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REVIEW OF HOUSEHOLD DEMAND ELASTICITIES IN ARGENTINA

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SUMMARY

Demand elasticities are widely used in economic studies to predict the demand for goods. In recent years several studies have estimated price and income elasticities of household goods consumed in Argentina. However, the review of these papers shows that (a) virtually all estimates come from the Survey of Household Expenditure of 1996 (ENGHo'96) and, therefore, do not reflect changes in consumers' behavior after the country moved towards a flexible currency exchange rate, (b) demand functions other than LINQUAD and LOG-LOG have not been explored, which - in our view - do not represent correctly the demand for all goods consumed by the population, and (c) despite sharing a common information source and, in many cases, the same functional form, the resulting estimates are highly variable between studies. For these reasons, we review the already computed demand elasticities and compare them with updated estimates from ENGHo'04 data. We propose specific demand functions for each article and a simple aggregation procedure in order to cover all items consumed by the population.

Key words. Demand Elasticities.

REVISIÓN DE ELASTICIDADES DE DEMANDA DE HOGARES DE LA ARGENTINA

RESUMEN

Las elasticidades de demanda son ampliamente utilizadas en estudios económicos para predecir la demanda de bienes. En los últimos años varios estudios han estimado elasticidades precio e ingreso de bienes o grupos específicos de bienes. Sin embargo, la revisión de dichos trabajos revela que (a) prácticamente todas las estimaciones provienen de la Encuesta de Gastos de los Hogares de 1996 (ENGHo'96) y, por lo tanto, no reflejan los cambios en el comportamiento del consumidor posteriores a la derogación de la ley de Convertibilidad; (b) no se han explorado funciones de demanda distintas a LINQUAD y LOG-LOG, las que –a nuestro juicio– no representan correctamente la demanda de la mayoría de los bienes consumidos por la población; y (c) a pesar de compartir una fuente informativa común y, en muchos casos, una misma forma funcional, las estimaciones resultantes son notablemente variables entre estudios. Por estas razones, el informe que presentamos a continuación se propone revisar dichas elasticidades pero a partir datos de la ENGHo'04, y ampliar las estimaciones a otros artículos de la canasta de consumo de los hogares. Para ello propondremos funciones de demanda específicas para cada artículo de la ENGHo'04 y un sencillo procedimiento de agregación por clases, a fin de cubrir todos los artículos consumidos por la población.

Palabras clave. Elasticidades de demanda.

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INTRODUCTION

In economics, elasticity is defined as the function that measures the sensitivity of one variable to changes in another variable. In particular, own-price and income elasticities measure the percentage change in quantity demanded of a good after a small change in the price of the same good or in the consumer's income, respectively. Price and income elasticities are widely used in economic studies to estimate the demand for goods. For example, in the System of National Accounts of Argentina the gross production value of several activities (e.g. bars and restaurants, repair of home appliances, taxis, etc.) are estimated by demand indices (DNCN, 1999), that is by functions whose parameters are own-price and income elasticities.

In recent years, several studies have estimated price and income elasticities in Argentina of specific goods or groups of goods, mostly from the 1996 Survey of Household Expenditure. For example, Berges and Casellas (2002) estimated the elasticity of demand of 18 classes of foods, Lema *et al.* (2007) analyzed the elasticities of 11 classes while Rossini *et al*. (2008) analyzed another 10 and Galetto *et al.* (2005) conducted a specific study on cheeses. Even the U.S. Department of Agriculture (Seale *et al.,* 2003; Seale and Regmi, 2006, and Muhammad *et al.,* 2011) maintains a database of demand elasticities of 8 classes of foods and 8 non-food items, covering approximately 100 countries[3]. Sánchez *et al.* (2010) computed the income elasticity of taxis in the city of Salta, and Margulis and Greco (2014) computed price and income elasticities of electricity demand, being these papers two of the few that use data from the 2004 Survey of Household Expenditure[4]. Margulis and Greco also present an exhaustive compilation of demand elasticities of electricity obtained previously worldwide. Another useful compilation is the one of Castro and Barafani (2015) who gathered several price elasticities of automotive and rail passenger-transport, and of gas and electricity, computed between 1984 and 2015 by nearly ten authors. A remarkable paper for its completeness is González Rozada (2000), who estimated the elasticities of 69 food and non-food items, although this review is hardly known because it remained as an internal report of the BID 826 OC/AR project.

The reviewed literature reveals that (a) most estimates come from the 1996 Survey of Household Expenditure (hereafter ENGHo'96) and, therefore, do not reflect economic changes following the revocation of the Convertibility Law, (b) the pre-vailing demand functions are LINQUAD and LOG-LOG, or less frequently some linear function, and (c) despite sharing a common information source and, in many cases, the same functional form, the resulting estimates are remarkably variable among studies[5-6]. As a consequence, demand estimates arising from the elasticities reported in the mentioned papers are unreliable, either because of changes in the consumers' preferences due to the time past - as suggested by (a) - or because of a misspecified analytical form of the demand function - as suggested by (b) - most probably due to the selection of the functional form by goodness of fit to an available sample of households' expenditures. Moreover, if such misspecification occurs it might be difficult to detect due to the multiple constraints that are usually imposed to the parameters' estimator to meet the economic theory on demand functions. The last point (estimators variability) might occur

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3 García Arancibia *et al.* (2011) also presented an interesting study on the determinants of food consumption away from home, but without calculating demand elasticities.

4 Both papers report notable differences among elasticities along quintiles of personal income. Regarding electricity demand, for example, Margulis and Greco (2014) report higher income elasticity at higher incomes and higher price elasticity (in absolute value) in poorer households.

5 By Convertibility Law we mean Law No. 23.928/91 which established a fix exchange rate of one dollar per peso.

6 In 2014 the INDEC published the results of ENGHo'12. However, due to the recent availability of this database, very few estimates of demand elasticities have been published. Among them, we highlight the paper of Pace Guerrero *et al.* (2014) on elasticities of meat and fish, for its rigorous econometric analysis.

by the criterium followed by each author to group ‘‘related goods’’ into classes of goods, a topic scarcely discussed in the literature.

Objectives

The aim of this paper is to review previous demand elasticities using the 2004 Survey of Household Expenditure (hereafter ENGHo’04) and to extend the estimates to items not included in the mentioned papers in order to present a complete table of elesticities computed under a common methodological framework. To do so, we shall estimate the parameters of the demand function of each single item of the ENGHo’04 and group the items into classes by a simple but statistically sound procedure. These classes cover presumably all goods and services consumed by the population although some rare items were excluded from the study. We note that the estimation of elasticities will be done individually for each item rather than through a demand system due to the large amount of goods to be estimated. For the same reason the explanatory variables of each demand function will be only the item’s own price and the consumer’s income. We shall omit the prices of substitutes and complements, as well as specific attributes of the consumer or household. Although the omission of potentially relevant variables may introduce some bias in the parameter estimates, we believe the effect will be partially offset by the subsequent grouping of items into classes. However, we admit that this is a real but unavoidable drawback of the chosen course of action.

MATERIALS AND METHODS

The Demand Function

Consider a single Marshallian demand function represented by a broken hyper-plane, that is, a function in which each individual demands positive amounts of a certain good or service in the price range $0 \leq x_1 \leq x_1^*$ and income range $x_2 \geq 0$, and does not demand it if $x_1 > x_1^{*}$[7]. Then,

$$q_i = (\beta_0 + \beta_1 x_{i1})\, \delta_{x(1) \leq x(1)*} + (\beta_2 + \beta_3 x_{i1})\, (1 - \delta_{x(1) \leq x(1)*}) + \beta_4 x_{i2} + \beta_5 x_{i3} + \ldots + \beta_{j+2} x_{ij} + \ldots,$$

where q_i is the quantity of a certain good or service demanded by the i-th individual, x_{i1} is the price of that good, x_{i2} is the income of the individual, x_j for all $4 < j < j'$ is the price of the j-th substitute good and x_j for all $j \geq j'$ is the price of the j-th complementary good, the β_j are fixed but unknown parameters of the demand function and $\delta_{x(1) \leq x(1)*}$ is a Kronecker delta that equals 1 if x_{i1} lies in the interval $0 \leq x_1 \leq x_1^*$, or 0 otherwise. Substitute and complementary goods also have break-points, but for brevity we omit the corresponding terms in the above expression. In practice, the full model is reduced to

$$q_i = \beta_0 + (\beta_2 - \beta_0)\, \delta_{x(1) \geq x(1)*} + \beta_1 x_{i1} + (\beta_3 - \beta_1)\, x_{i1} \delta_{x(1) \geq x(1)*} + \beta_4 x_{i2} + \varepsilon_i$$

where ε_i is a random variable distributed $\varepsilon_i \sim N(0,\sigma^2)$ that represents all terms of x_{ij} for $j > 2$ under the condition that the associated parameters $\beta_j \approx 0$ or that x_j’$x_{j'}$ for all $j' > 2$, and the δ changes direction for expository clarity. Then, an equivalent form (and consistent with the notation commonly used in the literature) of the previous function in the positive demand interval is

$$q_i(x, y \mid x \leq x_0) = \alpha_0 + \alpha_1 x_i + \alpha_2 y_i + \varepsilon_i\, ,\ \varepsilon_i \sim N(0,\sigma^2), \tag{1}$$

7 Recall that consumer theory is an individual theory.

in which $\alpha_0 = \beta_0$, $\alpha_1 = \beta_1$ and $\alpha_2 = \beta_4$ and the variables x and y are the price of the aforementioned good and the consumer's income, respectively, in the intervals $q_i \geq 0$, $x_i \geq 0$ and $y_i \geq 0$. The threshold price is now $x_0 = x_1^*$, and the function (1) is conditional on $x \leq x_0$. This demand function satisfies economic theory if $\alpha_1 \geq 0$ and $\alpha_2 \geq 0$[8]. On this basis, the own-price elasticity of demand for the i-th individual, conditional on x and q, is

$$\lambda(x_i,q_i) = (\partial q_i/\partial x_i)\, x_i q_i^{-1} = \alpha_1 x_i/q_i$$

for all $0 \leq x \leq x_0$ and $y \geq 0$, and $\partial \varepsilon_i/\partial x_i = 0$ or in terms of the independent variables,

$$\lambda(x_i,q_i) = [1 + (\alpha_0/\alpha_1)\, x_i^{-1} + (\alpha_2/\alpha_1)\, y_i x_i^{-1}]^{-1}. \tag{2}$$

The income elasticity of demand is $\lambda(y_i,q_i) = \alpha_2 y_i/q_i$, or more explicitly

$$\lambda(y_i,q_i) = [1 + (\alpha_0/\alpha_2)\, y_i^{-1} + (\alpha_1/\alpha_2)\, x_i y_i^{-1}]^{-1}, \text{ for all } y > 0 \text{ and } \partial\varepsilon_i/\partial y_i = 0. \tag{3}$$

Note that under this specification the elasticity of demand is a function of the price faced by each individual as well as its income, unlike the functions specified in most studies (*e.g.* González Rozada 2000) in which the demand elasticities are constant.

Computing Elasticities at the Average Price and Income

In the previous section we obtained expressions for the own-price and income elasticities of a single good or service. We now want to compute the own-price elasticity at the average price of the good and the income elasticity at the average income of all individuals. Therefore, let's write the own-price elasticity as

$$\lambda_{\bar{x}} = [\partial q(x,y)/\partial x]_{\bar{x}}\, \bar{x}/\bar{q} = \alpha_1 [(n_1 \bar{x}_1 + n_2 \bar{x}_2)/(n_1+n_2)]\, [(n_1 \bar{q}_1 + n_2 \bar{q}_2)/(n_1+n_2)]^{-1}$$

where n_1 is the number of individuals who demand the referred good or service and its complement $n_2 = N - n_1$ is the number of individuals in the population that do not demand it. Of course, the price $\bar{x}_2$ is not observable and the amount of good demanded at that price is $\bar{q}_2 = 0$. So, the quantity demanded at the mean price and the mean income is

$$\bar{q} = \alpha_0 + \alpha_1 \bar{x} + \alpha_2 \bar{y}, \text{ for all } 0 < \bar{x} < x_0,\ \bar{y} > 0,$$

x_0 being the threshold price at which demand is null. Then, $\bar{x} = (\bar{q} - \alpha_0 - \alpha_2 \bar{y}) / \alpha_1$ and

$$\lambda_{\bar{x}} = \alpha_1 (\bar{q} - \alpha_0 - \alpha_2 \bar{y}) / (\alpha_1 \bar{q})$$

8 Actually, α_2 can be equal to or less than 0, but this situation is seldom verified in practice.

After canceling factors conveniently and multiplying by the ratio of prices $\bar{x}_1/\bar{x}_1$, we rewrite the expression of $\lambda_{\bar{x}}$ as

$$\lambda_{\bar{x}} = 1 - [\alpha_2\, \bar{y}\,(\bar{x}_1/v) + \alpha_0\,(\bar{x}_1/v)] \quad (4)$$

where $v = \bar{x}_1\,\bar{q}$ and $\bar{q} = \bar{q}_1\, n_1/N$. The main advantage of expression (4) is that it does not require knowledge of the unobserved price $\bar{x}_2$. However, it does require knowledge of the ratio n_1/N, which in practice may be easily estimated by sampling. Replacing the first term between brackets in (4) by $\lambda_{\bar{y}}$ and rearranging conveniently we find that

$$\lambda_{\bar{y}} = 1 - (\lambda_{\bar{x}} + \alpha_0\, \bar{x}_1/v) \quad (5)$$

The expressions (4) and (5) not only allow us to find $\lambda_{\bar{x}}$ and $\lambda_{\bar{y}}$ ignoring $\bar{x}_2$, but also to aggregate several goods by adding up their values and re-expressing them in terms of one of them[9]. To do so consider, for example, two goods identified with the subscripts *j* and *j'*. The aggregated own-prices and income elasticities of this two-items-class may be obtained in the following fashion

(i) Estimate $\boldsymbol{\alpha}_j' = [\alpha_{0j}, \alpha_{1j}, \alpha_{2j}]$ and $\boldsymbol{\alpha}_{j'}' = [\alpha_{0j'}, \alpha_{1j'}, \alpha_{2j'}]$ by regression of q_i on x_i and y_i. Call the estimate of α_j, a_j. Check that the demand functions of both goods are close enough so as not to reject that they are perfect substitutes. In other words, that $\mathbf{R}(\mathbf{a}_j' - \mathbf{a}_{j'}') \sim N(\mathbf{0}, \sigma^2\mathbf{I})$.

(ii) If *j* and *j'* are close substitutes, compute the total expenditure (on an average individual) of both goods as the sum

$$v = \bar{p}_j\,\bar{q}_j + \bar{p}_{j'}\,\bar{q}_{j'}.$$

Then choose a reference price, which may be the price of the main good of the class or the average price of both goods. Let's choose $\bar{p}_j$.

(iii) Estimate the class own-price elasticity and income elasticity through (4) and (5) but replacing the true parameters of the demand function of *j* by their estimates and $\bar{x}_1$ by $\bar{p}_j$. For reasons which will become apparent hereinafter, re-estimate a_0 by

$$\hat{a}_{0j} = 1 - (\lambda^*_{\bar{x}} + \lambda^*_{\bar{y}}).$$

where the asterisk stands for the estimate of the corresponding true parameter.

9 We define aggregation as the grouping of assets in higher-order categories. In the context of this paper we restrict the definition to the grouping of substitutes.

The Demand Function in Terms of Indices

If we rewrite the demand function (1) of the average individual but dividing both sides of the equation by the quantity consumed in the referential year, and multiply conveniently by x_0/x_0 and y_0/y_0 on the right hand side we obtain

$$q/q_0 = \alpha_0/q_0 + \alpha_1 (x_0/q_0)(x/x_0) + \alpha_2 (y_0/q_0)(y/y_0)$$

or, in terms of elasticities,

$$q/q_0 = \alpha_0/q_0 + \lambda_{x(0)} (x/x_0) + \lambda_{y(0)} (y/y_0). \quad (6)$$

where we omit the tilde on x, y and q for readability. The ratio q/q_0 is an index of the quantity demanded, x/x_0 is a price index and y/y_0 is an index of individual income, and λ_{x0} and λ_{y0} are the own-price and income elasticities, respectively, at a certain base year[10]. Note that at the base year $q = q_0$, so that

$$\alpha_0 = (1 - \lambda_{x(0)} - \lambda_{y(0)})\, q_0.$$

Estimating the Parameters of the Demand Function

We selected 1,070 items consumed by a sample of 39,139 households from ENGHo'04. For each item, we fitted a demand function by generalized least squares following the procedure below:

(a) First we divided the income and the expenditures of each household by the number of individuals within it. As some households did not record income we built two separate data sets, one excluding those households and another with the missing incomes replaced by the total expenditure. The econometric model proposed was

$$\mathbf{q}_j = \mathbf{X}_j\boldsymbol{\alpha}_j + \boldsymbol{\varepsilon}_j \text{ where } \boldsymbol{\varepsilon}_j \sim N(\mathbf{0},\sigma_j^2\mathbf{I}),\ \mathbf{q}_j \geq \mathbf{0} \text{ and } \mathbf{X}_j \geq \mathbf{0}, \quad (7)$$

and $\mathbf{q}_j$ is a vector of $n\times1$ quantities acquired for the j-th item, $\mathbf{X}_j = [\mathbf{1},\mathbf{x}_j,\mathbf{y}]$ is a matrix whose first vector is $\mathbf{1}_{nx1}$, the second is a vector of prices (that is prices paid by the i-th individual for the j-th item) and the third is a vector of individual incomes y_i; $\boldsymbol{\alpha}_j$ is the vector of parameters to be estimated and $\boldsymbol{\varepsilon}_j$ is a vector of n independent and identically distributed errors.

(b) Then, we computed the elasticity of single items according to (2) and (3). As both the own-price and the income elasticities are specific to each individual, we estimated their mean values as a weighted average of the elasticities of all individuals, the weights being the number of individuals of each family multiplied by the expansion factor of each family[11]. We noticed that the empirical distribution of the individual

10 We call base-year to a benchmark year, usually the ENGHo's year.

11 The expansion factor is a proportionality constant that relates the total expenditure of each household in the sample to the total expenditure of similar households in the population.

elasticities was markedly asymmetric with heavy tails on the side of the expected sign of the associated regression coefficient (negative for positive α_1 and α_2) but only a few values on the opposite side. At this point we obtained estimated own-price and income elasticities for 1,070 items of the ENGHo'04.

(c) All items were grouped into classes. To do this we compared all items classified at six digits of the ENGHo'04 descriptor and grouped them into pre-defined or new categories. For this purpose, we first considered the four-digits-class definitions provided by the ENGHo'04 classifier. Then, we selected one or a few typical items of each class, and compared the distance between the estimated parameters of demand of other difficult to categorize items with those of the typical items. For such comparisons we used the test statistic

$$(\mathbf{Ra}_j - \boldsymbol{\alpha}_j)'[\mathbf{R}(\mathbf{X}'\mathbf{X})^{-1}\mathbf{R}']^{-1}(\mathbf{Ra}_j - \boldsymbol{\alpha}_j)/\sigma^2 \sim \chi^2_{(q)}$$

where $\mathbf{R} = \mathbf{I}_k$, $\mathbf{a}_j$, is the vector of estimated parameters of an item to be included in a certain class, and $\boldsymbol{\alpha}_j$ is a theoretical vector of ''true'' parameters deduced from the elasticities of typical items of the class and/or from the bibliography. However, in many cases, the final decision on the inclusion of an item in a certain class (or the definition of new classes) relied on personal judgments about the nature (whether it is a substitute or not) of the goods of that class. At the end of this stage all the 1,070 items were assigned to one of the approximately 100 classes described in the appendix.

(d) Finally, we estimated class elasticities after the expressions (4) and (5) and the estimator $\hat{a}_{0j}$. The chosen a_0 and a_2 estimators were those of the main item, except in cases where none of the items is clearly predominant so one of them was chosen as the typical item.

The estimator $\mathbf{a}_j$, its covariance matrix and all the mentioned tests where programmed in the matrix language of the free software Euler Math Toolbox v.18 developed by Rene Grothmann, associate professor of Katholische Universität Eichstätt (Germany).

RESULTS

Table 1 shows the price and income elasticities of more than 100 classes of items estimated according to the procedure described above[12]. We omit, due to its extent, to present here the parameter estimates and other statistics of the 1,070 regressions. These estimates are available upon request. It suffices to say that almost all regressions fitted the observations and that the regression coefficients of most of them showed the sign expected according to the theory of demand. The same protocol was carried out to fit other functional forms, for example LOG-LOG, but without success since most of the regression coefficients showed signs opposite to those suggested by the theory and non-significant values. As can be seen, some items in table 1 (*e.g.* textbooks and other texts for study) are blank. That is because the sample size of the items included in the class was too small to guarantee a reliable estimation. Nevertheless, we kept those classes in the list to make clear which elasticities were not covered by the study.

12 We refer to classes of items in a broad sense, not necessarily 4-digit categories of ENGHo'04.

DISCUSSION

The signs of the elasticities presented in the appendix are consistent with economic theory although, in general, price elasticities appear highly variable (considered in absolute value) to those found by other authors. We attribute these discrepancies to three possible causes: (a) the definition of classes followed by each author, (b) the analytical form chosen to represent the demand function, and (c) changes in consumers' behaviour due to the time past. We discuss these three possibilities by comparing our findings with those of González Rozada (2000), as we believe this is the most complete and comprehensive text among the ones consulted.

Grouping Items into Classes

Due to the large amount of goods and services consumed by households, almost all the papers actually present class-elasticities under the assumption that the differences in elasticity within each class are smaller than among classes. However, the properties of the original elasticities do not transfer to aggregate elasticities, and the grouping criteria may even introduce undesirable properties to the aggregated elasticities.

González Rozada(2000), for example, grouped items into classes already defined in the ENGHo'96 item-classifier, which in turn implies the assumption that all the items that make up each class follow the same demand function. As this is clearly false, the elasticities obtained for many classes (i) appear artificial (since they do not put together substitute goods) and (ii) vary over time even if the elasticities of the items that compose them remain constant, which is certainly undesirable[13]. Point (ii) is especially important since the ultimate goal of the author was to compute indices to estimate demand over time. For a formal proof of these assertions consider two demand functions, $q_1(x_1,y)$ and $q_2(x_2,y)$, and let

$$z = \theta_1 x_1 + \theta_2 x_2, \text{ where } \theta_1 + \theta_2 = 1,\ 0 \leq \theta_1 \leq 1, \text{ and } 0 \leq \theta_2 \leq 1.$$

The new variable z is a weighted average of the prices x_1 and x_2 which are in turn average prices (we omit the tildes for readability) of specific items consumed by households. Then the class-price elasticity is

$$\lambda_z = [\partial(q_1+q_2) / \partial z]\, z/(q_1+q_2)$$

where

$$\partial(q_1+q_2) / \partial z = (\partial q_1/\partial x_1)\,(\partial x_1/\partial z) + (\partial q_2/\partial x_2)\,(\partial x_2/\partial z) = \theta_1\, \partial q_1/\partial x_1 + \theta_2\, \partial q_2/\partial x_2$$

so that the aggregated elasticity is

$$\lambda_z = [\theta_1 \alpha_{x1} + \theta_2 \alpha_{x2}\,](\theta_1 x_1 + \theta_2 x_2)/(q_1+q_2).$$

13 For example, the study of González Rozada considers two categories called "sugar, jam and cocoa".

Writing this expression in terms of the own-price elasticities and calling $w_j = q_j / (q_1+q_2)$ yields

$$\lambda_z = w_1 (\theta_1 + \theta_2\alpha_{x2}/\alpha_{x1}) \theta_1\lambda_{x1} + (1-w_1) (\theta_2 + \theta_1\alpha_{x1}/\alpha_{x2}) \theta_2\lambda_{x2}. \quad (8)$$

It becomes clear from expression (8) that unless $\alpha_{x1} = \alpha_{x2}$ and $\theta_1 = 1$ or $\theta_2 = 1$, that is, in the trivial case where all items within a class follow the same demand function, the estimated class-price elasticity will be biased[14]. But even in the more realistic situation where $\alpha_{x1} \neq \alpha_{x2}$, $\theta_1+\theta_2 = 1$ and the elasticities λ_x are fixed, it is unlikely that w_1 would remain constant over time (at least in the long run) and therefore that λ_z would also remain fixed.

Our approach to the problem of clustering into classes followed essentially three stages: (a) identification of classes of related (actually substitute) goods, (b) selection of a typical demand function for each class; (c) estimation of class demand elasticities on the basis of the typical demand functions and the total consumption of goods within the class but expressed in equivalent amounts of the typical good. Although this is an ad-hoc procedure, it avoids some of the drawbacks pointed out before. First, our classes gather goods with similar demand functions. Second, as the class demand elasticities correspond to a single demand function instead of a hybrid function we avoid one source of variability in class elasticities, the one due to shifts in quantities consumed of goods of the same class. Third, we are able to build demand indices of constant elasticities without assuming constant elasticities at an item or class level. However, the clustering criterion proposed is ad-hoc and sometimes relies on personal judgment which is not a minor issue.

The Functional Form

Regarding the analytical form of the demand function, González Rozada suggested that the LOG-LOG function was the most appropriate to explain the demand of households, although it requires that all individuals consume the same goods, as $\lim_{xj\to 0} \ln x_j = -\infty$. However, simple inspection of the ENGHo'96 and ENGHo'04 databases reveals that such an assumption is clearly false. Therefore, González Rozada employed the LOG-LOG function only to estimate conditional (to those individuals who had indeed consumed the good under study) demand elasticities, and introduced another demand function to estimate unconditional elasticities. The analytical form of the latter was

$$w_j = \ln\beta_0 + \beta_1 \ln x_j + \beta_2 \ln y + \varepsilon_j\,,\ \beta_1 < 0 \text{ and } \beta_2 > 0$$

where w_j is the proportion of total expenditure in the j-th good, and x_j and y have the same meaning as before. This specification, however, still has a serious drawback: it either assumes knowledge of the prices faced by those individuals who do not consume the good or (even worse) assumes that the prices of goods actually consumed are the same as those faced by non-consumers, which contradicts the demand theory, especially in the context of Marshallian functions. This specification also implies that demand elasticities are not constant but depend on w_j, as it may be shown that $\lambda_{1j} = \beta_{1j}/w_j$ and also that $\lambda_{2j} = \beta_{2j}/w_j$. The point is quite disturbing since it implies that the bigger the share of an item (or a

14 It is difficult to imagine why two items with similar demand functions would appear separately in the household item-classifier.

class of items) on the total expenditure, the smaller the elasticities. As a consequence, the least amount of classes considered in González Rozada's paper together with the chosen functional form may explain the smaller absolute values of most elasticities in his findings.

On the other hand, our results suggest that the broken line function is the one that best explains the demand of households in Argentina at an item level. In fact, some preliminary fits on ENGHo'04 data using LOG-LOG functions led to non-significant regression coefficients and, in many cases, to coefficients with a sign opposite to that expected according to the economic theory. Therefore, we rejected the hypothesis of constant elasticities in early stages of the research although we admit that this hypothesis prevails in the literature. Despite its simplicity, the broken line function also leads to demand indices of fixed parameters, as shown in (6), as long as the proportion of individuals that consume the good remains constant[15].

Short and Long Term Elasticities

The comparison of the elasticities presented in the appendix against those computed by Frank (2012) between 2004 and 2010 shows that the former are usually larger in absolute value than the latter. We attribute this result to the homogeneity condition of demand systems (see Ferris 1998, p. 35) which states that the sum of the price elasticity, cross-price elasticities and the income elasticity must equal zero. Consequently, goods with multiple substitutes (or with few substitutes but high substitution elasticities) also exhibit high own-price elasticities. If we assume that in the long run any good has higher chances of substitution than in the short-term, it is reasonable to expect that ENGHo elasticities were lower in absolute value than those obtained from time series. However, simple inspection of the results reveals that for example about half of the food-classes of ENGHo exhibit higher own-price elasticities, although this result should be interpreted with caution because of the many confounding effects derived from the class definition and estimation technique followed by each author. Regarding income elasticities, most food-classes of ENGHo showed lower elasticities than those computed by other authors. This result could not be checked on non-food classes because of the unavailability of further information. So far we do not provide an explanation on these findings.

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15 This requirement involves only demand indices of aggregates of goods such as the classes mentioned in the appendix.

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APPENDIX

Table 1. Own-price (λ_x) and income (λ_y) elasticities of grouped items from ENGHo'04 corresponding to the aggregate demand function $q = \lambda_0 + \lambda_x x + \lambda_y y$ [16].

	Class description	λ_0	λ_x	λ_y
Bread, crackers & pasta	Crackers and sweet biscuits (packaged or loose), breadsticks and toasts, croissants, dry or fine masses	1.3709	-0.6290	0.2581
	White bread and bread (canned or fresh), joss sticks, hamburger or hot dogs buns	1.2274	-0.2502	0.0228
	White and brown rice, and other types of rice	2.9134	-2.5564	0.6429
	Flours and starches, semolina and semolina, oatmeal and dry cereal mixes, pizza, gnocchi, etc.	2.2681	-1.8456	0.5775
	Dried and fresh pasta, filled or unfilled (noodles, ravioli, cannelloni, gnocchi, etc.)	1.2029	-0.3855	0.1826
	Pizza ready to cook, pizza's dough, empanadas prepared uncooked pie fresh tapas or pies, other semi-prepared foods of pastries	2.6309	-2.0871	0.4562
Meat & fish	Beef (including minced meat, hamburgers and frozen)	1.1194	-0.2785	0.1590
	Offal and beef offal, bone with or without meat	3.0714	-3.4498	1.3784
	Whole or chopped chicken, burgers and chicken supreme, other semi-prepared food with chicken	2.7729	-2.1324	0.3594
	Cold cuts and salami, fresh sausages, sausages and other meats (pate de foie excluded, the canned corned beef and corned beef)	1.8516	-1.0533	0.2017
	Fresh or preserved sea food	5.1154	-4.8913	0.7758
Oil & fats Dairy & eggs	Vegetable oils, margarine and animal fats for cooking	2.1412	-1.5546	0.4134
	Fluid or powdered milk, whole or skim	1.3850	-0.5326	0.1476
	Cheese of all kinds, excluding cream cheese.	1.9542	-1.2254	0.2712
	Butter, cream cheese and «dulce de leche»	3.2492	-2.6319	0.3828
	Yogurt and fermented milk	3.2535	-2.7086	0.4551
	Eggs	2.3401	-1.7006	0.3605
Fruits	Tropical fruits (banana and pineapple)	3.4892	-2.8128	0.3236
	Seasonal fruits (peach, plum, strawberry, melon, watermelon, pear and grapes, except citrus)	3.9491	-3.7332	0.7842
	Apple	3.6291	-3.0668	0.4377
	Citrus fruits (lemon, tangerine, orange and grapefruit)	3.7827	-3.0406	0.2579
	Canned fruit (including olives) and dried fruit or dried	4.2623	-4.2946	1.0323
Vegetables	Onion, garlic and green onions	2.0398	-1.3180	0.2782
	Leafy vegetables (spinach, celery, spinach, radishes, lettuce, etc.), Cabbage (cabbage, cauliflower, broccoli)	1.7992	-0.9844	0.1852
	Potato, sweet potato and cassava	1.2497	-0.3605	0.1108
	Tomatoes	1.2114	-0.4116	0.2002
	Carrot, beetroot and radishes	2.2229	-1.5837	0.3608
	Squash and zucchini,fresh	2.1725	-1.5007	0.3282
	Canned vegetables (mainly tomatoes and beans)	0.9839	-0.2299	0.2460
Sugar & sweets	Sugar and sweetener	3.3292	-2.6327	0.3035
	Jam, jelly, and honey	5.9592	-5.6364	0.6772
	Single ice-cream, packaged or loose	1.9116	-1.5353	0.6237
	Alfajores, chocolates and other goodies	0.8394	-0.1738	0.3344
Spices & powders	Salt, vinegar, spices and condiments (including concentrated broth)	0.8151	-0.0028	0.1878
	Yeast, baking powder and baking products	4.1385	-4.0991	0.9606
Meals	Roast beef, rotisserie chicken, pizzas, cakes and pies ready to eat	2.3483	-1.4045	0.0562
	Infusions (coffee, cocoa, tea and yerba mate, etc.)	1.5177	-0.7933	0.2756
	Non-alcoholic beverages (soft drinks, juices, soda, mineral water, etc.)	1.0317	-0.1755	0.1438
	Alcoholic beverages (wine, beer, spirits, aperitifs and spirits)	1.6699	-0.9604	0.2905
	Meals outside with table service (lunch, dinner, breakfast and lunch)	1.9639	-1.2017	0.2378
	Meals outside without table service (fast-food, sandwiches, pizza and drinks)	3.0575	-2.3568	0.2993
	Infusions consumed outside the home (coffee, tea, mate tea with or without croissants)	4.6577	-4.2802	0.6225
	Drinks consumed outside the home (soft and alcoholic)	5.0303	-4.8366	0.8063

16 This is an aggregate demand function in which q, x and y are indices of quantity, real price and real income, respectively, with base year 2004.

Table 1. *continuación*

	Class description	λ_0	λ_x	λ_y
Clothing & footware	Cloth and threadsfor weaving, from cotton, wool or synthetic	—	—	—
	Clothing for men (including underwear)	1.0684	-0.3416	0.2732
	Women's apparel (including underwear)	0.9512	-0.1319	0.1807
	Clothing for children and babies (including underwear)	1.6143	-0.9634	0.3491
	Leather goods and accessories to dress	4.2306	-3.7336	0.5030
	Laundry, laundromat, laundry and dry cleaning of clothing, shoes, and cleaning sheets and tablecloths	3.6295	-2.9702	0.3407
	Men's footwear (shoes, moccasins, slippers, sandals, etc.)	5.1758	-4.9090	0.7332
	Women's shoes (shoes, sneakers, slippers, sandals, etc.)	4.7209	-4.2518	0.5309
	Kid's shoes (slippers, sandals, sandals, etc.)	5.7288	-5.5105	0.7817
	Repair of personal items (clothing alterations, shoe composure, etc.), furniture and carpets	3.0566	-2.4661	0.4095
Rent & services	Rental housing for permanent use	1.8690	-1.1713	0.3023
	Materials and construction labor	0.8635	-0.2205	0.3570
	Water and sewer (including garbage collection, plumbing and cesspools cleaning)	3.7715	-2.5000	-0.2715
	Electricity	2.7496	-1.2923	-0.4573
	Natural gas in tubes, kerosene, wood, coal and other fuels for home	1.2893	-0.7171	0.4278
	Natural network gas for homes	7.2871	-4.9902	-1.2969
Homeware	Furniture, mattresses and somiers (excluding repair)	2.8861	-2.2464	0.3603
	Pillows, blankets, sheets, table cloths, dish cloths and towels (excluding repair)	2.5998	-2.0606	0.4608
	Home appliances (cooker, ovens, heaters, refrigerators and other appliances, excluding repair)	4.9017	-4.6432	0.7415
	Repair of home appliances (stoves, heaters, appliances, tools, TV and video players, computers, etc.)	1.8503	-1.1176	0.2673
	Kitchen utensils (pans, pots, kettles, fountains, dishes and other utensils including tupperware)	1.7323	-1.8499	1.1176
	Tools and large equipment	—	—	—
	Small tools for house and garden	—	—	—
	Electric equipment (lamps, switches, transformers, cables, batteries, etc.)	2.1259	-1.4125	0.2866
Cleaning ítems & house-keeping	Detergents, degreasers, dishwashing and cleaning powders and bathroom (including bleach)	1.0954	-0.2485	0.1531
	Detergent, soap loaf, detergents, conditioners and dressings for clothes	0.7776	-0.1061	0.3285
	Furniture polish, and cleaner	3.8692	-3.2083	0.3391
	Broom, duster, mop, dryer, bucket, sponges, rubber gloves and cellulose cloths	1.7855	-1.0809	0.2954
	Trash bags, paper towels and tinfoil for cooking, disposable tableware	3.7829	-2.9384	0.1554
	Candles, incense, matches	0.7919	0.0203	0.1878
	Housekeeping (cleaning, cooking, ironing and childcare)	4.9430	-4.1919	0.2490
Medical care	Medicines and vitamins (excluding infant food)	2.9743	-2.4222	0.4480
	Alcohol, gauze, bandages, syringes, thermometers, etc. (includes disposable diapers for adults)	1.8892	-1.4032	0.5140
	Glasses and dentures	5.1657	-4.7523	0.5866
	Medical and psychological consultation (not including surgery or nurse), laboratory and radiological studies	1.4518	-0.6217	0.1699
	Dental consultation	3.8084	-3.1627	0.3543
	Prepaid medical aid and medical emergency (including surgery, hospitalization, and geriatric nurse)geriatric nurse)	6.5941	-6.1976	0.6035
Transport	Gasoline, diesel and CNG, change or purchase of motor oil (not including washing and greasing)	2.4937	-2.2130	0.7193
	Washing, greasing the automotive, parking and tolls	3.9999	-3.5538	0.5539
	Train ticket, subway and bus (including charter)	0.9702	-0.2320	0.2619
	Taximeter and car rental with chauffer	2.1632	-1.7697	0.6064
Phone & electronic devices	Phone service at home (including phone cards, excluding installation)	3.2372	-2.9361	0.6988
	Cell phone service (including phone cards), paging and beepers	2.5870	-2.1292	0.5422
	Internet service from home and from booths, booths, etc	1.5698	-0.8720	0.3022
	TV, radio, tape recorder, VCR, DVD player, personal computer (including laptops), diskettes, CD ROM, DVD, video games, etc. (excluding repair)	6.0052	-5.6535	0.6484

Table 1. *continuación*

	Class description	λ_0	λ_x	λ_y
Leisure & recreation	Games, toys, costumes, etc. (excludes boats and canoes)	3.2662	-2.8407	0.5745
	Sports items and games (balls, chips, etc.), canoes, kayaks, surfboards and boats	4.5000	-5.5225	2.0225
	Food and petcare	3.3105	-3.3171	1.0066
	Club membership, gym, summer camp and sports court rental	7.0333	-6.8968	0.8636
	Cable or satellite TV	2.3580	-1.6315	0.2735
	Cinema, theater, concert, dance and other cultural and recreational events	3.8567	-3.4430	0.5863
	Newspapers and magazines (including journals)	2.1879	-1.5540	0.3661
	Children's books and textbooks, novels, essays, short stories, dictionaries and encyclopedias	1.9694	-1.3714	0.4020
	Hotel or pension, campsite or rental of housing or timeshare	4.3000	-3.6387	0.3388
Education	Formal education (tuition and fees for primary, secondary and university)	-2.5333	-0.0003	3.5336
	Textbooks and other texts for study	—	—	—
	School supplies (notebook, folder, notebook, pen, ruler, etc., excluding photocopies)	1.4705	-0.6098	0.1393
	Photocopies	1.5176	-1.6786	1.1610
Tabacco	Cigarettes, cigars, pipes, etc.	1.3392	-0.6753	0.3361
Beauty and pers. items	Hairdresser for men and boys	3.8624	-3.1869	0.3245
	Hairdressing and personal care of women	3.8033	-3.3479	0.5446
	Disposable baby diapers and baby food	1.1124	-0.4165	0.3041
	Toilet paper, toothbrushes, razors, sanitary napkins, disposable tissues (excluding diapers)	0.8489	-0.0417	0.1927
	Cosmetics, beauty creams, deodorant, shampoo and conditioner, hairspray, etc.	1.6256	-0.7475	0.1219
	Toilet soap, toothpaste, shaving cream	1.5605	-0.9345	0.3740
	Scissors, pliers, tweezers, comb, brush, razor and shave	4.7980	-4.8092	1.0112
Other items or services	Watches, jewelry and fantasies	3.8302	-3.0776	0.2474
	Social protection	—	—	—
	Insurance except life and automobile insurance	4.7087	-4.3965	0.6878
	Financial Services	—	—	—
	Funeral Services	0.2309	0.0020	0.7671