The Causal Effect of Female Labour Participation on Household Consumption. Evidence from Spanish Data *

by

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Abstract

When a household decides whether the woman participates or not in the labour market, we ask two questions: (i) Is the loss in female leisure made up for a change in consumption?, and (ii) Is this change considered when the household makes the decision? In order to answer such questions, we propose a collective model that takes into account the joint decision on consumption of several commodities and female leisure. As commodity demands switch at the corner solution of female nonparticipation, we measure the causal effect of female participation on the consumption of commodities through treatment parameters commonly used in the program evaluation literature. These treatment parameters can be interpreted as the effect of changing the ration of the rationed good (female leisure) on the consumption of freely chosen commodities. The collective analysis parallel to the traditional analysis of rationing needs to incorporate an effect of wages that operates through the man's and the woman's bargaining powers. Our results show that female labour participation causes a benefit in the consumption of several commodities based on observable household characteristics. Female labour participation also causes changes in consumption that are unobservable for us but are observed and considered by the household when it decides whether the woman participates.

JEL codes: D11, D12, C34, J22

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1. Introduction

The behaviour of female labour supply has an impact on many other household decisions, such as marriage, fertility, divorce, and consumption. Because of the interest in explaining the secular increase in the labour participation of women while there has been a decrease in their working-hours (Heckman and Killingsworth, 1986), economic literature has dealt with the cause-effect relationship between female labour supply and other household decisions. We consider there is an open problem in the study of the causal effect of female participation on consumption. That effect can be viewed as a compensation for the loss in the leisure time that the woman suffers when she participates. We wonder whether such compensation occurs in Spain and what kind of consumption is most affected.

The effect of female labour participation on commodity demands can be seen as the effect of a rationed good, female leisure, on freely chosen commodities. In this sense, Browning and Meghir (1991) analyze the conditional effect of male and female labour supplies and also of male and female labour participation on demands for seven commodities assuming a single decision-maker in the household. In this conditional framework, although the conditional demand for commodities does not switch at the corner solutions of zero hours of work, the authors allow for a shift in the intercept and the income-slope parameters depending upon participation. Consequently, the effect of participation depends on the amount of work chosen by the agents. Moreover, as the authors derive conditional demands from a unitary conditional cost function, they do not then consider the effect of wages on commodity demands. Alternatively, from a unitary unconditional approach, Blundell and Walker (1982) estimate a matched pair of rationed and unrationed systems of commodity and leisure demand equations considering male and female leisure separately, where the man is constrained to take a full-time job, and the woman is allowed to choose between any positive amount of work or zero hours. Although the framework posed in Blundell and Walker (1982) is adequate for answering our questions, the authors only estimate the commodity and female leisure demand system for the case in which the woman

participates, which does not allow the effect of female participation on commodity demands to be measured. In Both Browning and Meghir (1991) and Blundell and Walker (1982), the traditional ordering of commodities as complements to or substitutes for female leisure can be defined. Considering that the effect of female participation on consumption is the effect of changing the ration of female labour from zero hours to any positive amount, it can be analyzed according to the effects defined in Tobin and Houthakker (1950-51) and Neary and Roberts (1980) in the unitary framework.

The effect of female labour participation on consumption can also be studied by assuming the multi-person character of the household. A general approach to the multi-person character of household behaviour is the collective approach introduced by Chiappori (1988, 1992). In these seminal papers, Chiappori models the household's joint decision on the consumption of the man's and woman's leisure and of an aggregate commodity assuming that the man and the woman are involved in an unspecified intrahousehold bargaining process that results in Pareto efficient allocations. In this model, Pareto-efficiency and the assumptions of egoistic preferences over private goods and interior solutions are the minimal assumptions capable of generating testable necessary and sufficient conditions for the identification of individual preferences. Keeping in mind the purposes of testability and identifiability, Chiappori's original model has been extended to consider altruistic preferences or public goods (see Browning and Chiappori, 1998; Chiappori *et al.*, 2002a; Chiappori and Ekeland, 2002a; Chiappori and Ekeland, 2002b; Browning *et al.*, 2004) or corner solutions in male and/or female leisure (see Blundell *et al.*, 2001; Donni, 2001; Donni, 2003; Vermeulen, 2002; Zamora, 2003). When public goods are considered, testability and identifiability of the model have been achieved from interior solutions of both labour supplies or from interior solutions of several commodity demands only. When the corner solution at labour nonparticipation is considered, the existing studies do not allow the effect of female labour participation on consumption to be measured. For example, Donni (2001, 2003) analyzes the problem of joint determination of private commodity de-

mands and male and female labour supplies taking into account female nonparticipation. In his model he shows how the labour supply and commodity demands switch at the corner solution of nonparticipation. However, Donni (2001) estimates a unique system of four commodity demands and the female labour supply by combining the likelihood functions of the households in which the woman participates and those in which the woman does not work. Therefore, it is not possible to measure the effect of female participation on consumption from these parameters. The evidence supporting the collective assumptions for Spanish households is unconfirmed. Fernández-Val (2003) finds no evidence against the collective assumptions, but Crespo (2004) rejects the empirical restrictions of the standard collective model.

We consider the multi-person character of the household. Nevertheless, the purpose of this paper is not to test the collective model or identify individual preferences. We assume the general collective model on consumption presented in Browning and Chiappori (1998) and we extend it in two directions: first to take into account the joint decision of consumption and leisure as presented in Vermeulen (2000), and second to allow for female nonparticipation and rationing of the male labour supply. Assuming such a model as the guide for the household behaviour, our purpose is to measure the causal effect of female labour participation on the consumption of several commodity demands for Spanish couples.

The measures of the effect of a rationed good (female leisure in our case) on freely chosen goods proposed in Tobin and Houthakker (1950-51) and Neary and Roberts (1980) cannot be directly applied to our collective demands. We need to consider an additional effect in the collective model: that of the woman's and the man's bargaining powers. Under our model assumptions we can identify the sign of this bargaining effect, but that does not guarantee that we can identify the sign of the substitution effects that play a role in the Tobin-Houthakker effect. In consequence, we cannot order commodities as traditional complements or substitutes for female leisure. However, we can assert whether

there is a positive or negative change in the consumption of a commodity caused by female participation. We measure such change by three treatment parameters commonly used in the policy evaluation literature and we relate these parameters to an extended interpretation of the effects described by Tobin and Houthakker (1950-51) and Neary and Roberts (1980), which considers the bargaining power effect .

Our estimates imply that female labour participation causes a generalized benefit for participants in the consumption of food, commodities included under the heading 'clean house' (energy, water and non-durable goods and services related to cleaning and furnishing), transport and communications, and alcohol and tobacco. However, the benefits for these commodities do not lead households to decide whether the woman will participate. But self-selection based on expected changes in consumption occurs. The group of commodities that induce such selection depends on distributional assumptions.

The rest of the paper is structured as follows. Section 2 describes the theoretical model that generates the demand system for commodities and female leisure. Section 3 discusses the identification of several effects, such as the bargaining power effect and the traditional price and income effects. Section 4 specifies the identifying assumptions made to measure the effect of female labour participation on consumption. This effect is described by treatment parameters. Section 5 links the treatment parameters to the effects described in section 3. Section 6 presents the empirical model that is estimated with the data and method described in section 7. Section 8 describes, presents and interprets the estimation results. Finally, we point out several possible extensions.

2. Theoretical Model

Our theoretical model has to consider the following aspects of our problem: (i) household decisions are taken by both members of the couple, (ii) the household consumes a positive amount of several commodities, (iii) the man works full-time in most cases, and (iv) the woman chooses her labour supply from within a broader interval of time, including in many

cases zero hours.

Our model is based upon the general collective household model of Browning and Chiappori (1998), as extended by Vermeulen (2000) to include leisure. Moreover, we extend that model to include corner solutions in female leisure. In this model the household consists of two working-age agents m and f. Preferences are assumed to be very general, allowing for altruism and externalities in consumption and leisure. Commodities $\mathbf{q}$ can be consumed privately, publicly or both ($\mathbf{q} = \mathbf{q^m} + \mathbf{q^f} + \mathbf{Q}$). Preferences of individual i ($i = m, f$) are assumed to be representable by the following direct utility function:

$$U^i(\mathbf{q^f}, \mathbf{q^m}, L^f, L^m, \mathbf{Q}),$$

where U^i is a twice continuously differentiable strongly concave utility function with the private consumption vectors $\mathbf{q^i} \in \mathbb{R}^J_+$, the leisure amounts L^i taken as minus the labour amounts $h^i \in [0, 1]$, and the vector of public consumption $\mathbf{Q} \in \mathbb{R}^J_+$ as arguments. The utility function U^i is assumed to be strictly increasing in $\mathbf{q^i}$, L^i and $\mathbf{Q}$.

Following the standard collective approach (Chiappori, 1988, 1992), we assume that the household decision making process results in Pareto efficient outcomes. We make the following assumptions in order to consider the main aspects of our problem:

Assumption 1 *The household consumes a positive amount of each commodity q_j with $j = 1, 2, ..., J$.*

Although we observe zero expenditures for some commodities, we assume that zero expenditures are due to purchase infrequency or voluntary abstention. Hence, we model such cases differently from corner solutions.

Assumption 2. *The man's labour supply is constrained and such that $c \leq h^m \leq 1$ for $0 < c < 1$. The woman chooses her labour supply freely such that $0 \leq h^f < 1$.*

In our Spanish data set we have no precise data on the working hours of the agents: we only know whether they work more or less than thirteen hours per week. In the study of working hours in a complementary Spanish data set, we see that the distribution of

working hours for men and women is not censored at this lower bound. We observe that more than 99 percent of men work more than thirteen hours per week, and almost half of them work 40 hours per week. We also observe some kinks at 32, 50 and 60 hours. We will thus consider that the man is rationed in his labour supply. For the woman's working hours, we observe a more continuous distribution, with a mode at 40 hours. In spite of the existence of several kinks in the distribution of the female working hours, we assume that women are free to choose their labour supply and we do not observe censoring of the female labour supply at an upper limit. However, we observe censoring of the female labour supply at nonparticipation, i.e, we observe a corner solution at $h^f = 0$, since 68 percent of the married women in our sample do not work.

Taking into account Pareto efficiency and assumptions 1 and 2, the household allocation can be defined as the unique solution to the following problem:

$$\max_{\mathbf{q^m},\mathbf{q^f},\mathbf{Q},h^f} H(\mathbf{q^m},\mathbf{q^f},\mathbf{Q},-h^f;h^m,p,w^m,w^f,y) = \qquad (\overline{P})$$

$$\max_{\mathbf{q^m},\mathbf{q^f},\mathbf{Q},h^f} U^m(\mathbf{q^m},\mathbf{q^f},\mathbf{Q},-h^f;h^m) + \mu(\mathbf{p},w^m,w^f,y)U^f(\mathbf{q^m},\mathbf{q^f},\mathbf{Q},-h^f;h^m)$$

$$\text{s.t.} \quad \mathbf{p}'\mathbf{q} - w^f h^f = w^m h^m + y$$

$$0 \leq h^f < 1$$

The Pareto weight μ is a continuously differentiable nonnegative scalar function that measures the sharing of bargaining power between the woman and the man. The arguments of this function are the exogenous variables of the problem but not the rationed man's labour supply, and the power function can also be affected by 'distribution factors' (variables that affect the decision making process without affecting preferences or the budget constraint, for example, the sex ratio and divorce laws used in Chiappori *et al.*, 2002b). The exogenous variables of the problem are the vector of prices of commodities, $\mathbf{p}$, the wages, (w^f, w^m), and the amount of non-labour income and savings, y, which

is predetermined[1] . Therefore, full-income (value of commodities and female leisure) is $m_1 = w^m h^m + y$.

If the demand system corresponding to interior solutions of the problem $(\overline{P})$ has a *Pseudo-Slutsky* matrix (as it is called in Browning and Chiappori, 1998) that can be decomposed as the sum of a negative symmetric matrix plus a matrix of rank one, Chiappori and Ekeland (2002b) demonstrate that individual preferences and μ are uniquely identified. Such a condition is empirically satisfied for Canadian data (Browning and Chiappori, 1998) and we assume it in our problem.

The nonnegativity constraint for female labour supply is binding for nonparticipation. Lee and Pitt (1986) show that, in this case and in a traditional unitary model, there is a unique virtual price (in our case the female reservation wage) that separates two regimes or sets such that the demand for positively consumed goods switches at the frontier between the two sets. This result does not follow directly from our collective framework since the 'collective household indirect utility function' it is not necessarily a strictly quasi-concave, strictly monotonic function. We need an additional assumption that has empirical implications. The assumption needed is:

Assumption 3 *For each* $(\mathbf{p}, w^m, y, h^m)$*, the implicit function for the female reservation wage, defined as the marginal rate of substitution between female leisure and consumption of any good along the axis* $h^f = 0$*, is upper-bounded and is a contraction with respect to* w^f*.*

Under Assumption 3 there exists a function $\gamma(m_1, \mathbf{p}, w^m, y, h^m)$ such that the woman participates in the labour market if and only if $w^f > \gamma(m_1, \mathbf{p}, w^m, y, h^m)$. The Kunh-Tucker conditions that characterize the demands of the vector $\mathbf{q}$ when $h^f = 0$ are equivalent to this switching condition (Lee and Pitt, 1986). An equivalent assumption is explained in Donni (2003) and Blundell *et al.* (2001) in a framework without public goods. With public

[1] $y = \mathbf{p}'\mathbf{q} - w^f h^f - w^m h^m$.

goods, our assumption has the same implications as reported by these authors because our model with public goods could be described in terms of private equivalents through a household production function (see the model in Browning *et al.*, 2004).

According to this condition we characterize two regimes:

Participation Regime (1)[2]

This regime is characterized by the interior solutions of the problem $(\overline{P})$.

$$\{q_j^*, h^{f*} \text{ with } j = 1, .., J \text{ such that } w^f \geq \gamma(m_1, \mathbf{p}, w^m, y, h^m) \text{ and } q_j^* > 0, h^{f*} > 0\}$$

Nonparticipation Regime (0)

This regime is characterized by the demands for commodities when the ration of female labour at zero hours is binding.

$$\{\overline{q}_j \text{ with } j = 1, .., J \text{ such that } w^f < \gamma(m_1, \mathbf{p}, w^m, y, h^m) \text{ and } \overline{q}_j > 0, \overline{h}^f = 0\}$$

The functional forms for demands corresponding to each regime are linked by virtue of the preferences from which they are derived. Demands in the nonparticipation regime can be seen as conditional counterparts of demands in the participation regime. Deaton and Muellbauer (1981) show the functional forms for conditional and unconditional demands corresponding to a labour supply that is linear in wages and in nonlabour income. These demand functions generate linear Engel curves. Moreover, they show that the validity of a simple linear relationship linking rationed and unrationed demands is subject to the linearity in full-income of the rationed demands. Donni (2003) uses this linear relationship for linking rationed and unrationed male labour supplies. It is easy in this case to test assumption 3, or equivalently, the continuity of labour supply and commodity demands along the participation frontier. We use a different approach, the conditional approach in Browning and Meghir (1991), for linking rationed and unrationed commodity demands.

[2] By convention, we include the Participation Frontier, when $w^f = \gamma(m_1, p, w^m, y, h^m)$, in the Participation Regime

Under this approach, we trade greater flexibility of Engel curves off against the possibility of directly testing the continuity of the demands along the participation frontier.

The commodity demands and the female labour supply in the participation regime are the collective counterparts of Marshallian demands. Let these demands be the following functions:

$$q_j^* = f_j(m_1, \mathbf{p}, w^f, h^m, \mu(\mathbf{p}, w^m, w^f, y)), \text{ with } j = 1, ..., J,$$

$$h^{f*} = f_h(\mathbf{p}, m_1, w^f, h^m, \mu(\mathbf{p}, w^m, w^f, y)).$$

The reduced or unrestricted observed form for this demand system is:

$$q_j^* = \psi_j(m_1, \mathbf{p}, w^m, w^f, y, h^m), \text{ with } j = 1, ..., J,$$

$$h^{f*} = \psi_h(m_1, \mathbf{p}, w^m, w^f, y, h^m).$$

The corresponding commodity demands in the nonparticipation regime are:

$$\overline{q}_j = f_j^c(m_1, \mathbf{p}, h^m, \mu(\mathbf{p}, w^m, w^f, y)), \text{ with } j = 1, ..., J,$$

with a reduced or unrestricted observed form:

$$\overline{q}_j = \psi_j^c(m_1, \mathbf{p}, w^m, w^f, y, h^m), \text{ with } j = 1, ..., J.$$

3. Ordering of Goods

The female participation effect can be viewed as the effect of an increase in the female labour ration when the ration is fixed at zero hours. Taking into account the well-known results of Tobin and Houthakker (1950-51), an increase in the female labour ration –with prices, wages and income remaining unchanged– will increase the consumption of unrationed substitutes for female leisure and diminish the consumption of unrationed complements to female leisure. However, Neary and Roberts (1980) demonstrate that if, when the woman does not participate, she is consuming less leisure than she wishes due to time

constraints, then an increase in the female labour ration produces the aforesaid Tobin-Houthakker's substitution effect and an additional income effect. These substitution and income effects have opposite signs for commodities that are normal and complements to female leisure. Consequently, the ordering of commodities as complements to or substitutes for female leisure cannot be done directly according to the sign of the female participation effect.

The ordering of commodities as complements to or substitutes for female leisure relies in the unitary framework on the identification of the derivatives of the unrationed compensated commodity demands with respect to the female wage, that is, on the identification of the cross-terms of the traditional Slutsky matrix in the participation regime. If we want to keep this traditional definition of complements and substitutes in our collective model, we have to identify these same cross-terms of the traditional Slutsky matrix. Browning and Chiappori (1998) demonstrate that the *Pseudo-Slutsky* matrix derived from the collective counterparts of the compensated demands generalizes the unitary Slutsky matrix, such that the generalized *Pseudo-Slutsky* matrix equals the traditional Slutsky matrix plus a matrix that has at most rank one[3] . This latter matrix incorporates the bargaining power effect. Consequently, identifying the traditional Slutsky cross-terms entails two problems. First, we have to identify the bargaining power effect. Second, we have to consider whether identification comes from the observed demands in the participation regime or from the observed demands in the nonparticipation regime.

Taking the foregoing discussion into consideration, we decompose the demand derivatives with respect to wages and full-income as follows.

Demands in the Participation Set:

$$\frac{\partial \psi_j}{\partial w^m} = \frac{\partial f_j}{\partial \mu} \frac{\partial \mu}{\partial w_m} \tag{3.1}$$

[3] In our case we make the identifying assumption that this matrix has rank one.

$$\frac{\partial \psi_j}{\partial w^f} = \frac{\partial f_j}{\partial w_f}\bigg|_{\mu=\mu^*} + \frac{\partial f_j}{\partial \mu}\frac{\partial \mu}{\partial w_f} \tag{3.2}$$

$$\frac{\partial \psi_j}{\partial m_1} = \frac{\partial f_j}{\partial m_1}\bigg|_{\mu=\mu^*} + \frac{\partial f_j}{\partial \mu}\frac{\partial \mu}{\partial y} \tag{3.3}$$

Demands in the Non-Participation Set:

$$\frac{\partial \psi_j^c}{\partial w^m} = \frac{\partial f_j^c}{\partial \mu}\frac{\partial \mu}{\partial w_m} \tag{3.4}$$

$$\frac{\partial \psi_j^c}{\partial w^f} = \frac{\partial f_j^c}{\partial \mu}\frac{\partial \mu}{\partial w_f} \tag{3.5}$$

$$\frac{\partial \psi_j^c}{\partial m_1} = \frac{\partial f_j^c}{\partial m_1}\bigg|_{\mu=\mu^*} + \frac{\partial f_j^c}{\partial \mu}\frac{\partial \mu}{\partial y} \tag{3.6}$$

In any kind of intrahousehold bargaining context, we assume that

$$\frac{\partial \mu}{\partial w^f} > 0 \text{ and } \frac{\partial \mu}{\partial w^m} < 0.$$

Then, from (3.1), (3.4) and (3.5) we can identify the sign of the woman's bargaining power on the commodity demands, $\frac{\partial f_j}{\partial \mu}$ and $\frac{\partial f_j^c}{\partial \mu}$. We can order commodities as affected negatively or positively by the woman's bargaining power according to this sign. This ordering can change from the nonparticipation set to the participation set. The sign of the bargaining power effect is identified for its effect on household aggregate consumption; therefore, it does not depend on assumptions on preferences or on exclusivity or assignability of goods.

The sign of the traditional price-effect measured on the demand in the participation set, $\frac{\partial f_j}{\partial w_f}\Big|_{\mu=\mu^*}$, can be identified in some cases from (3.2) if, for example, the sign of the woman's power effect is different from the sign of the observed female wage effect, $\frac{\partial \psi_j}{\partial w^f}$.

Our objective is to identify the sign of the cross-term of the Slutsky matrix

$$\left(\frac{\partial f_j}{\partial w_f}\bigg|_{\mu=\mu^*} - h^f \frac{\partial f_j}{\partial m_1}\right)$$

from the observed effects (3.1), (3.2) and (3.3). We assume that the bargaining effect of y is negligible in such a way that for normal goods the sign of $\frac{\partial \psi_j}{\partial m_1}$ is positive. Consequently,

for normal goods, we can only identify a negative sign of the cross-terms of the Slutsky matrix in those cases when we have a negative sign for $\frac{\partial f_j}{\partial w_f}\Big|_{\mu=\mu^*}$.

The analysis of the derivatives of demands in the nonparticipation set is simpler since the only effect of wages on these demands operates through the bargaining effect.

What about the effect of the rationed good, that is, the effect of increasing female labour supply from zero hours to any positive amount of work? Since the ration is set at a fixed amount of zero hours for every household, we cannot measure the derivatives of commodity demands with respect to the conditional or rationed female labour supply. Browning and Meghir (1991) choose the path of measuring the effect of a female participation dummy without considering the complete switching of demands. The problem with this measure is that it depends on the amount of female labour supply chosen. The procedure we follow consists of measuring the switching of commodity demands at the corner solution of female nonparticipation. This measurement depends only on the conditioning variables in both regimes and not on on the amount of female labour supply. To that end we apply the policy evaluation methods we detail below. We will see that the measures obtained by these methods can be interpreted according to the effects of the rationed good on the demand of freely chosen goods described by Tobin and Houthakker (1950-51) and Neary and Roberts (1980).

4. Policy Evaluation

Consider a model of outcomes or demands and the switching condition:

$$Y^1 = \{q_j^*, h^{f*} \text{ with } j = 1, .., J\},$$

$$Y^0 = \{\overline{q}_j \text{ with } j = 1, .., J\},$$

$$D = 1(w^f \geq \gamma(m_1, \mathbf{p}, w^m, y, h^m)),$$

where Y^1 denotes potential outcomes in the participation regime, and Y^0 denotes potential outcomes in the nonparticipation regime. 1(A) is the indicator function which takes the value 1 if event A is true and 0 otherwise.

We assume linearity and an additively separable model relating outcomes to a vector of observable conditioning variables and to unobservables. From the model described in Lee and Pitt (1986) it results that the outcome equations in both regimes depend on the same vector of unobservables or random components. The randomness comes from unobservable heterogeneity in preferences and measurement errors in outcomes data. We postulate that measurement errors are due to purchase infrequency. Following the policy evaluation practice, we allow for differences in the unobservables between regimes. In our theoretical model this can be justified since the demand functions that link outcomes to unobservables have different functional forms in each regime. Consequently, we can write the outcome equations as:

$$Y^1 = X^1\beta^1 + V^1, \tag{4.1}$$

$$Y^0 = X^0\beta^0 + V^0, \tag{4.2}$$

where X^1, X^0 are sets of conditioning variables, β^1 and β^0 are parameter vectors, and V^1, V^0 are the random components.

We can interpret (4.1) and (4.2) as reduced forms (ψ and ψ^c respectively) of the collective counterparts of the Marshallian demands or causal functions, with the set of variables $X = (X^1, X^0)$ being causal variables. We can measure the *ceteris paribus* effects of changing one variable X_k by external manipulation while keeping others constant.

We allow for the possibility that $E(V^1|X^1) \neq 0$ and $E(V^0|X^0) \neq 0$, but we assume the existence of a set of instruments Q such that $E(V^1|Q) = 0$ and $E(V^0|Q) = 0$. The separability of the random components enables us to isolate the effect of self-selection based on unobservables.

We define a latent index model for the participation equation such that:

$$D^* = w^f - \gamma(m_1, \mathbf{p}, w^m, y, h^m) = Z\theta + V^D. \tag{4.3}$$

The set of variables Z includes wages and the preference conditioning variables that affect the female reservation wage. *A priori* the sets of variables X and Z are the same. The

switching condition is represented by the following index model:

$$D = 1(Z\theta + V^D \geq 0). \tag{4.4}$$

In this framework, we define the measured outcome, random variable Y in a hypothetical population, as:

$$Y = DY^1 + (1 - D)Y^0.$$

Following the general definition in Heckman and Vytlacil (2000) we define the causal effect of female labour participation on consumption or the 'Treatment Effect Causal Effect' as the value $Y^1 - Y^0$ for each household. To obtain a meaningful interpretation of that causal effect we need a mechanism for changing D while holding X fixed. To obtain such a meaningful interpretation of the Treatment Effect Causal Effect we need the following two assumptions (A-1) and (A-2):

(A-1) X is not caused by D given the vector of potential outcomes. More precisely, we require that for the conditional density

$$f(X|D, Y) = f(X|Y)$$

(A-2) There is a variable in Z not included in X. We postulate that such a variable or instrument inducing households to change regimes given X is the regional female unemployment rate. The effect of the regional female unemployment rate on female labour participation is considered in Arellano and Meghir (1992) and in Martínez-Granado (2001) as a labour demand factor that affects female participation. We assume independence and monotonicity for this instrument (Imbens and Angrist, 1994).

The model is fully-identified if the parameters β^1, β^0, θ and the joint distribution $F(V^1, V^0, V^D)$ are identified. Heckman and Smith (1998) show that this full-identification is necessary to implement an evaluation of the program under the 'Selfish Voting' criterion. An evaluation of the program under the 'Cost-Benefit' criterion requires only the estimation of the conditional means $E(Y^1|D = 1)$ and $E(Y^0|D = 1)$ such that we can estimate the

mean counterfactual $E(Y^1 - Y^0|D = 1)$. We use a cross-section estimator to estimate these conditional means. The estimation of $E(Y^1|D = 1)$ comes directly after the observability in the cross-section sample of the empirical distributions $F(Y^1|D = 1, X, Z)$ and $Pr(D = 1|Z)$. Additional assumptions are needed to estimate $E(Y^0|D = 1)$ since we observe the empirical distribution $F(Y^0|D = 0, X, Z)$ but we do not observe $F(Y^0|D = 1, X, Z)$. The fundamental assumption made in order to circumvent this 'Fundamental Problem of Causal Inference' as it is called by Holland (1986) is:

(A-3) $$0 < Pr(D = 1|x) < 1 \qquad \text{for every } x \in Support(X).$$

The cross-section method we use to identify $E(Y^0|D = 1)$ is a selection bias correction method developed in Heckman (1979) and Heckman and Robb (1985, 1986), also known as 'index sufficient' method, or 'control functions' method. We use a method that relies on distributional assumptions. Our additional identifying assumptions for the model are:

(A-4) (V^1, V^0, V^D) are stochastically independent from the matrix Q and from Z.

(A-5) The distribution of V^D, $F(V^D)$, is a complete specified function that is strictly increasing in V^D. The functional form of the joint distribution of (V^1, V^0) is specified.

(A-6) There is a linear regression relationship for the conditional expectations of V^1 and V^0 given V^D, such that knowledge of the marginal distribution of V^D determines the functional form of the selection bias terms:

$$E(V^1|D = 1) = \sigma_{1D} E(V^D|V^D \geq -Z\theta) = K_1(Z\theta),$$

$$E(V^0|D = 0) = \sigma_{0D} E(V^D|V^D < -Z\theta) = K_0(Z\theta),$$

and from the identity

$$0 = E(V^0) \equiv E(V^0|D = 1)Pr(D = 1) + E(V^0|D = 0)Pr(D = 0),$$

we obtain that

$$E(V^0|D = 1) = -K_0(Z\theta)\frac{Pr(D = 0)}{Pr(D = 1)}.$$

Under assumptions (A-1) to (A-6) we can identify the conditional mean $E(Y^0|D=1)$ from the estimation of both $E(Y^0|D=0)$ and $E(Y^1|D=1)$. In other words, we can characterize the selection bias as a function of a scalar index. Moreover, estimation of conditional means together with the distributional assumptions allow us to recover the joint distribution $F(Y^1, Y^0|D=1)$ and to answer distributional questions.

The procedure is based upon the estimation of the following regression equation, with the observed outcome $Y = DY^1 + (1-D)Y^0$ as the dependent variable:

$$E(Y|X,Z,D) = E(Y^1D + Y^0(1-D)|X,Z,D) = DX_1\beta_1 + (1-D)X_0\beta_0 +$$

$$DE(V^1|X,Z,D=1) + (1-D)E(V^0|X,Z,D=0). \tag{4.5}$$

Heckman and MaCurdy (1986) and Heckman *et al.* (2000) present a catalogue of parametric models under different assumptions on the distributions of (V^1, V^0) and V^D. Among these distributions we compare the trivariate normal sample selection model with a model with fatter tails: a logistic distribution for the latent index variable and a Student t distribution with three degrees of freedom for the outcome variables.

Once β^1, β^0 and $(\sigma_{1D} - \sigma_{0D})$ have been estimated, we obtain simple estimators for the following three treatment parameters (see Heckman *et al.* 2000): the Average Treatment Effect (ATE), the effect of Treatment on the Treated (TT), and the Local Average Treatment Effect (LATE) of Imbens and Angrist (1994). In our framework, these three population treatment parameters are weighted versions of the Marginal Treatment Effect (MTE) (Heckman and Vytlacil, 2001).

The Average Treatment Effect (ATE) is defined for each $X = x$ as the household's expected gain from female labour participation for a randomly chosen household. We estimate the unconditional ATE by integrating over the distribution of X. The Treatment of the Treated is the average gain from female labour participation for those households with characteristics $X = x, Z = z$ in which the woman actually works. The Local Average Treatment Effect (LATE) of Imbens and Angrist (1994) in our case estimates the expected

outcome gain for those households in which the woman is induced to participate through a decrease in the female unemployment rate from $Z_k = z_k^1$ (40 percent) to $Z_k = z_k^0$ (4 percent), all other components of Z, $\mathbf{Z_{-k}}$, unchanged. The Marginal Treatment Effect (MTE) estimates the expected outcome gains from female labour participation of households on the participation frontier. This effect depends on the value of unobservables V^D. The woman is more likely to participate if the value of the unobservables is high, and less likely if that value is low. In our framework, the MTE is a linear function of V^D with a slope equal to $(\sigma_{1D} - \sigma_{0D})$ and intercept equal to the ATE.

4.1. Cost-benefit analysis

How can we answer cost-benefit questions from our estimates? For example we can wonder whether there is a *ceteris paribus* change in the aggregate consumption of a commodity derived from a change in the female wage, or whether there is a *ceteris paribus* change in the aggregate consumption of a commodity derived from a change in the female unemployment rate. Ignoring supply-side effects, the marginal benefit in terms of a commodity of a change in the female wage for a particular household can be separated into (i) the net gain if the household switches regimes, measured by the Marginal Treatment Effect, and (ii) the derivative of the demand for the commodity with respect to the female wage, which depends on the regime to which the household belongs. The marginal benefit of a change in the female unemployment rate is, therefore, the Marginal Treatment Effect for those households that are *compliers*, that is, households that are induced to switch regime due to the change in the female unemployment rate. We can compare such marginal benefits (aggregating over commodities) with the marginal cost. In our case, the marginal cost is the derivative of the value of the female leisure ($w^f h^f$) with respect to the policy variable. Then, the marginal cost is zero when the policy variable is the female unemployment rate.

If only efficiency matters, there is an 'optimum' female unemployment rate and an 'optimum' female wage. But distributional questions are relevant in these cases. We can also

answer distributional questions under our identifying assumptions, such as what proportion of households benefits in terms of total consumption from female labour participation. Moreover, we can detail these proportions according to the benefits in each commodity.

5. Rationing and Policy Evaluation

There is a link at this point between Treatment Effects and the effects of full-income and wages as described in section 3. In a unitary framework, the MTE can be interpreted as the effect of the female labour supply on commodity demands when the ration at zero hours 'just' bites. In a unitary model, this is the Tobin-Houthakker effect, and it would lead to the ordering of commodities as complements to or substitutes for female leisure if the effect is negative or positive, respectively. On the other hand, the treatment effects ATE, TT, and LATE can be interpreted as the effect of increasing the female labour ration on commodity demands when the ration at zero hours is strictly binding for different groups of households. This is the effect described in Neary and Roberts (1980).

A parallel analysis that in Tobin and Houthakker (1950-51) and Neary and Roberts (1980) can be applied to our collective counterparts of Marshallian demands. The novelty implied by the collective model in comparison with traditional results consist of the interpretation of the compensated effects of prices on demands. These compensated effects are described by the *Pseudo-Slutsky* matrix instead of the traditional Slutsky matrix.

Consequently, our measurement of the MTE can be interpreted as the following effect:

$$\frac{\partial q_j^{comp}}{\partial h^f} = \left(\frac{\partial \psi_j}{\partial w^f} - h^f \frac{\partial \psi_j}{\partial m_1}\right) \Big/ \left(\frac{\partial \psi_h}{\partial w^f} - h^f \frac{\partial \psi_h}{\partial m_1}\right), \tag{5.1}$$

with $h^f = 0$. According to assumption 3, the switching in consumption at the participation frontier has to be 'small enough' for the female reservation wage to exist. This means that effect (5.1) has to be close to zero. The ordering into complements and substitutes of female leisure according to the sign of effect (5.1) is not direct because the *Pseudo-Slutsky* terms incorporate a bargaining effect.

Neary and Roberts (1980) decompose the effect of the rationed good (female labour supply in our case) on unrationed commodities at any point in the set $(m_1, \mathbf{p}, w^m, w^f, h^m, y)$ as the following expression:

$$\frac{\partial q_j^*}{\partial h^f} = \frac{\partial q_j^{comp}}{\partial h^f} + \frac{\partial q_j^*}{\partial m_1}(w^f - \gamma(m_1, \mathbf{p}, w^m, y, h^m)), \tag{5.2}$$

where $\frac{\partial q_j^{comp}}{\partial h^f}$ is the compensated effect or the effect measured at the participation frontier, that is, the above effect (5.1). The second effect is an income effect that, in the participation regime, depends on the positive amount $(w^f - \gamma(m_1, \mathbf{p}, w^m, y, h^m))$. Therefore, the income effect is positive for normal commodities in the participation regime.

Effect (5.2) is the effect on consumption of any change in female labour supply that implies a switch from the nonparticipation regime to the participation regime. Since the first substitution effect in (5.2) is close to zero for all households, the differences between ATE, TT and LATE come from differences in the value of the latent index $D^* = (w^f - \gamma(m_1, \mathbf{p}, w^m, y, h^m))$ for the different group of households that each parameter considers.

6. Empirical Model

The empirical specifications of demand systems for commodities are not the same as the empirical specifications for labour supply. We can see a unification of the two specifications in the generalization, due to Muellbauer (1981), of the Gorman Polar form. This parametric specification, however, has the drawback of assuming quasi-homothetic preferences with linear Engel curves.

Although we have to model female labour supply jointly with commodity demands, our priority is the analysis of the behaviour of commodity demands. In consequence, we choose a general empirical specification for commodity demands taking into account that the conditioning variable 'total expenditure' includes the value of female leisure. Because of this, the Working-Leser empirical specification in budget shares does not fit the data. Alternatively, we use a model of the system of expenditure functions due to Bourguignon *et al.* (1995) that generalizes the Working-Leser functional form.

Following the framework in Lee and Pitt (1986), we have on the one hand a system of freely chosen commodity demands and female leisure (conditioned by male labour supply) and on the other hand a system of commodity demands where male and female leisure are rationed. For the empirical specification of the two systems we follow the conditional approach in Browning and Meghir (1991). Accordingly, the conditional demands have the same parametric specification as the unconditional demands but for both systems we have to take four points into account. First, when we condition on male labour supply or female labour supply, there is no traditional price-effect of wages. However, wages can bear on a bargaining power effect, including the female potential wage in the nonparticipation regime. Second, commodity demands depend on the ration amount of the male labour supply in the two regimes, and on the ration amount of the female labour supply in the nonparticipation regime, which is zero for every household. Third, the only source of price variability in our cross-section sample comes from the female wage, so the property of homogeneity of degree one in prices and full-income cannot be tested, but the functional form has to allow for such a property. Fourth, according to assumption 3, commodity demands are continuous everywhere, in particular along the frontier where the regime switches.

In the participation regime, the system for commodities and female labour supply has the following form (with commodity prices set to one):

$$q_j^* = (\beta_{11j} + \beta_{12j} h^m) m_1 + (\beta_{13j} + \beta_{14j} h^m) m_1 ln(\frac{m_1}{nw^f}) + (\beta_{15j} + \beta_{16j} h_m) ln(w^f) + \beta_{17j} ln(\frac{w^f}{w^m}) + \boldsymbol{\beta_{18j}}' H, \tag{6.1}$$

where n is the size of the household and H includes the intercept and demographics and household characteristics. By adding-up the parameters of the female labour supply, $\boldsymbol{\beta_{1kh}}$, are such that

$$\beta_{11h} = \sum_{j=1}^{J} \beta_{11j} - 1 \quad \text{and} \quad \beta_{1kh} = \sum_{j=1}^{J} \beta_{1kj} \text{ for } k = 2, .., 8.$$

In the nonparticipation regime, the system for commodity demands conditioned to zero hours of female labour supply has the following form:

$$\overline{q}_j = (\beta_{01j} + \beta_{02j} h^m) m_1 + (\beta_{03j} + \beta_{04j} h^m) m_1 ln(\frac{m_1}{n}) + \beta_{05j} ln(\frac{w^f}{w^m}) + \beta_{\mathbf{06j}}{}' H. \quad (6.2)$$

Continuity of these systems at the participation frontier can be studied by measuring effect (5.1) and checking whether it is close to zero.

We can write a stochastic version of (6.1) and (6.2) as the linear in variables forms (4.1) and (4.2). To estimate these systems we take the following regression for the 'random coefficient model' proposed in Heckman and MaCurdy (1986):

$$Y = DY^1 + (1-D)Y^0 = DX_1\beta_1 + (1-D)X_0\beta_0 + \sigma_{1D} D\mu_1 + \sigma_{0D}(1-D)\mu_0 + e, \quad (6.3)$$

where $\sigma_{1D}\mu_1$ and $\sigma_{0D}\mu_0$ are the conditional means of the error terms or 'control functions' (Heckman and Robb, 1985, 1986) [4] whose specific functional form depends on distributional assumptions on V^D.

We try two different distributional assumptions. First, the trivariate normal model under which

$$\mu_0 = -\frac{\phi(Z\theta)}{1-\Phi(Z\theta)} \text{ and } \mu_1 = \frac{\phi(Z\theta)}{\Phi(Z\theta)}.$$

Second, we assume that (V^1, V^0) is distributed as a joint standardized Student-t with three degrees of freedom, and V^D follows the logistic distribution. According to Heckman *et al.* (2000), we have the following expressions:

$$\mu_1 = ((3 + (T_3^{-1}(\Lambda(Z\theta)))^2)/2)(\frac{t_3(T_3^{-1}(\Lambda(Z\theta)))}{\Lambda(Z\theta)}) \text{ and}$$

$$\mu_0 = -((3 + (T_3^{-1}(\Lambda(Z\theta)))^2)/2)(\frac{t_3(T_3^{-1}(\Lambda(Z\theta)))}{1-\Lambda(Z\theta)}),$$

[4] We assume that $E(V^k|V^D, X) = \sigma_{kD} V^D$ with $k = 0, 1$. Therefore, $E(V^1|V^D, X, D = 1) = \sigma_{1D} E(V^D \geq -Z\theta)$ and $E(V^0|V^D, X, D = 0) = \sigma_{0D} E(V^D < -Z\theta)$

where T_3^{-1} denotes the inverse of the univariate standardized cumulative distribution function Student-t_3, t_3 denotes the Student-t_3 density function, and Λ denotes the logistic distribution function.

We compare the results of these models with those of an exogenous switching model where D and (Y^1, Y^0) are uncorrelated such that σ_{0D} and σ_{1D} are zero.

7. Data and Estimation Method

To estimate the demand system (6.3) we use the expenditures, individual labour incomes, female and male participation, and household characteristics data for a subsample of the Spanish survey *Encuesta de Presupuestos Familiares de 1990-91* (EPF-90)[5] . To estimate weekly-hours of work for men and women we use the complementary data set, Labour Force Survey, *Encuesta de Población Activa* for the four corresponding quarters of 1990-91.

The expenditure data gathered on 918 types of goods are given annualized based on various criteria depending on frequency of purchase. Monetary income from employment is net of tax and social contribution withholdings, while income from self-employment is gross income less deductible expenses. According to Sanz (1995), the EPF-90 labour income data underestimate aggregate labour income measured by the Spanish National Accounts. The man's and woman's hourly-wages used as explanatory variables in the Engel curves are estimated from the labour income data in the EPF-90 according to the procedures explained below, linking the two complementary data sets.

The sample we select comprises 4946 households formed by couples with or without children younger than 17 in which the husband works more than thirteen hours per week (see details of sample selection in Table 1 of the Appendix). We break down this sampling of households into two regimes: regime 1 comprises households in which the woman has market work as either an employee or self-employed worker (1577 households), and regime

[5] Data and documentation are available at the web page of the Department of Economics of *Universidad Carlos III de Madrid*: http://www.eco.uc3m.es/investigacion/index.html♯toc4.

0 comprises households in which the woman does not have market work (3369 households).

We break down household expenditures into twelve commodities (see Table 2 of the Appendix). The consumer expenditure considered does not include major durable goods such as housing, automobiles, furniture, appliances, or expenditures on financial services or taxes[6] . Measuring the vector of consumption, $\mathbf{q}$, based on expenditure data poses various statistical problems depending on the commodity considered. We regroup the vector of twelve commodities into four groups depending on the statistical problems of measuring consumption that arise. Group I comprises expenditures on food, which is affected by bulk purchases, making it hard to impute annual consumption. We take the imputation made according to the estimation technique presented in Peña and Ruiz-Castillo (1998). Group II comprises the commodities, 'clean house', and transportation and communications. Since we observe no households in which expenditure on these commodities is zero, and there is no information available on the making of bulk purchases on a cycle different from that of consumption, we assume that expenditures on these commodities equal consumption. Group III comprises seven commodities that we assume are consumed regularly over the year: mens clothing, women's clothing, health, personal care, home entertainment, outside home entertainment, and the residual group of other expenditures. For these seven commodities there is a considerable percentage of households whose expenditure is zero because no purchases were made during the survey reference period. We believe that the appearance of zero expenditure in these cases is due to the purchase infrequency phenomenon, for which we will correct by applying the two-stages technique proposed by Meghir and Robin (1992). Finally, group IV is made up of the two remaining commodities: one is the group formed by alcohol and tobacco which we head as 'vices', and the other one is the group formed by child-related commodities which we head as 'children'. In these cases, we believe that zero expenditures are due to voluntary abstention and that abstention is not random

[6] Implicitly we are assuming separability between the commodities included and the ones not included, with the exception of the house, the car, and other durables, the number of which condition the system.

with respect to the consumption decision. This phenomenon of voluntary abstention is corrected with a double-hurdle model that assumes that the decision to spend dominates the decision on how much to spend (first-hurdle dominance). Therefore, following Jones (1989), we apply a Heckman's lambda-type correction.

To estimate the consumption of the seven commodities affected by purchase infrequency we use the two-stages method detailed in Meghir and Robin (1992), with a modification. Due to the size of our sample, instead of using the sample in which we observe positive expenditures for all the commodities, we substitute zeros in consumption by predictions, previously estimated based on the same model.

The estimation of wages requires the estimation of the working hours from the complementary data set, the Labour Force Survey. Since we assume that the man's labour supply is rationed, we will assume that the ration amount in each household depends on occupation and type of employment. We obtain the amounts for the man's rationed labour supply for 200 types of employment from the Labour Force Survey for the second quarter of 1990. We obtain the distribution of the man's hourly-wages by dividing the male labour income in our sample by the imputed annual working hours. We compare this distribution with that of of the man's wages in a small different survey with data on working hours and labour income, the *Encuesta Piloto de Ganancias y Subempleo 1990*. The two distributions turn out to be similar (see graph 1 in the Appendix). To estimate the female hourly-wage, we obtain the annual working hours by estimating a reduced form equation for weekly-hours of work from the complementary Labour Force Survey 1990 (see Table 3 in the Appendix). The explanatory variables of this reduced form equation are variables that explain the female labour participation decision and the wage equations (see Martínez-Granado, 2001). We also add dummies for type of employment so as better to capture the kinks that can be caused by rationing. Results for the weekly-hour equations and the graph of the comparison between the distribution of female wages obtained in our sample from EPF-90 and that obtained from the small different survey *Encuesta Piloto*

de Ganancias y Subempleo 1990 are given in the Appendix. Table 4 in the Appendix presents the female wage equation in which the estimation of the female potential wage for non-working women is based.

The female participation latent index model is estimated by maximum likelihood according to a probit model when the distributional assumption is normality, and according to a logit model when the distributional assumption is the logistic function. The exclusion restriction of the regional female unemployment rate has been tested by a Sargan test for orthogonality of instruments considering as the set of instruments the regional female unemployment rate together with the remaining instruments in Q. This test validates the exclusion restriction of the female unemployment rate for all the commodities with the exception of outside home entertainment ($\chi^2_3 = 10$ p-value: 1.5 %)[7] .

Once the consumption vector, wages, and the self-selection terms have been estimated, we estimate in the second stage the parameters of the system of Engel curves, $\widehat{\beta^1}$, $\widehat{\beta^0}$, and $\widehat{\sigma_{1Dj}}, \widehat{\sigma_{0Dj}}$.

The method we use allows for endogeneity of m_1, it assumes exogeneity of wages, male labour supply[8] , and observable preference heterogeneity due to demographics and household characteristics. We do not include y in the set of explanatory variables. We consider the fact that there are 181 households in the participation regime for which $m_1 \leq 0$ without dropping them from the estimation sample that it could generate a selection bias.

We obtain the OLS predictions for the complete sample and for the eight endogenous variables in m_1 by OLS regressions on a set of ten instruments (see Table 5 in the Appendix) and the remaining explanatory variables in (6.3) using the sample of 4765 households with

[7] We think that this rejection of the null is due to the effect of the interval of the woman's age incorporated into the regional female unemployment rate, which is the aggregate unemployment rate by region and by age group.

[8] One can argue that wages and male labour supply are endogenous but we cannot test exogeneity in these cases because wages and male working-hours are estimated using data from the complementary data set.

positive amounts of m_1. The instruments are validated by the Sargan test for orthogonality of instruments (see Table 5 in the Appendix). Identification is greatly improved if we make the plausible assumption that the intercept is the same in both regimes [9] . We build the system of twelve equations using as explanatory variables the OLS predictions of the eight variables in m_1 and the remaining explanatory variables. We apply Zellner's method of Seemingly Unrelated Regressions iteratively to the estimation of this system. We estimate the variance and covariance matrix for the system corresponding to the variance of Three-stage Least Squares (3SLS) estimation. Applying Murphy and Topel's (1985) correction to this matrix to correct for the measurement errors of generated regressors due to the parameters estimated in the first stage (purchase infrequency parameters in m_1, female wage equation parameters in female wage, and female participation parameters in control functions), we find that the correction matrix is close to zero.

The estimation of the ATE, TT and LATE parameters is straight forward according to Heckman *et al.* (2000). We estimate the unconditional ATE, TT, and LATE at the mean of X. We estimate their standard deviations by the delta method.

Table 1 presents sample statistics for dependent and explanatory variables used in outcome and participation equations. A test of equality of unconditional means of these variables in both regimes is presented in the last column.

8. Results

Table 2 presents the female participation latent index model under the normality assumption. A negative effect on female participation is observed of both, male wage and male labour supply[10] . The instrument – regional female unemployment rate – has a significant negative effect on female participation. Table 6 in the Appendix presents the estimation

[9] The intercept can approximate the minimum subsistence consumption for a reference group.

[10] In the reduced form estimation using data from the complementary survey – Labor Force Survey – as the male wage is not included we observe a positive sign of male labour supply on female participation.

Table 1. Sample Statistics

	Participation (1) #1577 Obs.		Nonparticipation (0) #3369 Obs.		
OUTCOME VARIABLES	Mean(1) (Std. D.)	% Zeros	Mean(0) (Std. D.)	% Zeros	t-ratio
FOOD	6.111 (3.394)	0.51%	5.945 (3.045)	0.03%	-1.72
CLEAN HOUSE	2.617 (2.651)	0.06%	1.496 (1.203)	0.00%	-20.45
TRANSPORT AND COMM.	2.637 (2.645)	2.28%	1.808 (1.743)	4.90%	-13.11
MEN'S CLOTHING	0.891 (1.439)	37.54%	0.676 (1.206)	36.78%	-5.49
WOMEN'S CLOTHING	1.129 (2.380)	29.17%	0.667 (1.163)	33.18%	-9.16
HEALTH	0.780 (1.239)	21.50%	0.671 (1.224)	23.39%	-3.43
PERSONAL CARE	0.460 (0.757)	36.78%	0.351 (0.749)	38.68%	-4.78
HOME ENTERTAINMENT	0.816 (1.329)	17.06%	0.471 (0.872)	27.43%	-10.88
OUTSIDE HOME ENTERT.	3.167 (3.191)	3.55%	2.023 (2.304)	5.05%	-14.31
OTHER EXPENDITURES	0.751 (1.648)	23.02%	0.441 (1.026)	30.51%	-8.07
VICES	0.625 (0.796)	16.93%	0.526 (0.605)	15.49%	-4.83
CHILDREN	1.416 (1.814)	22.95%	1.063 (1.465)	24.76%	-7.30
$w^f h^f$ (annual)	10.597 (6.327)		...		
h^f (weekly hours)	34.893 (2.702)		...		
EXPLANATORY VARIABLES					
m_1	10.8223 (9.818)		16.1387 (8.081)		20.09
h^m (weekly hours)	37.002 (4.135)		37.794 (3.430)		7.07
w^f	0.594 (0.373)		0.289 (0.139)		-41.72
w^m	0.843 (0.435)		0.770 (0.513)		-4.85
n (household size)	3.512 (1.032)		3.696 (1.077)		5.68
n1/n (n1=children aged 0-3)	0.083 (0.139)		0.083 (0.136)		0.03
n2/n (n2=children aged 4-8)	0.128 (0.158)		0.126 (0.155)		-0.41
n3/n (n3=children aged 9-14)	0.136 (0.175)		0.158 (0.183)		4.02
n4/n (n4=children aged 15-16)	0.028 (0.082)		0.037 (0.093)		3.42
Man's age	36.372 (7.137)		39.278 (9.182)		11.10
Man's Primary Education	0.212 (0.409)		0.234 (0.424)		1.70
Man's Secondary Education	0.275 (0.447)		0.182 (0.386)		-7.50
Man's Higher Education	0.265 (0.442)		0.096 (0.294)		-15.97
Woman's Primary Education	0.222 (0.416)		0.271 (0.444)		3.67
Woman's Secondary Education	0.257 (0.437)		0.142 (0.349)		-9.96
Woman's Higher Education	0.280 (0.449)		0.045 (0.206)		-25.24
Urban residence	0.624 (0.485)		0.538 (0.499)		-5.73
Executive	0.244 (0.430)		0.085 (0.279)		-15.61
Labourer	0.536 (0.499)		0.627 (0.484)		6.09
Businessman	0.105 (0.307)		0.132 (0.338)		2.65
Home Ownership	0.715 (0.451)		0.726 (0.446)		0.76
Car Ownership	0.918 (0.275)		0.834 (0.372)		-7.93
Number durables	10.944 (3.357)		9.484 (2.950)		-15.50
Region 1 (Cataluña)	0.115 (0.320)		0.066 (0.249)		-5.86
Region 2 (Madrid)	0.037 (0.188)		0.046 (0.209)		1.45
Regional Female Unemployment	21.558 (10.649)		21.858 (12.598)		0.82

Sources: *Encuesta de Presupuestos Familiares* 1990-91, *Encuesta de Población Activa* (quarters: 2-90 to 1-91)
Units: outcomes and m_1 in pesetas of 1990 (10^-5), hourly wages in pesetas (10^-3)

Table 2. Female Participation Latent Index Model under Normality

Variable	Coef.	t-ratio
$Log(w^m)$	-0.3375	-7.59
h^m	-0.0130	-2.08
Woman's age	0.1024	2.81
(Woman's age)^2	-.0017	-3.58
Man's age	-0.0389	1.09
(Man's age)^2	0.0004	0.99
Woman's Primary Education	-0.0345	-0.11
Woman's Secondary Education	-0.0877	-0.24
Woman's Higher Education	0.0833	0.19
Man's Primary Education	0.8513	2.51
Man's Secondary Education	0.7849	2.28
Man's Higher Education	1.2652	3.18
Woman's age × Primary	0.0082	0.86
Woman's age × Secondary	0.0235	2.21
Woman's age × Higher	0.0407	3.22
Man's age × Primary	-0.0220	-2.38
Man's age × Secondary	-0.0164	-1.75
Man's age × Higher	-0.0252	-2.42
Number of children aged 0-3	-0.3593	-7.98
Number of children aged 4-8	-0.1421	-4.22
Number of children aged 9-14	-0.0839	-2.7
Number of children aged 15-16	-0.0196	-0.34
Regional Female Unemployment[1]	-0.0140	-6.66
Intercept	-0.6696	-1.10

Pseudo R^2: 0.1670

[1] The regional female unemployment is calculated from the *Encuesta de Población Activa* by 51 geographical areas and by 11 age groups.

of the female participation model under the logistic distribution.

Table 3 presents the *ceteris paribus* effects of full-income and wages on the demand system for the two regimes under the normality assumption and evaluated at the mean of X (Tables 7 and 8 in the Appendix present the estimation of these effects under alternative assumptions). According to these derivatives we can identify several effects of female bargaining power. In the participation regime we observe a significant negative effect of the woman's power on the consumption of 'clean house'. This effect is not observed under the logistic/Student-t_3 distributional assumption or under the assumption of exogeneity of female participation. 'Clean house' is a normal good and the female-wage effect on it is

positive. In consequence, by equation (3.2), the traditional female-wage effect is positive but the sign of the traditional compensated female-wage effect cannot be identified. More bargaining effects are identified in the nonparticipation regime. In concrete, a negative effect of the female power on the consumption of home entertainment and on outside home entertainment.[11]

The last row of Table 3 presents the partial derivatives of the expenditure function for female labour supply evaluated at the mean of X. These derivatives have been calculated by virtue of the adding-up property. The female labour supply is downward-sloping with the decreasing interval starting around $h^f = 10$ annual hours. The big size of the effect of the female wage on female working-hours, $\frac{\partial h^f}{\partial w^f} = \frac{10}{w^f} - \frac{h^f}{w^f}$, for a mean female-wage around 0.6 thousand pesetas and for the mean annual working-hours (35×52), allows us to say that effect (5.1) is close to zero. This result supports assumption 3. Female labour supply elasticity at the mean is minus one.

Table 4 presents the ATE, TT and LATE parameters and the self-selection parameter $(\sigma_{1D} - \sigma_{0D})$ under the normality assumption. The last column gives the proportion of participants who benefit from female participation in the consumption of a commodity: $Pr(Y_j^1 - Y_j^0 > 0|D = 1) = Pr(TT_j > 0)$.

The identification of the proportions of participants benefiting from the program relies on the distributional assumption on (V^1, V^0). We present two estimates of these proportions.

First, considering the normality assumption[12] , $TT_j \sim N(\widehat{\overline{TT_j}}, \widehat{V(\overline{TT_j})})$, such that

$$Pr(TT_j > 0) = 1 - \Phi(-\widehat{\overline{TT}} \Big/ \sqrt{\widehat{V(\overline{TT})}}).$$

[11] Under alternative assumptions, an additional significant positive effect of the woman's power on food consumption is observed.

[12] In the Student-t_3 case, TT_j follows a Student-t_3 with mean equal to $\widehat{\overline{TT}}$ and variance $\widehat{V(\overline{TT})}$ such that

$$Pr(TT_j > 0) = 1 - T_3(-(\sqrt{3})(\widehat{\overline{TT}})/\sqrt{\widehat{V(\overline{TT})}}).$$

Table 3. Ceteris Paribus Effects under Normality

	Participation Regime			Nonparticipation Regime		
	$\partial\psi/\partial m_1$	$\partial\psi/\partial w^f$	$\partial\psi/\partial w^m$	$\partial\psi^c/\partial m_1$	$\partial\psi^c/\partial w^f$	$\partial\psi^c/\partial w^m$
FOOD	0.0933*	0.7516*	0.7875	0.5640*	0.9951	-0.7447
	(0.0480)	(0.3669)	(0.5834)	(0.1122)	(0.5363)	(0.4013)
CLEAN HOUSE	0.1549*	1.6563*	0.5324*	0.0667	-0.3098	0.2318
	(0.0207)	(0.1582)	(0.2515)	(0.0484)	(0.2312)	(0.1730)
TRANSPORT AND COMM.	0.2214*	1.4129*	0.0906	0.1292*	0.3512	-0.2629
	(0.0249)	(0.1903)	(0.3025)	(0.0582)	(0.2781)	(0.2081)
MEN'S CLOTHING	0.0460*	0.3926*	-0.3872	-0.0401	-0.1175	0.0879
	(0.0191)	(0.1457)	(0.2317)	(0.0446)	(0.2130)	(0.1594)
WOMEN'S CLOTHING	0.1150*	0.8760*	-0.6487	-0.0806	-0.4468	0.3344
	(0.0357)	(0.2726)	(0.4334)	(0.0833)	(0.3984)	(0.2982)
HEALTH	0.0366*	0.3162*	-0.1364	0.0271	-0.2104	0.1575
	(0.0166)	(0.1270)	(0.2020)	(0.0388)	(0.1856)	(0.1389)
PERSONAL CARE	-0.0143*	0.0799	0.1526	0.0549*	0.0558	-0.0417
	(0.0099)	(0.0758)	(0.1206)	(0.0232)	(0.1108)	(0.0830)
HOME ENTERTAINMENT	0.0391*	0.5307*	-0.2534	-0.0637	-0.5250*	0.3929*
	(0.0159)	(0.1217)	(0.1935)	(0.0372)	(0.1779)	(0.1331)
OUTSIDE HOME ENTERT.	0.2220*	2.2556*	-0.4392	-0.0425	-0.8819*	0.6600*
	(0.0375)	(0.2866)	(0.4558)	(0.0876)	(0.4189)	(0.3135)
OTHER EXPENDITURES	0.0943*	0.8387*	-0.0658	0.0052	-0.2519	0.1885
	(0.0137)	(0.1045)	(0.1662)	(0.0320)	(0.1528)	(0.1144)
VICES	0.0394*	0.2849*	0.0042	0.0342	0.0470	-0.0352
	(0.0092)	(0.0700)	(0.1112)	(0.0214)	(0.1025)	(0.0767)
CHILDREN	0.0336	0.7089*	-0.0591	-0.0066	-0.4468	0.3344
	(0.0220)	(0.1679)	(0.2661)	(0.0516)	(0.2506)	(0.1876)
$w^f h^f$	$\frac{\partial w^f h^f}{\partial m_1}$	$\frac{\partial w^f h^f}{\partial w^f}$	$\frac{\partial w^f h^f}{\partial w^m}$			
	0.0814	10.104	-0.4223			

* Significant at 95% confidence level

The second method gives the proportion of positive values of $\widehat{TT}$ conditional to X as a proportion of the sample participants (these numbers are in brackets).

Comparison between the two proportions gives a measure of the robustness of the results to the distributional assumptions. The proportions of the total population benefiting from female labour participation can be calculated by multiplying the above numbers by the probability of participation (0.32).

The point estimates for ATE in the normality case show significant benefits in consumption caused by female participation in terms of observable characteristics for the con-

Table 4. Point Estimates and Standard Errors of Alternate Treatment Parameters under Normality

	$\overline{ATE}$	$\overline{TT}$	$\overline{LATE}$	$(\sigma_{1D} - \sigma_{0D})$	Percentages of participants benefiting from the program[1]
FOOD	2.3770	8.3750	3.3933	1.8070	100%
	(1.8286)	(1.7547)	(1.6445)	(1.2021)	[98.48%]
CLEAN HOUSE	4.2386	1.7939	3.7900	-0.7976	99.11%
	(0.7884)	(0.7566)	(0.7091)	(0.5183)	[88.71%]
TRANSPORT AND COMM.	3.0608	1.1156	1.9915	-1.9011	88.99%
	(0.9482)	(0.9099)	(0.8528)	(0.6233)	[68.23%]
MEN'S CLOTHING	-0.1647	-2.4207	-0.4914	-0.5809	0.03%
	(0.7263)	(0.6970)	(0.6532)	(0.4775)	[19.66%]
WOMEN'S CLOTHING	1.4518	-2.4087	0.3591	-1.9428	3.23%
	(1.3584)	(1.3036)	(1.2217)	(0.8930)	[26.44%]
HEALTH	0.8844	0.5586	0.7070	-0.3155	82.11%
	(0.6330)	(0.6074)	(0.5693)	(0.4161)	[70.01%]
PERSONAL CARE	-0.1036	0.1478	0.0837	0.3330	65.82%
	(0.3780)	(0.3627)	(0.3399)	(0.2485)	[75.02%]
HOME ENTERTAINMENT	-0.0295	-1.6326	0.1248	0.2743	0.25%
	(0.6065)	(0.5820)	(0.5454)	(0.3987)	[34.50%]
OUTSIDE HOME ENTERT.	2.7030	-2.3603	2.3852	-0.5650	4.25%
	(1.4285)	(1.3708)	(1.2847)	(0.9390)	[44.45%]
OTHER EXPENDITURES	0.8771	0.3933	1.0866	0.3724	78.42%
	(0.5210)	(0.5000)	(0.4686)	(0.3425)	[71.91%]
VICES[2]	0.8527	0.4694	0.6142	-0.4241	91.97%
	(0.3491)	(0.3345)	(0.3138)	(0.2294)	[91.30%]
CHILDREN[2]	1.4275	-0.7834	1.2155	-0.3770	16.42%
	(0.8344)	(0.8016)	(0.7504)	(0.5501)	[50.95%]

[1] Derived from the normal cumulative distribution function. Derived from summarizing in brackets.

[2] For households in which the expenditure is positive.

sumption of 'clean house', 'transport and communication' and 'vices'. Differences between treatment parameters indicate that there is heterogeneity in benefits from the program due to characteristics that are unobservable for us but observed by the household. This heterogeneity cames from the unobserved gain $V^1 - V^0$. We distinguish two situations related to this unobserved gain. First, such a gain occurs ex post but the household does not act on it when it decides whether the woman participates. In this case there is no selection according to the unobserved change and $(\sigma_{1D} - \sigma_{0D}) = 0$. Second, the unobserved change occurs and the household acts on it while deciding whether the woman is to participate such that self-selection into the participation regime occurs. In this case, $(\sigma_{1D} - \sigma_{0D}) > 0$ if selection

is positive or a gain in consumption is expected by comparing participants with respect to households chosen at random. By contrast, $(\sigma_{1D} - \sigma_{0D}) < 0$ if selection is negative. The findings for such a selection depend on our distributional assumptions. In the normality case, we observe negative selection for consumption of transport and communications and women's clothing. In the Student-t_3/logit case, we find negative selection based on the consumption of home entertainment. This finding gives a hint that households in the tails of the distribution are decisive in regard to selection in female participation matters.

Almost all the households in the participation regime benefit from the program in the consumption of 'food', 'clean house', 'transport and communications' and 'vices'. A very small percentage of households benefits in the consumption of men's and women's clothing and in both types of entertainment but results on these latter commodities seem very sensitive to our distributional assumptions.

9. Concluding Remarks

Here we point out three possible extensions to our work that could answer the questions posed by our problem in more detail.

1. Although the assumptions made in our theoretical model allow us to identify the value of the bargaining power, such value depends on the cardinalization of utility chosen. We identify its sign, but identification of a well-defined measure of the sharing of power between the man and the woman, such as the 'sharing rule', would help to identify the components of the *Pseudo-Slutsky* matrix. Browning *et al.* (2004) show that such identification is possible from a demand system for commodities but they do not consider female leisure in the system or corner solutions.

2. We present three measures of the effect of female participation on consumption but we do not discuss which one is most relevant. Carneiro *et al.* (2003) present the 'Policy Relevant Treatment Parameter', which it is a weighted average of the Marginal Treatment Effect with weights that depend on the changes in the proportion of people induced into

the program. We do not present measures for the 'Policy Relevant Treatment Parameter' but, together with our treatment parameters, we present the changes in the proportion of households induced to decide upon the woman's participation for different commodities.

3. We see that the conclusions about the existence of gains in consumption that induce households to make the female participation decision or deter them from doing so depend on distributional assumptions. More robust estimates in this sense could be obtained by applying semiparametric methods such as those surveyed by Heckman (1990) and Powell (1994).

Finally, as a general answer to our problem we can say that the secular increase in female labour participation in Spain is largely responsible for the increase in aggregate consumption, in particular, for the consumption of food, energy, water and domestic goods related to cleaning and furnishing, transport and communications, and alcohol and tobacco.

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APPENDIX

Table 1 Sample Selection

Couples, with or without children aged less than 17, in which the man and the woman are less than sixty-six years old	6694
If the man works more than 13 hours per week, he declares positive labour income, and it can be imputed his weekly working hours	5307
Dropped observations:	
If the woman works but does not declare income	38
If there are inconsistencies in the type of employment declared by the woman and the relationship with the economic activity	273
If the woman does not work but she declares some labour income	50
Sample selected	4946
Households in which D=1	1577
Household in which D=0	3369

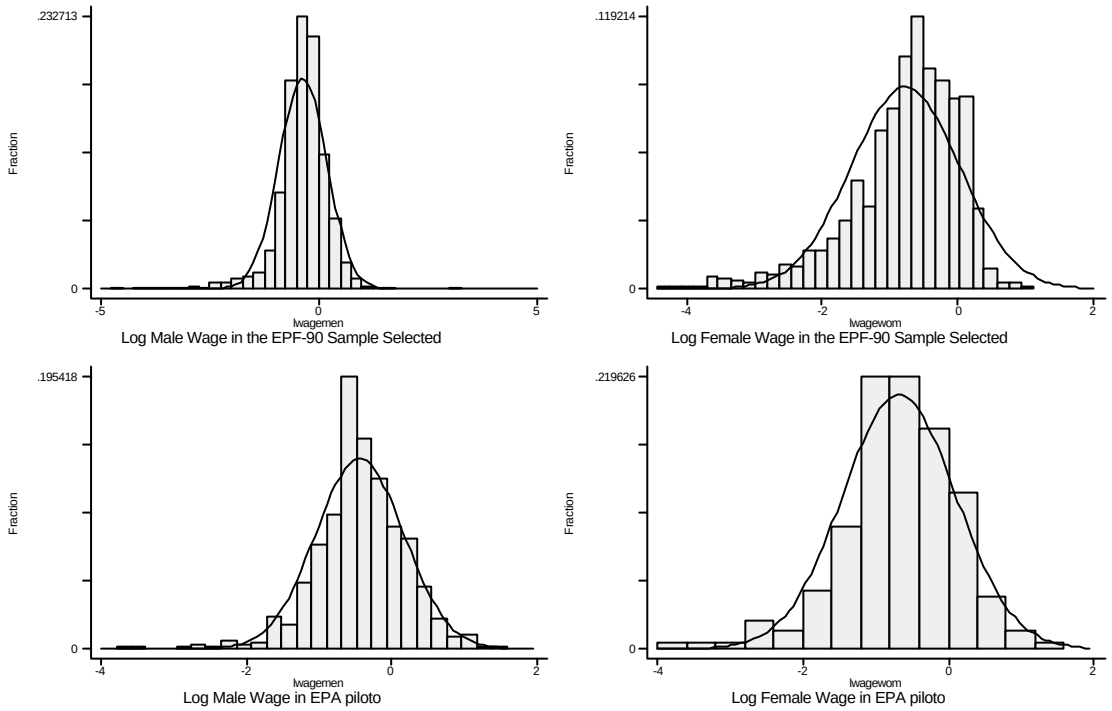
TABLE 2. COMMODITIES SELECTED FROM HOUSEHOLD CURRENT EXPENDITURE

VARIABLE	DESCRIPTION	Correspondence with the EPF-90 variables
FOOD	Food at home + Food at work place	R1+..+R22+RESTO1 + GASTO en CLEX=(8058,8059,8060)
VICES	Alcoholic beverages + tobacco	R23+R24
MEN'S CLOTH.	Men's clothing and footwear	R25+R29
WOMEN'S CLOT	Women's clothing and footwear	R26+R30
CLEAN HOUSE	Heat, electricity, water + Household textiles +Small appliances (not included in the category Durable)+ housekeeping + cleaning supplies and other nondurable goods+domestic help	R34+RESTO3+ R37+ GASTO en CLEX=(4049,4057,4058,4059,4060,4061,4064,4065, 4068,4069,4070,4071,4072, 8030)+ + R39+R40+R41+RESTO4
HEALTH	Medicine + pharmacy	R42+R43+RESTO5
PERSONAL CARE	Personal use articles	R55
TRANSPORT AND COMMUNIC.	Public transportation, mail and comm.+ Automotive accesories, automotive repairs and fuel	R45+R46+R47+RESTO6+ GASTO en CLEX=(6006,6007,6008,6009,6010,6011,6012,6013, 6014,6015,6016,6017,6018,6019,6020,6021,6022,6023,6024,6025, 6026,6027,6028,6029)
HOME ENTERTAIN-MENT	Non durable recreational and culltural goods (not including toys)	GASTO en CLEX=(7002,7003,7008,7009,7010,7011,7013,7014,7015 7017,7018,7020,7021,7022,7023,7024,7025,7026,7027,7028,7029, 7030,7031,7037,7038,7039,7040,7041,7042,7043,7044,7045,7046 7058,7059,7060,7061,7062,7063,7064,7065,7066,7067,7068,7069)
OUTSIDE HOME ENTERTAIN.	Shows, spending in bars and restaurants and on tourism	GASTO en CLEX=(7047,7048,7049,7050,7051,7052,7053,7054, 7055,7056,7057 8040,8041,8045,8046,8047,8048,8049,8050,8051,8052,8053,8054, 8055,8056,8057,8061,8062,8065,8066)
CHILDREN	Children's clothing and footwear+ Primary and secondary education + Kindergarten + school transportation School cafeteria. + toys	R27+R31+GASTO en CLEX=(8033,8034)+ R51+R52+GASTO en CLEX=(6033, 7032,7033,7034,7035,7036, 7110,7111,7112,7128,7129,7130,7131,7132, 7141,7142,7143,7144,7145,7146,7147,8042,8063,8072)
OTHER EXPENDITURES	Aditional clothing and footwear, stationary and adult education	R28+R32+RESTO2+R53 GASTO en CLEX=(7122,7123,7124,7125,7126,7127,7133,7134,7135,7136,7137,7138,7139,7140, 7148, 8024,8025,8026,8027,8028,8029,8031,8032,8035,8036,8037, 8038,8039,8043,8044,8064)

Table 3. Reduced form for equations of woman's working hours and female participation (Labour Force Survey – Second Quarter 1990)

Hours equation for the woman's weekly hours of market work			Female Participation Equation		
	Coef.	t-ratio		Coef.	t-ratio
h^m	0,3168	20,22	h^m	0,0088	7,63
Man's age	-0,7133	-3,12	Man's age	-0,0414	-2,44
(Man's age)^2	0,0093	3,42	(Man's age)^2	0,0005	2,71
Woman's age	0,6034	2,55	Woman's age	0,0640	3,91
(Woman's age)^2	-0,0086	-2,89	(Woman's age)^2	-0,0012	-5,87
(Primary Education)^m	3,3544	-1,49	(Primary Education)^m	0,2291	1,43
(Secondary education)^m	-0,5031	-0,22	(Secondary education)^m	0,3976	2,33
(High Education)^m	3,5774	1,43	(High Education)^m	0,8304	4,15
(Primary education)^f	-0,3839	-0,16	(Primary education)^f	0,0504	0,32
(Secondary Education)^f	1,7160	0,71	(Secondary Education)^f	-0,0367	-0,21
(High Education)^f	-2,6438	-1,04	(High Education)^f	0,1716	0,77
Age^{m}xPrimary^m	0,0755	1,22	Age^{m}xPrimary^m	-0,0064	-1,46
Age^{m}xMedium^m	0,0290	0,46	Age^{m}xMedium^m	-0,0118	-2,56
Age^{m}xHigh^m	-0,0721	-1,11	Age^{m}xHigh^m	-0,0209	-4,08
Age^{f}xPrimary^f	0,0238	0,34	Age^{f}xPrimary^f	0,0051	1,11
Age^{f}xMedium^f	-0,0498	-0,69	Age^{f}xMedium^f	0,0173	3,28
AgefxHigh^f	0,0027	0,04	Age^{f}xHigh^f	0,0301	4,85
Entrepreneur	6,0483	6,21	Number children aged 0-3	-0,3175	-13,79
Self-employed	4,5598	9,92	Number children aged 4-8	-0,1589	-8,88
Member of cooperative	3,3758	1,67	Number children aged 9-14	-0,1003	-6,2
Works in the family business	0,1648	0,35	Number children aged 15-16	-0,1331	-4,25
Public Employee	1,5099	4	Female Unemployment Rate	-0,0211	-16,3
Number children aged 0-3	-1,0211	-3,03	Intercept	-0,2980	-1,02
Number children aged 4-8	-0,8503	-3,49			
Number children aged 9-14	-0,8305	-3,88			
Number children aged 15-16	-1,0579	-2,49			
Intercept	26,6211	6,43			
Heckman´s lambda	-0,6913	-0,96			
Log Likelihood	-29923				
Number censored obs	11200				
Number uncensored obs.	5497				

Graph 1. Comparison of the distribution of hourly-wages estimated in our sample from EPF-90 with those of the *Encuesta Piloto de Gananacias y Subempleo-1990*



Sample Statistics

	EPA-Piloto 1990			EPF-90 Sample Selected		
	# Obs.	Mean	Std. Dev	# Obs.	Mean	Std. Dev.
Female Hourly-Wage	214	0.663	0.505	1577	0.594	0.372
Male Hourly-Wage	742	0.767	0.486	4946	0.793	0.491

Table 4. FEMALE WAGE EQUATION: Ln(w^f)

	Coef.	t-ratio
Woman's age	0.1085	5.54
Woman's age^2	-0.0013	-5.58
Woman's Primary Education	0.2674	0.97
Woman's Secondary Educat	0.8129	3.05
Woman's Higher Education	0.5139	1.99
Primary x Age	0.0033	0.41
Secondary x Age	-0.0025	-0.33
Higher Education x Age	0.0229	3.18
Intercept	-3.6532	-8.99
Heckman's Lambda	0.1797	3.58
Log Likelihood		-4165.73
Censored obs		3369
Uncensored obs		1577

Table 5. Instruments and Sargan Test for Orthogonality of Instruments

Instruments included in Q and excluded in X
ln(household monetary income)
ln(household monetary income/n).h^m
ln(household monetary income/n)ln(GTOTAL/n) (*)
ln(household monetary income/n)ln(GTOTAL/n)h^m
(1- Φ_D)ln(household monetary income)
(1- Φ_D)ln(household monetary income/n).h^m
(1- Φ_D)ln(household monetary income/n)ln(GTOTAL/n)
(1- Φ_D)ln(household monetary income/n)ln(GTOTAL/n)h^m
(1- Φ_D)Health Purchase probability
h^m/n
(*) The exogeneity of the variable GTOTAL , which comprises household total expenditures including durables and monetary transfers, can be discussed. Nevertheless, the Sargan test does not reject the hypothesis of exogeneity of these instruments.
Φ_D =Pr(D=1) under normality.

Sargan Overidentification Test					
	$c^2(2)$ (p-val)		$c^2(2)$ (p-val)		$c^2(2)$ (p-val)
Food	0.734 (69%)	Women's Cloth	0.361 (83%)	Outside Home Ent.	0.286 (87%)
Clean House	1.017 (60%)	Health	0.838 (66%)	Other Expenditures	0.808 (67%)
Transport	0.241 (88%)	Personal care	0.612 (74%)	Vices	1.261 (53%)
Men's Cloth.	0.409 (81%)	Home Entert.	0.852 (65%)	Children	1.588 (45%)

Table 6. Female Participation Model under Logistic

Variable	Coef.	T
$\ln(w^m)$	-0.5725	-7.59
h^m	-0.0235	-2.17
Woman's age	0.1969	2.97
(Woman's age)^2	-0.0032	-3.71
Man's Age	-0.0742	-1.19
(Man's age)^2	0.0008	1.1
Woman's Primary Education	-0.0781	-0.13
Woman's Secondary Education	-0.1747	-0.27
Woman's Higher Education	-0.0111	-0.01
Man's Primary Education	1.4353	2.38
Man's Secondary Education	1.2841	2.12
Man's Higher Education	2.0455	2.96
Woman's age x Primary	0.0147	0.85
Woman's age x Secondary	0.0401	2.13
Woman's age x Higher	0.0717	3.2
Man's age x Primary	-0.0369	-2.22
Man's age x Secondary	-0.0265	-1.61
Man's age x Higher	-0.0403	-2.21
number children aged 0-3	-0.6149	-8
number children aged 4-8	-0.2480	-4.3
number children aged 9-14	-0.1565	-2.92
number children aged 15-16	-0.0334	-0.33
Regional Female Unemployment	-0.0239	-6.61
Intercept	-1.2565	-1.17
Pseudo R2: 0.1676		

Table 7. *Ceteris Paribus* Effects under Student-t3/logit

	PARTICIPATION REGIME			NONPARTICIPATION REGIME		
	$\partial y / \partial m_1$	$\partial y / \partial w^f$	$\partial y / \partial w^m$	$\partial y^c / \partial m_1$	$\partial y^c / \partial w^f$	$\partial y^c / \partial w^m$
FOOD	0.0958	0.7022	0.7468	0.5439	1.0533	-0.7883
	(0.0447)	(0.3212)	(0.6650)	(0.0948)	(0.3757)	(0.2812)
CLEAN HOUSE	0.1574	1.5911	0.4046	0.1023	-0.0207	0.0155
	(0.0222)	(0.1593)	(0.3299)	(0.0470)	(0.1863)	(0.1395)
TRANSPORT AND COMM.	0.2259	1.4430	-0.3144	0.1073	0.0019	-0.0014
	(0.0271)	(0.1947)	(0.4031)	(0.0575)	(0.2277)	(0.1704)
MEN'S CLOTHING	0.0544	0.3910	-0.6029	-0.0514	-0.2022	0.1513
	(0.0260)	(0.1867)	(0.3865)	(0.0551)	(0.2183)	(0.1634)
WOMEN'S CLOTHING	0.1223	0.8924	-0.8942	-0.0797	-0.5691	0.4259
	(0.0390)	(0.2803)	(0.5803)	(0.0827)	(0.3278)	(0.2453)
HEALTH	0.0377	0.3113	-0.1158	0.0382	-0.1382	0.1035
	(0.0156)	(0.1124)	(0.2327)	(0.0332)	(0.1315)	(0.0984)
PERSONAL CARE	-0.0074	0.0860	0.0492	0.0482	0.0753	-0.0564
	(0.0078)	(0.0564)	(0.1167)	(0.0166)	(0.0659)	(0.0493)
MHOME ENTERTAINM.	0.0446	0.4962	-0.2952	-0.0522	-0.3304	0.2473
	(0.0157)	(0.1129)	(0.2338)	(0.0333)	(0.1321)	(0.0989)
OUTSIDE HOME ENTERT.	0.2220	2.1923	-0.5065	-0.0146	-0.5750	0.4303
	(0.0358)	(0.2574)	(0.5330)	(0.0760)	(0.3011)	(0.2253)
OTHER EXPENDITURES	0.0903	0.8159	-0.0293	0.0115	-0.1184	0.0886
	(0.0145)	(0.1045)	(0.2164)	(0.0308)	(0.1222)	(0.0915)
VICES	0.0393	0.2839	-0.0426	0.0360	0.0248	-0.0186
	(0.0095)	(0.0682)	(0.1415)	(0.0202)	(0.0799)	(0.0598)
CHILDREN	0.0352	0.6531	-0.0628	0.0251	-0.1852	0.1386
	(0.0215)	(0.1542)	(0.3190)	(0.0457)	(0.1822)	(0.1364)
FEMALE LABOUR INCOME	0.1174	9.8584	-1.6631			

Table 8. *Ceteris Paribus* Effects and ATE under Exogenous Switching

	PARTICIPATION REGIME			NONPARTICIPATION REGIME			
	$\partial y / \partial m_1$	$\partial y / \partial w^f$	$\partial y / \partial w^m$	$\partial y^c / \partial m_1$	$\partial y^c / \partial w^f$	$\partial y^c / \partial w^m$	ATE
FOOD	0.1028	0.8020	0.7632	0.5349	0.9878	-0.7393	3.8174
	(0.0421)	(0.2966)	(0.7062)	(0.0893)	(0.3515)	(0.2631)	(1.0328)
CLEAN HOUSE	0.1504	1.5438	0.7196	0.1310	0.0888	-0.0665	2.7182
	(0.0278)	(0.1960)	(0.4665)	(0.0590)	(0.2322)	(0.1738)	(0.6823)
TRANSPORT AND COMM.	0.2243	1.4014	-0.4107	0.1056	0.0088	-0.0066	2.0489
	(0.0271)	(0.1915)	(0.4558)	(0.0576)	(0.2269)	(0.1698)	(0.6667)
MEN'S CLOTHING	0.0514	0.3629	-0.6476	-0.0433	-0.1714	0.1283	-0.7076
	(0.0245)	(0.1727)	(0.4111)	(0.0520)	(0.2047)	(0.1532)	(0.6013)
WOMEN'S CLOTHING	0.1179	0.8014	-0.9664	-0.0623	-0.4913	0.3677	-0.1887
	(0.0352)	(0.2480)	(0.5904)	(0.0746)	(0.2939)	(0.2200)	(0.8636)
HEALTH	0.0351	0.2867	-0.0910	0.0445	-0.1116	0.0835	0.3933
	(0.0144)	(0.1016)	(0.2420)	(0.0306)	(0.1205)	(0.0902)	(0.3539)
PERSONAL CARE	-0.0100	0.0871	0.0693	0.0482	0.0545	-0.0408	0.1189
	(0.0078)	(0.0547)	(0.1302)	(0.0165)	(0.0648)	(0.0485)	(0.1904)
MHOME ENTERTAINM.	0.0421	0.5014	-0.2050	-0.0387	-0.3020	0.2260	-0.3219
	(0.0144)	(0.1013)	(0.2412)	(0.0305)	(0.1201)	(0.0899)	(0.3528)
OUTSIDE HOME ENTERT.	0.2166	2.1359	-0.1601	0.0300	-0.4005	0.2997	1.2204
	(0.0316)	(0.2225)	(0.5298)	(0.0670)	(0.2637)	(0.1974)	(0.7749)
OTHER EXPENDITURES	0.0914	0.8249	0.1446	0.0260	-0.0661	0.0495	0.8485
	(0.0170)	(0.1196)	(0.2848)	(0.0360)	(0.1418)	(0.1061)	(0.4165)
VICES	0.0384	0.2701	-0.0292	0.0393	0.0399	-0.0298	0.5154
	(0.0093)	(0.0654)	(0.1556)	(0.0197)	(0.0775)	(0.0580)	(0.2276)
CHILDREN	0.0303	0.6360	0.1460	0.0435	-0.1247	0.0933	0.4868
	(0.0233)	(0.1635)	(0.3894)	(0.0493)	(0.1951)	(0.1460)	(0.5696)
FEMALE LABOUR INCOME	0.0906	9.6535	-0.6673				

Table 9. Point Estimates and Standard Errors of Alternate Treatment Parameters under Student-t3/logit

	ATE	TT	LATE	$(s_{1D} - s_{0D})$	Participants benefiting
FOOD	3.0648	7.0883	3.1340	0.0104	99.62%
	(1.2634)	(1.8986)	(1.4568)	(0.0802)	[97.97%]
CLEAN HOUSE	2.5137	1.4792	2.4179	-0.0144	96.37%
	(0.6267)	(0.9417)	(0.7226)	(0.0398)	[90.55%]
TRANSPORT AND COMM.	2.4631	2.7314	2.3557	-0.0162	98.70%
	(0.7659)	(1.1509)	(0.8831)	(0.0486)	[97.21%]
MEN'S CLOTHING	-0.4421	-2.3455	-0.8325	-0.0588	1.73%
	(0.7342)	(1.1032)	(0.8465)	(0.0466)	[23.72%]
WOMEN'S CLOTHING	0.4697	-1.6803	-0.1426	-0.0922	8.86%
	(1.1025)	(1.6567)	(1.2712)	(0.0700)	[32.91%]
HEALTH	0.5127	0.4138	0.3212	-0.0288	82.02%
	(0.4421)	(0.6643)	(0.5098)	(0.0281)	[67.15%]
PERSONAL CARE	0.0661	0.2239	0.2104	0.0217	83.56%
	(0.2217)	(0.3332)	(0.2557)	(0.0141)	[78.76%]
HOME ENTERTAINM.	-0.5575	-2.6509	-0.9485	-0.0589	0.31%
	(0.4442)	(0.6675)	(0.5122)	(0.0282)	[19.53%]
OUTSIDE HOME ENTERT.	1.2527	-2.8993	1.1883	-0.0097	2.29%
	(1.0125)	(1.5216)	(1.1675)	(0.0643)	[36.27%]
OTHER EXPENDITURES	0.6729	0.0411	0.9019	0.0345	54.22%
	(0.4110)	(0.6177)	(0.4739)	(0.0261)	[59.35%]
VICES	0.5762	0.6968	0.5512	-0.0038	97.10%
	(0.2684)	(0.4032)	(0.3094)	(0.0171)	[98.70%]
CHILDREN	0.2338	-1.3337	0.0588	-0.0264	4.26%
	(0.6071)	(0.9120)	(0.6999)	(0.0385)	[34.48%]

Table 10. Purchase Infrequency Models

	Men's Clothing		Women's clothing		Health		Personal Care	
	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio
ln(income)	-0.001	-0.03	0.113	2.56	0.168	3.55	0.158	3.64
n	-0.005	-0.2	-0.025	-0.95	-0.004	-0.16	0.058	2.26
Man's age	-1.816	-0.84	-3.847	-1.73	-1.914	-0.81	-0.016	-0.01
Man's age^2	2.102	0.84	3.944	1.53	3.282	1.2	0.128	0.05
children 0-3	-0.050	-0.61	-0.134	-1.55	0.734	7.99	-0.071	-0.86
children 4-8	-0.024	-0.29	-0.177	-2.05	0.227	2.54	-0.026	-0.32
children 9-14	-0.019	-0.23	-0.072	-0.84	0.255	2.83	0.068	0.82
children 15-16	0.157	1.13	-0.248	-1.83	0.052	0.37	0.327	2.33
adults	0.052	0.52	0.038	0.37	0.076	0.68	0.076	0.77
Man's Secondary	0.064	1.24	0.021	0.39	0.163	2.75	0.158	3.02
Man's Higher	-0.052	-0.68	-0.038	-0.48	0.255	2.81	0.316	4
Woman's Secondary	-0.136	-2.49	-0.079	-1.42	0.018	0.28	-0.017	-0.31
Woman's Higher	-0.070	-0.96	0.064	0.82	0.005	0.05	-0.121	-1.62
Urban	0.027	0.69	0.060	1.52	-0.035	-0.82	0.015	0.39
Executive	0.126	1.58	0.083	1	0.112	1.22	0.028	0.34
Labourer	0.013	0.23	-0.017	-0.3	0.182	3.05	0.087	1.56
Businessman	-0.045	-0.63	-0.084	-1.14	0.084	1.08	0.034	0.48
Home Ownership	0.057	1.34	0.066	1.51	0.037	0.78	0.006	0.14
Car Ownership	0.032	0.57	0.070	1.23	0.107	1.79	0.086	1.53
Number Durables	0.007	0.93	0.014	1.87	0.040	4.9	0.013	1.79
Winter	-0.095	-1.82	0.134	2.54	-0.010	-0.17	-0.014	-0.27
Summer	-0.141	-2.75	0.078	1.49	-0.006	-0.1	-0.097	-1.89
Autumn	-0.070	-1.31	0.164	3.02	0.025	0.43	-0.020	-0.37
Intercept	0.683	1.61	0.873	2.01	-0.484	-1.04	-0.658	-1.56

	Home Entertainment		Outside Home Entert.		Other Expenditures		Vices		Children	
	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio
ln(income)	0.297	6.17	0.155	2.1	0.178	3.87	-0.013	-0.25	0.145	2.84
n	-0.034	-1.19	0.075	1.6	0.120	4.29	0.098	3.06	0.108	3.29
Man's age	2.026	0.84	2.389	0.69	-1.002	-0.44	-3.028	-1.18	-1.180	-0.47
Man's age2	-3.389	-1.22	-4.238	-1.07	0.905	0.35	2.197	0.74	1.359	0.47
children 0-3	0.059	0.62	-0.072	-0.48	-0.040	-0.46	-0.040	-0.4	1.756	17.97
children 4-8	0.081	0.85	-0.157	-1.07	0.011	0.12	-0.083	-0.84	1.624	16.65
children 9-14	0.168	1.78	0.186	1.24	0.228	2.57	-0.001	-0.01	1.381	14.32
children 15-16	0.307	1.98	0.417	1.54	0.395	2.65	-0.122	-0.82	0.861	6.22
adults	0.051	0.47	0.466	2.28	-0.036	-0.35	0.165	1.23	-0.187	-1.62
Man's Secondary	0.234	3.83	0.064	0.65	0.121	2.14	-0.111	-1.79	-0.023	-0.37
Man's Higher	0.490	4.86	0.084	0.53	0.013	0.15	-0.191	-2.17	0.025	0.27
Woman's Secondary	0.133	2.02	0.107	1	0.211	3.49	0.020	0.3	-0.040	-0.6
Woman's Higher	0.143	1.47	0.284	1.72	0.190	2.28	-0.005	-0.06	0.101	1.09
Urban	0.250	5.81	0.123	1.8	0.010	0.24	0.097	2.12	-0.001	-0.02
Executive	-0.112	-1.1	-0.145	-0.9	0.127	1.41	-0.068	-0.74	-0.107	-1.08
Labourer	0.157	2.53	-0.034	-0.35	0.081	1.38	0.019	0.29	-0.047	-0.7
Businessman	-0.024	-0.3	0.036	0.29	0.019	0.25	-0.165	-1.98	-0.084	-0.96
Home Ownership	-0.066	-1.35	0.014	0.19	-0.029	-0.64	-0.155	-2.93	0.051	0.99
Car Ownership	0.113	1.89	-0.010	-0.11	-0.042	-0.71	-0.097	-1.37	-0.058	-0.86
Number Durables	0.078	8.76	0.054	3.71	0.062	7.67	-0.010	-1.19	0.030	3.44
Winter	0.025	0.43	-0.171	-1.76	0.064	1.16	-0.076	-1.23	0.032	0.52
Summer	0.098	1.69	-0.249	-2.64	0.092	1.7	-0.042	-0.68	0.151	2.43
Autumn	0.104	1.73	-0.201	-2.04	0.193	3.38	-0.063	-0.99	0.096	1.51
Intercept	-1.505	-3.18	0.341	0.49	-0.927	-2.09	1.907	3.75	-1.366	-2.75