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ESTIMATION OF THE WELFARE EFFECTS OF INDIRECT TAX CHANGES ON SPANISH HOUSEHOLDS: AN ANALYSIS OF THE 1992 VAT REFORM *

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In this paper we estimate a Linear Expenditure System (LES) using micro data for several categories of consumption goods paying particular attention to the way demographic characteristics affect the consumption patterns of Spanish households. Then in a second step, we obtain measures for the welfare impact of the VAT reform of 1992 and comparisons of the subsistence expenditures associated to different demographic structures. This analysis is also done at the household level. In both estimation and simulation we use data from the Continuous Family Expenditure Survey for the period 1985-89. The results suggest that the impact of demographics is important in determining consumption patterns and therefore can provide useful evidence when calculating the effects of tax reforms on different types of households.

1. Introduction

A considerable amount of research has been devoted to investigate the decisions of households regarding allocation of expenditures within periods, choice of hours of work or distribution of consumption between periods. Most of these studies allow the demographic characteristics of the individuals (potentially correlated with income) to affect their decisions. There are many reasons which support the introduction of socio-economic factors into the analysis. This inclusion allows the researchers, first, to combine heterogeneous households within the same specification for the equation of interest. Second, to throw some light on the behaviour of families with different demographic structures. Third, and perhaps more important, to make welfare comparisons across households.

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In this paper we estimate a complete demand system for Spain and we obtain measures for the welfare impact of the 1992 VAT reform. We try to solve two related controversies before estimation: the choice of a suitable functional form for the demand equations and the appropriate introduction of demographic characteristics within the specification. Both questions are important for the welfare comparisons to be valid and had been a matter of great preoccupation in the literature on demand analysis [1].

Our analysis is applied to Spain with a pool of cross-sections from the Continuous Family Expenditure Survey (ECPF) for the period 1985-89 and our first goal was to choose a flexible functional form in order to adequately accommodate flexible price responses. This attempt failed because price effects were not estimable due to their scarce variability during the time span of our sample. As a result, with the data at hand, we adopt a generalization of the Linear Expenditure System (LES) in which the different demographic structures are introduced using a household production framework. The restrictions embodied in the LES guarantee the retrieval of a cost function from data sets without price variation. It should be clear at the outset, however, that the estimates for such a system can only be considered as a summary of the information contained in the data set being used without any value as a tool to predict new levels of expenditure after a tax reform, say. Further, evidence from other studies suggests that the additive separability assumption we are forced to invoke would not pass a statistical test if our data set have allowed its computation. In these circumstances, the results from this exercise have to be taken with the necessary caution.

On the side of the econometric implementation, an important problem which arises when estimating a demand system with household data is that of zero expenditures even when some aggregation across goods is done.[2] We will also comment upon the method chosen to deal with this problem, which also highlights the usefulness of demographic variables and upon some alternative econometric approaches.

Our results suggest that the impact of demographics is important in determining consumption patterns and they may, with the necessary caveats, constitute a source of relevant information at the time of designing tax changes, since they permit to approximate the level of subsistence needs for each good associated to different demographic structures. Another interesting result is that although the reform we simulate is the first which contemplates a decrease in the reduced rate which is applied to necessities, the majority of households experience welfare losses which increase with the number of children..

The rest of the paper is structured as follows. In Section 2 we justify the convenience and interest of the model. In Section 3 we present the data and

[1] See, for instance, Deaton and Muellbauer (1980), Deaton (1981), King (1983) or Blundell and Walker (1984).

[2] See Wales and Woodland (1983), Pudney (1985), Lee and Pitt (1986), Kay et al. (1984), Keen (1987), Blundell and Meghir (1987) or Meghir and Robin (1992).

review the main econometric issues for estimating the system. The estimation results and a simple simulation exercise trying to highlight their usefulness for welfare comparisons are presented in Section 4. Section 5 summarizes and suggests some possible extensions.

2. Justification and interest of the model

2.1. Overall framework

An attractive way of considering the effects of demographic variables on consumption is provided by the so-called household production framework. Its basic postulate is that utility is derived from a set of intermediate goods (e.g. cooked meals) not directly available in the market but which, instead, are the result of marketed inputs and a production technology specific to the household. In this context, Lewbel (1985) shows how demographics can be incorporated to the household cost function as the arguments of some «modifier» functions that pick up this particular technology for processing market goods into intermediate goods. Thus it is possible to extend an usual cost function, $\tilde{E}$ below, to take into account the household production technology in the following fashion:

$$E(p, z, \bar{u}) = \tilde{E}(p, z, \bar{u}) + C(p, z) \qquad [1]$$

where p are prices, $\bar{u}$ is a given level of utility and z is a vector of demographic characteristics. The second term of the right hand side is interpreted as the cost of maintaining the given demographic structure.

A particular parameterization of this modified cost function is given in Blundell and Walker (1984) through the following expressions:

$$\tilde{E}(p, z, \bar{u}) = A(p) + B(p, z)\,\bar{u} \qquad [2]$$

where:

$$A(p) = \sum_i \sum_j \alpha_{ij}\, p_i^{1/2}\, p_j^{1/2} \qquad [3]$$

$$B(p, z) = \prod_i p_i^{\beta_i(z)} \qquad [4]$$

and

$$C(p, z) = \sum_i \sum_j \gamma_{ij}(z)\, p_i^{1/2}\, p_j^{1/2} \qquad [5]$$

which by Sheppard's lemma and substitution give rise to the following demand equations in budget share form:

$$w_i = \sum_j \left[\alpha_{ij} + \gamma_{ij}(z)\right] \mu_i^{1/2}\, \mu_j^{1/2} + \beta_i(z) \left\{1 - \sum_i \sum_j \left[\alpha_{ij} + \gamma_{ij}(z)\right] \mu_i^{1/2}\, \mu_j^{1/2}\right\} \qquad [6]$$

with $\mu_i = p_i / Y$, where Y is full expenditure.

Note that this demand function nests Stone's LES. In particular, the restriction $\alpha_{ij} = 0$ for all $i \neq j$ imposes additive separability, $\gamma_{ij} = 0$ for all $i \neq j$ implies the absence of substitution within the technology function and $\gamma_{ij} = 0$ for all $i \neq j$ and $\beta_i(z) = \beta_i$ for all i determines the separability of demands from demographic characteristics.

2.2. *Lack of price variation and additive separability*

The last of the issues quoted relates to the nature of the effects of changes in household characteristics on demands.[3] The two first issues, on the other hand, are connected with the possibilites of substituting among commodities when relative prices change. In order to estimate them, the researcher must have available data sets on which these effects are well defined but it is often the case that budget surveys do not have a long enough temporal dimension so as to ensure their identification. Such is unfortunately the case with demand data from Spanish households. As we have argued elsewhere, relative price variation over the period for which recent budget surveys are available does not grant the identification of many cross-price responses.[4] In the particular case of the non-linear model of equation [6], it is easy to check that minimization routines fail to converge due to multicollinearity of the regressors.[5]

Although not the unique way to solve this problem,[6] to resort to additive separability has been a frequent solution to the absence of relative price variation in applied demand analysis. Coupled with the other two restrictions,[7] additive separability turns equation [6] into the following demand system:

$$w_i = \gamma_i(z)\,\mu_i + \frac{\beta_i}{Y}\left(Y - \sum_j p_j \gamma_j(z)\right) \quad i, j = 1, \ldots, n \qquad [7]$$

[3] When separability holds, demographic changes do not act merely as income effects but also induce substitution between commodities.

[4] Labeaga and López (1993a) present a principal components analysis of relative price variation in Spain over the decade of the eighties and estimate a non-additively separable demand system for seven goods which exploits the little possibilities of such price variation.

[5] This is the case even for a system of three equations (using non-linear three stages least squares). We have estimated the model in the usual fashion (i.e. as in equation [6]) and found that all γ's lacked statistical significance. The results are available on request.

[6] It is possible, for instance, to use both micro data to obtain income responses and time series data to obtain price responses (Blundell et al. (1994)).

[7] Note that the insufficiency of relative price variation also determines the lack of identification of the γ's across goods. The issue of demographic separability has been studied by Deaton et al. (1989) for the Spanish households and therefore it does not constitute the main concern of this paper. In any case, their results would partly justify the our adopted assumption that demographic characteristics induce income effects exclusively on demands.

which, in the context of the Spanish literature, has been estimated by Abadía (1985), Lorenzo (1987) and Hernando (1992) under alternative structures for the γ's.[8]

In this paper we adopt a strategy which differs in at least two ways from these previous studies. First, we implement a reparameterisation which seems more suitable to the type of data available and, second, in doing so we highlight the effect of demographic structures on the patterns of demand in a much more comprehensive way than any of these studies.

2.3. Reduced form, identification and interpretation of the model

Given the lack of variation, prices can be normalized, so that $p_i = 1$, for all i and budget shares may be written as:

$$w_i = \beta_i + \frac{\gamma_i(z)}{Y} - \frac{\beta_i \Sigma_j \gamma_j(z)}{Y} \qquad [8]$$

then by letting:

$$\gamma_i = \sum_{k=0}^{K} \gamma_i^k z^k \qquad [9]$$

we arrive at a reduced form given by (with the constraints imposed by additivity): [9]

$$w_i = \beta_i + \frac{\Sigma_k \pi_i^k z^k}{Y}, \text{ where } \sum_i \beta_i = 1, \text{ and } \sum_i \pi_i^k = 0 \text{ for all } k \qquad [10]$$

In the context of additive separability it is possible to identify the entire substitution matrix from a single price elasticity. Therefore, it would have been possible to use information from other studies to obtain our structural form parameters. Here we have opted for an alternative solution consisting in assuming a particular structure for the vector of subsistence expenditures for the households.

It is worth noting that if we let:

$$r^k = \sum_i \gamma_i^k \qquad [11]$$

[8] Abadía (1985) uses the size of the household. Lorenzo (1987) and Hernando (1992) do not consider dependence among the parameters and the demographic variables.

[9] See Baccouche and Laisney (1990).

the reduced form parameters are related to the structural form parameters in the following way:

$$\pi_i^k = \gamma_i^k - \beta_i r^k, \qquad [12]$$

where we can interpret r^k as the subsistence expenditure on all goods associated to each demographic characteristic.

The identification of the structural parameters requires thus the introduction of $K+1$ restrictions on the values of r^k, $(k = 0, ..., K)$. An usual way to identify them in these circumstances is by assuming that there exists some good, j, for which the necessary expenditure associated to the demographic characteristic k, γ_i^k, is zero so that $r^k = -\pi_j^k/\beta_j$. This identifies γ_i^k for all i. The most frequent example consists in assuming that the existence of small children requires no necessary expenditures on adult goods (see Trognon (1981)).

In this exercise, we use two different identifying assumptions. The first one consists in setting $r^k = 0$ for all $k \neq 0$ and $r^0 = 200{,}000$, that is, apart from a minimum level of expenditure across all commodities for all households of 200,000 pta. per quarter, commodity specific requirements associates to each demographic characteristics cancel themselves out across the system. Clearly, there is no objective reason why the level of subsistence expenditures should be equal across all households (it will probably increase with household size). In order to illustrate the sensitivity of results to the particular hypothesis that any researcher wishes to use, we offer results for a second identifying assumption consisting in letting every child add 50,000 pta. to the total subsistence cost of 200,000. This amount will be distributed among commodities in accordance with the marginal propensity to consume and will be added to the subsistence needs obtained with the first assumption.

Thus, it should be clear that the differences in commodity specific needs among households depend crucially on the identifying method and, therefore, the results must be interpreted conditional on the corresponding assumption. That is, in the case of the second identifying hypothesis, the reader will get a picture of commodity specific differences if each additional child adds 50,000 pta. to overall subsistence costs. Needless to say that this condition is subject to confirmation and we hope to provide such a test in subsequent work using appropriate data.

It is useful to recall that in this form of the LES, subsistence expenditures in [7] are linear functions of demographics and for every household, $\gamma_i(z)$ is a measure of need for the ith good which, relative to the need of a hypothetical base household for which $z = (1, 0, ..., 0)$, is said to be a commodity specific equivalence scale of the Barten type.[10] In this framework, changes in demographic characteristics act in a way such that an increase in one of the commodity specific needs induces both an increase in the demand for such

[10] See Deaton and Muellbauer (1980).

commodity and substitution away from it. The first effect is given by the fact that more of the commodity has to be consumed to achieve the same contribution to overall utility and the second is equivalent to a price effect (i.e. the commodity is relatively more expensive now for the household).

2.4. Some welfare comparisons

One of the exercises that can be done with the estimated parameters of the demand system consists in making welfare comparisons across households. On one hand, given that we are able to identify subsistence parameters, we may measure subsistence expenditures for different demographic structures from which commodity specific equivalence scales can be computed. On the other hand, recent changes in the structure of indirect taxes present us an attractive opportunity to apply our estimated preference ordering to evaluate the impact of the 1992 tax reform on household welfare. [11]

This tax reform simulation is carried within a framework whose main features need to be mentioned. First, we do not consider durable goods in our demand system. They generate a great amount of revenue and the simulated reform contained important changes in the VAT rates applied to these commodities. Second, the exercise is carried out with a real reform and we do not pay attention to issues such as neutrality or the government's proposed usage of the revenue. We adopt a partial equilibrium framework in the sense that we assume the vector of market prices to differ from the vector of producer prices because of VAT alone (i.e. supply is perfectly elastic). In the pre-reform situation, a household h has a disposable income Y_h^0 net of tax and the price of the N goods is p_i^0 (we assume that all individuals face the same prices at a point in time). After the reform, the price vector is $p_i^1 = (1 + t_i^1)\, p_i^0/(1 + t_i^0)$ with t_i^0 and t_i^1 the pre and post-reform taxes, respectively. A reform is defined as a mapping of income and prices from the initial to the post situation for all individuals. The individual measure we calculate is derived from a measure of the money value of the household's welfare, the well-known equivalent income function. This function is expressed for the LES as:

$$Y_{Eh} = \sum_k \gamma_k p_k^R + \prod_k \left(\frac{p_k^R}{p_k} \right)^{\beta_k} \left(Y_h - \sum_j \gamma_j p_j \right) \qquad [13]$$

where Y_{Eh} is implicitly defined by $v(p^R, Y_{Eh}) = v(p, Y_E)$. $v(.)$ is the indirect utility function and p^R a reference price vector (we choose the initial price vector as the reference). The individual welfare moving from one situation (initial) to another (post-reform) is given by the equivalent gain $EG_h = Y_{Eh}^1 - Y_{Eh}^0$. It

[11] Roughly speaking, this reform consisted in decreasing the reduced rate from 6 to 3% for some of the components of the groups food and health and drugs, maintaining the reduced rate for the rest of the food, non-alcoholic drinks as well as public transport and increasing the standard rate of 13 to 15% in the rest of groups. For further details see note 3 on Table 2 and Labeaga and López (1994b).

should be made clear that we are using a cardinal representation of utility here and that the value of equivalent income would change if we have used a monotonic transformation of our utility function. In addition to the tables showing the equivalent gain, we provide information on gainers and losers alone, a distinction among households which should in principle be less affected by our choice of cardinalisation.

3. Data and econometric modelling

We apply the analysis presented above to the estimation of a demand system composed by eleven non durable goods for Spain. The data used for estimation comes from the ECPF, a pooling of cross-sections with the subsample of households collaborating for the first time in the survey from the last quarter of 1985 to the last of 1989. We ignore the top and bottom 2.5% of the total expenditure distribution to avoid outliers and also delete those households reporting zero total expenditure, arriving thus to a final sample size of 13,507 observations. The variables used in the estimation and simulation processes as well as descriptive statistics are presented in the Data Appendix.

Concerning estimation, we have to be aware of the typical problem of zero expenditures which arises in demand analysis using microdata. The ECPF has a recording period of a week for most of the commodities we are analyzing.[12] Besides corner solutions and non participation, infrequency of purchase is an important reason for the existence of zeros and could probably be the most relevant in surveys with short recording periods. Table 1 lists the good categories and the percentage of zero expenditures for our choice of the system of eleven commodities. [13]

There are several solutions that deal with each of the reasons generating zeros. Besides aggregation, [14] these zeros can be addressed by Tobit, double hurdle or infrequency of purchase models, respectively. However, the application of these to a whole system is somehow cumbersome and thus, remains much more single equations than system techniques. In applications to complete demand systems, Wales and Woodland (1983) use the Kuhn-Tucker conditions to derive a multivariate Tobit model for the estimation of a system of Engel curves. Lee and Pitt (1986) treat the zeros under the rationing (or virtual prices)

[12] Although clothing and footwear and some goods on the housing and household non durable groups have recording periods of a month and a quarter.

[13] We justify the grouping chosen for the following reasons. First, we exclude durable goods mainly because we have no information on ownership. The exclusion of tobacco and petrol is due to the fact that infrequency is not the only source of zeros as empirical evidence suggest (García and Labeaga (1993), Labeaga and López (1993b) and López (1994)).

[14] In a previous paper, Labeaga and López (1992) presented an aggregation procedure for dealing with the zero expenditure problem. The analysis was carried out with other set of commodities from both the ECPF and the EPF 1980-81.

TABLE 1
Good categories and zero expenditures

Good category	%
1. Food and non-alcoholic drinks	0.44
2. Alcoholic drinks	32.40
3. Clothing and footwear	12.35
4. Housing	0.41
5. Fuel for housing	1.53
6. Household non durables	21.66
7. Health and drugs	37.72
8. Public transport	53.07
9. Personal care	38.76
10. Meals out	20.26
11. Other non durable goods	24.74

approach to derive the suitable empirical model. With N goods the number of demand regimes is 2^N. In both cases, the empirical application becomes unfeasible with $N > 3$.

Similarly, Meghir and Robin (1992) provided a maximum likelihood estimator (also intractable with a large number of goods) and a corresponding instrumental variables (IV) method for whose application is necessary to know or estimate the infrequency model (the purchase probability) in order to obtain consistent estimates of the demand parameters (see López (1994) for an application to Spanish data in a single equation context). Clearly, none of these approaches are adequate to be applied to our demand model.

Thus, since our purpose is to estimate a demand system, we are in some sense forced to assume that the source of zeros for all equations is due to a single reason. Given our range of goods, the most appropriate cause is infrequency of purchase.[15] In these circumstances, Ordinary Least Squares yield inconsistent estimates due to the existence of correlation between the stochastic component and the total expenditure regressor. Although we assume that the expected value of the observed and desired expenditure coincides, the latter suffers from an error in variables problem and these errors are correlated with the unobserved component of the demand equations.

A solution that overcomes the above problem has been proposed by Keen (1987) by means of an IV estimator in which total expenditure is instrumented with a range of exogenous variables, including total income, in order to remove the bias. This brings us back to the usefulness of demographic variables: our

[15] We have corroborated this assumption using evidence on the pattern of purchases across time in a similar data set. See López (1993).

theoretical model assumes them to be exogenous and therefore they can act as instruments for the identification of the model. It must be said that we use total income as an additional instrument even if we are aware that there is no apparent reason to believe that such variable is not endogenous to the household decision making process. However, since we are imposing separability of demand from labour, total income is not affected by households' purchase decisions and yet it is highly correlated with total expenditure so that it could be a good instrument.

Thus, we follow Keen's suggestion and use a three stage least squares estimator for the whole system of eleven equations where the last is deleted to avoid singularity. Our set of exogenous variables is basically composed of demographic variables and interactions between them and income as explained in the Data Appendix. [16]

4. Results

We present in this section a summary of the results obtained. Table 2 shows the distribution of the welfare change associated to the reform for the sample of households we use in our simulation (those in the last quarter of 1989). The first interesting feature consists in the existence of some households who actually gain with the reform (due to the reduction of some taxes). However, these households make up less than 1% of the sample. In fact, they add up to 21 out of 2,179 households. The most salient feature of these households is their position along the distribution of total expenditure: all gainers lie within the bottom decile. There seem to be some differences in other characteristics such as a bigger proportion of rural and home renter households among gainers but they cannot be said to be statistically significant given the small size of this group.

Concerning the size of welfare losses (which depend on our cardinalisation of utility), it is noteworthy the fact that the existence of children pushes up the level of welfare loss for all households. For instance, a family with one earner and children loses more than a family with two earners and no children. Indirect taxation cannot be said to provide incentives for fertility and, although the evolution of the latter does of course depend on many other reasons, there may be some lesson to learn from these results, especially when the low fertility rate in Spain is raising questions about the feasibility of the pensions system in the near future.

We now turn to a comparison of the differences in commodity-specific subsistence expenditures for a set of different family types defined to facilitate

[16] In subsequent work, we plan to include macroeconomic indicators such as real interest and unemployment rates amongst the set of exogenous variables. In our intertemporally separable framework, this is desirable because these variables pick up expectations about the future and let those influence the determination of expenditure. See Blundell (1988) and Blundell et al. (1993).

TABLE 2
Distribution of the equivalent gain [1, 3]

A. *All the sample*

	Minimum	25%	Median	75%	Maximum
EG	0.758	-1.313	-2.327	-3.846	-31.333

B. *By family composition and number of earners* [2]

Earners	No children	Children
One	-1.833	-3.143
Two	-2.731	-3.510
Three	-3.288	-4.016

[1] Values in 1983 thousand pta. per quarter.

[2] The figures below are mean values of the EG.

[3] The pre-reform taxes were 6% for food and non-alcoholic drinks, some medical services, public transport and meals out and 13% for the rest of groups. Since the ECPF data we have available does not contain information at a level of disaggregation that we need to simulate the reform carried out in August 1992, we have used information on expenditure shares corresponding to the households which collaborated in the last quarter of 1983 in the Permanent Consumption Survey in order to calculate the new real VAT rates. The maintained hypothesis is that the structure of household expenditure remains constant in 1992. The resulting post-reform taxes are 4.74% for food and non-alcoholic beverages, 6% for public transport and meals out, 13.28% for housing, 14.42% for health and drugs and 15% for the remaining groups.

this presentation. The results and description of the households are reported in Table 3 and 4 for the first and second identifying assumptions we use, respectively. These expenditures are revealing how diverse the pattern of needs can be for different households. Take the results corresponding to the first identifying assumption. Both h6 and h9 need to spend on food roughly a 90% of the base household's expenditure on food. However, h6 spends more than four times the base's level on meals out while h9 spends a half of such amount. This difference can be attributed to the existence of children, which not only preempts household's expenditure from resources for meals out but makes them more «expensive» in the sense that a larger number of people need to be served at the restaurant.

The location of the household seems to play an important role in this difference for urban workers (represented by h6) may find difficult to go back home at lunch time, for instance. In this sense, it is interesting to note that they need to spend more than six times h9's expenditure on public transport. Housing needs are also representative of the information supplied by the model. Three children household in a city, h10, needs to spend nearly twice as much on housing than a childless couple in an intermediate area, h5. Finally, the presence of children seems to reduce significantly the expenditure on alcoholic drinks.

TABLE 3
Variation of subsistence expenditure with household characteristics[1,2]

Household type	Food and non-alc.	Alcoholic drinks	Clothing footwear	Housing	Fuel for housing	Household non-dur.
$H1$	63.143	3.103	21.648	74.423	7.395	3.123
$H2$	49.092	3.136	18.890	73.542	8.192	4.907
$H3$	67.068	4.363	23.664	53.258	8.599	6.251
$H4$	65.934	3.886	24.348	52.222	8.116	6.020
$H5$	71.158	3.927	21.666	52.655	8.050	5.461
$H6$	58.490	3.830	24.332	34.601	10.500	6.361
$H7$	58.329	2.447	21.542	61.106	9.496	7.380
$H8$	72.243	3.890	22.687	54.552	8.206	7.179
$H9$	57.231	2.275	24.162	79.823	9.751	6.804
$H10$	40.126	−0.049	19.291	100.364	8.958	10.068
$H11$	64.174	1.766	26.461	47.680	9.251	10.114

Household type	Health and drugs	Public transport	Personal care	Meals out	Other non durables
$H1$	4.563	2.288	3.338	7.999	8.976
$H2$	6.317	5.375	3.354	20.518	6.676
$H3$	6.543	0.490	3.149	17.573	9.043
$H4$	6.398	0.395	2.917	18.003	11.761
$H5$	5.256	2.389	4.082	14.038	11.317
$H6$	8.652	6.254	5.444	30.861	10.673
$H7$	7.899	6.799	4.611	16.764	3.626
$H8$	5.405	1.259	3.163	11.325	10.091
$H9$	5.183	0.996	2.564	4.508	8.694
$H10$	6.596	6.802	1.962	1.031	5.850
$H11$	5.388	7.009	3.205	15.272	9.679

[1] The household types defined have the following characteristics:
$H1$: Childless couple in a town between 10,000 and 500,000 inhabitants. Two earners. Head of household is high rank civil servant or executive with secondary education and is aged between 35 and 50. $H2$: Single person in city with more than 500,000 inhabitants. Searching unemployed with secondary education and aged less than 35. $H3$: Single person in town with less than 10,000 inhabitants. Self-employed with secondary education and aged less than 35. $H4$: Single person in town with less than 10,000 inhabitants. Pensioner with secondary education and aged above 65. $H5$: Childless couple in town with population between 10,000 and 500,000 inhabitants. One earner. Head of household is an unskilled blue collar worker with no schooling and aged below 35. $H6$: Childless couple in city with more than 500,000 inhabitants. Two earners. Head of household is a skilled blue collar worker or a civil servant with university education and aged below 35. $H7$: Single parent in city with more than 500,000 inhabitants. Searching unemployed with secondary education and aged below 35. $H8$: Couple with one child below six years of age in town with population between 10,000 and 500,000 inhabitants. One earner. Head of household is an unskilled blue collar worker aged between 35 and 50. $H9$: Couple with one child below six years of age and another child age 7-14 in town with population below 10,000. One earner. Head of household is an skilled blue collar worker or a civil servant with secondary education and aged between 35 and 50. $H10$: Couple with three children in city with population above 500,000. Two earners. Head of household is self-employed with university education and aged between 50 and 65. $H11$: Couple with four children in city with population above 500,000. One earner. Head of household is an unskilled blue collar worker aged between 35 and 50.

[2] In order to evaluate the variation of subsistence expenditures we assume that households spend 200,000 pta. each quarter. All values are expressed in 1983 thousand pta. per quarter.

TABLE 4
Variation of subsistence expenditure with household characteristics[1,2]

Household type	Food and non-alc.	Alcoholic drinks	Clothing footwear	Housing	Fuel for housing	Household non-dur.
$H1$	63.143	3.103	21.648	74.423	7.395	3.123
$H2$	49.092	3.136	18.890	73.542	8.192	4.907
$H3$	67.068	4.363	23.664	53.258	8.599	6.252
$H4$	65.934	3.886	24.348	52.222	8.116	6.020
$H5$	71.158	3.927	21.666	52.655	8.051	5.461
$H6$	58.490	3.830	24.332	34.601	10.501	6.362
$H7$	58.329	2.447	21.542	61.106	9.496	7.380
$H8$	82.364	4.537	29.623	69.019	9.434	9.234
$H9$	77.472	3.569	38.036	108.757	12.207	10.913
$H10$	70.487	1.892	39.101	143.765	12.642	16.231
$H11$	104.656	4.355	54.207	105.548	14.163	18.332

Household type	Health and drugs	Public transport	Personal care	Meals out	Other non durables
$H1$	4.563	2.288	3.338	8.000	8.976
$H2$	6.317	5.375	3.354	20.519	6.676
$H3$	6.543	0.490	3.149	17.573	9.042
$H4$	6.398	0.395	2.917	18.003	11.760
$H5$	5.256	2.389	4.082	14.038	11.317
$H6$	8.652	6.254	5.444	30.861	10.673
$H7$	7.899	6.799	4.611	16.764	3.626
$H8$	7.348	1.844	4.313	18.157	14.127
$H9$	9.070	0.173	4.864	18.172	16.766
$H10$	12.427	8.556	5.413	21.527	17.958
$H11$	13.163	9.347	7.805	42.600	25.823

[1] The household types defined have the following characteristics:
$H1$: Childless couple in a town between 10,000 and 500,000 inhabitants. Two earners. Head of household is high rank civil servant or executive with secondary education and is aged between 35 and 50. $H2$: Single person in city with more than 500,000 inhabitants. Searching unemployed with secondary education and aged less than 35. $H3$: Single person in town with less than 10,000 inhabitants. Self-employed with secondary education and aged less than 35. $H4$: Single person in town with less than 10,000 inhabitants. Pensioner with secondary education and aged above 65. $H5$: Childless couple in town with population between 10,000 and 500,000 inhabitants. One earner. Head of household is an unskilled blue collar worker with no schooling and aged below 35. $H6$: Childless couple in city with more than 500,000 inhabitants. Two earners. Head of household is a skilled blue collar worker or a civil servant with university education and aged below 35. $H7$: Single parent in city with more than 500,000 inhabitants. Searching unemployed with secondary education and aged below 35. $H8$: Couple with one child below six years of age in town with population between 10,000 and 500,000 inhabitants. One earner. Head of household is an unskilled blue collar worker aged between 35 and 50. $H9$: Couple with one child below six years of age and another child age 7-14 in town with population below 10,000. One earner. Head of household is an skilled blue collar worker or a civil servant with secondary education and aged between 35 and 50. $H10$: Couple with three children in city with population above 500,000. Two earners. Head of household is self-employed with university education and aged between 50 and 65. $H11$: Couple with four children in city with population above 500,000. One earner. Head of household is an unskilled blue collar worker aged between 35 and 50.

[2] In order to evaluate the variation of subsistence expenditures we assume that households spend 200,000 pta. each quarter and we add 50,000 pta. per child to their expenditure. All values are expressed in 1983 thousand pta. per quarter.

The results associated to the second assumption are identical except for households with children ($h8$, $h9$, $h10$ and $h11$). As explained above, their subsistence expenditures increase by an amount equal to 50,000 ptas. per child times the commodity specific marginal propensity to consume. Urban households with three or four children increase their subsistence needs on housing and other non durable goods. The increase on meals out seems to be due to the presence of high school or university aged kids which are contributing to reduce the subsistence on food in $h10$, at the same time. Moreover, two earner households need to spend more on clothing and housing and less on public transport, probably because they are carrying children to the school by car. Finally, the comments for alcoholic drinks, personal care and health and drugs under the first hypothesis, apply here as well.

Table 5 describes the distribution of the total expenditure elasticities evaluated over the subsample of households with positive budget shares. Own price elasticities are not reported because they do not provide additional information since, with additive separability, they are close to being proportional across goods to the total expenditure elasticities as Deaton (1974) has shown. Given that their distribution is strongly skewed to the right, we choose the median values as summary statistics. These show that we cannot reject that alcoholic drinks, fuel for housing and public transport are necessities and the rest are luxuries. These results tend to support previous empirical evidence with Spanish data (Labeaga and López (1994a)).

TABLE 5
Distribution of expenditure elasticities

Group	Minimum	25%	Median	75%	Mean	St. de. [1]
Food and non alcoholic d.	0.222	0.455	0.568	0.810	0.758	0.659
Alcoholic drinks	0.024	0.363	0.667	1.260	1.096	1.293
Clothing and footwear	0.218	0.727	1.240	2.320	1.902	1.825
Housing	0.289	0.888	1.290	1.980	1.690	1.324
Fuel for housing	0.042	0.541	0.820	1.210	1.038	0.910
Household non durables	0.089	0.841	1.440	2.760	2.168	1.968
Health and drugs	0.044	0.623	1.320	2.850	2.142	2.372
Public transport	0.017	0.290	0.660	1.510	1.381	1.798
Personal care	0.085	0.439	1.170	2.880	2.064	1.992
Meals out	0.172	0.859	1.480	2.880	2.255	2.066
Other non durables	0.084	0.863	1.820	3.740	2.595	2.266

[1] St. de. is the standard deviation of the mean.

Finally, Table 6 contains, jointly with the goodness of fit, *F*-tests statistics for the identifying restrictions associated to our set of instruments and the linear Engel curves specification. While the former compares the models with and without instrumenting, the latter compares two specifications with households below and above the median of total expenditure versus the results for the whole sample. They reject the validity of the set of instruments used for total expenditure in the housing and household non durables equations. The second set of diagnostics confirms the strong rejection of the linearity hypothesis for some equations. This result suggests the need to use higher rank demand models (see Banks et al. (1994)).

TABLE 6
Adjusted R^2 and *F*-tests

Good category	R^2	*F*-test [1]	*F*-test [2]	*F*-test [3]
Food and non alcoholic d.	0.17	103.43	1.98	224.05
Alcoholic drinks	0.02	14.90	0.82	5.20
Clothing and footwear	0.03	21.19	2.68	0.85
Housing	0.10	141.06	11.69	57.77
Fuel for housing	0.09	43.06	0.65	5.07
Household non durables	0.02	17.26	32.68	1.97
Health and drugs	0.01	5.42	0.54	0.92
Public transport	0.05	41.44	3.12	16.90
Personal care	0.01	12.04	3.44	9.30
Meals out	0.18	57.62	4.28	76.86

[1] Tests of joint significance distributed as an $F(23, 13484)$. The theoretical value at 1% significance level is approximately 1.88.

[2] Test for overidentifying restrictions distributed as an $F(4, 13480)$. The theoretical value at 1% significance level is 3.32.

[3] Test for linear Engel curves. They are distributed as an $F(23, 13484)$.

5. Summary and conclusions

In this paper we have made use of a microeconometric demand system to show the importance of demographic variables, together with the usual income effects, in explaining the demand patterns of Spanish households. We have also evaluated the effects of different demographic structures on subsistence expenditures for these households and, finally, we have

conducted a simple simulation exercise in order to see how welfore was affected by the indirect tax reform of August 1992. While the realism of the exercise is severely impaired due to the use of a restrictive model, we feel that the results can have some tentative value as evidence on what were the likely effects of the reform. The analysis demonstrates how important is to consider demographic characteristics of the households both to evaluate expenditure and welfare after estimating a demand system.

There is still a series of important points to solve. Firstly, we should investigate revenue-neutral reforms in order to analyze the scope of tax changes as a redistribute tool. This opens the possibility of bringing into the analysis the computation of social welfare under different values for inequality aversion. Secondly, we have only considered VAT changes, but current tax harmonization proposals consist largely of changes in the levels of excise duties that are levied on some commodities (alcohol, tobacco and some fuels), and they should be incorporated into the analysis via the inclusion of these goods in the demand system. This is connected to another issue which we have ignored in this paper but may well be of importance in future research, that of the likely changes to government revenue due to indirect tax reforms with behavioral responses. Third, we must include durable goods both in estimation and simulation because of the importance of this group as far as taxation is concerned. Though some effort could have been devoted to these issues, we felt that it was better to obtain a more realistic base for simulation first. The use of the ECPF in panel data form or the pooling of different surveys available for Spain could help to obtain suitable price responses. This and another issues are being considered in our current research.

Appendix 1

Means and standard deviations (all observations) [1]

Variable	*Mean*	*S.D.*
$W1$	0.377	0.153
$W2$	0.019	0.027
$W3$	0.116	0.109
$W4$	0.041	0.036
$W5$	0.223	0.144
$W6$	0.031	0.038
$W7$	0.030	0.062
$W8$	0.014	0.032
$W9$	0.018	0.029
$W10$	0.080	0.094
$W11$	0.051	0.085
GASTO	417377.300	349016.740
Household composition and age		
NKID1	0.274	0.570 (γ_0)
NKID2	0.502	0.831 (γ_1)
NKID3	0.553	0.915 (γ_2)
FSIZE	3.563	1.655 (γ_3)
NEARN	1.585	0.823 (γ_4)
DAGE1	0.178 (γ_5)	
DAGE2	0.295 (γ_6)	
DAGE3	0.226 (γ_7)	
Occupation		
UNEM	0.057 (γ_8)	
DENT	0.146 (γ_9)	
DNSK	0.115 (γ_{10})	
DCMS	0.044 (γ_{11})	
DNAC	0.345 (γ_{12})	
DWWIF	0.362 (γ_{13})	
DSPA	0.006 (γ_{14})	
DPENSI	0.061 (γ_{15})	
DDEPS	0.091 (γ_{16})	
Education		
ED1	0.179 (γ_{17})	
ED2	0.080 (γ_{18})	
Size of town of residence		
DM1	0.273 (γ_{19})	
DM2	0.163 (γ_{20})	
Other characteristics of the household		
DRENT	0.172 (γ_{21})	
DSEH	0.101 (γ_{22})	

[1] The coefficients which correspond to each one of the variables in Appendix 2 are in parenthesis.

Definition of the variables:

Wi (i = 1, ..., 11): Share of expenditure on each commodity.
GASTO: Total real expenditure (out of durables) in thousands of 1983 pesetas/quarter.

Household composition and age:

NKID1: Number of children up to 6 years.
NKID2: Number of children from 6 to 14.
NKID3: Number of children from 14 to 23.
FSIZE: Number of members.
NEARN: Number of earners.
DAGE i = 1 (i = 1, 2, 3) if the head is aged up to 35, between 50 and 65 and over 65, 0 otherwise.

Occupational dummies:

UNEM: Unemployed.
DENT: Self-employed.
DNSK: Non skilled worker.
DCMS: White collar worker.
DNAC: Non active.
DWWIF: Working wife.
DSPA: Single parent.
DPENSI: Pensioner.
DDEPS: Executives and A.F.

Educational dummies:

EDi = 1, (i = 1, 2) if the head of the household is illiterate or has no educational background pre-university studies or university studies respectively, 0 otherwise.

Size of town of residence:

DMi = 1, (i = 1, 2) if the family lives in a town of under 2,000 and over 500,000 inhabitants respectively, 0 otherwise.

Other characteristics of the household:

DRENT: If they live in a rented accommodation.
DSEH: If they own a second residence.

Reference household:

Childless couple in a town between 10,000 and 500,000 inhabitants. Two earners. Head of household is high rank civil servant or executive with secondary education and is aged between 35 and 50.

Appendix 2

Estimation results [1,2]
(Three-stage least squares estimators)

Variable	$W1$	$W2$	$W3$	$W4$	$W5$	$W6$	$W7$	$W8$	$W9$	$W10$
β_i	0.2024	0.0129	0.1387	0.2893	0.0246	0.0411	0.0388	0.1169	0.0230	0.1366
	(26.4)	(10.8)	(29.8)	(46.1)	(16.9)	(24.6)	(14.5)	(8.48)	(18.1)	(31.6)
γ_{i0}	14.9823	0.4790	−2.4780	9.0797	3.2020	−1.9615	−2.4860	−0.8706	−1.0249	−15.3303
	(7.09)	(1.46)	(1.93)	(5.25)	(7.99)	(4.27)	(3.38)	(2.29)	(2.93)	(12.9)
γ_{i1}	−1.7477	−0.3983	1.5424	2.9237	0.2183	1.6529	0.1673	−0.6726	−0.4406	−2.5255
	(1.65)	(2.42)	(2.41)	(3.38)	(1.09)	(7.19)	(0.45)	(3.54)	(2.51)	(4.24)
γ_{i2}	−0.8272	−0.6039	1.7455	2.9373	−0.0032	0.6253	−0.6951	−0.2792	−0.5464	−2.0633
	(0.91)	(4.28)	(3.17)	(3.95)	(0.02)	(3.17)	(2.20)	(1.71)	(3.64)	(4.04)
γ_{i3}	−2.6001	−0.4352	2.0643	0.1778	−0.1496	−0.1663	−1.1626	1.1461	−0.0408	1.3090
	(3.12)	(3.36)	(4.08)	(0.26)	(0.95)	(0.92)	(4.00)	(7.66)	(0.30)	(2.79)
γ_{i4}	9.1988	0.4009	−1.4328	−7.3740	−0.0135	−0.5770	0.3368	0.1733	−0.0112	−0.5937
	(13.0)	(3.66)	(3.35)	(12.8)	(0.10)	(3.76)	(1.37)	(1.37)	(0.10)	(1.49)
γ_{i5}	2.5335	0.4473	1.2633	−5.5579	0.2194	−0.2275	−0.3512	0.1112	0.2260	2.3253
	(3.67)	(4.17)	(3.02)	(9.84)	(1.67)	(1.52)	(1.46)	(0.90)	(1.98)	(5.98)
γ_{i6}	−8.9533	0.1919	1.1410	5.7120	−0.9175	−0.9720	0.5596	−0.0845	−0.4417	5.6632
	(6.42)	(0.88)	(1.35)	(5.00)	(3.47)	(3.21)	(1.15)	(0.34)	(1.91)	(7.21)
γ_{i7}	0.1817	0.2652	1.3069	−0.0188	−0.1582	−0.5639	−0.2847	−0.4008	0.1837	0.3601
	(0.15)	(1.37)	(1.73)	(0.02)	(0.67)	(2.09)	(0.66)	(1.79)	(0.89)	(0.51)
γ_{i8}	−0.1795	−0.1663	−2.9225	4.1752	0.2835	1.0141	0.8789	−0.3525	−0.4539	−2.1399
	(0.15)	(0.95)	(4.27)	(4.51)	(1.32)	(4.13)	(2.23)	(1.74)	(2.42)	(3.36)
γ_{i9}	−8.3321	−0.6383	−2.3249	9.5749	0.1554	1.2901	0.0678	−0.0125	−0.1702	1.2538
	(5.22)	(2.58)	(2.41)	(7.33)	(0.51)	(3.72)	(0.12)	(0.04)	(0.64)	(1.40)

Appendix 2 (Continuation)

Estimation results
(Three-stage least squares estimators)

Variable	$W1$	$W2$	$W3$	$W4$	$W5$	$W6$	$W7$	$W8$	$W9$	$W10$
γ_{i10}	−1.4794	0.0338	−1.9283	3.4383	0.1260	0.5784	1.1889	−1.0455	−0.2449	1.2997
	(1.06)	(0.15)	(2.28)	(3.01)	(0.48)	(1.91)	(2.44)	(4.17)	(1.06)	(1.65)
γ_{i11}	−2.4038	−0.0290	−2.5222	4.9856	−0.3186	0.6515	−0.3742	0.0058	−0.1754	0.7152
	(1.71)	(0.13)	(2.96)	(4.33)	(1.19)	(2.13)	(0.76)	(0.02)	(0.75)	(0.90)
γ_{i12}	−8.5909	−0.4401	−0.1612	0.7152	1.9130	1.8630	1.1582	−1.2557	0.8114	2.5104
	(2.52)	(0.83)	(0.08)	(0.26)	(2.96)	(2.52)	(0.98)	(2.05)	(1.44)	(1.31)
γ_{i13}	−2.7991	−0.5273	−1.5742	6.2654	0.1319	1.0791	−0.5059	−0.1381	0.1553	−1.3282
	(1.95)	(2.36)	(1.81)	(5.33)	(0.48)	(3.46)	(1.01)	(0.53)	(0.65)	(1.64)
γ_{i14}	−6.4365	−0.6491	−0.1579	2.5376	−0.2944	0.9090	0.4412	0.7468	−0.0241	1.6324
	(7.15)	(4.64)	(0.29)	(3.44)	(1.72)	(4.65)	(1.41)	(4.62)	(0.16)	(3.22)
γ_{i15}	4.8764	−0.9863	−0.9542	7.2509	0.6645	1.6963	0.7639	0.3346	0.3391	−9.4764
	(1.38)	(1.80)	(0.48)	(2.51)	(0.99)	(2.22)	(0.62)	(0.53)	(0.58)	(4.77)
γ_{i16}	−2.4334	−0.2764	1.6786	−1.7724	−0.6404	−0.6670	0.1652	−0.7880	−0.0236	3.8696
	(2.09)	(1.52)	(2.38)	(1.86)	(2.90)	(2.64)	(0.41)	(3.77)	(0.12)	(5.90)
γ_{i17}	−2.8327	−0.3614	0.5222	1.0265	0.0626	−0.0653	0.0187	0.4571	0.4786	0.1877
	(2.13)	(1.75)	(0.65)	(0.94)	(0.25)	(0.23)	(0.04)	(1.91)	(2.17)	(0.25)
γ_{i18}	−15.3646	−1.2480	1.1678	8.0494	0.4548	4.1032	1.2399	1.9989	0.1755	−2.7213
	(6.65)	(3.48)	(0.83)	(4.25)	(1.04)	(8.17)	(1.54)	(4.82)	(0.46)	(2.09)
γ_{i19}	1.3511	0.4126	0.4930	−4.1967	0.1533	0.2211	−0.0790	−0.2175	−0.3960	2.5444
	(1.82)	(3.57)	(1.09)	(6.90)	(1.09)	(1.37)	(0.31)	(1.63)	(3.22)	(6.08)
γ_{i20}	−0.8187	−0.3341	−5.0250	4.2390	0.6340	−0.8631	0.4151	3.7192	0.1757	−0.1270
	(0.75)	(1.97)	(7.58)	(4.73)	(3.05)	(3.63)	(1.09)	(18.9)	(0.97)	(0.21)

Appendix 2 (Continuation)

Estimation results
(Three-stage least squares estimators)

Variable	$W1$	$W2$	$W3$	$W4$	$W5$	$W6$	$W7$	$W8$	$W9$	$W10$
γ_{i21}	4.3610	0.2969	3.6056	−19.6875	0.6396	0.7775	0.8180	1.0900	0.9178	5.7220
	(5.23)	(2.29)	(7.14)	(28.9)	(4.05)	(4.29)	(2.82)	(7.29)	(6.65)	(12.1)
γ_{i22}	−9.3487	−1.0129	−3.1237	30.8008	−0.8367	−2.4329	−1.1383	−0.4967	−0.6433	−9.0929
	(4.92)	(3.43)	(2.71)	(19.8)	(2.32)	(5.89)	(1.72)	(1.46)	(2.04)	(8.49)

[1] T-ratios (in absolute value) are in parenthesis.

[2] Set of instruments used: Total income, income squared, all demographics plus interactions among total income and child dummies.

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Resumen

El objetivo de este trabajo es mostrar la importancia de las variables socioeconómicas en la explicación de la demanda de bienes de consumo de los hogares españoles. Para ello necesitamos disponer de los parámetros de un sistema de demanda, un Sistema Lineal de Gasto en este caso. La estimación del mismo se lleva a cabo con una combinación de cortes transversales provenientes de la Encuesta Continua de Presupuestos Familiares para el período 1985-89, agregando los bienes de acuerdo a criterios de similitud en los patrones de consumo y en los tipos impositivos. Los resultados, primero, muestran la importancia de la inclusión de variables socioeconómicas en las ecuaciones de demanda para realizar comparaciones de gasto y bienestar y, segundo, proporcionan evidencia de los efectos que sobre dicho bienestar tiene la puesta en práctica de reformas impositivas indirectas.

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