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# The Impact of Inflation on Heterogeneous Groups of Households: an Application to Italy

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**Abstract**

This paper explores the determinants of the heterogeneity in the expenditure behaviors of the Italian households, using the Households Expenditure Survey provided by the Italian National Institute of Statistics (ISTAT) for the year 2005. We assume that differences among consumers are associated with differences in their economic and socio-demographic characteristics (such as gender, employment status and age of the householder, number of household components, presence of under 18 years old components), and we look for those characteristics that better differentiate groups of households according to their purchasing patterns. We apply a nonparametric discriminant analysis based on the various expenditure budget components, and detect the most discriminating partitions of families. The technique allows us also to identify the specific goods of consumption that significantly differ across the groups identified by the best partitions. We then study the different effects of the price dynamics on subgroups of households, and propose consumer price indices specific for the optimal households groups.

Keywords: consumption, consumer price index, discriminant analysis, household expenditure survey.

JEL Codes: C43, D12, H31, E31

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# 1 Introduction

Households differ considerably from each other in terms of consumption attitude. In order to explain the heterogeneity in the expenditure distribution, households are typically partitioned into groups, whose average consumption patterns are then compared; in particular, one may assume that differences in shopping behaviors are associated with differences in socio-demographic characteristics of household members. Bono, Cuffaro and Giaimo (2004) for example assumed that households living in the same region and therefore sharing same historical, social, economic and environmental factors, as well as groups of households belonging to the same income class or having same size, are characterized by similar consumer attitudes.

Also, the Italian National Institute of Statistics (ISTAT) usually proposes to classify households into 11 categories that are based on different characteristics, such as age, number of children, marital status. Those groups, however, show in fact low degree of homogeneity in terms of consumption patterns, as we will show in Section 3. The choice of the households partition is usually arbitrary and based on socio-demographic characteristics that are chosen a priori.

In order to reduce the arbitrariness, we base the choice of partitions on criteria of optimality. In particular, in this paper we propose a method to explain the heterogeneity in consumption patterns that overcomes the problem of subjective choice of the groups, by looking for the optimal groups that are as much homogenous as possible in terms of shopping attitude.

Through a technique of discriminant analysis based on each specific consumption variable, we detect the partitions that better differentiate households into well separated clusters according to their purchasing patterns.

Moreover, we identify the subset of the specific variables of consumption that are significantly different among the best groups; in that way, the huge set of specific variables of consumption that constitute the expenditure basket can be reduced to the sole significant ones, so that we can focus only on significant differences across the most differentiated

groups.

The problem of identifying the characteristics that better differentiate households in terms of expenditure has an important application to the analysis of consumer price indices (or CPI) for subgroups.

A recent debate has raised about the importance of studying the effect of the price dynamics on specific groups of households or even on each household; see for example Biggeri and Leoni (2003). In particular, the national consumer price index, being a weighted mean of the relative prices of goods or services belonging to the expenditure basket, with weights that are based on the expenditure pattern of the whole population, may be considered a rough approximation of the inflationary impact on each household. Expenditure attitudes usually vary across households in terms both of quantity of the goods purchased and of their quality; moreover, households purchase similar goods in different cities or regions and also in different shops within the same city.

Quite few authors, to the best of our knowledge, have proposed a CPI specific for each household. Cage, Garner and Ruiz-Castillo (2002) for example derived price indices specific for households in Spain and in U.S., in order to study the effect of inflation on the inequality of the real consumption distribution among households. For the Italian case, authors such as Baldini (2004) and Liberati (2007) proposed household specific indices, while ISTAT (2007) and Rapacciolo (2005), provided CPI specific only for groups of households.

As pointed out also by Baldini (2004), the available data usually do not allow the construction of an household specific CPI that takes into account different quantity, different quality and different places where the households purchase goods and services. Therefore, assuming that each household pays the same price for each good, and ignoring the differences in quality and location, one can construct household specific CPI that vary mainly in terms of consumer attitudes. It means that the national index and the household specific indices differ from each other only in the weighting system, which is based on the share of consumption of the whole population for the former, and on the share of the specific household consumption for the latter.

In the second part of this paper we therefore propose a household specific CPI; we then aggregate them by the optimal groups in terms both of plutocratic and of democratic indices, and detect differences in their values. Moreover, we focus only on the consumption variables that are on average significantly different between the optimal groups, constructing household and group specific CPI based on these significant goods, in order to study the effects of their prices change.

In the rest of this paper we first describe the discriminant analysis that we have performed in order to find out the best partition of households; in Section 3 we discuss the results obtained from an empirical application to the Italian Household Expenditure Survey for the year 2005. In Section 4 we construct consumer price indices specific for the most discriminating groups of households and discuss the different impact of inflation on those subpopulations.

# 2 Discriminant analysis: a brief review

In order to identify the socio-demographic characteristics that better differentiate the Italian households in terms of expenditure attitude, we employ the statistical technique of discriminant analysis.

Given a classification variable that defines $G$ groups $g_1, \ldots, g_G$ of households and given a vector of quantitative variables, the discriminant analysis develops a criterion to classify each household into one of the groups.

We follow a Bayesian discriminant rule, which first estimates group specific densities and prior probabilities and then calculates the estimated posterior probability of group membership. An household is classified into the group that shows the largest value of posterior probability.

When the quantitative variables do not follow a normal distribution (as in the empirical case described in Section 3), the group specific densities can be estimated in a nonparametric way; in particular, we follow the $k$-th-nearest-neighbor method due to Fix and Hodges

(1951), according to which proximity between two realizations of the vector of quantitative variables $\mathbf{x}$ and $\mathbf{y}$ is measured by the Mahalanobis squared distance

$$d^2(\mathbf{x}, \mathbf{y}) = (\mathbf{x} - \mathbf{y})^{\mathbf{T}} \mathbf{S_p^{-1}} (\mathbf{x} - \mathbf{y}),$$

where $\mathbf{S_p}$ is the pooled covariance matrix defined as

$$\mathbf{S_p} = \frac{1}{n - G} \sum_{h=1}^{G} (n_h - 1) \mathbf{S_h},$$

where $\mathbf{S_h}$ is the sample covariance matrix for realization $\mathbf{x}$ that belongs to group $h$, $n_h$ is the number of households in group $h$ and $n = \sum_{h=1}^{G} n_h$.

Chosen a number $k$ common to all observations, the $k$-th-nearest-neighbor method determines for each observation $\mathbf{x}$ the radius $r_k(\mathbf{x})$, that is the Mahalanobis distance between $\mathbf{x}$ and its $k$-th nearest point; therefore, $k$ distances are associated with each observation $\mathbf{x}$. For each $\mathbf{x}$, let $k_h$ represent the number of those distances that are related to group $h$, that is the number of realizations $\mathbf{y}$ belonging to group $h$ that lie within the closed ellipsoid centered at $\mathbf{x}$ and specified by $d^2(\mathbf{x}, \mathbf{y}) \leq r_k(\mathbf{x})$. The estimated density at $\mathbf{x}$ specific for group $h$ is

$$f_h(\mathbf{x}) = \frac{k_h}{n_h v_k(\mathbf{x})} = \frac{1}{n_h v_k(\mathbf{x})} \sum 1(\mathbf{y} \in g_h : d^2(\mathbf{x}, \mathbf{y}) \leq r_k(\mathbf{x})),$$

where $v_k(\mathbf{x})$ is the volume of the ellipsoid bounded by $\{\mathbf{z} | d^2(\mathbf{z}, \mathbf{x}) = r_k(\mathbf{x})\}$. The density $f_h(\mathbf{x})$ is therefore the proportion in group $h$ of the $k_h$ closest observations to $\mathbf{x}$.

The prior probabilities $\pi_1, \ldots, \pi_G$ for the groups are the probabilities that observation $\mathbf{x}$ comes from group $g_1, \ldots, g_G$, respectively. We estimate them from data, using the sample proportions $\pi_h = \frac{n_h}{n}$.

The Bayesian discriminant criterion assigns observation $\mathbf{x}$ to the group that has the highest posterior probability $p(h|\mathbf{x})$ to generate it, where

$$p(h|\mathbf{x}) = \frac{\pi_h f_h(\mathbf{x})}{\sum_{k=1}^{G} \pi_k f_k(\mathbf{x})}$$

is the probability that, given observation $\mathbf{x}$, this comes from group $h$.

Performance of a discriminant analysis can be evaluated by estimating the probabilities of misclassification, that are based on the posterior probabilities $p(h|\mathbf{x})$, for $h = 1, \ldots, G$.

The overall probability of misclassification for a given partition is defined as

$$M = \sum_{h=1}^{G} \frac{n_h}{n} M_h = \sum_{h=1}^{G} \frac{n_h}{n} \left( 1 - \frac{1}{n\pi_h} \sum_{\mathcal{R}_h} p(h|\mathbf{x}) \right), \tag{1}$$

where $\mathcal{R}_h$ is the set of observations such that the posterior probabilities of belonging to group $h$ is the highest one. The best grouping will be the one associated with the lowest value of $M$ in (1).

Formula (1) shows that no misclassification error occurs if for each group $g_h, h = 1, \ldots G$ the posterior probability of all individuals belonging to that group is the highest one.

The $k$-th nearest neighbor method is one of the most popular technique in statistical pattern recognition (see for example Hand, 1982); however its main drawback is the choice of $k$. Theoretical and empirical analyses have suggested alternative guidelines for choosing $k$, but none of the methods prevails over the others in literature. Most of the empirical applications of the $k$-th nearest neighbor technique chooses for $k$ the value that is associated with the minimum error rate over a given range of $k$'s values. Moreover, Enas and Choi (1986) proved that the choices of $k \approx n^{2/8}$ as well as of $k \approx n^{3/8}$ are reasonable. Holmes and Adams (2002) proposed to overcome the problematic choice of $k$ by using a probabilistic Bayesian approach that marginalizes over the values of $k$. Moreover, Hand and Vinciotti (2003) showed that in case of unbalanced groups, there is no monotonic relationship between the misclassification error rates and the values of $k$, so that larger values of $k$ do not necessarily perform better than smaller values of $k$. For more details on discriminant analysis and on the $k-$th nearest neighbor method we refer to Hand (1982).

# 3 Discriminant analysis: empirical results

The discriminant analysis described in the previous section has been applied to the Italian Household Expenditure Survey ("Indagine sui consumi delle famiglie") carried out by the Italian National Institute of Statistics (ISTAT) for the year 2005. Throughout the paper we will refer to that survey as ICF05.

The ICF05 is primarily a survey of 24,107 private household expenditure on goods and services, including goods from own farm and non-farm production directly consumed by the household, services and commodities provided by the employer, imputed rent for owner or rent-free occupiers. The survey does not include expenditures for the purchase of dwelling house or land, for tax payment or any expenditure that is not aimed at consumption.

The sampling design of the survey has two stages, the first of which is stratified: the units of the first stage are the municipalities, and the units of the second stage are the households.

In particular, the survey includes a totality of 279 *specific variables of consumption* (see ISTAT 2007 for a detailed list of those variables), which are grouped into *9 classes of consumption*: expenditures for housing, for furniture and electrical appliance, for clothing and footwear, for health care, for travel and communication, for leisure time and education, for other commodities and services (such as extraordinary and periodical expenses, other personal goods), for foods and drinks, for workaday goods and services (such as tobacco consumption, personal hygiene, housing goods, etc.). Data have been collected throughout the year 2005 to cover seasonal variations in expenditures.

Following the approach of the Italian National Institute of Statistics, we consider as basic unit of the analysis the household, defined as either one person living alone or people living together. Persons living in institutions are excluded from the target population.

The survey provides also information on socio-economic characteristics of the household components, such as age, gender, educational level attained, occupation.

We transform each specific consumption item with an equivalence scale, in order to take into account the different needs and economies of scale that may exist when the number of components differs. In particular, we consider the equivalence scale proposed by Carbonaro (1985) and calculated at a national level for the year 2005 by ISTAT (2007).[1]

We consider as basic units of the analysis the households, and propose to explain the

[1]The national Carbonaro equivalence scale for the year 2005 assigns coefficient 0.6, 1, 1.33, 1.63, 1.90, 2.15, 2.40 if the household has one, two, three, four, five, six and seven or more components, respectively; see Istat (2007).

heterogeneity in consumption behaviors across the Italian households in the year 2005, by identifying, through a discriminant analysis, the socio-demographic characteristics that better differentiate households' expenditure.

The following classification variables are compared: age, gender and occupation of the householder, number of household components, presence in the household of under18 years old components. We construct partitions that are based both on these classification variables and on their combinations, comparing them also with the partition proposed by ISTAT (2007); see Table 1 for a description of these groupings.

We decompose the overall household consumption into the 279 expenditure budget items and use all of them as the quantitative variables in the discriminant analysis; in this way, we can take advantage of the information included in each specific variable of consumption, instead of using only the summarized information of the overall household expenditure.

We first run canonical discriminant analyses to find linear combinations of the variables of consumption that better synthesize the variation among groups. Those linear combinations (named *canonical variables* or CV) have the highest possible multiple correlation with the groups and are uncorrelated to each other. We choose a number of canonical variables equal to the minimum between the number of quantitative variables $J$ and the number of groups $G$ minus one, i.e. $min(J, G-1)$. Canonical discriminant analysis is equivalent to a canonical correlation analysis between the set of quantitative variables and a set of dummy variables coded from the classification variables.

The canonical discriminant analysis identifies moreover the specific variables of consumption, whose means are significantly different among the groups, according to a univariate ANOVA test.[2] We will refer to these variables as the *significant variables of consumption*, or $SV$.

[2]Since the Kolmogorov-Smirnov goodness-of-fit test rejects the null hypothesis of normal distribution for the consumption variables, we use the ANOVA test, by looking at the values of the test statistics rather than at the probabilities. In particular, we use the $\alpha$-quantile ($\alpha = 0.05$) of the $F$-distribution as an indicator, so that anytime the statistic is greater than that indicator, we reject the null hypothesis of equal means among groups.

In particular, for each partition considered we carry out 11 canonical discriminant analyses that are based on the following variables of consumption: the set of the 9 macro-classes of consumption described above, the specific variables of consumption that constitute each of the 9 classes, and all 279 specific variables of consumption; see Table 2 for details.

In order to obtain more robust results, for each partition then two different discriminant analyses are proposed, using as quantitative variables first the canonical variable(s) $CV$ and then the significant variables $SV$.

The different partitions are thus evaluated and compared to each other according to the posterior probability of misclassification $M$ in (1) related to each discriminant analysis. For the reasons discussed in Section 2, we consider the values of $k$ in the range $\{3, 6, 10, 13, 20\}$. Results are synthesized in Tables 2 and 3.[3] From all discriminant analyses and from the different values of $k$ it emerges that the socio-demographic characteristics that better discriminate the households, in terms of their purchasing patterns, are the presence of under18 years old components and the gender of the householder. With these two partitions the consumption behaviors of households are both better differentiated among groups and internally more homogeneous than with the other partitions.

Moreover, Tables 2 and 3 show that the consumption items that significantly differ across the groups of households are considerably fewer than all the 279 variables of expenditure (the significant variables are 153 for the presence of under18s and 134 for the gender of householder).

We note that the partitions obtained as combinations of more than one socio-demographic characteristics (such as gender and occupation, gender and presence of under18s and the partition proposed by ISTAT) show much worse performances than the groupings obtained from one sole classification variable; in our analysis, therefore, the more detailed partitions are less able to classify correctly households.

[3]For the sake of brevity, we report in Table 3 only the results from the discriminant analysis based on all 279 variables of consumption; results from the discriminant analyses based on the 9 macro-classes and on the specific consumption items within each macro-class are analogous to the ones reported in Table 3. Estimates are available upon request from the authors.

Tables 4 and 5 describe means and standard deviations of the quantitative variables of consumption that are significantly different between the groups identified by the two best partitions.

In Table 4 we note that households without under18 years old components obviously spend on average more than households with under18s for children-specific goods, such as children's outwear and footwear, games, school books, stationery, school canteen, and so on.

Table 5 show that households with female householder are generally characterized by higher levels of consumption than households with male head; one of the reason is related to the household size, since the average number of components is lower in the former than in the latter type of households (the average number of components in the two groups is 1.7 and 2.8, respectively). Exceptions are the expenses for car-related goods and services, for life insurance and for men's footwear and outwear.

# 4 Consumer price indices for groups of households

The results obtained in the previous sections find an important application to the theory of consumer price indices for subgroups of households. Quite recent is the interest in studying the impact of inflation on particular groups of households, since the national consumer price index is considered an extreme synthesis of the inflationary effects on households (see for example Biggeri and Leoni (2003), Baldini 2004, Nuccitelli 2006).

Baldini (2004) constructed household specific indices, with the aim at detecting the categories of Italian households that are most affected by inflation. He concluded that between the years 2002 and 2004 inflation has become slightly higher for the richer than for the poorer households and has affected more the households with several children and the renter households.

ISTAT (2007), Rapacciolo (2005), Nuccitelli (2006) and Giraldo and Trivellato (2004) proposed consumer price indices for groups of households, although not for specific households, revealing that there are not significant differences between the household group specific

indices and the national index. Mostacci, Natale and Pugliese (2004) compared different National Bureaus of Statistics in the use of CPI specific for population subgroups, showing that in most of the countries, no significant differences are recorded between group specific and overall indices.

Aim of this section is to verify whether inflation effects differ significantly between groups of households, when considering the most discriminating groups in terms of consumption attitude. In this way, we are able to detect the highest possible differences in inflation impact across population subgroups, with clearly important consequences for welfare policies.

We study the effects of inflation on the groups of households identified by the best partitions described in Section 3, and compare the group specific consumer price indices based on all goods and services that belong to the consumption basket, proposed by the National Institute of Statistics for the year 2005, with the group specific indices based only on the significant variables of consumption.

Let us indicate with $p_{0j}$ and $p_{1j}$ the price of good $j$, $j = 1, \ldots, J$, for the base year (here, year 2005) and for the reference year (here, year 2006), respectively. We determine a consumer price index specific for each Italian household, following the work in Liberati (2007). The Laspeyres consumer price index for household $h$ is defined as

$$P_L^h = \frac{\sum_{j=1}^J p_{1j} q_{0j}^h}{\sum_{j=1}^J p_{0j} q_{0j}^h} = \sum_{j=1}^J r_j s_{0j}^h,$$

where $r_j = p_{1j}/p_{0j}$ and $s_{0j}^h = p_{0j} q_{0j}^h / \sum_{j=1}^J p_{0j} q_{0j}^h$; see for example Schultze and Mackie (2002) and Chelli and Mattioli (2005).

The index $P_L^h$ is based on the assumption that different households can purchase different quantities of the same good, but at the same price. The hypothesis is supported by the limited data availability, as we do not have information on the actual prices paid by each household. Moreover the Laspeyres index assumes that the consumption basket remains the same both in the base and in the reference year. It would be more appropriate to use an economic consumer price index as the Törnqvist-Theil index, which distinguishes the household consumption basket of the base year from the one of the reference year. Again,

because of the lack of panel data on household consumption, we will work with the Laspeyres index. For a review on consumer price indices we refer to Schultze and Mackie (2002).

In order to obtain the indices $P_L^h$, we have to match two different data sources: the Consumer Price Survey which is provided by ISTAT for the year 2005 and includes 208 elementary price indices of the goods and services belonging to the expenditure basket, and the ICF05. We follow the work in Liberati (2007), by linking the *relative price* of each good belonging to the consumption basket to one or more specific consumption variable included in the Household Expenditure Survey, ICF05.

The Household Expenditure Survey and the Consumer Prices Survey are based on different classifications of goods and services; approximations are required in order to connect the relative prices to the variable(s) of consumption included in ICF05. In particular, Liberati (2007) showed that 147 relative prices can be linked to corresponding consumption goods in ICF05. For more details, see Liberati (2007).

We construct the index $P_L^h$ for each household based first on all 147 goods and then on the goods that are significantly different between the groups identified by the presence of under18s and by the gender of the householder.[4]

Table 6 describes the distributions of the household consumer price indices based both on all 147 consumption variables and on the sole significant variables. We note that the difference in the means of household CPI between the groups is higher for the partition identified by the gender of householder than for the partition given by the presence of under 18s; moreover, when all variables of expenditure are included, inflation affects more the households without under 18s than households with under 18s, while the opposite trend happens when we focus only on the significant items of expenditure. The latter result seems particular important, in particular in the context of welfare policies, revealing that the price dynamics is actually affecting more the families with higher needs (i.e. with young children).

[4]Note that in the construction of CPI based on the sole significant variables, some of the relative prices which in Liberati (2007) were linked to a group of specific variables are linked to a subgroup of them; although they should be reweighed according to the weight of each significant variable, in this version of the paper we prefer to use the same elementary indices as in Liberati (2007).

Figures 1 and 2 show kernel density estimations of the distributions of the household CPI specific for subgroups. Looking within each partition, the households with male head tend to assume higher CPI than households with female head (see also Table 6). The households with under 18 years old components are instead much more concentrated around the CPI mean than the households without under 18s, and in case of significant variables they tend to assume higher values of CPI than households without under 18s.[5] The distribution of the household indices, depicted Figures 1 and 2, can well explain the problematic differences between the inflation measured by ISTAT and the inflation perceived by the consumers: behind an average price dynamics there is a huge variability across households.

We now aggregate the household indices into both a plutocratic CPI and a democratic CPI and make a comparison between them. The plutocratic Laspeyres index aggregates the Laspeyres household CPI $P_L^h$ through a weighted arithmetic average, where the weights are equal to the proportion of total expenditure of each household over the total expenditure of all households:

$$P_L^P = \sum_{h=1}^{H} \frac{x_0^h w^h}{\sum_{k=1}^{K} x_0^k w^k} P_L^h, \tag{2}$$

where $x_0^h$ indicates the total consumption of the $h$-th household in the base period, $w^h$ is the number of Italian households that are represented in the sample by the $h$-th household. In index $P_L^P$ more importance is thus given to the households that spend more, that is to the richest ones.

The Laspeyres democratic consumer price index aggregates instead the Laspeyres house-

[5]Looking at the partition identified by the presence of under 18s, statistical tests show a significant difference in the distribution of familiar CPI between the two groups, both if the indices are built on all 147 consumption goods (p-value of the t-test is $< 0.0001$ and of Wilcoxon test is $< 0.0001$) and if the price indices are based on the sole significant consumptions (p-value of t-test is $< 0.0001$ and of Wilcoxon test is $< 0.0001$). According to the partition induced by the gender of the householder, the distribution of the familiar CPI appears to be significantly different between the groups both if the indices are based on all consumption variables (p-values of t-test is $< 0.0001$ and of Wilcoxon test is $< 0.0001$) and if based on the significant variables (p-values of t-test is $< 0.0001$, but of Wilcoxon test is $< 0.0001$).

hold CPI through an arithmetic mean that gives same importance to each households:

$$P_L^D = \sum_{h=1}^{H} \frac{w^h}{\sum_{k=1}^{K} w^k} P_L^h. \tag{3}$$

Note that while the plutocratic index gives same weight to each monetary unit, the democratic index counts at the same way each household; for more details we refer to Schultze and Mackie (2002) and Chelli and Mattioli (2005).

Table 7 shows the values of plutocratic and democratic CPI computed over all Italian households and referred to the 147 commodities of the consumption basket. We note that the plutocratic index over all households is significantly lower than the corresponding democratic index, revealing that the poorest households are characterized by higher CPI.[6]

Plutocratic and democratic CPI are constructed also for the groups that better discriminate households according to their purchasing pattern. Table 7 shows that the democratic index is significantly higher than the plutocratic only for households without under18s and for households with male head.

In Table 10 we propose a plutocratic and a democratic CPI based on an alternative consumption basket made up by the significant expenditure goods described in Tables 4 and 5.

If we compare Table 9 with Table 8 we note that all of the plutocratic and the democratic indices based on significant variables are significantly higher than the indices based on all expenditure items, both for whole population and for all groups but the group of female head households. Analogous to Table 7, the democratic index is higher than the plutocratic index for the overall population and for the group of households with male head and the group of households without under 18s.

Moreover, the households with male head and with female head are significantly discriminated in terms both of plutocratic and of democratic indices, in sense that the impact of inflation is significantly lower for the households with female head.

[6]Note that our plutocratic index cannot be compared to the National Consumer Index $NIC$ elaborated by ISTAT for the year 2005, since the weighting structure of the latter is based on data from the National Accounting System rather than from the Household Expenditure Survey.

A last important result emerges when comparing Table 7 with Table 8: when taking into account all items of the expenditure basket, the most affected households between the groups identified by the presence of under 18 components are the households without under 18s,reveals that, while when focusing only on the significant expenditure items, families with under 18s are characterized by a significantly higher plutocratic index of consumer price than the households without under18s.

# 5 Concluding remarks

We have proposed a method to study the heterogeneity in the expenditure behavior of households that overcomes the arbitrariness in the choice of groups, being based on an optimization criterion. We have compared alternative partitions of households that are based on socio-demographic characteristics (such as gender, employment status and age of the householder, number of household components, presence of under18 years old components) through a technique of discriminant analysis, and looked for the best partition of the population in terms of minimum misclassification error. The empirical analysis, which was based on the Italian Households Expenditure Survey for the year 2005, has shown that the dummy variable of the presence of under18 years old components in the households as well as the gender of the householder are the attributes that better differentiate the families in terms of shopping attitude. We have then identified the consumption variables that significantly differ on average between those groups; those consumption items may constitute an alternative consumption basket, complementary to the one proposed by the National Statistical Office and aimed at controlling for significant differences across the most discriminate groups.

We have then studied the differences between the optimal groups in terms of consumer price indices, asking whether the rates of inflation experienced by the households differ significantly among the identified groups and from the overall inflation rate. We have calculated a consumer price index for each household and aggregate them both over all the population and within groups.

Overall, the consumer price indices based on significant consumption variables discriminate the households' groups better than the indices based on all consumption goods. When focusing on the significant variables, we have higher distance of both $P_L^P$ and $P_L^D$ between the groups of households with male and with female head than between the groups of households with and without under18s.

Further research may include inter-temporal comparisons of the CPI distributions among the groups identified by the best discriminant partitions in order to study changes over time, as well as study of the degree of concentration in the CPI distribution within and between the identified groups.

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Table 1: *Distribution of the Italian households (HH), according to different partitions*

| **Partition** | % | **Partition** | % |
|---|---|---|---|
| **(1) Presence of under 18 years** | | **(7) Head gender and occupation** | |
| yes | 28.0 | Male and employed HH head | 42.4 |
| no | 72.0 | Male and retired HH head | 26.9 |
| | | Male and other HH head* | 2.5 |
| **(2) Gender of HH head** | | Female and employed HH head | 9.1 |
| Male | 72.3 | Female and retired HH head | 12.0 |
| Female | 27.7 | Female and other HH head* | 7.1 |
| **(3) Age of HH head** | | | |
| $\leq$ 34 years | 8.4 | **(8) Head occupation and under 18s** | |
| [35;64] years | 56.8 | Employed head and no under 18s | 27.2 |
| $\geq$ 65 years | 34.8 | Retired head and no under 18s | 37.5 |
| | | Other head and no under 18s* | 6.5 |
| **(4) Occupation of HH head** | | Employed head and under 18s | 24.3 |
| Employed | 51.5 | Retired head and under 18s | 1.4 |
| Retired | 38.9 | Other head and under 18s* | 3.1 |
| Other | 9.6 | | |
| | | **(9) ISTAT partition** | |
| **(5) No. Of HH components** | | Single <35 years | 2.6 |
| 1 | 23.8 | Single [35;64] years | 8.6 |
| 2 | 28.0 | Single $\geq$ 65 years | 12.6 |
| 3 | 21.7 | Couple no children, head <35 years | 1.9 |
| $\geq$ 4 | 26.5 | Couple no children, head [35;64] years | 7.5 |
| | | Couple no children, head $\geq$ 65 years | 11.8 |
| **(6) Head gender and under 18s** | | Couple with 1 child | 18.1 |
| Male head and no under 18s | 48.8 | Couple with 2 children | 18.2 |
| Male head and under 18s | 23.5 | Couple with 3 children | 4.5 |
| Female head and no under 18s | 23.4 | Monoparental HH | 7.7 |
| Female head and under 18s | 4.3 | Other type of HH | 6.5 |

*Source: Own elaboration of ICF05*

*: "other" means "unemployed, actively looking for a job, housekeeper, student or else".

Table 2: *Posterior probability (in %) of misclassification in discriminant analysis applied both to canonical variable(s) (CV) and to significant variables (SV). K-th nearest neighbor method with $k = 3$*

| Consumption variables | No. of QV | | Partitions* (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **9 classes** | **9** | **CV** | 18.41 | 19.01 | 28.27 | 30.50 | 46.26 | 38.48 | 47.27 | 44.08 | 67.39 |
| | | **SV** | 15.59 | 17.33 | 26.45 | 29.00 | 44.26 | 37.12 | 47.01 | 43.72 | 67.39 |
| | | **No. of SV** | 7 | 7 | 9 | 9 | 8 | 7 | 9 | 9 | 9 |
| **housing** | **53** | **CV** | 17.80 | 18.77 | 31.06 | 33.26 | 45.63 | 39.08 | 50.11 | 47.61 | 68.00 |
| | | **SV** | 16.92 | 18.28 | 29.58 | 32.10 | 42.99 | 38.44 | 49.23 | 47.49 | 67.84 |
| | | **No. of SV** | 22 | 13 | 20 | 18 | 21 | 18 | 19 | 24 | 23 |
| **Furnishing** | **17** | **CV** | 23.74 | 26.45 | 42.69 | 46.41 | 62.24 | 47.03 | 56.77 | 55.87 | 76.57 |
| | | **SV** | 25.99 | 27.29 | 42.69 | 35.33 | 68.37 | 49.20 | 56.87 | 55.93 | 76.59 |
| | | **No. of SV** | 3 | 4 | 16 | 16 | 3 | 3 | 12 | 15 | 15 |
| **Clothing** | **11** | **CV** | 13.79 | 22.62 | 43.16 | 35.45 | 47.11 | 35.11 | 50.04 | 42.89 | 66.88 |
| **and footwear** | | **SV** | 13.72 | 22.01 | 43.17 | 35.26 | 45.51 | 34.93 | 49.57 | 42.84 | 66.67 |
| | | **No. of SV** | 7 | 7 | 8 | 8 | 6 | 7 | 8 | 8 | 9 |
| **Health care** | **12** | **CV** | 25.71 | 26.80 | 43.09 | 46.12 | 63.10 | 48.72 | 56.14 | 58.99 | 76.91 |
| | | **SV** | 26.06 | 27.02 | 43.10 | 46.41 | 64.33 | 49.25 | 56.35 | 60.17 | 77.44 |
| | | **No. of SV** | 5 | 4 | 6 | 6 | 6 | 5 | 5 | 6 | 4 |
| **Transport** | **23** | **CV** | 18.87 | 20.60 | 34.27 | 32.05 | 30.00 | 38.17 | 46.40 | 44.02 | 52.33 |
| | | **SV** | 18.82 | 20.81 | 34.25 | 32.07 | 27.14 | 37.90 | 46.38 | 44.12 | 52.20 |
| | | **No. of SV** | 8 | 6 | 12 | 13 | 7 | 10 | 13 | 12 | 14 |
| **Leisure time** | **30** | **CV** | 22.13 | 26.66 | 43.18 | 44.69 | 58.30 | 45.88 | 56.80 | 51.61 | 74.87 |
| **and education** | | **SV** | 22.82 | 27.58 | 43.20 | 45.34 | 58.80 | 46.40 | 57.70 | 51.79 | 74.68 |
| | | **No. of SV** | 12 | 7 | 22 | 23 | 12 | 10 | 18 | 20 | 23 |
| **Various goods** | **22** | **CV** | 21.33 | 24.30 | 41.71 | 38.45 | 45.20 | 42.87 | 51.79 | 48.11 | 63.96 |
| **and services** | | **SV** | 21.04 | 24.43 | 41.75 | 38.38 | 44.69 | 43.00 | 52.21 | 48.15 | 63.72 |
| | | **No. of SV** | 9 | 12 | 17 | 17 | 12 | 13 | 17 | 16 | 18 |
| **Food and drinks** | **66** | **CV** | 16.92 | 18.16 | 36.58 | 29.00 | 49.33 | 37.93 | 47.58 | 43.50 | 70.64 |
| | | **SV** | 17.25 | 18.49 | 36.71 | 30.21 | 48.75 | 39.53 | 48.75 | 47.14 | 70.84 |
| | | **No. of SV** | 56 | 53 | 58 | 58 | 58 | 60 | 61 | 61 | 63 |
| **Workaday goods** | **45** | **CV** | 17.32 | 18.56 | 35.41 | 29.61 | 49.41 | 36.52 | 46.06 | 42.82 | 66.12 |
| **and services** | | **SV** | 15.45 | 18.18 | 35.40 | 29.56 | 45.49 | 35.91 | 47.04 | 43.41 | 67.28 |
| | | **No. of SV** | 32 | 30 | 35 | 39 | 36 | 34 | 41 | 37 | 38 |
| **All** | **279** | **CV** | 10.92 | 15.07 | 28.10 | 23.72 | 37.33 | 27.26 | 37.92 | 32.85 | 56.75 |
| | | **SV** | 13.41 | 17.41 | 25.07 | 27.72 | 43.28 | 33.60 | 45.24 | 42.26 | 66.13 |
| | | **No. of SV** | 153 | 134 | 194 | 196 | 161 | 160 | 194 | 189 | 207 |

*Source: Own elaboration of ICF05*

*: The numbers in the header row refer to the partitions described in Table 1; QV means quantitative variables.

Table 3: *Posterior probability (in %) of misclassification in discriminant analysis applied both to canonical variable(s) (CV) and to significant variables (SV). K-th nearest neighbor method with different values of k*

| k | Consumption variables | No. of QV | | Partitions* (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6** | **All** | 279 | **CV** | 16.75 | 23.98 | 29.27 | 30.37 | 45.43 | 33.61 | 41.82 | 37.05 | 58.49 |
| | | | **SV** | 23.75 | 27.63 | 35.12 | 35.82 | 52.52 | 41.64 | 49.92 | 46.12 | 67.40 |
| **10** | **All** | 279 | **CV** | 15.77 | 22.79 | 28.10 | 29.73 | 45.31 | 32.55 | 40.98 | 36.67 | 58.74 |
| | | | **SV** | 22.01 | 26.70 | 33.68 | 35.48 | 53.62 | 41.02 | 49.63 | 45.86 | 68.89 |
| **13** | **All** | 279 | **CV** | 13.73 | 20.51 | 26.60 | 28.89 | 45.34 | 31.66 | 41.07 | 36.44 | 58.83 |
| | | | **SV** | 17.09 | 24.32 | 31.94 | 35.13 | 54.76 | 40.94 | 49.52 | 45.83 | 69.62 |
| **20** | **All** | 279 | **CV** | 14.88 | 22.17 | 27.38 | 29.30 | 45.53 | 31.96 | 41.16 | 36.31 | 59.09 |
| | | | **SV** | 20.32 | 26.35 | 32.43 | 35.34 | 56.50 | 41.28 | 49.41 | 46.41 | 70.56 |
| | | | **No. of SV** | 153 | 134 | 194 | 196 | 161 | 160 | 194 | 189 | 207 |

*Source: Own elaboration of ICF05*

*: The numbers in the header row refer to the partitions described in Table 1; QV means quantitative variables.

*Table 4: Descriptives of the 153 significant variables of consumption for the groups of households without and with under18 years old components. (Mean is the weighted average of the monthly equivalent consumption, in Euro, within each group.)*

| **Variables of consumption** | **Without under18s** | | **With under18s** | | |
|---|---|---|---|---|---|
| | **Mean (A)** | **St. Dev.** | **Mean (B)** | **St. Dev.** | **(A)-(B)** |
| Boys', girls' and babies' outwear | 4.59 | 28.42 | 37.61 | 64.38 | -33.0 |
| Mortgage loan for main housing | 32.66 | 143.03 | 52.82 | 132.49 | -20.2 |
| Boys', girls' and babies' footwear | 0.49 | 6.43 | 10.70 | 23.02 | -10.2 |
| Kindergarten, baby sitter, etc. | 0.35 | 12.96 | 9.50 | 46.90 | -9.2 |
| School books | 1.45 | 17.71 | 8.71 | 43.60 | -7.3 |
| Toys and video games | 5.27 | 5.27 | 12.09 | 33.63 | -6.8 |
| Loan repayment | 12.58 | 71.38 | 18.46 | 66.20 | -5.9 |
| Bed and board, in Italy | 15.62 | 147.34 | 20.02 | 151.05 | -4.4 |
| Sport: swimming pool, gym | 5.12 | 29.79 | 9.48 | 34.19 | -4.4 |
| School canteen | 0.20 | 0.20 | 4.38 | 18.06 | -4.2 |
| Fees (including language or computer courses) | 2.17 | 40.69 | 6.27 | 51.41 | -4.1 |
| Gas oil for cars and motorcycle | 16.51 | 16.51 | 20.42 | 45.88 | -3.9 |
| Paper tissues, nappies, toilet paper | 8.26 | 8.26 | 12.16 | 20.48 | -3.9 |
| Notebooks, stationery | 1.41 | 1.41 | 4.35 | 12.48 | -2.9 |
| Overnight stay in Italy | 7.84 | 87.94 | 10.21 | 85.80 | -2.4 |
| Other cereals | 4.90 | 12.20 | 7.22 | 12.53 | -2.3 |
| Life insurance | 17.74 | 53.17 | 19.82 | 42.72 | -2.1 |
| Bus tickets | 2.68 | 13.52 | 4.12 | 18.70 | -1.4 |
| Childhood articles | 1.33 | 26.16 | 2.47 | 21.76 | -1.1 |
| Fruit juice, etc. | 3.73 | 3.73 | 4.82 | 7.12 | -1.1 |
| School bus | 0.04 | 1.24 | 1.04 | 8.79 | -1.0 |
| Other maintenance | 3.02 | 60.36 | 3.95 | 74.60 | -0.9 |
| Private lessons | 0.61 | 16.77 | 1.53 | 13.73 | -0.9 |
| Photographic films | 2.83 | 2.83 | 3.74 | 11.94 | -0.9 |
| Purchase of new motorcycle | 0.07 | 7.77 | 0.87 | 36.32 | -0.8 |
| Ferry boat tickets | 0.74 | 14.86 | 1.45 | 22.38 | -0.7 |
| Milk powder | 0.41 | 3.88 | 1.05 | 6.94 | -0.6 |
| Gas cylinders | 6.00 | 26.91 | 6.62 | 24.00 | -0.6 |
| Calculator, typewriters | 1.13 | 16.76 | 1.73 | 17.17 | -0.6 |
| Camping equipment | 2.01 | 24.73 | 2.52 | 20.94 | -0.5 |
| Mobile phone | 2.28 | 15.57 | 2.78 | 11.93 | -0.5 |
| Other milk based products | 1.77 | 4.92 | 2.20 | 4.34 | -0.4 |
| Driving lessons | 0.62 | 10.58 | 1.03 | 10.13 | -0.4 |
| Purchase of clean-up machines | 0.55 | 11.28 | 0.95 | 15.01 | -0.4 |
| Repair of water installation (secondary housing) | 0.05 | 3.44 | 0.31 | 16.57 | -0.3 |
| Coke | 4.35 | 4.35 | 4.59 | 7.19 | -0.2 |
| Entertainment: dance and painting courses | 0.74 | 13.11 | 0.96 | 8.99 | -0.2 |
| Margarine | 0.38 | 1.77 | 0.32 | 1.18 | 0.1 |
| Lard | 0.14 | 1.47 | 0.07 | 0.83 | 0.1 |
| Water (secondary housing) | 0.35 | 3.30 | 0.16 | 1.52 | 0.2 |
| Needles, crochet needles | 0.50 | 0.50 | 0.30 | 2.27 | 0.2 |
| Other foods based on fish | 0.91 | 4.43 | 0.69 | 3.01 | 0.2 |
| Central heating (secondary housing) | 0.28 | 7.08 | 0.06 | 2.40 | 0.2 |
| Telephone (secondary housing) | 0.34 | 3.71 | 0.12 | 1.54 | 0.2 |
| Secondary housing insurance | 0.59 | 10.77 | 0.29 | 9.21 | 0.3 |
| Soups,baking powder | 1.21 | 4.56 | 0.87 | 2.78 | 0.3 |
| Olive residues and seeds oil | 1.36 | 4.26 | 0.98 | 2.48 | 0.4 |
| Flour | 1.78 | 4.66 | 1.39 | 3.21 | 0.4 |
| Gas (secondary housing) | 0.72 | 8.10 | 0.29 | 3.16 | 0.4 |
| Taxi | 0.73 | 0.73 | 0.29 | 4.62 | 0.4 |
| Preserved or dry vegetables | 1.90 | 1.90 | 1.45 | 4.03 | 0.4 |
| Repair of small home appliances | 1.02 | 1.02 | 0.55 | 6.11 | 0.5 |
| Clinical examination | 3.04 | 17.04 | 2.56 | 12.65 | 0.5 |
| Beer | 4.13 | 4.13 | 3.64 | 7.52 | 0.5 |
| Concerts and theater subscription | 0.86 | 13.35 | 0.37 | 5.31 | 0.5 |
| Food based on legumes and vegetables | 1.53 | 1.53 | 1.02 | 3.27 | 0.5 |
| Paper napkin, plates, glasses | 5.49 | 5.49 | 4.98 | 7.86 | 0.5 |
| outwear's repair | 1.34 | 1.34 | 0.83 | 6.24 | 0.5 |
| Canned tomatoes and preserves | 2.31 | 2.31 | 1.80 | 3.90 | 0.5 |

Continued on next page

**Table 4 – continued from previous page**

| | | | | | |
|---|---|---|---|---|---|
| Smoked fish | 2.03 | 7.49 | 1.52 | 5.40 | 0.5 |
| Other fresh fruits | 3.42 | 3.42 | 2.85 | 6.17 | 0.6 |
| Dried fruits | 1.96 | 1.96 | 1.38 | 3.99 | 0.6 |
| Bananas | 5.42 | 5.42 | 4.80 | 5.55 | 0.6 |
| Preserved or dry legumes | 1.59 | 1.59 | 0.96 | 2.58 | 0.6 |
| Salt, pepper, spices | 2.88 | 6.47 | 2.24 | 4.27 | 0.6 |
| Firm and university canteen | 1.98 | 1.98 | 1.33 | 7.50 | 0.7 |
| Costs for custody in private parking | 2.08 | 20.88 | 1.41 | 11.20 | 0.7 |
| Telephone cards | 4.68 | 4.68 | 4.01 | 15.85 | 0.7 |
| Parking | 3.90 | 3.90 | 3.22 | 11.60 | 0.7 |
| Condominium (secondary housing) | 1.13 | 12.35 | 0.41 | 5.90 | 0.7 |
| Jam, honey, chocolate | 4.71 | 10.15 | 3.99 | 6.23 | 0.7 |
| electric power (secondary housing) | 1.42 | 7.87 | 0.69 | 4.12 | 0.7 |
| Biscuits | 8.93 | 11.44 | 8.18 | 8.80 | 0.8 |
| Butter | 2.51 | 5.19 | 1.75 | 3.04 | 0.8 |
| Train tickets | 3.25 | 22.64 | 2.44 | 13.52 | 0.8 |
| Examination in radiology | 2.86 | 19.26 | 2.01 | 13.01 | 0.8 |
| Aluminium containers | 3.51 | 3.51 | 2.63 | 5.16 | 0.9 |
| Grapes and strawberries | 3.32 | 3.32 | 2.39 | 5.15 | 0.9 |
| Thermometer, syringes | 2.54 | 2.54 | 1.59 | 9.35 | 0.9 |
| The, cocoa, barley | 2.98 | 6.21 | 2.04 | 3.75 | 0.9 |
| Brooms, plastic gloves | 2.83 | 2.83 | 1.88 | 5.01 | 0.9 |
| Pork | 9.51 | 18.00 | 8.51 | 13.43 | 1.0 |
| Potatoes | 4.98 | 4.98 | 3.97 | 5.16 | 1.0 |
| Cinema and theater tickets | 4.72 | 4.73 | 3.64 | 14.48 | 1.1 |
| Fresh and frozen legumes | 3.54 | 3.54 | 2.44 | 4.54 | 1.1 |
| Furniture's repair | 2.30 | 2.30 | 1.18 | 16.92 | 1.1 |
| Sugar | 3.89 | 5.58 | 2.68 | 3.59 | 1.2 |
| Underwear | 6.56 | 20.82 | 5.34 | 14.24 | 1.2 |
| Fruits with stone | 4.16 | 4.16 | 2.94 | 6.67 | 1.2 |
| Auxiliary health care services | 2.54 | 33.45 | 1.28 | 14.71 | 1.3 |
| Footwear's repair | 2.56 | 2.56 | 1.29 | 5.52 | 1.3 |
| Liquor | 3.30 | 3.30 | 2.01 | 8.01 | 1.3 |
| Eggs | 4.93 | 6.67 | 3.63 | 4.39 | 1.3 |
| Rice | 3.65 | 6.61 | 2.34 | 3.91 | 1.3 |
| Buttons, sewing thread, balls of thread | 2.90 | 2.90 | 1.51 | 6.69 | 1.4 |
| Other expenses | 1.86 | 47.70 | 0.47 | 13.79 | 1.4 |
| Pears | 3.76 | 3.76 | 2.35 | 3.98 | 1.4 |
| Rabbit, turkey | 5.25 | 13.20 | 3.82 | 8.60 | 1.4 |
| Coal oil, gas oil | 6.17 | 42.84 | 4.66 | 28.62 | 1.5 |
| Repair of large home appliances | 6.05 | 6.05 | 4.48 | 29.34 | 1.6 |
| Glasses | 5.05 | 40.89 | 3.40 | 23.59 | 1.7 |
| Coal and firewood (main housing) | 4.84 | 29.34 | 3.05 | 18.80 | 1.8 |
| Newspaper and magazine subscription | 4.55 | 28.81 | 2.53 | 13.14 | 2.0 |
| Wallpaper | 7.76 | 75.41 | 5.71 | 44.08 | 2.1 |
| Lotto, bingo | 6.09 | 6.09 | 3.78 | 11.19 | 2.3 |
| Pasta | 12.16 | 16.61 | 9.77 | 11.37 | 2.4 |
| Beef | 12.14 | 24.86 | 9.70 | 18.53 | 2.4 |
| Vehicles' insurance | 57.15 | 52.26 | 54.66 | 31.88 | 2.5 |
| Fresh tomatoes | 8.19 | 8.19 | 5.69 | 7.19 | 2.5 |
| Cold cut | 23.07 | 26.50 | 20.42 | 19.28 | 2.6 |
| Poultry | 13.91 | 19.86 | 11.12 | 13.97 | 2.8 |
| Pet feed | 8.20 | 8.20 | 5.36 | 16.97 | 2.8 |
| Main housing insurance | 7.43 | 33.36 | 4.51 | 18.46 | 2.9 |
| Cigarettes, tobacco | 19.08 | 19.08 | 16.04 | 26.90 | 3.0 |
| Repair of heating | 5.84 | 77.83 | 2.74 | 28.07 | 3.1 |
| Radio, TV, pay-TV, internet subscription | 9.29 | 18.78 | 6.18 | 11.85 | 3.1 |
| Man's footwear | 13.35 | 40.98 | 10.19 | 26.53 | 3.2 |
| Mineral water | 12.91 | 12.91 | 9.63 | 11.93 | 3.3 |
| Citrus fruits | 9.80 | 9.80 | 6.46 | 9.09 | 3.3 |
| Apples | 8.35 | 8.35 | 4.99 | 6.50 | 3.4 |
| Water (main housing) | 11.79 | 16.51 | 8.41 | 11.69 | 3.4 |
| Washing powder, floor wax, bug spray | 18.80 | 18.80 | 15.35 | 18.65 | 3.4 |
| Airplane tickets | 7.41 | 86.47 | 3.63 | 47.35 | 3.8 |
| Physical examination | 12.13 | 51.78 | 8.23 | 31.98 | 3.9 |
| Coffee | 10.23 | 13.34 | 6.27 | 7.68 | 4.0 |

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**Table 4 – continued from previous page**

| | | | | | |
|---|---|---|---|---|---|
| Flowers and plants | 10.23 | 10.23 | 5.95 | 18.46 | 4.3 |
| Elderly, disabled assistance | 5.10 | 70.20 | 0.81 | 17.94 | 4.3 |
| Meals at bar, pastry stores, vending stands | 23.87 | 23.87 | 19.52 | 26.14 | 4.4 |
| Woman's footwear | 16.06 | 44.51 | 11.52 | 27.26 | 4.5 |
| Toothpaste, bar soap | 26.37 | 26.37 | 21.60 | 29.98 | 4.8 |
| Newspaper and magazine | 14.45 | 14.45 | 9.65 | 15.97 | 4.8 |
| Laundry | 12.13 | 12.13 | 7.25 | 18.34 | 4.9 |
| Veal and tender beef | 28.83 | 38.31 | 23.88 | 28.58 | 4.9 |
| Woman's outwear | 40.63 | 113.16 | 34.92 | 76.14 | 5.7 |
| Bread, crackers etc | 30.53 | 20.71 | 24.72 | 14.59 | 5.8 |
| Olive oil | 14.09 | 25.91 | 8.20 | 13.69 | 5.9 |
| Frozen or fresh fish | 31.81 | 41.73 | 25.73 | 29.88 | 6.1 |
| Fresh and frozen vegetables | 18.16 | 18.16 | 12.05 | 12.65 | 6.1 |
| House servant, gardener | 11.35 | 72.46 | 5.09 | 35.56 | 6.3 |
| Wine | 14.81 | 14.81 | 7.89 | 18.96 | 6.9 |
| Electric power | 37.76 | 27.96 | 29.86 | 20.47 | 7.9 |
| Cheese | 30.04 | 30.66 | 22.05 | 20.58 | 8.0 |
| Central heating | 13.16 | 46.52 | 4.73 | 22.05 | 8.4 |
| Restaurants | 46.93 | 46.93 | 38.50 | 72.18 | 8.4 |
| Man's outwear | 36.98 | 109.02 | 28.25 | 64.55 | 8.7 |
| Mobile and telephone | 39.83 | 30.64 | 29.57 | 22.20 | 10.3 |
| Petrol for cars and motorcycle | 98.07 | 98.07 | 87.68 | 73.77 | 10.4 |
| Hairdresser, coiffeur | 33.62 | 33.62 | 22.09 | 41.67 | 11.5 |
| Condominium | 23.91 | 56.78 | 10.87 | 26.31 | 13.0 |
| Gas | 51.28 | 71.28 | 34.19 | 43.19 | 17.1 |
| Drugs | 44.19 | 44.19 | 26.23 | 46.22 | 18.0 |
| Rent (main housing) | 69.31 | 182.04 | 43.38 | 106.46 | 25.9 |
| Imputed rent (main housing) | 476.97 | 402.87 | 288.04 | 226.98 | 188.9 |

*Source: Own elaboration of ICF05*

*Table 5: Descriptives of the 134 significant variables of consumption for the groups of households with male and with female head. (Mean is the weighted average of the monthly equivalent consumption, in Euro, within each group.)*

| **Variables of consumption** | **Male** | | **Female** | | |
|---|---|---|---|---|---|
| | **Mean (A)** | **St. Dev.** | **Mean (B)** | **St. Dev.** | **(A) -(B)** |
| Imputed rent (main housing) | 389.75 | 329.45 | 511.86 | 449.29 | -122.10 |
| Rent (main housing) | 55.28 | 154.07 | 78.83 | 188.01 | -23.56 |
| Woman's outwear | 33.61 | 89.33 | 52.22 | 133.03 | -18.61 |
| Drug | 34.85 | 61.95 | 49.94 | 87.19 | -15.08 |
| Gas | 43.37 | 59.43 | 54.52 | 76.90 | -11.16 |
| Hairdresser, coiffeur | 27.30 | 50.89 | 38.24 | 75.68 | -10.95 |
| Woman's footwear | 11.86 | 32.84 | 21.91 | 54.24 | -10.06 |
| Condominium | 17.50 | 45.71 | 27.24 | 60.31 | -9.75 |
| Mobile and telephone | 35.10 | 27.24 | 41.65 | 32.19 | -6.55 |
| Central heating | 9.10 | 36.89 | 14.92 | 50.21 | -5.82 |
| Toothpaste, bar soap | 23.40 | 35.00 | 29.13 | 54.05 | -5.72 |
| Elderly, disabled assistance | 2.30 | 40.43 | 7.84 | 92.48 | -5.54 |
| Electric power | 34.23 | 25.24 | 38.85 | 28.58 | -4.62 |
| Fresh and frozen vegetables | 15.18 | 17.05 | 19.65 | 22.70 | -4.47 |
| House servant, gardener | 8.62 | 58.35 | 11.98 | 77.23 | -3.36 |
| Flowers and plants | 8.18 | 25.65 | 11.21 | 34.70 | -3.03 |

Continued on next page

**Table 5 – continued from previous page**

| | | | | | |
|---|---|---|---|---|---|
| Washing powder, floor wax, bug spray | 17.05 | 22.86 | 19.83 | 28.57 | -2.78 |
| Olive oil | 11.64 | 21.32 | 14.42 | 27.44 | -2.78 |
| Physical examination | 10.32 | 42.59 | 12.95 | 57.03 | -2.63 |
| Poultry | 12.40 | 17.27 | 14.92 | 21.01 | -2.52 |
| Mineral water | 11.32 | 14.64 | 13.67 | 18.43 | -2.35 |
| Frozen or fresh fish | 29.50 | 37.22 | 31.74 | 42.77 | -2.25 |
| Veal and tender beef | 26.80 | 34.12 | 29.03 | 40.11 | -2.23 |
| Wallpaper | 6.60 | 56.44 | 8.76 | 90.89 | -2.16 |
| Cheese | 27.25 | 27.32 | 29.31 | 31.06 | -2.06 |
| Religious ceremony | 1.97 | 34.87 | 3.96 | 68.35 | -1.99 |
| Bread, crackers etc | 28.35 | 18.49 | 30.33 | 21.39 | -1.99 |
| Water (main housing) | 10.28 | 14.56 | 12.24 | 17.16 | -1.95 |
| Milk | 15.22 | 13.04 | 17.15 | 15.38 | -1.93 |
| Buttons, sewing thread, balls of thread | 1.97 | 9.26 | 3.81 | 15.20 | -1.84 |
| Glasses | 4.06 | 32.16 | 5.87 | 46.41 | -1.80 |
| Repair of large home appliances | 5.11 | 34.70 | 6.87 | 47.23 | -1.76 |
| Bus season tickets | 4.30 | 17.92 | 5.97 | 27.17 | -1.67 |
| Suitcase | 2.04 | 17.28 | 3.69 | 28.23 | -1.65 |
| Underwear | 5.75 | 16.92 | 7.35 | 23.92 | -1.60 |
| Citrus fruits | 8.42 | 12.35 | 10.01 | 15.52 | -1.59 |
| Apples | 6.96 | 9.64 | 8.52 | 11.40 | -1.56 |
| Yogurt | 6.68 | 10.09 | 8.04 | 13.28 | -1.36 |
| Radio, TV, pay-TV, internet subscription | 8.06 | 16.26 | 9.38 | 19.33 | -1.31 |
| Coffee | 8.75 | 11.37 | 10.05 | 13.88 | -1.30 |
| Biscuits | 8.36 | 10.07 | 9.62 | 12.33 | -1.26 |
| Beef | 11.13 | 21.72 | 12.33 | 26.78 | -1.20 |
| Fresh tomatoes | 7.17 | 10.37 | 8.30 | 11.58 | -1.14 |
| Paper tissues, nappies, toilet paper | 9.03 | 16.24 | 10.15 | 18.06 | -1.12 |
| Footwear's repair | 1.89 | 8.44 | 2.99 | 12.99 | -1.10 |
| Laundry | 10.44 | 26.00 | 11.53 | 32.09 | -1.09 |
| Thermometer, syringes | 1.96 | 13.62 | 3.02 | 20.42 | -1.06 |
| The, cocoa, barley | 2.44 | 5.07 | 3.40 | 6.84 | -0.96 |
| Pears | 3.11 | 5.72 | 3.98 | 7.47 | -0.87 |
| Jam, honey, chocolate | 4.26 | 8.42 | 5.12 | 10.96 | -0.85 |
| Auxiliary health care services | 1.95 | 25.73 | 2.79 | 37.18 | -0.84 |
| Eggs | 4.35 | 5.74 | 5.11 | 7.01 | -0.76 |
| Bananas | 5.03 | 7.01 | 5.79 | 8.66 | -0.76 |
| Pastry store | 11.32 | 20.62 | 12.05 | 25.81 | -0.73 |
| Spa | 0.27 | 13.55 | 0.98 | 41.07 | -0.71 |
| Potatoes | 4.50 | 7.03 | 5.20 | 8.29 | -0.70 |
| Rice | 3.08 | 5.54 | 3.78 | 7.03 | -0.70 |
| Taxi | 0.40 | 6.13 | 1.09 | 12.92 | -0.69 |
| Fruits with stone | 3.62 | 8.73 | 4.30 | 11.17 | -0.68 |
| Pet feed | 7.22 | 24.18 | 7.89 | 30.52 | -0.67 |
| Non school books | 4.21 | 19.60 | 4.88 | 22.51 | -0.67 |
| Rabbit, turkey | 4.67 | 11.44 | 5.29 | 13.62 | -0.62 |
| Fresh and frozen legumes | 3.07 | 6.46 | 3.64 | 7.71 | -0.57 |
| Brooms, plastic gloves | 2.40 | 6.94 | 2.97 | 9.05 | -0.57 |
| Butter | 2.13 | 4.27 | 2.70 | 5.61 | -0.57 |
| Furniture's repair | 1.83 | 31.40 | 2.39 | 49.27 | -0.56 |
| Fees (including language, PC courses) | 3.19 | 42.56 | 3.71 | 47.91 | -0.53 |
| Sugar | 3.40 | 4.87 | 3.91 | 5.72 | -0.51 |
| Costume jewelery | 0.59 | 5.48 | 1.09 | 10.30 | -0.50 |
| Aluminium containers | 3.12 | 6.80 | 3.62 | 9.41 | -0.50 |
| Food based on legumes, vegetables | 1.26 | 4.27 | 1.68 | 5.97 | -0.42 |
| Grapes and strawberries | 2.96 | 6.96 | 3.33 | 8.00 | -0.37 |
| Preserved or dry legumes | 1.32 | 4.08 | 1.64 | 5.24 | -0.32 |
| Soups,baking powder | 1.03 | 3.71 | 1.34 | 5.05 | -0.31 |
| Preserved or dry vegetables | 1.69 | 5.15 | 1.98 | 6.66 | -0.29 |
| Fruit juice, etc. | 3.96 | 7.73 | 4.24 | 9.11 | -0.28 |
| Paper napkin, plates, glasses | 5.29 | 9.69 | 5.51 | 11.40 | -0.22 |
| Needles, crochet needles | 0.38 | 2.89 | 0.60 | 5.57 | -0.22 |
| Olive residues and seeds oil | 1.19 | 3.45 | 1.39 | 4.68 | -0.20 |
| Salt, pepper, spices | 2.65 | 5.67 | 2.82 | 6.59 | -0.17 |
| Flour | 1.63 | 4.20 | 1.78 | 4.56 | -0.15 |
| Margarine | 0.34 | 1.43 | 0.41 | 2.03 | -0.07 |

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**Table 5 – continued from previous page**

| | | | | | |
|---|---|---|---|---|---|
| Purchase of videotape recorder | 0.24 | 3.77 | 0.18 | 3.76 | 0.06 |
| School bus | 0.36 | 5.00 | 0.18 | 3.39 | 0.19 |
| Electric device for personal care | 0.87 | 7.55 | 0.68 | 6.61 | 0.19 |
| Insurance for boats, caravan | 0.44 | 10.23 | 0.23 | 7.76 | 0.21 |
| Coke | 4.53 | 9.01 | 4.18 | 9.61 | 0.34 |
| Firm and university canteen | 1.91 | 12.66 | 1.54 | 12.23 | 0.37 |
| Horse meat | 2.00 | 8.82 | 1.58 | 8.09 | 0.42 |
| Accommodation (for education) | 1.71 | 24.03 | 1.30 | 23.67 | 0.42 |
| Driving lessons | 0.85 | 10.25 | 0.40 | 10.59 | 0.45 |
| Mutton or lamb | 2.12 | 9.20 | 1.61 | 9.84 | 0.50 |
| School canteen | 1.52 | 10.55 | 1.01 | 10.25 | 0.51 |
| Notebooks, stationery | 2.40 | 10.31 | 1.85 | 10.18 | 0.56 |
| Photographic films | 3.26 | 14.47 | 2.69 | 14.00 | 0.57 |
| Mobile phone | 2.61 | 15.35 | 1.99 | 12.94 | 0.62 |
| Childhood articles | 1.86 | 27.27 | 1.19 | 19.04 | 0.67 |
| Cold cut | 22.55 | 24.19 | 21.85 | 26.09 | 0.70 |
| Other cereals | 5.77 | 12.34 | 5.05 | 12.43 | 0.73 |
| Shellfish | 3.40 | 12.12 | 2.63 | 11.11 | 0.78 |
| House and garden tools | 1.38 | 23.12 | 0.57 | 13.60 | 0.80 |
| Outer furniture | 1.38 | 23.53 | 0.56 | 10.41 | 0.82 |
| Gas cylinders | 6.41 | 26.94 | 5.58 | 24.05 | 0.82 |
| Purchase of TV | 2.34 | 30.27 | 1.50 | 21.47 | 0.84 |
| Purchase of air conditioning | 2.16 | 30.52 | 1.19 | 20.47 | 0.97 |
| Records, videotapes | 4.35 | 17.79 | 3.32 | 16.52 | 1.02 |
| Liquor | 3.24 | 12.97 | 2.22 | 12.42 | 1.03 |
| Newspaper and magazine | 13.48 | 24.26 | 12.37 | 25.76 | 1.11 |
| Pork | 9.57 | 16.47 | 8.35 | 17.79 | 1.22 |
| Parking | 4.13 | 17.34 | 2.71 | 14.31 | 1.42 |
| Boys', girls', babies' footwear | 3.84 | 14.68 | 2.13 | 12.43 | 1.70 |
| Beer | 4.53 | 10.72 | 2.67 | 9.01 | 1.86 |
| Oil and lube oil | 4.08 | 16.49 | 2.20 | 13.04 | 1.89 |
| School books | 4.00 | 29.28 | 2.12 | 23.21 | 1.89 |
| Illness insurance | 5.74 | 41.21 | 3.65 | 35.32 | 2.08 |
| Lotto, bingo | 6.09 | 19.27 | 3.93 | 16.37 | 2.16 |
| Inner repairs (main housing) | 6.07 | 146.81 | 2.81 | 68.45 | 3.25 |
| School fees | 9.12 | 75.23 | 4.93 | 55.84 | 4.19 |
| Loan repayment | 15.54 | 72.82 | 11.01 | 62.86 | 4.53 |
| Meals at bar, pastry stores | 24.06 | 39.75 | 19.46 | 37.58 | 4.60 |
| Wine | 14.25 | 34.92 | 9.60 | 26.79 | 4.66 |
| Spare part for vehicles | 15.82 | 77.45 | 10.78 | 70.26 | 5.04 |
| Life insurance | 19.95 | 51.77 | 14.43 | 47.16 | 5.52 |
| Cigarettes, tobacco | 19.84 | 37.37 | 14.28 | 35.81 | 5.56 |
| Boys', girls', babies' outwear | 15.48 | 44.54 | 9.84 | 43.67 | 5.64 |
| Mortgage loan for main housing | 41.11 | 140.62 | 32.25 | 141.59 | 8.86 |
| Man's footwear | 15.71 | 41.74 | 4.67 | 22.98 | 11.04 |
| Gas oil for cars and motorcycle | 21.27 | 58.29 | 8.82 | 39.59 | 12.45 |
| Maintenance and repair | 30.57 | 131.06 | 17.82 | 102.48 | 12.75 |
| Restaurants | 49.41 | 104.59 | 33.43 | 85.73 | 15.99 |
| Purchase of a new car | 51.78 | 575.70 | 34.93 | 415.79 | 16.85 |
| Vehicles' insurance | 63.04 | 45.73 | 40.84 | 48.12 | 22.20 |
| Man's outwear | 42.85 | 107.20 | 14.64 | 71.55 | 28.21 |
| Petrol for cars and motorcycle | 104.07 | 104.46 | 74.31 | 106.22 | 29.76 |

*Source: Own elaboration of ICF05*

Table 6: *Descriptives of the household CPI*

| **Variables of consumption** | | N | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|---|
| **All** | | | | | | |
| All households | | 24107 | 1.0261 | 0.0080 | 0.9763 | 1.1361 |
| Presence of under18s | no | 17363 | 1.0262 | 0.0083 | 0.9763 | 1.1361 |
| | yes | 6744 | 1.0259 | 0.0069 | 0.9775 | 1.1300 |
| Gender of HH head | male | 17187 | 1.0265 | 0.0076 | 0.9763 | 1.1300 |
| | female | 6575 | 1.0253 | 0.0087 | 0.9846 | 1.1361 |
| **Significant** | | | | | | |
| Presence of under18 | no | 17363 | 1.0276 | 0.0084 | 0.9849 | 1.0798 |
| | yes | 6744 | 1.0282 | 0.0073 | 0.9720 | 1.0768 |
| Gender of HH head | male | 17187 | 1.0277 | 0.0075 | 0.9774 | 1.0781 |
| | female | 6575 | 1.0265 | 0.0089 | 0.9789 | 1.0776 |

*Source: Own elaboration of ICF05*
Note: in ICF05 the variable *Gender of the householder* has 345 missing values.

Table 7: *Plutocratic ($P_L^P$) and democratic ($P_L^D$) CPI based on all 147 specific consumptions. Percentage variation from the overall plutocratic ($\Delta^P\%$) and democratic ($\Delta^D\%$) indices. Between brackets: Bootstrap confidence interval at 95% level*

| | $P_L^P$ | $P_L^D$ | $(P_L^D - P_L^P)\%$ | $\Delta^P\%$ | $\Delta^D\%$ |
|---|---|---|---|---|---|
| All households | 1.0251 | 1.0261 | 0.100 | ./. | ./. |
| | (1.0247, 1.0254) | (1.0256, 1.0264) | | | |
| HH with under18s | 1.0249 | 1.0259 | 0.101 | -0.026 | -0.025 |
| | (1.0240, 1.0255) | (1.0248, 1.0264) | | | |
| HH without under18s | 1.0252 | 1.0262 | 0.101 | 0.009 | 0.010 |
| | (1.0247, 1.0257) | (1.0257, 1.0267) | | | |
| HH with male head | 1.0255 | 1.0265 | 0.104 | 0.030 | 0.034 |
| | (1.0250, 1.0260) | (1.0262, 1.0271) | | | |
| HH with female head | 1.0244 | 1.0254 | 0.094 | -0.071 | -0.077 |
| | (1.0241, 1.0257) | (1.0250, 1.0265) | | | |

*Source: Own elaboration of ICF05*
Note: the bootstrap estimates are based on a subsample of size n=2000.

Table 8: *Plutocratic ($P_L^P$) and democratic ($P_L^D$) CPI based on the significant consumptions. Percentage variation from the overall plutocratic ($\Delta^P\%$) and democratic ($\Delta^D\%$) indices. Between brackets: Bootstrap confidence interval at 95% level*

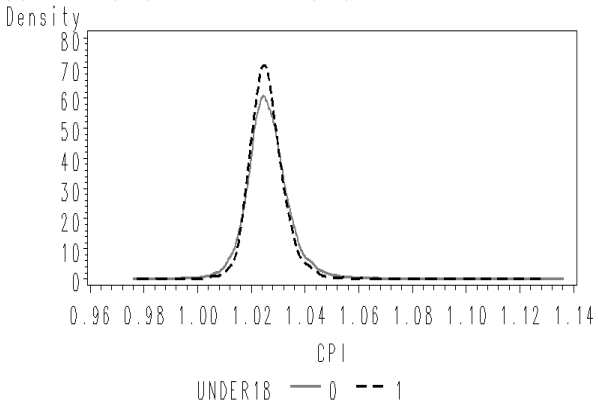
| Based on | Households | $P_L^P$ | $P_L^D$ | $(P_L^D - P_L^P)\%$ | $\Delta^D\%$ | $\Delta^P\%$ |
|---|---|---|---|---|---|---|
| Under18s | All | 1.0266 (1.0263, 1.0271) | 1.0277 (1.0273, 1.0281) | 0.111 | ./. | ./. |
| | with under18s | 1.0271 (1.0264, 1.0278) | 1.0282 (1.0276, 1.0288) | 0.107 | 0.050 | 0.046 |
| | without under18s | 1.0265 (1.0256, 1.0265) | 1.0276 (1.0271, 1.0281) | 0.110 | -0.017 | -0.018 |
| Gender | All | 1.0263 (1.0261, 1.0269) | 1.0274 (1.0269, 1.0278) | 0.103 | ./. | ./. |
| | with male head | 1.0267 (1.0261, 1.0271) | 1.0277 (1.0272, 1.0280) | 0.105 | 0.035 | 0.036 |
| | with female head | 1.0255 (1.0242, 1.0260) | 1.0265 (1.0252, 1.0269) | 0.101 | -0.081 | -0.083 |

*Source: Own elaboration of ICF05*

Note: the bootstrap estimates are based on a subsample of size n=2000.

Figure 1: *Kernel density estimation of household consumer price indices, based on all variables of consumption*

(a) With (=1) and without (=0) under18s




(b)Male (=1) and female (=2) HH head

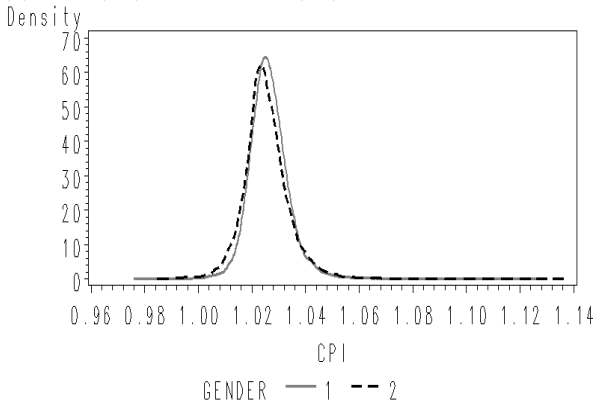
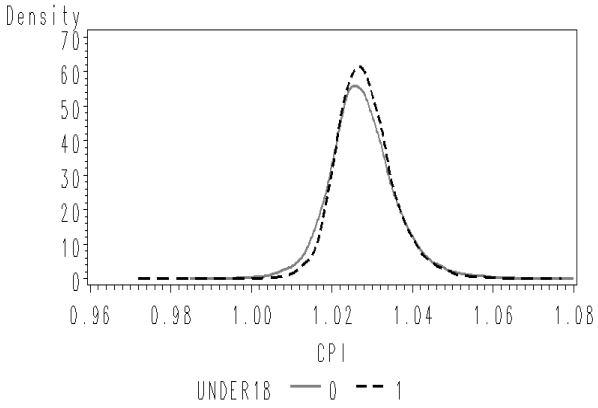



Figure 2: *Kernel density estimation of household consumer price indices, based on the significant variables of consumption*

(a) With (=1) and without (=0) under18s




(b)Male (=1) and female (=2) HH head