Female Labor Participation and the Allocation of Household Expenditure. Evidence on Spanish Data. *

by

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Abstract

We study the influence of the female labor participation in the household expenditure allocation, considering the joint decision between consumption and leisure. The theoretical framework is a collective model in which the agents are the man and the woman and it is assumed that the result of their decisions is Pareto-efficient. The change in expenditure-elasticities depending on the female labor participation allows us to classify goods as complements (substitutes) of the woman's leisure if the elasticity is lower (higher) if the woman works than if she does not work. The sign of the effect of individual labor incomes on consumption allows us to classify goods in two spheres: the masculine sphere if the power of the man increases the consumption of the good and the feminine sphere in the contrary case.

1. Introduction

In the investigation of demand and consumption, empirical evidence suggests that (i) the collective setting conditions are not rejected in contrast to neoclassical conditions (Browning and Chiappori, 1998), and (ii) preferences over goods are not separable from labor supply (Browning and Meghir, 1991). These two facts have been taken into account in the adoption of the collective model as the appropriate setting for studying the consumption decisions in households formed by couples in full time employment (Browning and Chiappori, 1998). In a general collective model of joint decision of public, private goods, and labor supply, it is not possible to identify completely the intrahousehold distribution of resources and the individual preference parameters. Although some conditions for the partial identification can be derived when the presence of distribution factors (observable variables that affect the sharing rule but do not affect individual preferences directly) is taken into account. Examples of distribution factors are individual labor incomes (Bourguignon et *al.*, 1993 and Browning and Chiappori, 1998).

In this paper we study the household expenditure allocation on various goods and services taking into account the effect of the female labor participation on it. We model the household behavior as a collective model with two agents (the man and the woman) who make Pareto-efficient decisions on their joint allocation of consumption and leisure. We consider the individual labor incomes as distribution factors. The first objective of the paper is to examine the effect of the female labor participation on the household expenditure allocation. We use the measurement of this effect on the expenditure elasticities to classify goods as complements or substitutes of the woman's leisure. When the expenditure elasticity is higher (lower) when the woman works, we say that the good is substitute (complement) of the woman's leisure. The second objective of the study falls under the collective theoretical structure of the model. The definition of individual labor incomes as distribution factors allows us to identify the effect of the individual power on the goods demands under a bargaining assumption. Based on the sign of this effect we classify the goods in two spheres: if the woman's power increases the consumption of the good we classify the good in the feminine sphere and, on the contrary, if it is the man's power what increases the consumption, we classify the good in the masculine sphere [1].

The empirical model takes into account the self-selection problem of the household derived from the nonseparability between consumption and female labor participation. The model falls in the general class of switching model with endogenous switching. We estimate a system of eleven Engel curves using the Spanish expenditure survey of 1990. The estimation faces different measurement problems. First of all, we consider the relationship between expenditure and consumption taking into account problems of bulk purchases, purchase infrequency and voluntary abstention in consumption. Second, one of the explanatory variables is the woman's potential income that we estimate from a wage equation. Third, we take into account the endogeneity of the total household expenditure estimating by instrumental variables.

The estimates reflect the differences in the expenditure allocation based on female labor participation. First, we find that those goods related to health (health and personal care) and men's clothing are complements of the woman's leisure. The only substitute of the woman's leisure is "clean house"[2]. Second, we present the results on the classification of goods in the feminine and in the masculine sphere depending on the woman's participation. When the woman does not work, the effect of her potential labor income classifies in the masculine sphere the men's and women's clothing, health and home entertainment, and in the feminine sphere, transportation and outside home entertainment. However, when the woman works, transportation is in the masculine sphere and home entertainment in the feminine sphere. In this case, clean house and personal care are in the feminine sphere.

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[1] We use Lundberg and Pollak's (1993) terminology although a different theoretical concept.

[2] We denote by clean house the current expenditure on goods used for cleaning, equipment and comfort, such as heating, energy, domestic help, etc.

The organization of the paper breaks down into the following sections. In the next section we present the theoretical model and the identification of the sign of the bargaining power on the goods consumption. In section 3, we present the characteristics of the empirical model. In section 4, we present the data and descriptive statistics. In section 5, we summarize the results of the estimation. Finally, we conclude in section 6. Details of the data, estimations, and application of econometric techniques to measurement problems are presented in the appendixes.

2. Theoretical Model

We consider a static version of the collective model of expenditure allocation with labor participation for a two-member household (i=1,2, 1 being the man and 2 being the woman). We assume that the man's and woman's labor incomes are distribution factors that have effects also on the budget constraint.

2.1. The Household Problem

The agents have preferences regarding the goods and the woman's leisure time. Household consumer goods are represented by a vector of goods $\mathbf{q}$. The preferences of the agents are based on the various alternative or simultaneous uses of the goods: the private consumption of each agent $\mathbf{q}^1$ and $\mathbf{q}^2$, and public consumption $\mathbf{Q}$, and therefore $\mathbf{q} = \mathbf{q}^1+\mathbf{q}^2+\mathbf{Q}$. In the analysis of expenditure with cross-section data we ignore the variability of prices by assuming that all individuals face the same price vector, normalized to unit $\mathbf{e}$. The endowment of time for the agents is 1 unit. We assume that agent 1 dedicates all his time to work ($\overline{L}^1 = 0$) and that agent 2 can decide on the alternative use of her time ($L^2 = 0, 1$). The wages that agent 1 receives for his unit of labor time are his labor income, y_1. The woman's labor income is $y_2(1 - L^2)$.

The household budget allocated to consumption of $\mathbf{q}$ is the total household expenditure, X. We denote by y the difference between total expenditure and labor income, such that y is made up of savings and nonlabor income. We assume that y is predetermined.

Total household expenditure depends on the woman's labor income through her decision to participate in the labor market.

With this notation, the household budget restriction is:

$$\mathbf{e}'\mathbf{q} = X \tag{2.1}$$

$$X = y_1 + y_2(1 - L^2) + y \tag{2.2}$$

Preferences allow for nonseparability between leisure and consumption and for altruism, externalities or any other preference interaction. Agents' preferences can be represented by the following utility functions:

$$U^1(\mathbf{q}^1, \mathbf{q}^2, \mathbf{Q}, \overline{L}^1, L^2; z) \quad \text{y} \quad U^2(\mathbf{q}^1, \mathbf{q}^2, \mathbf{Q}, \overline{L}^1, L^2; z) \quad \text{con} \quad \overline{L}^1 = 1 \quad \text{y} \quad L^2 = 0, 1$$

The basic assumption of the collective model is that the result of the household decision process is Pareto-efficient. This is equivalent to assuming that household allocations are determined by the solution of the problem:

$$\max_{q^1, q^2, Q} U^1(\mathbf{q}^1, \mathbf{q}^2, \mathbf{Q}, \overline{L}^1, L^2; z) + \mu(X, y_1, y_2, z) U^2(\mathbf{q}^1, \mathbf{q}^2, \mathbf{Q}, \overline{L}^1, L^2; z) \tag{2.3}$$

$$\text{subject to} : \mathbf{e}'(\mathbf{q}^1 + \mathbf{q}^2 + \mathbf{Q}) = X$$

Several points about the problem should be noted:

i) The Pareto weight μ reflects the woman's power relative to the man's power. This is a function of the total expenditure and household characteristics, as well as individual labor incomes that are taken as distribution factors. We assume that μ is continuous and differentiable in X, y_1 and y_2. We also assume that the woman's power is increasing in her labor income and decreasing in her husband income (bargaining).

ii) For each vector (X, y_1, y_2, z) the allocation resulting from the problem can be found in one of the following sets: the participation set, P, if the woman decides to participate in the labor market ($L^2 = 0$), the non-participation set, N, if $L^2 = 1$, and the participation frontier if the woman is indifferent between participating and not participating.

Empirically, we will consider the allocation in the participation and the non-participation sets. If vector **q** is the allocation of goods resulting from the problem (2.3), then it will be in one of the two sets.

2.2. Interpretation of the Effects of Labor Income

The interpretation of the effects of individual labor incomes on the expenditure allocation takes into account the structural form of the Engel curves that depends on μ. Since these functions are equal to the reduced form of the Engel curves in each set, we are able to identify the effect of a change in the bargaining power of the agents, μ, over the allocation of a given good based on the effect of individual labor incomes.

1) In the participation set P we have:

$$q = \psi_1(X, y_1, y_2, z) = f_1(X, \mu(X, y_1, y_2, z)), \tag{2.6}$$

where the effects of labor income on the Engel curves ψ_1 that are observed can be analyzed based on the following equations:

$$\frac{\partial \psi_1}{\partial y_i} = \frac{\partial f_1}{\partial X} + \frac{\partial f_1}{\partial \mu}(\frac{\partial \mu}{\partial X} + \frac{\partial \mu}{\partial y_i}) = \frac{\partial \psi_1}{\partial X} + \frac{\partial f_1}{\partial \mu}\frac{\partial \mu}{\partial y_i} \qquad \text{for} \quad i = 1, 2 \tag{2.7}$$

2) Analogously, in the non-participation set N, where the reduced form of the Engel curves ψ_2 are equal to the structural functions f_2, we have the following effects:

$$\frac{\partial \psi_2}{\partial y_1} = \frac{\partial f_2}{\partial X} + \frac{\partial f_2}{\partial \mu}(\frac{\partial \mu}{\partial X} + \frac{\partial \mu}{\partial y_1}) = \frac{\partial \psi_2}{\partial X} + \frac{\partial f_2}{\partial \mu}\frac{\partial \mu}{\partial y_1} \tag{2.8}$$

$$\frac{\partial \psi_2}{\partial y_2} = \frac{\partial f_2}{\partial \mu}\frac{\partial \mu}{\partial y_2} \tag{2.9}$$

There is remarkable that, when the distribution factors affect the budget constraint, the model does not respect the property of *Distribution Factor Proportionality* (Browning and Chiappori, 1998).

The effects that we observe in each case are $\frac{\partial_i}{\partial y_i}$. In a bargaining context we know that $\frac{\partial \mu}{\partial y_1} < 0$ and $\frac{\partial \mu}{\partial y_2} > 0$. Taking into account what we observe and the bargaining context, we can identify the sign of $\frac{\partial f_i}{\partial \mu}$. According to this sign, we will classify a good in the feminine sphere if this sign is positive and in the masculine sphere if this sign is negative.

3. Empirical Model

We estimate an Engel curve system for the following twelve goods: (1) food, (2) clean house, (3) transportation and communications, (4) men's clothing, (5) women's clothing, (6) health, (7) personal care, (8) home entertainment, (9) outside home entertainment, (10) vices (alcohol and tobacco), (11) child-related consumption, and, finally, (12) a residual group of other expenses.

We essentially adopt the parametric functional form Working-Leser used by Deaton *et al.* (1989), adding as explanatory variables the agents' labor incomes. Delgado and Miles (1996) justify non-parametrically the linear relationship between the sharing of expenditure on food and the logarithm of total household expenditure using the Spanish expenditure survey "Encuesta de Presupuestos Familiares". The expression of the Engel curve for good j is:

$$W_j = \frac{q_j}{X} = \alpha_{kj} + \beta_{kj} \ln \frac{X}{n} + \gamma_{1kj} y_1 + \gamma_{2kj} y_2 + \eta_{0kj} \ln n + \sum_{i=1}^{J-1} \eta_{ikj} \frac{n_i}{n} + \varphi_{kj} \mathbf{z} + v_{kj}, \quad (3.1)$$

where k takes the value 1 if the woman works and the value 2 if the woman does not work. The effect of the size of the household is captured by the logarithm of the number of members ($\ln n$), while the proportion of members of the household in the age group i, ($\frac{n_i}{n}$) capture effects of the composition of the household.

If we denote the vector of explanatory variables by $\mathbf{X}$, and the coefficients vector by β_{kj}, we obtain the expression of the curve for good j as:

$$W_j = \mathbf{X}\beta_{kj} + v_{kj} \quad \text{with} \quad k = 1, 2. \quad (3.2)$$

The distribution of errors v_{1j} and v_{2j} can depend on the decision process of woman's labor participation because of the joint decision about participation and consumption. In this case, the separate estimation of the Engel curves in each sample, that is, on the one hand in households in which both spouses work, and on the other hand in households in which only the man works, is a biased estimate.

In our case, the two regimes considered are defined by the woman's labor participation. We call the indicator variable of the woman's labor participation P:

$$P = \mathbf{I}(\eta_p' W_p + \varepsilon_p) \quad \text{with} \quad \varepsilon_p \sim N(0,1), \tag{3.3}$$

where $P = 1$ if the woman works, and $P = 0$ if the woman does not work. The errors (v_{1j}, v_{2j}) are correlated with ε_p , such that the conditional means of the Engel curve errors are not zero. With the linear specification of the Engel curves, the expressions of the selection biases are (Maddala, 1983):

$$E(v_{1j}|P = 1) = -E(v_{1j}\varepsilon)\frac{\phi(\eta_p' W_p)}{\Phi(\eta_p' W_p)}, \tag{3.4}$$

$$E(v_{1j}|P = 0) = E(v_{2j}\varepsilon)\frac{\phi(\eta_p' W_p)}{1 - \Phi(\eta_p' W_p)}, \tag{3.5}$$

where ϕ and Φ are, respectively, the density and distribution functions of the standardized Normal.

One possible estimation method is proposed by Lee (1978) and Willis and Rosen (1979). Using this method, each of the Engel curves system for each of the regimes is estimated separately. However, it is possible and desirable to estimate the Engel curves jointly for both regimes, primarily because in this way we can directly compare the structural change based on the woman's labor participation. We follow this second joint estimation method proposed by Lee *et al.* (1979). The expression of the Engel curve system in this case is:

$$E(W_j) = E(W_j|P = 1)\Pr(P = 1) + E(W_j|P = 0)\Pr(P = 0) =$$

$$= \beta_{2j}'\mathbf{X} + (\beta_{1j}' - \beta_{2j}')\mathbf{X}\Phi + \phi(E(v_{2j}\varepsilon) - E(v_{1j}\varepsilon)) \tag{3.6}$$

The estimation method consists of two stages. The participation probabilities are estimated in the first stage in order to use them to estimate the Engel curve system for the second stage. In the second stage, the Engel curve system that we estimate is the following [3]:

$$W_j = \beta'_{2j}\mathbf{X} + (\beta'_{1j} - \beta'_{2j})\mathbf{X}\widehat{\Phi} + \widehat{\phi}(E(v_{2j}\varepsilon) - E(v_{1j}\varepsilon)) + v_j \tag{3.7}$$

$$\text{with} \quad \mathbf{X} = \left(1, \ln\frac{\widehat{X}}{n}, y_1, \widehat{y_2}, \ln n, \frac{n_i}{n}, \mathbf{z}\right) \quad \text{for goods 1,2,..,9}$$

$$\mathbf{X} = \left(1, \ln\frac{\widehat{X}}{n}, y_1, \widehat{y_2}, \ln n, \frac{n_i}{n}, \mathbf{z}, \frac{\phi(s_j\widehat{\theta})}{\Phi(s_j\widehat{\theta})}\right) \quad \text{for goods 10,11}$$

where $\ln\frac{\widehat{X}}{n}$ is the prediction of the logarithm of the total per capita household consumption in the instrumental variables estimation, $\widehat{y_2}$ is vector of woman's labor income including the estimation of her potential income when she does not work, and $\frac{\phi(s_j\widehat{\theta})}{\Phi(s_j\widehat{\theta})}$ is the Heckman lambda that corrects the selection bias generated by voluntary abstention from consumption of vices and child-related goods.

4. Data

To estimate the Engel curves we use the expenditure, income, and household characteristics data for the 21,155 Spanish households in the "Encuesta de Presupuestos Familiares 1990-91". The expenditure data gathered on 918 types of goods is given annualized based on various criteria depending on the frequency of purchase. We use the data on individual labor income as explanatory variables, while we use total household income as an instrumental variable. 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 "Encuesta de Presupuestos Familiares" labor income data underestimate aggregate labor income according to the Spanish National Accounts. Therefore, the measure of the effects of labor income is going to be affected by this underestimation.

The theoretical model assumes two adult decision-makers in the household. Therefore, the sample of households we select comprises couples with or without children younger

[3] In the Appendix 2, we explain the difference in the estimation of the Engel curves for each good depending on the relationship between expenditure and consumption

than 17 in which the husband works full-time (5,619 households). Within this sampling of households we break out two types: A) households in which the woman works full- or part-time for pay as either an employee or self-employed (1,864 households), B) households in which the woman does not work (3,755 households).

The breakdown of household expenditure by twelve goods is shown in table 1 of Appendix 1. The consumer expenditure considered does not include the major durable goods such as housing, automobiles, furniture, or appliances, or expenditure on financial services, taxes, etc. Measuring the consumption based on expenditure data presents several statistical problems depending on the good considered. We regroup the vector of twelve goods into four groups based on the statistical problem of measuring consumption that arises. Group I is the expenditure on food that is affected by making bulk purchases, which makes it hard to impute annual food consumption. This imputation has already been made in the expenditure data we use according to the estimation technique presented in Peña and Ruiz-Castillo (1998). Group II is made up of the following two goods: clean house, and transportation and communications. Since in these goods we do not observe households whose expenditure is zero, nor is there information available on the making of bulk purchases on a cycle different from that of consumption, we assume that expenditure on these goods is equal to consumption. Group III comprises seven goods that we assume are consumed regularly over the year: men's clothing, women's clothing, health, personal care, home entertainment, entertainment outside the home, and other expenditure. For these seven goods there is a considerable percentage of households whose expenditure is zero, since 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, which we will correct by applying the technique proposed in Meghir and Robin (1992). Finally, group IV is made up of the two remaining goods: vices and child-related consumption. There are many households that also present zero consumption of these goods, but in these cases we believe that abstention is voluntary and that it is not random with respect to the consumption decision. This phenomenon of voluntary abstention is corrected with a double-hurdle model that takes into account the dependence between the binary decision about whether or not to consume and the decision about how much to consume. In Appendix 2 we present the models that we have used to treat the problems of measuring consumption.

We present in table 1 information on the data for the distribution of expenditure (W_j) into its twelve components. The means, typical deviations and percentages of zeros are calculated based on the original expenditure data. In the explanatory variables we provide the means for total per capita expenditure before correcting for infrequency and for total per capita consumption (X/n), which is corrected for purchase infrequency. We also show statistics for labor income of the agents who work and the prediction of the mean logarithm of potential labor income for women who do not work. The factors that affect preferences are the demographic variables and characteristics of the household. These do not include statistics for the region of residence although they have been taken into account in the estimation. We test the mean differences between the two types of households considered.

As can be seen in the means difference test, there is quite a lot variation in expenditure patterns and in demographic characteristics across the two regimes.

5. Results

Below we present the results of the two stages estimation of the Engel curve system.

5.1. The First Stage

The first stage estimates describe the woman's participation process and the purchase process of those goods that present purchase infrequency of abstention from consumption.

The Woman's Labor Participation and Her Potential Labor Income

The results of the probit model for the woman's labor participation and the estimated wages equation for households in which both spouses work is shown in Table 2 of Appendix 1. The woman's labor participation depends on her age and education level and on the

Table 1. Descriptive Statistics

	Woman Works (1)		Woman does not work (2)		Mean Diff.
	# 1864		# 3755		$\mu_2 - \mu_1 = 0$
	Mean (desv.)	% zeros	Mean (desv.)	% zeros	t-Student
GOODS (W_j)					
(1) Food	.320 (.141)	0.16	.393(.139)	0.03	18.33
(2) Clean House	.106 (.078)	0.06	.090 (.057)	0.05	-8.52
(3) Transportation	.122 (.088)	2.25	.110 (.085)	4.74	-4.82
(4) Man Clothes	.038 (.055)	37.45	.038 (.055)	36.78	-.35
(6) Woman Clothes	.045 (.064)	29.14	.037 (.057)	33.24	-4.65
(7) Health	.037 (.053)	21.35	.039(.055)	22.93	1.32
(8) Personal Care	.020 (.030)	36.75	.019 (.030)	38.86	-1.29
(9) Home Entertainment	.034 (.047)	17.11	.026 (.043)	27.08	-6.01
(4) Outside home Entert.	.141 (.115)	3.54	.118 (.104)	5.11	-7.58
(10) Vices	.035 (.036)	9.07	.037(.036)	10.55	2.03
(11) Children Consumption	.070 (.074)	21.94	.068 (.072)	21.82	-1.08
(12) Other expenses	.030 (.053)	23.39	.024 (.045)	30.44	-4.97
EXPLANATORY VARIABLES					
Total Expenditure per capita	659.116 (376.278)		484.878 (292.494)		-19.06
Total consumption per capita	626.722 (366.615)		459.871 (283.500)		-18.78
Man's labor income	1.581.188 (832.795)		1.514.648 (1.031.027)		-2.42
Woman's labor income	999.642 (643.102)		13.254 (.337)*		-18.08
No members	3.49 (1.03)		3.665(1.083)		5.69
n1/n	.086 (.140)		.085 (.138)		-.1399
n2/n	.1265 (.158)		.124 (.155)		-.503
n3/n	.133 (.174)		.153 (.182)		4.0
n4/n	.026 (.079)		.035 (.091)		3.70
na1/n	.032 (.139)		024 (.110)		-2.37
na2/n	.596 (.214)		.570 (.215)		-4.25
Man's age	36.23 (7.309)		39.34 (9.571)		12.35
Primary studies man	.224 (.417)		.235(.424)		.91
High school man	.271 (.445)		.190 (.392)		-7.01
University man	.244 (.429)		.096 (.295)		-15.03
Primary studies woman	.231 (.422)		.272(.445)		3.26
High school woman	.255 (.436)		.149 (.356)		-9.76
University woman	.258 (.438)		.047 (.211)		-24.44
Urban	.612 (.487)		.538 (.499)		-5.25
Executive	.218 (.413)		.084 (.277)		-14.43
Laborer	.520 (.499)		.598 (.490)		5.56
Businessman	.140 (.347)		.162 (.369)		2.21
Own home	.707 (.455)		.727 (.446)		1.59
Car	.911 (.284)		.837 (.369)		-7.65
No. durable goods	10.84 (3.33)		9.56 (2.98)		-14.54

* logaritm of woman's labor income from the wage equation estimation

n1=children 0-3 years , n2=4-8, n3=9-14, n4=15-16, na1=adults 18-24 years , na2 > 24 age and education level of her husband. It also depends on the number of children and their ages. The age of the woman has an increasing, concave effect on the probability of participation. The expected effect of the woman's education is observed in interaction with her age: the older the woman, the greater is the effect of her education level on the probability of participation. The man's education level has a positive effect on the woman's participation. This effect decreases with the man's age. The presence of children younger than 14 has the expected negative effect.

The wage equation for the woman depends on the woman's age and education level. We correct the selection bias based on the woman's participation decision. This wage equation shows the concave profile of earned income with respect to the woman's age. The educational returns are evident for secondary and university education. We do not observe any selection bias due to the woman's participation.

Purchase Probabilities

We present the specification of the purchase decision process of the various goods in Appendix 2. The estimation of the parameters for this process is made in order to correct the purchase infrequency and abstention from consumption in the measurement of consumption of goods. Tables 3 and 4 of Appendix 1 show estimates for the probit models for decisions to purchase the seven goods of group III and the two goods of group IV. For example, we can explain the positive effect on the probability of purchase when the woman does not work, that does not appear when the woman works, if we consider the use of the woman time in the purchase process. The effects of education on the purchase probability of health and the effect of children on the purchase probability of home entertainment falls under this interpretation.

5.2. The Second Stage: The Engel Curve System

The estimation of the parameters for the Engel curve system is shown in Table 5 of Appendix 1. From these estimates we focus on the expenditure elasticities and on the effects of woman's and man's labor incomes. The objective is to classify the goods in different groups according to these estimates. Taking into account the expenditure elasticities we classify the goods as complements or substitutes of the woman's leisure. Taking into account the sign of the income labor effect, we classify the goods in the feminine or in the masculine sphere.

Expenditure Elasticities

We have estimated the elasticities for total household expenditure and standard deviations for both types of households based on the Engel curve parameters [4].

The elasticities obtained taking into account the endogeneity of the woman's labor participation are shown in Table 2.

Table 2. Expenditure Elasticities

Woman Does Not Work (#3.755)		Woman Works (#1.864)	
NECESSITIES		NECESSITIES	
Clean House**	0.530 (.045)	Food	0.694 (.031)
Vices	0.659 (.101)	Health**	0.861 (.105)
Food	0.654 (.020)	Vices	0.952(.124)
Transportation	0.965 (.088)	Clean House**	0.961 (.070)
LUXURIES		Child-related	0.964 (.059)
Child-related	1.032 (.039)	Transportation	0.974 (.136)
Health**	1.198 (.068)	LUXURIES	
Personal Care*	1.334 (.056)	Personal Care*	1.079 (.087)
Home Entertainment	1.424 (.078)	Men's Clothing**	1.166 (.087)
Outside Home Entertainment	1.427 (.049)	Home Entertainment	1.258 (.122)
Women's Clothing	1.569 (.064)	Outside Home Entertainment	1.473 (.076)
Men's Clothing **	1.837 (.056)	Women's Clothing	1.504 (.010)

** significative differences at 95 % level (* at 90 % level)

In order to appreciate the importance of the bias that occurs if we do not take into account that the woman's labor participation is endogenous, we have estimated the expenditure elasticities based on the Engel curve systems in which the woman's labor participation

[4] The Engel curves give us directly the marginal propensity to consumption when the woman does not work. From the estimates, we calculate the corresponding coefficient when the woman works.

is considered exogenous. If we do not take into account the endogeneity of participation, the elasticities we obtain show significant biases in the following sense. If the woman does not work, the elasticity of clean house (0.61) is overestimated and the elasticity of men's clothing (1.68) is underestimated. If the woman works, elasticities of health (0.95), personal care (1.21), men's clothing (1.45) and women's clothing (1.66) are overestimated. The elasticities of clean house (0.73) and transportation and communications (0.83) are underestimated.

The changes in elasticities due to the woman's labor participation can be explained if we consider a given good as complement or substitute of the woman's leisure. If the good is a substitute (complement) of the woman's leisure, expenditure on the good increases (decreases) when the woman works and, therefore, its elasticity is greater (less) in this case.

The differences in the expenditure elasticities are not significant for food, transportation and communications, home entertainment, outside home entertainment, women's clothing, vices and child-related consumption. Therefore, we cannot classify properly these goods as substitutes or complements of the woman's leisure. Significantly, the expenditure elasticity of clean house is greater when the woman works, then we classify this good as substitute of the woman leisure. On the other hand, the higher expenditure elasticities of health, personal care and men's clothing when the woman does not work leads to the classification of these goods as complements of the woman's leisure.

Effects of Labor Income

The effects of individual labor income are shown in Table 3.

First, we interpret the effects of labor income on the participation set if the woman works according to the equations (2.7). We know that all goods are normal because $\partial\psi_1/\partial X > 0. Inthebargainingcontextweknowthat (\partial\mu/\partial y_2 > 0)$ and $(\partial\mu/\partial y_1 < 0)$. Thus, a negative effect of the woman's labor income can only be due to the fact that the good belongs to the masculine sphere $(\partial f_1 j/\partial\mu < 0)$, while a negative effect of the mans labor

Table 3. Labor Income Effects

	Woman Works		Woman Does Not Work	
	$\partial\psi_j/\partial y_1$	$\partial\psi_j/\partial y_2$	$\partial\psi_j/\partial y_1$	$\partial\psi_j/\partial y_2$
(1) Food	-.01326 (-1.03)	-.00064 (-.05)	.00365 (.56)	-.00939 (-1.15)
(2) Clean House	.00160 (.23)	.02328 (3.32)	.00370 (1.03)	.00024 (.05)
(3) Transportation	.01067 (1.15)	-.02466 (-2.70)	-.00813 (-1.74)	.01318 (2.24)
(4) Men's Clothing	.00605 (1.55)	.00342 (.88)	-.00199 (-1.0)	-.00485 (-1.95)
(5) Women's Clothing	.00417 (.89)	.00642 (1.38)	.00482 (2.03)	-.00654 (-2.2)
(6) Health	.00969 (2.04)	.00054 (.11)	-.00363 (-1.5)	-.00567 (-1.88)
(7) Personal Care	-.00436 (-2.13)	.00250 (1.23)	.00135 (1.3)	-.00178 (-1.4)
(8) Home Entertainment	-.00883 (-2.14)	.00635 (1.56)	-.00061 (-.29)	-.00506 (-1.94)
(9) Outside Home Entertainment	.00736 (.67)	-.01136 (-1.04)	-.00015 (-.03)	.01396 (2.0)
(10) Vices	-.00367 (-.90)	-.00388 (-.97)	-.00051 (-.25)	.00151 (.59)
(11) Child-related	.00121 (.16)	.00199 (.26)	-.00276 (-.72)	.00229 (.48)

incomecan only be explained if ($\partial f_1 j/\partial\mu > 0$), that is, the good belongs to the feminine sphere.

In the Participation set, we observe that the woman's labor income has a negative effect on transportation and communications (masculine sphere) and that the mans labor income has a negative effect on personal care and home entertainment (feminine sphere). The effects of labor income on clean house and health do not allow us to unambiguously identify the sign of the μ-effect. Nevertheless, the effect of the womans labor income on clean house is positive and big and the effect of the mans labor income is null. Therefore, we conjecture that this good is in the feminine sphere. Likewise, the positive sign of the effect of the mans labor income and the null effect of the womans labor income on health leads us to assume that this good belongs to the masculine sphere.

In the Non-Participation set, we must interpret the effects of labor income according to the equations (2.8) and (2.9). The only effect of the mans labor income that we observe is a positive effect on womens clothing. This effect is compatible with a small, positive effect of the power of the woman as weel as with a negative effect thereof. The effects of the womans potential labor income allows us to identify the sign $\partial f_1 j/\partial\mu$ according to the equation (2.9). We observe positive signs for the womans potential labor income on transportation and communications and entertainment outside the home. Therefore, we classify both goods in the feminine sphere. On the other hand, mens clothing, womens clothing, health and home entertainment are classified in the masculine sphere.

Table 4. Goods Classification

	CHANGES IN ELASTICITIES	LABOR INCOME EFFECTS			
	P=0$\mapsto$ P=1	P=1		P=0	
		y_1	y_2	y_1	y_2
(1) Food	-	-	-	-	-
(2) Clean House	S	-	F*	-	-
(3) Transportation	-	-	M	-	F
(4) Men's Clothing	C	-	-	-	M
(5) Women's Clothing	-	-	-	M	M
(6) Health	C	M*	-	-	M
(7) Personal Care	C	F	-	-	-
(8) Home Entertainment	-	F	-	-	M
(9) Outside Home Entertainment	-	-	-	-	F
(10) Vices	-	-	-	-	-
(11) Child-related	-	-	-	-	-

* empirically plausible assumption

C=complement, S=sustitute, M=masculine, F=feminine

Problems of Self-selection

The Engel curve system considers two types of self-selection problems. First, in the case of group IV goods, the selection of households with respect to their participation in the consumption of vices and having children. Second, for all goods, we consider that the woman chooses her labor participation bearing in mind the losses or gains in the consumption of each good.

We test the existence of the first type of self-selection in the consumption of vices and of child-related goods. We find that there is a selection bias in the consumption of child-related goods and that this bias is negative. We cannot test the selection problem caused by the relationship between the woman's labor participation and the consumption of goods. However, as long as the term of the difference of covariances between the errors for consumption of the good and the woman's labor participation is significant and negative for expenditure on health and on personal care, we confirm that the woman's labor participation is not associated with a gain in the consumption of these goods. This result is consistent with the classification of these goods as complements to the woman's leisure.

6. Conclusions

In this chapter we have proposed a collective model that studies the general form of expenditure allocation among various goods, based on the binary decision of the woman's labor participation. The allocation of expenditure is based on three sets of variables: i) total household expenditure, ii) demographic, socioeconomic, and geographic characteristics of the household that determine preferences, and iii) the man's and the woman's labor income that, on the one hand, affect the reservation utility of the agents in the bargaining game and, on the other hand, affect the budget restriction.

We interpret the differences in the effects of the three sets of explanatory variables on the consumption vector according to the participation of the women in the following terms:

i) The differences in the effects of the explanatory variables should reflect the (positive or negative) offset of consumption of goods against the loss of leisure if the woman participates. The results are interpretable if we consider that goods and services consumed are substitutes or complements of the woman's leisure.

ii) We interpret the effects of labor income in the context of a bargaining process in our collective model. The analysis of the effects of labor income observed in this context allows us to identify in which direction the bargaining power of each agent acts on the allocation of expenditure and, therefore, to classify goods in separate spheres, either feminine or masculine.

We have estimated the Engel curves for the vector consumption of goods for the household based on the woman's labor participation, taking into account that the participation is not random with respect to the consumption of goods. The principal conclusions associated with i) the general interpretation of the compensation effect and ii) the interpretation of the effect of the bargaining power are the following:

i) The time of the woman who does not work is dedicated to production of health, and it is also associated with higher expenditure of men's clothing. Consequently, these goods are complements of the woman's leisure. Some effects of the purchase process reinforce this result. For example, we observe that the woman's education (more time value) increases the purchase frequency of health when the woman does not work. On the other hand, expenditure on clean house increases if the woman's leisure time decreases. Then, it is a substitute of the woman's leisure.

ii) The interpretation of the effects of labor income in terms of bargaining power leads us to classify goods in two spheres, the feminine and the masculine. If the woman works, clean house, personal care, and home entertainment are in the feminine sphere, and transportation and health in the masculine sphere. If the woman does not work, transportation and outside home entertainment are in the feminine sphere, and men's clothing, women's clothing, health and home entertainment are in the masculine sphere.

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APPENDIX 1

TABLE 1. VARIABLE DESCRIPTION FOR CURRENT EXPENDITURE GROUPS

VARIABLE	DESCRIPTIÓN	Correspondence with the EPF variables
FOOD	Food at home + Food at work place	GI-R23-R24=R1+..+R22+RESTO1 GASTO en CLEX=(8058,8059,8060)
ALCOHOL AND TOBACCO	Alcoholic beverages + tobacco	R23+R24
MEN'S CLOTHING	Men's clothing and footwear	R25+R29
WOMEN'S CLOTHING	Women's clothing and footwear	R26+R30
CLEAN HOUSE	Heat, electricity, water + Household textiles + Small appliances (not included in the category Durable goods)+ 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 articlesl	R55
TRANSPORTATION AND COMUNICATIONS	Urban public transportation, mail and communications + 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 ENTERTAINMENT	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 ENTERTAINMENT	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)
CHILD RELATED CONSUMPTION	Children's clothing and footwear+baby items Primary and secondary education + school transportation + toys + Kindergarten + School cafeteria.	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 2. DECISION MODEL FOR THE WOMAN'S PARTICIPATION AND WAGE EQUATION

PROBIT OF WOMAN'S LABOR PARTICIPATION			WAGE EQUATION		
Variable	Estimator	t-value	Variable	Estimator	t-value
Constant	-.9851	-2.26	Constant	11.063	26.89
Woman's age	.10501	3.63	Woman's age	.099492	5.6
Woman's Age Square	-.00141	-3.83	Woman's age square	-.001081	-4.96
Man's age	-.05668	-1.91	Woman's Primary	.18275	.71
Man's age Square	.00048	1.32	Woman's High School	.85124	3.27
Woman's Primary education	-.16224	-.54	Woman's University	.6293	2.42
Woman's High School	-.12199	-.38	Age*Woman's Primary	.0052695	.70
Woman's University	-.07541	-.18	Age*Woman's High Sch.	-.0068347	-.91
Man's primary education	.87921	2.87	Age*Woman's University	.011795	1.63
Man's High School	.57333	1.86	Heckman Lambda	-.011043	-.84
Man's University	1.00828	2.61	R2	.279	
Age*Woman's Primary	.01074	1.22	F(k,n-k-1)	72	
Age*Woman's High School	.02157	2.27	Rho	-.1516	
Age*Woman's University	.04114	3.51	Sigma2	.53019	
Age*Man's Primary	-.02582	-2.87			
Age*Man's High School	-.01531	-1.71			
Age*Man's University	-.02669	-2.43			
N1	-.34872	-8.58			
N2	-.15254	-5			
N3	-.08057	-2.86			
N4	-.0615	-1.15			
Chi-2 (20)	932.7				
-2 Log Likelihood	6227				
Pseudo R2	.15				

TABLE 3. PROBIT MODEL OF PURCHASE DECISION IF THE WOMAN WORKS

	ALCOHOL AND TOBACCO		MEN'S CLOTHING		WOMEN'S CLOTHING		HEALTH		PERSONAL CARE		HOME ENTERTAINMENT		OUTSIDE HOME ENTERTAINMENT		CHILD RELATED CONSUMPTION		OTHER EXPENDITURE	
	Coef.	t-valor	Coef.	t-valor	Coef.	t-valor	Coef.	t-valor	Coef.	t-valor	Coef.	t-valor	Coef.	t-valor	Coef.	t-valor	Coef.	t-val
Constant	-3,5480	-2,07	-8,9020	-7,12	-7,8770	-5,99	-6,4553	-4,65	-7,0244	-5,62	-7,1906	-4,89	-12,690	-5,08	-10,617	-6,31	-10,1313	-7,41
ln(expend)	0,4455	4,47	0,6785	9,12	0,7794	9,86	0,5124	6,27	0,6169	8,3	0,5662	6,39	1,1328	7,28	0,7081	7,07	0,7351	8,92
Nº memb.	0,0999	1,37	0,0784	1,52	0,0646	1,21	0,0119	0,2	0,1222	2,37	0,1480	2,39	0,1203	1,15	0,1697	2,19	0,2697	4,5
Man's age	-0,0151	-0,3	-0,0188	-0,49	-0,0894	-2,2	-0,0299	-0,69	-0,0485	-1,27	0,0176	0,41	-0,0432	-0,59	-0,0240	-0,5	0,0039	0,1
(M. age)2	-0,0000	-0,07	0,0001	0,16	0,0009	1,89	0,0005	0,96	0,0007	1,39	-0,0003	-0,63	0,0000	0,05	0,0002	0,34	-0,0001	-0,12
D1	0,2833	1,6	-0,0657	-0,53	-0,0498	-0,38	1,0359	7,15	0,1852	1,49	0,0898	0,59	0,0752	0,28	2,2306	13,61	0,1063	0,78
D2	0,1244	0,71	0,2209	1,78	0,0331	0,25	0,3930	2,88	0,1779	1,44	-0,0345	-0,23	0,1185	0,47	2,4633	13,96	0,1394	1,02
D3	0,1831	0,98	0,1768	1,31	0,1339	0,93	0,5194	3,44	0,2515	1,86	0,1228	0,74	0,6671	2,31	2,3406	12,25	0,3048	2
D4	0,2067	0,54	0,2254	0,81	0,0536	0,19	0,2389	0,82	0,5917	2	-0,1747	-0,58	-0,1062	-0,24	1,6693	5,14	0,7622	2,13
Da1	0,2490	0,95	0,1329	0,85	-0,3038	-1,87	-0,0049	-0,03	-0,1066	-0,7	0,0886	0,5	0,0747	0,23	-0,5728	-2,88	0,0563	0,35
Man's Sec.	-0,2574	-2,17	0,0909	1,09	-0,0289	-0,33	0,1356	1,44	-0,0679	-0,82	0,2179	2,15	-0,0499	-0,28	-0,1105	-0,94	0,1198	1,29
Man'sUniv.	-0,2217	-1,41	-0,0029	-0,03	-0,1297	-1,1	0,1812	1,41	0,1515	1,34	0,3941	2,72	-0,1885	-0,77	-0,1358	-0,86	-0,0050	-0,04
Wom. Sec.	-0,0168	-0,09	0,0320	0,24	-0,2775	-1,94	0,0634	0,42	-0,0984	-0,73	-0,1950	-1,24	0,3713	1,35	-0,0878	-0,48	0,2533	1,72
Wom.Univ.	-0,1426	-0,41	0,3618	1,43	-0,1860	-0,69	-0,0628	-0,23	-0,4122	-1,65	-0,1765	-0,6	1,0822	2,04	0,0468	0,14	0,0697	0,26
Urban	0,2793	3,06	0,0654	0,99	0,0376	0,55	-0,1215	-1,64	-0,0423	-0,64	0,1987	2,54	0,0817	0,61	0,1417	1,55	-0,0060	-0,08
Executive	-0,1625	-0,95	0,0892	0,75	0,1775	1,44	0,1904	1,41	0,2215	1,86	-0,2920	-1,84	-0,2435	-0,88	0,0750	0,44	-0,1528	-1,1
Laborer	-0,0875	-0,61	-0,0285	-0,29	0,1152	1,13	0,1659	1,53	0,1635	1,65	-0,0437	-0,36	-0,1214	-0,59	0,0811	0,59	-0,1332	-1,17
Business	-0,2687	-1,62	-0,0035	-0,03	-0,0496	-0,4	0,0729	0,56	0,1196	1	-0,1819	-1,28	-0,2202	-0,93	0,1079	0,65	-0,1750	-1,29
Own home	-0,1652	-1,59	0,0946	1,35	0,0801	1,09	0,0748	0,95	-0,0588	-0,83	-0,0461	-0,54	0,0946	0,65	0,1307	1,36	-0,1179	-1,5
Car	-0,6598	-3,14	-0,1465	-1,27	0,1530	1,33	-0,0234	-0,19	-0,0963	-0,84	-0,0599	-0,46	-0,4907	-2,11	-0,3159	-2,05	-0,0545	-0,45
Nº durabl	0,0050	0,33	-0,0247	-2,26	-0,0187	-1,63	0,0200	1,59	-0,0072	-0,65	0,0433	3,04	0,0151	0,62	0,0126	0,78	0,0229	1,8
Winter	0,0635	0,61	0,0252	0,34	0,0385	0,5	-0,0393	-0,48	0,0359	0,49	0,0456	0,51	-0,1352	-0,9	0,1835	1,77	0,0942	1,14
Summer	0,0303	0,29	-0,1749	-2,34	-0,0892	-1,14	-0,0419	-0,49	-0,1214	-1,62	0,0477	0,52	-0,1202	-0,77	0,2264	2,09	-0,0736	-0,89
Lambda part.	-0,1069	-0,25	0,6887	2,21	-0,0861	-0,27	-0,0120	-0,03	-0,3226	-1,05	-0,4952	-1,41	0,8240	1,35	0,2610	0,64	-0,0684	-0,21
Likelihood Ratio	72.05		114.80		153.12		170.67		112.56		208.18		110.27		892.19		197.448	
-2Log Likelihood	1061.53		2350.49		2096.06		1762.60		2338.99		1498.07		460.35		1069.39		1830.41	

D1=children 0-3 year old, D2=4-8 years old, D3=9-14 yeaars old, D4=15-16 years old

TABLE 4. PROBIT MODEL OF PURCHASE DECISION IF THE WOMAN DOES NOT WORK

	ALCOHOL AND TOBACCO		**MEN'S CLOTHING**		**WOMEN'S CLOTHING**		**HEALTH**		**PERSONAL CARE**		**HOME ENTENTAIRMENT**		**OUTSIDE HOME ENTERTAINMENt**		**CHILD RELATED CONSUMPTION**		**OTHER EXPENDITURES**	
	Coef.	t-valor	Coef.	t-valor	Coef.	t-valor	Coef.	t-valor	Coef.	t-valor	Coef.	t-valor	Coef.	t-valor	Coef.	t-valor	Coef.	t-v.
Constant	-7.1525	-6,5	-9.5137	-11,39	-9.4923	-11,19	-6.3877	-7,08	-9.5265	-11,44	-10.8339	-11,52	-10.5610	-7,44	-10.7112	-9,84	-10.2332	-11,5
Ln(expend)	0,6529	9,38	0,7501	14,19	0,7746	14,42	0,5422	9,71	0,6280	12,12	0,6925	11,96	0,8446	9,24	0,6656	9,81	0,7277	13,12
Nº Memb	0,1961	4,12	0,1162	3,42	0,0948	2,75	0,0707	1,89	0,1835	5,33	0,0727	1,95	0,2054	3,34	0,2592	5,33	0,2359	6,45
Man's age	-0,0078	-0,29	-0,0081	-0,38	-0,0007	-0,03	-0,0144	-0,62	0,0340	1,57	0,0399	1,65	0,0509	1,57	-0,0124	-0,46	-0,0045	-0,2
(M age)2	-0,0000	-0,11	0,0001	0,49	-0,0000	-0,17	0,0001	0,26	-0,0003	-1,33	-0,0005	-1,63	-0,0008	-2,16	0,0002	0,75	0,0000	0,15
D1	0,0552	0,35	0,1402	1,21	0,0384	0,32	0,5301	4,2	0,0477	0,42	0,2887	2,23	-0,0521	-0,26	2.1885	14,62	0,1123	0,94
D2	-0,0112	-0,08	0,0229	0,21	0,0089	0,08	0,2338	2,06	0,0819	0,77	0,2593	2,18	-0,0743	-0,41	2.3223	16,69	0,1807	1,63
D3	0,0496	0,36	0,0087	0,08	0,0563	0,53	0,2279	2,08	0,0900	0,88	0,2595	2,28	0,2100	1,18	2.1852	16,24	0,3545	3,29
D4	-0,2984	-1,69	0,1235	0,79	-0,3223	-2,13	0,0396	0,25	0,2171	1,39	0,4303	2,39	0,7901	1,94	1.6702	9,39	0,2714	1,68
Da1	0,0868	0,51	0,0455	0,39	0,1373	1,16	0,0891	0,68	0,2734	2,38	0,0478	0,38	0,2635	1,24	-0,1339	-0,95	-0,0899	-0,77
Man's Sec.	-0,1185	-1,38	-0,0970	-1,54	-0,0735	-1,15	0,1597	2,22	0,1578	2,52	0,1513	2,09	-0,0100	-0,09	-0.1257	-1,5	-0,0066	-0,1
Man'sUniv	-0,0913	-0,67	-0,3613	-3,59	-0,1397	-1,35	0,3356	2,74	0,2163	2,08	0,4603	3,4	0,1330	0,62	-0,0153	-0,11	-0,2171	-1,95
Wom Sec.	-0,0035	-0,02	-0,2928	-2,74	-0,0464	-0,42	0,2300	1,85	-0,1174	-1,1	0,0811	0,65	0,1699	0,85	-0,1451	-1,03	0,0833	0,73
Wom Univ	-0,6079	-1,75	-0,6557	-2,5	0,2298	0,84	0,9361	2,95	-0,0872	-0,33	-0,2587	-0,85	0,1317	0,27	-0,2426	-0,71	0,2451	0,86
Urban	0,1750	2,93	-0,0114	-0,26	0,0458	1,02	-0,0124	-0,26	0,0500	1,14	0,2563	5,3	0,0639	0,82	0,1274	2,14	-0,0351	-0,75
Executive	-0,1854	-1,37	0,1185	1,15	0,0395	0,37	0,0289	0,24	-0,1444	-1,37	0,0062	0,05	-0,1839	-0,91	-0,0662	-0,46	0,3509	3
Laborer	0,0413	0,49	0,0068	0,11	-0,0732	-1,13	0,1374	2,02	0,0142	0,22	0,2206	3,23	-0,0021	-0,02	-0,0020	-0,02	0,1137	1,73
Business	-0,2618	-2,69	-0,1161	-1,51	-0,1279	-1,63	0,0751	0,9	-0,0601	-0,78	0,0291	0,35	-0,0236	-0,18	-0,0027	-0,03	0,0867	1,08
Own Home	-0,1240	-1,75	0,0205	0,41	0,0213	0,42	0,0189	0,34	0,0218	0,43	-0,0621	-1,12	-0,0636	-0,71	-0,0245	-0,36	-0,0543	-1,03
Car	-0,1275	-1,51	-0,0964	-1,55	-0,0900	-1,43	0,0141	0,21	0,0306	0,5	0,0558	0,86	-0,1076	-1,07	-0,1160	-1,44	-0,1592	-2,48
Nº durab	-0,0352	-3,03	-0,0209	-2,39	-0,0142	-1,59	0,0333	3,33	0,0007	0,08	0,0661	6,26	0,0153	0,89	0,0386	3,04	0,0510	5,17
Winter	0,0282	0,4	-0,0322	-0,61	0,0638	1,19	-0,0370	-0,64	-0,0207	-0,4	-0,0505	-0,88	0,0237	0,25	-0,0113	-0,17	-0,0193	-0,35
Summer	-0,0131	-0,19	-0,0792	-1,54	0,0216	0,41	-0,0323	-0,57	-0,0969	-1,9	0,0169	0,3	-0,1607	-1,84	0,3547	4,83	0,0275	0,51
Phi/(1-PHI) (P=0)	0,3969	0,95	0,4821	1,53	-0,2676	-0,83	-1.0138	-2,78	0,1813	0,57	0,5909	1,65	-0,2318	-0,42	0,1809	0,44	0,0972	0,29
Likelihood Ratio	184.98		245.02		252.599		299.90		267.41		630.12		199.45		1564.80		447.14	
-2Log Likelihood	2345.26		4694.77		4522.52		3743.65		4749.98		3756.41		1316.33		2374.23		4168.06	

TABLE 5. ESTIMATED PARAMETERS

Variable	FOOD		MAN'S CLOTHING		WOMAN'S CLOTHING	
	$\beta_2(t)$	$\beta_1 - \beta_2(t)$	$\beta_2(t)$	$\beta_1 - \beta_2(t)$	$\beta_2(t)$	$\beta_1 - \beta_2(t)$
$\ln(X/n)$	-.13223 (-17.4)	.015 (.86)	.03436 (14.9)	-.027 (-5.14)	.02455 (8.87)	-.003 (-.43)
Man's labor income	.00365 (.56)	-.017 (-.94)	-.00199 (-1.03)	.008 (1.48)	.00482 (2.03)	-.001 (-.10)
Woman's labor income	-.00939 (-1.15)	.009 (.45)	-.0048 (-1.95)	.008 (1.40)	-.0654 (-2.2)	.013 (1.82)
$\ln(n)$	.19726 (2.88)	-.560 (-2.67)	-.0063 (-.31)	-.031 (-.49)	-.00032 (-.01)	-.045 (-.63)
n1/n	-.33949 (-3.06)	.562 (1.42)	.0081 (.24)	-.020 (-.17)	-.0243 (-.60)	.215 (1.49)
n2/n	-.37343 (-3.2)	.603 (1.43)	.02936 (.83)	-.032 (-.25)	.0049 (.12)	.209 (1.36)
n3/n	-.40115 (-3.35)	.685 (1.57)	.01137 (.31)	.016 (.12)	-.0068 (-.15)	.234 (1.48)
n4/n	-.46023 (-3.85)	.708 (1.61)	.00437 (.12)	.057 (.43)	.00557 (.13)	.263 (1.63)
na1/n	.00733 (0.12)	-.452 (-1.59)	.01525 (.87)	.008 (.09)	.0021 (.09)	.247 (2.37)
na2/n	.00736 (0.19)	-.396 (-1.45)	.00693 (.59)	.011 (.14)	.01228 (.87)	.222 (2.22)
Man's age	.01114 (3.26)	-.026 (-2.67)	.00017 (.17)	-.003 (-1.15)	-.0032 (-2.5)	.001 (.35)
Man's age^2	-.00009 (-2.5)	.00 (2.49)	-.59e-6 (-.14)	.00 (1.01)	.00003 (2.3)	-.00 (-.12)
Man's Primary	-.00404 (-.33)	-.007 (-.18)	.00259 (.70)	-.002 (-.21)	.00505 (1.13)	.00 (.03)
Man's Secondary	-.01313 (-1.02)	-.025 (-.66)	.00420 (1.08)	-.004(-.34)	.0086 (1.83)	-.009 (-.64)
Man's University	-.05293 (-3.0)	.031 (.72)	.00537 (1.0)	-.007 (-.59)	.0038 (.59)	-.006 (-.37)
Woman's Primary	.01182 (.63)	-.081 (-1.15)	.00491 (.86)	-.007(-.34)	-.0028 (-.41)	.024 (.93)
Woman's Secondaryr	-.0392 (-1.04)	.024 (.21)	-.00474 (-.41)	.019 (.57)	.0053 (.38)	.027 (.65)
Woman's University	-.09944 (-.98)	.056 (.26)	.00422 (.14)	.023 (.36)	.0071 (.19)	.062 (.80)
Urban	.01208 (1.76)	-.029 (-1.56)	-.00631 (-3.03)	.012 (2.06)	-.0019 (-.75)	-.006 (-.85)
Executive	-.01658 (-1.1)	.023 (.73)	.00231 (.50)	.008 (.80)	.0062 (1.12)	-.018 (-1.55)
Laborer	-.02508 (-2.7)	.052 (2.01)	-.00017 (-.06)	.005 (.63)	-.0021 (-.60)	.004 (.45)
Businessman	-.05054 (-4.4)	.114 (3.42)	-.00171 (-.49)	.007(.70)	-.0018 (-.43)	-.008 (-.70)
Own home.	.00601 (.78)	-.014 (-.73)	-.00003 (-.01)	-.001 (-.10)	.0072 (2.6)	-.009 (-1.30)
Car	-.04601 (-4.8)	.071 (2.3)	-.00692 (-2.37)	-.001 (-.09)	-.0096 (-2.7)	.020 (1.81)
Num. durables	-.00198 (-1.5)	-.003 (-.83)	-.00158 (-4.01)	.002 (2.14)	-.00065 (-1.4)	.001 (.71)
Constant	1.8874 (11.2)	1.17 (2.36)	-.29809 (-5.8)	.153 (1.02)	-.1623 (-2.6)	-.492 (-2.72)
$E(v_{2j}\varepsilon) - E(v_{1j}\varepsilon)$	.01083 (.06)		.0475 (.92)		.0632 (1.01)	
$\chi^2(16)$ region	50.55*	22.78	84.37*	29.75*	37.59*	27.03*

TABLE 5. (continue)

Variable	CLEAN HOUSE $\beta_2(t)$	CLEAN HOUSE $\beta_1-\beta_2(t)$	HEALTH $\beta_2(t)$	HEALTH $\beta_1-\beta_2(t)$	PERSONAL CARE $\beta_2(t)$	PERSONAL CARE $\beta_1-\beta_2(t)$
$\ln(X/n)$	-.0437 (-10.5)	.040 (4.12)	.00815 (2.9)	-.014 (-2.12)	.0071 (5.9)	-.005 (-1.94)
Man's labor income	.0037 (1.03)	-.002 (-.21)	-.0036 (-1.5)	.013 (2.02)	.0013 (1.3)	-.006 (-2.01)
Woman's labor income	.00024 (.05)	.023 (2.15)	-.0057 (-1.88)	.006 (.87)	-.0018 (-1.4)	.004 (1.39)
$\ln(n)$	-.0368 (-.97)	.093 (.81)	-.0834 (-3.3)	.088 (1.14)	.0011 (.10)	-.007 (-.21)
n1/n	-.0779 (-1.27)	.204 (.94)	.1604 (3.9)	.067 (.46)	.0037 (.21)	-.137 (-2.18)
n2/n	-.0596 (-.93)	.092 (.39)	.1347 (3.1)	-.019 (-.12)	.01702 (.92)	-.167 (-2.5)
n3/n	-.0467 (-.71)	-.037 (-.15)	.1449 (3.3)	-.035 (-.22)	.0129 (.68)	-.165 (-2.39)
n4/n	-.0458 (-.69)	-.097 (-.40)	.1295 (2.9)	-.018 (-.11)	.0166 (.87)	-.159 (-2.27)
na1/n	-.0769 (-2.4)	.175 (1.12)	.0254 (1.2)	.101 (.96)	.0259 (2.8)	-.192 (-4.25)
na2/n	-.01746 (-.82)	.040 (.27)	.0151 (1.06)	.132 (1.32)	.0193 (3.2)	-.176 (-4.01)
Man's age	-.0029 (-1.57)	.011 (2.02)	-.00142 (-1.1)	.00 (.03)	-.0002 (-.32)	.001 (.71)
Man's age^2	.00003 (1.5)	-.00 (-1.54)	5.7e-6 (.42)	.00 (.75)	1.8e-6 (.30)	-.00 (-.53)
Man's Primary	-.0027 (-.39)	.018 (.83)	-.0087 (-1.93)	.026 (1.8)	.0019 (.99)	-.003 (-.53)
Man's Secondary	-.0042 (-.59)	.021 (1.04)	-.0041 (-.86)	.029 (2.13)	.0029 (1.44)	-.002 (-.33)
Man's University	.0029 (.30)	.031 (1.32)	.0109 (1.7)	.002 (.13)	.0068 (2.44)	-.002 (-.24)
Woman's Primaryr	.0042 (.40)	-.024 (-.61)	-.0006 (-.09)	.015 (.59)	.0033 (1.13)	-.009 (-.79)
Woman's Secondary	.0104 (.50)	-.041 (-.65)	.0499 (3.5)	-.089 (-2.1)	.0122 (2.03)	-.031 (-1.72)
Woman's university	.1472 (2.63)	-.228 (-1.95)	.0558 (1.49)	-.094 (-1.21)	.0167 (1.04)	-.045 (-1.34)
Urban	-.0091 (-2.42)	.009 (.85)	-.0031 (-1.2)	-.003 (-.45)	.0009 (.88)	.002 (.63)
Executive	.0134 (1.6)	-.032 (-1.85)	.0017 (.30)	.00 (.02)	.0008 (.31)	-.002 (-.45)
Laborer	.0148 (2.8)	-.044 (-3.03)	-.00004 (-.01)	.009 (.98)	-.0011 (-.75)	-.001 (-.22)
Businessman	.0202 (3.3)	-.044 (-2.41)	.0030 (.72)	.010 (.85)	-.0003 (-.19)	-.00 (-.05)
Own home	.01002 (2.4)	-.008 (-.78)	-.00067 (-.24)	.001 (.18)	.0024 (2.01)	-.004 (-1.31)
Car	-.0050 (-.95)	-.012 (-.69)	-.00063 (-.18)	-.007 (-.63)	.0007 (.46)	-.013 (-2.65)
Num. durables	.00088 (1.24)	.003 (1.75)	.0008 (1.7)	-.00 (-.24)	.0008 (3.97)	-.002 (-3.84)
Constant	.7459 (8.07)	-1.18 (-4.33)	.1831 (2.96)	-.328 (-1.8)	-.0828 (-3.1)	.318 (4.05)
$E(v_{2j}\varepsilon)-E(v_{1j}\varepsilon)$	-.0452 (-.48)		-.1478 (-2.35)		-.0578 (-2.13)	
$\chi^2(16)$ region	35.03*	17.3	14.44	13.58	12.42	22.09

TABLE 5. (continue)

Variable	TRANSPORTATION		HOME ENTERTAINMENT		OUTSIDE HOME ENTERT.	
	$\beta_2(t)$	$\beta_1-\beta_2(t)$	$\beta_2(t)$	$\beta_1-\beta_2(t)$	$\beta_2(t)$	$\beta_1-\beta_2(t)$
$\ln(X/n)$	-.0022 (-.40)	.001 (.05)	.0131 (5.4)	-.005 (-.91)	.0565 (8.7)	.006 (.41)
Ingreso lab. hombre	-.0081 (-1.7)	.019 (1.46)	-.0006 (-.29)	-.008 (-1.44)	-.00015 (-.02)	.007 (.49)
Ingreso lab. mujer	.01318 (2.24)	-.038 (-2.71)	-.0051 (-1.94)	.011 (1.84)	.01395 (2.0)	-.025 (-1.53)
$\ln(n)$	.0031 (.06)	.067 (.45)	-.0203 (-.93)	.018 (.26)	-.0356 (-1.12)	.414 (2.31)
n1/n	-.0937 (-1.2)	.258 (.91)	.0774 (2.18)	-.143 (-1.14)	.0952 (1.0)	-1.05 (-3.12)
n2/n	-.0979 (-1.2)	.295 (.97)	.0554 (1.48)	-.083 (-.61)	.0964 (.97)	-.945 (-2.63)
n3/n	-.0840 (-.97)	.273 (.87)	.0466 (1.22)	-.061 (-.44)	.1063 (1.04)	-.960 (-2.59)
n4/n	-.1018 (-1.2)	.347 (1.1)	.0540 (1.41)	-.024 (-.17)	.1813 (1.78)	-1.10 (-2.93)
na1/n	-.0965 (-2.3)	.592 (2.90)	.0124 (.66)	-.035 (-.39)	.0086 (.17)	-.237 (-.98)
na2/n	-.0196 (-.71)	.442 (2.27)	.0056 (.45)	-.010 (-.11)	-.0301 (-.92)	-.222 (-.95)
edad hombre	-.0025 (-1.0)	.002 (.24)	.0014 (1.26)	-.004 (-1.40)	-.0020 (-.68)	.016 (1.96)
edad hombre^2	.00001 (.5)	-.00 (-.03)	-.00001 (-1.0)	.00 (.85)	.00002 (.61)	-.0002 (-2.3)
EGB hombre	.0106 (1.2)	-.035 (-1.25)	.0084 (2.14)	-.025 (-1.96)	-.0111 (-1.06)	.052 (1.54)
Medios hombre	.0165 (1.78)	-.030 (-1.11)	.0056 (1.37)	-.015 (-1.23)	-.0097 (-.88)	.049 (1.51)
Univers. hombre	.0027 (.21)	-.002 (-.08)	.0042 (.75)	.004 (.28)	.0139 (.92)	-.007 (-.19)
EGB mujer	-.0187 (-1.4)	.083 (1.62)	-.0035 (-.59)	.015 (.65)	-.0040 (-.25)	-.021 (-.35)
Medios mujer	-.0040 (-.15)	.064 (.78)	-.0061 (-.50)	.018 (.48)	.0167 (.52)	-.107 (-1.09)
Univers. mujer	-.0031 (-.04)	.089 (.58)	.0408 (1.26)	-.059 (-.87)	-.0439 (-.51)	-.036 (-.20)
Urbano	.0035 (.70)	-.006 (-.45)	.0019 (.85)	-.001 (-.13)	-.0057 (-.98)	.027 (1.67)
Ejecutivo	-.0113 (-1.04)	.024 (1.06)	.0100 (2.06)	-.014 (-1.38)	-.0060 (-.46)	-.011 (-.40)
Obrero	.0039 (.58)	-.020 (-1.05)	.0014 (.46)	-.002 (-.29)	.0115 (1.44)	-.020 (-.89)
Empresario	.0094 (1.14)	-.043 (-1.82)	.0001 (.04)	-.001 (-.13)	.0318 (3.24)	-.052 (-1.85)
Vivienda pro.	.0020 (.37)	-.004 (-.32)	-.0054 (-2.23)	.012 (1.96)	.0012 (.19)	-.019 (-1.13)
Coche	.0891 (12.9)	-.033 (-1.51)	-.0037 (-1.2)	.006 (.60)	-.0033 (-.41)	-.043 (-1.62)
Num. bienes equipo	.00005 (.05)	.001 (.48)	.0015 (3.6)	-.001 (-.57)	-.0007 (-.67)	-.002 (-.63)
Constante	.1285 (1.07)	-.351 (-.99)	-.1223 (-2.28)	.182 (1.15)	-.7263 (-5.06)	.109 (.26)
$E(v_{2j}\varepsilon)-E(v_{1j}\varepsilon)$	.0174 (.14)		.01413 (.26)		-.0056 (-.04)	
$\chi^2(16)$ región	15.37	13.34	11.18	18.04	38.19*	25.18

CUADRO 5. (continúa)

Variable	ALCOHOL AND TOBACCO $\beta_2 (t)$	ALCOHOL AND TOBACCO $\beta_1 - \beta_2 (t)$	CHID CONSUMPTION $\beta_2 (t)$	CHID CONSUMPTION $\beta_1 - \beta_2 (t)$
$\ln (X/n)$	-.0180 (-3.4)	.015 (1.42)	.0049 (.83)	-.010 (-.76)
Man's laboral income	-.0005 (-.25)	-.003 (-.56)	-.0027 (-.72)	.004 (.38)
Woman's laboral income	.0015 (.59)	-.005 (-.88)	.0023 (.47)	-.00 (-.03)
$\ln(n)$	-.0014 (-.06)	.076 (1.14)	-.0496 (-.99)	.188 (1.14)
n1/n	-.0501 (-1.4)	-.011 (-.09)	.1583 (1.57)	-.227 (-.68)
n2/n	-.0497 (-1.3)	-.009 (-.07)	.1832 (1.80)	-.257 (-.75)
n3/n	-.0458 (-1.2)	-.019 (-.14)	.1935 (1.90)	-.276 (-.80)
n4/n	-.0325 (-.86)	-.063 (-.45)	.1766 (1.75)	-.255 (-.74)
na1/n	.0125 (.69)	.022 (.25)	.0609 (1.77)	-.099 (-.59)
na2/n	-.0003 (-.03)	.038 (.45)	.0141 (.63)	-.034 (-.21)
Man's age	-.0031 (-2.89)	.003 (1.06)	.0016 (.79)	.003 (.51)
Man's age^2	.00002 (2.13)	-.00 (-.53)	-5.5e-6 (-.25)	-.00 (-.85)
Man's Primary	-.0066 (-1.7)	.019 (1.58)	.0076 (1.05)	-.029 (-1.24)
Man's Secondary	-.0052 (-1.2)	.009 (.80)	.0011 (.15)	-.017 (-.79)
Man's University	-.0036 (-.65)	.0005 (.04)	.0097 (.94)	-.036 (-1.41)
Woman's Primary	.0080 (1.36)	-.029 (-1.3)	.00017 (.02)	.013 (.31)
Woman's Secondary	.0062 (.52)	-.027 (-.74)	.0008 (.04)	.013 (.20)
Woman's University	-.0042 (-.13)	-.024 (-.37)	-.0656 (-1.1)	.121 (.97)
Urban	.0030 (1.17)	-.007 (-1.08)	-.0103 (-2.52)	.032 (2.88)
Executive	.0013 (.27)	-.00 (-.01)	.0054 (.60)	-.010 (-.56)
Laborer	-.0039 (-1.36)	.009 (1.08)	-.0018 (-.33)	-.001 (-.05)
Businessman	-.0060 (-1.46)	.014 (1.28)	-.0015 (-.22)	.003 (.15)
Own home	-.0075 (-2.92)	.004 (.68)	-.0070 (-1.55)	.030 (2.59)
Car	-.0052 (-1.56)	-.002 (-.016)	-.00116 (-.20)	-.003 (-.19)
Num. durables	.00003 (.06)	-.001 (-.65)	-.0008 (-1.08)	.003 (1.40)
Heckman Lambda	-.0369 (-1.51)	.037 (.66)	-.0340 (-2.91)	.028 (.94)
Constant	.3853 (4.45)	-.257 (-1.27)	-.0459 (-.41)	-.116 (.71)
$\mathrm{E}(v_{2j}\varepsilon) - E(v_{1j}\varepsilon)$	-.0423 (-.79)		.0817 (.81)	
$\chi^2 (16)$ region	32.30*	17.26	34.54*	26.40*

APPENDIX 2. The Relationship between expenditure and consumption

The following three sections discuss the measurement of the dependent variables, goods consumption, based on expenditure data. Finally, the problem of the endogeneity or measurement error for total household expenditure is solved.

The Estimate for Food Consumption

The record for expenditure on food in the "Encuesta de Presupuestos Familiares " computes expenditure during the sample week. To determine the amounts for this good in the Consumer Price Index, the Spanish Statistics Institute considers annual consumption to be equal to weekly expenditure multiplied by 52. This measurement overestimates the consumption of food for households that have made a bulk purchase during the sample week and underestimates the consumption of food for households that made bulk purchases in prior weeks. The availability of information in the "Encuesta de Presupuestos Familiares" on bulk purchases during the sample week and/or in the three weeks prior to the sample week has made it possible to estimate the annual consumption of foodstuffs correcting this phenomenon (Peña and Ruiz-Castillo, 1998).

Infrequency of Purchase

If a household has not made any purchases of men's clothing, women's clothing, health, personal care, home entertainment, entertainment outside the home, or other expenses during the survey reference period, this does not mean that annual consumption of these goods is null. Given the nature of these goods, we assume that households consume them regularly over the course of the year.

We model the probability of purchase for the good j using the indicator variable:

$$I_j = \mathbf{I}(s\theta_j + \omega_j) \quad \text{with} \quad \omega_j \sim N(0,1) \tag{1}$$

with $I_j = 1$ if $e_j > 0$, with $I_j = 0$ if $e_j = 0$. Based on this probit model we find the purchase probability to be:

$$p_j = \Pr(I_j = 1) = \Pr(e_j > 0|q_j, s_j) = \Phi(s_j\theta) \tag{2}$$

where e_j is the observed expenditure, q_j is the consumption, and s_j is a vector of variables that determine the probability of purchase.

The fundamental relationship between expenditure and consumption is:

$$E(e_j|q_j, s_j) = E(e_j|I_j = 1)p_j + E(e_j|I_j = 0)(1 - p_j) = E(e_j|I_j = 1)p_j \equiv q_j. \tag{3}$$

Since the probability is less than one, the identity (3) implies that the expenditure observed, when it is positive, exceeds the level of services consumed. Using this identity, the relationship of expenditure to consumption is:

$$p_j e_j = q_j + p_j u_j, \tag{4}$$

where the error u_j captures the random discrepancies between the expenditure and consumption processes (Bundell and Meghir, 1987). From (4) we obtain the relationship between the variable observed, e_j, and the unobserved consumption q_j:

$$e_j = \begin{cases} q_j/p_j + u_j, & \text{if } I_j = 1; \\ 0, & \text{if } I_j = 0. \end{cases} \tag{5}$$

If we describe the consumption process using the following Engel curve:

$$q_j = \psi_j(X, y_1, y_2, z) + v_j, \tag{6}$$

and we take into account that $X = \sum_{j=1}^{12} q_j$, then X is not directly observable. To estimate X, we adopt Meghir and Robin's (1992) proposal, according to which it is assumed that $u_j = 0$. This gives us a structure for total household expenditure as a weighted sum of the various consumptions and eliminates the error of unobservable measurement. This assumption implies that we can explain all the discrepancies between leisure and consumption through the purchase decision-making process.

We assume that the errors in the Engel curves and the purchase decision-making process are independent, just as Blundell and Meghir (1987), Meghir and Robin (1992) and Sanchis-Llopis (1999). This assumption implies that we do not commit selection bias by the separate estimation of (1) and (6).

The two stages estimator proposed by Meghir and Robin (1992) gives us consistent estimators for the Engel curves (6), given the structure of the model and the prior assumptions. Due to the nature of our data and our problem, we adopted the following modifications with respect to the Meghir and Robin (1992) estimator:

i) When a dependent variable is zero, we use its prediction, previously estimated based on the same model. Thus we are able to use all households in estimating the Engel curve systems, since if we only use households that have positive expenditure on all goods, as Meghir and Robin (1992) did, our sample would be considerably smaller.

ii) We did not use the Meghir and Robin (1992) proposal in estimating the matrix of variances and covariances of the estimator in two stages since our vector of explanatory variables for the probability of purchase does not coincide with the instruments vector. Instead, we used the method proposed by Murphy and Topel (1985).

Abstention from Consumption

For group IV goods (vices and child-related consumption) we assume that when we observe expenditure equal to zero, this is due to voluntary abstention from consumption, rather than to a corner solution. That is, a price change will not stimulate consumption. The appropriate statistical model for this case is a double-hurdle model. Specifically, we use Jones's (1989) proposal, plausibly assuming in the case of these two types of goods that the participation decision (to spend) dominates the consumption decision (first hurdle dominance). That is, the decision to smoke or not to smoke or to have or not to have children dominates the decision to consume. Jones demonstrates that the likelihood function under this assumption coincides to the Heckman (1979) selection model. Therefore, the technique we use to estimate the Engel curves for these goods is the Heckman estimator in two stages. In the first stage we estimate the probability of expenditure on these goods (participation). Based on these probabilities, in the second stage we correct the selection bias due to the relationship of the probability of expenditure and the consumption process.

The Endogeneity of Total Household Consumption

Delgado and Miles (1996), using data from the "Encuesta de Presupuestos Familiares" 1980-81, discuss the endogeneity of total expenditure for a Working-Leser specification of the Engel curve for food. They conclude that rejection of the Hausman test depends on the instruments chosen and on the sub-sample considered. They warn against bias that can occur in estimations if the mechanism of estimating by instrumental variables is adopted automatically. In our case, we have two reasons justifying estimation based on instrumental variables. The first is that in estimating a system of Engel curves the aggregation property defines total household consumption as the sum of the consumptions of goods and, therefore, the marginal distribution of total consumption is related to the conditioned distributions of the goods. That is, total consumption is endogenous. The second is that total consumption is affected by measurement errors since it is estimated as a sum of components that include measurement errors. The measurement error for total household consumption correlates to the errors for the Engel curves.

First, we choose the usual instruments: the total household income logarithm and the same squared. The correlations between these variables and the logarithm for per capita household expenditure are 0.4418 and 0.4454, respectively. The probabilities of purchase for group III and IV goods show a high correlation with X. Given the assumptions of independence of the consumption and purchase decision-making processes ($E(v_j \omega_j) = 0$), and of non-existence of random discrepancies between expenditure and consumption ($u_j = 0$), the probabilities of purchase, which are a non-linear combination of demographic variables and household features, can be used as instruments. In the Engel curve system made up of goods of groups I, II, and III we used the probabilities of purchase for vices, child-related consumption, and other expenses as instruments. In the Engel curve system for the two goods of group IV we used the probabilities of purchase for men's clothing, women's clothing, and leisure outside the home as instruments.

APPENDIX 3. Correction of the variances and covariances matrix

The generated regressors that enter the Engel curve system as explanatory variables add a term of error that produces an increase in the variances for the estimated parameters. We calculate the asymptotic distribution of the two stages linear ordinary least squares estimator using Murphy and Topel's (1985) methodology.

We start from the expressions of the stochastic process and the generated regressors that we use on the right-hand side of the Engel curve.

$$I_j = \mathbf{I}(s\theta_j + w_j) \rightarrow \Pr(I_j = 1) = \Phi(s\theta_j) \qquad \text{(purchase probability)}$$

$$X = \sum\nolimits_{j\in I} q_j + \sum\nolimits_{j\in II} e_j + \sum\nolimits_{j\in III} \Phi(s\theta_j)e_j + \sum\nolimits_{j\in IV} e_j$$

$$y_2 = W_Y\eta_Y + \varepsilon_Y \qquad \text{(ln of potential woman's labor income)}$$

$$P = I(W_p\eta_p + \varepsilon_p) \rightarrow \Pr(P = 1) = \Phi(W_p\eta_p) \qquad \text{(labor participation)}$$

$$\ln(X/n) = Q\gamma_1 + v_1 \qquad \text{(prediction of} \ln(X/n))$$

The parameters for these equations are estimated in the first stage and the variances and covariances matrix for these parameters is a matrix of dimension $P = p_1 + p_2 + p_3 + p_4$, which are, respectively, the number of parameters for $\gamma_1, \theta, \eta_Y, \eta_p$, with the following form:

$$V(\Theta) = \begin{pmatrix} V(\gamma_1) & & & \\ 0 & V(\theta) & & \\ 0 & 0 & V(\eta_i) & \\ 0 & 0 & 0 & V(\eta_p) \end{pmatrix}.$$

To construct the matrix $V(\theta)$, we have assumed that there is no correlation between the purchase probabilities of the various goods, and therefore this matrix is a block-diagonal matrix.

In the second stage we used Ordinary Least Squares to estimate the new Engel curve system for group I, II, and III goods. We denote V_b the variances and covariances matrix for the parameters of the Engel curve system, allowing heteroskedasticity.

Expressing the Engel curves based on the estimated regressors in the first stage and the rest of the regressors that we will group together in matrix $\mathbf{Z}$ (it is not the vector of household characteristics), we built the following matrices:

$$A = (\,1 \quad \ln(X/n) \quad y_2 \quad \mathbf{Z} \quad \Phi_p \quad \Phi_p \ln(X/n) \quad \Phi_p y_2 \quad \Phi\mathbf{Z} \quad \phi\,)$$

$$\widehat{A} = \big(1 \quad \ln\widehat{(X/n)} \quad \widehat{y_2} \quad \mathbf{Z} \quad \widehat{\Phi_p} \quad \widehat{\Phi_p}\ln\widehat{(X/n)} \quad \widehat{\Phi_p}\widehat{y_2} \quad \widehat{\Phi}\mathbf{Z} \quad \widehat{\phi}\big)$$

$$A1 = (\,\ln(X/n) \quad y_2 \quad \Phi_p \quad \Phi_p \ln(X/n) \quad \Phi_p y_2 \quad \Phi\mathbf{Z} \quad \phi\,)$$

$$\widehat{A1} = \big(\ln\widehat{(X/n)} \quad \widehat{y_2} \quad \widehat{\Phi_p} \quad \widehat{\Phi_p}\ln\widehat{(X/n)} \quad \widehat{\Phi_p}\widehat{y_2} \quad \widehat{\Phi}\mathbf{Z} \quad \widehat{\phi}\big)$$

such that the Engel curve for the good j is

$$w_j = AB_j + u_j = \widehat{A}B_j + (A1 - \widehat{A1})B1_j + u_j.$$

The Ordinary Least Squares estimator for this Engel curve is

$$\widehat{B_j} = (\widehat{A}'\widehat{A})^{-1}\widehat{A}'w_j = B_j + (\widehat{A}'\widehat{A})^{-1}\widehat{A}'(A1 - \widehat{A1})B1_j + (\widehat{A}'\widehat{A})^{-1}\widehat{A}'u_j.$$

Using the Murphy and Topel (1985) method, we show that

$$\sqrt{n}(\widehat{B}_j - B_j) =^A (n^{-1}\widehat{A}'\widehat{A})^{-1}n^{-1}\widehat{A}'F_j^*(\sqrt{n}(\Theta - \widehat{\Theta}))(n^{-1}\widehat{A}'\widehat{A})^{-1}n^{-1/2}\widehat{A}'u_j$$

where F_j^* is a matrix n$\times P$ with $P = p_1 + p_2 + p_3 + p_4$.

$$F_j^* = \Big(\frac{\partial\widehat{A1}B1_j}{\partial\gamma_1'}, \frac{\partial\widehat{A1}B1_j}{\partial\theta'}, \frac{\partial\widehat{A1}B1_j}{\partial\eta_Y'}, \frac{\partial\widehat{A1}B1_j}{\partial\eta_p'}\Big).$$

To calculate these derivatives we had to take into account the following expressions:

$$\ln\widehat{(X/n)} = Q\widehat{\gamma_1} = P_Q \ln(\frac{X(\theta)}{n}), \qquad P_Q = Q(Q'Q)^{-1}Q'$$

$$\widehat{y_1} = W_Y\widehat{\eta_Y}$$

$$\widehat{\Phi_p} = \Phi(W_p\widehat{\eta_p})$$

$$\widehat{\Phi_p}\,\widehat{\ln(X/n)} = \Phi_p(W_p\widehat{\eta_p})Q\widehat{\gamma_1} = P_Q\Phi(W_p\widehat{\eta_p})\ln(X/n)$$

$$\widehat{\Phi_p}\widehat{y_1} = \Phi(W_p\widehat{\eta_p})W_i\widehat{\eta_i}$$

$$\widehat{\Phi_p}x_k = \Phi(W_p\widehat{\eta_p})x_k \qquad \text{for} \qquad k = 1, ...k_x$$

$$\widehat{\phi_p} = \frac{1}{\sqrt{2\pi}}e^{-(W_p\widehat{\eta_p})^2/2}$$

(The multiplication of matrices is considered element to element) Calculating the derivatives for the matrix F_j^* gives us:

$$
\begin{aligned}
&\frac{\partial \widehat{A1}B1_j}{\partial \gamma_1'} = B1_{j1}Q + B1_{j4}\Phi_p Q \\
&\frac{\partial \widehat{A1}B1_j}{\partial \theta_{ik}} = B1_{j1}P_Q\frac{\phi_p s_i e_k}{X} + B1_{j4}P_Q\Phi_p\frac{\phi_p s_i e_k}{X}, \qquad k \in \text{group III} \\
&\frac{\partial \widehat{A1}B1_j}{\partial \eta_Y} = B1_{j2}W_Y + B1_{j5}\Phi_p W_Y \\
&\frac{\partial \widehat{A1}B1_j}{\partial \eta_p} = B1_{j3}\Phi_p W_p + B1_{j4}P_Q\ln(X/n)\Phi_p W_p + B1_{j5}(W_i\widehat{\eta_i})\phi_p W_p + \\
&+ B1_{j6}\phi_p W_p \mathbf{Z} + B1_{j7}(-\phi)(W_p\widehat{\eta_p})W_p
\end{aligned}
$$

Once the matrix F^* has been built, we calculate the following matrix:

$$C_j = n^{-1}\widehat{A}'F_j^*.$$

The parameters for the purchase probability and probability of the woman's labor participation are estimated by the maximum likelihood method, while the parameters for the instrumental equation for expenditure and the woman's potential labor income are estimated by the Ordinary Least Squares method. Therefore, we have the following asymptotic distribution

$$\sqrt{n}(\Theta - \widehat{\Theta}) =^A V(\Theta)\sqrt{n}\begin{pmatrix} Q'v_1 \\ l'(s,\theta) \\ W_Y'\varepsilon_Y \\ l'(W_p,\eta_p) \end{pmatrix}$$

where $l()$ is the gradient for the likelihood function of the probit models:

$$l(z,\theta) = \sum_{h=1}^{n}\frac{\phi(s_h'\theta_j)}{\Phi(s_h'\theta_j)}z_h', \qquad \text{for} j \in \text{group III and} \qquad l(W_p,\eta_p) = \sum_{h=1}^{n}\frac{\phi(W_{ph}'\eta_p)}{\Phi(W_{ph}'\eta_p)}W_{ph}'.$$

$Q'v_1$ and $W_i'\varepsilon_i$ are the derivatives of the objective function for the Ordinary Least Squares regressions. We estimate the matrix

$$R_j = \widehat{A}'v_j\begin{pmatrix} Q'v_1 \\ l'(s,\theta) \\ W_Y'\varepsilon_Y \\ l'(W_p,\eta_p) \end{pmatrix}.$$

With this notation, we demonstrate that the variances and covariances matrix for the estimators for each Engel curve is:

$$V_{b_j}^* = V_{b_j} + V_{b_j}[C_j V(\Theta) C_j' - C_j V(\Theta) R_j' - R_j V(\Theta) C_j'] V_{b_j}$$

And the variances and covariances matrix for the parameters of the system is

$$V_b^* = V_b + V_b[CV(\Theta)C' - CV(\Theta)R' - RV(\Theta)C']V_b$$

where $C = (C_1 : C_2 : .. : C_9)'$ and $R = (R_1 : R_2 : .. : R_9)'$.

To correct the variances and covariances matrix for the Engel curve system for group IV goods (vices and child-related consumption), we had to take into account an additional generated regressor: the Heckman lambda that corrects the selection bias. This variable is estimated based on the purchase probabilities for vices and child-related consumption. These are based on a new set of parameters θ_k. The matrices that must be added to the matrices C_j and R_j are, respectively, :

$$\frac{\partial \widehat{A1} B1_j}{\partial \theta_{ik}} = B1_{j8} \frac{\partial \lambda(s\theta_k)}{\partial \theta_{ik}} = B1_{j8} \frac{-\phi_k s_i (\Phi_k + \phi_k)}{\Phi_k^2} \qquad \text{for} \qquad k \in \text{group IV}$$

$$l(s, \theta_k) = \sum_{h=1}^{n} \frac{\phi(s_h' \theta_k)}{\Phi(s_h' \theta_k)} s_h'$$