Joint Labour Supply of Married Couples: Efficiency and Distribution Effects of Tax and Labour Market Reforms

by

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Abstract

The paper presents a model of household labour supply that allows for simultaneous decisions of household members, complex and non-convex choice sets induced by tax and benefit rules, and quantity constraints on hours choice. The model is estimated using the 1993 Bank of Italy's Survey of Household Income and Wealth, and used to simulate three hypothetical tax reforms: namely, a flat tax and two versions of a negative income tax system, under the constraint of equal tax revenue. All the reforms produce a larger household average disposable income, without worsening much the equality of the income distribution, and are supported by a majority of winners in the sample, although the proportion of winners varies considerably across income deciles. We also simulate the impact on labour supply and income of removing the quantity constraints on hours-wage packages available on the market, constraints that in Italy typically make full-time jobs more easily available than other jobs. The results show a considerable increase in participation among women belonging to relatively poor households, and a slight reductions in hours worked – given participation – across all households.

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1. Introduction

In this paper we present a microeconometric model which features simultaneous treatment of both spouses' choices; exact representation of income taxes and quantity constraints on the distribution of hours. Previous structural analyses of labor supply in Italy based on microdata have been carried out for example by Colombino and Zabalza (1982), Colombino (1985), Colombino and Del Boca (1990), Del Boca and Flinn (1984) and Rettore (1990). Most of these studies are based on local samples. None of them develops a truly simultaneous model of partners' decisions. Taxes are either ignored or given a simplified representation.

For the estimation and the simulation we use the data from the 1993 Bank of Italy's Survey of Household Income and Wealth (SHIW93). The analysis is restricted to married couples, with both partners in the age interval 18-54. Self-employed and retired persons are excluded. Household decisions must therefore be interpreted as conditional on not being self-employed nor retired.

We run the model to simulate the labor supply responses and welfare effects of replacing the current (1993) tax system (on personal incomes) with hypothetical alternatives, namely a flat tax and two versions of a negative income tax, under the constraint of equal tax revenue.

The paper is organized as follows. Section 2 develops the model. Sections 3 and 4 describe the empirical specification, the data used and the estimates. Section 5 presents the results of various policy simulations. Section 6 is dedicated to the final remarks.

2. The model

Our study draws upon the framework introduced by Dagsvik (1994) and may be viewed as an extension of the model in Dickens and Lundberg (1993). Models similar to the one applied here to Italy have also been estimated for Sweden (Aaberge et al. 1990) and Norway (Aaberge et al. 1995). Our approach to modeling labor supply is rather different from the traditional one, originally adopted in a well-specified microeconometric framework by Heckman (1974). A version of the traditional model that also included taxes was later estimated by Hausman and co-authors for the U.S. (Hausman (1980, 1981 and 1985), Burtless and Hausman (1978), Hausman and Ruud (1984)), and also adopted in numerous other studies (e.g. Blomquist (1983) for Sweden, Arrufat and Zabalza (1986) for the U.K., Kapteyn et al. (1990) for Holland, Colombino and Del Boca (1990) for Italy).

The traditional approach is essentially based on the standard textbook model. The agent's behavior is interpreted as the solution to the problem:

$$\begin{aligned} &\max_h U(C,h) \\ &s.t. \\ &C = wh + I \\ &h \in [0,T] \end{aligned} \qquad 1.$$

where

h = hours of work
w = wage rate
I = other (exogenous) income
T = total available time
C = disposable income.

In this model the wage rate w is fixed. Given the wage, a job is just described by a value of h belonging to the interval [0,T]. The individual is free to choose any value of h in that interval. The set of "jobs" in the (h,w) space among which the individual is assumed to choose under this traditional approach is represented in Fig. 1.

Fig. 1 approximately here

Under standard regularity conditions, if we define h*(w,I)* as the value of h which solves $\partial U(wh+I,h)/\partial h=0$, then the solution to problem (1) is:

$$h^{*}=\begin{bmatrix} 0 & \text{if} & h(w,I)\leq 0 \\ h(w,I) & \text{if} & 0\leq h(w,I)\leq T \\ T & \text{if} & h(w,I)\geq T \end{bmatrix} \qquad 2.$$

The solution h^{*} is typically a random variable, due to some unknown preference parameter that is treated as random.

When taxes are introduced, the budget constraint in problem (1) becomes $C = f(wh,I)$, where *f* is the function, which transforms gross income into net income. In most countries, *f* defines a piece-wise linear budget, with each segment k defined by a net wage rate w_k (the slope) and a "virtual" income I_k (the intercept of the extension of the segment). The solution can be easily characterized in terms of the functions $h(w_k, I_k)$ [1]. In principle, this approach can be generalized to any type of tax system that can be approximated by a piece-wise linear tax rule, and to simultaneous decisions of household members. In practice it may become prohibitively burdensome for complex rules f and for the decisions of a married couple. Therefore the analyses based on this approach tend to rely on some simplified representation of the tax rule and on some recursive structure of household decisions. It seems also very unrealistic to assume that for each individual there is just one market wage and that hours can be freely chosen in the interval [0,T] [2].

The approach that we follow here assumes that the agents choose among jobs, each job being defined by a wage rate *w,* hours of work *h* and other characteristics *j.* As an example of *j*, think of commuting time or specific skills involved in the job. For expository simplicity we consider in what follows a single person household, although the model we estimate considers married couples[3]. The problem solved by the agent looks like the following:

$$\begin{aligned} &\max_{h,w,j} U(C,h,j) \\ &s.t. \\ &C = f(wh,I) \\ &(h,w,j)\in B \end{aligned} \qquad 3.$$

The set *B* is the opportunity set, i.e. it contains all the opportunities available to the household. For generality we also include non-market opportunities into *B*; a non-market opportunity is a "job" with $w = 0$ and h=0. Agents can differ not only in their preferences and in their wage (as in the traditional model) but also in the number of available jobs of different type. Note that for the same agent, wage rates (unlike in the traditional model) can differ from job to job. As analysts we do not know exactly what opportunities are contained in *B*. Therefore we use probability density functions to represent *B*. Let us denote with $p(h,w)$ the density of jobs of type (h,w). By specifying a probability density function on *B* we can for example allow for the fact that jobs with hours of work in a certain range are more or less likely to be found, possibly depending on agent's characteristics; or for the fact that for different agents the relative number of market opportunity may differ. Fig. 2 illustrates a possible opportunity set in the (*h,w*) space as represented in this approach.

Fig. 2 approximately here

From expression (3) it is clear that what we adopt is a choice model; choice, however, is constrained by the number and the characteristics of jobs in the opportunity set. Therefore the model is also compatible with the case of involuntary unemployment, i.e. an opportunity set that does not contain any market opportunity; besides this extreme case, the number and the characteristics of market (and non-market) opportunities in general vary from individual to individual. Even if the set of market opportunities is not empty, in some cases it might contain very few elements and/or elements with bad characteristics.

We assume that the utility function can be factorized as

$$U(f(wh,I),h,j) = V(f(wh,I),h)\varepsilon(h,w,j) \qquad 4.$$

where V and ε are the systematic and the stochastic component respectively, and ε is i.i.d. according to[4]:

$$\Pr(\varepsilon \le u) = \exp(-u^{-1}) \qquad 5.$$

The term ε is a random taste-shifter which accounts for the effect on utility of all the characteristics of the household-job match which are observed by the household but not by us. We observe the chosen *h* and *w*. Therefore we can specify the probability that the agent chooses a job with observed characteristics (*h,w*). It can be shown that under the assumptions (3), (4) and (5) we can write the probability density function of a choice (*h*,*w*) as follows [5]:

$$\varphi(h,w) = \frac{V(f(wh,I),h)p(h,w)}{\iint_{x,y} V(f(yx,I),x)p(x,y)dxdy} \qquad 6.$$

Expression (6) is analogous to the continuous multinomial logit developed in the transportation and location analysis literature (Ben-Akiva and Watanatada, 1981). The intuition behind expression (6) is that the probability of a choice (*h*, *w*) can be expressed as the relative attractiveness – weighted by a measure of "availability" *p(h,w)* – of jobs of type (*h*, *w*).

From (6) we also see that this approach does not suffer from the complexity of the tax rule *f*. The tax rule, however complex, enters the expression as it is, and there is no need to simplify it in order to make it differentiable or manageable as in the traditional approach. The crucial difference is that in the traditional approach the functions representing household behavior are derived on the basis of a comparison of marginal variations of utility, while in the approach that we follow a comparison of levels of utility is directly involved.

3. The empirical specification

In order to estimate the model we choose convenient but still flexible parametric forms for *V* and *p*.

$$\ln V(C,h_F,h_M) = [\alpha_2 + a_3 N]\cdot\left(\frac{C^{\alpha_1}-1}{\alpha_1}\right) + [a_5 + a_6 \ln A_M + a_7(\ln A_M)^2]\cdot\left(\frac{L_M^{a_4}-1}{a_4}\right)$$
$$+ [a_9 + a_{10}\ln A_F + a_{11}(\ln A_F)^2 + a_{12}CU6 + a_{13}CO6]\cdot\left(\frac{L_F^{a_8}-1}{a_8}\right) \qquad 7.$$

where the subscripts *F* and *M* denote female (wife) and male (husband), $C = f(wh,I)$ is household net (disposable) income, *N* is the size of the household, A_k is the age of gender k, *CU6* and *CO6* are number of children below and above 6 years old and L_k is leisure for gender k, defined as

$$L_k = 1 - \frac{h_k}{8760}.$$

For the purpose of estimating the model, we find it convenient to write the density of hours and wages $p(h,w)$ as follows:

$$p(h,w) = \begin{cases} g(h,w)g_0 & \text{if } (h,w) > 0 \\ 1-g_0 & \text{if } (h,w) = 0 \end{cases} \qquad 8.$$

where $g(h,w)$ is the conditional density of (h,w) given that $(h,w) > 0$, and g_o is the probability density of market opportunities in the opportunity set, i.e. the proportion of market jobs in the opportunity set.

We assume that hours and wages available to the husband and hours and wages available to the wife are independent[6]:

$$g(h,w) = g_{1F}(h_F)g_{1M}(h_M)g_{2F}(w_F)g_{2M}(w_M) \qquad 9.$$

where g_{1k} and g_{2k} denote the marginal probability functions respectively of hours and wages, for gender *k*.

Hours in the opportunity set are assumed to be uniformly distributed with a peak in the interval [1846,2106], corresponding to full-time jobs (36-40 weekly hours):

$$g_{1k} = \begin{cases} \gamma_k & \text{if } h_k \in [0,1846] \\ \gamma_k \pi_k & \text{if } h_k \in [1846,2106], \quad k = F,M \\ \gamma_k & \text{if } h_k \in [2106,3432] \end{cases} \qquad 10.$$

where π_k is the full-time peak for gender k, and 3432 is the maximum number of hours observed in the sample [7].

Moreover, since g_{2F} and g_{2M} are defined to be probability densities we must also have:

$$\gamma_k = \frac{1}{3172 + 260\pi_k}, \quad k = F, M \qquad 11.$$

The proportions of market opportunities g_{0F} and g_{0M} are assumed to depend on whether individuals are living in Northern or Southern Italy according to:

$$g_{ok} = \frac{1}{1 + \exp(-\mu_{ok} - \mu_{1k} RE_k)}, \quad k = F, M \qquad 12.$$

where RE_k = 1 if the household is living in Northern Italy, RE_k = 0 otherwise. Note that a positive (negative) value of the coefficient of *RE means* that living in Northern Italy increases (decreases) the proportion of market opportunities in the opportunity set.

The density of offered wages is assumed to be lognormal with gender specific means that depend on length of schooling and on past potential working experience, where experience is defined equal to age minus length of schooling minus six. Thus, the wage equations are given by

$$\log(w_k) = \beta_{0k} + \beta_{1k} S_k + \beta_{2k} EX_k + \beta_{3k} (EX_k)^2 + \xi_k, k = F, M \qquad 13.$$

where S_k = years of education, EX_k = years of potential experience and ξ_k is a random variable i.i.d. normal.

4. Data and estimation

The estimation of the model is based on data from the 1993 Survey of Household Income and Wealth (SHIW93). This survey is conducted every two years by the Bank of Italy and besides household and individual socio-demographic characteristics, contains detailed information on labor, income and wealth of each household component.

The labor incomes measured by the survey are *net* of social security contributions and of taxes on personal income. Therefore, in order to compute gross incomes we have to apply the "inverse" tax code. In turn, the “direct” tax code has to be applied to every point in each household’s choice set to compute disposable income associated to that point [8].

Hourly wage rates are obtained by dividing gross annual wage income by observed hours.

Only married couples with at least one of the partners working in the wage employment sector are included in the sample used for estimation and simulation. Couples with income from self-employment are excluded from the sample: this is due to the assumption that their decision process may be substantially different from wage-employees' and typically involves a permanent element of uncertainty[9].

We have restricted the ages of the husband and of the wife to be between 18 and 54 in order to minimize the inclusion in the sample of individuals who in principle are eligible for retirement, since the current version of the model does not take the retirement decision into account.

Due to the above selection rules, the estimates and the simulations should be interpreted as conditional upon the decisions not to be self-employed and not to retire for both partners. The sample covers 2160 households. Tab. 1 contains the descriptive statistics of the variables used.

Tab. 1 approximately here

The parameters appearing in expressions (7) and (10)-(13) are estimated by maximum likelihood. The likelihood function is the product of the choice densities (6) for every household in the sample. The estimates are reported in Tab.2 and Tab.3. Note that the opportunity set of the model is infinite. In order to overcome the computational problems that can arise in estimating models with very large (or even infinite) opportunity sets, McFadden (1978) has suggested a procedure that approximate exact ML estimation and provides consistent estimates. The method essentially consists in representing the true opportunity set with a sample of weighted alternatives, with the weighting depending on the sampling scheme. As a first step we estimate empirical univariate densities for the variables $\left(w_M, w_F, h_F, h_M\right)$. We then draw 199 values from these densities and build 200 alternatives (adding the observed choice). In expression (6) every term V( )p( ) is weighted, i.e. divided, by the previously estimated density of the corresponding alternative[10].

Overall, the parameters are measured with good precision and their magnitude and sign seem to conform qualitatively to what could be inferred from economic reasoning or previous labor supply estimates. More novel and hard to compare to other research results are the estimates of the market opportunity density and hour's density. The market opportunity density estimates imply that market opportunities are relatively more abundant in northern regions. For example using (12) we can compute that the density of market opportunities is 4.3 times larger in northern regions for males, and 1.5 times for females. Also the full-time peaks of the hours density are very important. The estimates imply that 73% of the jobs available to males and 70% of the jobs available to females require at least 1846 hours.

Tables 2 and 3 approximately here

5. Policy simulations

Once the parameters have been estimated, we can simulate the effects of different policies. A policy can be defined as the introduction of a new opportunity set B^* and /or of a new tax rule f*. Then we can evaluate the effect of the policy by solving the new problem:

$$\begin{aligned}&\max_{h,w,j} V(f^*(wh,I),h,j)\varepsilon(h,w,j)\\&s.t.\\&(h,w,j)\in B^*\end{aligned} \qquad 14.$$

As a practical matter, the simulation procedure works as follows. First, for each household we simulate the opportunity set, which – as in the estimation procedure - contains 200 points: one is the chosen alternative, the other 199 are built by drawing from the estimated *p(h,w)* density (or from a different density in case the policy is defined also by a change in the opportunity density). Second, for each household and each point in the opportunity set we draw a value ε from the distribution (5). Third, for each household we solve problem (14). The whole procedure is repeated 10 times, and the results are averaged across repetitions. The results of the policy simulation are uncertain both because they are based on uncertain parameters (estimation uncertainty) and because they also rely on simulated opportunity sets and simulated stochastic components of the utility functions (simulation uncertainty). In the Appendix we present a decomposition of total uncertainty into its estimation and simulation components.

5.1. Tax reforms

There is an increasing concern in Italy for the efficiency and distribution performance of the tax and benefit system. By and large we can identify two focal areas of interest. One is centered on the possible merits of a flatter profile of the tax rates, as an instrument to reduce distortions and incentives to tax evasion [11]. The other focuses upon a restructuring of the policies in favor of low-income groups, possibly switching from a system essentially based on implicit in-kind transfers and categorical benefits to a system based to a larger extent upon means-tested income transfers [12]. Although interesting, this discussion is lacking support from appropriate measurement of the effects of the policies that are proposed. The models used by default are "static" microsimulation models, which do not account for behavioral responses[13]. In this matter, however, we think that behavioral responses and incentive effects are the crucial points.

The first four sections of Table 4 report the results of the simulation of different personal income tax regimes, namely: the current (1993) regime, a flat tax and two versions of a negative income tax regime. The hypothetical reforms are connected to the above mentioned discussion since the flat tax is an extreme and simple way to reduce distortion costs and the negative income tax is a general, means-tested, way to support the poor.

The simulation of the model with the actual tax rules (as of 1993) is used to give us the base-case predictions of participation rates, annual hours of work (given participation), gross earnings, gross family income, taxes and disposable income. The marginal tax rates applied in 1993 are as follows:

Income (1000 LIT)	Marginal tax rate (per cent)
Up to 7,200	10
7,200 – 14,400	22
14,400 – 30,000	27
30,000 – 60,000	34
60,000 – 150,000	41
150,000 – 300,000	46
Over 300,000	51

Besides the application of the basic marginal tax rates, the tax system envisages other tax rates for special categories of income, deductions from taxable income, tax credits and family benefits. All the details of the tax-and-benefit system are accounted for in the model [14].

In the second simulation the actual taxes are replaced by a flat tax (FT) on total income. The flat tax rate is determined so as to yield constant total tax revenue.

In the third and fourth simulations we replace the actual taxes by a negative income tax (NIT). For a household with *N* members, let us define the *guaranteed* household income *G(N)* as:

$$G(N)=a\sigma(N)m \qquad 15.$$

where $0 \le a \le 1$, *m* is the average per capita disposable income in the total sample and σ(N) is given by the equivalence scale proposed by the Commissione di Indagine sulla Poverta' (1985):

$$\sigma(N) = \begin{bmatrix} 1.00 & for & N=2 \\ 1.33 & for & N=3 \\ 1.63 & for & N=4 \\ 1.90 & for & N=5 \\ 2.16 & for & N=6 \\ 2.40 & for & N=7. \end{bmatrix} \qquad 16.$$

The tax R is then given by

$$R = \begin{cases} Y - G(N) \text{ if } Y \leq G(N) \\ t(Y - G(N) \text{ if } Y > G(N) \end{cases} \qquad 17.$$

where t is a marginal (constant) tax rate and Y is total household gross income. The tax is negative if total gross income is less than G. Otherwise the tax is a fixed proportion t of the part of income exceeding G[15].

In the simulations shown here we set m = 13473 (1000 ITL), a is alternatively set equal to 0.5 or to 0.75 and t is determined so that total tax revenue in the sample is constant. According to the definition used in Commissione di Indagine sulla Poverta'(1985) the term $\gamma(N)m$ is the poverty threshold for a household with N members. Therefore we simulate a system where household income is supported up to 1/2 (or alternatively, 3/4) the poverty threshold, if necessary; otherwise, income exceeding the poverty threshold is taxed at a constant marginal rate equal to t.

In interpreting the following results of reform simulations, it should be kept in mind that what we are using is just a supply model. We assume that the opportunity densities remain unchanged, while of course one might argue that they would change too as a consequence of a new tax regime[16].

Table 4 indicates that the effects on labor supply of the two tax-reforms are modest but not irrelevant. Note that the average tax rate paid by the household in 1993 was 0.20. A shift to a FT (t = 0.184) increases the labor supply of men and women, in particular poor women who are predicted to participate more in the labor market and to work longer hours, given participation. A shift to a NIT produces an increase of aggregate supply in the (a = 0.5, t = 0.234) version, and a decrease in the (a = 0.75, t = 0.284) version, with very modest variations in both versions.

All the reforms would produce a significantly larger disposable income for the households. Together with the fact that aggregate hours of work do not increase much, this provides a rough indication that the reforms might be efficient although disequalizing when income inequality is measured by the Gini coefficient[17].

There is one apparently counter-intuitive result in Table 4, which provides a good example of the possibly different implications of our model as compared to the traditional approach. Since the flat tax (18.4%) is higher than the first marginal tax under the 1993-system (10%), we might expect a decrease in participation rates. This is even more valid of the negative income tax system, which introduces a guaranteed minimum income coupled with a 23% or alternatively 28% flat tax. Our model predicts instead an increase in aggregate supply as a consequence of the shift to a FT(t = 0.184) or to NIT(a = 0.5, t = 0.234) system. A traditional model would assume that every value of h is equally available in the choice set; moreover, given preferences, the utility associated to a particular point in the choice set would be uniquely determined by (h,w). Under these assumptions a traditional model would indeed predict a decrease in participation rates under either reform. In the model presented in this paper, however, not every value of h is equally likely to be available in the choice set. Job opportunities offering less than 1846 or more than 2106 hours are relatively unlikely to be found. The opportunities in the range 1846-2106 may carry lower tax rates under both reforms than under the 1993-tax code. Thus participation may become more attractive. Moreover, in our model the utility is random; there are unobserved components attached to every market or non-market opportunity which make it more or less desirable. Thus a market opportunity may turn out to be more desirable than a non-market opportunity (non-participation) even though the opposite is true when the comparison is made solely in terms of hours and disposable income.

There is another result that deserves a comment. When NIT(*a*=0.75, *t*=0.284) is applied, aggregate labor supply is slightly reduced. Still, aggregate net income increases, despite the fact that the opportunity densities and tax revenue are invariant by construction. More generally, in all the reforms, average gross income increases far more than labor supply. How does this happen? It must be that the least productive, those with lower wages, reduce (or increase less) their supply, and at the same time the most productive, those with higher wages, increase (or reduce less) their labor supply. So it seems that the reforms interact in a virtuous way with the pattern of elasticities, inducing a sort of favorable selection process.

The Gini coefficients displayed in Table 5 suggest that the distribution of income (both gross and net) would be made slightly more unequal as a consequence of the introduction of any of the reforms, more markedly so for the flat tax. Note however that NIT (*a*=0.75, *t*=0.28) is more effective in redistributing than the 1993 tax rule, and its disequalizing effect on the distribution of net income is very small.

In Tab.6 we give the fraction of winners for deciles of the distribution of household disposable income. A household is a winner if the utility level reached under 1993 system is lower than the utility level reached after the reform. This procedure of course bypasses the problem of inter-household welfare comparison[18].The results show that the majority of the households would support all the three reforms, with a more robust majority for NIT (*a*=0.5, *t*=0.23). Behind this almost uniform result, we observe that the effects of the reforms differ dramatically across deciles. No reform receives a majority support in all deciles, although NIT (*a*=0.75, *t*=0.28) gets close to it, which suggests that some careful design of a NIT system might be supported by a diffuse majority across the deciles, and possibly even reach a higher degree of equality in view of the results of Table 5. It is also interesting to note that NIT (*a*=0.75, *t*=0.28) would be supported in a referendum both by the poorest and by the richest income decile. Of course a definite judgement upon the reforms would depend on the relative magnitude of gains and losses, and thus ultimately on the comparability issue[19].

Table 4 approximately here

5.2 Labour market reforms: removing hours constraints.

Constraints limiting the choice of the number of hours worked appear to be very important. Given the estimates of α_{18} and α_{19} reported in Table 2, we can compute that the percentage of jobs available in the hours range (1846, 2106) is 49% for females and 54% for males. In this section we report the results of a simulation exercise consisting in removing these constraints: namely we simulate household behaviour after replacing the hours density specified in expression (14) with a uniform density.

In the last section of Tab.4 we report the results of removing the constraints on the distribution of hours in the opportunity set. For each individual we impose to every individual a strictly uniform hours opportunity density, so that, given the wage, any value of hours is equally available in the interval [0, 3432]. The opportunity set of every individual is also adjusted in order to keep fixed the average amount of hours *per* job available in the opportunity set (including non-market opportunities. This can be done by adjusting g_{ok} so that the above condition is met. The tax regime is kept as in 1993. From Tab. 4 we observe that aggregate participation rates are very close to the reference case. This probably reflects the above adjustment that introduces a sort of invariance of the "average" opportunity available. We note however that females belonging to households in the lower deciles of the reference-case income distribution increase their participation to the labour market: in the first decile in particular the participation rate doubles, from 14.4% to 28.8%. On the on the hand, in richer households females tend to reduce their participation rate. From the next two columns of Tab. 4 we observe that by removing hours constraints, that is reducing the dominance of full-time jobs relative to other types of jobs, reduces supplied hours among females belonging to the upper deciles of the pre-reform income distribution. This is the result that one would expect. The rigidity of the Italian labour market seems to have forced, in particular women in the "richest" deciles, to work longer hours than they would prefer. Moreover it seems that women in the lowest deciles of the income distribution have been prevented by hours constraint to participate. For many of these women it may be hard to combine the care taking of children, for example, with working on a full-time job. By making jobs with shorter hours more easily available on the market, the burden of combining market work and other activities at home is reduced. It should be noted that women living in households belonging to the lowest deciles of the income distribution are not necessarily poor in the sense of having a low potential wage rate: they might be poor not because of a poor market potential but because they find it hard to combine market work and other activities.

It is interesting to observe that the tax revenue does not change much after removing hours constraints, in fact it increases slightly. Since this happens together with a reduction of the total amount of worked hours, it must be the case that the post-reform labour force is more productive than before: the average wage rates of those who are working is higher and/or those with higher wages work more and those with lower wages work less with respect to the pre-reform regime. So there appears to be a favourable selection effect similar to the one we already noted in the previous section when commenting tax reforms.

From the last row of Tab. 5 we also observe that with uniformly distributed hours, the distribution of gross household income becomes more unequal, despite the fact that household income is increased in poorest deciles. This must be due to changes in the intra-decile distribution.

Table 5 approximately here.

6. Conclusions

We have developed a model of household labour supply that adopts an econometric framework of the continuous multinomial logit type and allows for complex non-convex budget sets, highly nonlinear labor supply curves and imperfect markets with institutional constraints

Policy simulations indicate that less distortionary tax systems such as a flat tax or a negative income tax system would have modest but not irrelevant impacts on aggregate labor supply and on the distribution of disposable income among married couples. The reforms contain incentives to work less for some and to work more for others. The incentive to work more seem to prevail at least for two of the reform, and the supply elasticity is large enough to induce a significant increase of average household disposable income. There is also some indication that the reforms activate a sort of favorable selection process, by inducing the more productive to work more and the less productive to work less. The results suggest that the reforms might be efficient but slightly disequalizing. A majority – although not a large one - of households would support the reforms. The proportion of winners varies widely across the deciles, depending on the reform. There is some indication that a careful design of a NIT-like system might attain an improvement in both efficiency and equality, and possibly also get a majority support in all the deciles. Thus a more systematic search of the reform-space looks promising. We have also simulated a policy consisting in removing the quantity constraints on hours choice, i.e. imputing to every household an opportunity set with uniformly distributed hours. The most noteworthy results are the increase in participation of women in the poorest income deciles and the decrease of hours worked by women in the richest deciles. Thus the results of this reforms reveal that the low participation rates of women in poor households is due at least in part to the difficulty of combining market work and other activities at home, given that part-time jobs are hard to find. On the other end, women in the richer households can probably substitute “home production” time with income (market goods); however, if given the opportunity, at least some decide to switch to part-time.

Appendix

For some of the variables of interest, we have conducted the simulation in a more complex manner than explained in section 5. Namely, the procedure of section 5 is repeated for 10 different values of the parameter vector, randomly drawn from the estimated joint distribution (multivariate normal). This allows to account not only for simulation uncertainty but also for estimation (or parameters) uncertainty. Estimation uncertainty stems from the sampling variability of the estimated parameters. Simulation variability is due to the fact that we do not observe all the relevant variables affecting the preferences and the constraints: we do not observe ε nor do we observe the exact choice sets, and we are therefore forced to simulate them. This more complex simulation procedure is very time consuming and the results that we report in what follows are just suggestive of a more systematic investigation that we plan to complete in a future contribution. For a certain variable X we can define X_{PR} as the value obtained with parameters P in repetition R, with P=1,…,10 and R=1,…,10. We then define:

$$M_{P.} = \sum_R X_{PR} / 10 \qquad M_{.R} = \sum_P X_{PR} / 10 \qquad 18.$$

$$M = \sum_{P,R} X_{PR} / 100 \qquad 19.$$

$$V_{TOT} = \sum_{P,R} (X_{PR} - M)^2 / 100$$

$$V_{EST} = \sum_P (M_{P.} - M)^2 / 10 \qquad 20.$$

$$V_{SIM} = V_{TOT} - V_{EST} \qquad 21.$$

$$MIN_{EST} = \min_P (M_{P.}) \qquad MAX_{EST} = \max_P (M_{P.}) \qquad 22.$$

$$MIN_{SIM} = \min_R (M_{.R}) \qquad MAX_{SIM} = \max_R (M_{.R}) \qquad 23.$$

$$MIN_{TOT} = \min_{P,R} (M_{PR}) \qquad MAX_{TOT} = \max_{P,R} (M_{PR}) \qquad 24.$$

The definition of V_{EST}, the variance imputable to estimation uncertainty, and of V_{SIM}, the residual variance imputable to simulation uncertainty, is based on the standard analysis-of-variance decomposition. Table 7 illustrates the results of the simulation of the 1993 tax regime.

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Table 1. Descriptive statistics – Married couples

	Mean	St.dev.	Min.	Max.
Individual variables:				
Annual hours of work (unconditional)				
Husband	1 990	507	0	3640
Wife	742	893	0	3640
Annual hours of work (conditional)				
Husband	2017	453	130	3640
Wife	1640	538	108	3640
Participation rates				
Husband	0.99	0.12	0	1
Wife	0.45	0.49	0	1
Hourly wage rates (1000 LIT)				
Husband	16.7	9.8	0.3	121.1
Wife	16.0	8.8	1.8	111.1
Gross annual earnings (1000 LIT)				
Husband	32691	1912	0	185998
Wife	11228	14424	0	69195
Age				
Husband	41.3	7.5	22	54
Wife	39.4	7.8	18	54
Education (years)				
Husband	9.7	3.9	0	19
Wife	9.4	4.0	0	19
Experience				
Husband	27	9	4	48
Wife	24	9	4	48
Household variables:				
Annual net taxes paid (1000 LIT)	11 026	10172	-5042	82623
Gross annual income (1000 LIT)	55 090	32831	1529	264907
Disposable annual income (1000 LIT)	44 064	23244	3000	198932
Region (North)	0.32	0.47	0	1
Number of children below 6	0.34	0.58	0	3
Number of children 6-15	0.58	0.73	0	3

Table 2. Estimates of the parameters of the utility function

Variables	Parameters	Estimates	t-values
Consumption	α_1	0.728	12.8
Constant	α_2	1.470	8.5
Household size	α_3	-0.103	3.7
Husband's leisure	α_4	-12.763	-14.7
Constant	α_5	-1.408	-1.3
log age	α_6	0.760	1.2
log age squared	α_7	-0.097	-1.1
Wife's leisure	α_8	-8.012	-10.3
Constant	α_9	74.509	3.3
log age	α_{10}	-41.708	-3.3
log age squared	α_{11}	5.880	3.3
# children below 6 years old	α_{12}	0.302	2.4
# children 6 or above 6 years old	α_{13}	0.277	2.7

Table 3. Estimates of the market opportunity, hours, and wage densities

	Parameters	Estimates	t-values
Market opportunities density:			
Wife			
Constant	μ_{0F}	-0.796	-8.4
Region	μ_{1F}	0.63	6.2
Husband			
Constant	μ_{0M}	-2.412	-10.9
Region	μ_{1M}	1.82	2.9
Hours density:			
Wife			
Full-time peak	π_F	11.670	27.3
Husband			
Full-time peak	π_M	14.454	50.5
Wage density:			
Wife			
Constant	β_{0F}	0.88	8.7
Education	β_{1F}	0.10	24.2
Experience	β_{2F}	0.02	3.6
Experience squared	β_{3F}	-0.224×10	-1.4
Husband			
Constant	β_{0M}	1.21	15.1
Education	β_{1M}	0.07	25.3
Experience	β_{2M}	0.02	4.4
Experience squared	β_{3M}	-0.154×10	-1.6

Table 4. Participation rates, annual hours of work, gross income, taxes and disposable income (1000 ITL) for couples under alternative different tax regimes and labour market reforms by deciles of household disposable income in 1993. Means.

Tax system		Participation rates(%)		Expected annual hours of work, given participation		Gross income	Taxes	Disposable income
		F	M	F	M	Households		
1993 tax-rules	I	14.1	95.6	1030	1571	15221	525	14695
	II	20.0	97.6	1209	1832	24372	2109	22263
	III	43.8	98.9	1546	1991	48187	8960	39227
	IV	65.5	99.4	1731	2117	85135	19983	65152
	V	74.4	99.4	1828	2237	128396	34365	94032
	VI	43.7	98.6	1590	1972	54525	11074	43150
FT (t=0.184)	I	19.6	95.4	1264	1706	22933	4219	18714
	II	24.4	97.8	1397	1924	31761	5845	25917
	III	44.7	99.0	1585	2048	54142	9961	44181
	IV	64.5	99.0	1741	2162	89459	16460	72999
	V	73.2	99.5	1834	2267	132888	24452	108435
	VI	45.0	98.6	1623	2036	60189	11074	49115
NIT (a=0.5, t=0.23)	I	16.5	95.3	1165	1617	19348	1435	17912
	II	21.7	97.5	1345	1873	28979	4244	24735
	III	43.4	98.8	1562	2027	52147	9727	42420
	IV	64.1	99.3	1739	2155	88449	18256	70193
	V	72.9	99.5	1834	2261	131752	28445	103307
	VI	43.6	98.5	1608	2009	58141	11074	47067
NIT(a=0.75,t=0.28)	I	14.4	95.3	1056	1551	16404	-1952	18356
	II	19.9	97.1	1240	1820	26199	2537	23662
	III	41.4	98.6	1540	1996	49801	9538	40263
	IV	63.3	99.2	1733	2138	86985	20218	66767
	V	72.6	99.5	1832	2252	130581	32714	97867
	VI	41.9	98.3	1589	1976	55897	11074	44823
Removing hours constraints	I	28.8	96.3	1071	1612	22776	2994	19782
	II	35.7	98.2	1178	1849	32080	4812	27269
	III	44.0	98.6	1274	1983	49647	9895	39752
	IV	53.8	98.8	1403	2095	77416	18082	59334
	V	57.9	99.0	1526	2189	110989	28832	82157
	VI	44.0	98.4	1307	1966	54115	11409	42706

Note to Table 4
I = first decile
II = second decile
III = third to eight decile
IV = ninth decile
V = tenth decile
VI = whole sample

Table 5. The Gini coefficient for distributions of households gross and disposable income, and degree of redistribution under various tax regimes

Tax regime	Gross income	Disposable income	Degree of redistribution
1993 tax-rules	0.323	0.283	0.875
FT (t=0.184)	0.332	0.332	1.000
NIT (*a*=0.5, *t*=0.23)	0.338	0.315	0.935
NIT (*a*=0.75, *t*=0.28)	0.343	0.298	0.869
Removing hours constraints	0.352	0.307	0.872

Table 6. Decile-specific proportions of winners from two alternative tax reforms, by household disposable income in 1993. Per cent

Tax reform	Deciles of the distribution of household disposable income in 1993					
1993 tax-rules	1	2	3-8	9	10	All
FT (*t*=0.184)	14.2	19.0	51.3	86.5	90.6	51.8
NIT (*a*=0.5, *t*=0.23)	45.9	29.9	50.7	76.5	83.3	53.9
NIT (*a*=0.75, *t*=0.28)	74.1	43.7	44.8	51.1	64.9	50.2

Table 7. Total, Estimation and Simulation Uncertainty. 1993 tax-rules.

	Husband's unconditional hours	Husband's participation rate (%)	Wife's unconditional hours	Wife's participation rate (%)	Household's disposable income(000 ITL)
M (Mean)	1960	98.7	704	44.1	43700
Total uncertainty:					
V_{TOT}	357.39	0.04	618.75	0.82	461824.11
Std. Err. of M	1.9	0.02	2.5	0.09	68.3
MIN_{TOT}	1927	98.2	672	42.3	41998
MAX_{TOT}	2001	98.9	772	45.8	44603
Estimation uncertainty:					
V_{EST}	345.96	0.03	590.49	0.81	450357.21
MIN_{EST}	1929	98.3	677	42.6	42154
MAX_{EST}	1998	98.9	764	45.4	44406
Simulation uncertainty:					
V_{SIM}	11.43	0.01	28.26	0.01	11448.90
MIN_{SIM}	1958	98.6	698	43.8	43520
MAX_{SIM}	1962	98.8	712	44.4	43890

Fig. 1 The opportunity set in the traditional approach

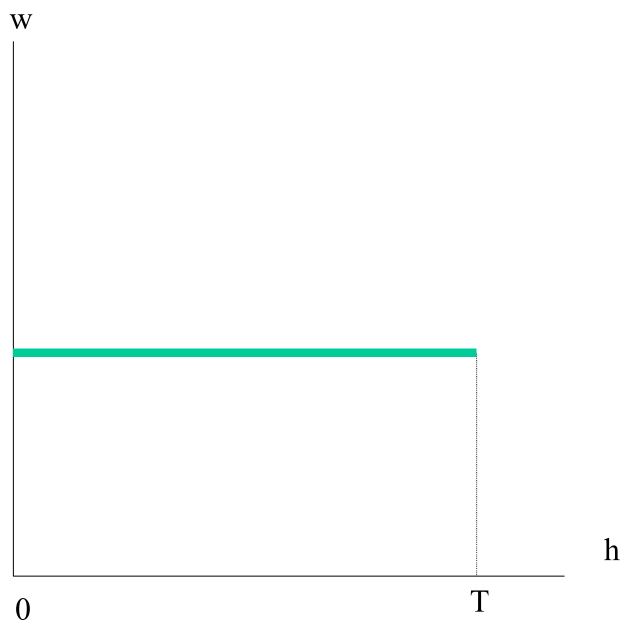
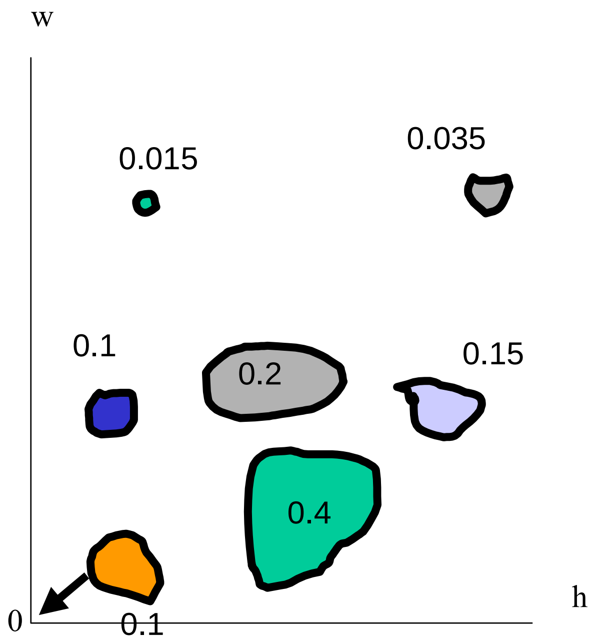


Fig. 2
The opportunity set in our model approach (the numbers represent hypothetical densities or relative frequencies of alternatives in the corresponding "spot")



[1] A very useful and clear exposition of the "Hausman approach" is given by Moffit (1986).
[2] A critical analysis of other aspects of the "Hausman approach" can be found in MaCurdy et al. (1990).
[3] See Aaberge, Colombino and Strøm (1998) for the extension to married couples as decision units.
[4] Expression (6) amounts to assuming that ln(ε) is distributed according to type I extreme value distribution.

[5] For the derivation of the choice density see Aaberge, Colombino and Strøm (1999).
[6] The assumption of independence of *h* and *w* is standard in microeconometric labor supply studies, where the traditional approach dictates a constant wage rate for any amount of hours of work (an exception is Moffit, 1984). In our model it is essentially a computational simplification
[7] Alternative ways to account for constraints on hours are represented by Ham (1982), Colombino (1985), Ilmakunnas and Pudney (1990), Kapteyn et al. (1990), Dickens and Ludberg (1993) and van Soest (1994).
[8] Dino Rizzi (University of Venezia) provided us with a program (TBM), written by him, which allows to apply detailed tax-benefit rules to gross incomes and also to recover gross incomes from net incomes by applying the inverse rule.
[9] We are currently working on a version of the model that includes the wage-employment / self-employment choice.
[10] Examples of this method of sampling a reduced choice set from previously specified densities, are provided by Atherton et a. (1990) and Colombino (1998). The discretization of the choice set for estimation purpose makes the empirical model somewhat close to the discrete multinomial logit estimated by van Soest (1994). The crucial differences are that in van Soest's model the choice set is equal for everyone, and the wage is fixed across jobs, hours being chosen in a discretized interval [0,T].
[11] See various contributions in Bernardi et al. (1995).
[12] See Commissione per l'analisi delle compatibilita' macroeconomiche della spesa sociale (1997). The issues of the performance of the Italian welfare system and of the perspectives for reform are also discussed in Rossi (ed.) (1996).
[13] Interesting applications of non-behavioral microsimulation models to the analysis of recent Italian tax policies or proposals are represented for example by Rizzi (1995), ISPE (1997) and Bourguignon et al. (1997).
[14] To be more precise, the tax program that we use accounts for all the details for which the dataset is sufficiently informative.
[15] One can think of many different variants of NIT. See Fortin et al. (1993) for a theoretical and empirical analysis of NIT systems.
[16] The assumption that the opportunity densities remain unchanged is equivalent to assuming – in a traditional setting - that the aggregate demand for labor is perfectly elastic. This is the case, for example, if the conditions for the so-called *non-substitution theorem* hold.
[17] The increase of average household disposable income is of course due to the household behavioral response. No such effect would be there in a non-behavioral simulation. Under the constraint of equal tax revenue, if household behavior remains unchanged, also average gross income and average net income should remain unchanged. Note that most part of our behavioral effect comes from (female) participation elasticity, which is probably a robust enough concept even for those who do not particularly trust behavioral and structural modeling.
[18] Aaberge et al. (1998a) perform an analysis of policy reforms based on interpersonally comparable welfare measures.
[19] We are currently working on the application of appropriate procedures for the social evaluation of reforms (Aaberge et al., 1998a).