DYNAMIC LABOR SUPPLY WITH TAXES: THE CASE OF ITALIAN COUPLES

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Labor force participation rate among married women in Italy is particularly low. In order to better understand the role played by the tax and benefit system on this phenomenon, we build and estimate a structural dynamic life-cycle model of household labor supply, saving, and consumption behavior. The model features several sources of heterogeneity in the characteristics of the members of the couple and it incorporates most of the fiscal rules which have an effect on the net incomes of the agents. The parameters of the model are estimated using cross-sectional and longitudinal data for the 2004-10 period. We use the estimated model to simulate a few counterfactual policies and study their effect on labor supply and poverty. In this version of our work we present some preliminary estimates and simulations.

1 Introduction

Government decisions about how to raise revenue have obviously a large impact on households' choices. The design of these policies can foster economic growth through the labor supply channel. Interventions in this area face a trade-off between the desire to increase the welfare in the poorest strata of the population and the need to avoid negative effects on the labor supply. In many developed countries these interventions take the form of special provision of the tax scheme or work-related cash benefits. Because the fixed cost of working is likely to be related to the number of children in the family these instruments vary accordingly. Moreover, a long series of studies have found that the margin which is more likely to be affected by these policies is the participation one for single and married women.

The role of taxes and family benefits on household labor supply and consumption decisions has been a topic of deep research interest for a long time. The works of Eckstein and Wolpin (1989), Sheran (2007), and Eckstein and Lifshitz (2011) are examples of contributions to the modelling of female labor supply in a dynamic framework. On the other hand, relatively few studies which estimate such complex models allow for a full specification of taxes and welfare benefits: the works of Haan and Prowse (2010) on joint retirement decisions of German workers, and Keane and Wolpin (2010) on labor supply effects of the Earned Income Tax Credit in the United States are exemplary of this strand of the literature. Other scholars decided to calibrate, rather than estimate, their models (see, for example, the recent contribution of Blundell *et al.*, 2011).

The introduction or the extension of cash benefits in several countries over the last twenty years created the opportunity for the study of the various effects of these policy tools. The works by Eissa and Liebman (1995) and Meyer (2002) deal with the effects of different extensions of the

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Earned Income Tax Credits in the United States; Blundell *et al.* (2000) studies the English Working Families Tax Credits instead.

The Italian labor market is characterized by a particularly low participation rate among women. According to data collected by Eurostat, this rate among women between the age of 15 and 64 was just 51.1 per cent in 2010 (up from 46.3 per cent ten years earlier). The same figure was between 64.4 and 70.8 per cent in the EU, United Kingdom, Germany, France, and Spain. The average degree of labor market attachment by married women is even lower. A few studies have dealt with the effects of the Italian tax system on this outcome. A series of simulations of alternative tax systems are presented in Colombino and Del Boca (1990), Aaberge *et al.* (1999), and Aaberge *et al.* (2004). More recently, Marcassa and Colonna (2011) present some extremely interesting evidence of the high implicit tax rates imposed by the Italian tax system on the second earners. All these studies, while accounting for the main features of the tax scheme and simulating the likely effects of hypothetical reforms, model the labor supply decisions of the households in a static framework.

We contribute to this strand of literature by building and estimating a dynamic life-cycle model of household labor supply and saving decisions. Our model incorporates fiscal rules in place in the period 2005-11, as well as the main features of the family allowances. The agents in the model are heterogeneous in terms of human capital (education and on-the-job experience), and the families differ also by the number of children. We use a two-step approach to estimate the parameters of our model; like in French (2005), we recover the estimates of the parameters in the wage equations separately from the preferences. We use the method of simulated moments (or indirect inference) to estimate the values of the parameters in the agents' utility function. In this, our approach is similar to that of the study by Van der Klaauw and Wolpin (2008) on the effect of social security reforms on retirement and savings decisions by elderly in the United States.

Dynamics enters our model in several ways. First of all, agents accumulate human capital while working (like in Imai and Keane (2004)): when comparing the costs and the benefits of participation, married women take into account the fact that each additional year in the market has long-lived effects. Secondly, households are allowed to accumulate and decumulate assets, thus providing a mechanism through which they can ensure against adverse shocks on the labor market. Finally, like in all life-cycle models, agents are forward looking, and they react not only to the implementation of policies, but also to their announcement. That is, they are allowed to intertemporally adjust both consumption and labor supply.

The goal of our research is to build a model which can be used to assess the effect of changes in the tax-benefit system on female participation to the labor market. In this version of our model we present the results of a set of highly preliminary experiments. In particular, we simulate the effects of policies which could be used to increase the female participation rate directly via an increase in the household net labor income or, indirectly, giving support to the low income households which are the ones where the female participation rate is particularly low (Marcassa and Colonna, 2011). Our results are consistent with the prediction of the economic theory. In general, an increase in households' non-labor income decreases the overall poverty (in terms of head-count ratio) but lowers the incentives of married women to participate in the labor market. On the contrary, policies aimed at increasing the return of the hours worked have positive effects on both dimensions.

The rest of the paper is organized as follows. Section 2 deals with the main features of the Italian labor market, while section 3 introduces the model, explaining our solution method as well. In section 4 we illustrate the main features of the Italian fiscal system, as well as those of the family allowances. Sections 5 and 6 provide respectively an illustration of the econometric technique and

Table 1

Activity and Employment Rates (15 to 64 Years)

Country	Activity Rate					Employment Rate				
	1997	**2007**	**2008**	**2009**	**2010**	**1997**	**2007**	**2008**	**2009**	**2010**
European Union (EU)	67.9	70.4	70.8	70.9	71.0	60.7	65.3	65.8	64.5	64.1
Euro area (EA)	66.2	70.9	71.3	71.3	71.4	58.6	65.6	65.9	64.5	64.2
Germany (DE)	70.6	75.6	75.9	76.3	76.6	63.7	69	70.1	70.3	71.1
Spain (ES)	62.4	71.6	72.6	73.0	73.4	49.5	65.6	64.3	59.8	58.6
France (FR)	68.1	69.9	70.0	70.5	70.5	59.6	64.3	64.8	64.0	63.8
Italy (IT)	*58.2*	*62.5*	*63*	*62.4*	*62.2*	*51.3*	*58.7*	*58.7*	*57.5*	*56.9*
United Kingdom (UK)	75.4	75.5	75.8	75.7	75.5	69.9	71.5	71.5	69.9	69.5

Source: Eurostat.

the data sources we use. Some preliminary results are presented in Sections 7 and 8, while Section 9 concludes, providing a guideline for our ongoing and future work.

2 The Italian labor market

The Italian labour market is characterized by participation and employment rates considerably lower than those of the other major European economies (Table 1) and well below the objective set by the Europe 2020 strategy. Although the decade preceding the 2008 financial crisis has seen a substantial improvement in both dimensions, the gap is still far from closing. The economic crisis has further deteriorated the picture. In particular in the years 2008-10, differently from the other largest EU countries, Italy has shown a decline not only in the employment rate but also in the participation to the market.

The positive dynamics in employment observed up to the pre-crisis period was determined mainly by the expansion in part-time and temporary contracts, whose shares increased by 6.8 and 5.3 percentage points respectively in the period 1997-2007 (more than 2 and 4 times the EU average). Moreover, unemployment in Italy was and still is more likely to be of long term duration with respect to the other EU countries: in 2007 the unemployment spell was at least 12 months for more than 47.4 per cent of the Italian unemployed workers while the EU average was 42.7 per cent; in 2010 the incidence of long term unemployment increased in Italy up to 48.4 per cent, while an opposite trend was observed on average in the other EU countries (39.9 per cent).

The aggregate data hide the large disparities that affect different groups of workers and that have led to an increasing dualism of the labour market. In particular, the poor performance of the labour market partly reflects its segmentation which tends to segregate the young and the women. Indeed, these are the dimensions along which Italy records some of the largest gaps. Differences by gender and age are well reflected in activity and employment rates (Table 2).

With respect to the other European countries, the young and the female workers are particularly distressed. The participation rate registered on average in Italy in 2010 in the age group 15-24 is lower than the corresponding value for the EU economies by almost 15 p.p. (23 percentage points with respect to Germany and more than 30 percentage points compared to UK). For what concerns employment the picture is analogous, with rates largely below the other major EU countries.

Table 2

Activity and Employment Rates by Sex and Age Groups, 2010
(percent)

Age Group	Activity Rate							Employment Rate						
	EU	**EA**	**DE**	**ES**	**FR**	**Italy**	**UK**	**EU**	**EA**	**DE**	**ES**	**FR**	**Italy**	**UK**
Males														
15-24	46.1	45.5	53.7	45.1	42.9	**33.2**	61.8	36.2	35.9	47.9	25.6	33.4	**24.3**	48.5
25-49	92.4	92.9	93.6	93.2	94.8	**89.5**	92.1	84.3	84.3	86.9	75.7	87.3	**83.3**	85.9
50-54	88.0	89.8	90.9	88.4	91.5	**88.9**	87.7	81.7	83.5	84.8	75.6	86.3	**85.1**	82.4
55-64	58.9	58.2	70.8	63.9	45.2	**49.6**	69.1	54.6	53.8	65.0	54.7	42.1	**47.6**	65.0
15-64	77.6	78.2	82.3	80.7	74.9	**73.3**	81.7	70.1	70.4	76	64.7	68.1	**67.7**	74.5
Females														
15-24	39.7	39.5	48.9	40.1	35.6	**23.4**	56.4	31.8	31.6	44.6	24.2	27.2	**16.5**	46.6
25-49	79.0	78.9	81.4	80.3	84.2	**65.7**	78.7	71.7	71.0	76.4	64.4	76.7	**59.3**	74.1
50-54	73.9	73	80.9	66.7	81.2	**57.8**	78.3	68.9	67.8	76.1	56.6	75.8	**55.1**	75.5
55-64	41.2	40.9	54.5	38.5	40.0	**27.0**	51.1	38.6	38.0	50.5	33.2	37.4	**26.2**	49.5
15-64	64.4	64.5	70.8	65.9	66.1	**51.1**	69.4	58.2	57.9	66.1	52.3	59.7	**46.1**	64.6

Source: Eurostat.

Particularly affected are the women, whose participation and employment rates in 2010 were the lowest within the EU (with the exception of Malta). The gap between men and women is also impressive: it is almost double than what can be observed on average in the EU, both in terms of participation and employment rates (respectively 22.2 and 21.6 percentage points in Italy vs. 13.2 and 11.9 on average in the EU in 2010). Moreover, the gender gap enlarges sensibly in case of married workers with children and in correspondence of lower levels of education attainment (Table 3).

3 Setup of the model

We model the household's problem in a standard dynamic framework. We also assume that the decision maker is the household. The agent chooses how much to consume and how many hours to work to maximize her lifetime utility. A series of state variables affect the decision process: the agent takes into account the level of accumulated assets, and the realized labor incomes of all the components of the household, as well as the cost related to raising children under different labor market participation scenarios. Clearly, expectations about the future play a role too. Moreover, the agent knows the structure of the tax-and-transfer system and its effect of the family net income under different circumstances.

For the sake of simplicity, for the moment being, we assume that the husband is always employed in a full time-job (except when he is retired). This assumption greatly simplifies the treatment of the problem, is broadly in line with empirical data, and is not unusual in this kind of literature (see for example Eckstein and Wolpin (1989)). On the other hand, the wife can be in one of the following three states: out of the labor force, employed in a part-time job, or employed in a full-time occupation. Both husband and wife receive a new job offer at the beginning of each period. The log hourly wages follow a Mincer-type structure:

$$\log(e^h_{jt}) = \alpha^h_0 + \alpha^h_1 age^h_{jt} + \alpha^h_2 agesq^h_{jt} + \alpha^h_3 edu^h_{jt} + \varepsilon^h_{jt} \tag{1}$$

$$\log(e^w_{jt}) = \alpha^w_0 + \alpha^w_1 edu^w_{jt} + \alpha^w_2 \exp^w_{jt} + \alpha^w_3 \exp sq^w_{jt} + \alpha^w_4 pt_{jt} + \varepsilon^w_{jt} \tag{2}$$

$$\varepsilon^i_{jt} \sim N(0, \sigma^{2,i}), \qquad \forall i \in \{h, w\} \tag{3}$$

The fact that women's wage equation depends on the accumulated experience allows us to incorporate in the model a new channel through which labor supply decisions (and therefore tax policy ones) may have long-lasting effects. The coefficient $\alpha_4{}^w$ captures the penalty in the hourly wage that a woman incurs when she works in a part-time occupation.

Once a member of the family reaches the age of 65, he or she retires and gets a pension which is a deterministic function of her income in the last year of employment. Every individual dies with certainty at age 85. Since wives and husbands are not necessarily the same age, the model accounts for possible periods of widowhood too.

The recursive problem can be written as follows:

$$V_t(X^h_t, X^w_t, A_t) = \max_{\{l^w, A_{t+1}\}} \left\{ U_t + \beta E[V_{t+1}(X^h_{t+1}, X^w_{t+1}, A_{t+1})] \right\}$$

subject to:

$$\frac{A_{t+1}}{(1+r)} = A_t + \tau_t[e^h l^h + e^w l^w] - c_t - K_t$$

Table 3

Gender Employment Rate Gap by Highest Level of Education Attained and Household Composition, 2010
(percent)

Country	Single Adult with Children	Single Adult without Children	Adult Living in a Couple with Children	Adult Living in a Couple without Children
Total				
EA	–13.1	–5.0	–22.6	–11.8
DE	–11.6	0.7	–23.3	–10.3
ES	–9.7	–8.7	–22.6	–14.2
FR	–15.6	–5.8	–15.6	–5.8
Italy	*–11.2*	*–11.7*	*–34.2*	*–21.4*
UK	–17.7	–0.9	–18.3	–12.6
Pre-primary, primary and lower secondary education				
EA	–18.7	–12	–35.1	–18.6
DE	na	–1.9	–35.3	–19.6
ES	–18.6	–15.3	–32.0	–22.9
FR	–23.4	–7.0	–24.8	–6.0
Italy	*–19.6*	*–20.7*	*–49.0*	*–28.9*
UK	–18.3	–3.2	–26.6	–22.2
Upper secondary and post-secondary non-tertiary education				
EA	–11.3	–4.8	–22.1	–7.6
DE	–7.3	–0.1	–20.9	–7.3
ES	3.5	–10.8	–22.4	–10.4
FR	–16.2	–8.6	–17.3	–3.1
Italy	*–10.2*	*–8.3*	*–30.9*	*–14.2*
UK	–14	0.8	–17.9	–9.9
First and second stage of tertiary education				
EA	–7.8	–1.1	–13.8	–5.6
DE	–14.4	3.1	–17.8	–5.5
ES	–9.3	–4.2	–15.7	–2.7
FR	–2.7	–2.5	–10.7	–6.3
Italy	*–6.8*	*–6.2*	*–17.6*	*–10.2*
UK	–11.1	0.1	–14.4	–5.1

Souce: Eurostat.

where A_t is the household's net wealth at the beginning of period t, l^h and l^w are the number of hours supplied on the labor market by husband and wife respectively, and τ_t a function which replicates the main features of the tax-and-benefit system in year t. c_t is household consumption, while K_t is the cost of childcare in period t: it depends on whether there are children in the household in that period, and on the mother's labor market participation.

For the moment being, a quite simple specification is chosen for the utility function:

$$U_t = \frac{\left(\frac{c_t}{n_t}\right)^{1+\eta}}{1+\eta} - \phi \cdot \frac{l_t^{1+\gamma}}{1+\gamma} \tag{4}$$

The household cares about both the level of consumption and the number of hours worked. In particular, η is the coefficient of relative risk aversion, while φ and γ measure the extent of the disutility of working. This specification of the preferences has been used often by the literature on dynamic labor supply (see Imai and Keane, 2004 and Keane, 2011).

One of the main drawbacks of the standard life-cycle model is its inability to replicate well the shape of consumption pattern over time. Adjusting for the demographic characteristics of the household can help to solve this problem: consumption is hump-shaped, it tracks income, and peaks when the head of the household is in her late thirties (Fernandez-Villaverde and Krueger, 2002). To accommodate for demographics, we rescale consumption in the utility function by dividing it by the equivalent number of household members, n_t, like in Laibson *et al.* (2007) and in Attanasio and Wakefield (2010).[1]

3.1 Solution of the model

As explained above, the dynamic programming involves several continuous and discrete state variables, making a full solution infeasible in this case. Therefore, we follow an approximation method which has become customary in this kind of large estimable dynamic models (Keane and Wolpin, 1994). In a nutshell, this approach is based on choosing a random subset of the points in the state space at each point in time and solve for the optimal value function there, while approximating the same function elsewhere on the basis of a flexible function of the state variables. The solution of the model is then obtained through value function iteration, starting from the last period and working backwards. The shocks are approximated numerically through Monte Carlo integration.

The solution of the dynamic programming allows us to obtain the optimal choices of the agents in each possible situation. Because of that, we can simulate the life of our households from the first period in which we observe them in the data onwards. For each household we simulate 20 realizations of the wage shocks for both members of the couple in each period. Our simulations involve about 20,000 wage offers in each period. For each of them, and for each possible labor supply choice, we compute the income of the members of the family, net of taxes and social security contributions and the implied level of family allowances. These simulations are at the basis of our econometric strategy to recover the preference parameters.[2]

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[1] We divide total household consumption by the square root of the number of household members.

[2] In order to deal with the computational burden implied by the very high number of computations, we choose Fortran 90 as programming language and we parallelize both the value function iteration and the simulation with the OpenMP libraries. Our program runs in parallel on as many as 32 processors.

Table 4

Income Brackets and Tax Rates

2005-06		2007-11	
Income Brackets (euros)	**Tax Rates**	**Income Brackets (euros)**	**Tax Rates**
0-26,000	23%	0-15,000	23%
26,000-33,500	33%	15,000-28,000	27%
33,500-100,000	39%	28,000-55,000	38%
Above 100,000	43%	55,000-75,000	41%
		Above 75,000	43%

4 The Italian tax and benefit system

The model incorporates the main features of the Italian tax-benefit system: the personal income tax (so-called Irpef) and family allowances.

Irpef is a "personal" and progressive tax. Its amount depends on specific characteristics of the taxpayer (occupation, household composition, specific expenses of a personal nature, and so on) and it is calculated applying increasing tax rates to specified income brackets (see Table 4). Horizontal and vertical equity are granted through deductions from taxable income (as for the period 2005-06) or tax credits (as for the years 2007-11) for work-related expenses and dependent people (Tables 5, 6, and 7). The amount of both instruments is inversely related and linearly dependent from income, ensuring different degrees of progressivity for different sources of income and family structures.

On the basis of these characteristics Irpef has become, since its introduction, the main tool for income redistribution policies in Italy, *i.e.*, policies aimed at alleviating the tax burden on households with low income and a large number of components. This is especially true since the Italian tax system lacks more appropriate redistribution tools, such as subsidies or a negative tax programs able to support people with tax liabilities smaller than tax credits (so-called "incapienti").

Family allowances are tax exempt public cash transfers to families with incomes below certain levels. To be eligible for these cash transfers, the sum of taxable salaries and pension incomes of the components of the household has to be at least 70 per cent of the gross family income. The amount of family allowances increases with the size of the household but it is inversely related to gross household income. Family income brackets are established by law every July and revalued each year by the percentage change in average annual index of consumer prices for the families of workers and employees, while the amount of the allowances remain unchanged. Family income limits are higher for lone parents and those with disabled persons.

The model contains the main characteristics of the Italian tax-benefit system in force in the period 2005-11 and allows the simulation of alternative schemes related to different features of Irpef and family allowances.

Table 5

Tax Deductions, 2005-06

Income Source	Maximum Amount (DEDB) (euros)	Dependent People	Maximum Amount (DEDF) (euros)
Dependent worker	7,500	Spouse	3,200
Pensioner	7,000	Child	2,900
Self-employed	4,500	Child younger than 3 years	3,450
Other	3,000	Child with handicap	3,700

Using:

$$x_i = \frac{26{,}000 + DEDB - y}{26{,}000}$$

Using:

$$x_i = \frac{78{,}000 + DEDF - y}{78{,}000}$$

Amount:

$$\begin{cases} 0, & if\ x_i \le 0 \\ x_i * DED, & if\ 0 < x_i < 1 \\ DED, & if\ x_i \ge 1 \end{cases}$$

5 Econometric strategy

The goal of our econometric exercise is to estimate the parameters in the utility function of the agents. In this preliminary version of our work we focus only on the coefficient of relative risk aversion and the parameters of the disutility of working. Possible extensions, including heterogeneity in the preferences are left for the future version of this work. We identify these parameters by searching for the vector of values which minimizes a weighted distance between our observed data and the behavior of the agents simulated by our model. The strategy is that of the so-called Method of Simulated Moments (or Indirect Inference), as in McFadden (1989). More formally, the econometric problem can be explained as follows:

$$\hat{\theta} = \arg\min\{g(\theta)' W g(\theta)\}$$

and:

$$g(\theta)' = \left[m_1^D - m_1^S(\theta), \ldots, m_J^D - m_J^S(\theta)\right]$$

where m_j^D be the j^{th} moment in the data and m_j^S the j^{th} simulated moment. The latter is found as an average across all the simulated individual observations, that is as $m_j^S = \frac{1}{NS} \sum m_j^s(\theta)$ where θ is the vector of parameters to be estimated.

The weighting matrix W is a diagonal matrix whose entries on the main diagonal are the inverse of the variances on the sample moments.

For the moment being, the moments used include the proportion of families in which wives participate to the labor force, work full-time, as well as the mean value of net worth. The pattern in the accumulation of the assets by the households is used to identify the coefficient of relative risk aversion, as in previous studies, such as those by Cagetti (2003) and Gourinchas and Parker (2002). The parameters governing the scale and the shape of the disutility from working are identified by the share of observations in each labor market status.

Table 6

Tax Credits for Work-related Expenses, 2007-11

Income Source	**Income Brackets** *(euro)*	**Tax Credit** *(euro)*
Dependent worker	0-8,000	1,840
	8,000-15,000	1,338+502*[(15,000–y)/7,000]
	15,000-55,000	1,338*[(55,000–y)/40,000]
	Above 55,000	0
	Plus:	
	23,000-24,000	10
	24,000-25,000	20
	25,000-26,000	30
	26,000-27,700	40
	27,700-28,000	25
Pensioner aged less than 76	0-7,750	1,725
	7,750-15,000	1,255+470*[(15,000–y)/7,500]
	15,000-55,000	1,255*[(55,000–y)/40,000]
	Above 55,000	0
Pensioner aged 76 and more	0-7,750	1,783
	7,750-15,000	1,297+486*[(15,000–y)/7,250]
	15,000-55,000	1,297*[55,000–y)/40,000]
	Above 55,000	0
Self-employed	0-4,800	1,104
	4,800-55,000	1,104*[(55,000–y)/50,200]
	Above 55,000	0

In order to obtain the optimal value of the parameters, our algorithm has to iterate between the solution of the model (and the simulation of the optimal behavior of our agents) and the minimization of the objective function. Because the objective function is likely to be discontinuous, we adopt a minimization algorithm which is based on the function values only, namely the Nelder and Mead (1965) method.

In order to alleviate the computational burden of the estimation, we choose to proceed in two steps, estimating the wage equations separately from the preference parameters. This approach is similar to that of French (2005), among others. This strategy is dictated mostly by the fact that a single dataset cannot provide all the needed information: in particular we use a different data source to estimate the wage offers, gross of any tax and social security contribution.

Table 7

Tax Credits for Dependent People, 2007-11

Dependent People	**Income Brackets** *(euro)*	**Tax Credit** *(euro)*
Spouse	0-15,000	800–110*[y/15,000]
	15,000-40,000	690
	40,000-80,000	690*[(80,000–y)/40,000]
	Above 80,000	0
	Plus:	
	29,000-29,200	10
	29,200-34,700	20
	34,700-35,000	30
	35,000-35,100	20
	35,100-35,200	10
Child	Aged 3 or more	$(800 \cdot nchild) \cdot \frac{((95,000 + 15,000 \cdot (nchild - 1)) - y)}{(95,000 + 15,000 \cdot (nchild - 1))}$
	Younger than 3	$(900 \cdot nchild) \cdot \frac{((95{,}000+15{,}000 \cdot (nchild-1)) - y)}{(95{,}000+15{,}000 \cdot (nchild-1))}$
	With handicap	(1)
	More than 3 children	(2)
Other dependent people		$(750 \cdot nother) \cdot \frac{(80{,}000 + 15{,}000 \cdot (nother - 1) - y)}{(80{,}000 + 15{,}000 \cdot (nother - 1))}$

(1) Previous formulas but 800 and 900 euros are increased by 200 euros.
(2) Maximum amount augmented by 200 euros for each child after the first one.

6 Data

We use two main sources of data. Data about family composition and asset accumulation come from the Bank of Italy Survey on Household Income and Wealth (SHIW). Data about gross labor incomes come from several waves of the EU Community Statistics on Income and Living Conditions (EU-SILC) survey. Observations are matched on the basis of comparable background information about both members of the couple. All monetary values are expressed in 2010 euros using the official price indexes computed by the Italian National Statistical Office (ISTAT).

Bank of Italy has been collecting a nationally representative household survey since the 1960s. The SHIW collects information about sources of income and wealth allocation for about 8,000 households. Since 1989, it features a longitudinal component. About half of the families are

Table 8

Descriptive Statistics

	Average	S.D.	Observations
Family-level data:			
Net worth	159,854	139,014	559
Number of kids	1.62	0.93	559
Individual-level data:			
Wife partecipation	0.51	0.5	559
Wife full-time work	0.39	0.49	559
Wife years of education	9.45	2.22	559
Husband years of education	9.33	2.15	559
Wife age	40.36	6.21	559
Husband age	43.58	6.21	559

Source: our calculations on the SHIW 2004 sample. Data in 2010 euros.

interviewed in up to five waves. Given its detailed information on assets, this dataset has been used widely in previous studies[3] and it is well suited for our research goal.

We use four continuous waves of the SHIW dataset: from 2004 to 2010, the most recent one. We focus only on married individuals, who are out of the labor force or dependent workers in each wave. Our selection decision is dictated by the fact that the rules for the determination of taxable income and some features of the tax structure are different for self-employed with respect to employees. We plan on extending our analysis to single individuals in future versions of this study. We drop very few observed households who accumulated an extremely high or extremely low level of assets. Since the SHIW is a rotating panel, our resulting sample is unbalanced. We observe 559 households in 2004: almost 70 percent of them are followed until 2010, more than 80 per cent until 2008. Overall, our resulting sample is composed of 2,792 individuals-years observations.

Table 8 reports some simple unweighted descriptive statistics about our sample in 2004. The average net worth is slightly lower than 160,000 euros. Only one every two married women is employed, while only about two fifths of them works full-time. The number of children per family is about two and it is about constant in our sampled families across the six observed years.

The EU-SILC survey is released annually within the European Statistical System. The survey aims at collecting cross-country comparable micro-data on income, poverty and social exclusion at European level. Starting in 2003 in six member states, it currently covers all EU countries. The database has both a cross-sectional and a longitudinal dimension. Concerning Italy, the survey started in 2004. The reference population is made of private households residing in the country and their current members. The sample design is a rotational one articulated in four groups

[3] See, for example, Jappelli and Pistaferri (2000).

drawn according to a stratified two-stage selection (where in the first stage municipalities are selected and in the second one households). The design attaches to each household (and to each member in the same household) a sample weight adjusted for non-response and external sources (such as the population distribution by age and sex). Over the period 2004-09 the average number of households interviewed each year is about 21,700, corresponding to 54,800 individuals (46,700 aged 15 or above). The Italian section of the EU-SILC survey includes some methodological peculiarities regarding in particular some sources of personal income, including earnings. The recorded data are indeed controlled and integrated with administrative data, via an exact match at individual level based on taxpayer identification numbers (ISTAT, 2008). This process allows for minimizing the under-reporting of the income data, making them more reliable.

In the estimation of the employee income generating process, we pool the 2004-09 waves together and select individuals aged between 25 and 55. We further restrict our sample by considering only employees and non-working women, ending up with 41,761 observations. Income is defined as the gross monthly earnings for employees, which includes only monetary earnings in the main job, gross of tax and social contributions.[4] We build hourly wages dividing these amounts by the reported number of hours worked.

Some parameters are kept constant during the estimation; this is the case of the discount rate β, which is set to 0.98, and of the annual return rate on financial investments r, which is set to 1.5 per cent, in line with other studies. Data from the 2009 survey on consumption conducted by ISTAT is used to parametrize the childcare costs, which vary according to the labor market status of the mother.

7 Preliminary results

As explained above, we estimate the parameters of the models in two separate steps. First, we estimate the wage functions separately for men and women, then we use these results to parametrize the model and estimate the preference parameters.

The log wage equations are estimated using standard techniques: ordinary least squares for men, maximum likelihood, with sample selection correction, for women. The results are shown in Table 9. As expected, the wage profile is hump-shaped. The return of an additional year of education is about 3.3 per cent for men and 4.4 per cent for women. Experience has a positive and significative effect on offered wages for women (one additional year on the job increases offered hourly wage by about 3 per cent). Part-time jobs come with a significative penalty: *ceteris paribus*, hourly wages are about 6 per cent lower than in full-time occupations.

As regards the preliminary estimates of the preference parameters (see Table 10), we find a coefficient of relative risk aversion of –2.76, which is within the range of the existing estimates. Moreover, working is associated with a sizable disutility, which varies with the number of hours worked. The standard errors around our estimates of the preference parameters are quite low.

The fit of the model to the observed data is quite good. The main features are reported in Table 11. Even though the model slightly underpredicts the average level of net worth in each wave, the asset distribution mirrors quite closely that observed in the data (Table 12). The model predicts very closely the average proportion of wives who are participating to the labor market, and the average proportion of full-time employees. In terms of net wages, the unconditional net income in 2006 is around 20,000 euros for men, while it is around 8,000 euros for women.

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[4] We use the variable PY200G.

Table 9

First Stage Estimates

	Men Coeff	(se)	Women Coeff	(se)
Age	0.0374	(0.0028)	-	
*Age*2	–0.0003	(0.0000)	-	
Experience	-		0.0343	(0.0014)
*Experience*2	-		–0.0005	(0.0000)
Part-time	-		–0.0637	(0.0066)
Education	0.0334	(0.0006)	0.0441	(0.0007)
Married	0.0751	(0.0050)	0.0693	(0.0050)
Constant	1.087	(0.0545)	1.472	(0.0179)
Observations:	42,343		41,761	
Method:	OLS		Heckit	

Table 10

Preference Parameters

η	φ	γ
–2.757	3.046	–0.078
(0.009)	(0.026)	(0.007)

8 Policy experiments (preliminary)

The model is used to simulate the effects of four main changes to the tax-benefit system on the female participation rate and on the overall poverty.[5] The policy exercises can be divided in two main groups: changes aimed at increasing the non-labor income of the households in the lowest part of the income distribution and changes which directly influence labor income. In particular, the policy experiments belonging to the first group include: i) a 20 per cent increase in family allowances; ii) a possible refund of at most 400 euros to households whose net tax liabilities are negative (so-called *incapienti*); iii) a 35 per cent rise in child-related tax credits. The fourth simulation which consists of a 30 per cent increase in work-related tax credits affects directly labor income.

[5] We define as poor a household whose net income is below the relative poverty line reported by the National Statistical Office (Istat). It should be noticed that such poverty line is calculated in terms of consumption expenditure. However in general in the lowest part of the income distribution consumption and net income tend to be of the same magnitude. As measure of poverty we consider the head-count ratio.

Table 11

Fit of the Model

Year	Data	Model
Female participation:		
2006	51.6	52.5
2008	54.4	53.5
2010	52.5	54.2
Female full-time employment:		
2006	37.6	37.6
2008	39.9	40.4
2010	40.1	42
Family net wealth:		
2006	185,113	153,996
2008	194,900	141,849
2010	202,386	133,026

Table 12

Distribution of the Assets in 2006
(thousands of 2010 euros)

Percentile	Data	Model
5%	3	5
10%	8	10
25%	59	40
50%	165	128
75%	278	227
90%	394	348
95%	479	435

All the experiments are announced in 2004 and implemented in 2007 (except the one concerning family allowances which is applied since 2005). This is because in 2005 and 2006 tax credits were replaced by tax deductions. The time lag allows us to also test to which extent these policies would create some inter-temporal shift in labor supply.

With respect to the baseline scenario (which simulate the actual tax-benefit system) all policy alternatives produce a reduction in net revenue amounting to around 4 per cent (defined as the algebraic sum of tax revenue, net of tax credits, of social security contributions and tax expenses for family allowances).

The model is used to simulate the optimal choices of about 10,000 families over their life-cycle, starting from the end of 2004. These optimal choices are obtained solving the dynamic programming using the optimal parameters estimated in section 7.

The main results are summarized in Table 13, which illustrate the effects of the simulated policies on the female participation rates, full-time jobs and poverty head-count ratio.

It is important to bear in mind that the treatment of unemployment in the current version of the model may play a crucial role. In particular, our model assumes that there are no frictions in the labor market. Being aware of the relevance of such assumption, it will be relaxed in the next version of the model.

As far as results as concerned, the policy experiments reduce, as expected, the overall head-count ratio. They however differ for the magnitude of the effect. In particular, it goes from a minimum of –0.4 percentage points, in the case of partially refundable tax credits, to –1.7 percentage points when an increase in child-related tax credits is implemented. Generally, the two alternatives involving tax credits produce effects which are almost twice that of the other designed policies.

Concerning the impact on the female participation rate, the policy experiments aimed at increasing the households' non-labor income are not effective, and sometimes even detrimental. In particular, an increase in the family allowances, which are not dependent from the active position of the second earner but only from the household overall income, would negatively affect both labor supply and full-time employment. This is due to the inverse relation between the amount of family allowances and household income. The same effect is obtained increasing proportionally child-related tax credits or making all tax credits (including those for the spouse) partially refundable. On the other hand, when only the work-related tax credits are increased wives' labor supply in general rises (both in terms of part-time and full-time employment). The initial decrease we observe in 2006 is exclusively due to inter-temporal shifts in labor supply related to the time lag between the announcement of the policy and its implementation. Therefore, overall, this policy experiment is the only one successful in reaching both higher female participation rates and lower headcount ratios.

9 Conclusions and agenda for ongoing work

In this work, we build and estimate a large dynamic life-cycle model of labor supply, consumption, and asset accumulation for a sample of Italian families, which were observed between 2004 and 2010. The model allows for heterogeneity across agents, and incorporates the main features of the tax-and-benefit schemes in place at that time. The goal of our research is to build a tool that could be used in the future to run a series of policy experiments in the area of taxation and labor supply. The Italian labor market is characterized by a low participation rate of married women. As highlighted by a series of previous works, the tax code may play an important role. In a set of highly preliminary results, we show the possible effect on labor supply of a short

Table 13

Policy Simulations
(preliminary)

	Year	Female Participation	Female Full-time Employment
Baseline:			
	2006	52.46	37.65
	2008	53.46	40.35
	2010	54.24	42.01
Head-count ratio in 2010: 7.24 per cent			
Increasing family allowances by 20 per cent:			
	2006	48.45	35.64
	2008	49.55	38.10
	2010	50.54	40.17
Change in net revenue in 2010: –4.10 per cent			
Change in head-count ratio in 2010: –0.84 per cent			
Making all tax credits refundable up to 400 euros:			
	2006	51.39	37.23
	2008	49.72	36.98
	2010	50.33	39.27
Change in net revenue in 2010: –4.50 per cent			
Change in head-count ratio in 2010: –0.38 per cent			
Increasing child-related tax credits by 35 per cent:			
	2006	51.40	36.73
	2008	52.76	39.14
	2010	53.32	41.19
Change in net revenue in 2010: –4.27 per cent			
Change in head-count ratio in 2010: –1.65 per cent			
Increasing work-related tax credits by 30 per cent:			
	2006	50.97	36.35
	2008	54.06	41.69
	2010	54.63	43.18
Change in net revenue in 2010: –4.35 per cent			
Change in head-count ratio in 2010: –1.34 per cent			

We compute net revenue as the algebraic sum of tax revenue, net of tax credits, of social security contributions and tax expenses for family allowances.

list of partial reforms to the system. This work can be extended in different directions. First of all, we plan to enrich the specification of the utility function, so that some forms of both observed and unobserved heterogeneity could be accounted for. This would give us the opportunity to study the differential effects of hypothetical reforms on different sectors of the population. Moreover, allowing for different *types* in the population would allow for a better treatment of the initial conditions.

The estimation of the risk aversion coefficient requires that our model captures the main aspects of the risks to which Italian families are exposed. This is unlikely to be the case in the present form of our study: in particular, we are working to incorporate a better treatment of unemployment into the setup of the model.

Both the introduction of unobserved permanent heterogeneity, and the introduction of labor market rationing through unemployment shocks are likely to increase the degree of persistence in the observed behavior of the simulated agents. We expect these features to lower the magnitude of our simulated responses to reforms to the tax and benefit system.

Finally, extending the study to a sample of single adults could allow us to investigate the role of preferences in the distribution of resources inside the household and the potential effects of taxation schemes, including those family based, on different sectors of the population.

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