

# Behavioural Microsimulation of In-Work Benefits with Discrete Labour Supply

Milagros Paniagua<sup>1</sup>

*Instituto de Estudios Fiscales, EQUALITAS*

Luis Ayala<sup>2</sup>

*Universidad Rey Juan Carlos, EQUALITAS*

(Very preliminary draft, please do not quote)

---

<sup>1</sup> Corresponding author. *Instituto de Estudios Fiscales, Cardenal Herrera Oria, 378, 28035 Madrid, SPAIN, [milagros.paniagua@ief.minhap.es](mailto:milagros.paniagua@ief.minhap.es)*

<sup>2</sup>*Facultad de Ciencias Jurídicas y Sociales, Universidad Rey Juan Carlos, Paseo Artilleros s/n, 28032 Madrid, SPAIN, [luis.ayala@urjc.es](mailto:luis.ayala@urjc.es)*

# Behavioural Microsimulation of In-Work Benefits with Discrete Labour Supply

## Abstract

In-Work Benefits (IWB) have become very common transfer programs as a tool aimed at gathering both efficiency and equity targets. An expanding literature has assessed the effects of these policies on the income distribution and the labour supply. In this paper, we estimate the redistributive impact of a simulated IWB in Spain based on the replacement of the existing working mother tax credit. We simulate the redistributive effects of this proposal using EUROMOD and a discrete choice model of labour supply. Our results show that the enhancement of the proposed IWB would yield significant and positive effects in terms of inequality and poverty reductions without creating substantial labour disincentives.

**Keywords:** in-work benefits; labour supply; microsimulation; poverty; EUROMOD.

JEL: I38, H21

## INTRODUCTION<sup>1</sup>

Policy-makers try to prevent unemployed individuals from falling into poverty by means of unemployment benefits and other out-of-work transfers, including insurance and means-tested social assistance. A usual criticism is that traditional cash benefits might reduce incentives to work. Alternative programs such as in-work benefits (IWB) have become increasingly popular. These benefits might yield positive effects in terms of labour participation and lower poverty rates gathering both efficiency and equity gains (Hotz and Scholz, 2003). In its most basic form, they are income tax credits available to low-income families –usually with children– that increase with earned income up to a certain point.

IWB have become very common transfer programs in some OECD countries. Many governments are using tax credits and work-conditioned transfers as a means of providing cash assistance to low-income families with children (Brewer *et al.*, 2009). An expanding literature has assessed the effects of these policies on income and the number of hours worked. One strand of this literature has focused on optimal design issues (Saez, 2002, Creedy, 2005, Blundell and Shephard, 2012). A number of papers have also evaluated the impact of in-work benefits on work incentives (Eissa and Hoynes, 2004, Brewer *et al.*, 2003, Eissa *et al.*, 2008, Blundell *et al.*, 2011). More recent research work has broadened the debate about in-work benefits away from just work incentives to wider questions (Francesconi and Van der Klaauw, 2007, Hoynes *et al.*, 2012, Chetty and Saez, 2013, Chetty *et al.*, 2013).

While IWB have become a central component of the tax-benefit system in a number of countries –the UK, the US, Canada and New Zealand–, the scope of these benefits is much more limited in other OECD countries. Paradoxically, some of these countries face similar challenges to those that stimulated the implemented reforms mentioned above. This is the case of Spain where the problems of lower participation rates and the incidence of low-paid jobs stand out among industrialized countries (OECD, 2008). Among other characteristic features that make a new IWB particularly attractive within the tax and benefit system, in Spain: i) women are delaying starting a family –the average age for having a baby has climbed

---

<sup>1</sup> Financial support for this research was provided by the Ministry of Science and Technology (ECO2010-21668-C03-01).

to 30 in contrast to the OECD average of 28.5; ii) in spite of a remarkable growth over the last decades, activity rates for married women are substantially lower in Spain than in industrialized countries; iii) the scope of family benefits in Spain is rather lower than in other European countries; iv) the proportion of low-paid workers and the share of persons who are at work and have incomes below the poverty threshold are –with the exception of Romania– the highest in the European Union.

Apart from the already existing working mother tax credit (WMTC) “*deducción de 100 euros por maternidad*” –which is a refundable tax credit for working mothers with children under age 3– there is little support for low-income earners in Spain. The introduction of an IWB could thereby improve labour participation of married women with children and reduce income poverty among these households. Some authors have simulated alternative reforms to the tax system based on the US or UK in-work schemes. One promising approach is the microsimulation of the likely effects on labour supply and income using structural models. Figari (2009) has analyzed the incentive and the redistributive effects of introducing either a family based or an individual in-work benefit in Italy. In Spain, Oliver and Spadaro (2012) have used discrete labor supply models to estimate the effects of alternative changes of the working mother tax credit. The potential effects of in-work benefits in Spain raise numerous interesting questions.

In this paper we estimate the redistributive impact of a simulated IWB in Spain based on the replacement of the current WMTC by a new IWB mirroring the structure of the US Earned Income Tax Credit (EITC). For this purpose we use data from the Spanish version of the 2006 EU-SILC survey which will be the input database for EUROMOD –the microsimulation tool to calculate disposable income before and after the reform. To evaluate labour responses we use the discrete choice approach proposed by Aaberge *et al.* (1995) and Van Soest (1995). Our target group is the set of working mothers either married –cohabiting– or single who are not self-employed ranging from 18 to 55 years of age.

Using our behavioral microsimulation approach we find that the proposed reform might produce significant efficiency and equity gains. On the one hand, the introduction of this IWB will yield a substantial increase in labour participation in the extensive margin (0 to 20 hours worked). On the other hand, it would also lead to a considerable reduction of income poverty, with a remarkable improvement of the poorest working households.

The structure of the paper is as follows. The opening section summarises the particular design features both of the current system and the design of the new IWB. The second section introduces the structural discrete choice model of labour supply we use to estimate potential changes in the number of hours worked. The third section presents the main results of the microsimulation exercise. The paper ends with a brief list of conclusions.

## **1. THE DESIGN OF AN IN-WORK BENEFIT**

### **1.1. The Working Mother Tax Credit (WMTC)**

The WMTC is a fiscal benefit for working mothers with children under three years of age that was first implemented in 2003. The credit can be received as a lump sum per year when filling a tax return or as a monthly tax-free subsidy. Since being working is mandatory to receive the benefit in either way, its level depends on the social contributions that have been paid taking into account both the employee's and the employer's. If monthly social contributions of the working mother are above 100 euros this amount is the benefit she will receive. If they are not she will receive the equivalent amount to the social contributions paid. In case of postponing this monthly benefit until the following year's tax return, the woman would have €1,200 per year with the same previous rules linked to the social contributions paid. When the working mother has more than one child fulfilling the requirements, proportional amounts are calculated to be added to her final disposable income.

< FIGURE 1 around here >

The WMTC started in 2003. The number of recipients has increased both taking into account the taxpayers who fill a tax return at the end of the fiscal year and the ones who receive a tax-free subsidy of 100 euros per month. The most outstanding trend has been the shift towards a clear higher proportion of women opting by the tax-free subsidy (Figure 1).

## 1.2. In-work benefits: general issues

In-work benefits (IWB) are essential in “making work pay” (OECD, 2005). They are employment conditional cash benefits paid to low-income families who have a full- or part-time job. These programs focus on reducing benefit dependence, enhancing people’s willingness to work and reducing unemployment among less skilled workers (Blundell, 2006). Once implemented, the labour supply is expected to increase making participation in the labour market higher. Nevertheless, they do not only focus on the efficiency side as these benefits also aim at improving the redistribution of income by reducing poverty.

There are different types of IWB in terms of benefit design and targeting. IWB may take the form of tax credits, wage-related transfers or lump-sum payments. The final choice largely depends on the target group. A very common target group is low-wage earners, in particular families with children. In this case, the main aim is fostering incentives to increase disposable income by extending the number of hours worked. Tax credits and wage-related transfers focus on low income working families whereas lump-sum payments do so on those currently not in work. It is not clear which the optimal design of income transfer programs is. Saez (2002) suggests that the best scheme is a traditional means-tested benefit with a substantial guaranteed income support and a large phase-out tax rate when behavioural responses are concentrated along the intensive margin. In contrast, when behavioural responses are concentrated on the extensive margin the optimal option is a transfer program with negative marginal tax rates at low income levels and a small guaranteed income.

Eligibility in these schemes is usually based on family income and typically requires the presence of children so that IWB and child benefits are highly related. Families with children face higher costs when working and also have higher labour supply elasticities than families without children. IWB can be family or individually based. The first option is more frequent in Anglo-Saxon countries whereas Canada, Belgium and France have implemented individual IWB. Family-income-based eligibility rules and the interaction with other features of the tax-benefit system make the analysis of the impact on work incentives quite complex. Although both of them aim at enhancing labour market participation, individual IWB end up promoting work incentives whereas family based IWB tend to discourage the participation of second earners. This is the evidence, for instance, for the

US Earned Income Tax Credit (EITC) or the British Working Family Tax Credit (WFTC) that seem to cause labour disincentives to secondary-earners, most often women (Bargain and Orsini, 2005). Nevertheless, empirical evidence suggests that the EITC promotes employment among eligible unmarried women with children whereas it seems to lead to traditional welfare-type disincentives for most eligible secondary earners (Eissa and Hoynes, 2004).

Among the different IWB enacted in OECD countries, a rapidly expanding literature has focused on the US Earned Income Tax Credit (EITC). It has become the largest benefit for low-income households in that country. Since it seems to encourage work it has become a very popular antipoverty program (Scholz, 1996, Eissa and Hoynes, 2009). In the UK, IWB have a long tradition although they have undergone several reforms. In the last three decades Britain has gone through three different IWB. Family Credit (FC) was introduced in 1988 and modified in 1992 and 1995. In 1999 FC was replaced by the Working Families' Tax Credit (WFTC) and in 2003 the Child Tax Credit (CTC) and Working Tax Credit (WTC) replaced the existing WFTC. These family-based IWB have turned into mechanisms enhancing efficiency and equity (Brewer, 2003).

There seems to be similar evidence for other OECD countries. Bargain and Orsini (2005) found for Finland, Germany and France that wage subsidies encourage married women to take up a job and family-based tax credits and individual wage subsidies yield significant poverty reductions. Figari (2009) also confirms the possibility of enhancing both the redistributive and incentive effects of the Italian tax-benefit system through the introduction of different IWB. Oliver and Spadaro (2012) results with a simulated IWB for Spain show a potential increase in the percentage of the labour supply of working mothers and a small reduction in the number of hours worked by their partners. The latter result is in keeping with the main findings for other countries where enlarging family disposable income using IWB seems to discourage second earners incentives to work.

### **1.3. The proposal of an IWB for Spain**

We propose as new policy to be implemented within the Spanish tax-benefit system an in-work benefit with the same structure as the US Earned Income Tax Credit (EITC) that follows the optimal design proposed by Saez (2002). It consists of three thresholds, T1

(750 euros), T2 (1200 euros) and T3 (1700 euros). Working mothers with earnings below T1 would receive a subsidy that phases in with income. There would be a lump-sum benefit for individuals with earnings between T1 and T2 and for those between T2 and T3 the benefit would phase out according to the program's implicit tax rate.

< FIGURE 2 around here >

In our simulated scenario the new IWB would replace the existing working mother tax credit (WMTC) so that a working mother fulfilling the requirements would receive the new IWB but not the WMTC.<sup>2</sup>

## **2. A DISCRETE CHOICE MODEL OF LABOUR SUPPLY**

In order to estimate Spanish women's reactions to the IWB we follow the well-known literature of static structural discrete choice models of labour supply (Aaberge *et al.*, 1995; Van Soest, 1995; Creedy and Kalb, 2005). These models are static because only current behaviour is considered and long-term reactions are not taking into account. The fact of having an economic model behind makes them structural, and they are discrete because only a few levels of hours are considered in the budgetary constraint. The decision on the different alternatives of hours to be included in the choice set is a very important issue within the discrete choice setting. Some authors show that a reduction of predicted errors is achieved when the alternatives are sampled from the original distribution rather than being imposed (Aaberge *et al.*, 2009).

We focus on working women between 18 and 55 years of age with children. Men's reactions have not been considered. Figure 3 provides an indication of the weekly hours worked by the target group. As expected, Spain has a traditional Mediterranean distribution of the hours worked, with sizeable peaks corresponding to part- and full-time, apart from the outstanding proportion of non-working mothers. It must also be noted the peak corresponding to the 35 hours a week jobs –mainly civil servants and bank employees.

---

<sup>2</sup> Mothers aged out of 18-55 and also self-employed women are removed from the scheme because self-employed women might have a different labour behaviour. Something similar occurs in the case of women aged out of 18-55.



< FIGURE 3 around here >

We convert weekly hours of work into a set of three possible alternatives: 0, 20 and 40 hours, where 0 is assigned to women working less than 10 hours, 20 to those working more than 10 but less than 35 and 40 to the remaining women who are considered full-time workers. Almost half of the women with children between 18 and 55 do not work (47.5%) and full-time workers (38.3%) nearly triple the percentage of part-time employees (14.2%).

Being our aim to determine whether a new IWB can encourage Spanish women to work – either by joining the labour market or by increasing the number of hours worked–, it must be noted that prior evidence shows that most transitions take place in the intensive margin with fewer movements around the part-time jobs number of hours. Scholz (1996) finds that the majority of workers who receive the EITC have incomes that place them in the flat or phase-out region<sup>3</sup>, whereas those not working find interesting getting a paid job when these schemes are implemented. Eissa and Hoynes (2004) show that labour supply responds to this transfer program but these responses are concentrated along the extensive margin rather than the intensive one.

A basic model of labour participation may clarify these relationships. In this model, individuals have a limited amount of time to allocate between hours of work and leisure.<sup>4</sup> The trade-off between leisure and income can be represented by the individual's utility function:

$$U=U(y,L) \tag{1}$$

where  $L$  is leisure and  $y$  is income, including labour and non-labour. If personal characteristics ( $X$ ) are considered a more generalized expression of the direct utility function is:

$$U=U(y,b; X) \tag{2}$$

---

<sup>3</sup> Where the tax credit provides incentives for people to work less hours.

<sup>4</sup> Leisure must be conceived as the counterpart of paid job. However, the allocation of the individual's time goes beyond the trade-off between earnings and leisure. There are several alternatives to not working like household production or personal wealth, among others.

where  $h$  is the number of hours worked. A usual functional form for this utility function is:

$$U_i = \alpha y_i + \beta y_i^2 + \gamma h_i + \delta h_i^2 + \lambda y_i h_i \quad [3]$$

where  $\alpha = \alpha_0 + \alpha_1 A$ ,  $\gamma = \gamma_0 + \gamma_1$ , being  $A$  the woman's age and  $\gamma$  the number of children.

Apart from the mentioned variables, fixed costs –such as childcare– are taken into account. In our model they depend on the woman's age and the number of children under 3 years of age. They are subtracted from disposable income when individuals work part- or full-time. This issue is addressed in the maximization of the likelihood function by reducing income for those women working 20 or 40 hours. Fixed costs are usually related to expenses incurred when using childcare services such as kindergartens. They are dependent thereby on the woman's age and the number of children under 3.

The variables chosen for equation [3] are those used as common explanations to assess behaviour in the standard theory of labour supply. The trade-off between income and hours of work is affected by personal characteristics to such extent that they may determine the final number of hours offered. However, there are certain components linked to individual preferences that cannot be modeled from a general perspective usually assumed as unobserved heterogeneity.

The proposed simulation is essentially probabilistic since the determinants of any individual's behaviour cannot be known with certainty. From a discrete choice point of view, individuals maximize their utility by selecting the number of hours they wish to work ( $h$ ) subject to the constraint that only discrete numbers of hours,  $h_i$   $i = 1, \dots, k$  are available. The utility associated with each level ( $U_i^*$ ) is a function of  $U(h_i / X)$  and  $v_i$ ,  $U_i^* = U(h_i / X) + v_i = U_i + v_i$ , where  $v_i$  is the error term.

There is a probability distribution over the available hours influenced by the properties of  $v_i$ :  $p_i = P(h = h_i)$  for  $i=1, \dots, k$ . Utility maximization implies that a level of hours  $i$  is chosen if  $U_i^* \geq U_j^* \forall j$  iff  $U_i + v_i \geq U_j + v_j \forall j$  iff  $v_j \leq U_i - U_j + v_i \forall j$ .

For any given value of  $v_i$ , probabilities are calculated as:

$$P(U_i^* \geq U_j^* \forall j) = P(U_i + v_i \geq U_j + v_j \forall j) = P(U_i + v_i - U_j \geq v_j \forall j) = P(v_1 + U_i - U_1 \geq v_1, v_1 + U_i - U_2 \geq v_2, \dots, v_1 + U_i - U_k \geq v_k)$$

that assuming independence leads to  $\prod_{j \neq i} P(v_j \leq U_i - U_j + v_i)$

The overall probability can be obtained by aggregating the above terms over possible values of  $v_i$ . Let us assume that the distribution of the error term  $v$  is specified by its density function  $f(v)$  –in the continuous case– and its distribution function  $F(v)$ . Then:

$$p_i = P(h = h_i) = \int_{-\infty}^{\infty} \left( \prod_{j \neq i} F(v_i + U_i - U_j) \right) f(v_i) dv_i \quad [4]$$

where the distribution of  $v$  in terms of its density function follows an Extreme Value Distribution:

$$f(v) = \exp(-v - e^{-v}) \quad [5]$$

The Extreme Value Distribution, also known as a Gumbel, double exponential, or Fisher-Tippett Type I, has a more general expression:

$$f(y) = \frac{1}{\beta} \exp\left(-\frac{y-\mu}{\beta}\right) \exp\left(-e^{-\frac{y-\mu}{\beta}}\right) \quad [6]$$

And equation [5] is obtained substituting  $\mu = 0$  and  $\beta = 1$  in [6]. Substituting [5] in [4] the probabilities turn into

$$p_i = P(h = h_i) = \frac{\exp(U_i)}{\sum_j \exp(U_j)} \quad \forall i \in J \quad [7]$$

which is a multinomial logit specification.

### 3. DATA

#### 3.1. EU-SILC and EUROMOD data

The dataset for the simulation of income changes and labour supply responses is the Spanish EU-SILC survey transformed into a EUROMOD format to follow the standard structure required to run the simulations. The year chosen for the estimates has been 2006 in order to avoid the demand side restrictions arising from the economic downturn that begun just after.<sup>5</sup>

EUROMOD is a tax-benefit microsimulation model for the European Union (EU) which allows to calculate the effects of tax-benefit reforms on household income, well-being, inequality or poverty in a national and supranational level (Sutherland, 2007). Tax-benefit models are based on micro-data from statistical sources that cover the national populations. The European Survey on Income and Living Conditions (EU-SILC) is the input database for the majority of the countries included in EUROMOD. This is the case of the Spanish version of EU-SILC (ECV) which contains information on income from various sources such as labour, pensions, social benefits, property and other incomes. EUROMOD calculates disposable income by defining what the sources of disposable income are. In general terms, disposable income is defined as market income plus public transfers –in various forms such as benefits, lump-sums or tax-credits– minus income taxes and social security contributions.

Earnings and property income are rarely simulated whereas pensions and taxes are the key elements of a tax-benefit microsimulation model. However, not all the elements of a tax-benefit model can be simulated because of missing information in the input dataset. For

---

<sup>5</sup> The reference period for income is the year prior to the interview.

instance, the old-age pensions or the unemployment benefits need knowledge of the individuals' working life. In such cases, some imputations are performed so that the final disposable income can be known.

Policy changes that EUROMOD simulates are national and local income taxes, social insurance contributions paid by employers, employees and the self-employed, family benefits, housing benefits, social assistance benefits and other income-related benefits. Unfortunately, as we mentioned above, there are certain taxes and benefits which are not generally simulated such as real estate taxes, pensions and survivor benefits, contributory benefits and disability benefits. In most cases, this is due to the lack of information related to the contributory base necessary to calculate pensions and unemployment benefits.

Like in other microsimulation models, all the calculations are performed twice, first under the current system and second for each policy change. Both disposable incomes are compared so it can be assessed whether households are better-off after the simulated reforms.

One of the advantages of using a microsimulation model whose input data base is a survey containing information of household and individual income is that it captures distributive changes. However, as in many other countries, household income is underestimated in Spain due to the lack of information on certain sources of income and the need of imputations (Adiego *et al.*, 2010). To overcome these problems, microsimulation models use administrative data to compensate the loss of accuracy.

The original sample from the EU-SILC 2006 transformed into a EUROMOD format has 17,640 households and 34,402 individuals. For our study we have selected 4,859 women with children, between 18 and 55 years of age and not self-employed. Within these women some of them work and others do not. Regardless of which the labour status is, but to assess transitions in the labour market a gross wage needs to be known for all of them. If the woman declares to be working the common solution is to assign the data provided by the survey. But if she does not work, a reservation wage needs to be estimated in order to avoid the likely selection bias of individuals who decide to join the labour market.

### 3.2. Missing wages

Labour supply models account for working and non-working individuals. Transitions within the labour market for those who work are of interest. However, the analysis of movements between working and non-working has become increasingly important since a rapidly expanding literature has found that transitions in the extensive margin seem to concentrate the impact of recent reforms. It seems necessary therefore to impute a wage to non-working women. Among the different alternatives, we use the Heckman's two-step sample selection correction. The two-step statistical approach starts setting a model for the probability of working, usually following a probit regression framework. Being  $X$  a vector of explanatory variables and  $Y$  a dummy variable set to 1 when the individual works and 0 when she does not, the model can be written as follows:

$$P(Y=1/X) = \Phi(X'\gamma) \quad [8]$$

where  $\Phi$  is the cumulative distribution function of the standard normal distribution.

The variables we include in  $X$  are the highest level of education achieved, age squared, work experience, other household incomes and two dummy variables representing whether the woman has a couple and if she has children between 3 and 6 years of age. Once the probit model has been estimated, the resulting estimators are used to predict probabilities of being working for all the individuals (working or non-working). The predicted values will be introduced in the second equation –wage equation– as an additional explanatory variable.

The wage equation may be specified as follows:

$$w = Z\delta + u \quad [9]$$

where  $w$  represents wages and  $u$  the unobserved determinants of wages.  $Z$  represents the set of explanatory variables for the wage equation, which in our data consist of the highest educational level, woman's age and work experience, apart from the probability of being working derived from [8].

If  $\varepsilon$  represents the unobserved determinants of the propensity to work from equation [8],  $u$  the unobserved determinants of wages in [9],  $\rho$  is the correlation between  $\varepsilon$  and  $u$  and these two error are jointly normal distributed, then

$$E(w/Z, Y=1) = Z\delta + E(u/Z, Y=1) = Z\delta + \rho\sigma_u\lambda(X'\gamma) \quad [10]$$

where  $\lambda$  is the estimated inverse Mills ratio,  $\varepsilon$  has information on all the unobserved determinants in [8], and  $u$  has information on all the unobserved determinants in [9]. If these two are highly correlated, the unobserved variables influence each other and, therefore, individuals in equation [9] have not been randomly chosen.

< TABLE 1 around here >

Table 1 presents estimates of the probability of being working for the women in our sample, the wage equation and the self-selection bias. Most of the coefficients of the two-step estimation have the expected signs according to economic theory. On the one hand, having children between 3 and 6 years of age and cohabiting with their partner reduces the probability of being working, whereas higher educational attainment and work experience increases it. On the other hand, the wage equation shows that both work experience and education increase gross wages, while age has the opposite effect. Finally, the inverse of Mill's ratio is significant indicating the need for correcting the selection bias.

## 4. RESULTS

### 4.1. Labour market participation

We apply the labour supply model described in section 2 to the selected sample of women. We replicate the dataset comprising 4,859 women three times (10, 20 and 40 hours). The variables that we allow to change are the hours worked by mothers –men and the rest of women in the survey are assumed to have an inelastic behavior–, monthly gross wages and other labour variables such as months in employment or unemployment.

This new dataset is used as the EUROMOD input to estimate behaviour using equation [3]. For the initial estimates no reform is considered and the tax and benefit rules in 2006 are applied to the new dataset. The output can be seen in Table 2. In general terms, the results of the estimation of the utility function are in keeping with standard economic theory. All the coefficients are significant, being positive the one for income while the corresponding to the number of hours worked is negative.

< TABLE 2 around here >

These parameters determine the labour supply structure of our data according to the utility function chosen. However, as mentioned before, the simulation is not deterministic and a stochastic component needs to be considered. We incorporate that random process by using the so-called maximum probability rule (Bargain *et al.*, 2005). This ensures that the optimal choice for each individual, given the estimated labour supply function, corresponds to the choice actually made. For its implementation, the observed distribution of the number of hours worked is replicated by drawing conditionally from the stochastic error structure such that the predicted choice probability is maximized at the observed state. We then keep a number of draws that leads to predictions where the predicted choice probability is maximized at the observed state. Using 80 draws we apply the maximum probability rule to derive the preferred choice after the introduction of the new IWB. To calculate transition probabilities for the mothers between states (0-20-40 hours) we use the mean of the predicted transitions over the 80 repetitions.

< TABLE 3 around here >

Table 3 contents the estimates of the three possible transitions. The introduction of an IWB would reduce the proportion of non-working women from 44.6 to 36.5% and the percentage of women working full-time. Nevertheless, part-time would double due to intensive margin transitions (0 to 20 hours) and extensive margin movements (40 to 20 hours). Results also reveal an increase in the number of mothers who decide to join the labour market (around 8%). This result is in line with other similar studies for Italy (Figari, 2009) and Spain (Oliver and Spadaro, 2012) where the increase in the labour market participation for coupled women with similar IWB rises to 6.0 and 6.5%, respectively.



## 4.2. Redistributive effects

Apart from improving labour market participation IWB schemes also aim at increasing income of low-wage individuals producing thereby changes in the income distribution. To assess how the implementation of the new policy might affect the original distribution, we estimate a set of inequality measures. In order to identify the global effects of our IWB first we present estimates that assume that there are no changes in labour participation. Then we allow individuals to change their behaviour according to the parameters of the estimated econometric model.

< TABLE 4 around here >

As a general conclusion, the new IWB for Spain seems to reduce inequality at both scenarios, either considering the reform with no reactions or when incorporating labour supply responses to the model. The reduction of the Gini index in the former case is rather modest, in contrast with the second case where the reform leads to a -9.4 per cent reduction. This remarkable difference gives support to the necessity of taking behavioural reactions into account to correctly interpret inequality changes resulting from the reform. Similar results are found for the Theil and Atkinson indices.

< FIGURE 4 around here >

Further insights into the nature of inequality changes can be gained by disaggregating the effects of the new IWB by income deciles. As stated before, when the effects of the new scheme are estimated without labour reactions differences between the baseline results and the ones corresponding to the reform are very small (Figure 4). However, when labour responses are considered, income grows for all the deciles except the richest ones. The most sizeable changes turn out to be those affecting the poorest decile where average income would grow with the reform from 276 euros a month to 447 euros. In general terms, results are in keeping with the fact that the end of the phase-out region is set at 1,700 euros, a very similar value to that of the ninth decile.

< TABLE 5 around here >

Given that one of the main goals of IWB is increasing incomes of low-wage individuals one of the most relevant results to test is how poverty changes with the new policy. As Table 5 shows the poverty rate would slightly fall from 19.5 per cent at baseline to 19.4 with the new IWB assuming that there is no behavioural reaction. However, when labour supply responses are taken into account the effects of the new IWB on the incidence of poverty become remarkably stronger, with a reduction higher than 30 per cent. This decrease in the poverty rate is even greater with lower poverty lines illustrating the potential of IWB schemes to reduce severe poverty.

< TABLE 6 around here >

An interesting question is how the poverty structure by household type might be affected by the IWB especially when behavioural changes are included in the evaluation. Prior empirical findings show that family-based tax credits and individual wage subsidies produce in some countries both significant poverty reductions as well as changes in the composition of poverty (Bargain and Orsini, 2005). Our own estimates show a larger reduction of poverty rates for couples with children due to the introduction of the new IWB in the Spanish tax and benefit system (Table 6). This reduction is even larger when using the 30 per cent of median income to determine the poverty threshold.

In short, the enhancement of the proposed IWB would yield significant and positive effects in terms of inequality and poverty reductions without creating substantial labour disincentives. These observed results are in keeping with previous findings for Spain assessing the impact on the labour supply of different tax reforms. As Labeaga *et al.* (2008) conclude this kind of redistributive policies may have a minor impact on economic efficiency affecting significantly social welfare. It must be noted, however, that the introduction of the new IWB would not be neutral revenue. The cost of this welfare program rises up to 180 million euros. Nevertheless, since the implementation of this reform implies the abolition of the existing working mother tax credit –for which approximately half of that amount is currently spent– the final cost of the new policy would swap around 90 million euros.

## 5. CONCLUSION

In-work benefits have proved to be effective tools to reduce poverty and enhance labour participation in many countries. Although the effects might not be so good in some population groups –like secondary earners– the overall assessment of their performance seems successful in terms of efficiency and equity gains in a number of countries. Furthermore, recent evidence also points to positive unintended effects in a variety of dimensions, including improvements in health status or social relationships.

In this paper we offer potential evidence for the possible effects the implementation of a specific scheme of IWB might have in Spain. Taking as reference the existing working mother tax credit we define a standard IWB scheme that follows the optimal design proposed by Saez (2002) with three earnings thresholds, a subsidy that phases in with income, a lump-sum benefit for individuals with earnings between the two first thresholds and benefits phasing out from the second threshold up to a given level.

One of the contributions of the paper is the treatment given to behavioural responses. In order to estimate Spanish women's reactions to the IWB we have followed a specific approach within the framework of structural discrete choice models of labour supply. As compared to other behavioural microsimulation models that are non-structural this approach has the advantage of resting on both an economic model and the current distribution of hours worked. The estimated parameters from the utility function are in keeping with the prototypical models of labour supply with income affecting positively utility and working hours having the opposite effect.

One of the paper's main findings is the sizeable impact the new scheme might have on the labour market participation of women. Our estimates yield a substantial reduction of the proportion of non-working women. Nevertheless, this result is compatible with extensive margin movements with a segment of working mother moving from full to part-time jobs. These results are somewhat similar to those of previous studies for other countries.

Taking into account behavioural reactions, the simulated results of the proposed IWB show unequivocal gains in terms of inequality and poverty reductions. However, these results do not hold when the reform is evaluated precluding the foreseeable changes in

labour participation. When labor transitions are addressed all the estimated inequality measures are remarkably lower after the simulated reform. Given that poverty reduction is one of the key targets of these reforms the drastic decrease of poverty rates stand out among the estimated indices. Our results unequivocally point to an especially marked reduction in the incidence of severe poverty. Furthermore, the introduction of an IWB like the simulated one would not only change poverty levels but also its composition. Families with children would particularly benefit from the new scheme.

Therefore, like in other countries, the proposed IWB might produce very positive equity effects without creating substantial labour disincentives. While the cost of the reform would not be negligible and the expected results are subjected to the natural caveats implicit in this type of microsimulation models, it seems that the resulting improvements both in efficiency and equity would give rise to higher levels of social welfare.

## References

- Aaberge, R., Colombino, U. and Wennemo, T. (2009). Evaluating alternative representations of the choice sets in models of labour supply. *Journal of Economic Surveys* 23, 586-612.
- Aaberge, R., Dagsvik, J. K. and Strom, S. (1995) Labour supply responses and welfare effects of tax reforms. *Scandinavian Journal of Economics* 97, 635-59.
- Adiego, M., Cantó, O., Levy, H. and Paniagua, M. (2010) EUROMOD Country Report. ISER
- Bargain, O. and Orsini, K. (2005). In-work policies in Europe: killing two birds with one stone? IZA Discussion Paper No. 1445.
- Blundell, R. (2006). Earned Income Tax Credits policies: impact and optimality The Adam Smith lecture 2005. *Labour Economics* 13:423-43.
- Blundell, R. and Shephard, A. (2012). "Employment, Hours of Work and the Optimal Taxation of Low-Income Families," *Review of Economic Studies* 79, 481-510.
- Blundell, R., Bozio, A. and Laroque, G. (2011): "Extensive and Intensive Margins of Labour Supply: Working Hours in the US, UK and France," IZA Discussion Papers 6051.
- Brewer, M. (2003): "The new tax credits". IFS Briefing Note No. 35. London: Institute for Fiscal Studies.
- Brewer, M.; Francesconi, M.; Gregg, P. and Grogger, J. (2009): "In-work Benefit Reform in a Cross-National Perspective - Introduction", *The Economic Journal* 119, 1–14.
- Chetty, R and Saez, E. (2013): "Teaching the Tax Code: Earnings Responses to an Experiment with EITC Recipients", *American Economic Journal: Applied Economics* 5, 1-31.
- Chetty, R.; Friedman, J. and Saez, E. (2013): "Using Differences in Knowledge Across Neighborhoods to Uncover the Impacts of the EITC on Earnings", *American Economic Review* (forthcoming).
- Creedy, J. (2005): "An in-work payment with an hours threshold: labour supply and social welfare. *Economic Record* 81, 367–77.
- Eissa, N. and Hoynes, H.W. (2004): " Taxes and the labor market participation of married couples: the earned income tax credit". *Journal of Public Economics* 88, 1931-1958.
- Eissa, N., Kleven, H. and Kreiner, C. (2008): "Evaluation of four tax reforms in the United States: labour supply and welfare effects for single mothers". *Journal of Public Economics* 92, 795-816.
- Figari, F. (2009). Can in-work benefits improve social inclusion in the Southern European countries? EUROMOD Working Paper No. EM4/09.
- Francesconi, M. and van der Klaauw, W. (2007): "The socioeconomic consequences of "in-work" benefit reform for British lone mothers", *Journal of Human Resources* 42, 1–31.

- Hotz, V. and K. Scholz (2003): "The earned income tax credit," in R. Moffitt (ed.): *Means-Tested Transfer Programs in the United States*. Chicago: University of Chicago Press.
- Hoynes, H.W.; Miller, D.L. and Simon, D. (2012): "Income, the Earned Income Tax Credit, and Infant Health," NBER Working Papers 18206.
- Labeaga, J.M.; Oliver, X. and Spadaro, A. (2008): "Discrete choice models of Labour Supply, behavioural microsimulation and the Spanish Tax Reforms". *Journal of Economic Inequality*, 6, 247-273.
- Saez, E. (2002) "Optimal income transfer programs: intensive versus extensive labour supply responses". *The Quarterly Journal of Economics* 117, 1039–73.
- Scholz, J.K. (1996): "In-work Benefits in the United States: the Earned Income Tax Credit", *The Economic Journal* 106, 156-169.
- OECD (2008): *Growing Unequal*. Paris: OECD.
- Oliver, X. and Spadaro, A. (2012) Active welfare state policies and women labour participation in Spain. Presented at the 2<sup>nd</sup> Microsimulation workshop 2012, Bucharest.
- Sutherland, H. (2007) EUROMOD: the tax-benefit microsimulation model for the European Union. In A. Gupta and A. Harding (eds): *Modelling Our Future: population ageing, health and aged care. International Symposia in Economic Theory and Econometrics*, 16. Oxford: Elsevier.
- Van Soest, A. (1995) Structural models of family labour supply. A discrete choice approach. *Journal of Human Resources* 30: 63–88.

**Table 1. Wage equation**

---

<i>Hourly gross wage (ln)</i>	
Highest degree of education	0.755 ***
Age	-0.270 ***
Work experience	0.281 ***
Constant	4.838 ***
<i>Selection equation</i>	
Highest degree of education	0.405 ***
Squared age	-0.002 ***
Work experience	0.111 ***
Couple	-0.877 ***
Children aged 3-6	-0.226 ***
Other household income	0.001 ***
Constant	-0.673 ***
Lambda	-0.741 ***
N	4859

---

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01

**Table 2. Estimates of the labour supply model**

---

Income	2.118 ***
*Age	-4.857 ***
Squared income	1.273 ***
Hours worked	-506.2 ***
*Number of children	2.091 ***
Squared hours worked	280.3 ***
Income * Hours	-8.569 ***
*Age	3.533 ***
*Number of children	0.214 **
Fixed costs	1.053 ***
*Age	-0.203 ***
*Number of children < 3	0.061 ***
N	4859
Log likelihood	-4444

---

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01



**Table 3. Labour supply effects (transitions between states)**

	Number of hours	After IWB			
		0	20	40	Total
Before IWB	0	16.9	12.7	15.0	44.6
	20	5.2	4.7	5.0	14.8
	40	14.5	11.7	14.4	40.6
	Total	36.5	29.1	34.4	

**Table 4. Gini and Theil indices**

	Baseline	After reform / no behaviour	After reform / behaviour
Gini	0,297	0,297	0,269
Theil (c=1)	0,149	0,148	0,124
Atkinson ( $\epsilon=0.5$ )	0,075	0,075	0,061
Atkinson ( $\epsilon=1$ )	0,155	0,155	0,123
Atkinson ( $\epsilon=2$ )	0,550	0,551	0,480
p90/p10	4,164	4,159	3,461
p90/p50	1,895	1,888	1,752
p50/p10	2,198	2,203	1,978

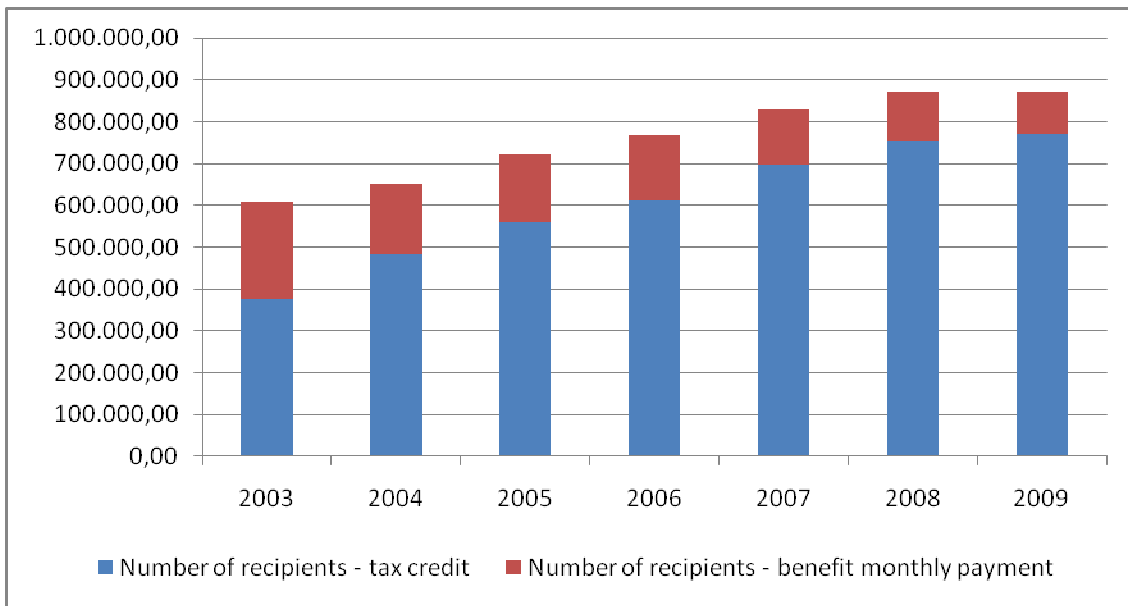
**Table 5. Changes in poverty rates after the reform**  
(threshold: 60 and 30% of median income)

$\bar{x} = 0.6$	Baseline	Reform / no behaviour	Reform / behaviour
Population under the threshold	8,455,192	8,424,243	5,890,934
Poverty rate	19.5	19.4	13.6
$\bar{x} = 0.3$	Baseline	Reform / no behaviour	Reform / behaviour
Population under the threshold	1,653,516	1,670,295	1,028,967
Poverty rate	3.8	3.8	2.4

**Table 6. Poverty rates by household type after the reform**

$\alpha = 0.6$	Household type	Baseline	Reform / no behaviour	Reform / behaviour
	1 adult	38.1	38.1	38.1
	2 adults with no dependent children	18.5	18.5	18.5
	Other households with no dependent children	13.9	13.9	13.9
	1 adult with 1 or more dependent children	36.1	36.1	33.6
	2 adults with 1 or more dependent children	19.3	19.1	7.6
	Other households with 1 or more depend. children	26.6	19.4	14.8

**Figure 1. Number of recipients of the WMTC**



**Figure 2. IWB proposal**

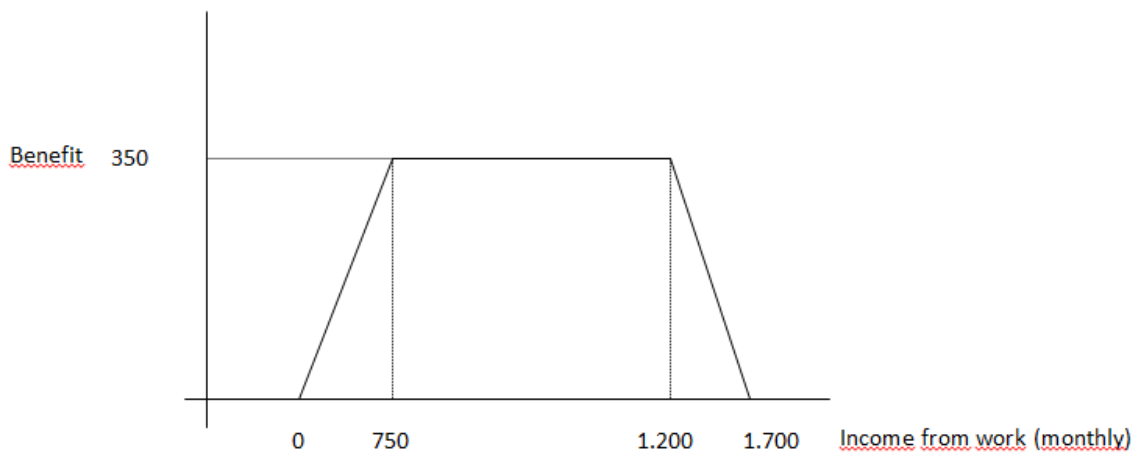


Figure 3. Number of hours worked per week

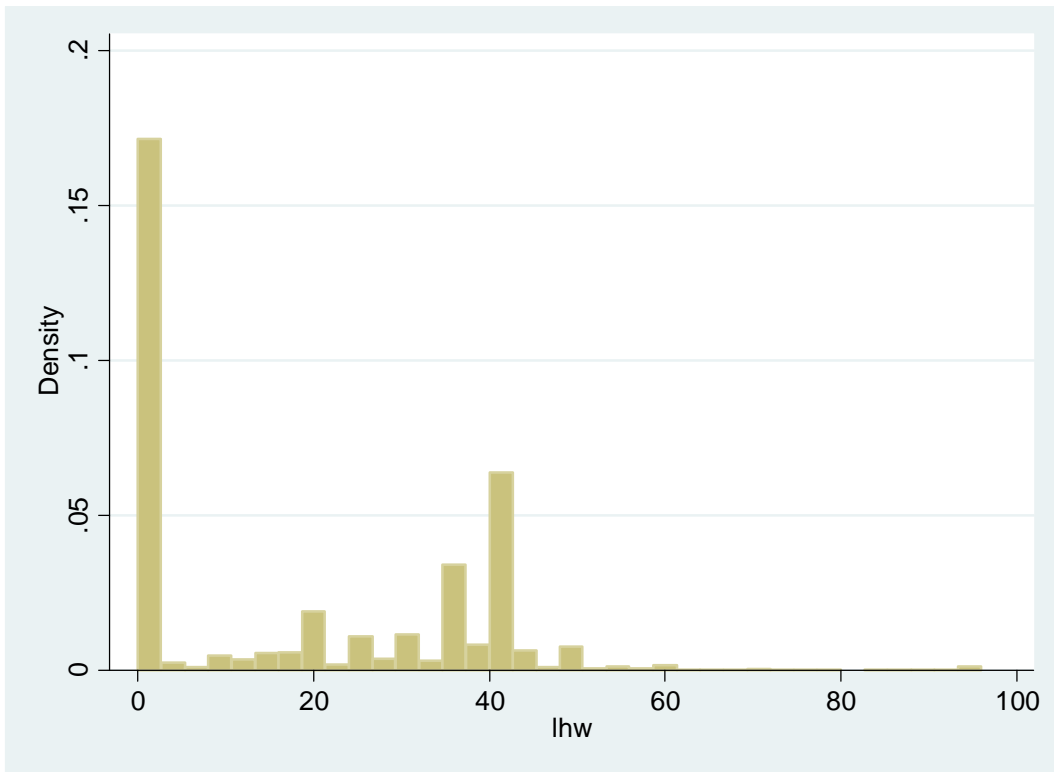


Figure 4. Mean income by deciles after the reform

