

**CITY SIZE AND HOUSEHOLD FOOD CONSUMPTION  
AN APPLICATION OF THE AIDS MODEL TO FOOD  
DEMAND ELASTICITIES IN SPAIN**

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# **City size and household food consumption**

## **An application of the AIDS model to food demand elasticities in Spain**

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### **Abstract**

Empirical evidence on consumer behavior is of major importance in the formulation and analysis of economic policies. Changes in prices, income level, or decisions regarding taxes or other structural reforms that affect relative prices may produce very different effects depending on family income distribution or also across space. The aim of this paper is to estimate expenditure and own-price elasticities for ten aggregated food product groups using the Spanish Household Budget Survey for the year 2010. These products are the ones for which the survey provides information regarding prices and quantities, thus allowing the application of the Almost Ideal Demand System model (AIDS). This estimation procedure allows comparisons to be made not only among different levels of income, but also how relevant could be the place of residence characteristics. The results confirm that the size of the city in which the household resides has a similar significant and relevant effect on consumption patterns as family income level. This is especially clear with own-price elasticities. In Spain, large cities show a greater response to price changes than small cities or rural areas.

**Key words:** *Almost Ideal Demand Systems (AIDS), food elasticities, Spain and municipality size.*

**JEL Classification:** *D12, R12 and R22.*

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## **1. Introduction.**

The economic crisis that southern European countries like Spain are facing not only implies significant changes in levels of household income, but also supposes major changes in prices as a result, among other things, of the stringent adjustment policies undertaken by governments. For example, one of the most important measures that the Spanish government has had to face throughout 2012 has been that of implementing a significant increase in Value Added Tax (VAT), the main indirect tax, that influencing the final price of products (VAT reform 2012). The VAT rate of most products has increased from 18% to 21%, although the tax on some specific products has risen from a reduced rate of 8% to the standard rate of 21%, leading to significant losses in consumer purchasing power in addition to affecting producers and traders. Whether households or businesses support the impact of price increases basically depends on the own-price elasticities of each product. Differences in these elasticities for different income levels or over space can mean that economic policy measures, such as adjustments in VAT rates, produce different effects depending on income level or even on the characteristics of the place of residence.

There is an extensive body of empirical literature on how own-price elasticities and expenditure elasticities vary depending on household income or life cycle, among other factors. However, the number of studies exploring the relationship between space and elasticities or, more generally, consumption patterns, is very limited. About the connection between the level of household income and its consumption structure see, for example, Houthakker and Taylor (1970). These authors used US data referred to the first three thirds of the twentieth century and showed estimations of own-price and expenditure elasticities were significantly different between income quartiles. Ahmed and Shams (1994), worked only with foodstuff demand in the case of Bangladesh and found striking differences between the estimated elasticities of poor and rich consumers, showing that low-income households are more price responsive than those with high incomes. Another example can be seen in a study on the consumption of animal products in Turkey over five income groups, which also shows considerable differences in consumption between these groups (Armagan and Akbay, 2008).

Based on all this evidence, it is therefore likely that changes in prices or income affect high-income and lower-income households very differently. Inasmuch as there are strong spatial differences in income levels, it is also understandable that such adjustments will have different effects throughout the territory. However, our interest in this paper is focused on understanding whether there are other spatial patterns in addition to those that may result from a simple concentration of income in space.

There are previous empirical studies that suggest that the place of residence, in an urban or rural area and even depending on the size of the city, also affects consumer behaviors as income levels or stage in the life cycle. Nevertheless there is yet little empirical evidence, most of the studies are focused in developing countries contexts, and researches found different results depending on the country and period of the analysis. For instance, Abdulai *et al.* (1999) find very different patterns of food consumption that they explain as a consequence of the different demographic and sociological characteristics of the urban areas regarding with traditional rural India. Burney and Akmal (1991) estimate own-price and expenditure elasticities in Pakistan, separating samples between rural and urban areas as well as into six different income levels. They found that the demand responses for different food items vary between urban and rural areas, as well as by household income. In general urban areas are more sensible to the income changes and regarding with own-price elasticities it depends on the product characteristics. Haq *et al.* (2008) likewise conducted an estimation exercise for Pakistan nearly two decades later. Their study, which focused on the impact of rising food prices on poverty in rural and urban areas, once again identified significant differences between rural and urban contexts with similar conclusions as previous study of Burney and Akmal (1991). Similar conclusions are by Alfonzo and Peterson (2006) for Paraguay. Finally, Lewis and Andrews (1998) conducted an analysis for China concluding that there are important differences among China largest metropolis and rural areas. This study shows that the city size, not only the rural or urban condition, have also effects over elasticities and consumption patterns. In all cases, the differences between rural and urban areas are significant at a comparable level of the influence that has the income level of the family. Normally,

comparing for the same level of income, cities appear more sensible to the changes in prices or income.

Why largest cities could have different consumption patterns to those of small towns or rural areas? Is this something that occurs only in developing countries and is it also present in already developed countries that have completed the process of urbanization? To what extent are these differences relevant and do they have an impact on urban dynamics? Will impact in a different way a policy measure like increment the added value taxes across the space and among different cities according with their size?

It is evident that urbanization, income, agricultural productivity and industrialization are deeply interconnected processes (Bairoch, 1988). The directions of causality between these phenomena are manifold and exert a feedback effect in the process of economic development of a nation (Polèse, 2005). Economic modernization and nascent industrial development lead to increases in agricultural productivity. These increases facilitate expulsion of the rural population to urban areas where industrial development is concentrated. Increases in income transform consumption structures (Engel's Law, 1821-1896). There is demand for more industrial and tertiary products and a decrease in the participation of agricultural products in overall income. According to the World Bank report (1990), whereas the percentage spent on food in Europe or the United States lies between 10% and 15% of income, this figure ranges between 30% and 50% in Latin America and Asia, and is consistently above 50% in African countries. The correlation with the level of urbanization on these continents is evident (this has been explored, among others, in Polèse, 2005). In the process of sectorial change, when all these dynamics come into play, significant gaps in income between rural and urban settings may result in very different consumption patterns between the two contexts. This would explain the results of the studies cited in the previous paragraph, all of which refer to developing countries. However, once the process of urbanization and sectorial transformation stabilizes, a leveling out of living conditions and patterns of behavior and consumption is to be expected. Yet, supported by empirical analysis or theoretical approaches, several authors have pointed out elements that could explain different

consumption patterns between rural and urban settings and, within the latter, especially in large cities.

On the one hand, the lifestyle in large cities is completely different to that in small towns or rural areas. In cities there are more competition in the commerce and better conditions to have perfect information and free entrance of new business being much more close to a perfect market context than in rural areas (Zukin, 1998). Family shopping is spaced over time and concentrated in space. There is a trend to eat out, seeing as displacements are greater. There is less time to cook or buy fresh products. On the other hand, the variety of consumer products and services that can be accessed in a large city, especially leisure and entertainment services, is much greater than that available in a rural area (Scott, 1997). All these aspects can affect the type of consumption and could be reflected in substitution elasticities and even by different preference structures to the expenditure elasticities of foodstuffs.

This paper proposes to cover these gaps with an analysis of consumption patterns of households along different city sizes in the context of a developed country. If the influence of the spatial setting is relevant, this would imply that measures affecting prices, such as increases in VAT, or situations that reduce income, such as the current crisis, will generate sharply differentiated spatial effects depending on the type of city.

We apply our analysis to the Spanish economy. This is especially attractive for a study of this kind for a number of reasons. First, the Spanish economy completed the process of sectoral change over two decades ago and its most intense process of urbanization mainly occurred during the 1960s and 70s (Lanaspa *et al.*, 2003). However, the legacy of this late industrialization and urbanization in relation to the rest of Europe was the very relevant presence of rural settings in terms of population. Around a third of the population still lives in population centers of less than 50,000 inhabitants. In addition, Spain's urban system is very comprehensive, comprising cities of different sizes throughout the territory (Lanaspa *et al.*, 2004). This makes the comparison of urban vs. rural and by city size especially interesting in the case of Spain. Second, there are major differences in income levels within Spain that have been aggravated by the crisis. This fact enhances the study of elasticities, allowing us to analyze not only the

differences between urban vs. rural spatial settings, but also by income levels within a substantially broad range (Gracia *et al.*, 1998; Angulo *et al.*, 2002).

The expenditure on food consumption in Spain represents 14.37% of overall household expenditure in 2010 (official data from INE). In spite of the economic crisis, these proportions have remained stable throughout the 2000s. However, if we compare 2010 with the previous year, the decrease in both quantities and expenditure is more pronounced than in the whole time series, being -1.1% and -2.3% respectively (data from the Spanish Ministry of Agriculture, Food and the Environment). This may be due to the worsening of the economic crisis since 2010 (see Varela-Moreiras *et al.*, 2010).

Since we are interested in capturing not only the changes in the structure of consumption over income levels, but also the possible effects of the level of urbanization of the place of residence, we need to estimate expenditure and price elasticities for foodstuffs using the Almost Ideal Demand System (AIDS) at level of spatial unit developed by Deaton and Muellbauer (1980) and the 2010 Household Budget Survey published by the Spanish Statistical Institute. This methodology is explained in the next section (Section 2). Subsequently, in Section 3, we adapt the methodology to the characteristics of the data and the analysis of the Spanish economy. This allows us to address the specific analysis for Spain in Section 4, which presents and discusses the results. Following that, we present the main conclusions of the study.

## **2. Methodology: the Almost Ideal Demand System procedure.**

The estimation of demand models can be performed by means of various methods. A summary and evaluation of the different options can be found in Kakhki *et al.* (2010). One of the most widely applied proposals has been that of Deaton and Muellbauer (1980). Their approach, known in the literature as the Almost Ideal Demand System (hereafter, AIDS), has important advantages over other procedures, the most important of these being the fact that it considers non-homothetic preferences for each household income group. This makes it especially valuable for comparisons across space, given that it allows the basket of preferences between consumers of different regions or areas to be varied.



The starting point is the specification of an expenditure function consistent with microeconomic foundations. We hence define this expenditure function as:

$$c(p, u) = (1 - u) \log(a(p)) + u \log(b(p)) \quad [1]$$

where  $c$  is the expenditure function,  $p$  is the price vector and  $u$  is the utility level; and where

$$\log(a(p)) = \alpha_0 + \sum_{i=1}^m \alpha_i \log p_i + \frac{1}{2} \sum_{i=1}^m \sum_{j=1}^m \gamma_{ij} \log p_i \log p_j \quad [2]$$

$$\log(b(p)) = \log(a(p)) + \beta_0 \prod_i p_i^{\beta_i} \quad [3]$$

Substituting [2] and [3] in the cost function [1], and applying Shephard's lemma, we can obtain the demand functions directly from this equation, deriving with respect to prices and multiplying by  $p_i/c(u, p)$ :

$$\frac{\partial \log(c(p, u))}{\partial \log p_i} = \frac{p_i q_i}{c(p, u)} = w_i \quad [4]$$

where  $w_i$  is the budget share of good  $i$ ,

$$w_i = \alpha_i + \sum_{j=1}^m \gamma_{ij} \log p_j + \beta_i u \beta_0 \prod_i p_i^{\beta_i} \quad [5]$$

If we define  $u$  in [1] as a function of prices and total expenditure and substitute the result in [5], we have the estimable shares as a function  $p$  and  $x$ , plus a set of parameters to be estimated. These shares are the AIDS demand functions:

$$w_i = \alpha_i + \sum_{j=1}^m \gamma_{ij} \log p_j + \beta_i \log\{x/P\} \quad [6]$$

where  $w_i$  is the share of the  $i$ th good,  $p_j$  is the price of the  $j$ th good,  $x$  is the total expenditure on all the goods in the system,  $\alpha_i$ ,  $\gamma_{ij}$  and  $\beta_i$  are parameters of the model, and  $P$  is a translog price index defined as:

$$\log P = \alpha_0 + \sum_{j=1}^m \alpha_j \log p_j + \frac{1}{2} \sum_{i=1}^m \sum_{j=1}^m \gamma_{ij} \log p_i \log p_j \quad [7]$$

Some empirical studies use the Stone Price Index to avoid problems of non-linear estimations. However, we estimated the original model as suggested by Deaton and Muellbauer (1980) using the translog price index described in [7]. As an alternative to [7], Cooper and McLaren (1992) suggest a modification of AIDS called MAIDS, which preserves regularity in a wider region of the expenditure-price space. Nevertheless, the most usual form in the literature is AIDS or its linear approximation, LAIDS.

The parameters of the AIDS model satisfy the adding-up restriction ( $\sum_i w_i = 1$ ) and are homogeneous of degree zero in prices and total expenditure taken together, while the total expenditure satisfies the Slutsky symmetry condition. These properties of consumer demand theory can be imposed as follows:

$$\sum_{i=1}^n \alpha_i = 1, \quad \sum_{i=1}^n \gamma_{ij} = 0, \quad \sum_{i=1}^n \beta_i = 0 \quad [8]$$

$$\sum_j \gamma_{ij} = 0, \quad [9]$$

$$\gamma_{ij} = \gamma_{ji} \quad [10]$$

The own-price and income elasticities will be obtained estimating [6] with real data. The following section will discuss how to apply this procedure to the Spanish databases.

After presenting the data and empirical model we will show the form of elasticities with AIDS (equations [12] and [13]).

### **3. Application to the Spanish case: data and empirical model.**

As in many other countries, the application of this approach to the Spanish case entails the difficulties arising from the lack of availability of data. The only survey that contains information on household expenditure and consumption patterns is the Household Budget Survey, an extensive survey of Spanish household purchases, income and other socioeconomic characteristics. The Spanish Statistical Institute (INE) conducts this survey annually. The estimation of the AIDS requires information on prices, quantities and household expenditure. As all the prices must be observable to estimate the model, we recover the unitary prices at which households purchase the commodities by dividing expenditures by quantities. This way to obtain the unit prices is well accepted in the literature and it is well known as *unit values*. All these information requirements explain that the applied estimation is only feasible for the foodstuffs group, divided into ten food sub-groups in the Household Budget Survey classification: (i) *Bread and cereals*, (ii) *Meat*, (iii) *Fish*, (iv) *Milk, cheese and eggs*, (v) *Oil*, (vi) *Fruits*, (vii) *Vegetables*, (viii) *Sugar*, (ix) *Coffee, tea and cacao*; and (x) *Mineral water and soft drinks*.

In many cases, the consumed quantities are not reported by a household, in which case we replace the price of the item by the average price of this item in the same region and in the same type of municipality. An additional problem in the estimation process is the existence of censored data or households that report zero consumption. Consequently, prices are not available for all items in all households. Regarding this issue, we shall follow the two-step procedure proposed by Shonkwiler and Yen (1999). This methodology permits include these censored observations and avoids the potential selection bias that can appear if they are ignored. (Atuesta & Paredes, 2012) In the first step, we compute a PROBIT regression with a binary variable that represents the decision to consume and is regressed as a function of socioeconomic variables. The

PROBIT model determines the probability that a given household consumes a given good and is used to estimate the cumulative ( $\Phi$ ) and density ( $\phi$ ) functions.

In the second step, we incorporate the cumulative function as a scalar in the equations for shares, whereas the density function is included as an extra variable. Additionally, fixed effects are included in the model by means of dummy variables for the 5 municipality sizes:

$$w_i = \Phi(x) \left[ \alpha_i + \sum_{j=1}^m \gamma_{ij} \log p_j + \beta_i \log\{x/P\} \right] + \sum_h m_h M_h + \delta \phi(x) \quad [11]$$

Where  $M_h$  is a dummy variable which represents the five municipality sizes available in the survey and  $m_h$  is the estimable parameter associated with  $M_h$ :

- $M_1$ , municipalities with more than 100,000 inhabitants,
- $M_2$ , municipalities with between 100,000 and 50, 001 inhabitants,
- $M_3$ , municipalities with between 50,000 and 20, 001 inhabitants,
- $M_4$ , municipalities with between 20,000 and 10, 001 inhabitants, and
- $M_5$ , municipalities with less than 10,000 inhabitants.

The set of  $n - 1$  equations like [11] makes up our demand system, where  $n$  is the number of shares and the last share is recovered as a residual of the remaining  $n - 1$  ones.

The derivations of elasticity formulas for the AIDS model are found in Green and Alston (1990). The expenditure elasticity,  $\eta_i$ , and the uncompensated cross- and own-price elasticities ( $\varepsilon_{ij}$ ) take the following form:

$$\eta_i = 1 + \frac{\beta_i}{w_i} \quad [12]$$

$$\varepsilon_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{\beta_i \alpha_j}{w_i} - \frac{\beta_i}{w_i} \sum_k \gamma_{ik} \log P_k \quad [13]$$

where  $\delta_{ij}$  is the Kronecker delta, which takes the value of 1 if  $i=j$ , and the value 0 for  $i \neq j$ .

The parameters of the model are estimated by applying Nonlinear Seemingly Unrelated Regression that fits a system of nonlinear equations by Feasible Generalized Nonlinear Least Squares (FGNLS). Appendices 1 to 3 shows the parameter estimates of the AIDS models for the whole sample, the first quartile sample and the fourth quartile sample.

#### **4. Elasticity results by income levels and city sizes.**

Table 1 shows the income and own-price elasticities for the whole sample, comprising almost 22,000 households, for Spain in 2010. It should be remembered that the expenditure elasticity measures the change in demand in terms of quantity and quality given a change in expenditure. Meanwhile the own-price elasticity measures the change in demand given a change in the price of the product.

Our results for the Spanish economy are similar to those found in previous studies that managed data from a decade ago (Gracia *et al.*, 1998 and Angulo *et al.*, 2002). Several groups, such as *Meat, Fish, Oils & fats, Fruits* and *Vegetables* have expenditure elasticities greater than 1. But most of the products present expenditure elasticities lower than 1 confirming the Engel law. There are also several groups of goods with own-price elasticities greater than or close to 1: *Oils & fats, Fruits, Vegetables, Coffee, tea & cocoa and Mineral waters & soft drinks*. This means that Spanish households are quite responsive to changes in prices. Nevertheless, most of the products present own-price elasticities lower than 1. Those that have the lower values, close to 0.5, are the staple food products in a standard family diet like *Bread & cereals, Meat, or Milk, eggs & cheese*.

In general, we thus find that the data for Spain are more similar to those reported by Pakistan, India and China by the aforementioned authors such as Alfonzo *et al.* (2006), Sheng *et al.* (2008) and Huq *et al.* (2010) than those found by the United States Department of Agriculture (2007) for Belgium, the USA, Canada, France, Denmark, Germany and the UK. However, many of these differences may be attributable to the

methodological approach. Overall, the estimates based on the AIDS procedure tend to give higher elasticities results than those found using other estimation methods.

**Table 1. Expenditure and own-price elasticities for the whole sample (2010)**

|                                         | Whole Sample       |                  |              |
|-----------------------------------------|--------------------|------------------|--------------|
|                                         | <i>Expenditure</i> | <i>Own-price</i> | <i>Share</i> |
| <i>Bread &amp; cereals</i>              | 0.6086             | -0.5407          | 15.28        |
| <i>Meat</i>                             | 1.2312             | -0.6436          | 25.01        |
| <i>Fish</i>                             | 1.4422             | -0.9054          | 12.10        |
| <i>Milk, eggs &amp; cheese</i>          | 0.8678             | -0.7173          | 14.58        |
| <i>Oils &amp; fats</i>                  | 1.4618             | -1.3011          | 2.29         |
| <i>Fruits</i>                           | 1.0132             | -1.0063          | 10.64        |
| <i>Vegetables</i>                       | 1.0254             | -0.9529          | 10.70        |
| <i>Sugar</i>                            | 0.7683             | -0.7636          | 2.82         |
| <i>Coffee, tea &amp; cocoa</i>          | 0.8427             | -1.0790          | 1.82         |
| <i>Mineral waters &amp; soft drinks</i> | 0.0860             | -0.9737          | 4.71         |

Table 2 presents the results for the same ten groups of products, though now divided into two sub-samples: first, the first three columns, corresponding to households that are in the 1<sup>st</sup> income quartile, i.e., lower-income earners, and then, the last three columns, corresponding to households that are in the 3<sup>rd</sup> income quartile, i.e., higher-income earners. As in Table 1, the Table 2 shows: expenditure elasticities, first and fourth columns; own-price elasticities, second and fifth columns; and expenditure shares, third and sixth columns. The results match expectations. In most food groups, there are no changes in sign or changes from elastic to inelastic products in terms of aggregate behavior. But we can observe that for many groups of goods appear significant differences between first and third income quartiles.

Considering expenditure elasticities, we can observe that regarding to high elastic goods with expenditure elasticity greater than 1, such as *Meat*, *Fish* or *Vegetables*; the expenditure elasticities for lower-income households are significantly higher than those for higher-income households. This also occurs in products which, even though they are not elastic, present expenditure elasticities approaching the value of 1, such as *Milk, eggs & cheese* and *Fruits*. However, for more inelastic products, with expenditure elasticities far below 1, like *Bread & cereals* or *Sugar*, the first quartile expenditure

elasticities are lower than those of the third quartile. This indicates that reductions in earnings in lower-income households lead to a rapid reduction in the consumption of more luxury foodstuffs, with these households consuming cheaper products than higher-income households. In a context of economic crisis, when reductions in earnings are generalized, we observe that the purchasing structure and the quality of consumption is affected much more rapidly in lower-income households with a reduction of the consumption of higher quality and higher protein value products compared to high-income households, whose consumption structure is less sensitive to changes in earnings.

The behavior pattern is similar with respect to own-price elasticities, though even more pronounced. Except for *Vegetables*, all own-price elasticities are higher for lower-income households. Low-income households are much price responsive than high-income households. This greater sensitivity is more pronounced the more elastic the product is.

All these results are consistent with microeconomic theory and empirical evidence found in similar studies cited previously, such as Bouis (1990), Ahmed *et al.* (1994), Abdulai *et al.* (1999) and Alfonzo *et al.* (2006). They are also in keeping with the evidence found in the Spanish case by Gracia *et al.* (1998) and Angulo *et al.* (2002).

**Table 2. Expenditure and own-price elasticities by income quartiles (2010).**

|                                         | 1st quartile global |                  |              | 3rd quartile global |                  |              |
|-----------------------------------------|---------------------|------------------|--------------|---------------------|------------------|--------------|
|                                         | <i>Income</i>       | <i>Own-price</i> | <i>Share</i> | <i>Income</i>       | <i>Own-price</i> | <i>Share</i> |
| <i>Bread &amp; cereals</i>              | 0.4219              | -0.5816          | 0.1919       | 0.7324              | -0.5264          | 0.1258       |
| <i>Meat</i>                             | 1.2900              | -0.7917          | 0.2135       | 1.2010              | -0.5224          | 0.2755       |
| <i>Fish</i>                             | 1.5262              | -1.2329          | 0.0977       | 0.9921              | -0.6699          | 0.1440       |
| <i>Milk, eggs &amp; cheese</i>          | 1.0075              | -0.7207          | 0.1643       | 0.8799              | -0.6793          | 0.1300       |
| <i>Oils &amp; fats</i>                  | 1.6120              | -1.6735          | 0.0216       | 1.7669              | -1.0813          | 0.0248       |
| <i>Fruits</i>                           | 1.1020              | -1.0743          | 0.1227       | 0.8490              | -1.0027          | 0.1009       |
| <i>Vegetables</i>                       | 1.1254              | -0.9481          | 0.1145       | 1.0938              | -0.9925          | 0.1017       |
| <i>Sugar</i>                            | 0.5563              | -0.9043          | 0.0291       | 0.7506              | -0.6733          | 0.0284       |
| <i>Coffee, tea &amp; cocoa</i>          | 0.8276              | -1.3530          | 0.0197       | 0.7706              | -0.8399          | 0.0184       |
| <i>Mineral waters &amp; soft drinks</i> | -0.1026             | -1.4982          | 0.0249       | 0.8616              | -0.9486          | 0.0505       |

In this paper, we specifically sought to study whether it is possible to identify if the city size significantly affects elasticities. This is the objective addressed in Table 3, which once again shows the same ten product groups divided between the 1<sup>st</sup> and 3<sup>rd</sup> quartiles, though also distinguishing municipalities by size according to the scale the database allows us to apply. The results are quite interesting, as they show that the size of the city where the household resides has an influence almost as relevant as that of its level of income.

Although there are differences among the groups of goods, in general, with no relevant differences between levels of income, expenditure elasticities are higher in largest cities. Lower values of expenditure elasticities are observed for small cities with less than 50,000 inhabitants, which is especially clear in rural areas with less than 10,000 inhabitants. The elasticities rise significantly in medium sized cities with more than 50,000 inhabitants. We cannot observe relevant increments when we move from medium cities to those of more than 100,000 inhabitants. This is not the case in certain groups of goods like *Coffee, tea & cocoa*, *Meat* or *Fruits* which maintain almost the same expenditure elasticity for all type of cities.

In virtually all cases, there are only two exceptions: own-price elasticities are more sensible the higher the size of the city is; and the less elastic values are normally found in small towns (rural areas) with fewer than 10,000 inhabitants. This occurs for both income levels, but is more clearly among lower-income households. The group of *Fish* is one that presents bigger differences depending on the income level of the household and the city size: in higher income levels families this product presents own-price elasticity close to 1 and the variations across city size are very small; but in lower income level families, *Fish* is a very elastic good and the own-price elasticity is very sensitive to the size of the city, being higher in medium and large cities than in the small ones or rural areas. Something similar happens with *Bread & Cereals* but less intensively: the evolution along the different city sizes is very similar for both quartiles, but the increments in own-price elasticities are higher for the lower income level families. The rest of the groups of goods also show higher own-price elasticities in



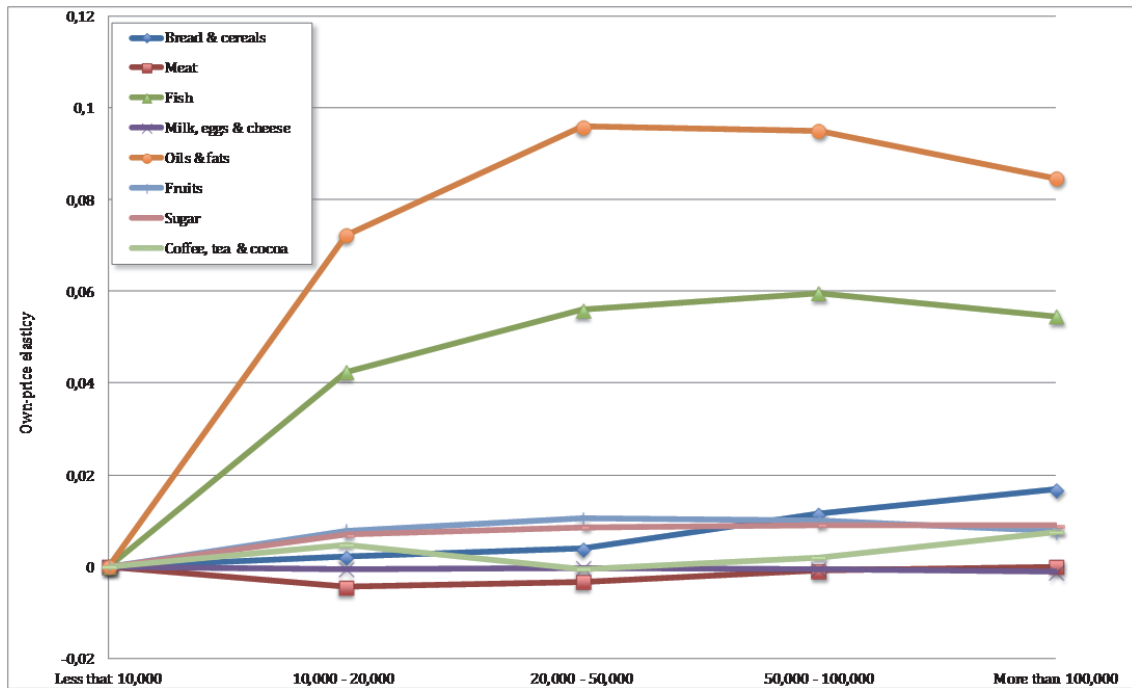
medium size or large cities than in rural areas. The virtual exceptions are with respect to *Milk, cheese & eggs* and *Meat*.

**Table 3. Expenditure and price elasticities by municipality size (2010).**

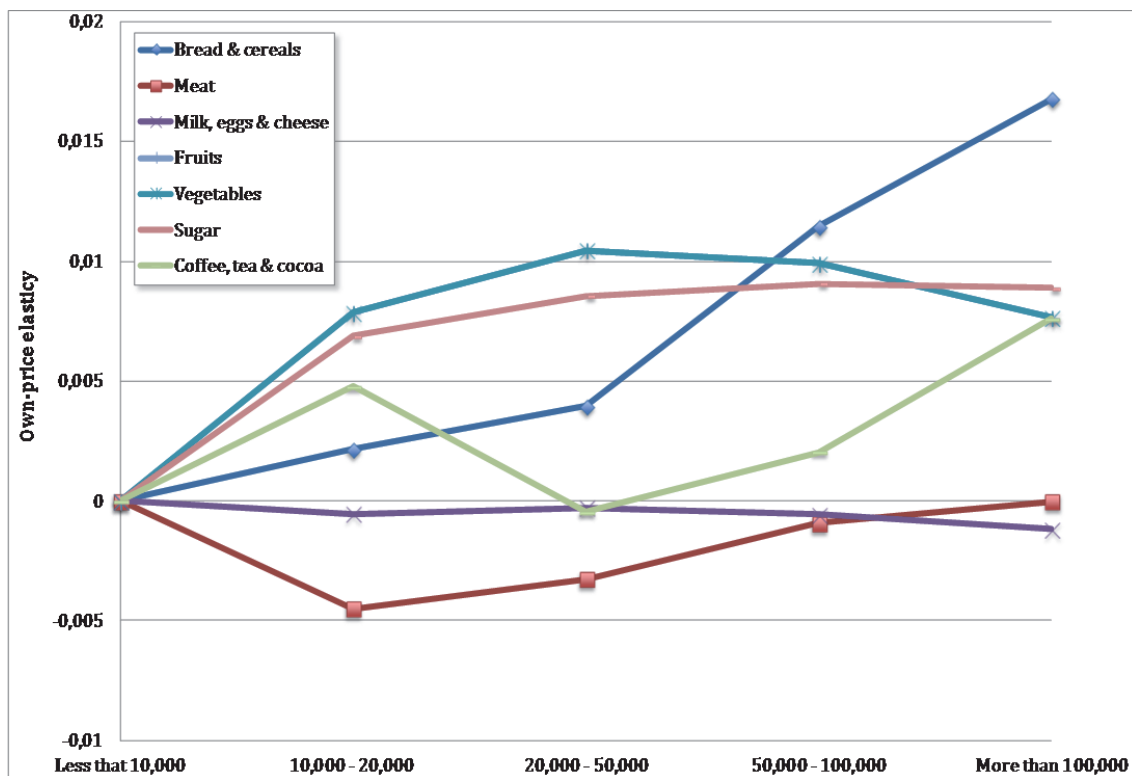
|                                         | Expenditure elasticities |                    |                   |                   |                        | Own-price elasticities |                    |                   |                   |                        |
|-----------------------------------------|--------------------------|--------------------|-------------------|-------------------|------------------------|------------------------|--------------------|-------------------|-------------------|------------------------|
|                                         | 1st quartile             |                    |                   |                   |                        | 1st quartile           |                    |                   |                   |                        |
|                                         | more than<br>100,000     | 100,000-<br>50,000 | 50,000-<br>20,000 | 20,000-<br>10,000 | less<br>than<br>10,000 | more than<br>100,000   | 100,000-<br>50,000 | 50,000-<br>20,000 | 20,000-<br>10,000 | less<br>than<br>10,000 |
| <i>Bread &amp; cereals</i>              | 0.42901                  | 0.42568            | 0.41937           | 0.41500           | 0.39367                | -0.58318               | -0.58013           | -0.57582          | -0.57479          | -0.57356               |
| <i>Meat</i>                             | 1.29373                  | 1.29387            | 1.29284           | 1.29178           | 1.29639                | -0.79591               | -0.79520           | -0.79333          | -0.79235          | -0.79594               |
| <i>Fish</i>                             | 1.55721                  | 1.56650            | 1.56321           | 1.54325           | 1.48120                | -1.25822               | -1.26427           | -1.25991          | -1.24377          | -1.19306               |
| <i>Milk, eggs &amp; cheese</i>          | 1.00957                  | 1.00966            | 1.00970           | 1.00966           | 1.00975                | -0.72104               | -0.72148           | -0.72168          | -0.72150          | -0.72189               |
| <i>Oils &amp; fats</i>                  | 1.70243                  | 1.71754            | 1.71938           | 1.68554           | 1.58262                | -1.75715               | -1.77381           | -1.77530          | -1.73690          | -1.61987               |
| <i>Fruits</i>                           | 1.10970                  | 1.11244            | 1.11349           | 1.11001           | 1.09789                | -1.08595               | -1.09388           | -1.09682          | -1.08672          | -1.04958               |
| <i>Vegetables</i>                       | 1.13257                  | 1.13424            | 1.13475           | 1.13289           | 1.12742                | -0.95264               | -0.95476           | -0.95529          | -0.95283          | -0.94540               |
| <i>Sugar</i>                            | 0.56592                  | 0.57041            | 0.56887           | 0.55326           | 0.49267                | -0.90340               | -0.90356           | -0.90310          | -0.90159          | -0.89544               |
| <i>Coffee, tea &amp; cocoa</i>          | 0.83868                  | 0.84157            | 0.84286           | 0.84013           | 0.84262                | -1.39004               | -1.38237           | -1.37891          | -1.38615          | -1.37957               |
| <i>Mineral waters &amp; soft drinks</i> | 0.27342                  | 0.39232            | 0.42646           | 0.32476           | -0.23416               | -1.29644               | -1.23175           | -1.21175          | -1.26679          | -1.54682               |
|                                         | 3rd quartile             |                    |                   |                   |                        | 3rd quartile           |                    |                   |                   |                        |
|                                         | more than<br>100,000     | 100,000-<br>50,000 | 50,000-<br>20,000 | 20,000-<br>10,000 | less<br>than<br>10,000 | more than<br>100,000   | 100,000-<br>50,000 | 50,000-<br>20,000 | 20,000-<br>10,000 | less<br>than<br>10,000 |
| <i>Bread &amp; cereals</i>              | 0.74220                  | 0.73583            | 0.74273           | 0.72826           | 0.71449                | -0.53299               | -0.52734           | -0.53320          | -0.52100          | -0.50847               |
| <i>Meat</i>                             | 1.20258                  | 1.20185            | 1.20399           | 1.20001           | 1.19766                | -0.52353               | -0.52267           | -0.52371          | -0.52201          | -0.52053               |
| <i>Fish</i>                             | 0.99189                  | 0.99216            | 0.99196           | 0.99245           | 0.99282                | -0.66743               | -0.66924           | -0.66790          | -0.67078          | -0.67212               |
| <i>Milk, eggs &amp; cheese</i>          | 0.88365                  | 0.88232            | 0.88263           | 0.87873           | 0.87379                | -0.68060               | -0.67989           | -0.68008          | -0.67807          | -0.67509               |
| <i>Oils &amp; fats</i>                  | 1.89149                  | 1.76818            | 1.83881           | 1.72715           | 1.64663                | -1.10248               | -1.08113           | -1.09340          | -1.07408          | -1.05910               |
| <i>Fruits</i>                           | 0.84664                  | 0.84813            | 0.84696           | 0.85055           | 0.85375                | -1.00666               | -1.00453           | -1.00617          | -1.00126          | -0.99672               |
| <i>Vegetables</i>                       | 1.09794                  | 1.09549            | 1.09706           | 1.09293           | 1.08917                | -0.99967               | -0.99466           | -0.99788          | -0.98935          | -0.98120               |
| <i>Sugar</i>                            | 0.76275                  | 0.75460            | 0.75361           | 0.74699           | 0.73737                | -0.68560               | -0.67672           | -0.67569          | -0.66845          | -0.65783               |
| <i>Coffee, tea &amp; cocoa</i>          | 0.78450                  | 0.77437            | 0.77717           | 0.77144           | 0.75129                | -0.84695               | -0.84149           | -0.84302          | -0.83991          | -0.82885               |
| <i>Mineral waters &amp; soft drinks</i> | 0.87348                  | 0.85852            | 0.87549           | 0.84313           | 0.81484                | -0.93868               | -0.94445           | -0.93776          | -0.94921          | -0.95566               |

Figure 1. Own-price elasticity variations by municipality size (2010).

1<sup>st</sup> quartile, all groups of products



1<sup>st</sup> quartile, less sensitive groups of products



### 3<sup>rd</sup> quartile, all groups of products

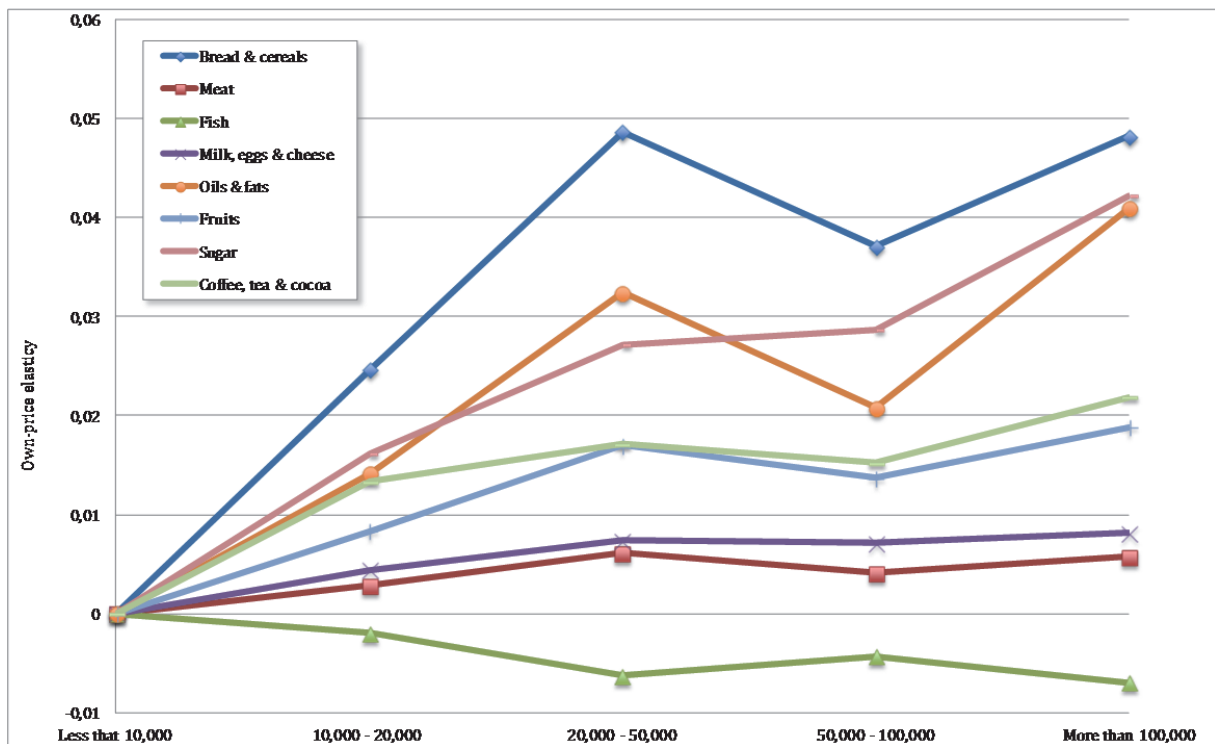


Figure 1 graphically summarizes these results, allowing them to be more clearly identified. According to this figure, we can conclude that when a price increase occurs in largest cities businesses and shops will be forced to respond to it with a more pronounced reduction in their profit margins than those similar businesses or shops have to apply in smaller cities or rural areas.

Summarizing the different tables' results we can conclude that in the Spanish case (i) expenditure and own-price elasticities show that, in general, households with lower income levels are more sensible to changes (ii) also both elasticities, but much more clearly the own-price elasticities, in large cities are more reactive to the changes than in small cities or rural areas. Our database does not distinguish between areas or neighborhoods within cities. However, we know that the population tends to concentrate within these areas or neighborhoods according to income levels across the space. That happens at national or regional levels but also at local level, inside of the cities and especially in the largest ones (Alonso, 1964). Inasmuch as we identified that higher-

income households (3<sup>st</sup> quartile of earnings) present higher own-price elasticities than lower-income households (1<sup>rd</sup> quartile), we conclude that, in neighborhoods or areas where lower-income households tend to concentrate in big cities, increases in costs or taxes will be mainly supported by businesses or shops, whereas they are passed on to a greater extent to the consumer in higher-income areas, more clearly in small cities or rural areas. This will result in a highly differentiated business landscape over the city and different prices within it depending on areas or neighborhoods as well as the size of the city.

The economic policy conclusion from these results is that a measure such as the increase in VAT rates will cause different effects between areas and between types of city. In large cities, particularly in neighborhoods where there is a concentration of lower-income households, the reaction to a price change will be very intense and probably it should be absorbed to a greater extent by businesses. The behavior will be different, less sensible to the price changes, in small cities, especially if they belong to a region of high income levels or if we refer to the neighborhoods which concentrate the higher-income families. No wonder, therefore, that a measure of this kind in the context of a crisis can lead to the closing down of businesses and effects on employment which are concentrated in large cities and low-income neighborhoods.

## **5. Summary and conclusions.**

There is ample evidence of how consumption patterns are affected by factors such as the level of income or stage in their life cycle at which households find themselves. Evidence on spatial effects is more limited and contradictory. Several studies have found significant differences in consumption patterns of households living in rural areas compared to those residing in urban areas. However, most of these studies refer to developing countries that have not completed the process of urbanization and where the realities of urban and rural life are clearly poles apart. There is barely any empirical evidence on similar differences in developed countries. The aim of this study was to estimate expenditure and own-price elasticities in Spain by income level and by city size. Spain is particularly attractive for a study of this type as it has fully completed its

process of urbanization and development. It possesses a very rich urban structure with several large cities, a large network of medium-sized towns and a rural setting which is still important. Furthermore, differences in earnings have worsened since the onset of the economic crisis and so the breach between high- and low-income households has become wider.

With this goal in mind, we have used data on foodstuffs from the Household Budget Survey of the Spanish Statistical Institute for the year 2010. Limiting our study to these goods is due to the fact that the information on expenditure and quantities needed to derive prices and apply the estimation of the AIDS procedure is only available for these products. This procedure allows much more precise comparisons in space on account of its microeconomic and econometric fundamentals. Although the study would be greatly enhanced if it could be extended to other goods and services, the fact that it only refers to foodstuffs goods is very valuable as these comprise the major item of household expenditure and incorporate in their prices the costs associated with distribution and sales (services), which gives us a fairly accurate view of consumption patterns.

Our results confirm that differences in income between households clearly affect their consumption patterns. As expected, higher-income households react to changes in income with moderate changes in the quantities consumed compared to lower-income households. Similarly, low-income households are much more sensitive to price changes than high-income households.

A very interesting finding is that the intensity of the effect of the size of the city of residence is quite similar to that of income level. This means that different consumption patterns exist depending on whether the household resides in a large city, a small or medium-sized town or a rural area in the case of a country like Spain, which has completed its process of urbanization and development. The changes affect own-price elasticities more than expenditure elasticities. Although the latter vary depending on different city sizes, there are exceptions with respect to types of products. However, own-price elasticities are always higher in larger cities. Price sensitivity is higher in large cities compared to smaller towns and in rural areas.

The conclusion to be drawn when combining the effects of income and city size while, at the same time, being aware that households tend to concentrate according with their income levels, especially in large cities, is that changes in income but mainly in prices could lead to very differentiated spatial effects. For example, a price increase due to an exogenous factor, such as an increase in VAT rates in lower-income neighborhoods of large cities they should be absorbed to a greater extent by businesses or shops. But, the same change in small cities that belong to higher-income regions will probably be passed on to a greater extent to prices, thus increasing the cost of living. In the context of a crisis, it may lead to the closing down of shops and businesses in the lower-income areas of largest cities where the price sensitivity of potential consumers is much higher. This can result in the negative effects on employment and the business fabric of a measure such as the increase in VAT rates or any situation that causes a general increase in prices being spatially concentrated.

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**Appendix 1: Coefficients of the Almost Ideal Demand System for the whole sample.**

|            | Coeff.     |           | Coeff.      |               | Coeff.      |            | Coeff.     |
|------------|------------|-----------|-------------|---------------|-------------|------------|------------|
| $\alpha_1$ | 0.01469**  | $\beta_1$ | -0.06002*** | $\gamma_{11}$ | 0.05938***  | $\delta_1$ | 0.10153*** |
| $\alpha_2$ | 0.37243*** | $\beta_2$ | 0.05801***  | $\gamma_{12}$ | -0.04195*** | $\delta_2$ | 0.26056*** |
| $\alpha_3$ | 0.25345*** | $\beta_3$ | 0.05387***  | $\gamma_{13}$ | -0.02196*** | $\delta_3$ | 0.25016*** |
| $\alpha_4$ | 0.08636*** | $\beta_4$ | -0.01934*** | $\gamma_{14}$ | -0.01151*** | $\delta_4$ | 0.13588*** |
| $\alpha_5$ | 0.04896*** | $\beta_5$ | 0.01089***  | $\gamma_{15}$ | -0.00182*** | $\delta_5$ | 0.05276*** |
| $\alpha_6$ | 0.07616*** | $\beta_6$ | 0.00141     | $\gamma_{16}$ | 0.00345***  | $\delta_6$ | 0.19885*** |
| $\alpha_7$ | 0.09151*** | $\beta_7$ | 0.00273*    | $\gamma_{17}$ | -0.00008    | $\delta_7$ | 0.13849*** |
| $\alpha_8$ | 0.00769*** | $\beta_8$ | -0.00669*** | $\gamma_{18}$ | 0.00259***  | $\delta_8$ | 0.00669**  |
| $\alpha_9$ | 0.01585*** | $\beta_9$ | -0.00296*** | $\gamma_{19}$ | 0.00125*    | $\delta_9$ | 0.01149*** |
|            |            |           |             | $\gamma_{22}$ | 0.03812***  |            |            |
|            |            |           |             | $\gamma_{23}$ | 0.01373***  |            |            |
|            |            |           |             | $\gamma_{24}$ | -0.00820**  |            |            |
|            |            |           |             | $\gamma_{25}$ | 0.00233**   |            |            |
|            |            |           |             | $\gamma_{26}$ | 0.00567***  |            |            |
|            |            |           |             | $\gamma_{27}$ | -0.00063    |            |            |
|            |            |           |             | $\gamma_{28}$ | -0.00270*** |            |            |
|            |            |           |             | $\gamma_{29}$ | -0.00117    |            |            |
|            |            |           |             | $\gamma_{33}$ | 0.00673***  |            |            |
|            |            |           |             | $\gamma_{34}$ | 0.00140     |            |            |
|            |            |           |             | $\gamma_{35}$ | 0.00476***  |            |            |
|            |            |           |             | $\gamma_{36}$ | -0.00297**  |            |            |
|            |            |           |             | $\gamma_{37}$ | 0.00592***  |            |            |
|            |            |           |             | $\gamma_{38}$ | -0.00137**  |            |            |
|            |            |           |             | $\gamma_{39}$ | -0.00097    |            |            |
|            |            |           |             | $\gamma_{44}$ | 0.02124***  |            |            |
|            |            |           |             | $\gamma_{45}$ | -0.00070    |            |            |
|            |            |           |             | $\gamma_{46}$ | 0.00223***  |            |            |
|            |            |           |             | $\gamma_{47}$ | -0.00315*** |            |            |
|            |            |           |             | $\gamma_{48}$ | -0.00024    |            |            |
|            |            |           |             | $\gamma_{49}$ | -0.00070**  |            |            |
|            |            |           |             | $\gamma_{55}$ | -0.00724*** |            |            |
|            |            |           |             | $\gamma_{56}$ | 0.00436***  |            |            |
|            |            |           |             | $\gamma_{57}$ | 0.00119     |            |            |
|            |            |           |             | $\gamma_{58}$ | -0.00230*** |            |            |
|            |            |           |             | $\gamma_{59}$ | -0.00004    |            |            |
|            |            |           |             | $\gamma_{66}$ | -0.01212*** |            |            |
|            |            |           |             | $\gamma_{67}$ | -0.00116    |            |            |
|            |            |           |             | $\gamma_{68}$ | 0.00131***  |            |            |
|            |            |           |             | $\gamma_{69}$ | 0.00214***  |            |            |
|            |            |           |             | $\gamma_{77}$ | -0.00649*** |            |            |
|            |            |           |             | $\gamma_{78}$ | 0.00059     |            |            |
|            |            |           |             | $\gamma_{79}$ | 0.00309***  |            |            |
|            |            |           |             | $\gamma_{88}$ | 0.00614***  |            |            |
|            |            |           |             | $\gamma_{89}$ | -0.00221*** |            |            |
|            |            |           |             | $\gamma_{99}$ | -0.00181**  |            |            |

Note: \*, \*\* and \*\*\* represent the level of significance to 10%, 5% and 1%, respectively.

## Appendix 2: Coefficients of the Almost Ideal Demand System for the first quartile.

|       | Coeff.     |            | Coeff.      |           | Coeff.      |               | Coeff.      |            | Coeff.     |
|-------|------------|------------|-------------|-----------|-------------|---------------|-------------|------------|------------|
| $m_1$ | 0.00152*** | $\alpha_1$ | -0.20255*** | $\beta_1$ | -0.11033*** | $\gamma_{11}$ | 0.09377***  | $\delta_1$ | 0.17231*** |
| $m_2$ | 0.00205*** | $\alpha_2$ | 0.40011***  | $\beta_2$ | 0.06203***  | $\gamma_{12}$ | -0.05697*** | $\delta_2$ | 0.24584*** |
| $m_3$ | 0.00088**  | $\alpha_3$ | 0.27341***  | $\beta_3$ | 0.05172***  | $\gamma_{13}$ | -0.02529*** | $\delta_3$ | 0.22316*** |
| $m_4$ | 0.00185*** | $\alpha_4$ | 0.13541***  | $\beta_4$ | 0.00156     | $\gamma_{14}$ | -0.02476*** | $\delta_4$ | 0.20117*** |
|       |            | $\alpha_5$ | 0.05018***  | $\beta_5$ | 0.01363***  | $\gamma_{15}$ | -0.00402    | $\delta_5$ | 0.05593*** |
|       |            | $\alpha_6$ | 0.08663***  | $\beta_6$ | 0.01297***  | $\gamma_{16}$ | 0.00119     | $\delta_6$ | 0.26655*** |
|       |            | $\alpha_7$ | 0.11837***  | $\beta_7$ | 0.01483***  | $\gamma_{17}$ | -0.00994*   | $\delta_7$ | 0.17747*** |
|       |            | $\alpha_8$ | -0.02152**  | $\beta_8$ | -0.01248*** | $\gamma_{18}$ | 0.00920***  | $\delta_8$ | 0.00864    |
|       |            | $\alpha_9$ | 0.01915*    | $\beta_9$ | -0.00295    | $\gamma_{19}$ | 0.00681***  | $\delta_9$ | 0.02206*** |
|       |            |            |             |           |             | $\gamma_{22}$ | 0.01448**   |            |            |
|       |            |            |             |           |             | $\gamma_{23}$ | 0.01956***  |            |            |
|       |            |            |             |           |             | $\gamma_{24}$ | 0.00422     |            |            |
|       |            |            |             |           |             | $\gamma_{25}$ | 0.00552***  |            |            |
|       |            |            |             |           |             | $\gamma_{26}$ | 0.01459***  |            |            |
|       |            |            |             |           |             | $\gamma_{27}$ | 0.00064     |            |            |
|       |            |            |             |           |             | $\gamma_{28}$ | -0.00126    |            |            |
|       |            |            |             |           |             | $\gamma_{29}$ | 0.00121     |            |            |
|       |            |            |             |           |             | $\gamma_{33}$ | -0.02147*** |            |            |
|       |            |            |             |           |             | $\gamma_{34}$ | 0.00827***  |            |            |
|       |            |            |             |           |             | $\gamma_{35}$ | 0.01015***  |            |            |
|       |            |            |             |           |             | $\gamma_{36}$ | -0.00100    |            |            |
|       |            |            |             |           |             | $\gamma_{37}$ | 0.01250***  |            |            |
|       |            |            |             |           |             | $\gamma_{38}$ | -0.00097    |            |            |
|       |            |            |             |           |             | $\gamma_{39}$ | -0.00411**  |            |            |
|       |            |            |             |           |             | $\gamma_{44}$ | 0.01889***  |            |            |
|       |            |            |             |           |             | $\gamma_{45}$ | -0.00241**  |            |            |
|       |            |            |             |           |             | $\gamma_{46}$ | 0.00204     |            |            |
|       |            |            |             |           |             | $\gamma_{47}$ | -0.00412*   |            |            |
|       |            |            |             |           |             | $\gamma_{48}$ | -0.00060    |            |            |
|       |            |            |             |           |             | $\gamma_{49}$ | -0.00099    |            |            |
|       |            |            |             |           |             | $\gamma_{55}$ | -0.01429*** |            |            |
|       |            |            |             |           |             | $\gamma_{56}$ | 0.00436***  |            |            |
|       |            |            |             |           |             | $\gamma_{57}$ | 0.00164     |            |            |
|       |            |            |             |           |             | $\gamma_{58}$ | -0.00339*** |            |            |
|       |            |            |             |           |             | $\gamma_{59}$ | 0.00020     |            |            |
|       |            |            |             |           |             | $\gamma_{66}$ | -0.02345*** |            |            |
|       |            |            |             |           |             | $\gamma_{67}$ | -0.00266    |            |            |
|       |            |            |             |           |             | $\gamma_{68}$ | 0.00155     |            |            |
|       |            |            |             |           |             | $\gamma_{69}$ | 0.00265**   |            |            |
|       |            |            |             |           |             | $\gamma_{77}$ | -0.00631**  |            |            |
|       |            |            |             |           |             | $\gamma_{78}$ | 0.00094     |            |            |
|       |            |            |             |           |             | $\gamma_{79}$ | 0.00444***  |            |            |
|       |            |            |             |           |             | $\gamma_{88}$ | 0.00259**   |            |            |
|       |            |            |             |           |             | $\gamma_{89}$ | -0.00285*** |            |            |
|       |            |            |             |           |             | $\gamma_{99}$ | -0.00743**  |            |            |

Note: \*, \*\* and \*\*\* represent the level of significance to 10%, 5% and 1%, respectively.

### Appendix 3: Coefficients of the Almost Ideal Demand System for the fourth quartile.

|       | Coeff.      |            | Coeff.     |           | Coeff.      |               | Coeff.      |            | Coeff.      |
|-------|-------------|------------|------------|-----------|-------------|---------------|-------------|------------|-------------|
| $m_1$ | 0.00030     | $\alpha_1$ | 0.09114*** | $\beta_1$ | -0.03359*** | $\gamma_{11}$ | 0.04687***  | $\delta_1$ | -0.11253*** |
| $m_2$ | -0.00071*** | $\alpha_2$ | 0.34164*** | $\beta_2$ | 0.05538***  | $\gamma_{12}$ | -0.02932*** | $\delta_2$ | 0.20002***  |
| $m_3$ | -0.00046**  | $\alpha_3$ | 0.09083*** | $\beta_3$ | -0.00111    | $\gamma_{13}$ | -0.01123*** | $\delta_3$ | 0.33884***  |
| $m_4$ | -0.00024    | $\alpha_4$ | 0.13476*** | $\beta_4$ | -0.01554*** | $\gamma_{14}$ | -0.00881*** | $\delta_4$ | -0.03007**  |
|       |             | $\alpha_5$ | 0.07035*** | $\beta_5$ | 0.01906***  | $\gamma_{15}$ | -0.00181    | $\delta_5$ | 0.11041***  |
|       |             | $\alpha_6$ | 0.05997*** | $\beta_6$ | -0.01517*** | $\gamma_{16}$ | 0.00294     | $\delta_6$ | 0.13958***  |
|       |             | $\alpha_7$ | 0.10555*** | $\beta_7$ | 0.00959     | $\gamma_{17}$ | -0.00149    | $\delta_7$ | 0.17014***  |
|       |             | $\alpha_8$ | 0.01822*** | $\beta_8$ | -0.00704*** | $\gamma_{18}$ | 0.00230*    | $\delta_8$ | -0.01225    |
|       |             | $\alpha_9$ | 0.01164*** | $\beta_9$ | -0.00418*** | $\gamma_{19}$ | -0.00089    | $\delta_9$ | -0.02010*** |
|       |             |            |            |           |             | $\gamma_{22}$ | 0.06366***  |            |             |
|       |             |            |            |           |             | $\gamma_{23}$ | -0.00314    |            |             |
|       |             |            |            |           |             | $\gamma_{24}$ | -0.01370*** |            |             |
|       |             |            |            |           |             | $\gamma_{25}$ | -0.00114    |            |             |
|       |             |            |            |           |             | $\gamma_{26}$ | -0.00072    |            |             |
|       |             |            |            |           |             | $\gamma_{27}$ | 0.00267     |            |             |
|       |             |            |            |           |             | $\gamma_{28}$ | -0.00304*   |            |             |
|       |             |            |            |           |             | $\gamma_{29}$ | -0.00481*** |            |             |
|       |             |            |            |           |             | $\gamma_{33}$ | 0.02679***  |            |             |
|       |             |            |            |           |             | $\gamma_{34}$ | -0.00666*** |            |             |
|       |             |            |            |           |             | $\gamma_{35}$ | -0.00149    |            |             |
|       |             |            |            |           |             | $\gamma_{36}$ | -0.00520*   |            |             |
|       |             |            |            |           |             | $\gamma_{37}$ | 0.00615**   |            |             |
|       |             |            |            |           |             | $\gamma_{38}$ | -0.00516*** |            |             |
|       |             |            |            |           |             | $\gamma_{39}$ | 0.00119     |            |             |
|       |             |            |            |           |             | $\gamma_{44}$ | 0.02546***  |            |             |
|       |             |            |            |           |             | $\gamma_{45}$ | 0.00235*    |            |             |
|       |             |            |            |           |             | $\gamma_{46}$ | 0.00077     |            |             |
|       |             |            |            |           |             | $\gamma_{47}$ | -0.00370**  |            |             |
|       |             |            |            |           |             | $\gamma_{48}$ | -0.00121*   |            |             |
|       |             |            |            |           |             | $\gamma_{49}$ | 0.00044     |            |             |
|       |             |            |            |           |             | $\gamma_{55}$ | -0.00168    |            |             |
|       |             |            |            |           |             | $\gamma_{56}$ | 0.00343*    |            |             |
|       |             |            |            |           |             | $\gamma_{57}$ | 0.00272*    |            |             |
|       |             |            |            |           |             | $\gamma_{58}$ | -0.00097    |            |             |
|       |             |            |            |           |             | $\gamma_{59}$ | 0.00007     |            |             |
|       |             |            |            |           |             | $\gamma_{66}$ | -0.00983*** |            |             |
|       |             |            |            |           |             | $\gamma_{67}$ | 0.00054     |            |             |
|       |             |            |            |           |             | $\gamma_{68}$ | 0.00065     |            |             |
|       |             |            |            |           |             | $\gamma_{69}$ | 0.00316***  |            |             |
|       |             |            |            |           |             | $\gamma_{77}$ | -0.00931**  |            |             |
|       |             |            |            |           |             | $\gamma_{78}$ | -0.00059    |            |             |
|       |             |            |            |           |             | $\gamma_{79}$ | 0.00104     |            |             |
|       |             |            |            |           |             | $\gamma_{88}$ | 0.00858***  |            |             |
|       |             |            |            |           |             | $\gamma_{89}$ | -0.00179*** |            |             |
|       |             |            |            |           |             | $\gamma_{99}$ | 0.00264**   |            |             |

Note: \*, \*\* and \*\*\* represent the level of significance to 10%, 5% and 1%, respectively.

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