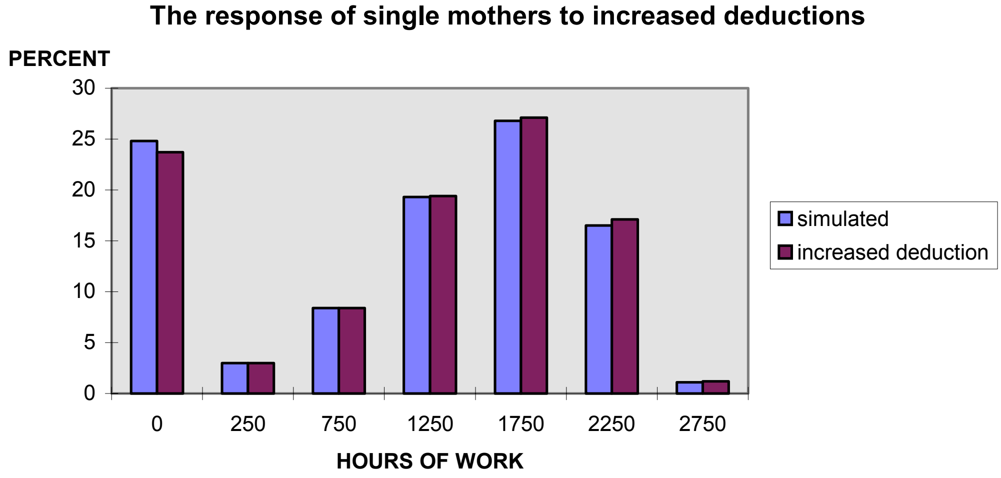


Figure 9.2

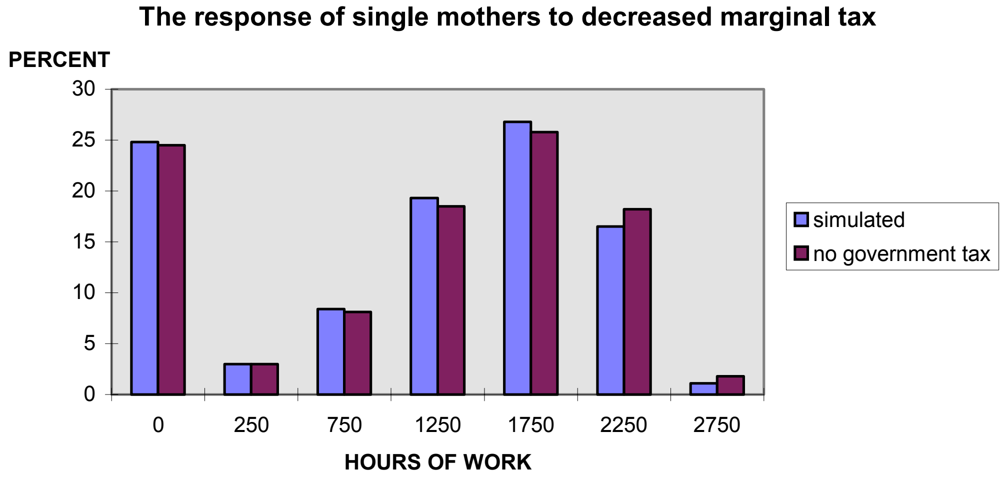


Figure 9.3

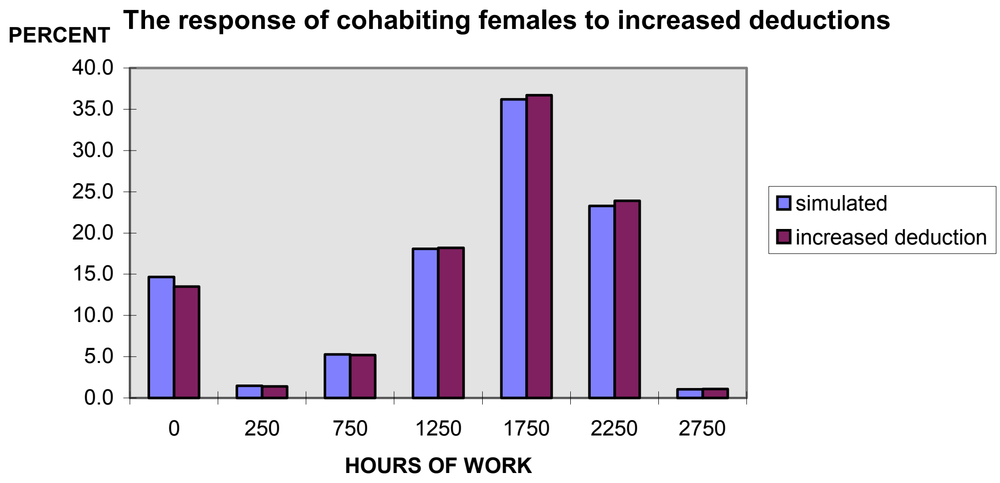


Figure 9.4

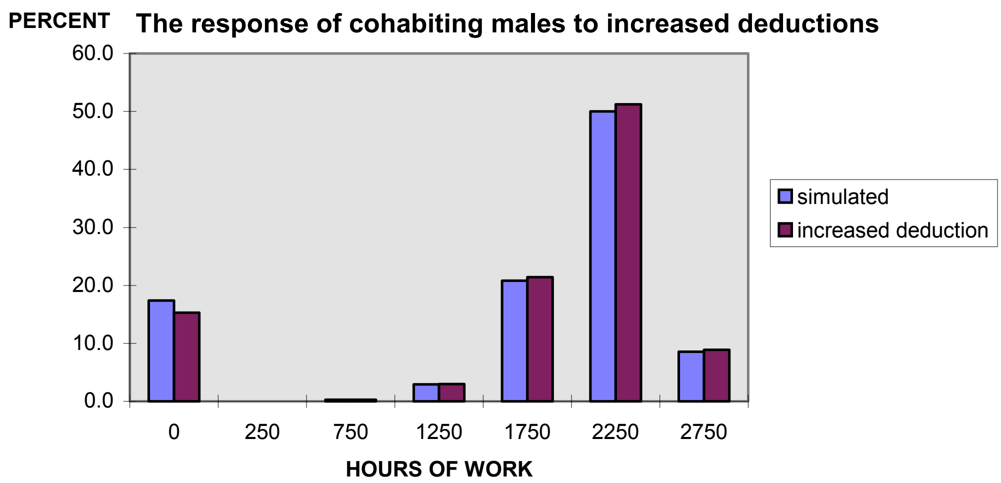


Figure 9.5

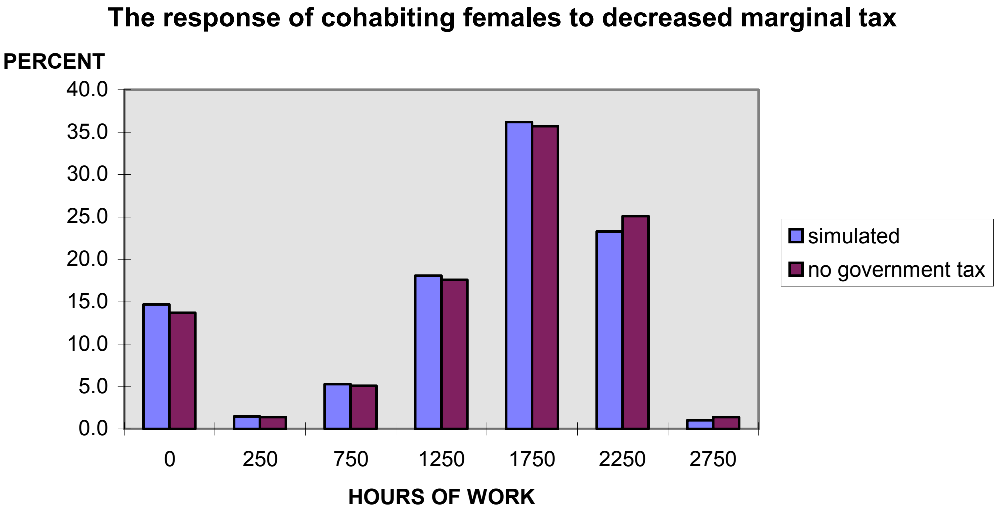


Figure 9.6