Women at work: the impact of welfare and fiscal policies in a dynamic labor supply model

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Abstract

We build and estimate a structural dynamic life-cycle model of household labor-supply, saving, fertility and consumption behavior. The model features several sources of heterogeneity in household members' characteristics and it incorporates most of the fiscal rules that affect household net income. The parameters of the model are estimated using Italian cross-sectional and longitudinal data for the 2004-2010 period, in order to shed a light on the causes of the low labor force participation rate among married women in this country. We use the estimated model to simulate a few counterfactual fiscal and welfare policies.

Keywords: household labor supply, taxes

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1 Introduction

The design of welfare and fiscal policies can heavily influence the behavior of household members, thus affecting the pace of economic growth in several ways. In particular, the choice of labor market participation by (single and married) women is largely affected by those policies (see for example Meghir and Phillips (2010) and Saez et al. (2012)).

Extensive research has been devoted over time to the role of taxes and family benefits in explaining household labor supply and consumption decisions. A specific stream of the literature has focused on female labor supply within a dynamic framework. Eckstein and Wolpin (1989), Sheran (2007), and Eckstein and Lifshitz (2011) are among the main contributions to this field. A full specification of taxes and welfare benefits in estimated models is, however, relatively rare. In this respect indeed few studies can be referred to: among these, the papers by Haan and Prowse (2010) on joint retirement decisions of German workers, Keane and Wolpin (2010) on labor supply effects of the Earned Income Tax Credit in the United States and Blundell et al. (2011) are particularly relevant.

In general, government interventions may generate a trade-off between possible distortions of the incentives in the labor market and income redistribution in favor of the poorest. Several studies have focused on the effects associated with the introduction and the extension of family-related cash benefits and on the effects of alternative taxation schemes, which have been implemented in some developed countries over the last twenty years. For example, the analyses made by Eissa and Liebman (1995) and Meyer (2002) deal with different extensions of the Earned Income Tax Credits in the United States, while Blundell et al. (2000) studies the English Working Families Tax Credits. However, the possible perverse effect stemming from the lack of coherence between the tax and the benefit systems is still a well recognized open issue in many countries. For example, for the United Kingdom the Mirrlees Review (Mirrlees et al., 2011) calls for an integrated tax-and-benefit scheme characterized by lower effective tax rates for poorer individuals and kept as simple and transparent as possible, thus avoiding arbitrary and inefficient tax differentiation across people and forms of economic activity.

Within this framework, the Italian case is particularly interesting. In 2010, the participation rate for women aged between 15 and 64 (51.1%, while it was 46.3% ten years earlier according to Eurostat) was between 13 and 20 percentage points lower than the figures registered in the largest European countries (United Kingdom, Germany, France, Spain) and, on average, in the EU. The average degree of labor market attachment by married women is even lower. A few studies have investigated the role of the Italian tax

system on this outcome: simulations of alternative tax systems are presented in Colombino and Del Boca (1990), Aaberge et al. (1999), and Aaberge et al. (2004)[1]. However, all of them model the labor supply decisions of the households in a static framework.

In this paper, we contribute to the literature on dynamic labor supply models by building and estimating a dynamic life-cycle model of household labor supply, saving and fertility decisions. The model incorporates fiscal rules in place in the period 2005-2011, as well as the main features of the family allowances. Agents are heterogeneous with respect to human capital (education and on-the-job experience), and families differ in the number of children and in the preferences for offspring. Moreover we account for permanent and unobservable heterogeneity in the behavior of the agents.

We use a two-step approach in the estimation of the model; like in French (2005), we estimate the parameters of the wage equations separately from those of the preferences. We use the method of indirect inference to identify those in the agents' utility function. In that, our approach is similar to the one used by Van der Klaauw and Wolpin (2008) to study 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 (as 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. Second, households are allowed to accumulate and decumulate assets, thus providing a mechanism through which they can insure against adverse shocks on the labor market. Finally, agents are forward looking, and they react not only to the implementation of policies, but also to their announcement, i.e. they are allowed to intertemporally adjust both consumption and labor supply.

The model also features fertility choices by the households. In that, we follow the seminal studies of Wolpin (1984) on the estimation of dynamic models of fertility and of Francesconi (2002) on the joint decision on labor supply and fertility.

To the best of our knowledge, this study is the first attempt to structurally estimate a dynamic model which incorporates all the mentioned features[2]. The richness of the model comes at the cost of a heavy computational burden, which we overcome through specific modelling, econometric, and computational choices.

[1] Marcassa and Colonna (2011) has also shown interesting evidence of the high implicit tax rates imposed by the Italian tax system on second earners.

[2] For an highly preliminary (and non peer-reviewed) version of this study, which did not account neither for unobservable heterogeneity, nor for fertility decisions of the households and in which only very few parameters were estimated, see Marino et al. (2013). No form of catastrophic shock on the labor market is present there either.

We use the estimated model to assess the effects of changes in the existing tax-and-benefit system on married women's labor supply, and on the distribution of income. Overall, we find that an increase in households' non-labor income decreases overall poverty (in terms of head-count ratios) but lowers the incentives of married women to supply labor. On the contrary, some 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 introduces the model, explaining our solution method as well. In section 3 we illustrate the main features of the Italian tax system, as well as those of the family allowances. Sections 4 and 5 provide respectively an illustration of the econometric technique and the data sources we use. The results of the study are presented in sections 6 to 8, while 9 concludes. A brief overview of the Italian labor market is presented in Appendix A.

2 Setup of the model

The household's problem is modelled as a dynamic one. We also assume that the decision maker is the household. The agent chooses how much to consume, how many hours the wife spends in a paid occupation, and how many kids to raise to maximize her lifetime utility. A series of state variables affects 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. Given the dynamic nature of the problem, household's expectations about the future play a role too. Moreover, the agent knows the structure of the tax-and-transfer system and its effect on the family net income under different circumstances.

2.1 Gross incomes

Differently from the majority of the studies on labor supply, our model incorporates a stylized-form of labor market rationing. We assume that with probability p each agent receives a job offer (whose characteristics will be described shortly); on the other hand, with probability $(1 - p)$ the agent is hit by a catastrophic labor market shock which prevents him/her from taking any paid job. In what follows, we set $p = 0.95$. This characteristic of the model should be understood as a relatively simple way to account for the risk of being rationed out of the labor market for a number of different reasons (health and family issues, relocations, pure lack of demand, etc.). If a member of a

family is hit by this shock, the household's consumption can be financed by two sources: the labor income of the spouse (if alive and employed) and the accumulated stock of assets. This feature of the model therefore has a small positive effect on both the desire to accumulate assets for precautionary reasons and to be employed (spouses provide each other with mutual insurance against any fluctuation in earned income).

For the sake of simplicity, we assume that the husband is always employed in a full time-job (except when he is retired or he is hit by the catastrophic labor market shock). 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 labor market statuses: out of the labor force, employed in a part-time job, or employed in a full-time occupation. Both husband (h) and wife (w) receive a new job offer (if any) at the beginning of each period. The log hourly wages follow a Mincer-type structure:

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

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

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

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 α^w_4 captures the penalty in the hourly wage that a woman incurs when she works in a part-time occupation.

The model assigns each continuously-employed pregnant woman a maternity income which is proportional to the average income of married women with the same observable characteristics (age, number of kids, education, years of work experience)[3].

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 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.

[3]To be consistent with the features of the Italian labor market for employees, we assign each pregnant women 80% of the previous income for the first 6 months and 30% for the next 5 months.

2.2 Budget constraint

In making their optimal choices, households take into account a budget constraint, which we model as follows:

$$\frac{A_{t+1}}{(1+r)} = A_t + \tau_t[e^h l^h + e^w l^w] - K_t(k_t, l^w) - c_t \tag{4}$$

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 the number of children in the household in that period, and on the mother's labor market participation.

2.3 Preferences and choice set

Household's preferences are defined over consumption, labor supply (i.e. leisure), and the number of offspring. We follow the literature in specifying preferences which are additive separable in consumption and labor (see for example Imai and Keane (2004) and Keane (2011)):

$$U_t = U_c - U_l + U_k \tag{5}$$

Preferences for consumption take the form of a standard CRRA utility function, where η is the coefficient of relative risk aversion:

$$U_c = \frac{(c_t/n_t)^{1+\eta}}{1+\eta} \tag{6}$$

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, as in Laibson et al. (2007) and in Attanasio and Wakefield (2010)[4].

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

The utility of paid work by wives is modeled as follows:

$$U_l(l_t^w) = \begin{cases} 0 & \text{if } l_t^w = 0 \\ \phi_j + \gamma \cdot (I(ft)) & \text{if } l_t^w > 0 \end{cases} \tag{7}$$

where $(I(ft))$ is a dummy that takes value one if the wife is employed in a full-time job and zero otherwise; ϕ_j indicates the fixed-cost of working and it is heterogeneous across types $(j = 1, .., J)$ of households.

As for the fertility choice, we follow Wolpin (1984) and Francesconi (2002) and we insert the number of offspring into the utility function in this fashion:

$$U_k = (\rho + \epsilon_\rho) \cdot k_t + \chi \cdot k_t^2 \tag{8}$$

where ϵ_ρ is a normal shock with zero mean and variance σ_{ϵ_ρ}. Thanks to this specification, the utility of having kids is heterogeneous across families and across time. Moreover it is not constrained to be linear. Economic theory would predict that $\rho > 0$ and $\chi < 0$.

Summing up, in each period during the working life of the wife, the household chooses consumption and the optimal labor supply of the wife. If the wife is in her fertile age (i.e. younger than 46), the household has the option to have a new baby[5]. In that case, the wife is prevented from working for one year. For the sake of simplicity we assume that the couple has full control over fertility (Francesconi, 2002). During retirement the only choice is on consumption.

The recursive problem can be written as follows:

$$V_t(X_t^h, X_t^w, A_t, k_t) = max_{\{l^w, A_{t+1}, k_{t+1}\}}\{U_t + \beta E[V_{t+1}(X_{t+1}^h, X_{t+1}^w, A_{t+1}, k_{t+1})]\}$$

subject to the budget constraint specified in 4. X^h and X^w are the state variables which affect the behavior of the husband and the wife respectively (including the realization of the shocks and types).

2.4 Heterogeneity

The agents in the model are heterogeneous in several dimensions. Firstly, individuals and families differ according to several observable characteristics (age in a given year, age difference between husband and wife, number of kids, experience, education, level of

[5]We constrain the number of kids per family to a maximum of 5. Given our sample, this seems to be a reasonable assumption.

accumulated assets). Secondly, the preferences for the number of offspring are not the same neither in any given period, nor across households. Thirdly, we allow families to differ on their predisposition towards wife's employment in a permanent and unobservable fashion. As customary in this kind of discrete choice dynamic models (Heckman and Singer, 1984), we allow the population of families to be composed of a small and discrete number of types ($j = 1, ..., J$). In what follows, we set $J = 3$, which we found to be a good compromise between the needs for realism and computation tractability. The probability of being of a certain type j is modeled as a standard logit:

$$Prob(i = j) = \frac{exp(b_{0,j})}{1 + \sum_{j=1}^{J-1} exp(b_{0,j})} \tag{9}$$

where $b_{0,1}$ and $b_{0,2}$ are coefficients to be estimated together with the preference parameters. For identification purposes, we impose $b_{0,3} = 1$. These parameters will drive the estimated proportion of types in our sample.

Finally, because each individual (and therefore each family) receives different shocks to the realization of gross earned income (through both the catastrophic labor market shock and the offered wages), similar individuals may find optimal to behave very differently.

2.5 Solution of the model

The presence of several continuous and discrete state variables, makes the full solution of the dynamic programming problem infeasible in this case. Therefore, we follow an approximation method which has become customary in this kind of large dynamic models (Keane and Wolpin, 1994). This approach is based on drawing 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 expected value 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 optimal level of consumption is obtained in each period, and for each selected point of the state space, through a modified version of the golden section search algorithm, which is applied once for each possible discrete choice.

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 member of the household we simulate 40 realizations of the wage and labor market catastrophic shocks. For each household, moreover, we draw 40 realizations of the preferences for kids in each period. Our simulations involve about 45,000 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[6].

3 The Italian tax and benefit system

As explained above, this model takes into account the main features of both the tax system and of the welfare benefits affecting families.

In Italy, individuals are subjected to a personal and progressive income tax (the so-called "Irpef"). While every taxpayer faces the same schedule of tax brackets and marginal rates (see Table 4), specific tax reliefs are granted in the form of deduction from taxable income (as for the period 2005-06) or tax credits (as for the years 2007-2011), whose amounts and schedule vary according to the type of earned income, and the number and kind of dependents (Tables 5, 6, and 7). This last feature of the tax code, together with the fact that the amounts of these tax reliefs are inversely related to individual income, generates different degrees of progressivity by source of income and family type. Even though its personal income tax is a very important tool for income redistribution, Italy lacks a proper tax scheme (such as subsidies, refundable tax credits, or negative income tax programs) targeted towards people with very low incomes, or, more generally, towards taxpayers whose tax liabilities are smaller than their tax credits.

Family allowances are instead tax exempt cash transfers granted by the government to families whose overall income falls below certain thresholds[7]. The amount of the support guaranteed through this welfare benefit is related positively to the size of the household and inversely to the gross household income[8]. Specific provisions are made for lone parents and for families with disabled members. While the amounts of the family allowance is kept constant, family income brackets are updated annually on the basis of

[6] 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.

[7] To be eligible for these cash transfers (called "Assegni per il nucleo familiare"), the sum of taxable earned and pension incomes of the household components must account for at least 70 per cent of the gross family income.

[8] As an example, according to the 2010 values, a family with two kids and a gross income below 13,000 euros would have been eligible for a monthly family allowance of about 260 euros.

inflation.

4 Econometric strategy

The goal of our econometric exercise is to estimate the parameters in the utility function of the agents. We focus on the coefficient of relative risk aversion, the parameters of the disutility of working, as well as those driving the fertility choices. We identify these parameters by searching for the vector of values which minimizes a weighted distance between the 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:

$$\hat{\theta} = argmin\{g(\theta)'Wg(\theta)\}$$

and

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

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 $m_j^S = \frac{1}{NS}\sum_{s=1}^{NS} m_j^s(\theta)$ 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 of the sample moments[9].

The variance of the estimator is:

$$\hat{V} = (1 + \frac{1}{rep}) \cdot (\hat{G}'W\hat{G})^{-1} \qquad \text{and} \qquad \hat{G} = \frac{\partial g(\theta)}{\partial \theta} \mid_{\theta=\hat{\theta}}$$

where rep is the number of replications per number of observed households. $\hat{G}$ is a matrix which contains the first derivatives of every moment with respect to every parameter[10].

We estimate 10 parameters with the method of the indirect inference, while using 49 moments. The moments used include the proportion of families in which wives are employed, 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

[9] The variances are obtained through bootstrap re-sampling with 100 replications.
[10] The derivatives are approximated numerically with the finite-differences method.

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. Finally, a group of moments related to the number of kids per family is used to identify the preferences driving fertility choices. Table 8 provides a list of all the moments used in the estimation procedure, together with the indication of which parameters they help to identify.

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 also by the fact that a single dataset cannot provide all the information that we need: in particular we use a different data source to estimate the wage offers, gross of any tax and social security contribution.

5 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).

The 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 interviewed in up to five waves. Given its detailed information on assets, this dataset has been used widely in previous studies[11] and it is well suited for our research goal.

We use four continuous waves of the SHIW dataset: from 2004 to 2010, the most

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

recent one. We focus only on married individuals, who, in each wave, are either out of the labor force or dependent workers. 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 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 percent until 2008. Overall, our resulting sample is composed of 2,792 individuals-years observations.

Table 9 reports some simple unweighted descriptive statistics about our sample in 2004. The average net worth is slightly lower than 160,000 euro. 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 slightly less than two and it grows over the six observed years at a modest pace.

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 drawn according to a stratified two-stage selection (where in the first stage municipalities are selected and in the second one households). Over the period 2004-2009 the average number of households interviewed each year is about 21,700, corresponding to 54,800 individuals (46,700 aged 15 or above). 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 2004-2009 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. 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 in line with many studies on life-cycle behavior, and of the real net annual return rate on assets r, which is set to 2.0%, which corresponds to a real return of 2.5% (like in Jappelli et al. (2008)) together with a capital income tax rate of 20%. 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 and the number of kids in the household. The replacement rate for public social security is set to 71.20%, in line with estimates by the Italian Treasury for an average worker retiring in 2020 (Ragioneria Generale dello Stato, 2012). Table 10 summarizes the values we choose.

6 Results of the estimates

As explained above, we use a two-step approach to estimate the parameters of the model. 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 11. As expected, the wage profile is hump-shaped. The return of an additional year of education is about 3.3% for men and 4.4% 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%). Part-time jobs come with a significant penalty: *ceteris paribus*, hourly wages are about 6% lower than in full-time occupations.

Table 12 summarizes our estimates for the preferences parameters and the distribution of types (together with the estimated standard errors). We find a coefficient of relative risk aversion of about -3, which is within the range of the existing estimates. Moreover, the size of the disutility from working varies with the number of hours worked and the family type. Type 1 families are those who find paid employment for the wifes less attractive. On the contrary type 2 families have the lowest aversion for employment. Type 3 families lie in between these two cases. The mean utility for kids is positive, while the effect of additional children is not linear ($\rho > 0$ and $\chi < 0$).

7 Fit of the model

The fit of the model to the observed data is satisfactory. The main features are reported in Table 13. The model replicates quite closely the labor market behavior of Italian married women: about half of them are employed, and about two fifth work full-time. The average number of kids per couple in the model is remarkably close to the one observed in the data: the model replicates both the level and the trends in fertility. The proportion of families with at least one new baby between 2004 and 2010 is 11.5% in the data and 11.8% in the model.

One feature of the data is worth mentioning. As shown in the last two rows of Table 13, the proportion of married women who are always[12] observed working is about 50%. The proportion of those who never work is close to 40%. Therefore, only a few actually switch across different labor market statuses over the period we observe[13]. It is reasonable to expect a relative limited overall response to marginal incentives aimed at increasing labor market participation.

The model slightly underpredicts the median level of net worth in each wave. On the other hand, it captures its increasing trend over time in real terms. Moreover, as reported in Table 14, the asset distribution mirrors closely what can be observed in the data, even though the characteristics of the distribution of the assets are not included among the moments that our econometric procedure tries to match.

Our model is able to predict several features of the population. As an example, the last two columns of 14 show a comparison of the distribution of net-of-taxes family incomes (inclusive of family allowances) in the model and as reported by the SHIW for the same set of families we use for our replications for the year 2010. The average value in the model is very close to the one in the data (about 29,000 euro in both cases), while the standard deviation and the distributions look alike as well. This is an indirect evidence of both the goodness of fit of the model and the correctness of our fiscal simulation algorithm.

In terms of individual net wages, the unconditional net income in 2006 is around 20,000 euro for men, while it is around 8,000 euro for women. In terms of consumption, our model predicts a median monthly consumption level of about 2,300 euro per family,

[12] In 2006, 2008, and 2010.

[13] This feature of the data can be originated by different phenomena. On one hand, this could be the effect of a strong persistence in offered wages. On the other, it can be explained by a distribution of tastes for work in the population (due to culture, family traditions, etc.). Because of the particular structure of the dataset that we use, our model can capture persistence in the offered wages only through a rich specification of the wage equations based on observable characteristics: any possible remaining persistence due to unobservables would be attributed by our model to differences in tastes.

which is close to that reported by ISTAT for the generality of families whose head of the household is a dependent worker. The percentage of families whose net income is lower than the official poverty-level thresholds is quite similar to the official one (about 1 family in 10).

8 Policy experiments

The model is used to simulate the effects of hypothetical changes to the tax-benefit system on the female employment and full-time employment rates and on the overall poverty rate[14]. The goal is to study the dynamic effects of different structures of the tax-and-transfer system on household behavior. 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) an increase in family allowances; ii) a rise in child-related tax credits. The second group of experiments raises the return from working in different ways: i) by directly raising work-related tax credits; ii) by lowering the net taxes paid by women-only through an increase in their tax credits; iii) by lowering the marginal tax rate of the first income bracket; iv) by using a mix of different policies.

All the experiments are announced in 2004 and implemented in 2007, except those concerning family allowances which are applied since 2005. The time lag allows us to 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 ranging between 4% and 4.5% of the total net revenue cashed in 2010 from the households in the sample[15]. We define net revenue as the sum of tax revenue and social security contributions, net of tax credits and family allowances[16].

The model is used to simulate the optimal choices of about 22,000 families over their life-cycle, starting from the end of 2004. These choices are obtained solving the dynamic programming using the parameters estimated in section 6.

[14]We define as poor the households whose net income is below the relative poverty line reported by 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.

[15]It has to be noted that the household in our sample represent only a specific subgroup of taxpayers. Therefore, the reduction in revenue cannot be straightforwardly reported to the National Account data.

[16]From the computational point of view, this measure is obtained as the average value of the net revenue over all our replications.

The main results are summarized in Table 15, which illustrates the effects of the simulated policies on the female employment, full-time jobs and poverty head-count ratio. 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 about -0.5 p.p., in the case of a gender-specific intervention, to about -1.5 p.p. when an increase in work-related tax credits is implemented. The number of kids per couple reacts weakly to the various policies, even though some policies seem to encourage a small number of families to have a new baby (this is the case of the increase in family allowances and in child-related tax credits).

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. When we simulate an increase of the family allowances (column (2) in Table 15), we obtain a small overall decrease of female employment, with a more preeminent decline of full-time employment. This result can be explained by the structure of the family allowances, which decline with family (not individual) earned income and increase with the number of children. The sign of the effects, albeit not the magnitude, is the same as for an increase in child-related tax credits (column (3)): in this case, full-time employment declines by about half of a percentage point in 2010. The monetary return is enhanced for a family in which the wife works relatively less.

On the other hand, positive effects on the number of hours worked by married women seem to result from the policies targeting directly the return from work. In column (4) we show the results of a simulation which implements a generalized increase of work-related tax credits by 30%. Two competing effects play a role in this case: on one hand, the family is richer thanks to the higher take-home pay of the husband (who always works, unless he is hit by the catastrophic labor market shock); on the other, the opportunity cost of not working rises for the wife. Overall, there is a shift of married women from part-time towards full-time employment. The three years lag of the implementation of the policy triggered a small reduction in the number of women working full-time as an announcement effect more than recovered afterwards. Targeting the same amount of resources (in terms of net revenue in 2010, as defined above) only on married women rather than on the totality of married taxpayers, should result in increased effects on female labor supply. To test this hypothesis we run a simulation to experiment the doubling of work-related tax credits for women only[17]. Column (5) shows the results.

[17]It is important to stress that, because these tax credits are not refundable, the actual benefit of this policy for the majority of the individuals is much lower than the nominal one.

Even though the overall participation is unaffected, this gender-specific policy would result in an increase of the proportion of wives working full-time by about 2.5 p.p. in 2010. The overall poverty rate is only marginally affected, though.

Lowering the first marginal tax rate from 23% to 21% (column (6)) increases the number of married women who choose to work full-time (by almost 1 p.p. in 2010) and decreases the overall poverty rate at a sizable pace (in 2010 by 1.22 p.p. with respect to the baseline).

In the last column of Table 15 we show the results of a policy mix which on one hand reduces the distortions embedded in the tax system, while on the other, it increases the return from paid employment through a series of mechanisms. In particular, this policy would: 1) lower the benefits provided by the family allowances by 20%; 2) decrease the tax credit for dependent spouses by 20%: 3) increase all work-related tax credits by 20%; 4) lower the marginal tax rate of the first income bracket by 3 p.p. to 20%. These changes were chosen in such a way to balance the incentive effect on the labor market and the need to maintain a safety-net for single-earner families; higher cuts of the family allowances and the tax credits for dependent spouses would have affected negatively the welfare of some particular poor strata of the population and could have translated in a increase of the overall poverty rate. The effect of this particular policy mix is positive on both overall participation rate and full-time employment (up by more than 3 p.p. in 2010 with respect to the baseline). At the same time, this policy would drive poverty down by about 1 p.p..

9 Conclusions

In this work, we build and estimate a large dynamic life-cycle model of labor supply, consumption, asset accumulation, and fertility for a sample of Italian families, which were observed between 2004 and 2010. The model accounts for several sources of heterogeneity across agents, and it incorporates the main features of the tax-and-benefit schemes in place at that time.

The estimates reveal that families are heterogeneous with respect to their degree of distaste for paid work by the wives. On average utility is affected positively by new kids, but this effect is non-linear. Italian families are risk averse.

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. Using the estimated model and a series of simulations, we show the possible

effect on labor supply of a short list of partial reforms to the system. A few policies can have positive effects on the reduction of overall poverty, while being detrimental to the degree of labor market participation of married women. This is the case for the welfare and tax tools which are related to family rather than individual income, as well as policies which increase transfers to families irrespectively of the labor market status of their members. On the other hand, we find that there are a series of policies which can be effective both at stimulating labor market attachment of married women and at decreasing overall poverty.

A Some features of the Italian labor market

Italian labor market participation and employment rates are considerably lower than those of the other major European countries (Table 1), as well as the targets sets by the Europe 2020 strategy. While Italy improved on both dimensions in the decade preceding the latest economic and financial crisis, both employment and participation rates have decreased in Italy in the 2008-2011 period, unlike in other European countries.

Two aspects of the Italian labor markets are worth highlighting. First, the positive dynamics in employment observed in 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). Second, long-term unemployment is much more widespread in Italy than in other EU countries: in 2007 the unemployment spell was at least 12 months for more than 47.4% of the Italian unemployed workers while the EU average was 42.7%; in 2010 the incidence of long term unemployment increased in Italy up to 48.4%, while an opposite trend was observed on average in the other EU countries (39.9%).

The aggregate data hide the large disparities that affect different groups of workers and that have led to an increasing dualism of the labor 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 p.p. with respect to Germany and more than 30 p.p. compared to UK). For what concerns employment the picture is analogous, with rates largely below the other major EU countries.

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 p.p. 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).

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Table 1: Activity rates and employment rates (15 to 64 years)

	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	69.0	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	63.0	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.

Table 2: Activity rates and employment rates by sex and age groups (%) - 2010

	Activity rate							Employment Rate						
	EU	EA	DE	ES	FR	IT	UK	EU	EA	DE	ES	FR	IT	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	76.0	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	73.0	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.

Table 3: Gender employment rate gap by highest level of education attained and household composition (in p.p.) - 2010

	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
IT	-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	-12.0	-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
IT	-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
IT	-10.2	-8.3	-30.9	-14.2
UK	-14.0	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
IT	-6.8	-6.2	-17.6	-10.2
UK	-11.1	0.1	-14.4	-5.1

Source: Eurostat.

Table 4: Income brackets and tax rates

2005-2006		2007-2011	
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%

Table 5: Tax deductions (2005 - 2006)

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

$$Amount = \begin{cases} 0, & \text{if } x_i \leq 0 \\ x_i * \text{DED}, & \text{if } 0 < x_i < 1 \\ \text{DED}, & \text{if } x_i \geq 1 \end{cases}$$

Table 6: Tax credits for work-realted expenses (2007 - 2011)

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

Table 7: Tax credits for dependent people (2007 - 2011)

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	$(800 * n.child) * [\frac{((95,000+15,000*(n.child-1))-y)}{(95,000+15,000*(n.child-1))}]$
	Younger than 3	$(900 * n.child) * [\frac{((95,000+15,000*(n.child-1))-y)}{(95,000+15,000*(n.child-1))}]$
	With handicap	(1)
	More than 3 children	(2)
Other dependent people		$(750 * n.other) * [\frac{((80,000+15,000*(n.other-1)-y)}{(80,000+15,000*(n.other-1))}]$

(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.

Table 8: Moments

Description	Number	Helps to identify
Median net worth by year	3	Risk aversion
OLS coefficients of a regression of net worth on lagged net worth, education, and experience	12	Risk aversion
Average female participation by year	3	Disutility of working
OLS coefficients of a regression of participation on lagged participation	6	Types
Average female full-time employment by year	3	Slope in disutility of working
Average number of kids per couple by year	3	Mean utility of kids
Proportion of families with at least one new kid between 2004 and 2010	1	Variance of utility of kids
Proportion of families with at least one new kid between 2008 and 2010 ...		
... among those with new kids between 2004 and 2008	1	Variance of utility of kids
Proportion of families with at least 3 kids, by year	3	Curvature in utility for kids
OLS coefficients of a regression of number of kids on experience and education	9	Mean utility of kids
Proportion of women always employed between 2006 and 2010	1	Types
Proportion of women never employed between 2006 and 2010	1	Types
Standard deviation of the number of kids by year	3	Variance of utility of kids
Total number of moments:	49	

Table 9: Descriptive statistics

	Average	S.D.	Obs.
Family-level data:			
Net worth	159,854	139,014	559
Number of kids	1.73	1.00	559
Individual-level data:			
Wife partecipation	0.51	0.50	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	41.36	6.22	559
Husband age	44.58	6.21	559

Source: our calculations on the SHIW 2004 sample.

Net-worth data in 2010 euros.

Table 10: Parametrization

Name		Value
Social security replacement rate		0.7120
Real net interest rate	r	0.02
Discount rate	β	0.98
Probability of catastrophic shock	(1-p)	0.05
Annual childcare cost (mother employed)		910.73
Annual childcare cost (mother not employed)		266.18

Childcare costs are per child and in 2010 Euro.

Table 11: First stage estimates

	Men		Women	
	Coeff	(se)	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	1.0870	(0.0545)	1.4720	(0.0179)
Observations:	42,343		41,761	
Method:	OLS		Heckit	

Table 12: Second stage estimates

Consumption:		
η	-3.00	(0.00)
Labor:		
ϕ_1 (a)	94.76	(14.34)
ϕ_2 (a)	0.17	(6.88)
ϕ_3 (a)	2.84	(6.59)
γ	8.37	(0.42)
Fertility:		
ρ	6.42	(0.14)
σ_ρ	18.99	(8.32)
χ	-1.79	(0.02)
Types:		
$b_{0,1}$	1.10	(0.08)
$b_{0,2}$	1.24	(0.10)
Types proportion:		
Type 1: 41.9%, Type 2: 45.3%, Type 3: 12.9%		

Table 13: Fit of the model

Year	Data	Model
Women employment rate:		
2006	51.6	54.8
2008	54.4	54.2
2010	52.5	52.6
Women full-time employment rate:		
2006	37.6	39.7
2008	39.9	39.8
2010	40.1	38.3
Median net worth:		
2006	165.9	146.3
2008	173.6	155.1
2010	194.0	170.5
Average number of kids per couple:		
2006	1.800	1.789
2008	1.833	1.817
2010	1.853	1.856
Proportion of women who:		
always work:	47.2	46.0
never work:	42.2	43.3

Table 14: Predictions of the model

	Assets at the end of 2010		Net family earned income in 2010	
Percentile	Model	Data	Model	Data
1	100.00	0.00	3,100.00	0.00
5	1,094.35	3,968.31	15,124.95	10,000.00
10	13,034.50	10,000.00	17,741.85	14,300.00
25	83,085.50	93,281.31	21,666.85	20,000.00
50	170,536.50	194,000.00	27,550.55	28,900.00
75	269,735.50	287,719.20	35,584.15	38,000.00
90	374,849.50	400,000.00	42,838.75	47,000.00
95	451,315.00	451,000.00	47,118.40	56,000.00
99	580,691.60	608,500.00	55,970.10	83,000.00
Mean	187,589.20	202,386.00	28,913.16	29,782.34
S.D.	137,334.70	141,608.00	10,356.91	14,668.70

Statistics on data are computed on the selected sample from the 2010 SHIW sample.
Statistics on the model are computed on the basis of the simulated families.

Table 15: Policy simulations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Percentage of women who are employed:							
2006:	54.8	54.6	54.7	54.8	54.8	54.8	55.2
2008:	54.2	54.0	54.1	54.2	54.2	54.2	54.4
2010:	52.6	52.4	52.5	52.6	52.6	52.5	52.7
Percentage of women who are employed full-time:							
2006:	39.7	35.2	39.3	39.2	38.7	39.2	41.0
2008:	39.8	34.8	39.5	41.1	43.2	40.7	43.7
2010:	38.3	34.2	37.8	39.5	41.8	39.0	42.1
Number of kids per couple:							
2006:	1.789	1.815	1.806	1.776	1.776	1.777	1.756
2008:	1.817	1.850	1.834	1.801	1.799	1.803	1.768
2010:	1.856	1.890	1.875	1.839	1.833	1.842	1.792
Other variables:							
Headcount poverty ratio in 2010:	12.76	-0.82 pp	-1.14 pp	-1.52 pp	-0.49 pp	-1.22 pp	-0.96 pp
Monthly median consumption in 2010:	2393.33	2466.51	2404.37	2406.29	2411.52	2407.31	2380.78

Policies:
(1) Baseline
(2) Raising family allowances by 12% for families making less than 40,000 euros
(3) Raising child-related tax credits by 25%
(4) Raising work-related tax credits by 30%
(5) Raising tax credits for women only
(6) Lowering the first marginal tax rate to 21%
(7) Mix of policies:
- lowering family allowances and spouse-related tax credits by 20%;
- raising work related tax credits by 20% ;
- lowering the first marginal tax rate to 20%