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# HOUSEHOLD LABOR SUPPLY: EVIDENCE FOR SPAIN

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*This paper estimates and tests household labor supply models for Spain within a structural approach. Following Fortin and Lacroix (1997), we postulate a general system of labor supplies and we obtain the set of parametric restrictions imposed by the unitary and collective models of household labor supply. The empirical results clearly reject the restrictions of the unitary model, while the restrictions of the collective model cannot be rejected. Futhermore, we verify that the estimated labor supply elasticities agree with the empirical regularities observed in other countries.*

*Keywords: Labor supply, unitary model, collective model.*

(*JEL* J22, D1)

## 1. Introduction

The consumption-leisure decision is one of the most important in Microeconomics. Thus, the study of labor supply not only helps in understanding the behavior of individuals with regard to the participation and hours of work decision, but also allows a better evaluation of certain tax reforms and social welfare programs. In spite of this, there are few studies that analyze this decision for the Spanish case. The main reason is the lack of a microeconomic database that gathers all the relevant variables in the choice of labor supply. Existing studies

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are limited to partial dimensions of the problem like the participation decision (Novales, 1989; Novales and Mateos, 1990; Bover and Arellano, 1995; Sánchez, 1999) or the determination of wages (Moltó, 1984; Peinado, 1988, 1990; Calvo, 1991; Ugidos, 1993; Hernández, 1995). The European Community Household Panel (ECHP) fills this gap allowing a more complete approach to the problem.

In the estimation of labor supply the first question to be addressed is the selection of the theoretical framework. There are several alternatives (Blundell and MaCurdy, 1999). First, whether to use a static model or a dynamic model in which considerations of lifetime can be included. Second, whether to assume that the agents individually take their decisions or that there exist some institutions (mainly the family) conditioning the decisions. Third, whether to assume a linear budget constraint or a nonlinear one, which captures aspects like the progressiveness of the income tax, social welfare programs, fixed costs of working or minimum daily hours of work. Fourth, whether to adopt a representative agent approach or take into account the heterogeneity in preferences. Fifth, whether to analyze the labor market participation decision. In the choice of the theoretical model we should consider both the existing theoretical developments and the available data. With regard to the data, we use the ECHP version that contains observations for 1994, 1995, 1996 and 1997 (the latter will be lost since the income variables are referred to the previous year), which precludes the selection of a dynamic model. Within the static models, the current lines of research put more emphasis on the study of household labor supply models and on the introduction of nonlinearities into budget sets.[1] We have chosen to use a household labor supply model with a linear budget constraint without considering the participation decision because of the limited theoretical developments in these areas.[2]

Within studies of household labor supply, the first model was the so-called neoclassical or unitary model. This model treats the household or family as an individual agent who maximizes a utility function that depends on the consumption and leisure of each member. Therefore, the obtained demands must satisfy two types of restrictions: income pooling, which establishes that the level of nonlabor income is what

[1] Household labor supply means the joint decision of a couple about how many hours each member works.

[2] In a recent paper, Donni (2001) incorporates the labor market participation decision and the possibility of nonlinearity of the budget constraint in the collective setup.

matters in the decision making, not its distribution among the members of the household; and the common restrictions of a demand function derived from the maximization of a utility function subject to a convex budget set (symmetric and negatively semidefined substitution matrix). The main advantages of this model are the direct applicability of the Welfare Theorem results and the ease of incorporation in an intertemporal setup. Nevertheless, the unitary model has received numerous theoretical and empirical critiques. From the theoretical point of view, it is argued that it contradicts individual rationality, in which each individual has her own preferences (Chiappori, 1992). It could be argued that the utility function of the household is the outcome of an aggregation process, but this aggregation would be *ad hoc*, since it does not establish how to derive the preferences of the household from the individual preferences of its members. This also precludes the recovery of the individual preferences and forces to us to consider the decision process as a "black box". On the other hand, the aggregation can be questioned as well, because there is no theoretical justification for the notion that the outcome of a collective decision must satisfy the same properties as that of an individual decision. From the empirical point of view, several studies have rejected both income pooling (Schultz, 1990; Thomas, 1990; Phipps and Burton, 1994), and symmetry (Kooreman and Kapteyn, 1986; Fortin and Lacroix, 1997).

Dissatisfaction with the unitary model has given rise to models that try to incorporate individual preferences and to analyze the decision making process within the household. Thus, noncooperative bargaining models *à la* Nash have been developed, where the members of the household negotiate taking as reference a reservation level of utility. Additionally, cooperative bargaining models have appeared with the common feature that the outcome of the bargaining process is Pareto-efficient (PE) under symmetric information (Chiappori, 1988; McElroy, 1990). In this sense, the use of a cooperative setup for the analysis of a social institution like the family seems more natural and appropriate.

Within the cooperative models, the collective model (Chiappori, 1988 and 1992) is prominent. According to this model each individual has a utility function and her demands of consumption and leisure are determined in a unobservable decision process within the household, whose outcome is Pareto-efficient. Under certain assumptions this model produces restrictions (collective rationality constraints or CRC), similar to those of symmetry in the unitary model, that can be tested from the observed behavior of the individuals. It does not impose income pooling, however, since the bargaining power of each member of the household could depend on her initial proportion of nonlabor income. In comparison with the unitary model, the main advantage of the collective model is the explicit consideration of individual preferences, which allows the recovery of parameters of these preferences and of the decision process, and therefore the evaluation of public policies for individuals instead of only for households. The main advantage of the collective model with respect to other cooperative models is that it does not impose structure on the decision process. Therefore, the rejection of its restrictions cannot be due to an incorrect specification of that process. However, this approach is not free of problems. It is only possible to derive parametric restrictions for the case where the utility functions of the individuals are egoistic.[3] This would imply that an individual's utility of leisure is independent of the leisure of his/her spouse (Kooreman and Kapteyn, 1992), which seems questionable.

For Spain, Zamora (2000) estimates a system of Engel curves incorporating the effect of the participation decision of women within the collective framework. The differences with this study are that she puts emphasis on the decision of allocating expenditure among different consumption goods (instead of the decision of labor supply) and her data are drawn from the Spanish Consumer Expenditure Survey (CES) for 1990-91 (instead of the ECHP).

Taking into account all these facts, the objective of this paper is to estimate a household labor supply and to test the unitary and collective models for Spain. Following Fortin and Lacroix (1997), we postulate a general functional form for the labor supply and we test the parametric restrictions imposed by the unitary and collective models using the data of the European Community Household Panel.

The following section provides a formal analysis of both unitary and collective models of labor supply. Section 3 discusses the empirical specification adopted for estimation and testing purposes. Sections 4 and 5 describe the econometric model and the data respectively. Empirical results for Spain are given in Section 6. Section 7 concludes.

[3] In the context of preferences defined over the consumption of a composite private good and leisure, egoism means that the individual gets utility solely from her own consumption of the private good and leisure.

## 2. Theoretical framework

This section describes in more detail the unitary and collective models. Common assumptions in both cases are that households are composed of two members of working age (the spouses), preferences are defined over consumption and leisure, and there exists a unique private consumption good in the economy (Hicks composite good) taken as the numeraire.

### *2.1 Unitary model*

In the unitary model the household is the decision unit. It behaves like an individual who maximizes a utility function that does not depend on prices (wages and nonlabor incomes). Let $c^i$ and $h^i$ be consumption and hours worked of member $i$ of the household ($i = 1, 2$). Normalizing the time endowment to one and assuming that there is no domestic production, consumption of leisure of each member would be 1 - $h^i$. Let $w^i$ and $y^i$ be the exogenous wage rate and the nonlabor income of $i$. The utility function of the household $\widetilde{u}(c^1, c^2, 1 - h^1, 1 - h^2)$ is well behaved (increasing, strictly quasi-concave and twice differentiable in its arguments). Given that in most data sets only aggregate consumption of the household ($c = c^1 + c^2$) is observed and that it is reasonable to assume that both spouses face the same prices for consumption goods, we can use the Hicks composite commodity theorem to define a well behaved reduced form of the household utility function $u(c, 1 - h^1, 1 - h^2)$. Then, household behavior is the solution of the following program:

$$\begin{aligned} \max_{\{c,h^i\}_{i=1,2}} \quad u &= u(c, 1 - h^1, 1 - h^2) \\ \text{s.t.} \quad c &\leq w_1 h^1 + w_2 h^2 + y_1 + y_2, \\ 0 &\leq h^i \leq 1, \\ c &\geq 0, \\ i &= 1, 2. \end{aligned} \qquad [1]$$

Let $h^i(w_1, w_2, y_1, y_2)$ ($i = 1, 2$) be the solutions of [1]. The unitary model imposes two types of restrictions: first, the so-called income pooling restrictions, meaning that what matters in the decision process is the aggregate level of nonlabor income and not its allocation among members of the household. In terms of labor supplies this restriction takes the following form:

$$\left.\begin{array}{l} h^1(w_1, w_2, y_1, y_2) = H^1(w_1, w_2, y_1 + y_2), \\ \\ h^2(w_1, w_2, y_1, y_2) = H^2(w_1, w_2, y_1 + y_2), \end{array}\right\} \Rightarrow \left\{\begin{array}{l} h^1_{y_1} = h^1_{y_2} = h^1_y, \\ \\ h^2_{y_1} = h^2_{y_2} = h^2_y, \end{array}\right. \qquad [2]$$

where $h^i_{y_j} = \frac{\partial h^i}{\partial y_j}$ $(i = 1, 2; j = 1, 2)$ and $y = y_1 + y_2$.

Second, assuming that the solution of the program is interior (and therefore only valid for households where both spouses work), the usual Slutsky restrictions must hold. The effect of these restrictions on the substitution matrix $S$ can be expressed as follows:

- Symmetry of the substitution matrix:

$$s_{12} = s_{21}. \qquad [3]$$

- Positive semidefiniteness of the substitution matrix:

$$\begin{array}{rcll} s_{ii} & \geq & 0 & i = 1, 2, \\ s_{11}s_{22} - s_{12}^2 & \geq & 0, & \end{array} \qquad [4]$$

  where $s_{ij} = h^i_{w_j} - h^j h^i_y$ $(i = 1, 2; j = 1, 2)$, $h^i_{w_j} = \frac{\partial h^i}{\partial w_j}$, $h^i_y = \frac{\partial h^i}{\partial y}$.

### *2.2 Collective model*

In this model each spouse has individual preferences and interacts with the spouse in a bargaining process within the household. The main assumption is that this process is cooperative, leading to a PE outcome. Nevertheless, in order to obtain testable parametric restrictions we need an additional assumption: preferences of each member of the household are egoistic.[4]

Let $c^i$ and $h^i$ be consumption of the private good and hours worked by member $i$ $(i = 1, 2)$, leaving $(1 - h^i)$ consumption of leisure if the endowment of time is normalized to one. Let $u^i(c^i, 1 - h^i)$ be the utility function (supposed to be well behaved) and let $w_i$ and $y_i$ be

[4]Strictly speaking, it is only necessary that the utility function be separable in the consumption-leisure allocations of each individual. Therefore, the model can be generalized to the Beckerian caring preferences. The utility functions that represent this kind of preferences have the form $W^i = W^i(u^1(c^1, 1 - h^1), \widetilde{u}^2(c^2, 1 - h^2))$.

exogenous hourly wage and nonlabor income of member $i$ ($i = 1, 2$). Assuming that there is no domestic production, the efficiency condition is equivalent to the following program:[5]

$$\begin{aligned} \max_{\{c^i,h^i\}_{i=1,2}} \quad u^1 &= u(c^1, 1-h^1) \\ \text{s.t.} \quad c &= c^1 + c^2 \leq w_1 h^1 + w_2 h^2 + y_1 + y_2, \\ u^2 &= u^2(c^2, 1-h^2) \geq \overline{u}^2(w_1, w_2, y_1, y_2), \\ 0 &\leq h^i \leq 1, \\ c^i &\geq 0, \\ i &= 1, 2, \end{aligned} \qquad [5]$$

where $\overline{u}^2(w_1, w_2, y_1, y_2)$ is the point of the utility possibility frontier finally achieved after the decision process.

Chiappori (1992), using the Second Fundamental Theorem of Welfare, shows that the result of this program is equivalent to a two stage decision process. In the first stage, the members of the household decide a sharing rule for nonlabor income that depends potentially on its initial distribution and wages.[6] This rule completely defines the bargaining process within the household and can be represented by the following functions:

$$\phi_1 = \phi(w_1, w_2, y_1, y_2), \qquad [6]$$

$$\phi_2 = y_1 + y_2 - \phi(w_1, w_2, y_1, y_2), \qquad [7]$$

where $\phi_i$ is the amount received by member $i$ and is not restricted to $0 \leq \phi_i \leq y_1 + y_2$, allowing for transfers of wage from one spouse to the other.

[5]There are some theoretical models that take into account domestic production (Apps and Rees (1997), Chiappori (1997)), but their restrictions are difficult to test because they require data on individual consumption usually not collected in labor surveys.

[6]Chiappori *et al.* (2001) add variables called distribution factors to the sharing rule. These factors are variables that affect the bargaining process but neither the preferences nor the budget set of the household. Examples are the initial distribution of nonlabor income and the so-called environmental parameters related to the opportunities of the spouses outside marriage. These authors use the sex ratio on the marriage market (measure of the relative “supply” of men and women) and rules governing divorce.

In the second stage, given the previous sharing rule and therefore the nonlabor income finally received, each member maximizes his/her own utility function subject to his/her own budget constraint:

$$\begin{aligned} \max_{\{c^i,h^i\}} u^i &= u^i(c^i, 1-h^i) \\ \text{s.t.} \quad c^i &\leq w_i h^i + \phi_i, \\ 0 &\leq h^i \leq 1, \\ c^i &\geq 0, \\ i &= 1,2. \end{aligned} \qquad [8]$$

Assuming an interior solution for both $h^1$ and $h^2$, the individual labor supply functions can be written as:

$$h^1(w_1, w_2, y_1, y_2) = \widetilde{H}^1(w_1, \phi(w_1, w_2, y_1, y_2)), \qquad [9]$$

$$h^2(w_1, w_2, y_1, y_2) = \widetilde{H}^2(w_1, y_1 + y_2 - \phi(w_1, w_2, y_1, y_2)). \qquad [10]$$

It must be stressed that the collective model does not impose income pooling, because initial allocations could affect labor supplies through the sharing rule.

Chiappori (1988) shows that the restrictions imposed by [9] and [10] take the form of a set of four partial differential equations (collective rationality constraints or CRC). Moreover, Slutsky conditions on compensated individual labor supply in the second stage of the decision making process impose:

$$\widetilde{H}^i_{w_i} - h^i \frac{\partial \widetilde{H}^i}{\partial \phi_i} \geq 0 \qquad (i = 1, 2). \qquad [11]$$

If restrictions [9] to [11] are satisfied, then it is possible to recover uniquely the sharing rule (up to an additive constant) and the individual indifference curve (up to a vertical translation). The partial recovery of the sharing rule and individual preferences results from the fact that only aggregate consumption is observable rather than individual consumption (Chiappori, 1992).

Finally, it must be noted that the sets of restrictions imposed by the unitary and collective models are independent and therefore compatible with each other. Hence, it is possible that none, both or only one be satisfied empirically.

## 3. Parametric specification

In order to test the theoretical models with the data, we must first specify a functional form either for the utility functions or for the labor supply functions. We postulate a general functional form for the individual labor supplies. Then, we derive the restrictions imposed by unitary and collective models.

### *3.1 Labor supplies*

Ideally, the model specification should satisfy the following list of desirable properties:

1. Not impose, but permit the test of unitary and collective restrictions.
2. Allow getting a closed form for the utility function of the household in the unitary model and for the individual utility functions and the sharing rule in the collective model.
3. Impose globally or allow the testing of the properties of monotonicity and concavity (convexity) of the direct (indirect) utility functions.
4. The functional form imposed should possess a certain degree of flexibility, in the sense of being robust to mis-specification errors.

Following Fortin and Lacroix (1997) we choose a nonlinear labor supply system:

$$h^1 = \frac{a_1 w_1 + a_2 w_2 + a_3 y + a_4 y_1 + a_5}{a_6 w_1 + a_7 w_2 + a_8 y + a_9 y_1 + a_{10}}, \quad [12]$$

$$h^2 = \frac{b_1 w_1 + b_2 w_2 + b_3 y + b_4 y_1 + b_5}{b_6 w_1 + b_7 w_2 + b_8 y + b_9 y_1 + b_{10}}, \quad [13]$$

where $w_i$ and $y_i$ are wage and nonlabor income of member $i$ ($i = 1, 2$), and $y = y_1 + y_2$ is total nonlabor income of the household.

### *3.2 Restrictions of the unitary model*

From inspection of functional forms [12] and [13] it is clear that income pooling restrictions will impose that the coefficients of $y_1$ be zero and therefore both labor supplies will depend only on the aggregate level of nonlabor income.

Slutsky equations (given that the starting point is labor supply instead of utility) can be derived using the results of integration of the Classical Demand Theory. From Roy's identities we have:

$$H^1(w_1, w_2, y) = \frac{v_{w_1}}{v_y}, \quad [14]$$

$$H^2(w_1, w_2, y) = \frac{v_{w_2}}{v_y}, \quad [15]$$

where $v_{w_i} = \frac{\partial v}{\partial w_i}$ $i = 1, 2$, $v_y = \frac{\partial v}{\partial y}$.

In general, this would be a system of partial differential equations, but in this case it is easy to solve because of the form of the supply functions. Thus, equalizing $v_{w_i}$ and $v_y$ to the numerator and denominator of $h^i$ $(i = 1, 2)$, we obtain that the only functional form possible for the indirect utility function of the household is:

$$\begin{aligned} v(w_1, w_2, y) &= c_1w_1^2 + c_2w_2^2 + c_3y^2 + c_4w_1w_2 + c_5w_1y + c_6w_2y + \\ &\quad c_7w_1 + c_8w_2 + c_9y. \end{aligned} \quad [16]$$

Once the form of the indirect utility function is determined, we can make use again of Roy's identities in the opposite way, getting:

$$H^1 = \frac{2c_1w_1 + c_4w_2 + c_5y + c_7}{c_5w_1 + c_6w_2 + 2c_3y + c_9}, \quad [17]$$

$$H^2 = \frac{c_4w_1 + 2c_2w_2 + c_6y + c_8}{c_5w_1 + c_6w_2 + 2c_3y + c_9}. \quad [18]$$

Equalizing the coefficients of [12] and [13] (with income pooling restrictions already imposed) to [17] and [18], we get a system of 16 equations (corresponding to $a_1$ to $a_3$, $a_5$ to $a_8$, $a_{10}$, $b_1$ to $b_3$, $b_5$ to $b_8$ and $b_{10}$) and 9 unknowns ($c_1$ to $c_9$). The solution of this system allows recovering the structural parameters of the indirect utility function from the labor supplies and deriving the Slutsky conditions.[7] These and income pooling restrictions are:

$$\text{Income pooling} : a_4 = a_9 = b_4 = b_9 = 0, \quad [19]$$

$$\text{Slutsky} : \left\{ \begin{array}{c} a_2 = b_1,\ a_3 = a_6 = b_6, \\ a_8 = b_8,\ a_7 = b_3 = b_7, \\ a_{10} = b_{10}. \end{array} \right.$$

[7] Details are available upon request.

Additionally, plugging the structural parameters of the indirect utility function into their expressions in terms of parameters of the labor supply functions, we have the following global convexity restrictions:

$$\begin{aligned} a_1 &\geq 0, \\ a_1 b_2 - a_2^2 &\geq 0, \\ a_1 a_8 b_2 - a_1 a_7^2 - a_8 a_2^2 &\geq 0. \end{aligned} \qquad [20]$$

### *3.3 Restrictions of the collective model*

The restrictions of the collective model can be obtained in a similar way, taking into account that once the sharing rule is determined, the individual problem is a standard demand program. Roy's identities adapted to this case are:

$$\widetilde{H}^1(w_1, \phi_1) = \frac{v^1_{w_1}}{v^1_{\phi_1}}, \qquad [21]$$

$$\widetilde{H}^2(w_2, \phi_2) = \frac{v^2_{w_2}}{v^2_{\phi_2}}, \qquad [22]$$

where $v^i_{w_i} = \frac{\partial v^i}{\partial w_i}$, $v^i_{\phi_i} = \frac{\partial v^i}{\partial \phi_i} \quad (i = 1, 2)$.

Here, in addition to the system of partial differential equations, we need to know the functional form of the sharing rule. It can be shown that $\phi$ can only be linear (this comes from the linearity of the numerator and denominator of the labor supplies). Hence, the only utility functions and sharing rule compatible with [12] and [13] are:

$$\phi = \alpha_0 + \alpha_1 w_1 + \alpha_2 w_2 + \alpha_3 y + \alpha_4 y_1, \qquad [23]$$

$$v^1(w_1, \phi_1) = d_1 w_1^2 + d_2 \phi_1^2 + d_3 w_1 \phi_1 + d_4 w_1 + d_5 \phi_1, \qquad [24]$$

$$v^2(w_2, \phi_2) = e_1 w_2^2 + e_2 \phi_2^2 + e_3 w_2 \phi_2 + e_4 w_2 + e_5 \phi_2. \qquad [25]$$

Operating as in the unitary model (see appendix A1), we can get the following CRC:[8]

$$\begin{aligned} a_2 &= \frac{a_7 a_3}{a_8}, \quad b_1 = \frac{b_3 b_6}{b_8}, \\ a_9 &= \frac{a_4 a_8}{a_3}, \quad b_9 = \frac{b_4 b_8}{b_3}, \\ a_7 &= \frac{a_8 b_1 (a_8 b_1 - a_6 b_3 + a_6 b_7 - a_3 b_7)}{(a_8 b_1 - a_3 b_3)}, \\ b_4 &= \frac{a_4 b_3 (b_3 - b_7)}{(a_3 b_3 - a_2 b_8)}. \end{aligned} \qquad [26]$$

Note that the form of the sharing rule cannot be global because individual consumption amounts must be nonnegative. This constraint imposes $\phi_i \geq -w_i h^i$ (transfers of labor income should be lower than the labor income level), but this restriction cannot be tested because of the arbitrary normalization of $\alpha_0$ necessary for identifying completely the sharing rule. However, global convexity of the indirect utility functions with respect to $(w_i, \phi_i)$ can be tested from the structural parameters:

$$\begin{aligned} d_1 &\geq 0, \quad 4d_1 d_2 - d_3^2 \geq 0, \\ e_1 &\geq 0, \quad 4e_1 e_2 - e_3^2 \geq 0. \end{aligned} \qquad [27]$$

On the other hand, the indirect utility functions derived for both unitary and collective models are quadratic, not guaranteeing global monotonicity. In the empirical part this condition will be tested locally for each individual.

Finally, the above discussion suggests that the proposed labor supply system performs very well in terms of properties [19], [20] and [26]. With regard to property [27], the system chosen is not flexible in the Diewert sense of being a second-order approximation to any well-behaved labor supply function. However, it is more flexible than the linear forms frequently used in empirical analysis (e.g. Hausman, 1981; Triest, 1990), because it includes them as particular cases.

[8] The parameter $\alpha_0$ is not identified because the sharing rule can be recovered only up to an additive constant. Therefore, it will be arbitrarily normalized to zero for recovering $d_4, d_5, e_4$ and $e_5$.

## 4. Stochastic specification

This section enumerates some econometric issues related with the transition from the theoretical models described above to the empirical models finally estimated.

### *4.1 Homogeneity of the labor supply functions*

The labor supply functions are homogeneous of degree zero in the parameter because of the functional form chosen. Therefore the equations are identified up to a scale factor. In order to recover uniquely the parameters we need to impose an additional restriction. Following Fortin and Lacroix (1997), the intercepts of the denominators are normalized to one ($a_{10} = b_{10} = 1$).

### *4.2 Heterogeneity of the preferences*

In order to account for heterogeneous preferences, the intercepts of the numerators of the supply functions ($a_5$ and $b_5$) are rewritten as depending on observable and unobservable characteristics. Within the observables, we include socio-demographic characteristics relative to the level of schooling and the number of children. Thus, if $\overline{x}_i$ is the vector of characteristics of member $i$, we have:

$$a_5 = \overline{a}_5 + \overline{x}_1'\gamma_1 + \varepsilon_1, \qquad [28]$$

$$b_5 = \overline{b}_5 + \overline{x}_2'\gamma_2 + \varepsilon_2, \qquad [29]$$

where $(\varepsilon_1, \varepsilon_2)'$ is the vector of unobservable characteristics of the household that is assumed to follow a bivariate normal distribution with mean $(0, 0)'$ and variance-covariance matrix $\Sigma$.

Replacing $a_5$ and $b_5$ in the labor supply functions, we get:

$$h_1 = \frac{x_1'\beta_1 + \varepsilon_1}{z'\delta_1}, \qquad [30]$$

$$h_2 = \frac{x_2'\beta_2 + \varepsilon_2}{z'\delta_2}, \qquad [31]$$

where $z = (w_1, w_2, y, y_1, 1)'$, $x_i = (z', \overline{x}_i')'$, $i = 1, 2$, $\varepsilon = (\varepsilon_1, \varepsilon_2)'\tilde{\ } N_2(0, \Sigma)$.

### *4.3 Endogeneity of the wage*

There are two reasons to believe that the hourly wage variable may be endogenous:

- Measurement error: as will be shown in the section on the data, the hourly wage variable is computed as annual labor income divided by annual hours worked (the dependent variable). The latter is not directly observable as well and it is calculated as the product of number of hours usually worked during the week and the number of weeks of work, which in turn is obtained from a set of dummy variables that indicate if the individual worked or not each month of the year. During this process many errors have been accumulated in the hours variable and therefore in the wage. Given that the errors come from the same sources these variables will be correlated, resulting in the so-called "division bias" if we do not take into account this feature in estimation. One way to solve this problem is to consider that the individual, when deciding the number of hours of work, faces a wage that is a function of her observable characteristics (true wage). The observed wage is this wage with a measurement error. Therefore, we would have:

$$\begin{aligned} w_i &= \pi_i' \overline{x}_i, & [32] \\ w_i^* &= w_i + u_i = \pi_i' \overline{x}_i + u_i, & [33] \\ i &= 1, 2 \end{aligned}$$

  where $w_i$ is the true wage, $\overline{x}_i$ is the vector of observable individual characteristics, $w_i^*$ is the observed wage and $u_i$ is a zero mean measurement error.[9] Using OLS on [33] we can get an exogenous measure (given that it is assumed that observable characteristics are exogenous in the hours equations) of the true wage ($\widehat{w}_i = \widehat{\pi}_i' \overline{x}_i$), that can be introduced in the hours equations, replacing $w_i$. Then we can estimate the system by Full Information Maximum Likelihood (FIML).

- Simultaneity: this comes from the fact that some aspects, like the progressiveness of personal income taxes or overtime, may create a causality from number of hours worked to the wage.

[9] This specification also solves the so-called "forbidden regression problem" for the functional forms proposed, if we assume that the measurement errors of wages are independent for each spouse. This problem occurs typically in the nonlinear case when there are endogeneity problems, due to the non-separability between the endogenous and exogenous parts of the endogenous RHS variables, making the usual 2SLS method inconsistent. See Hausman (1983) for a more detailed description of the "forbidden regression problem".

This kind of problem can be solved using instrumental variables techniques, or more generally the Generalized Method of Moments (GMM), that do not require distributional assumptions about the disturbance $\varepsilon$.

### *4.4 Selectivity bias*

The properties derived from the economic models are only valid for households in which both spouses work. The sample used in the estimation satisfies this condition and it could suffer from the so-called selectivity bias. The way to avoid this problem would be to use economic models that take into consideration explicitly participation decisions of both spouses, but these models are still not well developed within the collective framework. This leads to two possible alternatives: (a) not taking into account the selectivity problem. This would be justified if the selection produced by the participation decision were exogenous. And (b) consider that we have a truncated sample. We would be implicitly assuming that individuals solve the theoretical model without taking into account the nonnegativeness restrictions of hours worked, and we only observe households for which the supply is strictly positive for both spouses.

### *4.5 Econometric model*

Here we describe the econometric model finally estimated, taking into account the previous discussion about the problems of endogeneity and selectivity bias. With regard to the endogeneity of the wage, we consider that the measurement error problem is more severe than the simultaneity problem due to the way the variables of hours are constructed, thus choosing the FIML estimation.

In relation to the selection bias, given that none of the solutions proposed is totally satisfactory, we decide to include a truncation, because estimations of individual models of labor supply (see appendix A3) show that the effect of selection is significant, at least for women.[10]

[10] For checking the robustness of the solution adopted, all estimations are repeated without truncation, obtaining very similar results.

The likelihood function is obtained starting from the following latent model:

$$\begin{aligned} h_{1i}^* &= \frac{x_{1i}'\beta_1 + \varepsilon_{1i}}{z_i'\delta_1}, && [34] \\ h_{2i}^* &= \frac{x_{2i}'\beta_2 + \varepsilon_{2i}}{z_i'\delta_2}, && [35] \\ \varepsilon_i &= (\varepsilon_{1i}, \varepsilon_{2i})'\tilde{\ } iidN_2(0, \Sigma), && [36] \\ i &= 1, ..., n. \end{aligned}$$

However, the labor supplies are only observed when both are strictly positive, having the following observed model:

$$\left.\begin{array}{l} h_{1i} = h_{1i}^* \\ h_{2i} = h_{2i}^* \end{array}\right\} \text{ if } h_{1i}^* > 0 \text{ and } h_{2i}^* > 0. \qquad [37]$$

Using the probability transformation from the unobservable $(\varepsilon_{1i}, \varepsilon_{2i})$ to the observable $(h_{1i}, h_{2i})$ and the symmetry properties of the bivariate normal, the log-likelihood is given by:

$$\begin{aligned} l \;=\; & \sum_{i=1}^{n} [\ln |z_i'\delta_1| + \ln |z_i'\delta_2| + \ln \phi(z_i'\delta_1 h_{1i} - x_{1i}'\beta_1, z_i'\delta_2 h_{2i} - x_{2i}'\beta_2; \Sigma) \\ & - \ln \Phi(x_{1i}'\beta_1, x_{2i}'\beta_2; \Sigma)], \qquad [38] \end{aligned}$$

where $\phi(.,.;\Sigma)$ and $\Phi(.,.;\Sigma)$ are the probability density and cumulative distribution functions of a bivariate normal with vector of means $(0,0)'$ and variance-covariance matrix $\Sigma$.

The model is estimated using a two-step procedure:[11]

1. Estimation of wage equations: for each spouse the measure of the wage is obtained regressing the observed wage on dummy variables of schooling, a polynomial of degree 3 on age and its interactions with schooling variables, and a measure of years worked in the current job. Also, in both cases a Heckman-type correction is included in order to correct for selectivity bias, which is significant for women (see appendix A3 for details).

[11] Given that there are some doubts in the empirical literature about the exogeneity of the variables related to nonlabor income, fertility and experience (in this case specific experience), we previously performed exogeneity tests in the context of GMM for nonlabor income, years worked in the current job, and the categorical variables relative to the number of children. Exogeneity cannot be rejected in any case at the 5% significant level. The results of the GMM are available upon request.

2. Estimation of the system of equations for hours worked: once wages are replaced by their estimates, we use FIML.[12]

## 5. Data

The data used in this study are drawn from the European Community Household Panel (ECHP) for the years 1994 to 1997, collected by EUROSTAT[13]. The study is restricted to Spain and, given that the variables relating to labor supply are from the to current year of the survey while the income variables refer to the previous year, it is necessary to overlap the 4 available waves of the panel, ending up with a potential population of 3x8000 households, with all the variables referring to 1994, 1995 and 1996. After a depuration and selection process we obtain a sample of 9718 households, in 1863 of which both spouses work and contain information about all the relevant variables.[14] Because of the small sample size and the availability of only three years, we do not consider the temporal dimension of the panel, using the sample as a cross-section.[15] Additionally, all the estimation will also be done for a restricted sample of couples without pre-school (less than six years old) children, in order to minimize the extent of domestic production, reducing the sample size to 1347 households.[16]

Table 1 provides descriptive statistics for the variables included in the estimation of the system of labor supplies for Spain, as well as some of the variables used by Fortin and Lacroix (1997) in their study for Canada.[17] For facilitating the comparison, the income data for Spain

[12] Strictly speaking, all inference is approximate because in the calculation of standard errors in the second step we do not take into account the uncertainty added in the first step. Murphy and Topel (1985) propose a simple method to account for sampling error of the estimated regressors, but their method is only applicable when the model is additive in the estimated regressors and the disturbance.

[13] See appendix A2 for more details about depuration, selection, construction and description of the data.

[14] Basically, we drop households for which it is not possible to overlap years, or the head of the household does not have or does not live with his/her spouse, or any of the spouses is older than 65 years.

[15] We will obviate the effect on the independence of the observations for simplicity, assuming implicitly that the unobservables of the household are not serially correlated and there are no fixed effects.

[16] Ideally, the sample should be restricted to couples without children, but this restriction would reduce the sample size considerably.

[17] Their data are drawn from the Canadian Census of Population and Housing (CCPH) of 1986 and refer to 1985.

are divided by 100. The dependent variables, yearly hours of work for men and women, are not directly observed and are computed as the product of number of hours usually worked during the week and number of weeks worked in the year. The latter in turn is calculated from a set of dummy variables indicating for each month the activity status of the individual. The hourly wage rate is the ratio of annual total net income from work to hours of work. Nonlabor income includes for each spouse annual total net earnings from capital income and property, from private transfers, and from social programs. To avoid the effect of inflation, income variables for 1995 and 1996 are computed in constant 1994 prices using the CPI (the deflators used are 4.67% for 1995 and 8.40% for 1996).[18] With regard to schooling, the data

TABLE 1
Descriptive Statistics
Mean (Standard error)

| Variable | ECHP* 1994-1996 | CCPH§ 1986 |
|---|---|---|
| Men | | |
| Hours worked | 2290.88 (594) | 2084.76 (617) |
| Hourly wage | 9.86† (5.96) | 14.05‡ (6.36) |
| Nonlabor income | 815.32† (3183) | 1221.82‡ (3733) |
| Educ1 | 0.42 | |
| Educ2 | 0.21 | |
| Educ3 | 0.37 | |
| Age | 40 | |
| Years of service | 9.55 | |
| Women | | |
| Hours worked | 1873.80 (566) | 1688.28 (627) |
| Hourly wage | 8.62† (4.68) | 11.75‡ (6.25) |
| Nonlabor income | 360.89† (2004) | 984.38‡ (2588) |
| Educ1 | 0.38 | |
| Educ2 | 0.22 | |
| Educ3 | 0.40 | |
| Age | 38 | |
| Years of service | 8.06 | |
| Household | | |
| kid14 | 0.86 | |
| kid1416 | 0.14 | |
| Observations | 1863 | 4496 |

Notes: *European Community Household Panel.
§Canadian Census of Population and Housing.
†Pesetas of 1994/100.
‡Canadian $ of 1985.

[18] Source: *Boletín Estadístico*, Banco de España (2002).

available allow creating three categorical dummies (Educ1, Educ2 and Educ3) from lower to higher level of education. In the estimation Educ1 will be excluded. For fertility, two variables are constructed (kid14 and kid1416) that measure number of children less than 14 years old and between 14 and 16 years old, respectively. Additionally the table includes age and years worked in the current job, which are used in the wage equations.

Comparing with Canada, in Spain both men and women work more hours with similar variability (despite of the presumed higher rigidity of the Spanish labor market) and Spanish couples work for a lower wage rate, even assuming an exchange rate of 100 Pesetas/Canadian dollar and without taking into account the effects of the inflation in Canada.[19] By gender, we observe that on average men work more hours, are older, have more years worked in the current job and earn both higher labor and nonlabor income, despite their slightly lower level of schooling.

## 6. Empirical results

This section reports the results of the truncated FIML for the Spanish data. It starts with the estimates of the parameters for each model (unconstrained, collective and unitary), for the sample of couples in which both spouses work, and for the subsample that in addition do not have pre-school children.[20] From these estimates we can test the restrictions and obtain the structural parameters. Finally, we provide some measures of the elasticities for the labor supplies of men and women in Spain.

### *6.1 Parameter estimates*

Tables 2 and 3 report the estimates for couples with and without pre-school kids respectively. In both cases, after the normalization of $a_{10}$ and $b_{10}$ there are 29 free parameters in the unconstrained model, 23

[19] Chiappori *et al.* (2001) get similar variability for the US (635 for men and 571 for women) using the PSID. Nevertheless, given the idiosyncrasy of the Spanish labor market, we make an Analysis of Variance for the variables of hours worked, obtaining that regional dummies (7 categories), economic activity (agriculture, industry or services) and sector (public or private) only can explain jointly 6% and 2% of the variability for men and women respectively.

[20] It is not likely that the restriction of the sample to couples without pre-school children generates selectivity bias, because we cannot reject the exogeneity of the fertility variables.

in the collective model and 19 in the unitary model (including the nuisance parameters). From these parameters 16, 17 and 15 are statistically significant at the 10% level respectively for the full sample, getting similar numbers for the restricted sample.

The interpretation of the coefficients of the wage and nonlabor income is not straightforward because of the nonlinearity, so we are leaving it for the section on elasticities. With regard to the control variables, the highest level of education is significant for men in all the models for the full sample (the negative sign means that men with the highest level of education work less hours, for the same wage and the remaining variables). The fertility variables are not significant for men for the full sample and have opposite significant effects for the reduced sample (this could be measuring a cohort effect, because the probability of having kids in each range varies depending on the individual's age).

TABLE 2
Parameter estimates†
Full sample ($n$ = 1863)

Labor supply function for men

$$h_{1i} = \frac{a_1 w_{1i} + a_2 w_{2i} + a_3 y_i + a_4 y_{1i} + \overline{a}_5 + k_1 kid14_i + k_2 kid1416_i + k_3 educ2_{1i} + k_4 educ3_{1i} + \varepsilon_{1i}}{a_6 w_{1i} + a_7 w_{2i} + a_8 y_i + a_9 y_{1i} + a_{10}}$$

| | | Model | | |
|---|---|---|---|---|
| Variable | Parameter | Unconstrained | Collective | Unitary |
| $w_1$ | $a_1$ | 0.085 (0.023)** | 0.078 (0.020)** | 0.195 (0.030)** |
| $w_2$ | $a_2$ | 0.014 (0.023) | 0.017 (0.017) | 0.103 (0.016)** |
| $y$ | $a_3$ | 0.205 (0.455) | 0.080 (0.022)** | 0.068 (0.009)** |
| $y_1$ | $a_4$ | −0.556 (0.476) | −0.063 (0.022)** | 0 |
| *Intercept* | $\overline{a}_5$ | 2.304 (0.091)** | 2.299 (0.089)** | 2.399 (0.143)** |
| *kid*14 | $k_1$ | −0.008 (0.021) | −0.009 (0.021) | −0.003 (0.034) |
| *kid*1416 | $k_2$ | 0.043 (0.049) | 0.040 (0.049) | 0.082 (0.079) |
| $educ2_1$ | $k_3$ | −0.063 (0.055) | −0.063 (0.054) | −0.084 (0.091) |
| $educ3_1$ | $k_4$ | −0.168 (0.082)** | −0.167 (0.079)** | −0.251 (0.131)** |
| $w_1$ | $a_6$ | 0.030 (0.007)** | 0.026 (0.006)** | 0.068 (0.009)** |
| $w_2$ | $a_7$ | 0.011 (0.008)* | 0.013 (0.007)** | 0.065 (0.008)** |
| $y$ | $a_8$ | 0.140 (0.163) | 0.060 (0.039)* | 0.046 (0.019)** |
| $y_1$ | $a_9$ | −0.277 (0.167)** | −0.048 (0.034) | 0 |
| *Intercept* | $a_{10}$ | 1 | 1 | 1 |

Notes: † Hours of work/1000, wage/100, nonlabor income/1000000.
Asymptotic standard errors in parentheses. Constrained parameters in italics.
*Significant at 10%.
**Significant at 5%.

TABLE 2 (cont.)
Parameter estimates†

Labor supply function for women

$$h_{2i} = \frac{b_1 w_{1i} + b_2 w_{2i} + b_3 y_i + b_4 y_{1i} + \bar{b}_5 + c_1 kid14_i + c_2 kid1416_i + c_3 educ2_{2i} + c_4 educ3_{2i} + \varepsilon_{2i}}{b_6 w_{1i} + b_7 w_{2i} + b_8 y_i + b_9 y_{1i} + b_{10}}$$

| Variable | Parameter | Model: Unconstrained | Collective | Unitary |
|---|---|---|---|---|
| $w_1$ | $b_1$ | –0.195 (0.069)** | –0.188 (0.070)** | 0.103 (0.016)** |
| $w_2$ | $b_2$ | 1.746 (0.535)** | 1.804 (0.571)** | 0.254 (0.031)** |
| $y$ | $b_3$ | –1.292 (1.405) | –2.043 (0.630)** | 0.065 (0.008)** |
| $y_1$ | $b_4$ | 0.961 (1.568) | 2.240 (0.766)** | 0 |
| *Intercept* | $\bar{b}_5$ | 0.702 (0.485)* | 0.664 (0.511)* | 1.393 (0.126)** |
| *kid*14 | $c_1$ | –0.469 (0.158)** | –0.489 (0.168)** | –0.169 (0.034)** |
| *kid*1416 | $c_2$ | –0.731 (0.302)** | –0.761 (0.318)** | –0.306 (0.078)** |
| $educ2_2$ | $c_3$ | –0.096 (0.251) | –0.100 (0.260) | –0.010 (0.085) |
| $educ3_2$ | $c_4$ | –1.712 (0.584)** | –1.790 (0.623)** | –0.546 (0.133)** |
| $w_1$ | $b_6$ | –0.031 (0.029) | –0.023 (0.029) | 0.068 (0.009)** |
| $w_2$ | $b_7$ | 0.695 (0.217)** | 0.715 (0.230)** | 0.065 (0.008)** |
| $y$ | $b_8$ | 0.167 (0.963) | –0.249 (0.297) | 0.046 (0.019)** |
| $y_1$ | $b_9$ | –0.403 (1.003) | 0.273 (0.332) | 0 |
| *Intercept* | $b_{10}$ | 1 | 1 | 1 |
| | $\Uparrow^2_1$ | 0.650 (0.079)** | 0.645 (0.072)** | 1.715 (0.233)** |
| | $\Uparrow^2_2$ | 10.570 (6.124)** | 11.423 (6.840)** | 1.348 (0.175)** |
| | $\Leftarrow$ | 0.009 (0.022)** | 0.098 (0.022)** | 0.097 (0.022)** |
| | $l$ | –3003.36 | –3011.19 | –3098.91 |

Notes: † Hours of work/1000, wage/100, nonlabor income/1000000.
Asymptotic standard errors in parentheses. Constrained parameters in italics.
*Significant at 10%.
**Significant at 5%.

For women, the dummy for the highest level of education is also significant in every case, and has the same sign and interpretation as for men. It is prominent that fertility variables are highly significant and have a negative effect on labor supply, as we would expect.

Finally, note that the estimates of the correlation coefficient are positive and highly significant in all specifications, suggesting that the unobservable variables that affect the decision of hours worked are positively correlated across the spouses. This also provides evidence on the efficiency gain of the joint estimation of both labor supplies over individual models.

TABLE 3
Parameter estimates†
Couples without pre-school children ($n$ = 1347)

Labor supply function for men

$$h_{1i} = \frac{a_1 w_{1i} + a_2 w_{2i} + a_3 y_i + a_4 y_{1i} + \overline{a}_5 + k_1 kid14_i + k_2 kid1416_i + k_3 educ2_{1i} + k_4 educ3_{1i} + \varepsilon_{1i}}{a_6 w_{1i} + a_7 w_{2i} + a_8 y_i + a_9 y_{1i} + a_{10}}$$

| Variable | Parameter | Model: Unconstrained | Collective | Unitary |
|---|---|---|---|---|
| $w_1$ | $a_1$ | 0.039 (0.022)** | 0.032 (0.020)* | 0.140 (0.025)** |
| $w_2$ | $a_2$ | 0.022 (0.029) | 0.020 (0.026) | 0.069 (0.014)** |
| $y$ | $a_3$ | 0.145 (0.588) | 0.018 (0.025) | 0.049 (0.007)** |
| $y_1$ | $a_4$ | –0.996 (0.640)* | –0.009 (0.021) | 0 |
| *Intercept* | $\overline{a}_5$ | 2.248 (0.091)** | 2.239 (0.088)** | 2.328 (0.137)** |
| $kid14$ | $k_1$ | –0.051 (0.024)** | –0.056 (0.024)** | –0.072 (0.037)** |
| $kid1416$ | $k_2$ | 0.096 (0.045)** | 0.089 (0.045)** | 0.164 (0.071)** |
| $educ2_1$ | $k_3$ | –0.009 (0.054) | –0.009 (0.054) | 0.003 (0.089) |
| $educ3_1$ | $k_4$ | –0.064 (0.086) | –0.062 (0.082) | –0.072 (0.133) |
| $w_1$ | $a_6$ | 0.012 (0.007)** | 0.009 (0.006)* | 0.049 (0.007)** |
| $w_2$ | $a_7$ | 0.012 (0.010) | 0.011 (0.009) | 0.046 (0.007)** |
| $y$ | $a_8$ | 0.091 (0.187) | 0.010 (0.018) | 0.015 (0.021) |
| $y_1$ | $a_9$ | –0.428 (0.201)** | –0.005 (0.014) | 0 |
| *Intercept* | $a_{10}$ | 1 | 1 | 1 |

Notes: † Hours of work/1000, wage/100, nonlabor income/1000000.
Asymptotic standard errors in parentheses. Constrained parameters in italics.
*Significant at 10%.
**Significant at 5%.

TABLE 3 (cont.)
Parameter estimates†

Labor supply function for women

$$h_{2i} = \frac{b_1 w_{1i}+b_2 w_{2i}+b_3 y_i+b_4 y_{1i}+\bar{b}_5+c_1 kid14_i+c_2 kid1416_i+c_3 educ2_{2i}+c_4 educ3_{2i}+\varepsilon_{2i}}{b_6 w_{1i}+b_7 w_{2i}+b_8 y_i+b_9 y_{1i}+b_{10}}$$

| | | Model | | |
|---|---|---|---|---|
| Variable | Parameter | Unconstrained | Collective | Unitary |
| $w_1$ | $b_1$ | −0.245 (0.078)** | −0.240 (0.078)** | 0.069 (0.014)** |
| $w_2$ | $b_2$ | 1.704 (0.579)** | 1.758 (0.610)** | 0.195 (0.027)** |
| $y$ | $b_3$ | −0.306 (1.321) | −1.685 (0.662)** | 0.046 (0.007)** |
| $y_1$ | $b_4$ | −0.351 (1.639) | 1.654 (0.875)* | 0 |
| *Intercept* | $\bar{b}_5$ | 0.852 (0.475)** | 0.831 (0.496)* | 1.492 (0.117)** |
| *kid*14 | $c_1$ | −0.479 (0.175)** | −0.499 (0.183)** | −0.167 (0.039)** |
| *kid*1416 | $c_2$ | −0.865 (0.356)** | −0.902 (0.376)** | −0.313 (0.069)** |
| *educ2*$_2$ | $c_3$ | −0.054 (0.264) | −0.057 (0.271) | 0.014 (0.080) |
| *educ3*$_2$ | $c_4$ | −1.620 (0.620)** | −1.696 (0.657)** | −0.463 (0.125)** |
| $w_1$ | $b_6$ | −0.059 (0.027)** | −0.052 (0.028)** | 0.049 (0.007)** |
| $w_2$ | $b_7$ | 0.688 (0.237)** | 0.707 (0.249)** | 0.046 (0.007)** |
| $y$ | $b_8$ | 0.479 (0.944) | −0.363 (0.198)** | 0.015 (0.021) |
| $y_1$ | $b_9$ | −0.820 (1.059) | 0.356 (0.230) | 0 |
| *Intercept* | $b_{10}$ | 1 | 1 | 1 |
| | $\Uparrow_1^2$ | 0.469 (0.056)** | 0.468 (0.053)** | 1.182 (0.158)** |
| | $\Uparrow_2^2$ | 8.577 (5.488)* | 9.244 (6.039)* | 0.907 (0.113)** |
| | $\Leftarrow$ | 0.096 (0.028)** | 0.091 (0.027)** | 0.089 (0.028)** |
| | $l$ | −2107.15 | −2120.77 | −2201.75 |

Notes: † Hours of work/1000, wage/100, nonlabor income/1000000.
Asymptotic standard errors in parentheses. Constrained parameters in italics.
*Significant at 10%.
**Significant at 5%.

## 6.2 *Tests of restrictions*

Having estimated the parameters, we can compare the unitary and collective models with the unconstrained model using the likelihood ratio ($LR$) and Wald ($W$) tests for the two samples considered.[21] Additionally, we report separately the test for the income pooling restrictions, because they are interesting by themselves and the first versions of the collective model (Chiappori, 1988 and 1992) imposed them.

[21] The Wald test is not reported for the collective model because its restrictions are nonlinear and this test is not invariant to specification of the restrictions.

Table 4
Tests of restrictions

Full sample ($n$ = 1863)

| Statistic | Restrictions: Collective | Unitary | Income Pooling |
|---|---|---|---|
| *LR* | 15.65 (0.018) | 191.11 (0.000) | 13.82 (0.008) |
| *W* | – | 37.40 (0.000) | 7.52 (0.111) |
| Degrees of freedom | 6 | 10 | 4 |

Couples without pre-school children ($n$ = 1347)

| Statistic | Restricciones: Collective | Unitary | Agrup. rentas |
|---|---|---|---|
| *LR* | 27.26 (0.000) | 189.20 (0.000) | 14.92 (0.005) |
| *W* | – | 45.97 (0.000) | 6.50 (0.165) |
| Degrees of freedom | 6 | 10 | 4 |

Note: P-values in parentheses. *LR* = Likelihood ratio test. *W* = Wald tests.

Table 4 reports $LR$ and $W$ statistics and their p-values for each model and sample. Income pooling restrictions are rejected with the $LR$ statistics for both samples at the 1% level, while the $W$ test has lower power and it cannot reject even at the 10%. Although this result already allows rejecting the restrictions of the unitary model, we test jointly all its constraints (except for $a_{10} = b_{10}$, which is imposed as a normalization), obtaining a clear rejection in the data.

For the collective model, the empirical evidence is not so clear. Thus, for couples without pre-school children it is rejected even at the 1% level, while it cannot be rejected at this level for the full sample. This may be evidence that the problem of not considering domestic production is not very severe.

### *6.3 Structural parameters*

The functional form chosen permits recovering the parameters of preferences and of the sharing rule from the estimated coefficients of the labor supplies. We do not include the results for the unitary model because it is clearly refuted by the data. For the collective model, we report the estimated parameters for both subsamples. Tables 5 and 6 provide estimates of the indirect utility functions and the sharing rule respectively, as well as their standard errors calculated using the Delta method.

TABLE 5
Indirect utility functions

Full sample ($n$ = 1863)

| Men $v^1 = d_1 w_1^2 + d_2 \phi_1^2 + d_3 w_1 \phi_1 + d_4 w_1 + d_5 \phi_1$ | | | Women $v^2 = e_1 w_2^2 + e_2 \phi_2^2 + e_3 w_2 \phi_2 + e_4 w_2 + e_5 \phi_2$ | | |
|---|---|---|---|---|---|
| Variable | Parameter | | Variable | Parameter | |
| $w_1^2$ | $d_1$ | 0.036 (0.010)** | $w_2^2$ | $e_1$ | 1.199 (0.480)** |
| $\phi_1^2$ | $d_2$ | 0.008 (0.005)* | $\phi_2^2$ | $e_2$ | 0.048 (0.053) |
| $w_1\phi_1$ | $d_3$ | 0.022 (0.005)** | $w_2\phi_2$ | $e_3$ | 0.788 (0.243)** |
| $w_1$ | $d_4 = a_5$ | 2.299 (0.089)** | $w_2$ | $e_4 = b_5$ | 0.664 (0.512)* |
| $\phi_1$ | $d_5 = a_{10}$ | 1 | $\phi_2$ | $e_5 = b_{10}$ | 1 |

Couples without pre-school children ($n$ = 1347)

| Men $v^1 = d_1 w_1^2 + d_2 \phi_1^2 + d_3 w_1 \phi_1 + d_4 w_1 + d_5 \phi_1$ | | | Women $v^2 = e_1 w_2^2 + e_2 \phi_2^2 + e_3 w_2 \phi_2 + e_4 w_2 + e_5 \phi_2$ | | |
|---|---|---|---|---|---|
| Variable | Parameter | | Variable | Parameter | |
| $w_1^2$ | $d_1$ | 0.016 (0.009)** | $w_2^2$ | $e_1$ | 2.606 (5.854) |
| $\phi_1^2$ | $d_2$ | 0.002 (0.002) | $\phi_2^2$ | $e_2$ | 0.156 (0.289) |
| $w_1\phi_1$ | $d_3$ | 0.008 (0.005)* | $w_2\phi_2$ | $e_3$ | 1.450 (2.552) |
| $w_1$ | $d_4 = a_5$ | 2.239 (0.088)** | $w_2$ | $e_4 = b_5$ | 0.831 (0.496)** |
| $\phi_1$ | $d_5 = a_{10}$ | 1 | $\phi_2$ | $e_5 = b_{10}$ | 1 |

Notes: Asymptotic standard errors in parentheses.
*Significant at 10%.
**Significant at 5%.

TABLE 6
Sharing rule

$\phi = /_0 + /_1 w_1 + /_2 w_2 + /_3 y + /_4 y_1 = /_0 + /_1 w_1 + /_2 w_2 + (/_3 + /_4)\, y_1 + /_3 y_2$

| Full sample ($n$ = 1863) | | | Without pre-school children ($n$ = 1347) | | |
|---|---|---|---|---|---|
| Variable | Parameter | | Variable | Parameter | |
| $w_1$ | $/_1$ | 0.239 (0.070)** | $w_1$ | $/_1$ | 0.166 (0.286) |
| $w_2$ | $/_2$ | 0.755 (0.736) | $w_2$ | $/_2$ | 2.382 (3.905) |
| $y_1$ | $/_3 + /_4$ | 0.749 (0.389)** | $y_1$ | $/_3 + /_4$ | 1.021 (0.383)** |
| $y_2$ | $/_3$ | 3.594 (0.563)** | $y_2$ | $/_3$ | 2.162 (2.091) |
| | $/_4$ | −2.845 (0.745)** | | $/_4$ | −1.141 (2.103) |

Notes: Asymptotic standard errors in parentheses.
*Significant at 10%.
**Significant at 5%.

– *Indirect utility functions*

In the full sample the parameters are estimated with more precision for men than for women, the latter also do not satisfy one of the global convexity conditions [27]. For the reduced sample, none of the free parameters are statistically significant and women also do not satisfy the global convexity condition. On the other hand, in both cases the marginal utility of the own wage and nonlabor income are positive for all individuals in the sample.[22]

– *Sharing rule*

First, remember that the sharing rule, as defined in table 6, measures the amount of nonlabor income that the husband finally obtains. Coefficients $\alpha_1$, $\alpha_2$, $\alpha_3$, $\alpha_3 + \alpha_4$ and $\alpha_4$ provide, respectively, the effects of variations of wage of the husband, wage of the wife, nonlabor income of the husband, nonlabor income of the wife and redistributions of nonlabor income within the household, on nonlabor income that the husband receives after the bargaining process.[23]

For the full sample, when the wage of the husband increases, he not only does not share this increment with his partner but he also receives an additional transfer of nonlabor income from her. Contrary to men, women share increases in both labor and nonlabor income with their partners (although the effect for wage is not very precisely measured). Finally, increments in nonlabor income of the husband are only shared when they are compensated with reductions in wife's nonlabor income. In summary, according to these estimates we can conclude that men use their wage as a source of bargaining power and are more altruistic with nonlabor income, while women show a more altruistic behavior with all their incomes.

For the reduced sample the results are similar but they are estimated with less precision.

### *6.4 Elasticities*

Table 7 reports two different measures of the elasticities of the labor supply of men and women with respect to wages and nonlabor in-

[22] They are the numerator and denominator of the estimated equations, respectively.
[23] $\alpha_4$ measures the effect of reallocations of nonlabor income from the wife to the husband that keep total nonlabor income of the household constant.

TABLE 7
Labor supply elasticities
Full sample ($n$ = 1863)

Average individual

| | Model | | |
|---|---|---|---|
| Men | Unconstrained | Collective | Unitary |
| $\Omega_{h^1, w_1}$ | 0.054 (0.036) | 0.056 (0.036) | 0.075 (0.033)** |
| $\Omega_{h^1, w_2}$ | –0.032 (0.026) | –0.033 (0.056) | –0.077 (0.018)** |
| $\Omega_{h^1, y_1}$ | –0.001 (0.002) | –0.000 (0.000) | –0.001† (0.001) |
| $\Omega_{h^1, y_2}$ | –0.001 (0.002) | –0.001 (0.001) | |
| Women | | | |
| $\Omega_{h^2, w_1}$ | –0.108 (0.024)** | –0.110 (0.024)** | –0.060 (0.023)** |
| $\Omega_{h^2, w_2}$ | 0.301 (0.042)** | 0.302 (0.042)** | 0.272 (0.045)** |
| $\Omega_{h^2, y_1}$ | 0.001 (0.002) | 0.001 (0.002) | |
| $\Omega_{h^2, y_2}$ | –0.005 (0.001)** | –0.004 (0.001)** | –0.001† (0.001)** |

Average elasticities

| | Model | | |
|---|---|---|---|
| Men | Unconstrained | Collective | Unitary |
| $\Omega_{h^1, w_1}$ | 0.037 (0.713) | 0.055 (0.016) | 0.073 (0.017) |
| $\Omega_{h^1, w_2}$ | –0.033 (0.046) | –0.033 (0.009) | –0.074 (0.013) |
| $\Omega_{h^1, y_1}$ | 0.049 (2.152) | –0.000 (0.001) | –0.001† (0.002) |
| $\Omega_{h^1, y_2}$ | –0.001 (0.004) | –0.001 (0.003) | |
| Women | | | |
| $\Omega_{h^2, w_1}$ | –0.116 (0.050) | –0.117 (0.046) | –0.058 (0.017) |
| $\Omega_{h^2, w_2}$ | 0.309 (0.082) | 0.310 (0.079) | 0.266 (0.045) |
| $\Omega_{h^2, y_1}$ | 0.001 (0.002) | 0.001 (0.005) | |
| $\Omega_{h^2, y_2}$ | –0.005 (0.023) | –0.005 (0.031) | –0.001† (0.002) |

Notes: Asymptotic standard errors in parentheses.
*Significant at 10%.
**Significant at 5%.
† Since pooling is imposed, this elasticity correspond to $\Omega_{h^i, y}$.

comes.[24] The first measure corresponds to the evaluation of the elasticities in the average individual (his/her characteristics are the average in the sample), while the second is the average of the elasticities of the individuals in the sample.[25] The standard errors are measuring different aspects as well, so whereas in the first case they reflect the uncertainty due to using estimated parameters in the calculation of elasticities, in the second case they are measuring the variability of the distribution of elasticities within the sample (computed as the standard error of the individual elasticities).

[24] Due to space limitations we only report the elasticities for the full sample. For the restricted sample the results are very similar.

[25] The empirical studies usually provide the first measure. Nevertheless, we report the mean of the elasticities because the average individual need not be representative of the population for certain configurations of parameters and correlation structures of the explanatory variables (especially in a nonlinear model).

The comparison of the two measures shows that the average individual is quite representative of the sample for the three models and therefore the interpretation will be made using his elasticities. The own-wage elasticities are only statistically significant at the 5% level for women (except for the unitary model where they are also statistically significant for men), have the expected sign and are pretty robust to the restrictions of the unitary and collective models. Besides, they are in line with the range of estimates obtained in the relevant literature for other countries (Blundell and MaCurdy, 1999). By gender, as is frequently the case in this kind of study, female labor supply is more sensitive to the wage. Cross-wage elasticities are in general smaller than own-wage elasticities and have the expected negative sign (if we assume that increases in wages are shared with the couple in the collective model and that leisure is a normal good). Note that this cross effect is only statistically significant for women (that show a more altruistic behavior in the collective model). Finally, nonlabor income elasticities are not very precisely estimated and are negative when statistically significant.

## 7. Conclusion

This section summarizes the main results obtained in the study. With regard to the household labor supply models analyzed, both income pooling and the rest of the restrictions of the unitary model are clearly rejected by the data, while the restrictions of the collective model cannot be refuted for one of the subsamples considered.

On the other hand, the labor supply elasticities obtained with the three models are consistent with those for other countries, and satisfy the empirical regularity that the own-wage elasticity is bigger for women than for men (30.1% against 5.4% in the unconstrained model).

From the estimates we can also extract some ideas about how to improve the collective model. Thus, we can consider explicitly the participation decision. This will allow not only a better understanding of the behavior of the agents, but also a substantial increase in the sample size. In this respect, the theoretical paper of Donni (2001) analyzes the participation decision within the collective setup.

Additionally, for the full sample the collective model has similar results to the unconstrained model in terms of parameters and elasticities, but it is less satisfactory in the interpretation of the sharing rule. This would lead us to try to improve the specification of this rule. Two possible ways would be: first, introduce more distribution factors in addition to the initial distribution of the nonlabor income. In this line, Chiappori *et al.* (2001) introduce some variables of the marriage market in their study for the US. However, the low divorce rate in Spain suggests trying to find other social (e.g. region, rural or urban area, or a dummy for big cities, would be proxies of the kind of mentality of the couple that could affect to the decision making process) or economic (e.g. measures of job instability for each spouse) factors. Secondly, we could try to derive the determinants of the sharing rule in a situation where it is observable, at least approximately, like a divorce (Chiappori, 1992). Nevertheless, this situation is not free of problems due not only to the data requirements but also to the peculiar legislation on divorce.

Finally, and as a variant of the theoretical model explained, we could think of a discrete choice model for labor supplies that would take into consideration explicitly the restrictions that the agents face in their choice of number of hours of work (minimum daily hours, fixed costs of work, unions or labor regulations in general), that may be especially important for Spain.

## Appendix A1. Derivation of the collective model

Applying Roy's identities on [24] and [25] we get:

$$\widetilde{H}^1 = \frac{2d_1 w_1 + d_3\phi_1 + d_4}{d_3 w_1 + 2d_2\phi_1 + d_5}, \qquad \text{[A1.1]}$$

$$\widetilde{H}^2 = \frac{2e_1 w_2 + e_3\phi_2 + e_4}{e_3 w_2 + 2e_2\phi_2 + e_5}. \qquad \text{[A1.2]}$$

Plugging the expressions for $\phi_1$ and $\phi_2$ from [23] into [A1.1] and [A1.2] (taking into account that $\phi_1 = \phi$ and $\phi_2 = y - \phi$) we have:

$$h^1 = \frac{(2d_1 + d_3\alpha_1)w_1 + (d_3\alpha_2)w_2 + (d_3\alpha_3)y + (d_3\alpha_4)y_1 + (d_4 + d_3\alpha_0)}{(d_3 + 2d_2\alpha_1)w_1 + (2d_2\alpha_2)w_2 + (2d_2\alpha_3)y + (2d_2\alpha_4)y_1 + (d_5 + 2d_2\alpha_0)}, \qquad \text{[A1.3]}$$

$$h^2 = \frac{(-e_3\alpha_1)w_1 + (2e_1 - e_3\alpha_2)w_2 + e_3(1-\alpha_3)y + (-e_3\alpha_4)y_1 + (e_4 - e_3\alpha_0)}{(-2e_2\alpha_1)w_1 + (e_3 - 2e_2\alpha_2)w_2 + 2e_2(1-\alpha_3)y + (-2e_2\alpha_4)y_1 + (e_5 - 2e_2\alpha_0)}. \qquad \text{[A1.4]}$$

Equalizing the coefficients in [A1.3] and [A1.4] to the correspondents in [12] and [13], we end up with a system of 20 equations (corresponding to $a_1$ to $a_{10}$ and $b_1$ to $b_{10}$) and 15 unknowns ($\alpha_0$ to $\alpha_4$, $d_1$ to $d_5$, $e_1$ to $e_5$). The solution of this system determines the parameters of the indirect utility functions and sharing rule, and the collective rationality constraints.[26]

**Appendix A2. Data**

- Source: European Community Household Panel (ECHP) for the years 1994, 1995, 1996 and 1997 (ultimately, we only use the information corresponding to 1994, 1995 and 1996, because the labor supply variables refer to the year of the survey and the income variables to the previous year, losing one year in the overlap).

- Criteria of sample selection. We keep the households satisfying the following characteristics:

    1. It is possible to overlap. Thus, the household must be in the panel during two consecutive waves.
    2. The head of the household lives with his/her spouse.
    3. Both members of the household have worked and earned some income from work during the year of reference.[27]
    4. Both are younger than 65 and provide information about all the relevant variables.

- Variables: we enumerate the list of variables used in the estimations of the individual and household models, as well as the original codes of the variables of the ECHP used in their construction.

    1. Yearly hours worked ($h$): constructed as the product of the number of hours usually worked during the week (PE005) and number of weeks worked.
    2. Number of weeks worked: sum of number of weeks in the months when the individual works. We say that an individual works if the main activity status of the month

[26] The resolution of this system of equations is available upon request.
[27] Given that traditionally there exist some doubts about the accuracy of the income reported by self-employed workers, all estimations are repeated without including this group, obtaining very similar results. These results are available under request.

(PC001 to PC012) belongs to one of the following categories: paid employment, paid apprenticeship or training under special schemes related to employment, or self-employment (with or without employees).

3. Hourly wage ($w$): total net income from work (PI110) divided by hours worked in the year.
4. Nonlabor income ($y$): includes non-work private net income (PI120) (that in turn includes capital income (PI121), assigned property/rental income (PI122A) and private transfers received (PI123)) and total net social or social insurance receipts (PI130). For men, 76% of nonlabor income is nonwork private net income (83% capital income, 10% assigned property/rental income and 7% private transfers received) and 24% is total social/social insurance receipts (76% unemployment related benefits, 16% sickness/invalidity benefits, 4% family-related allowances, 2% assigned housing allowance, 1% old-age related benefits, 0.5% assigned social assistance and 0.5% any other (personal) benefit). For women, 54% of nonlabor income is non-private net income (53% capital income, 30% assigned property/rental income and 17% private transfers received) and 46% is total social/social insurance receipts (54% unemployment related benefits, 29% family-related allowances, 13% sickness/invali-\\dity benefits, 2% assigned housing allowance, 1% assigned social assistance and 1% any other (personal) benefit).
5. Schooling: we generate three dummies from highest level of education completed (PT022):
   - *Educ*3: recognized third level education (ISCED 5-7)[28] (graduate, undergraduate or second level of professional studies).
   - *Educ*2: second stage of secondary level education (ISCED 3) (high school or first level of professional studies).
   - *Educ*1: lower than second stage of secondary education (ISCED 0-2).
6. Fertility: we construct two variables from household size (HD001), number of adults in the household (16 years or

[28] ISCED stands for International Standard Classification of Education.

higher) (HD002) and number of adults in the household (14 years or higher) (HD003):

- $kid14$: number of children under 14 years (HD001 - HD003).
- $kid1416$: number of children between 14 and 16 years (HD003 - HD002).

7. *Age* (PD003).
8. *Sex* (PD004).
9. *Health* (PH001): ordinal variable that measures the health status and takes values from very good (1) to very bad (5).
10. Years worked in the current job (*years*): measure of specific experience. It is constructed from the year of start of current job (PE011). Given that this variable is truncated below at 1980, *years* variable will have an upper truncation at 16 years.

**Appendix A3. Individual labor supply models**

We extend the sample to couples in which one of the spouses doesn't work and estimate individual labor supply models using the Generalized Method of Heckman.[29] This method has three stages:

1. Participation equation: we define as participants individuals actually working and as nonparticipants unemployed and economically inactive individuals. We estimate a probit of the participation decision (a dichotomic variable that takes the value one if the individual works and zero otherwise) on the variables of nonlabor income, fertility, schooling, age (polynomial of degree three and interactions with education variables) and health of the individual, as well as nonlabor income and wage of the spouse.

2. Wage equation: we regress the wage on variables of age and education, years worked in the current job, and a Heckman-type correction term (Heckman's $\lambda$ or inverse of the Mills ratio) obtained in the participation equation.

3. Hours equation: we estimate by OLS, using as explanatory variables the wages predicted in the second stage, nonlabor income of

[29] In each case we restrict the sample to individuals with a working spouse, analogously to the previous studies of individual labor supply (Mroz (1987)).

the individual and spouse, age, fertility and schooling variables, health status and a Heckman-type correction term. The exclusion restrictions for both men and women are that the polynomial in age and its interactions with education affect hours worked through the participation decision and wage rate, while the measure of specific experience affects hours worked only through the wage rate.[30]

TABLE A1
Individual models†

| | Men | | |
|---|---|---|---|
| | | Equation | |
| Variable | Participation | Wage | Hours |
| *const.* | 2.020 (2.694) | –0.845 (6.697) | 2.257 (0.083)** |
| $w_1$ | – | – | 0.015 (0.010) |
| $w_2$ | 0.008 (0.007) | – | 0.000 (0.000) |
| $y_1$ | –1.182 (0.069)** | – | –0.139 (0.144) |
| $y_2$ | 0.279 (0.266) | – | –0.056 (0.044) |
| *kid*14 | –0.068 (0.041) | – | –0.015 (0.017) |
| *kid*1416 | –0.037 (0.088) | – | 0.023 (0.041) |
| *educ*2 | –12.807 (5.579)** | –1.909 (18.241) | –0.039 (0.043) |
| *educ*3 | –18.471 (6.092)** | 23.088 (20.872) | –0.119 (0.062)* |
| *years* | – | 0.179 (0.023)** | – |
| *health* | –0.114 (0.034)** | – | 0.001 (0.016) |
| *age* | –0.096 (0.198) | 0.395 (0.512) | –0.002 (0.002) |
| $age^2$ | 0.003 (0.005) | –0.007 (0.013) | – |
| $age^3$ | –0.000 (0.000) | 0.000 (0.000) | – |
| $age * educ2$ | 1.051 (0.423)** | 0.051 (1.378) | – |
| $age * educ3$ | 1.334 (0.450)** | –2.255 (1.604) | – |
| $age^2 * educ2$ | –0.027 (0.010)** | 0.002 (0.033) | – |
| $age^2 * educ3$ | –0.039 (0.011)** | 0.072 (0.040) | – |
| $age^3 * educ2$ | 0.000 (0.000)** | –0.000 (0.000) | – |
| $age^3 * educ3$ | 0.000 (0.000)** | –0.000 (0.000)** | – |
| $\rightarrow$ | – | –0.100 (0.314) | 0.155 (0.150) |
| Observations | 2434 | 1903 | 1903 |
| $R^2$ | 0.24 | 0.31 | 0.01 |
| Method | PROBIT | OLS + WHITE | OLS + WHITE |

Notes: † Hours of work/1000, wage/100, nonlaboral income/1000000.
Standard errors in parentheses.
*Significant at 10%.
**Significant at 5%.

Table A1 reports the results of the estimation by gender. For men, the probability of being employed decreases with own nonlabor income and

[30] There is some controversy in the empirical literature regarding the exogeneity of experience in the labor supply estimations due to the correlation between experience and participation in the labor force. We decide to include years worked in the current job in the wage equations, because Mroz (1987) shows the exogeneity of experience in models that control for self-selection, and because in Spain this variable has a direct effect in the determination of the wage rate for many jobs.

with worsening health status. Wage increases with years worked and does not depend on the participation decision ($\lambda$ is not statistically significant at the 10% level). Finally, labor supply grows with own wage (although this effect is not very precisely measured) and decreases with level of schooling. The selection term is not significant at the 10% level.

TABLE A1 (cont.)
Individual models†

Women

| Variable | Equation: Participation | Wage | Hours |
|---|---|---|---|
| *const.* | −2.162 (1.358) | 1.924 (5.430) | 1.183 (0.139)** |
| $w_1$ | −0.008 (0.003)** | – | −0.001 (0.001)** |
| $w_2$ | – | – | 0.093 (0.014)** |
| $y_1$ | 0.052 (0.061) | – | 0.010 (0.046) |
| $y_2$ | −0.454 (0.088)** | – | −0.398 (0.122)** |
| *kid*14 | −0.258 (0.024)** | – | −0.141 (0.020)** |
| *kid*1416 | −0.118 (0.049)** | – | −0.156 (0.035)** |
| *educ*2 | −4.404 (2.705) | −3.742 (12.422) | 0.010 (0.055)* |
| *educ*3 | 1.756 (3.323) | −13.945 (17.998) | −0.100 (0.087) |
| *years* | – | 0.177 (0.018)** | – |
| *health* | 0.017 (0.016) | – | 0.010 (0.011) |
| *age* | 0.122 (0.105) | −0.129 (0.447) | −0.010 (0.003)** |
| $age^2$ | −0.002 (0.003) | 0.009 (0.012) | – |
| $age^3$ | 0.000 (0.000) | −0.000 (0.000) | – |
| $age * educ2$ | 0.373 (0.214)* | 0.276 (1.032) | – |
| $age * educ3$ | −0.250 (0.259) | 1.238 (1.460) | – |
| $age^2 * educ2$ | −0.009 (0.005) | −0.004 (0.027) | – |
| $age^2 * educ3$ | 0.011 (0.007)* | −0.026 (0.038) | – |
| $age^3 * educ2$ | 0.000 (0.000) | 0.000 (0.000) | – |
| $age^3 * educ3$ | −0.000 (0.000)** | 0.000 (0.000) | – |
| $\rightarrow$ | – | 1.473 (0.483)** | 0.391 (0.087)** |
| Observations | 7155 | 1876 | 1876 |
| $R^2$ | 0.16 | 0.40 | 0.06 |
| Method | PROBIT | OLS + WHITE | OLS + WHITE |

Notes: † Hours of work/1000, wage/100, nonlaboral income/1000000.
Standard errors in parentheses.
*Significant at 10%.
**Significant at 5%.

On the other hand, the probability of participation for women drops with their own nonlabor income, number of children and wage of the spouse. They earn wages that also grow with year worked and the correction by selection term is highly significant. Their labor supplies grow with wage and decrease with nonlabor income, wage of the partner and number of children. The effect of selection is statistically significant even at the 1% level.

Table A2 provides the labor supply elasticities obtained with the individual models and evaluated for the average individual. In both cases the estimations are similar to the household models, except for the cross-wage elasticities that in this case are smaller in absolute value.

TABLE A2
Labor supply elasticities
Individual models

| | Average individual | |
|---|---|---|
| | Men | Women |
| $\Omega_{h,\, w_1}$ | 0.066 (0.045) | –0.005 (0.002)** |
| $\Omega_{h,\, w_2}$ | 0.000 (0.001) | 0.428 (0.064)** |
| $\Omega_{h,\, y_1}$ | –0.005 (0.005) | 0.000 (0.002) |
| $\Omega_{h,\, y_2}$ | –0.001 (0.001) | –0.008 (0.002)** |

Notes: Standard errors in parentheses.
*Significant at 10%.
**Significant at 5%.

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## Resumen

*En este trabajo se estiman y contrastan modelos de oferta de trabajo familiar para España dentro de un enfoque estructural. Para ello, siguiendo a Fortin y Lacroix (1997), se postula un sistema general de ofertas de trabajo y se deriva el conjunto de restricciones paramétricas que imponen los modelos familiares unitario y colectivo. Los resultados empíricos rechazan claramente las restricciones del modelo unitario, mientras que las restricciones del modelo colectivo no pueden ser rechazadas. Adicionalmente, se constata que las elasticidades de las ofertas de trabajo obtenidas para España cumplen las regularidades empíricas observadas para otros países.*

*Palabras clave: oferta de trabajo, modelo unitario, modelo colectivo.*

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