Labor Supply Responses and Welfare Effects from Replacing Current Tax Rules by a Flat Tax: Empirical Evidence from Italy, Norway and Sweden

by

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Abstract

This paper employs a microeconometric framework to examine the labor supply responses and the welfare effects from replacing current tax systems in Italy, Norway and Sweden by a flat tax on total income. The flat tax rates are determined so that the tax revenues are equal to the revenues as of 1992. The flat tax rates vary from 23 per cent in Italy, 25 per cent in Norway, to 29 per cent in Sweden. In all three countries the labor supply responses decline sharply with pre-reform disposable income. The results show that the efficiency costs of the current tax systems relative to a flat tax may be rather high in Norway and much lower, but positive, in Italy and Sweden. In all three countries "rich" households — defined by their pre-tax-reform income — tend to benefit (in terms of welfare) more than "poor" households. In Italy and Sweden a majority will lose from a shift to a flat tax, while in Norway a majority is predicted to win.

Key words: Labor Supply, Taxation, Microeconometric Cross-Country Analysis.
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1. Introduction

In recent years there have been a growing concern in many OECD-countries about the costs of redistribution. Tax reforms have been introduced with the purpose of enhancing economic efficiency. According to the conventional wisdom in economics to achieve this goal the income tax schedules thus have to be made less progressive. The reforms that have been introduced have been based on this wisdom to an extent that the marginal tax rates faced by top rate earners have dropped from 70-80 per cent to around 40-50 per cent, Blundell (1996). Hence, since the late 1980's the tax systems of most OECD-countries have been changed towards a proportional tax schedule.

Institutional changes that have taken place in Europe have added to the growing concern about the costs of progressive income tax schedules, which in the early 1980's also differed with respect to the degree of progressitivity across European borders. An important aspect to the institutional changes that took place in EU was the introduction of the socalled four liberties: Free mobility of goods, services, labor and capital. These four liberties have created a new climate of competition which makes it costly to maintain tax systems that differ substantially across nations within the European Economic Area.

Labor has normally been considered to be the least mobile factor, at least when judged on the basis of European data. The dismantling of country-specific barriers may increase the mobility in European labor markets. Cultural differences and language problems may, on the other hand, have a substantial negative effect on mobility. Yet, the removal of mobility costs and the fact that (some) high skilled workers and professionals are rather mobile may in the long run prevent European nations from allowing for significant differences in the taxation of labor income. Thus, tax system competition may arise as a result of EU's introduction of the four liberties. Since progressive tax systems normally tax the higher income of skilled workers and professionals more heavily than the lower income of the lesser skilled, tax system competition may strengthen the current trend away from highly progressive tax schedules. These current trends towards less progressive tax schedules and the tax discussions going on within EU is the motivation behind this paper.

To analyze the impact on household behavior and welfare of a sharp movement away from progressive tax schedules we have taken the extreme position of analyzing the possible outcome of replacing "current" tax systems by a flat tax. We have employed a labor supply model — estimated on data from three countries (Norway, Sweden and Italy) — to simulate labor supply responses of married couples from replacing the tax systems as of 1992 by a flat tax on total income. The focus on married couples is motivated by the fact that married females are considered to be more responsive to changes in tax rates than other individuals. The mean level and distribution of the labor supply responses depend on preferences,

demographic and educational structure, tax and benefit rules, and other institutional constraints. Although the estimates of some of the key parameteres are quite equal across the three countries, other parameters as well as tax systems and other aspects of the choice environment differ. From a methodological point of view it is of interest to study whether country-specific variations in preferences and budget constraints create significant differences in the labor supply responses when the households are exposed to similar changes in tax rules.

Key features of our modeling framework, that distinguishes it from more traditional labor supply modeling say, the Hausman approach, Hausman (1979, 1980, 1981, 1985) are:

- flexible functional form of the utility function that allows for rather general labor supply functions,
- exact representation of tax and transfer rules when estimating the model,
- restrictions on offered hours available in the market,
- joint decisions of married couples.

Like Dickens and Lundberg (1993) we assume offered hours to be drawn from a market distribution. In contrast to Dickens and Lundberg (1993) we do not introduce a fixed maximum of jobs available for each individual. Moreover, and as apposed to Dickens and Lundberg (1993), we allow each job to be characterized by more than one attribute say, a fixed quantity of hours, a wage rate and non-pecuniary attributes. The opportunity sets, describing the sets of jobs available for the individual, is allowed to vary across individuals. Individuals differ with respect to skills, education and age, and consequently the opportunity sets differ across individuals. To account for unobserved differences in preferences as well as in opportunity sets out labor supply model allow for random, preferences and random opportunity sets.

Heterogeneity, observed as well as unobserved, is an important aspect of our modeling framework. This is so not only when estimating the model but also when the model is used in policy experiments. Thus, labor supply elasticities as well as the impact on labor supply of changes in the tax schedules are derived from stochastic simulations. In reporting the results we also show how these results differ with respect to variations in observed household characteristics. According to Atkinson (1995) too few empirical welfare analyses take heterogeneity into account when policy experiments are analyzed and reported.

Since the purpose of this paper is to compare the outcomes of a tax experiment on a model estimated on data from three countries, we will not go into details with respect to the econometric model.

The paper is organized as follows. Section 2 gives a brief, but self-contained, description of our policy evaluation methodology which is based on a particular framework of modeling labor supply, see Dagsvik (1994) and Aaberge, Colombino and Strøm (1998) for

further details. The empirical specifications of the model and the estimation results, based on Italian, Norwegian and Swedish tax return data for married couples, are given in Appendix 1. Section 3 reports the policy simulation results, and Section 4 summarizes our findings.

2. Methodological framework

Our policy evaluation methodology relies on a microeconometric labor supply model. Labor supply behavior is analysed as a discrete choice problem, where the choice-alternatives are "job-packages". These job-packages are characterized by specific attributes such as wage rates, hours of work and other non-pecuniary variables. In addition, this framework is able to take into account that there are quantity constraints in the market, in the sense that different types of jobs are not equally available to every agent. Agents differ by qualifications, and jobs differ with respect to qualifications required.

Labor supply models are helpful devices for examining individual welfare effects from tax reforms. Normally, the welfare effects are measured by various Hicks-compensating measures, see Auerbach (1985), Hausman (1981) and King (1987) for a discussion of alternative money metrics of welfare change, and Hammond (1990) for arguments in favor of using Equivalent Variation (EV). Loosely speaking, EV is measured as the amount of money that has to be added to/subtracted from the household's disposable income under the initial tax rules in order to make the household indifferent between the intial and the alternative tax system. Note that EV is measured at the household level. EV sums up the household's net welfare gain/loss associated with behavioral responses induced by tax reforms, say, increased consumption and reduced leisure.

An empirical micro-model — such as the one we apply here — is designed to account for observed as well as unobserved heterogeneity. Unobserved heterogeneity arises from the fact that as econometricians we are unable to observe all factors that affect individual tastes and opportunities. These unobservables are modeled as random variables, which imply that a money metric of welfare change, at the household level, such as EV, becomes a random variable; see King (1987) and Atkinson (1990). In other words, micro-econometric models allow for studying the distribution of EV. The mean of this distribution is the overall mean of the welfare gain or loss which indeed can be interpreted as being derived from an utilitarian social welfare function. Note that most empirical analyses of tax reforms solely report the mean EV, see e.g. Hausman (1985), Hausman and Poterba (1987) and Blomquist (1983), despite the fact that microeconometric models with heterogeneous agents are estimated. Heterogeneous preferences and opportunity sets are important not only for estimation, but also for welfare analysis. Our approach allows for an evaluation that identifies both losers and winners.

2.1. The Simulation Framework

We will first give a brief outline of the microeconometric model. For expository reasons we focus on an one-person household. Next we will explain how the simulations have been performed.

Each agent is assumed to face a set of non-market and market opportunities. These sets may vary across households. A market opportunity is characterized by hours *h*, a wage rate *w* and other characteristics beyond hours and wages, say commuting time and the working environment. We let *j* summarize these other characteristics. A non-market opportunity carries zero hours and zero wage rates, but also in this case there may be many different opportunities according to different leisure and home production activities. Let $U_i(C,h,j)$ denote the utility for agent *i* of consumption *C*, hours *h* (or, equivalently, leisure, with a positive marginal utility of leisure) and other job-characteristics *j*. The argument *j* in the utility function accounts for the fact that the agent's preferences may vary across job characteristics beyond hours of work and the wage rate.

The economic budget constraint is given by

$$C = f(wh, I)\ , \tag{1}$$

where *I* is non-labor income and *f* is a function that transforms gross income into after-tax income. To this end we suppress the fact that the f-function should have a subscript *i* to indicate that tax deductions vary across households. The price index of the composite good (called consumption) is equal to one. When inserting the budget constraint into the utility function we get $U_i\ (f(wh,I),h,j)$. We will assume that

$$U_i(f(wh,I),h,j) = v_i(f(wh,I),h)\varepsilon_i(h,w,j) \tag{2}$$

where $v(C,h)$ is a positive, deterministic function which is quasi-concave in (C,h), increasing in the first argument and decreasing in the second. The term $\varepsilon_i(h, w, j)$ is a random taste-shifter that is supposed to capture the effect of unobservable attributes associated with opportunity *j*. Note that this term is viewed as random from the econometrician's point of view, while it is assumed known to the agent. Specifically $\varepsilon_i(h, w, j)$ accounts for the fact that for a given agent, tastes may vary over opportunities, hours and wages, and for a given opportunity, tastes may vary across agents. Let $B_i(h,w)$ denote the set of market opportunities with hours *h* and wage rate *w* that are feasible to agent *i*, whilst $B_i(0,0)$ is the set of non-market opportunities. The set B_i contains opportunities with fixed hours and wages, and where the remaining characteristics, captured by *j*, vary. Thus,

$j \in B_i(h,w)$, $h \geq 0$, $w \geq 0$. Again, we may assume that the sets B_i are known to the agents, but unknown to the econometricians. Finally, define

$$V_i(h,w,I) = max_{j \in B_i(h,w)} U_i(f(wh,I),h,j). \tag{3}$$

For agent *i*, $V_i(h,w)$ is the utility of the most preferred opportunity among the feasible opportunities with hours *h* and wage rate *w* and can be considered as the conditional indirect utility function, given hours of work and the wage rate.

From (2) and (3) we get

$$V_i(h,w) = \psi_i(h,w,I)e_i(h,w) \tag{4}$$

where

$$e_i(h,w) = max_{j \in B_i(h,w)} \varepsilon_i(h,w,j) \tag{5}$$

and

$$\psi_i(h,w,I) = v_i(f(wh,I),h). \tag{6}$$

Recall that hours and wage rates are fixed for each job so that when a job has been chosen, then hours and wage rate follow. The individual agent is assumed to choose the job from his/her opportunity set that maximizes utility. The corresponding hours and wage rate, (h,w), therefore follow from maximizing $V_i(h,w,I)$.

In order to obtain an explicit expression for the structure of the choice probabilities of realized hours and wage rates we have to make further assumptions about the distribution of the random components in this model. When the the taste-shifters are i.i.d. with distribution

$$P(\varepsilon_i(h,w,j) \leq y) = \exp\left(-\frac{1}{y}\right) \quad y > 0\,, \tag{7}$$

Dagsvik (1994) has demonstrated that the choice probabilities attain a multinomial logit form. To deal with the problem of unobserved opportunity sets we specify densities that reflect the distribution of the opportunities. The parameters of these densities may depend on observed characteristics.

Let $\varphi(h,w)$ be the probability that agent *i* shall choose a job with hours and wage rate (h,w). In Dagsvik (1994) it is then shown that

$$\varphi_i(h,w,I) \equiv P\left[V_i(h,w,I) = \max_{x,y} V_i(x,y)\right] = \frac{\psi_i(h,w,I)\, g_{i0}\, g_i(h,w)}{\psi_i(0,0,I) + g_{i0} \int_{x>0} \int_{y>0} \psi_i(x,y,I)\, g_i(x,y)\, dxdy} \quad (8)$$

for $h > 0, w > 0$.

The probability of not working equals

$$\varphi_i(0,0) = \frac{\psi_i(0,0)\, g_{i0}}{\psi_i(0,0) + g_{i0} \int_{x>0} \int_{y>0} \psi_i(x,y)\, g_i(x,y)\, dxdy} \quad (9)$$

The density function $g_i(h,w)$ can be interpreted as the mean of the fraction of jobs with hours h and wage rate *w* that are available for the individual. This density function arises from the fact that in the opportunity sets there are unobservable (to the econometrician) attributes associated with jobs with hours *h* and wage rate *w*. Similarly, g_{i0} is the mean of the fraction of opportunities that are feasible job-opportunities. g_{i0} will be less than 1 if there is a rationing of jobs, i.e. unemployment. Thus, this labor supply model can be estimated in an environment where there is unemployment. Note that the opportunity density, $g_i(\cdot,\cdot)$ may depend on the production technology of the firms as well as of the wage setting policies of the firms and the unions.

The functional form of (8) and (9) is particularly attractive. The labor supply density $\varphi(h,w)$ is expressed as a simple function of the structural term of the utility function, $\psi(\cdot)$, and of $g_0 g(\cdot)$, which is an aggregate representation of the set of feasible job opportunities. The extension of the model to deal with the joint decisions of husband and wife is analogous to the case of single person households. Then the household is assumed to have preferences over household consumption and leisure for the husband and wife. For further details about the microecometric model we refer to Aaberge et al. (1998).

The model has been estimated on Swedish (1981), Norwegian (1986) and Italian data (1987). In all three datasets the population is restricted to married couples. Households with an income from self-employment that exceeds 20 per cent of total gross income are excluded from the samples. For the included households, income from self-empolyment and capital-income have been added to net household income and are treated as exogeneous. We have restricted the ages of the husband and the wife to be between 20 and 68 years old. The sample sizes vary from 1640 in Sweden to 2960 in Italy. The Swedish data set does not allow us to estimate participation probabilities. However, the Swedish participation rates in 1981 were very high, even for females, and we might have gained little from including participation/non-participation observations in estimating the model. Empirical specifications and estimation results are reported in Appendix 1.

The estimated models are used to simulate the labor supply, incomes and tax revenue that follow from imposing the 1992 tax systems in all three countries. For Norway we have used the population characteristics of 1992 in the simulation experiment, whilst for the two other countries we have employed the characteristics used in estimating the model. For all three countries we have used all details of the tax system as of 1992 to simulate labor supply, incomes and tax revenue in 1992. Next, we have run the model to simulate the behavioral and welfare effects of replacing the 1992 system by a flat tax on total income. Note that these simulation experiments are stochastic because the choice opportunities and the preferences are random from the econometrician's point of view. Furthermore, it should be emphasized that the results reported below depend on the population characteristics and consequently, these result may change when these characteristics change.

The stochastic simulations are done in the following way. First, for each household we draw wage rates (male and female) from the wage distribution for the household. Throughout the experiments we keep this wage rates fixed. Second, for each household *i* we draw r points: $\left(h_{Mi}(t), h_{Fi}(t), \varepsilon_i(t)\right); t = 1,2,...,r;$ where the subscripts attached to hours indicate male and female. Offered hours that are feasible for each household are drawn from a uniform distribution with full-time and part-time peaks, while $\varepsilon_i(t)$ are drawn from the distribution given in (7). The optimal pair of jobs for each married couple is then derived from maximizing the utility function, given in (2), with respect to t; that is the jobs that yield the highest utility for the household are chosen.

Welfare gains and losses are measured by Equivalent Variation (EV). To describe the method of calculation it appears convenient to introduce the following notation. Let

$$\tilde{V}_i(EV, f) \equiv \max_{h,w} \max_{j \in B_i(h,w)} \left(U_i\left(EV + f(hw, I), h, j\right)\right). \tag{10}$$

Note that $\tilde{V}_i(EV, f)$ is the indirect utility for agent *i* under tax regime *f*, when the agent is endowed with non-taxable non-labor income EV.

We define equivalent variations for the agent as the amount EV determined by

$$\tilde{V}_i(EV, f_0) = \tilde{V}_i(0, f_1) \tag{11}$$

where the subscript 0 denotes the initial (reference) tax regime, and subscript 1 the alternative tax regime. Since the utility function is random so is also EV. The parameters of the distribution of EV are assessed by means of stochastic simulations.

3. Results of simulations

3.1 Labor Supply Elasticities

For each country the labor supply elasticities are derived by predicting labor supply (by stochastic simulation) for each household (wife and husband) when the tax rates are increased by 1 per cent. Individual responses are averaged across households to yield aggregate labor supply elasticities. Note that the elasticities depend on preferences, demographic and educational structure, tax functions and other constraints prevailing in the years that the elasticities refer to. These years are the years of the datasets used in estimating the model; for Italy it is 1987, for Norway 1986 and for Sweden 1981. Aggregated uncompensated elasticities are reported in Tables 1-3. The ”estimates” of the elasticities are based on 10 sets of simulation. In Tables 1-3 we report the mean and standard deviations for each elasticity.

Table 1. Uncompensated aggregate labor supply elasticities, Italy 1987*

Type of elasticity	Male elasticities		Female elasticities	
	Own wage	Cross wage	Own wage	Cross wage
Elasticity of the probability of participation	0.046 (0.001)	-0.081 (0.002)	0.654 (0.006)	-0.357 (0.008)
Elasticity of the conditional expectation of hours supply	0.007 (0.001)	-0.035 (0.002)	0.078 (0.003)	-0.136 (0.002)
Elasticity of the unconditional expectation of hours supply	0.053 (0.002)	-0.116 (0.002)	0.737 (0.006)	-0.489 (0.008)

*Standard deviations in parentheses.

Table 2. Uncompensated aggregate labor supply elasticities, Norway 1986*

Type of elasticity	Male elasticities		Female elasticities	
	Own wage	Cross wage	Own wage	Cross wage
Elasticity of the probability of participation	0.17 (0.004)	-0.03 (0.004)	0.37 (0.009)	-0.12 (0.008)
Elasticity of the conditional expectation of hours supply	0.11 (0.002)	-0.05 (0.004)	0.54 (0.007)	-0.12 (0.008)
Elasticity of the unconditional expectation of hours supply	0.28 (0.005)	-0.08 (0.005)	0.91 (0.11)	-0.24 (0.014)

*Standard deviations in parentheses.

Table 3. Uncompensated aggregate labor supply elasticities, Sweden 1981*

Type of elasticity	Male elasticities		Female elasticities	
	Own wage	Cross wage	Own wage	Cross wage
Elasticity of the conditional expectation of hours supply	-0.020 (0.001)	-0.021 (0.002)	0.070 (0.006)	-0.065 (0.008)

*Standard deviations in parentheses.

Tables 1-3 indicate that in all three countries female labor supply is more responsive than male labor supply. Moreover, the cross wage elasticities are all negative and sizeable relative to the own wage elasticities. This latter result is important to keep in mind when microeconometric results- as those reported here – are compared with labor supply elasticity estimates based on aggregate time series. The latter often tend to be lower than microeconometric based estimates of the own wage elasticities. However, the results reported here suggest that the time series estimates based on aggregate data might be downward biased when considered as estimates of the own wage elasticities. Wage rates for males and females typically vary in a similar way over the business cycle. Although estimation based on aggregate time series data often are done separately for males and females, very few time series analysts account for the fact that most adults live together in marriage or cohabitation. Consequently, they estimate the impact on labor supply of a simultaneous change in male and female wage rates over time, and where the own-wage effects are not disentangled from the cross effects. Therefore, time series analysts tend to pick up the net effect defined as the own wage rate elasticity minus the cross wage elasticity. Also in our microeconometric model we get low net effects. For instance in the case of Italy we observe that the net effect on labor

supply, given participation, is numerically small and negative both for men and women. The last row of Table 1 gives the labor supply elasticities in the total population and we observe that the net effect of an overall wage increase across gender dampens the labor supply response quite drastically compared to the impact given by the own wage elasticies. From Tables 1-3 we observe that this pattern is the same across countries.

Despite the differences in the choice environments and to some minor extent the differences in preferences across the three countries, the labor supply elasticities are quite similar. The labor supply elasticities suggest that the working females in Italy and Sweden are less responsive than in Norway. Since the late 1960s the female participation rate in Sweden has been the highest in the world. Thus, for the last two-three decades the labor market attachments of Swedish women have been very much the same as for men in Sweden. In addition Sweden is a highly unionized country with strict regulations of working hours. From Table 3 we see that the labor supply elasticities both for Swedish men and women are numerically small. We note that the mean labor supply curve for Swedish men even tend to be backward bending. The weak labor supply responses, given participation, in Italy may be due to relative high rigidity of working hours. This rigidity implies – like in Sweden - a more stringent choice for Italian workers: Either a normal "9 to 5" working day or not working at all; for further details about rigidity of working hours in Italy, see Di Tommaso(1998) and Malerba (1995).

The high rigidity of working hours in Italy and Sweden is well documented in OECD statistics. According to OECD (1997), the ratios of part time jobs to full time jobs in Sweden and Italy in 1996 were among the lowest in OECD-Europe (23.5 per cent and 20.9 per cent, respectively). By contrast, the part-time ratio in Norway was 46.5 per cent which was the second highest in OECD Europe. Thus, the Norwegian labor market is rather flexible by European standards[4]. These differences across countries in the rigidity of offered working hours are indeed reflected in the estimates of g_0 reported in Appendix 1. Rigidity of working hours may explain why labor supply elasticities are low.

Tables 1 and 2 demonstrate that the participation decision in Italy is more responsive to changes in the economic incentives to work than in Norway. Given the differences in rigidity of working hours alluded to above, this result may appear to be counterintuitive. However, because the participation rate among married females in Italy is rather low by Scandinavian standards, there is a larger potential for increased participation in Italy than in the Scandinavian countries. The lower the participation rate is, the higher is the percentage increase in participation when working incentives are improved.

[4] As an example, in Statistics Norway, which employs around 800 people, mostly women, there are above 60 different contracts of working hours.

In Tables 4-6 we illustrate the variation of the labor supply elasticities with household income. To our knowledge very few labor supply analysts report how labor supply elasticities vary with income. One reason why might be that often as in the Hausman model, a linear labor supply function is assumed. Hence, it is assumed a priori that labor supply elasticities increase with the wage rate and decrease with hours worked.

A striking similarity across the three countries is the decline of the labor supply elasticities with income. For the richest household the labor supply elasticities for both gender are close to zero, and they are even negative for males in Sweden and Italy but also for females in Sweden. Thus, for the poorest household the labor supply curve is upward sloping, while for the richest it tends to be backward bending.[5]

Table 4. Income-dependent uncompensated aggregate elasticities, Italy 1987

Type of elasticity	Deciles in the disposable income distribution	Male elasticities		Female elasticities	
		Own wage	Cross wage	Own wage	Cross wage
Elasticity of the probability of participation	10 percent poorest	0.053	-0.109	2.837	-1.089
	80 percent in the middle	0.051	-0.086	0.742	-0.356
	10 percent richest	-0.010	-0.013	0.031	-0.122
Elasticity of the conditional expectation of hours supply	10 percent poorest	0.021	-0.017	0.467	-1.410
	80 percent in the middle	0.011	-0.045	0.100	-0.150
	10 percent richest	-0.030	-0.015	0.004	-0.600
Elasticity of the unconditional expectation of hours supply	10 percent poorest	0.075	-0.126	3.441	-1.454
	80 percent in the middle	0.062	-0.130	0.832	-0.501
	10 percent richest	-0.041	-0.029	0.035	-0.181

[5] The compensated elasticities exhibit a similar variation with income; see Aaaberge et al (1990,1993,1995,1998).

Table 5. Income dependent aggregate labor supply elasticities, Norway 1986.

Type of elasticity	Deciles in the disposable income distribution	Male elasticities		Female elasticities	
		Own wage	Cross wage	Own wage	Cross wage
Elasticity of the probability of participation	10 percent poorest	1.89	-1.04	1.85	-1.44
	80 percent in the middle	0.09	-0.08	0.66	-0.29
	10 percent richest	0.03	0.00	0.07	-0.03
Elasticity of the conditional expectation of hours supply	10 percent poorest	0.29	-0.15	1.04	-1.04
	80 percent in the middle	0.07	-0.09	0.78	-0.29
	10 percent richest	0.03	-0.01	0.12	-0.06
Elasticity of the unconditional expectation of hours supply	10 percent poorest	2.23	-1.18	3.09	-2.23
	80 percent in the middle	0.16	-0.17	1.49	-0.57
	10 percent richest	0.06	-0.01	0.19	-0.08

Table 6. Income-dependent aggregate uncompensated labor supply elasticities, Sweden 1981.

Type of elasticity	Deciles in the disposable income distribution	Male elasticities		Female elasticities	
		Own wage	Cross wage	Own wage	Cross wage
Elasticity of the conditional expectation of hours supply	10 percent poorest	0.054	-0.038	0.069	-0.031
	80 percent in the middle	-0.025	-0.019	0.034	-0.067
	10 percent richest	-0.047	-0.024	-0.037	-0.072

3.2 Tax reform simulations

The married couple version of the model outlined in Section 2 is employed to simulate labor supply responses and individual welfare effects from introducing a flat tax on income. The tax reform simulations are performed in a partial equilibrium setting, as in Browning (1987). In our framework, this means that the opportunity densities of offered wages and hours are considered as exogenously given and they are thus unaffected by a change of tax systems. Moreover, the total number of jobs are assumed to increase (decrease) with increasing (decreasing) labor supply. The results reported below may have been modified if our econometric model of labor supply had been embedded in a general equilibrium framework. For instance, an increase in labor supply due to a change of tax rules might have had a negative impact on wage rate levels and hence some second order effects on labor supply would have appeared. However, to extend our econometric model with heterogeneous agents to a general equilibrium model is not an easy task, and it is left for future work.

As mentioned above, for all three countries the estimated microeconometric models are applied to simulate labor supply, incomes and tax revenue in 1992. This year was chosen

because similar tax reforms were introduced in Norway 1992, Sweden 1990 and in Italy gradually over years in the late 1980s and early 1990s. The tax revenue is kept fixed at the 1992 level when the model is used to assess the impacts of introducing a flat tax on income.

The results of Tables 7-9 show that the labor supply responses from replacing the 1992-tax-regime ("current tax regime") by a proportional tax are rather strong in Norway, in particular for females. The labor supply responses decrease with increasing pre-reform household income, which is in line with the predictions of the income-dependent elasticities. It should also be noted that for Norway and Sweden a shift to a flat tax implies that the "poor" households experience reduced marginal tax rates and increased average tax rate. Thus, the substitution as well as the income effect predict higher labor supply. For the "rich" households both the marginal and the average tax rates decrease. Consequently, the substitution and income effects for "rich" households have different signs and thus have counteracting impacts on labor supply. In Italy the lowest marginal tax rate under the 1992 tax regime is below the proportional tax rate calculated here.

In the model employed in this paper not every working hour is equally likely to be available in the opportunity set. Opportunities with full-time working loads are more likely to be available in the choice sets. After a change to proportional taxation the market opportunities with long working hours carry lower marginal tax rates than under the 1992 regime. Thus participation may become more attractive and hours worked makes a discrete jump from zero to rather long hours. Note that a traditonal – text book - labor supply model would not be able to capture this discret jump in labor supply.

As an implication of these labor supply responses gross as well as net income increase for almost all households in all three countries. The increase in income for the "poorest" households in Norway is rather strong and follows from the strong labor supply responses. Note that the total tax revenues are kept constant at the 1992 national levels.

Table 10 reports the Gini coefficients of gross and disposable household income. The results for Norway demonstrate that even inequality in the distribution of disposable income decreases substantially, which mainly is due to the strong labor supply responses among "poor" households. By contrast, for Sweden we find that the inequality in the distribution of disposable income increases. For Italy we find only minor changes in income inequality.

Table 7. Participation rates, annual hours of work, gross income, disposable income and taxes for married couples under alternative tax regimes by disposable household income in 1992. Italy

		Participation Rates per cent		Annual hours of work: Given Participation		Annual hours of work: In the total population		Households, 1000 ITL 1992: Gross Income	Taxes[1]	Disposable income
		F	M	F	M	F	M			
	I	4.3	97.0	1529	1832	66	1777	19756	3656	16100
1992-	II	38.5	96.3	1691	2036	651	1961	44877	10845	34032
tax rules	III	70.0	94.4	1809	2053	1265	1939	90452	21047	69405
	IV	38.2	96.2	1711	2017	654	1940	46920	11146	35774
	I	4.3	97.5	1398	1855	62	1809	20394	4882	15512
Proportional	II	36.5	96.2	1712	2058	625	1981	45717	10931	34786
taxes[1]	III	67.4	94.6	1819	2091	1225	1979	91544	19132	72411
	IV	36.4	96.2	1729	2041	692	1963	47765	11146	36619

1) The proportional tax rate of 23.3 per cent is determined by model simulation when the tax revenue is held fixed equal to the 1992 tax revenue.

Note that I = 10 per cent poorest households
II = 80 per cent in the middle of the income distribution
III = 10 per cent richest households
IV = all households

Table 8. Participation rates, annual hours of work, gross income, disposable income and taxes for married couples under alternative tax regimes by disposable household income in 1992. Norway

		Participation Rates per cent		Annual hours of work: Given Participation		Annual hours of work: In the total population		Households, NOK 1992: Gross Income	Taxes[1]	Disposable income
		F	M	F	M	F	M			
	I	41.5	74.1	926	1833	386	1360	160158	36454	123705
1992-	II	77.3	98.4	1494	2432	1154	2394	372208	115816	256392
tax rules	III	96.4	99.9	2279	2846	2198	2846	650958	235295	415662
	IV	75.4	96.0	1562	2427	1178	2331	383495	119437	264058
	I	73.2	96.2	1756	2660	1286	2557	413326	102137	311189
Proportional	II	80.6	99.5	1761	2743	1419	2729	471282	116107	355175
taxes[1]	III	95.8	99.9	2311	2906	2213	2902	672104	163658	508446
	IV	81.4	99.2	1825	2751	1485	2730	485481	119445	366036

1) The proportional tax rate of 25.4 per cent is determined by model simulation when the tax revenue is held fixed equal to the 1992 tax revenue.

Note that I = 10 per cent poorest households
II = 80 per cent in the middle of the incomedistribution
III = 10 per cent richest households
IV = all households

Table 9. Annual hours of work, gross income, disposable income and taxes for married couples under alternative tax regimes. Sweden

		Annual hours of work, Given participation		Households, SEK 1992		
		F	M	Gross income	Taxes[1)]	Disposable income
1992-tax rules	I	1 147	1 903	221 966	55 757	166 209
	II	1 690	2 117	382 603	110 792	271 811
	III	1 847	2 339	706 351	245 257	461 094
	IV	1 656	2 126	401 227	119 838	281 389
Proportional Taxes[1)]	I	1 188	1 977	232 468	67 835	164 632
	II	1 721	2 209	399 407	115 211	284 195
	III	1 874	2 464	741 690	208 837	532 853
	IV	1 683	2 211	416 952	119 839	297 113

1) The proportional tax rate of 29.5 per cent is determined by model simulation when the tax revenue is held fixed equal to the 1992 tax revenue.
Note that I = 10 per cent poorest households
II = 80 per cent in the middle of the incomedistribution
III = 10 per cent richest households
IV = all households

Table 10. Gini coefficients of distributions of gross and disposable income for couples in Italy, Norway and Sweden

Tax system	Nation	Gross income	Disposable income
1992 tax rules	Italy	.243	.234
	Norway	.205	.177
	Sweden	.192	.164
Proportional taxation	Italy	.238	.238
	Norway	.165	.165
	Sweden	.202	.202

Tables 11-13 give information on the distribution of equivalent variation by household income. Due to the responsive female labor supply in Norway nearly all (99 per cent) win from replacing the 1992 tax system by a flat tax. Only a few poor households lose. In the first decile of the pre-reform income distribution 8.6 per cent is predicted to lose from having a flat tax rather than the progressive tax structure of 1992. In Italy and Sweden the proportions of losers are rather high, in fact, in these two countries a majority is predicted to lose from replacing the 1992 tax rules by a flat tax (59 and 56 per cent, respectively). In Norway and Sweden, and to some minor extent in Italy, the proportion of winners increases with rising pre-reform household income. Note that the only measure of welfare change one is allowed to report in an ordinalist framework is the fractions of losers and winners in the population.

However, if one allows for an interpersonal comparisons of utility differences based on a money measure of welfare say, EV, one can compare the magnitudes of EV given in Tables 11-13. The mean EV in all three countries is positive which suggests that there are

efficiency costs related to the 1992 tax regimes compared to proportional taxation. Tables 11-13 report the mean EV relative to the tax revenue and the results indicate that the costs of the 1992 tax system relative to a flat tax vary from 1.5 per cent for Italy, 4.8 per cent for Sweden, to as much as 34.2 per cent for Norway.

King (1987) argues that a small mean welfare gain may shadow for a large variation in gains and losses across households. Thus, King stresses the importance of accounting for heterogeneity when making welfare assessments of tax reforms. Hammond (1990) puts forward the same warnings. Our results confirm the relevance of these warnings. Although only one per cent of the population lose from the considered tax reform in Norway, between 56 and 59 per cent lose in Italy and Sweden. In Italy the mean welfare loss among the losers is ITL 1 029 000, while the mean gain among the winners is ITL 1 890 000. In Sweden the mean loss among the losers is SEK 8 252, while the mean gain among the winners is approximately three times higher.

Table 11. Distribution of equivalent variation by household income[1)] under 1992-taxes. Italy

Equivalent variations, 1000 ITL 1992								
Total			Losers			Winners		
	Mean	EV relative to average tax Per cent	Per cent of popu-lation	Mean	EV Relative to Average tax Per cent	Per cent of popu-lation	Mean	EV relative to average tax Per cent
I	165	4.5	58.5	-1032	-28.0	41.5	1860	51.8
II	120	1.1	60.1	-1030	-9.6	39.9	1855	16.7
III	517	2.5	51.8	-1008	-4.8	48.2	2157	10.3
IV	164	1.5	59.1	-1029	-9.4	40.9	1890	16.5

1) Note that I = 10 per cent poorest households
II = 80 per cent in the middle of the distribution of households' disposable income
III = 10 per cent richest households
IV = all households

Table 12. Distribution of equivalent variation by household income[1)] under 1992-taxes. Norway

Equivalent variations, NOK 1992								
	Total			Losers			Winners	
	Mean	EV relative to average tax Per cent	Per cent of popu-lation	Mean	EV Relative to Average tax Per cent	Per cent of popu-lation	Mean	EV relative to average tax Per cent
I	21799	59.8	8.6	-3694	-11.8	91.4	24132	65.1
II	38199	33.0	0.3	-1301	-2.2	99.7	38288	33.0
III	80811	34.3	0.0	-	-	100.0	80811	34.3
IV	40804	34.2	1.0	-3425	-9.9	99.0	41258	34.2

1) Note that I = 10 per cent poorest households
II = 80 per cent in the middle of the distribution of households' disposable income
III = 10 per cent richest households
IV = all households

Table 13. Distribution of equivalent variation by household income[1)] under 1992-taxes. Sweden

Equivalent variations, SEK 1992								
	Total			Losers			Winners	
	Mean	EV relative to average tax Per cent	Per cent of popu-lation	Mean	EV Relative to Average tax Per cent	Per cent of popu-lation	Mean	EV relative to average tax Per cent
I	-8451	-15.2	95.2	-9420	-17.5	4.8	10503	13.0
II	1960	1.8	58.4	-8350	-9.6	41.6	16433	11.3
III	49962	20.4	3.6	-7642	-7.2	96.4	52139	20.3
IV	5722	4.8	56.6	-8525	-10.5	43.4	24291	14.3

1) Note that I = 10 per cent poorest households
II = 80 per cent in the middle of the distribution of households' disposable income
III = 10 per cent richest households
IV = all households

4. Summary and discussion

The current trend in tax reforms which has implied a sharp movement away from highly progressive taxes which may be further strengthened by a possible tax system competition (Sinn, 1997) may change the current progressive tax systems in Europe towards a proportional tax on income. This process may lead to proportional tax rates that differ across country to account for initial differences in tax revenues.

The objective of this paper is to examine the welfare effects for married couples from replacing current tax systems by a proportional labor income tax. To broaden the relevance of our study we compare Norway and Sweden with Italy, which has a low degree of progression in the taxation of labor income by Scandinavian standards. Based on a microeconometric labor supply model estimated on data from the three countries , we have simulated labor supply responses and welfare gains and losses for married couples from replacing the

country-specific 1992-tax systems by proportional taxation. The flat tax rates are chosen so as to keep the tax revenues fixed and equal to the country-specific 1992-revenue. The simulation results show that the proportional tax rates vary from 23 (Italy), 25 (Norway) to 29 percent (Sweden) which are close to the current tax rates on capital income. The mean welfare effect from introducing proportional taxation is found to be positive which indicates that there are efficiency costs associated with the current progressive labor income taxes. However, the results reveal large variation in the distribution of welfare gains and losses. Rich households — defined by their pre-reform income — tend to benefit in welfare terms more than the poor. Moreover, the losers tend to have lower pre-tax-reform incomes than the winners.

In the calculation of welfare gains and losses at the household level we have employed the widely used concept of Equivalent Variation (EV). EV is a money measure of the welfare change and may be interpreted as a money measure of the household's willingness to accept the current tax system instead of having an alternative tax system say, a flat tax on income. If EV is positive, then the household considers the alternative tax system to be better than the current one. Although the aggregate of EV across households is a commonly used money measure of welfare change in the total population, (see Rosen(1996) for a recent application), it is also a rather controversial one, and for two reasons. First, it requires a particular cardinalization of households' utility functions that should also be comparable across households. Second, it implies an utilitarian social welfare function where all households are given equal welfare weigths. However, in case we do not permit the utility differences to be comparable across households, judgements based on an ordinal representation of preferences nevertheless allow for determining the losers and winners of the reform. In our case a majority in Italy and Sweden lose from having a flat tax on labor income, while in Norway a majority wins. Thus, if a flat tax rate reform were to be decided in a referendum, our results indicate that it would have received a yes in Norway and a no in Sweden in Italy. However, it should be emphasized that these results depend, *inter alia*, on the demographic and educational structure of the households used in the simulations.

Female labor supply responses are high in Norway and modest in Italy and Sweden. The weak labor supply responses for Italy are due to rigidity of working hours in the opportunity sets and to the fact that the 1992 tax system did not differ much from a proportional tax system, whilst the low responses in Sweden may be due to stricter regulations of working hours and high incomes.

The transition from progressive to proportional taxation reinforces the efficiency gains from a freer trade in Europe caused by the dismantling of borders. Then one may ask whether the reduction in loss of efficiency is attained at the cost of increased income and welfare inequality. Our results, however, do not indicate any sharp increase in income

inequality. On the contrary, in the case of Norway we find that the inequality in the distribution of gross household income is reduced to an extent that the distribution of the net household income is even made more equal. However, when the value of leisure is taken into account, we find that the welfare of rich households, measured by EV, — in particular in Norway — increases far more than the welfare of poor households.

Appendix 1. Empirical specifications and estimation results

The specifications of the utility functions and the opportunity density are nearly the same across the three countries; Italy, Norway and Sweden.

Utility functions

The utility function is a Box-Cox transformation of disposable income = household consumption and leisure, with the exception that for Italy utility is an exponential function of consumption with dummies reflecting labor market participation in front of this function. This specification allows for a *lower* marginal utility of consumption when one of the spouses are reported not working. The justification for this specification is that in Italy there is believed to be a considerable underreporting of income relative to the situation in Norway and Sweden. When one of the spouses is reported not to work he or she may in fact work and hence the actual income and household consumption may be higher than observed. Because the marginal utility of consumption is declining with consumption our specification should allow for a negative shift in the marginal utility of consumption when income of one of the spouses is reported to be zero. When we assumed the same structure for Italy as for Norway and Sweden, together with allowing for dummies in front of the consumption term, the estimation of the coefficients did not converge to permittable magnitudes.

Opportunity densities

The opportunity densities consist of three parts. The *opportunity density for wages* is log-normal with the expectation depending on years of schooling and work experience. For Italy a regional dummy is introduced to capture the fact that the opportunities are quite different in the northern part of Italy relative to the southern part. The density of feasible job opportunities for Norwegian women depend on their education level, while in the case of Italy the regional distinction between Northern and Southern Italy together with local unemployment are considered to be important observable characteristics affecting job opportunities for males as well as for females. Unemployment was virtually non-existent in Norway and Sweden for the years covered by the data sets. Note that in the case of Sweden we estimate the model contingent upon the fact that both spouses work. In the 1980's the participation rate of Swedish women was so high — at the level of male participation — that to try to explain the non-participation of Swedish women by a utility maximizing behavior might have contaminated all estimates. Thus, in the Swedish case the model is estimated contingent upon observed wages and participation, and consequently there is no need to bring in opportunity densities for wages and jobs in this case.

For all three countries offered hours are assumed to be uniformly distributed apart from a peak at full hours for males. For females we allow the opportunity density for hours to vary across the three countries. In the Italian case the rigidity in the labor market is believed to be either a normal "9 to 5" working day or not working at all, Di Tommaso (1998). Consequently, in the Italian case offered hours follow the same pattern across gender. In the Nordic welfare states more emphasize has been on offered married women a higher flexibility to combine work outside the household with family life. Thus, for Norway and Sweden we assume that for institutional reasons part-time work is typically offered. Sweden has a long tradition of regulating for labor market, so in the Swedish case we assume that there more institutionally set peaks in the distribution of offered hours than in Norway. Thus, for Swedish women offered hours are assumed to be uniformly distributed apart from peaks at full-time, 2/3 part-time and part-time, while in Norway we exclude the 2/3 part-time peak.

Norway

Let the subscript *F* and *M* denote female and male, respectively. In the case of married couples the structural part of the utility function defined by (6) is

$$\begin{aligned} \log v(C,h_F,h_M) = \alpha_2 &\left(\frac{\left(10^{-4}C\right)^{\alpha_1}-1}{\alpha_1}\right)+\left(\frac{L_M^{\alpha_3}-1}{\alpha_3}\right)\left(\alpha_4+\alpha_5 \log A_M+\alpha_6(\log A_M)^2\right) \\ &+\left(\frac{L_F^{\alpha_7}-1}{\alpha_7}\right)\left(\alpha_8+\alpha_9 \log A_F+\alpha_{10}(\log A_F)^2+\alpha_{11}CU6+\alpha_{12}CO6\right) \end{aligned} \tag{A.1}$$

where A_F, A_M are the age of the wife and the husband, respectively, *CU*6 and *CO*6 are number of children less than 6 and above 6 years, L_K is leisure for gender $k = M, F$, defined as

$$L_K = 1 - h_K / 8760, \tag{A.2}$$

and α_j, $j = 1,2,\ldots,13$, are unknown parameters.

If $\alpha_1 < 1, \alpha_3 < 1, \alpha_7 < 1, \alpha_2 > 0,$

$$\alpha_4 + \alpha_5 \log A_M + \alpha_6 (\log A_M)^2 > 0,$$

and

$$\alpha_8 + \alpha_9 \log A_F + \alpha_{10} (\log A_F)^2 + \alpha_{11} CU6 + \alpha_{12} CO6 > 0$$

then $\log v(C, h_F, h_M)$ is increasing in *C*, decreasing in (h_F, h_M) and strictly concave in (C, h_F, h_M).

It is assumed that the offered hours are not correlated with offered wage rates, which may be justified by the fact that in most countries working hours are regulated by law or set in central negotiations between unions and employers associations. The fraction of jobs with a given number of hours is assumed to be consistent with a uniform distribution of hours apart from a peak at full-time hours for males and part-time hours for females. The fraction of jobs with a given wage rate is assumed to be a log normal density with gender-specific means that depend on length of schooling and on experience. "Experience" is defined as age minus length of schooling minus six. The opportunity density of feasible jobs is assumed to have a constant mean in the case of males and to depend on education in the case of females, with the coefficient α_{14} measuring the impact of education on female job opportunities.

The results from estimating the model on Norwegian data from 1986 are given in Table 14.

Note that most parameters are rather precisely determined and have the theoretically expected signs.

The estimates are in accordance with the theory in the sense that the mean utility function is an increasing and strictly concave function in consumption and leisure. The males marginal mean utility of leisure in Norway attains a minimum at the age of 41.9 years and in the case of females, at the age of 35 years. The wife's education turns out to affect the fraction of feasible job opportunities such that a higher educated woman has more job opportunities than a less educated one. (Implied by $\hat{\alpha}_{14} < 0.$)

For the estimate of the wage opportunity density we refer to Aaberge et al. (1995).

Table 14. Estimates of the parameters of the utility function and of the opportunity density. Norway 1986

Variables	Coefficient	Estimates	t-values
Preferences:			
Consumption	α_1	0.951	16.4
	α_2	1.269	5.6
Male leisure	α_3	-4.312	6.8
	α_4	100.598	3.0
	α_5	-53.091	3.0
	α_6	7.270	3.0
Female leisure	α_7	-2.240	5.5
	α_8	237.438	3.9
	α_9	-130.174	3.9
	α_{10}	18.492	4.1
	α_{11}	3.397	6.4
	α_{12}	1.648	4.8
Opportunities:			
Female opportunity measure	α_{13}	0.063	0.1
	α_{14}	-0.203	3.7
Male opportunity measure	α_{15}	-3.296	4.5
Interaction	α_{16}	1.289	4.5
Full-time peak, males	α_{17}	1.062	11.2
Full-time peak, females	α_{18}	0.710	5.8
Part-time peak, females	α_{19}	0.425	2.5

Sweden

The structural part of the utility function is defined by

$$\log v(C,h_F,h_M)=\alpha_2\left(\frac{\left(10^{-5}C-0.3\right)^{\alpha_1}-1}{\alpha_1}\right)+\left(\frac{L_M^{\alpha_3}-1}{\alpha_3}\right)\left(\alpha_4+\alpha_5\log A_M+\alpha_6(\log A_M)^2\right)$$
$$+\left(\frac{L_F^{\alpha_7}-1}{\alpha_7}\right)\left(\alpha_8+\alpha_9\log A_F+\alpha_{10}(\log A_F)^2+\alpha_{11}CU6+\alpha_{12}CO6\right) \quad \text{(A.3)}$$

The fraction of jobs with a given number of hours is assumed to be consistent with a uniform distribution of hours apart from a peak at full-time hours for males and peaks at full-time, 2/3 part-time and part-time hours for females.

We do not model the participation decision and thus, observations are only for married couples who are working. In 1981 the labor force rates both for males and females were very high in Sweden (highest in the world).

In Table 15 we present the estimates based on household data from 1981.

Table 15. Estimates of the parameters of the utility function and of the opportunity density, Sweden 1981

Variables	Coefficient	Estimates	t-values
Preferences:			
Consumption	α_1	0.574	9.4
	α_2	9.278	11.4
Male leisure	α_3	-4.607	5.8
	α_4	174.644	3.0
	α_5	-91.188	3.0
	α_6	12.371	3.1
Female leisure	α_7	-4.106	6.5
	α_8	153.041	2.5
	α_9	-78.834	2.4
	α_{10}	10.876	2.5
	α_{11}	1.541	3.8
	α_{12}	0.805	3.1
Opportunities:			
Full-time peak, males	α_{13}	3.424	47.1
Full-time peak, females	α_{14}	2.814	29.1
2/3 part-time peak, females	α_{15}	1.454	13.5
Part-time peak, females	α_{16}	1.830	18.8

Note that most parameters are rather precisely determined and they have the theoretically expected signs.

The estimates imply that the mean utility function is an increasing and strictly concave function in consumption and leisure. The males marginal mean utility of leisure attains a minimum at the age of 41.9 years and in the case of females, at the age of 35 years, exactly the same as for Norway.

The estimated wage opportunity density and aggregate labor supply elasticities are reported in Aaberge et al. (1990).

Italy

The functional form of the deterministic part of the utility function is defined by

$$\begin{aligned} log\, v(C,h_F,h_M) &= [\alpha_2 K_M K_F + \alpha_3 K_F + \alpha_4 K_M] e^{\alpha_1 C} \\ &+ [\alpha_6 + \alpha_7\, log\, A_M + \alpha_8 (log\, A_M)^2] \left(\frac{L_M^{\alpha_5} - 1}{\alpha_5} \right) \\ &+ [\alpha_{10} + \alpha_{11}\, log\, A_F + \alpha_{12} (log\, A_F)^2 + \alpha_{13} CU6 + \alpha_{14} CO6] \left(\frac{L_F^{\alpha_9} - 1}{\alpha_9} \right) \end{aligned} \quad \text{(A.4)}$$

$K_j = 1$ if spouse j is working; otherwise $K_j = 0,$ and the specification implies that the marginal utility of consumption differs with respect to the reported labor market participation.

Since the regional variation of wages is more important than in the Scandinavian countries, and since unemployment in Italy has been rather high by Norwegian/Swedish standards, we have included regional dummies and local unemployment rates as explanatory variables. The opportunity measure for wages are specified as follows,

$$log\, W_j(z) = \beta_{0j} + \beta_{1j}\, s_j + \beta_{2j}\, Exp_j + \beta_{3j} \left(Exp_j \right)^2 + \beta_{4j}\, Reg_j + \eta_j(z) \quad \text{(A.5)}$$

$j = F, M$, where $(\eta_F(z), \eta_M(z))$ are normally distributed, s_j denotes years of schooling, gender j, Exp_j = experience = $A_j - s_j - 6$ and $Reg = 1$ living in Northern Regions (North of Tuscany) and 0 otherwise. Moreover,

$$log(g_{01}) = \alpha_{15} + \alpha_{16}\, Reg_F + \alpha_{17} UE_F\,, \quad \text{(A.6)}$$

and

$$log(g_{10}) = \alpha_{18} + \alpha_{19}\, Reg_M + \alpha_{20} UE_M \quad \text{(A.7)}$$

where UE_j is the ratio between the number of unemployed and employed for gender *j*.

It should be noted that the specifications (A.6) and (A.7) imply the following interpretation of the model parameters. If α_{16} and α_{19} are positive, then living in Northern Italy improves the chances of finding a market opportunity, compared to living in Central and Southern Italy. Likewise, negative values of α_{17} and α_{20} indicate that unemployment has a negative impact on job opportunities.

Feasible hours in the market is assumed to be uniformly distributed except for peaks at full-time hours for females and males, which are defined by the interval [1846, 2106]. Note that this interval corresponds to weekly hours between 36 and 40.

The estimation results are reported in Table 16.

Table 16. Estimates of the parameters of the utility function and of the opportunity density, Italy 1987.

Variables	Coefficient	Estimates	t-values
Consumption	α_1	$-0.780 \cdot 10^{-4}$	-7.7
	α_2	-15.938	-8.3
	α_3	-10.020	-19.1
	α_4	-15.364	-11.4
Male leisure	α_5	-18.651	-16.4
	α_6	-0.180	-1.4
	α_7	0.102	1.5
	α_8	-0.015	-1.4
Female leisure	α_9	-6.805	-8.1
	α_{10}	34.428	2.2
	α_{11}	-19.039	-2.2
	α_{12}	2.716	2.3
	α_{13}	0.225	1.8
	α_{14}	0.275	2.7
Female opportunity density	α_{15}	-0.952	-2.8
	α_{16}	0.705	6.5
	α_{17}	-0.594	-0.9
Male opportunity density	α_{18}	-0.512	-8.4
	α_{19}	0.310	1.2
	α_{20}	0.243	0.1
Full-time peak, males	α_{21}	2.406	28.0
Full-time peak, females	α_{22}	2.501	51.9

The estimates imply that the deterministic part of the utility function is an increasing and strictly concave function of leisure and consumption. The basic parameters of the utility function are α_1, α_5 and α_9. These parameters are measured with good precision. Because $\alpha_1 - \alpha_4$ all are estimated to be negative, these empirical results imply — as expected — that the marginal utility of consumption, given the consumption level, is lower when one of the spouses are reported not to work. The marginal utility of consumption and leisure depends also on personal characteristics

such as age and number of children. The estimates for the coefficients of these variables are less precise. Children have the expected positive effect on the value of wife's leisure. However, a rather surprising result is that the presence of older children have essentially the same effect as younger ones; as a matter of fact the point estimate for the former ones is even larger (this result, however, accords with other analyses of Italian data, see e.g. Colombino and Del Boca (1990)). A possible explanation might be found in a cohort effect. Women with older children on average belong to older cohorts. For a variety of unobserved factors (attitudes, supply of child-care services, etc.) which change from one cohort to the other, older cohorts presumably tend to use a more "leisure-intensive" technology in child-care.

The estimated parameters of the job-opportunities density confirm – at least for females – a more favourable environment in Northern regions. On the other hand, the effect of unemployment is not measured precisely enough to draw any clear conclusion. For a more comprehensive discussion of the empirical results we refer to Aaberge et al. (1993) who also report the estimated wage opportunity density and various aggregate labor supply elasticities.

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