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Equivalence scales, the cost of children and household consumption patterns in Italy

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Abstract This article deals with the estimation of parametric equivalence scales for Italian households with different demographic characteristics: composition, location and number of employed members in the household. Using a sample of 43,701 observations on monthly current expenditures from 1997 to 2004 we estimate a demand system for ten goods and we tackle the problem of corner solutions for some goods adopting the Two Step estimator proposed by Shonkweiler and Yen (Am J Agric Econ 81:972–982, 1999). The consumption behavior of households is also analyzed calculating compensated, uncompensated and expenditure elasticites for each commodity. By considering households that differ in composition (number of children), geographic location (four-different macro-areas of Italy), and number of employed adults, we allow for a range of useful comparisons.

Keywords Equivalence scales · Demand analysis · Censoring

JEL Classifications D11 · D12

1 Introduction

Equivalence scales are used to make interpersonal comparisons of well-being for purposes such as indexing social transfers and measuring poverty, inequality and social welfare. Comparing equivalence scales that satisfy the property of

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independence of the base level of expenditure (IB) with equivalence scales that vary with the expenditure level of the household, like the class of equivalence scales that satisfy the generalized absolute equivalence scales exactness (GAESE) condition (Donaldson and Pendakur 2006), may bear important implications for the measurement of the pattern of inequality in Italy over the last ten years (Baldini and Toso 2004). This comparison has produced interesting findings for Canada: measured inequality seems to be lower in the late 1990s than in the 1970s when using IB scales, but the opposite is true when using GAESE scales (Donaldson and Pendakur 2006). A similar pattern of measured inequality could emerge for Italy. This paper can be regarded as a first contribution towards such comparison.

Our main contribution is the calculation of parametric equivalence scales, that satisfy the property of independence of the base level of expenditure (IB), for Italian households with different demographic characteristics: composition, location and number of employed members. Using a sample of 43,701 observations on monthly current expenditures from 1997 to 2004 we estimate a Censored non linear Almost Ideal Demand System for ten goods. The use of household level data is often complicated by zero values in the dependent variable, a problem which particularly affects highly disaggregated demand systems. There is a growing literature on the estimation of censored demand systems which has been developed since the works of Shonkweiler and Yen (1999), Perali and Chavas (2000), Golan et al. (2001). Given its simplicity we use the two step procedure suggested by Shokweiler and Yen (1999) to tackle censoring in some classes of expenditures.[1]

Our study contributes to the existing literature in the following ways. First, by estimating a rather disaggregated demand system we obtain better measurements of equivalence scales, whose calculation is sensitive to the number of commodities on which current expenditure is allocated. Second, by considering households that differ in composition (number of children), geographic location (four-different macro-areas of Italy), and number of employed adults, we allow for a range of useful comparisons. For example, some authors (Browning and Meghir 1991) have emphasized that having a second employed member may involve relevant policy implications; we find that equivalence scales calculated for such families are significantly lower than those referred to households with only one working adult. Third, for each household type we compare Engel scales and scales obtained imposing Pashardes' (1991) identifying restriction finding that Pashardes' scales are lower than Engel scales. Fourth, we analyze the consumption pattern of Italian households calculating own and cross price Marshallian and Hicksian elasticities of demand, expenditure elasticities and the rate of change in autonomous consumption for all household types. Finally, we test whether a structural break has occurred after the change of currency in January 2002. This is a highly debated question in Italy, although evidence on this is scant (Marini et al. 2004; Moschini and Rizzi 2007).

The remaining of the paper is structured as follows: Sect. 2 describes the data-set, outlines the censored demand system, the econometric strategy adopted and discusses the results of the demand system's estimation; Sect. 3 deals with the

[1] See Tauchmann (2005) for a review.

calculation of equivalence scales, discusses their economic content and the potential policy implications of the results; Sect. 4 concludes.

2 Specification and demand system estimation

2.1 Data

We use monthly cross-sections, from January 1997 to December 2004, of individual Italian households' current expenditures collected by the Istituto Nazionale di Statistica (ISTAT) through a specific and routinely repeated survey, which was completely renewed in 1997.[2] Current expenditures are classified in about 200 elementary goods and services, with the exact number changing from year to year due to minor adjustments in the item list.[3] The survey also includes detailed information on the household structure, so that relevant data on demographic characteristics (such as location on a regional basis, number of household members, sex, age, education and employment condition of each) are available. All annual samples are independently drawn according to a two-stage design.[4]

A sub-sample of 43,701 observations (which thereafter will be referred to as the sample) has been selected according to the following criteria.[5] We consider households: (i) whose members are aged less than 65; (ii) with a couple of adults, at least one of them employed, aged more than 24; (iii) with no additional members or with a number of children, aged less than 15, between 1 and 3. We estimate a ten goods demand system[6]: (1) Food and beverages; (2) Tobacco and Alcoholic beverages; (3) Clothing; (4) Housing excluding rent; (5) Household operation (including child care); (6) Health care; (7) Transports; (8) Communications; (9) Recreation; (10) Other goods and services. These aggregate goods are chosen according to the availability of monthly and regional consumption price indices also supplied by ISTAT, which are included in the data set. ISTAT provides, in fact, price indices for 12 goods. The first nine coincide with the commodities in our demand system. The residual class in our system, Other goods and services, also includes (i) Education and (ii) Hotels and Restaurants for which ISTAT supplies separate values.

A set of dummy variables is included to account for demographic and geographic factors: household types (Two Adults (N1), Two Adults and a Child (N2), Two Adults and Two Children (N3), Two Adults and Three Children (N4)); location

[2] A different sample of households is interviewed during each month; the items list also includes non current expenditures, with a total number of about 280 goods and services.

[3] We implicitly assume strong separability in consumers' preferences between current and other expenditures.

[4] Details on the sampling procedure used to collect these data can be found in ISTAT, *Indagine sui Consumi delle Famiglie. File standard. Manuale d'uso. Anni 1997–2004*.

[5] All the information described above, besides information on prices, have been handled within a single database used for the sample selection.

[6] See Perali (1999), Betti (2000) and Donaldson and Pendakur (2006) for demand systems chosen for similar purposes.

Table 1 The data

	Mean	Standard deviation	Min	Max
No. of households: 43,701				
Current expenditures (Euro/month)				
Total expenditure	1613.289	945.750	250.527	8972.019
Food from stores	425.660	227.771	0.000	2946.880
Alcohol and tobacco	40.063	49.977	0.000	624.009
Clothing	200.367	267.714	0.000	4824.001
Household operation	133.166	100.736	0.000	1173.626
Household furnishing and equipment	75.452	118.351	0.000	3268.560
Health	92.968	243.203	0.000	6615.609
Transports	209.922	233.349	0.000	5508.500
Communication	44.362	36.753	0.000	623.900
Recreation	118.095	137.878	0.000	2520.430
Other goods and services	273.234	396.778	0.000	5603.389
Price indices (1995 = 1)				
Food from stores	1.109	0.066	0.978	1.338
Alcohol and tobacco	1.241	0.105	1.059	1.561
Clothing	1.158	0.073	1.024	1.398
Housing	1.195	0.085	1.015	1.387
Household furniture and equipment	1.117	0.052	1.015	1.277
Health	1.150	0.067	1.011	1.310
Transports	1.148	0.072	1.009	1.361
Communication	0.974	0.059	0.750	1.071
Recreation	1.102	0.054	0.984	1.262
Other goods and services	1.151	0.083	1.009	1.349
Other exogenous variables				
Childless adult couple (N1)	0.324	0.467	0.000	1.000
Two adults and one child (N2)	0.315	0.464	0.000	1.000
Two adults and two children (N3)	0.316	0.465	0.000	1.000
Two adults and three children (N4)	0.045	0.207	0.000	1.000
NO	0.247	0.431	0.000	1.000
NE	0.223	0.416	0.000	1.000
CE	0.174	0.379	0.000	1.000
SI	0.356	0.479	0.000	1.000
E2	0.524	0.499	0.000	1.000
SCOLA1	4.876	1.463	1.000	8.000
SCOLA2	4.779	1.425	1.000	8.000
Annual time trend	4.607	2.273	1.000	8.000

(North West (NO), North East (NE), Centre (CE), South and the Islands (SI)); presence of a second employed adult member (E2). The education level of the adult members is accounted for through two additional discrete variables (SCOLA1, SCOLA2) ranging from 1 (highest level—PhD degree), to 8 (no education). Finally a logarithmic annual time trend is also included. Summary statistics of the data are shown in Table 1.[7]

2.2 Estimation of a censored almost ideal demand system (CAIDS)

The functional form chosen to specify the model is the Almost Ideal Demand System (AIDS, Deaton and Muellbauer 1980). To obtain the deterministic share equations we start from a modified logarithmic cost function, for household h, implying *PIGLOG* preferences:

$$ln\, C(u, \mathbf{p}, \mathbf{d}^h) = ln\, a(\mathbf{p}, \mathbf{d}^h) + u\, b(\mathbf{p}, \mathbf{d}^h) \tag{1}$$

where $\mathbf{p}$ is the vector of prices, $\mathbf{d}^h$ contains a number of demographic characteristics (such as number of children) and non-demographic characteristics (regional location) and u is the household's utility level. $a(\mathbf{p}, \mathbf{d}^h)$ and $b(\mathbf{p}, \mathbf{d}^h)$ are increasing in $\mathbf{p}$ and $\mathbf{d}^h$ and are linearly homogeneous in $\mathbf{p}$. We use a Translog in $\mathbf{p}$ specification for $a(\mathbf{p}, \mathbf{d}^h)$ and a Cobb-Douglas specification for $b(\mathbf{p}, \mathbf{d}^h)$:

$$\begin{aligned} ln\, a(\mathbf{p}, \mathbf{d}^h) = a + \sum_k \delta_{ok} d_k^h + \sum_i ln\alpha_i\, ln\, p_i + \frac{1}{2} \sum_i \sum_j c_{ij}^*\, ln\, p_i\, ln\, p_j \\ + \sum_i \sum_k \delta_{ik}\, d_k^h\, ln\, p_i \end{aligned} \tag{2}$$

$$b(\mathbf{p}, \mathbf{d}^h) = \beta_0(\mathbf{d}^h) \prod_i \left[p_i exp\left(\beta_i + \sum_k \lambda_{ik} d_k^h \right) \right] \tag{3}$$

where, following Pashardes (1991, p. 199), we will use β_{ik} to denote $\beta_i + \lambda_{ik} d_k^h$. This implies $\lambda_{ik} d_k^h = \lambda_{ik} D_k$, where $D_k = 1$ if $d_k^h > 0$ and $D_k = 0$ if $d_k^h = 0$ all $k = 1, \ldots, K$. The corresponding system of Marshallian demand functions as shares is:

$$w_i^h = \alpha_i + \sum_k \delta_{ik} d_k^h + \sum_j c_{ij}\, ln\, p_j + \beta_{ik}\, ln\left[\frac{y^h}{a(\mathbf{p}, \mathbf{d}^h)} \right] \tag{4}$$

where y^h is total expenditure of household h and the parameters c_{ij} are defined as: $c_{ij} = \frac{1}{2}(c_{ij}^* + c_{ji}^*) = c_{ji}$. These demand functions are consistent with utility maximization when the following parametric restrictions hold: $\sum_i \alpha_i = 1, \sum_i \beta_{ik} = \sum_i \delta_{ik} = 0$ (Adding-up); $\sum_j c_{ij} = 0$ (Homogeneity); $c_{ij} = c_{ji}$ for all i, j (Symmetry). To consider the implication of this approach for the calculation of equivalence scales we write:

$$ln\, a(\mathbf{p}, \mathbf{d}^h) = \alpha_0 + \sum_k \delta_{ok}\, d_k^h + ln\, P^h \tag{5}$$

[7] The sub-sample of 43,701 observations has been selected from the full sample, given by 192,882 households, through: (i) dropping observations with missing values in the relevant demographic variables, (ii) applying the selection criteria described above to identify the family types under investigation, (iii) dropping a very small number of outliers (about 20) having a nonnegligible impact on estimation. The full sample is obtained appending ISTAT annual samples from 1997 to 2004.

where

$$ln\,P^h = \sum_i \left(\alpha_i + \frac{1}{2} \sum_i \sum_j c^*_{ij}\, ln\, p_j + \sum_k \delta_{ik}\, d^h_k \right) ln\, p_i \qquad (6)$$

and replacing $[ln\, y^h - ln\, a(\mathbf{p}, \mathbf{d}^h)]$ in (4) by $lnq^h = lny^h - lnP^h$, the budget shares become:

$$w^h_i = \alpha_{ik} + \sum_k \delta^*_{ik} d^h_k + \sum_j c_{ij}\, ln\, p_j + \beta_{ik} ln\, q^h \qquad (7)$$

where $\alpha_{ik} = \alpha_i - \beta_{ik}\alpha_0$ and $\delta^*_{ik} = \delta_{ik} - \beta_{ik}\delta_{0k}$. The latter relationship suggests a problem of identification of the parameters reflecting the cost of household characteristics δ_{ik} and δ_{0k}, because $ln\, P^h$ does not capture differences in 'subsistence' costs attributed to differences in household characteristics (Pashardes 1991, p. 200). Its consequences for the calculation of equivalence scales will be discussed later.

Starting from the early work of Heien and Wessels (1990), estimation procedures for censored consumer demand systems have been developed and include the efficient Generalized Maximum Entropy procedure (Golan et al. 2001) and consistent but less efficient approaches such as Perali and Chavas (2000) multi-step procedure and Shonkweiler and Yen (1999) Two-Step (TS) estimator involving probit estimation in the first step and a selectivity-augmented equation system in the second step.[8] We use the TS procedure by Shonkwiler and Yen (1999) due to its simplicity. Following Yen et al. (2002) we denote the deterministic expenditure share for commodity i as $w_i(p, y; \theta)$, where θ is a vector containing all parameters (α_i, α_{ik}, β_{ik} and c_{ij}) in the demand system (7). Censoring of each commodity i is governed by a separate stochastic process $z_i'\tau_i + v_i$ such that

$$s_i = \begin{cases} w_i(p, y; \theta) + \varepsilon_i & \text{if } z_i'\tau_i + v_i > 0 \\ 0 & otherwise \end{cases} \qquad (8)$$

where s_i is the observed expenditure share, z_i is a vector of exogenous variables, τ_i is a parameters' vector, and ε_i and v_i are random errors. Using Eq. 7 and bivariate normality of the matrix $[\varepsilon_i, v_i]'$, the mean of s_i conditional on a positive observation is

$$E(s_i | v_i > -z_i'\tau_i) = w_i(p, y; \theta) + \delta_i \phi(z_i'\tau_i)/\Phi(z_i'\tau_i) \qquad (9)$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are, respectively, the standard normal probability density function (pdf) and the standard normal cumulative distribution function (cdf). Since $Pr(v_i > -z_i'\tau_i) = \Phi(z_i'\tau_i)$ and $E(s_i | v_i < -z_i'\tau_i) = 0$, the unconditional mean of s_i is:

$$E(s_i) = \Phi(z_i'\tau_i) w_i(p, y; \theta) + \delta_i \phi(z_i'\tau_i) \qquad (10)$$

and the system of share equations can be written as

$$s_i = \Phi(z_i'\tau_i) w_i(p, y; \theta) + \delta_i \phi(z_i'\tau_i) + \xi_i \qquad (11)$$

[8] Shonkweiler and Yen (1999), Yen et al. (2003) and Yen and Lin (2006) provide useful literature review on estimation procedures for censored demand systems.

where $\xi_i = s_i - E(s_i)$. The system of equations (11) is estimated in two-steps: (i) obtain ML probit estimates $\hat{\tau}_i$ of τ_i using the binary outcome $s_i = 0$ and $s_i > 0$; (ii) calculate $\Phi(z_i^{'}, \hat{\tau}_i)$ and $\phi(z_i^{'}\hat{\tau}_i)$ for all i and estimate $\theta, \delta_1, \delta_2, \ldots, \delta_n$ in the augmented system (11) by ML. Such two-step estimator is consistent, but the error terms in Eq. 11 are heteroscedastic, thus the estimated elements of the second-step conventional covariance matrix are inefficient. Yen et al. (2002) suggest using Murphy and Topel's procedure (1985) to compute the correct covariance matrix. For simplicity, we empirically calculate the standard errors of the elasticities and equivalence scales using bootstrapping and running 500 replications. This ensures that the standard errors of these derived parameters are correct.

Though the adding up restriction holds for the latent expenditure shares, it does not hold for the observed shares. To address this problem we adopt a simple approach suggested by Pudney (1989, p. 155) and used, among others, by Yen et al. (2003), Dong et al. (2004), Yen and Lin (2006). This consists of estimating $n - 1$ equations using the TS procedure together with an identity

$$s_n = 1 - \sum_{i=1}^{n-1} s_i, \tag{12}$$

defining the residual expenditure category as the difference between total expenditure and spending on the first $n - 1$ categories and treating the nth good as a residual category with no specific demand of its own. Demand elasticities for the residual good, if necessary, can be calculated using the adding up identity (12). For censored goods, elasticities are calculated from the unconditional means of the expenditure shares. Differentiation of Eq. 11 gives demand elasticities for the first $n - 1$ goods and elasticities for the nth good are obtained exploiting the Cournot and Engel restrictions (Deaton and Muellbauer 1980, p. 16): denoting Marshallian, Hicksian and expenditure elasticities for good i as e_{ij}^h, e_{ij}^{*h} and e_i^h, the corresponding elasticities for good n, denoted e_{nj}^h, e_{nj}^{*h} and e_n^h are obtained from the Cournot restriction $\sum_{i=1}^n w_i^h e_{ij}^h + w_j^h = 0$ and the Engel restriction $\sum_{j=1}^n e_{ij}^h + e_i^h = 0$.

Exogenous variables used in the first-step are: total expenditure, dummies denoting household type, level of education of the first and second member of the household, presence of a second employed member, geographic location and the annual time trend in logarithms. The dependent variable in the first-step probit estimates is the binary outcome defined by the expenditure in each good. The proportion of consuming households for Food, Housing and Communication exceed 95%, which prevents reliable probit estimates. Thus, probit is estimated only for the remaining products, for which the predicted pdf's and cdf's are included in the second step of the procedure (see Yen et al. 2003, p. 464). In all the estimates we impose homogeneity and symmetry. Economic theory also requires the matrix of the substitution effects to be negative semi-definite. Such a requirement is satisfied by the data without adopting any reparametrization procedure of the price coefficients. We drop the "other goods and services" equation to accommodate adding up.

2.3 Results

Table 2 reports first-step probit estimates along with their asymptotic standard errors. All the explanatory variables play significant roles in the probability of consumption of one or more of the commodities. Most of the variables included are significant at the 5% level. Income plays a positive role in explaining the budget share of all goods. Demographic and regional variation is also evident in the likelihood of consuming most goods. The presence of one or more children decreases the probability of consuming Alcohol and Tobacco and the presence of a second employed member significantly increases the likelihood of spending on Transports. Finally, an increase in the level of education of one of the adult members increases the likelihood of consuming Alcohol and Tobacco, but decreases the likelihood of spending on Recreation (although the coefficient is very low). Table 3 displays second-step estimates of the CAID system and second-step estimates of the symmetry restricted parameters c_{ij} using parameter estimates $\hat{\tau}_i$ from the first step. Standard errors have been computed from a heteroscedastic-consistent matrix using the White correction.

Hicksian (compensated) elasticities, based on parameters of the second-step, are computed at the sample mean as:

$$e_{ij}^{*h} = e_{ij}^{h} + e_i^h w_j^h \tag{13}$$

where e_{ij}^h is the uncompensated price elasticity of good i with respect to price j and e_i^h is the expenditure elasticity of good i. These elasticities are shown in Table 4 along with expenditure elasticities, estimated budget shares and the rate of change in autonomous consumption, calculated as the logarithmic derivative of the share equations with respect to the annual time trend. Expenditure elasticities for all goods are significantly different from zero. Food, Housing and Communication display elasticities which differ significantly from one, classifying Clothing, Health and Other goods and services as luxuries; Food, Housing and Communication as necessities. There is a rather high budget elasticity of Transports whereas Alcohol and Tobacco have a unit elasticity. The low expenditure elasticity of demand for Housing, which includes expenditures on electricity, water services, heating, housing and transport fuels, suggests these goods being necessities, a result which is in line with the literature. As to the budget shares, Food, Transports and Clothing are the consumption categories on which the largest part of the monthly expenditure is allocated. This is in line with similar works on Italian households consumption (Moschini and Rizzi 1997). All compensated own price elasticities, calculated at the sample means of variables, have the correct sign and are statistically significant. Some of them are greater than one: Housing, Household furniture, Health. Cross price elasticities, providing precise information on net complementarities and net substitutions among goods, may offer some explanation for the first two of these own price effects, as both commodities reveal a high level of substitution with each other. Housing also shows a high level of substitution with Food, while Household furniture also reveals a high level of substitution with Other goods and services. The high level of Health own price elasticity is in line with similar empirical works

Table 2 First-step probit estimates

No. obs. = 43,701	Goods					
	$i = 2$ Alc./Tob.	$i = 3$ Clothing	$i = 5$ Household furn.	$i = 6$ Health	$i = 7$ Transport	$i = 9$ Recreation
Constant	**0.158**	**0.189**	**0.659**	**−0.267**	**0.660**	**0.492**
	0.014	*0.018*	*0.019*	*0.014*	*0.024*	*0.024*
Income	**0.442**	**0.940**	**0.645**	**0.592**	**1.089**	**1.170**
	0.013	*0.020*	*0.020*	*0.013*	*0.029*	*0.029*
*N*2	**−0.055**	**0.287**	**0.085**	**0.055**	0.028	**0.071**
	0.016	*0.019*	*0.020*	*0.016*	*0.025*	*0.024*
*N*3	**−0.114**	**0.277**	**0.098**	**0.064**	**−0.065**	**0.084**
	0.017	*0.019*	*0.021*	*0.016*	*0.025*	*0.024*
*N*4	**−0.214**	**0.265**	**0.096**	0.038	−0.074	0.060
	0.033	*0.040*	*0.045*	*0.032*	*0.053*	*0.049*
NE	**−0.244**	0.037	**−0.214**	**0.111**	**−0.223**	**0.068**
	0.021	*0.025*	*0.025*	*0.020*	*0.031*	*0.031*
NO	**−0.153**	−0.028	**−0.148**	**−0.057**	**−0.120**	**0.133**
	0.020	*0.024*	*0.025*	*0.018*	*0.031*	*0.032*
SI	**0.141**	−0.035	**0.228**	**−0.081**	**0.281**	**−0.140**
	0.020	*0.023*	*0.026*	*0.014*	*0.031*	*0.028*
*E*2	−0.015	**−0.053**	**−0.081**	**0.032**	**0.057**	**−0.053**
	0.014	*0.017*	*0.018*	*0.005*	*0.022*	*0.021*
*SCOLA*1	**0.055**	0.011	0.002	**0.324**	0.002	**−0.049**
	0.005	*0.006*	*0.007*	*0.005*	*0.008*	*0.008*
*SCOLA*2	**0.060**	−0.010	0.004	**0.016**	0.006	**−0.045**
	0.006	*0.007*	*0.007*	*0.005*	*0.009*	*0.008*
LTrend	**−0.108**	**−0.032**	**−0.096**	**−0.221**	**0.043**	**−0.128**
	0.010	*0.012*	*0.013*	*0.009*	*0.015*	*0.015*
Mean of dep. var.	0.723	0.841	0.891	0.632	0.935	0.922
(*LR* zero slopes)	1984.59	3653.19	1825.38	2994.37	2270.16	3036.53
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Scaled R^2	0.045	0.084	0.042	0.068	0.054	0.072
Predicted power	0.724	0.840	0.890	0.661	0.935	0.922

Standard errors in italics below coefficients. Bold entries correspond to rejection of H_0: $e = 0$ at the 5% significance level for a two tailed test

(Rizzi and Balli 2002). A possible interpretation of this result is the introduction of generic (low cost) drugs which has taken place in Italy over the last decade. The high level of net substitution between Recreation and Clothing and between Communication and Clothing has also been found in similar studies.[9] A possible explanation of the first of these results is that part of the Clothing expenditure can be

[9] Moschini and Rizzi (1997) report a Morishima elasticity of substitution between Transports and Clothing and between Communication and Clothing of 1.47 and 0.94, respectively.

Table 3 Second-step AIDS estimates (1997–2004)

Coefficients	Goods								
	$i = 1$ Food	$i = 2$ Alc./Tob.	$i = 3$ Clothing	$i = 4$ Housing	$i = 5$ Household furn.	$i = 6$ Health	$i = 7$ Transport	$i = 8$ Communication	$i = 9$ Recreation
α_i	**0.282**	**0.010**	**0.100**	**0.087**	**0.049**	**0.042**	**0.138**	**0.031**	**0.093**
	0.001	*0.002*	*0.006*	*0.001*	*0.002*	*0.009*	*0.002*	*0.005*	*0.002*
β_i	**−0.102**	−0.000	**−0.061**	**−0.048**	**0.006**	**0.035**	**−0.007**	**−0.018**	**−0.016**
	0.001	*0.002*	*0.006*	*0.006*	*0.002*	*0.005*	*0.003*	*0.005*	*0.002*
δ_i	−0.769	**0.059**	**0.158**	0.494	0.004	**0.062**	0.005	0.000	**−0.138**
	0.455	*0.006*	*0.023*	*0.421*	*0.013*	*0.016*	*0.020*	*0.005*	*0.009*
$\alpha_{i,N2}$	**0.016**	**−0.005**	**0.015**	**−0.003**	**0.004**	**−0.018**	**−0.008**	**−0.012**	**−0.002**
	0.002	*0.001*	*0.003*	*0.001*	*0.004*	*0.002*	*0.001*	*0.000*	*0.001*
$\alpha_{i,N3}$	**0.032**	**−0.008**	**0.014**	−0.007	**0.002**	**−0.007**	**−0.017**	**−0.003**	−0.001
	0.002	*0.007*	*0.003*	*0.008*	*0.008*	*0.002*	*0.001*	*0.000*	*0.001*
$\alpha_{i,N4}$	**0.054**	**−0.011**	0.005	0.001	**0.005**	**−0.010**	**−0.023**	**−0.003**	−0.001
	0.003	*0.001*	*0.004*	*0.001*	*0.001*	*0.004*	*0.002*	*0.005*	*0.002*
$\alpha_{i,NO}$	**−0.007**	**−0.003**	**−0.010**	**0.014**	0.000	**0.008**	**−0.004**	**−0.002**	−0.001
	0.002	*0.008*	*0.002*	*0.001*	*0.001*	*0.002*	*0.002*	*0.000*	*0.001*
$\alpha_{i,NE}$	**−0.025**	**−0.008**	−0.003	**0.008**	0.001	**0.016**	**−0.002**	**−0.001**	0.002
	0.002	*0.001*	*0.002*	*0.001*	*0.001*	*0.002*	*0.002*	*0.000*	*0.001*
$\alpha_{i,SI}$	**0.017**	**0.006**	0.019	**−0.020**	**0.011**	**−0.012**	**−0.005**	−0.001	0.001
	0.002	*0.001*	*0.003*	*0.001*	*0.001*	*0.002*	*0.002*	*0.001*	*0.001*
$\alpha_{i,DU}$	**−0.019**	−0.000	**0.012**	− 0.002	**0.004**	**−0.005**	**0.005**	**−0.001**	0.001
	0.001	*0.001*	*0.001*	*0.001*	*0.001*	*0.002*	*0.001*	*0.000*	*0.001*
$\alpha_{i,SC1}$	**0.005**	**0.003**	**−0.002**	**-0.002**	**−0.001**	**0.003**	0.001	**−0.001**	−0.000
	0.000	*0.002*	*0.001*	*0.000*	*0.000*	*0.001*	*0.000*	*0.000*	*0.001*

Table 3 continued

Coefficients	Goods								
	$i = 1$ Food	$i = 2$ Alc./Tob.	$i = 3$ Clothing	$i = 4$ Housing	$i = 5$ Household furn.	$i = 6$ Health	$i = 7$ Transport	$i = 8$ Communication	$i = 9$ Recreation
$\alpha_{i,SC2}$	**0.007**	**0.003**	**−0.003**	**-0.001**	**−0.001**	0.001	0.000	**−0.001**	**−0.000**
	0.000	*0.000*	*0.001*	*0.000*	*0.000*	*0.001*	*0.000*	*0.000*	*0.000*
$\alpha_{i,LT}$	**−0.015**	**−0.003**	**0.019**	**0.004**	**−0.003**	**−0.015**	**0.002**	**0.001**	**0.004**
	0.001	*0.001*	*0.001*	*0.001*	*0.001*	*0.002*	*0.001*	*0.000*	*0.001*
Symmetric restricted estimates of c_{ij}									
c_{1j}	**0.091**								
	0.023								
c_{2j}	**−0.034**	0.012							
	0.002	*0.007*							
c_{3j}	−0.034	−0.004	**0.062**						
	0.019	*0.009*	*0.028*						
c_{4j}	**0.031**	0.003	−0.014	**−0.066**					
	0.011	*0.006*	*0.012*	*0.011*					
c_{5j}	**−0.074**	**−0.029**	**0.031**	**0.068**	**−0.067**				
	0.011	*0.006*	*0.011*	*0.008*	*0.011*				
c_{6j}	0.013	−0.006	−0.000	0.010	0.011	−0.020			
	0.014	*0.006*	*0.017*	*0.008*	*0.008*	*0.020*			
c_{7j}	**0.056**	**0.018**	**−0.068**	**−0.057**	0.006	**0.050**	0.004		
	0.014	*0.007*	*0.016*	*0.010*	*0.009*	*0.012*	*0.017*		
c_{8j}	**−0.043**	**0.008**	**0.035**	0.006	−0.007	**−0.025**	0.004	**0.005**	
	0.005	*0.003*	*0.005*	*0.003*	*0.004*	*0.004*	*0.004*	*0.002*	

Table 3 continued

Coefficients	Goods								
	$i = 1$ Food	$i = 2$ Alc./Tob.	$i = 3$ Clothing	$i = 4$ Housing	$i = 5$ Household furn.	$i = 6$ Health	$i = 7$ Transport	$i = 8$ Communication	$i = 9$ Recreation
c_{9j}	**−0.054**	−0.011	**0.078**	**0.030**	**0.018**	**−0.019**	**−0.061**	**0.010**	**0.043**
	0.012	*0.007*	*0.013*	*0.009*	*0.009*	*0.009*	*0.010*	*0.004*	*0.014*
Log Likelihood	553,001								
R^2	0.300	0.044	0.062	0.160	0.023	0.038	0.011	0.117	0.048
No. obs.	43,701								

Standard errors in italics below coefficients. Bold entries correspond to rejection of H_0: $e = 0$ at the 5% significance level for a two tailed test

Table 4 Mean household budget shares, w_j, expenditure elasticities, e_j, Hicksian elasticities e^*_{ij} and rate of change in autonomous consumption, e_{jT}

	Goods									
	$j = 1$ Food	$j = 2$ Alc./Tob.	$j = 3$ Clothing	$j = 4$ Housing	$j = 5$ Household furn.	$j = 6$ Health	$j = 7$ Transport	$j = 8$ Communication	$j = 9$ Recreation	$j = 10$ Other goods
w_j	0.297	0.027	0.113	0.095	0.044	0.050	0.130	0.032	0.069	0.144
e_j	**0.657**	**0.997**	**1.454**	**0.496**	**1.131**	**1.442**	**0.949**	**0.454**	**0.791**	**1.761**
	0.003	*0.035*	*0.043*	*0.005*	*0.037*	*0.058*	*0.022*	*0.012*	*0.019*	*0.040*
e^*1j	**−0.408**	**−0.057**	−0.004	**0.198**	**−0.204**	**0.092**	**0.319**	**−0.111**	**−0.105**	**0.279**
	0.070	*0.024*	*0.058*	*0.031*	*0.031*	*0.038*	*0.040*	*0.015*	*0.033*	*0.051*
e^*2j	−0.321	**−0.662**	−0.001	0.188	**−0.716**	−0.092	**0.605**	**0.232**	−0.222	**0.990**
	0.200	*0.142*	*0.204*	*0.129*	*0.135*	*0.135*	*0.148*	*0.069*	*0.139*	*0.172*
e^*3j	0.056	0.003	**−0.429**	−0.006	**0.271**	0.048	**−0.378**	**0.301**	**0.643**	**−0.510**
	0.130	*0.055*	*0.172*	*0.074*	*0.074*	*0.103*	*0.095*	*0.033*	*0.084*	*0.117*
e^*4j	**0.618**	0.055	−0.042	**−1.600**	**0.763**	**0.155**	**−0.469**	**0.093**	**0.397**	0.028
	0.100	*0.050*	*0.100*	*0.092*	*0.067*	*0.067*	*0.078*	*0.032*	*0.075*	*0.088*
e^*5j	**−1.202**	**−0.551**	**0.740**	**1.479**	**−2.325**	**0.265**	0.261	−0.106	***−0.436***	**1.002**
	0.192	*0.101*	*0.193*	*0.118*	*0.163*	*0.123*	*0.140*	*0.066*	*0.141*	*0.165*
e^*6j	**0.473**	−0.033	0.112	**0.229**	**0.175**	**−1.208**	**0.770**	**−0.287**	−0.173	−0.060
	0.141	*0.061*	*0.172*	*0.079*	*0.071*	*0.178*	*0.114*	*0.038*	*0.083*	*0.159*
e^*7j	**0.700**	**0.155**	**−0.377**	**−0.318**	0.091	**0.416**	**−0.842**	**0.055**	**−0.375**	**0.497**
	0.089	*0.042*	*0.092*	*0.054*	*0.046*	*0.065*	*0.099*	*0.021*	*0.057*	*0.078*
e^*8j	**−1.039**	**0.256**	**1.241**	**0.280**	**−0.168**	**−0.747**	**0.237**	**−0.801**	**0.338**	**0.404**
	0.143	*0.082*	*0.149*	*0.143*	*0.110*	*0.093*	*0.096*	*0.072*	*0.101*	*0.114*
e^*9j	**−0.430**	−0.122	**1.157**	**0.495**	**0.288**	***−0.195***	**−0.693**	**0.140**	**−0.344**	**−0.297**
	0.138	*0.072*	*0.148*	*0.091*	*0.092*	*0.092*	*0.104*	*0.042*	*0.154*	*0.122*

Table 4 continued

	Goods									
	$j = 1$ Food	$j = 2$ Alc./Tob.	$j = 3$ Clothing	$j = 4$ Housing	$j = 5$ Household furn.	$j = 6$ Health	$j = 7$ Transport	$j = 8$ Communication	$j = 9$ Recreation	$j = 10$ Other goods
$e^{*}10j$	**0.461**	**0.245**	**−0.382**	0.075	**0.304**	−0.093	**0.528**	**0.079**	**−0.152**	**−1.064**
	0.105	*0.042*	*0.099*	*0.057*	*0.052*	*0.070*	*0.074*	*0.025*	*0.061*	*0.125*
e_{jT}	**−0.048**	**−0.088**	**0.141**	**0.042**	**−0.070**	**−0.190**	**0.016**	**0.016**	**0.053**	**0.020**
	0.004	*0.016*	*0.010*	*0.008*	*0.016*	*0.026*	*0.008*	*0.013*	*0.011*	*0.012*

Standard errors in italics below coefficients. Bold entries correspond to rejection of H_0: $e = 0$ at the 5% significance level for a two tailed test

considered a recreation activity, in competition with similar activities. The high level of net substitution between Communication and Clothing and the high complementarity between Communication and Food can be interpreted as follows. The price level of Communication has declined in Italy over the period under investigation possibly due to market liberalization in the telephone industry. At the same time there has been a wide diffusion of mobile telephones in Italy (an expenditure included in the Communication commodity) which can also be considered, in part, a recreation activity. Communication and Clothing, therefore, can be thought of as substitutes, whereas an increase in the price of a necessity, such as Food, may have caused a large decrease in recreation activities. The logarithmic derivatives of the share equations with respect to the annual time trend e_{jT} are interpreted as the rate of change in autonomous consumption, i.e. the rate of change in the share equation for a particular good due to time or, alternatively, to a change in preferences over time (years in this case). The negative rate of change in exogenous consumption for Food and Alcohol/Tobacco may reflect a tendency towards healthier habits of Italian households. The large decrease in Health expenditures (almost 19%) may have been driven by a decline in the consumer price index for Health expenditures over the period under investigation due to the substitution of low cost drugs for high quality drugs mentioned above and, also, by a number of exogenous variables such as health and budget government policies.[10] Most complementarities and substitutions detected by compensated cross price elasticities are also confirmed by the uncompensated ones (Table 5).

As the sample period of our data encompasses the date of the introduction of the Euro, we try to give a contribution to the debate that has recently emerged in Europe, and particularly in Italy, on the inflationary effects of the introduction of the Euro from January 2002. The debated question is whether the change of currency was accompanied by an unexpected increase in the price levels, not accurately measured by official statistics. Following Moschini and Rizzi (2007), we test whether our model supports a structural break occurring in January 2002, when the Euro replaced the Lira, i.e. whether the parameters of the demand system have significantly changed after the introduction of the Euro, implying that consumers have changed the way they make their consumption choices. The test we carry out, proposed by Anderson and Blundell (1984), is based on the Likelihood Ratio test statistic:

$$\Lambda = 2\left[\frac{T}{T_1}L_1^* + 0.5ln\frac{T}{T_1} - L^*\right] \tag{14}$$

where $T = 43{,}701$ and $T_1 = 25{,}998$ are the sizes of the full sample and of the sub-sample up to the hypothesized structural break (i.e. January 1997 to December 2001), L^* is the maximized value of the log-likelihood function over the entire sample, and L_1^* is the maximized value of the Log-likelihood function over the sub-sample T_1. The computed value of this statistic is $\Lambda = 7{,}781$. Under the null hypothesis of parameters stability, the statistic Λ is distributed as a χ^2 with $(T - T_1)N$ degrees of

[10] In fact, over the period under investigation, there have been in Italy different governments of different political orientation.

Table 5 Marshallian elasticities e_{ij}

	Goods									
	$j = 1$ Food	$j = 2$ Alc./Tob.	$j = 3$ Clothing	$j = 4$ Housing	$j = 5$ Household furn.	$j = 6$ Health	$j = 7$ Transport	$j = 8$ Communication	$j = 9$ Recreation	$j = 10$ Other goods
e1j	**−0.597**	**−0.075**	−0.082	**0.135**	**−0.232**	0.061	**0.236**	**−0.134**	**−0.151**	**0.182**
	0.069	*0.027*	*0.056*	*0.033*	*0.031*	*0.038*	*0.040*	*0.016*	*0.034*	*0.055*
e2j	**−0.618**	**−0.686**	−0.117	0.093	**0.766**	−0.147	**0.476**	**0.210**	−0.282	**0.841**
	0.198	*0.140*	*0.210*	*0.129*	*0.136*	*0.137*	*0.144*	*0.075*	*0.134*	*0.172*
e3j	**−0.384**	−0.038	**−0.585**	−0.145	**0.209**	−0.021	**−0.570**	**0.245**	**0.542**	**−0.707**
	0.124	*0.060*	*0.165*	*0.072*	*0.072*	*0.098*	*0.091*	*0.035*	*0.083*	*0.117*
e4j	**0.473**	0.042	−0.100	**−1.647**	**0.741**	**0.130**	**−0.532**	**0.079**	**0.359**	−0.041
	0.103	*0.055*	*0.103*	*0.090*	*0.063*	*0.068*	*0.075*	*0.032*	*0.073*	*0.091*
e5j	**−1.535**	**−0.585**	**0.616**	**1.371**	**−2.363**	0.215	0.114	−0.148	**0.346**	**0.839**
	0.193	*0.102*	*0.194*	*0.125*	*0.167*	*0.120*	*0.133*	*0.069*	*0.139*	*0.162*
e6j	0.043	−0.075	−0.044	0.091	**0.116**	**−1.273**	**0.578**	**−0.330**	−0.283	−0.265
	0.146	*0.063*	*0.168*	*0.080*	*0.073*	*0.182*	*0.112*	*0.037*	*0.088*	*0.159*
e7j	**0.419**	**0.129**	**−0.487**	**−0.408**	0.049	**0.366**	**−0.964**	0.031	**−0.439**	**0.355**
	0.084	*0.041*	*0.093*	*0.053*	*0.049*	*0.066*	*0.097*	*0.023*	*0.058*	*0.079*
e8j	**−1.140**	**0.243**	**1.102**	**0.229**	−0.188	**−0.730**	0.199	**−0.835**	**0.338**	**0.325**
	0.139	*0.082*	*0.140*	*0.092*	*0.102*	*0.089*	*0.104*	*0.071*	*0.097*	*0.113*
e9j	**−0.664**	−0.139	**1.067**	**0.415**	**0.246**	**−0.246**	**−0.793**	**0.134**	**−0.403**	**−0.408**
	0.144	*0.072*	*0.140*	*0.086*	*0.093*	*0.090*	*0.110*	*0.044*	*0.139*	*0.125*
e10j	−0.078	**0.198**	**−0.559**	−0.087	**0.224**	**−0.188**	**0.293**	**0.023**	**0.272**	**−1.314**
	0.096	*0.044*	*0.102*	*0.058*	*0.053*	*0.071*	*0.072*	*0.028*	*0.065*	*0.126*

Standard errors in italics below coefficients. Bold entries correspond to rejection of H_0: $e = 0$ at the 5% significance level for a two tailed test

freedom, where $N = 9$ is the number of estimating equations. In line with previous results by Moschini and Rizzi (2007) we find no structural break as the hypothesis of constancy of the parameters is not rejected at the 5% significance level.

3 Equivalence scales

To compare welfare or real income across households with different sizes and composition index numbers known as equivalence scales are used. While true-indices-of-the-cost-of-living compare the welfare levels of households facing different price vectors, equivalence scales compare the welfare levels of households with different demographic profiles. If the demographic profile of two families varies only in relation to the number of children, the equivalence scale will measure the cost of children.

Engel (1895) proposed to use a household's share of food expenditure as a measure of a household's welfare or standard of living. The resulting Engel equivalence scale is defined as the ratio of incomes of two different sized households that have the same Food budget share (Lewbel and Pendakur 2008, p. 2). This is the method used by the United States Census Bureau to measure poverty and it is also used by the Italian National Institute of Statistics (Carbonaro 1985, 2004). Roughly, ISTAT first defines the poverty threshold for a typical household as 50% of the per capita consumption expenditure and then uses Food shares (Engel scales) to derive comparable poverty thresholds for households of different sizes and compositions. Although empirical evidence suggests that equivalent expenditure may have an increasing relationship with household expenditure (Koulovatianos et al. 2005), only absolute and relative equivalence scales that are independent of expenditure have been calculated until a few years ago, due to identification problems (Blundell and Lewbel 1991; Lewbel and Pendakur 2008). The property of independence of the base level of expenditure (IB) or exact equivalence scales (ESE) allows to calculate equivalence scales from demand data.[11] Define

$$ln\, m^h = ln\, C(u, \mathbf{p}, \mathbf{d}^h) - ln\, C(u, \mathbf{p}, \mathbf{d}^r) \tag{15}$$

where m^h is the general equivalence scale which, for the reference household, can be normalized to one and $\mathbf{d}^r$ is the reference household's vector of characteristics. Blundell and Lewbel (1991) start from the class of conditional preferences, due to Muellbauer (1976), defined in (1), where both price indices

[11] Recent advances on the identification of equivalence scales (Donaldson and Pendakur 2006) have proposed a more general class of equivalent expenditure functions satisfying a condition known as Generalized Absolute Equivalent Scale Exactness (GAESE). If the equivalent expenditure function falls in this class, identification from demand behavior of equivalence scales that are dependent on expenditure is possible. In this case we may also have equivalence scales declining with expenditure. The possibility of estimating this type of equivalence scales changes substantially the way they can measure inequality. Donaldson and Pendakur (2006), using Canadian data, show that, taking a single adult as the reference household, the equivalence scale for a family of dual parents with one child is 2.11 for poor households, but only 1.98 for rich households. This reveals that households consumption economies of scale increase not only in the number of individuals in the households (a known result in the literature) but also as the standard of living goes up, i.e. with increasing expenditure.

are demographic-dependent. Given the preferences specified in Sect. 2.2, the logarithm of the equivalence scale for a household with characteristic d^h is:

$$m^h = \delta_0 \, d^h + \beta_0(\mathbf{d}^h)(u^h - u^{h*}) \tag{16}$$

where u^{h*} is the reference household's utility level. Since $\beta_0(\mathbf{d}^h)$ is not observed from consumer behavior the scale is not identified. However identification is possible if we consider a restricted version of (16) in which the scale is independent of the base level of utility (*IB*), as argued by Deaton and Muellbauer (1986). More precisely, the logarithm equivalence scale at reference prices reduces to $m^h = \delta_0 d^h$ where d^h is now treated as a scalar, representing one household characteristic (for instance number of children), and the k subscript is dropped everywhere. The problem is that we can only estimate $\delta_i^* = \delta_i - \beta_i \delta_0$ from the budget share equations (7). This identification problem can be solved through one parameter restriction (per characteristic) in the system of budget share equations. The logarithm of the Engel scale can be obtained by imposing a zero restriction on the specific component δ_i for food obtaining:

$$\delta_0 = -\frac{\delta_i^*}{\beta_i} \tag{17}$$

where i denotes the Food category. This is called Engel scale because it's based on Engel's view that the share of food in demand indicates the level of (consumption based) welfare.

Pashardes (1991) suggests imposing demographic separability on all the system's equations. Given the estimate of β_i, Eq. 7 can be considered as a regression equation with δ_i interpreted as mean zero residuals and δ_0 as the slope of the same regression equation so that the logarithm of the equivalence scale becomes:

$$\delta_0 = -\frac{\sum_{i=1}^{n} \hat{\beta}_i \hat{\delta}_i^*}{\sum_{i=1}^{n} \hat{\beta}_i^2} \tag{18}$$

We estimate both scales (17) and (18) for households with different geographic location (NO = North West, NE = North East, CE = Centre, SI = South and the Islands) and composition (N1–N4), with the reference household being a Childless Adults' Couple (N1) living in central Italy (CE) with only one employed member. A second set of equivalence scales is calculated considering the same reference household and comparing it with households with two employed members and the same demographic and geographic profiles as before. This second set of equivalence scales should reveal how, having two employed members of the households, changes the cost of reaching a given level of welfare in comparison with households with a single member employed.

Tables 6 and 7 report equivalence scales where Engel's and Pashardes' demographic separability restrictions are imposed. Table 6 can be read both horizontally and vertically. If read horizontally, it conveys the usual information about variations in costs of reaching the same welfare level for households with different demographic dimension, whereas the vertical dimension suggests the variation in costs due to the geographic location of the household. The lower panel

Table 6 Equivalence scales (Engel identifying restriction)

Household location	Household type			
	*N*1	*N*2	*N*3	*N*4
NO	**0.929**	**1.117**	**1.307**	**1.579**
	0.015	*0.026*	*0.031*	*0.048*
NE	**0.785**	**0.944**	**1.105**	**1.336**
	0.014	*0.025*	*0.030*	*0.042*
CE	**1.000**	**1.203**	**1.407**	**1.700**
		0.021	*0.026*	*0.043*
SI	**1.206**	**1.451**	**1.698**	**2.052**
	0.026	*0.047*	*0.056*	*0.068*
*NO*2	**0.770**	**0.926**	**1.084**	**1.310**
	0.016	*0.022*	*0.027*	*0.043*
*NE*2	**0.651**	**0.783**	**0.916**	**1.107**
	0.014	*0.022*	*0.026*	*0.037*
*CE*2	**0.829**	**0.997**	**1.167**	**1.410**
	0.010	*0.019*	*0.024*	*0.039*
*SI*2	**1.000**	**1.203**	**1.408**	**1.701**
	0.025	*0.039*	*0.047*	*0.060*

Standard errors in italics below coefficients. Bold entries correspond to rejection of H_0: $e = 0$ at the 5% significance level for a two tailed test

NO north west, *NE* north east, *CE* centre, *SI* south and the Islands, *NO2* household with two employed adults living in the North West of Italy

of the table shows scales calculated for households with two employed members. For a given composition of the household, the North East area of Italy produces utility more efficiently than the other three areas of Italy. Specifically, a childless adults' couple spends about 22% less in the North East than in the Centre to reach a mean level of welfare and such cost represents 78.5% of the cost of an adult equivalent. The cost rises by about 20% in the South. This result is in line with previous studies, such as Patrizii and Rossi (1991, p. 143) and Perali (1999, p. 522). Such finding is also consistent across all household dimensions suggesting a marked difference in costs of living in different areas of Italy. Given the location of the reference household, one child increases the cost by about 20% in the Centre and in the North West, by 16% in the North East and by 25% in the South. Using the same identifying restriction, Pashardes (1995, Table 1), working on the 1984 Family Expenditure Survey (FES) cross-section, finds that, relative to a childless couple, one child increases the cost by about 29%.

Adding a child to an adult's couple is more expensive than adding a second child, but adding a third child produces a higher marginal cost in all areas of Italy, so the usual assumption of economies of scales in the dimension of the household does not hold here, as the cost of households is not a concave function of the number of children. Having two children raises the cost of the reference household by 40% in the Centre and by 49% in the South whereas having three children increases it by

70% in the Centre and by 85% in the South. Perali (2006), whose findings are similar, suggests this is not surprising, because the most reasonable source of household economies of scale is the presence of public goods to be shared within the household. The lower part of Table 6 shows equivalence scales in which the same reference household as before is compared with households with two employed members. As expected, the presence of a second employed member decreases by about 17% the cost of reaching the level of welfare of the reference household. This result is consistent with studies of the effects of female labor participation on demand (Browning and Meghir 1991) showing that the effect of children on demand is lower when female labor participation is considered. Costs decreases are largest for households living in the South of Italy. Thus, policy measures encouraging the labor participation of women in the South could produce a reduction in the cost of children as well as providing an incentive to the household's fertility decisions.

Table 7 shows equivalence scales calculated imposing Pashardes' parametric restrictions. As expected, using this restriction reduces the difference in the scales across households' composition, as in Pashardes (1995), and also across geographic location. The difference in costs between a childless couple living in the Centre (reference household) and a childless couple living the South goes from 20% when the Engel restriction is applied, to 7% when Pashardes' approach is used. A household with three children living in the South spends 35% more in comparison

Table 7 Equivalence scales (Pashardes identifying restriction)

Household location	Household type			
	*N*1	*N*2	*N*3	*N*4
NO	**0.989**	**1.054**	**1.157**	**1.293**
	0.013	*0.020*	*0.022*	*0.029*
NE	**0.877**	**0.936**	**1.026**	**1.147**
	0.013	*0.019*	*0.021*	*0.026*
CE	**1.000**	**1.066**	**1.169**	**1.307**
		0.014	*0.016*	*0.024*
SI	**1.072**	**1.143**	**1.254**	**1.402**
	0.020	*0.030*	*0.032*	*0.037*
*NO*2	**0.876**	**0.934**	**1.025**	**1.146**
	0.013	*0.016*	*0.018*	*0.027*
*NE*2	**0.778**	**0.828**	**0.909**	**1.016**
	0.014	*0.017*	*0.018*	*0.023*
*CE*2	**0.886**	**0.944**	**1.036**	**1.158**
	0.009	*0.013*	*0.015*	*0.024*
*SI*2	**0.950**	**1.013**	**1.111**	**1.242**
	0.018	*0.026*	*0.029*	*0.033*

Standard errors in italics below coefficients. Bold entries correspond to rejection of H_0: $e = 0$ at the 5% significance level for a two tailed test

NO north west, *NE* north east, *CE* centre, *SI* south and the Islands, *NO2* household with two employed adults living in the North West of Italy with a similar household living in the Centre when the Engel scale is considered, but this difference reduces to 10% according to Pashardes' scale. These findings support Pashardes' (1991) point that imposing demographic separability on all goods is likely to overstate demographic costs less than the Engel approach. Moreover, our results show that this also applies when geographic locations are considered. These differences suggest that policy makers should be careful in drawing policy implications from Engel scales as costs of characteristics may be overstated.

4 Concluding remarks

Using a sample of 43,701 observations on 1997–2004 monthly current consumption expenditures of Italian households we have estimated a censored nonlinear Almost Ideal Demand System. The demand system's parameters have been used to calculate *IB* equivalence scales imposing Engel and Pashardes restrictions for different types of households (number of children, geographic location, number of working adults). Such scales are used to evaluate differences in costs of demographic and geographic characteristics of the households. The demand system's parameters also allow for an analysis of the consumption patterns of Italian households. Finally, as the 1997–2004 investigation period encompasses the introduction of the Euro, a Likelihood Ratio test was carried out to detect whether a structural break occurred after January 2002. The hypothesis of constancy in the system's parameters is not rejected, thus denying the occurrence of the break. The problem of censoring in expenditure data has been tackled using the Two Step procedure developed by Shonkweiler and Yen (1999) and total expenditure has been split into ten goods to better capture complementarities and substitutions among them. Since the calculation of equivalence scales is sensitive the number of commodities on which current expenditure is allocated, estimating a rather disaggregated demand system allows us to obtain more precise measurement of equivalence scales.

Our findings allow for a range of useful comparisons across geographic location and demographic composition of the households. The Engel approach appears to overstate the variation in equivalence scales across households in comparison with Pashardes'. The North Eastern area of Italy seems to produce utility more efficiently, whereas living in the South increases the cost of reaching the same level of welfare across all households types. As the reference household is a childless couple living in the Centre, the scales imply significant household economies of scales going from one to two children, but adding a third child produces a higher marginal cost in all areas of Italy, a result in line with similar studies, so the usual assumption of costs of households being a concave function of the number of children does not hold here. Equivalence Scales are calculated for households with both one and two adults employed. This is a distinct contribution to the literature that bears interesting policy implications. Families with two employed members have considerably lower equivalence scales in comparison with families with only one member employed, irrespective of the location and the composition of the household, suggesting a marked saving in costs of reaching the same welfare level.

Browning and Meghir (1991) have shown that the interaction between household labor supply and commodity demand is of significance for analyzing both labor supply and consumption and that ignoring the effects of female labor supply may lead to biased inference on the effects of children on demand. Our findings suggest that having a second employed member in the household significantly reduces the social cost of children across all geographic locations. Thus, policy measures encouraging the labor participation of women could produce a reduction in the cost of children as well as providing an incentive to the household's fertility decisions. Such considerations are especially relevant in Italy, where fertility rates are among the lowest in the world and where there is a persistent low level of female labor force participation, particularly in the South.

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