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# RELATIVE PRICE CHANGES AND HOUSEHOLDS' WELFARE IN ITALY

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The entrance of Italy in the Euro area in 2001 has given rise to a wide debate about the perception of inflation on households' well-being. However, most of the debate has involved the measurement of the "correct" consumer price index at the national level. Much less analysis has been carried out on the distributional consequences of inflation on every household. The paper addresses this issue by performing a microsimulation analysis of the impact of inflation on Italian households in the period 1997–2007. It is shown that the impact of inflation has an ambiguous path over the period, with a large concentration of welfare losses around the introduction of the Euro currency. In particular, it is found that poorer and larger households are severely hurt by inflation and that the prices of *gas* and *gasoline* are largely responsible for determining the living conditions of Italian households.

**JEL Codes**: D12, H22, I31

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## 1. Introduction

After the entrance of Italy into the Euro area in 2001, the issue of the distributional impact of inflation has revived, mostly because of the wide perception that the change of currency could have worsened the position of the bulk of Italian households. A great debate has arisen around the ability of the official Consumer Price Index (CPI) to fully reflect the "true" impact of currency-induced inflation, especially because official estimates of the general price index have given no evidence of any structural break before and after the adoption of the Euro

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currency, despite a wide popular perception in that direction. However, the average CPI is not necessarily a good indicator for the assessment of the households' well-being when distributional effects are concerned; whenever prices of different commodities do not increase by the same proportion and consumption bundles differ among households, changes in relative prices may still cause significant distributional effects, possibly concealed by the average measure.

Notwithstanding the growing concern about the distributional effects of inflation and the important implications for policy-makers, the empirical evidence on this topic is still thin, both internationally and in the Italian case. With regard to the international literature, most of the available empirical evidence takes into account different dimensions of inflation in a multi-year perspective using various methodologies, which makes difficult to find a unifying descriptive characteristic.

The most common approach consists of constructing and comparing price indexes that approximate the average trend in the cost of living for particular groups of households. These group-specific price indexes, as suggested by Hobijn and Lagakos (2005), can be interpreted as representative of the underlying distribution of household inflation rates and thus alternative to the direct measure of the welfare effects of price changes. Within this approach, some studies group households according to their social characteristics (Boskin and Hurd, 1986; Amble and Stewart, 1994; Slesnick, 1990; Idson and Miller, 1999; Moulton and Stewart, 1999; Deaton, 2003; Lieu *et al*., 2004; Chiru, 2005; Hobijn and Lagakos, 2005; Artsev *et al*., 2006; McGranahan and Paulson, 2006; Leicester *et al*., 2008); others according to their economic characteristics (Snyder, 1961; Michael, 1979; Hagemann, 1982; Kahn, 1985; Slesnick, 1990; Crawford, 1994; Garner *et al*., 1996; Taktek, 1998; Crawford and Smith, 2002; Murphy and Garvey, 2004; McKay and Sowa, 2008; Grimm and Günther, 2007; Oosthuizen, 2007; IFS, 2008). In all cases, results are hardly unanimous in favor of a persistent pattern of inflation for specific subgroups, regardless of both the period and the country analyzed.

For example, in the U.S., Michael (1979), while showing strong evidence of significant differences of inflation rates across households groups, does not find any subgroup persistently experiencing higher or lower price changes. An extension of this work by Hagemann (1982) shows significant but temporally unstable differences in the price indexes across groups. An analysis by Taktek (1998) for Canadian households also gives support to the hypothesis that the inflation of a given population subgroup does not significantly differ from the average level.

With regard to households with children, Idson and Miller (1999) find that the presence of children slightly increases the cost of living. The same outcome is obtained when considering households with lower educational attainment (McGranahan and Paulson, 2006). Differential burdens for pensioners are also frequently analyzed, with mixed outcomes. While Boskin and Hurd (1986) find no evidence of a high inflation rate for U.S. pensioners, Amble and Stewart (1994), Jorgenson and Slesnick (1999), and McGranahan and Paulson (2006) find a sufficiently regular higher inflation burden for elderly people. As later shown in Hobijn and Lagakos (2005), most of the differential inflation for elderly people is often explained by the price index of medical care expenditures. The dependence of results from the movement of price indexes of specific products is also illustrated by the analysis of Leicester *et al*. (2008) in the U.K. While suggesting that

pensioner households often face significant higher inflation than non-pensioners, driven by the rapid increase of fuel and food prices in 2006 and 2008, they crucially show that, in 2007, non-pensioners would bear a higher inflation rate for opposite reasons (falling fuel prices and higher mortgage payments). Interestingly, they find significant variation in household inflation rates even within the pensioner population.

A common dimension of analysis is the comparison between the inflation of poorer and richer households. To this purpose, Slesnick (1990), for the U.S., concludes that price changes have had no effect on social welfare and inequality over a long time span, a conclusion that is later shared by Garner *et al*. (1996), Moulton and Stewart (1999), and Chiru (2005), who do not find the poorest undergoing a persistently higher inflation rate. On the other hand, Crawford (1994), Crawford and Smith (2002), and IFS (2008), for the U.K., show that poorer households have had a lower than average inflation rate, a result that is shared by Lieu *et al*. (2004) in Taiwan. Murphy and Garvey (2004), for Ireland, show instead that prices for the urban poor rose significantly more than for the general population, because of large increases of rental costs, cigarettes, and mortgage interest.

Finally, a handful of studies on group inflation following the same approach have dealt with other countries: Kahn (1985) and Oosthuizen (2007) for South Africa; Deaton (2003) for India; McKay and Sowa (2008) for Ghana; Artsev *et al*. (2006) for Israel; and Grimm and Günther (2007) for Burkina Faso. In particular, Kahn (1985) and Oosthuizen (2007) were unable to find higher inflation rates for lower income groups, at least over the whole period analyzed. The opposite occurs in Artsev *et al*. (2006), even though there is some evidence of higher than average inflation rates for the highest decile.

Alternative (and less common) approaches to evaluate the distributional impact of inflation consist of regressing household price indexes or inflation rates on household characteristics (Michael, 1979; Hagemann, 1982; Livada, 1990; Creedy and Van de Ven, 1997; Creedy, 1998; Drezgić, 2008), using various functional forms including a Linear Expenditure System (LES). Results can support either a statistically significant difference for the price index of different subgroups (Michael, 1979; Hagemann, 1982; Livada, 1990), or no significant global redistributive effects (Creedy and Van de Ven, 1997; Creedy, 1998; Drezgić, 2008).

Finally, with specific regard to the Italian case, the existing literature is even thinner. An extensive descriptive analysis of the determinants of inflation in the period 1986–2004 can be found in Baldini (2005), while other studies are instead usually confined to measure either year-specific effects (Giraldo and Trivellato, 2003) or the heterogeneity of price indexes among groups of households in a given year (Chelli *et al*., 2009).

This paper, rather than confining attention to one specific method of investigation, addresses the distributional and welfare impact of relative price changes in Italy in the period 1997–2007 using a set of methodologies. To this purpose, the welfare analysis is implemented using two complementary approaches. The first is a "synthetic" approach as applied by Newbery (1995) in Hungary and by Liberati (2001) in Italy. The second is the theory of marginal dominance developed by Mayshar and Yitzhaki (1995, 1996)—in its standard and sequential version—to derive sufficient conditions for welfare prescriptions. These methods will lead to

some insightful results in terms of which households suffered most from inflation and which goods contributed most to inflation over time.

## 2. Data and Methodology

### 2.1. *Data Issues*

It is well established that the general consumer price index (CPI) represents a satisfactory measure of the household cost-of-living only in the very special case in which commodities in households' consumption have the same weights they have in CPI. More commonly, the use of the average price index based on a *representative* household budget does not prove to be a good indicator for households who deviate from this benchmark.

A step beyond the concept of the representative household is therefore necessary when distributional effects are concerned. Usually, different households consume different goods in different proportions. Furthermore, prices of goods and services usually do not vary in the same proportion as the general price index. The contemporaneous occurrence of different consumption patterns and differentiated price increases would imply that specific inflation rates may be attached to different households. Thus, detailed information on households' consumption is required as well as price indexes for a large number of elementary commodities.

This information, in Italy, come from two different sources of data collected by the Italian Institute of Statistics (Istat).[1] The first is the dataset that reports the price indexes at national level (CPI), separately, for 208 commodities. The detail of this dataset allows one to build aggregate sub-indexes for categories of goods and services, but it does not allow one to embody any spatial differentiation. Thus, the possibility that inflation may have a differential spatial impact across Italian regions cannot be addressed in this framework because of the lack of regional price indexes for each elementary commodity. In what follows we will therefore assume that all commodities have the same inflation rate in the whole country.[2] Furthermore, consumers may not pay the same prices because they buy their goods and services at different shops or consume different brands for the same product at different stores. A number of applied papers have tried to take into account this possibility;[3] however, our data cannot be used to properly address this issue, as collection points are not known. Thus, in what follows, we are forced to the "one price" assumption to deal with both issues.

The second dataset is the Household Expenditure Survey (HES), built on an annual basis since 1968. HES collects a rich set of information on both socio-demographic characteristics and consumption expenditure for a very

[1]Istat does not bear any responsibility for the results presented in this paper.

[2]The only known attempt to deal with this issue in Italy is in Massari *et al*. (2009), with regional price indexes for seven broad categories of goods (Food; Clothing and Footwear; Furniture and Furnishing; Housing; Health; Maintenance and Repairs; Other Commodities and Services). The authors argue that housing prices account for almost 70 percent of the cost-of-living differences between the Northern and the Southern part of Italy.

[3]As in Caplovitz (1963), Alcaly and Klevorick (1971), Kunreuther (1973), Ambrose (1979), MacDonald and Nelson (1991), Hayes (2000), Frankel and Gould (2001), Kurtzon and McClelland (2007), and Broda *et al*. (2009).

disaggregated set of commodities (durables and non-durables). Up to 1996, the survey included 77 categories of items; since 1997 items have been grouped into 273 classes. In 1997 both the survey design and the procedure for the acquisition and validation of results underwent a deep process of revision in order to align definitions and methodology to the recent European precepts and to improve the quality of data. The sampling scheme is organized in two stages. In the first stage, municipalities are non-randomly selected among two groups according to the size of population; chief towns of provinces are fully included and selected to take part in the survey every month, while the remainder are grouped in strata according to some economic and geographic characteristics and are extracted every three months. In the second stage, households are randomly selected within the stratum from the registry office records.

Since 1988, the survey unit has been the *household*, i.e. the "group of individuals linked by ties of blood, marriage or affection, sharing the same dwelling and pooling all or part of their incomes" (Brandolini, 1999). The sample size is of about 28,000 households from 480 municipalities with weights that allow for a recalibration of population in each stratum.[4] For our purposes, two issues are particularly relevant: the treatment of durable goods, and the treatment of housing. *Durable goods* have been treated by recalculating the total amount spent in the year of the survey on each durable good (surveyed quarterly by Istat) and by assuming a depreciation period of either 36 (mainly home durable goods) or 60 months (mainly cars, motorcycles, etc.). In this case, the monthly expenditure on durable goods is the expenditure flow originated by each good, given the depreciation period.

Instead, to model the impact of *housing*, we distinguish three different cases. First, for households renting a house (as a main dwelling), we subtract the housing cost from total expenditures used for the social ranking. The rationale of this choice is that rent can be considered a "compulsory" expenditure; the inclusion of this item in total spending would result in an overestimation of well-being for these households, which would appear richer than they actually are. Second, for households owning a house and not paying any mortgage, we simply add the imputed rent of the owner occupied dwellings (both main and secondary) to total expenditures in order to account for the additional well-being that such an item provides to the household. Third, for households owning a house and paying a mortgage, we do not add the imputed rents nor do we subtract the mortgage installment. We pursue this strategy mainly for the reason that HES does not contain information on the length of the mortgage, the interest rate, and the amount originally borrowed. These features are extremely relevant in determining the size of the installment, so that the latter cannot be compared with the imputed income from the

[4]Data are recorded by means of two complementary methods: (a) a diary where the household keeps track of the expenditures made (Libretto degli Acquisti) and of internally produced goods consumed in the previous seven days (Taccuino degli Autoconsumi); and (b) a proper interview for the remaining purchases done in the previous month and for durables bought in the previous three months. Given the high degree of detail, the survey represents the official source for both the construction of cost-of-living indexes and the production of poverty (absolute and relative) consumption-based statistics in Italy. Also, since 1979 a purely indicative question concerning household monthly income (by range) has been introduced; however, unfortunately, the reliability of such information is rather limited due to a high under-reporting which undermines the estimations.

dwelling. Since households that pay high mortgage installments (higher than imputed rents) are more likely to be rich as they can borrow for shorter periods, the subtraction of the installment can be misleading as it would cause a downward re-ranking. The implicit assumption is therefore made that for those households that buy a house and have a debt, the imputed rent of owner-occupied dwellings equals the mortgage installment, so that we can omit them when we calculate expenditures for social ranking purposes.

### 2.2. *Household-Specific Price Indexes for the Descriptive Analysis*

Since CPI and HES give a non-homogenous classification of commodities, it is necessary to match each consumption item in HES with its own price index in CPI (details are given in the Appendix). This procedure yields an outcome in which 145 commodities are attached to the corresponding price indexes in the period 1997–99 and 147 commodities are associated with the same number of price indexes, in the period 2000–07. This homogeneous basket over time allows one to calculate, for each year, household-specific price indexes $P^h = \sum_i \omega_i^h p_i$, where $\omega_i^h = \frac{x_i^h}{X^h}$ is the expenditure share of each good on the total household expenditures $X^h$, and $p_i$ is the price of the $i$-th commodity. Preliminary summary information on the path of household-specific inflation rates can be obtained by taking their annual average across households. This average can have either a *democratic* or a *plutocratic* nature (see Prais (1959), and more recently, Ley (2002, 2005), for a description). The democratic (D) method requires one to calculate the average Household Price Index (HPI) as $HPI^D = H^{-1}\sum_h \sum_i \omega_i^h p_i = H^{-1}\sum_h P^h$, where $H$ is the total number of households. The democratic price index $HPI^D$ is therefore the unweighted average of household-specific price indexes.

Using the plutocratic (P) method, instead, implies that household-specific price indexes can be weighted by the contribution of each household on total expenditure in the economy. In symbols: $HPI^P = X^{-1}\sum_h x^h \sum_i \omega_i^h p_i = X^{-1}\sum_h x^h P^h$. Unlike in the previous case, here household-specific price indexes will be "heavier" in the calculation of the mean when they belong to households with a relatively higher shares of total expenditure.

Using these two alternative methods, one can compare the path of the estimated HPI with the official CPI calculated by Istat for the total population. The two series may diverge for two main reasons: first, HES does not include all consumption items on which CPI is calculated (for some goods matching is not possible); and second, the weighting structure of CPI is based on data from the National Accounting System, while our HPI is based on weights from households' actual consumption (Chelli *et al*., 2009). CPI is therefore expected to deviate from the calculated HPI for both reasons.

Table 1 shows the difference between the weighting structures of CPI and HPI for 22 homogeneous groups of goods. As can easily be seen, CPI weights either underestimate or overestimate actual consumption shares with some large

TABLE 1
CPI Weights, HES Weights and Difference, Average 1997–2007

| | CPI Weights (%) | HES Weights (%) | Difference (CPI-HES) |
|---|---|---|---|
| Beverages | 1.63 | 2.50 | –0.87 |
| Clothes and shoes | 10.15 | 8.25 | 1.90 |
| Communications | 2.72 | 3.30 | –0.58 |
| Household services | 1.78 | 0.80 | 0.98 |
| Education | 1.25 | 0.93 | 0.33 |
| Entertainment and culture | 7.64 | 6.64 | 1.00 |
| Food | 15.56 | 27.96 | –12.40 |
| Food away from home | 7.80 | 3.60 | 4.20 |
| Furnishing and other articles | 2.51 | 2.23 | 0.28 |
| Fuels | 4.71 | 7.07 | –2.35 |
| Health | 7.45 | 5.64 | 1.81 |
| Home durable goods | 0.93 | 0.39 | 0.54 |
| Home services and maintenance | 7.97 | 13.30 | –5.33 |
| Small elettric equipment and home accessories | 1.04 | 0.78 | 0.26 |
| Other expenditures on vehicles | 4.94 | 2.49 | 2.45 |
| Personal care | 2.81 | 3.80 | –0.99 |
| Personal items | 1.86 | 0.52 | 1.35 |
| Public transport | 1.86 | 1.02 | 0.85 |
| Tobacco | 1.92 | 1.24 | 0.68 |
| Transport services | 2.90 | 1.69 | 1.21 |
| Vehicles | 4.07 | 1.30 | 2.77 |
| Others | 6.49 | 4.58 | 1.92 |
| Totals | 100.0 | 100.0 | 0.0 |

*Source*: Authors' calculations, based on HES and CPI data.

differences (the negative and positive signs in the third column). Three striking examples of underestimation are *food*, *fuels*, and *home services and maintenance* (respectively: 15.6 against 28 percent; 4.7 against 7.1; and 8.0 against 13.3). Some examples of overestimation are instead *vehicles, clothes and shoes*, *restaurants*, *transport services*, and *health*. Figure 1 gives a partial account of this difference (as it also includes the difference deriving from the different extensions of the two datasets). It emerges that CPI always underestimates $HPI^D$ and $HPI^P$, with a progressively cumulative wider deviation eventually amounting to about 5 percentage points. This deviation implies that while the average CPI rate is 2.2 percent, either the democratic or the plutocratic price index estimated on HES is 2.6 percent on average.[5]

In what follows and considering the narrow average gap between the estimated plutocratic and democratic indexes, $HPI^D$ will be taken as the standard average measure of inflation for the descriptive analysis, if not differently stated. For simplicity of notation, the superscript will be dropped, and the democratic price index will be denoted simply by *HPI*.

[5]It is also worth noting that the plutocratic method can either underestimate or overestimate inflation measured with the democratic method. The two methods can therefore affect the results for groups of households in different ways. On average, the difference is usually small, but as shown by Chelli *et al*. (2009), the gap can be quantitatively more important for specific categories of households. Hobijn and Lagakos (2005), however, state that differences between plutocratic and democratic indexes seem negligible. See also Kokoski (2000) and Izquierdo *et al*. (2002) for Spain.

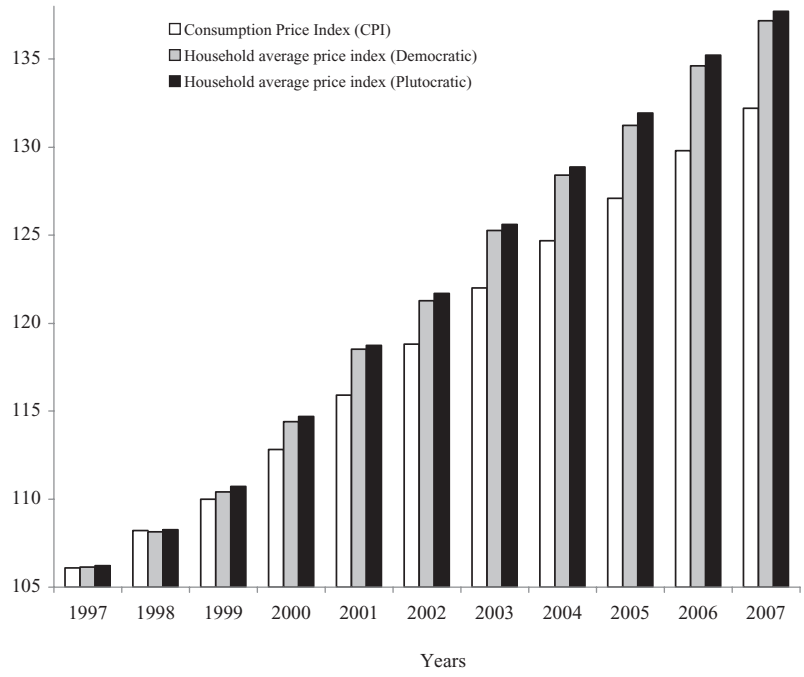



Figure 1. Official and Estimated Price Index, 1995 = 100

*Source*: Authors' calculations, based on CPI and HES.

### 2.3. *A Methodology for the Welfare Analysis*

Household-specific inflation rates convey information on the "inflation tax" borne by each household, but do not distinguish between the loss of real consumption caused by the general inflation rate and the loss imputable to changes of relative prices. In principle, if all prices increased by the same percentage, the "inflation tax" would be fully identified by the general inflation rate, as relative prices would stay constant. Conversely, if real expenditures were kept constant, the burden of inflation would be uniquely identified by changes in relative prices. Most commonly, the "inflation tax" is the product of an interaction between the two.

From a welfare perspective, this commonly implies that any change in welfare will be determined by the sum of two changes (Newbery, 1995). The first is the welfare change originated by variations of real expenditure by keeping real relative prices constant. The second is instead the welfare change attributable to a change of relative prices when real expenditure is kept constant. By defining the relative price as $\pi_i = \frac{p_i}{P^*}$, where $p_i$ is the price of the $i$-th good and $P^*$ is the general price index, one can write:

$$\Delta W = (W(\mathbf{Y}_t, \pi_t) - W(\mathbf{Y}_{t-1}, \pi_t)) + (W(\mathbf{Y}_{t-1}, \pi_t) - W(\mathbf{Y}_{t-1}, \pi_{t-1}))$$

where $W$ is welfare, $\mathbf{Y}$ is the vector of real expenditure, and $\pi$ is the vector of relative prices. This expression allows one to translate the descriptive concept of

"inflation tax" to the normative concept of social welfare changes, once steps to make the previous expression operational are made.

The easiest way to deal with this issue is to make recourse to the theoretical framework proposed by Newbery (1995) and applied to indirect tax changes by Liberati (2001), and to deal with inflation as a sequence of small price changes. In this case, a first-order approximation can be used to derive the sign of the welfare change caused by commodity-specific inflation rates over the period analyzed.

In order to develop this idea, one must pay the price of assuming that government ranks distributional outcomes according to a utilitarian social welfare function, which in its most general form can be represented by:

$$W = W\left(v^1, v^2, \ldots, v^h, \ldots, v^H\right), \tag{1}$$

where $v^h = v^h(y^h, \mathbf{p})$ is the indirect utility function of a generic agent $h$, $y$ is income, and $\mathbf{p}$ is the consumer price vector. From equation (1), the impact of a price change on social welfare can easily be derived as:

$$\frac{\partial W}{\partial p_i} = \sum_h \frac{\partial W}{\partial v^h}\frac{\partial v^h}{\partial p_i} = -\sum_h \beta^h x_i^h, \tag{2}$$

where $\beta^h \equiv \frac{\partial W}{\partial v^h}\frac{\partial v^h}{\partial y^h}$ is the social weight attached to an increase of the income of individual $h$, and the last part of equation (2) is obtained by making use of the Roy identity. It is worth noting that, at this stage, $\beta^h$ implicitly depends on income and prices, as it depends on the full specification of $v^h$. An alternative way of expressing (2) is to use the *distributional characteristic* of the good ($\phi$) (Feldstein, 1972). This indicator gives information on the distribution of consumption across individuals and it is expressed by:

$$\phi_i = \frac{\sum_h \beta^h x_i^h}{\bar{\beta} X_i}, \tag{3}$$

where $\bar{\beta}$ is the average social weight and $X_i = \sum_h x_i^h$ is total consumption of the $i$-th good. As the numerator of (3) is equivalent to the impact of a price change on social welfare (expression (2)), the combination of the two expressions gives rise to:

$$\frac{\partial W}{\partial p_i} = -\bar{\beta}\phi_i X_i. \tag{4}$$

It can easily be seen that under the assumption that individuals have the same social weight ( $\beta^h = \bar{\beta}$ for each $h$), the distributional characteristic would be equal to one, and the change in social welfare will only depend on the level of consumption. Alternatively, if all individuals consume the same amount of good $x_i^h = \bar{x}_i$ for each $h$, the distributional characteristic will again be equal to 1. Expressions (3) and (4) require a method to calculate social weights. Following Newbery (1995), one can assume $\beta^h = (y^h)^{-\rho}$, where $\rho$ is the coefficient of inequality

aversion (a greater $\rho$ implies a greater inequality aversion).[6] This assumption implies price-independent welfare weights and this may depart from the analytic specification. Also, it may be justified in the context of a first-order approximation but not when a second-order approximation of the welfare change is introduced.

The application of (1) to (4) quantifies $\Delta W$ without disentangling the impact of real income changes and relative price changes. By assuming that money incomes vary proportionally to the general price index (i.e., real incomes are kept constant), the impact of changes in relative prices can be isolated. The advantage of this approach is that $\Delta W$ has now the convenient interpretation of measuring the differential impact of differentiated price changes with respect to a hypothetical benchmark of a proportional increase of all prices. Analytically, this amounts to measure $\Delta W = W(\mathbf{Y}_{t-1}, \pi_t) - W(\mathbf{Y}_{t-1}, \pi_{t-1})$, as by assumption $\mathbf{Y}_t = \mathbf{Y}_{t-1}$ for every period.

A straightforward way to implement this analysis is to calculate a *real relative price* (RRP) change starting from the above definition of relative prices:

$$\pi_i = \frac{p_i}{HPI}, \tag{5}$$

where HPI is the estimated general price index.[7] After a price change, the new relative price of each good will be defined by:

$$\pi_i^* = \frac{p_i^*}{HPI^*}, \tag{6}$$

where $p_i^*$ is the new consumer price and $HPI^*$ is the new general price index with fixed weights referring to the base period.[8] The real relative price change (in every period) can therefore be defined as $\Delta\pi_i = \pi_i^* - \pi_i$.

This framework helps clarify in what sense a proportional increase of all prices represents a benchmark case for welfare analysis. Given $\pi_i$ and assuming that the price of a given good grows as the general inflation rate, $\pi_i^*$ in (6) will also

[6]In the practical application, welfare weights will be calculated using equivalent household expenditures.

[7]HPI is our estimation of $P^*$ in the previous definition of $\pi_i$. Also in this case, the calculation of *HPI*, i.e. the weighted average of individual prices, can in principle be either plutocratic or democratic. Using $HPI^P = X^{-1}\sum_h x^h P^h$ and $P^h = \sum_i \omega_i^h p_i$ the plutocratic index can be defined as $HPI^P = \sum_i \sum_h \frac{x_i^h}{X} p_i = \sum_i \omega_i p_i$ (which is the version used in Newbery (1995), Liberati (2001), and in this paper), where $\omega_i = \frac{x_i}{X}$ is the aggregate share of each good in total expenditures. The democratic scheme, instead, would require $HPI^D = H^{-1}\sum_h P^h$ (i.e., the average of the household-specific price indexes). Using again the definition of $P^h$, $HPI^D = H^{-1}\sum_i \sum_h \omega_i^h p_i = \sum_i \bar{\omega}_i p_i$, where $\bar{\omega}_i = H^{-1}\sum_h \omega_i^h$ is the average budget share of good *i* across households. See, for example, Hobijn and Lagakos (2005). The difference between the democratic and the plutocratic price index is therefore here characterized by the different budget share used to weight individual prices. In the plutocratic case, the relevant variable is the *aggregate* budget share. In the democratic case, the relevant variable is the *average of household-specific* budget shares.

[8]Technically, a Laspeyres index.

be equal to $\pi_i$ so $\Delta\pi_i = 0$. This means that the price of that good does not contribute to additional welfare gains or losses other than those caused by the general inflation rate.

If the price of the good grows less than *HPI*, $\pi_i^* < \pi_i$ and $\Delta\pi_i < 0$. By consuming that good, one has a relative gain compared with the case in which the price would have increased as the *HPI*. On the contrary, if the price grows more than the general price index, $\pi_i^* > \pi_i$ and $\Delta\pi_i > 0$.

The last step is to link RRPs to the welfare analysis. Using the indirect utility function and exploiting its homogeneity of degree zero in nominal prices and money income/expenditures, one can replace its arguments by dividing all prices and money income/expenditures for the general price index *HPI* to obtain the following:

$$v^h = v^h\left(Y^h, \pi\right), \tag{7}$$

where $Y$ is households' real income/expenditures. Accordingly, social welfare in (1) may be expressed as a function of these transformed indirect utility functions. Using (2) and (3) and generalizing expression (4) to multiple price changes give rise to the following operational formula for welfare analysis:

$$\Delta W = W(\mathbf{Y}_{t-1}, \pi_t) - W(\mathbf{Y}_{t-1}, \pi_{t-1}) = -\bar{\beta}\sum_i \phi_i X_i \Delta\pi_i. \tag{8}$$

Expression (8) clarifies the essence of the welfare analysis, as it quantifies whether inflation has produced any welfare change under the assumption that real consumption is kept constant. If all prices had changed in the same way as the general price index, all $\Delta\pi_i$ would have been equal to zero and the welfare change would have also been zero. When prices change more or less proportionally than the general price index, a redistribution of purchasing power would occur.[9] In other words, each non-zero value of (8) can be interpreted as the gain or loss of differentiated price changes compared with the benchmark case in which all prices would have grown in the same proportion.

Expression (8) can be further elaborated as a proportional change in welfare, i.e. $\Delta W / W$. For small changes of prices, $W$ is the initial level of welfare characterized by the base level of real relative prices. In symbols, $W = \bar{\beta}\sum_i \phi_i X_i \pi_i$. By dividing both $\Delta W$ and $W$ by total expenditures $X$, one can get the following expression:

$$\frac{\Delta W}{W} = -\frac{\sum_i \phi_i \omega_i \Delta\pi_i}{\sum_i \phi_i \omega_i \pi_i} = -\frac{\sum_i \phi_i \omega_i \Delta\pi_i}{\sum_i \phi_i \omega_i}, \tag{9}$$

where the last term in (9) holds if all relative prices in the base year are normalized to one.

[9]In particular, if a price grows less than the general price index, $\Delta\pi_i < 0$ and $\Delta W > 0$. The opposite occurs when a price grows more than the general price index. The algebraic sum of gains and losses across households gives the total impact on social welfare for the society as a whole.

Finally, the use of (9) gives the opportunity to find sufficient conditions for a positive change in welfare, an approach that has been developed by Yitzhaki and Thirsk (1990), Yitzhaki and Slemrod (1991), and Mayshar and Yitzhaki (1995), and is known as *marginal dominance*. In particular, Mayshar and Yitzhaki (1995) relax some usual assumptions required for welfare comparisons, providing an alternative to the welfarist method—which requires the specification of a social welfare function (Deaton, 1977; King, 1981; Ahmad and Stern, 1991)—ensuring a greater practical guidance in identifying welfare increasing (and hence desirable) changes.[10] The main goal of this approach is to unhook the welfare judgment from the choice of a specific social welfare function (and welfare weights) and to find sufficient conditions for unanimous welfare prescriptions according to a wide class of inequality-averse social welfare functions (SWF). The pre-conditions for the implementation of this approach are two. The first is the agreement on an observable indicator of well-being (such as equivalent consumption) according to which households can be socially ranked. The second (relatively more demanding) is to assume that welfare weights are non-negative and non-increasing for every degree of inequality aversion along the household ranking. This assumption, although requiring an agreement on the social marginal value of each household (which can be hard to reach), is less demanding than the specification of a complete SWF.

Focusing on the numerator of (9), and using $\omega_i = \frac{X_i}{X}$ and the definition of the distributional characteristic in (3), one can write $\Delta W = -X^{-1}\sum_h \beta^h \sum_i x_i^h \Delta\pi_i$. Now, define $dB^h = -\sum_i x_i^h \Delta\pi_i$. Then, $\Delta W = -X^{-1}\sum_h \beta^h dB^h$. Since $\beta^h$ are social weights assumed to be non-increasing with equivalent expenditures, a sufficient condition for $\Delta W \geq 0$ is $\sum_{k=1}^{h} dB^k \geq 0$ for $h = 1, \ldots, H$. It means that by progressively cumulating the changes attached to every household over a welfare rank, the non-negativity of the cumulated sum over the whole range would unambiguously identify a social welfare improvement regardless of the specific social weights. This approach can be interpreted as a generalization of the welfare analysis whose advantage is to provide additional information on the distribution of welfare gains and losses among households. For this purpose, it will be used later in the paper to complement the basic welfare analysis.

## 3. Empirical Findings: A Descriptive Approach

### 3.1. *Heterogeneity of Prices and Consumption*

The two fundamental determinants of the heterogeneity of HPI across households are different inflation rates among commodities and different households'

[10]This method is particularly fruitful if compared with the Pareto criterion (used, for instance, in Ahmad and Stern, 1984), often being too demanding and frequently producing no solution to welfare comparisons (especially in the presence of a high number of households and commodity heterogeneity). This happens because the Pareto criterion provides every individual in society with the veto power of blocking the reform.

consumption patterns. With all commodities experiencing the same price changes, all households would experience the same inflation rate, whatever their consumption bundle. In the same vein, if all households had the same consumption behavior, they would also have the same inflation rate, regardless of commodity-specific inflation rates. Different household-specific inflation rates must therefore be the outcome of both heterogeneous price increases among commodities *and* heterogeneous consumption bundles across households.

How these two factors combine in Italy in the period 1997–2007 is therefore a matter of interest. Following Hobijn and Lagakos (2005), *heterogeneity of consumption* can be captured by performing an analysis of variance (ANOVA) of consumption shares. Analytically, the total variance ($s^2$) is given by $s^2 = (H)\sum_{t=1}^{T}\sum_{h=1}^{h_t}(\omega_{hit} - \omega_{it})^2 + (H)\sum_{t=1}^{T} h_t(\omega_{it} - \omega_{i\cdot})^2$, where $T$ is the number of periods considered, $h_t$ is the number of households in year $t$, $H = \left(\sum_{t=1}^{T} h_t\right)^{-1}$, and $\omega_i$ is the consumption share of good $i$ ($\omega_{it}$ indicates average budget shares across households, $\omega_{i\cdot}$ the average across households and periods). The first term on the right hand side gives the *within-period* variance, measuring the importance of variations of budget shares across households. The second term on the same side, instead, gives the *between-period* variance, capturing the importance of fluctuations of households' *average* budget shares over time. The *heterogeneity of price increases*, instead, is captured by the distribution of annual prices of all commodities.

Table 2 shows the outcome for the same groups of goods reported in Table 1. Columns A and B refer to the *within*-variance and the *between*-variance, respectively. As expected, the *within-period* variance of shares is the main factor that explains the total variance, as it greatly outweighs the *between-period* variance for all groups of goods (both multiplied by $10^4$). In other words, consumption shares do not vary very much across periods; the largest variations are for *clothes and shoes*, *entertainment and culture*, *food*, *health*, and *home services and maintenance*. But they significantly vary among households, with very few exceptions. With regard to the *heterogeneity of prices*, there are two main findings to underline. First, the average inflation rate is widely differentiated among items. One has about 5 percent for *tobacco* and 3 percent for a series of goods (*fuels*, *transport services*, and *other items*); at the same time, *communications* have experienced an average decrease of 3.3 percent. Second, inflation rates themselves have a non-negligible fluctuation across years, as the estimated standard deviation shows. This also means that relative prices move significantly over time. These fluctuations are best appreciated in Table 3, reporting commodity-specific inflation rates for the same goods now ranked in a decreasing order of the cumulative price increase between 1997 and 2007. Fluctuations are particularly evident for *tobacco*, *transport services*, *fuels*, *public transports*, *food*, and *personal items*.[11] It will prove useful later in the paper to take into account that *fuels* (containing *gasoline* as the

[11]It is worth noting that *tobacco* and *fuels*, in Italy, are heavily taxed. Price increases can therefore reflect different tax policies across years.

TABLE 2
HETEROGENEITY OF EXPENDITURES AND PRICES

| | Heterogeneity of Expenditures Shares | | Heterogeneity of Prices | |
|---|---|---|---|---|
| | Within* A | Between* B | Average C | Standard Deviation D |
| Beverages | 6.6 | 0.002 | 1.8 | 1.041 |
| Clothes and shoes | 95.4 | 0.104 | 2.2 | 0.618 |
| Communications | 8.0 | 0.009 | –3.3 | 2.640 |
| Household services | 20.7 | 0.024 | 2.7 | 0.780 |
| Education | 1.9 | 0.001 | 2.6 | 0.428 |
| Entertainment and culture | 36.4 | 0.184 | 1.5 | 1.172 |
| Food | 190.5 | 0.156 | 1.8 | 1.543 |
| Food away from home | 32.9 | 0.015 | 2.9 | 0.722 |
| Furnishing and other articles | 5.0 | 0.003 | 2.0 | 0.278 |
| Fuels | 45.4 | 0.021 | 3.4 | 5.508 |
| Health | 120.3 | 0.193 | 1.8 | 0.813 |
| Home durable goods | 0.7 | 0.003 | 0.2 | 0.222 |
| Home services and maintenance | 139.3 | 0.189 | 3.1 | 1.701 |
| Small elettric equipment and home accessories | 3.5 | 0.001 | 1.9 | 0.682 |
| Other expenditures on vehicles | 3.5 | 0.003 | 3.8 | 1.288 |
| Personal care | 20.2 | 0.007 | 2.0 | 0.491 |
| Personal items | 1.8 | 0.003 | 3.0 | 2.724 |
| Public transport | 12.5 | 0.006 | 2.8 | 3.426 |
| Tobacco | 6.7 | 0.008 | 5.0 | 3.181 |
| Transport services | 66.2 | 0.008 | 3.0 | 0.637 |
| Vehicles | 25.0 | 0.015 | 1.6 | 0.943 |

*Note*: *Multiplied by $10^4$.
*Source*: Authors' calculations, based on HES data.

commodity with the highest share) have experienced two large price reductions in 2001 and 2002 (giving a –1.1 percent in 2001–03) around the entrance of Italy in the Euro area, but large price increases (on average) in other years, giving rise to a cumulative positive 39.5 percent (the highest cumulative price increase being *tobacco* with 63.4 percent).

### 3.2. *Aggregating Heterogeneity*

The previous analysis points toward a potentially wide dispersion of household-specific inflation rates. Heterogeneity of consumption shares is high (Table 2) and the variance of prices is also non-negligible (Table 3). The overall outcome of these two concomitant features is summarized in Figure 2 (with base 1995 = 100), reporting the kernel density estimation of household-specific $P^h$ in 2007 resulting from the interaction of *heterogeneity of consumption* and *heterogeneity of price increases*. Actual changes of HPI have caused some households to have a cumulative price index either well below or well above the average, as can be inferred by comparing the density with the hypothetical level of the price index (129.4) had all households faced the same cumulative inflation rates in the period.

TABLE 3

COMMODITY-SPECIFIC INFLATION RATES

| | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | A 97–07 | B 98–00 | C 01–03 | D 04–07 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tobacco | 5.51 | 2.09 | 1.10 | 2.67 | 1.87 | 8.29 | 9.86 | 8.91 | 6.27 | 4.22 | 63.4 | 2.9 | 4.2 | 9.5 |
| Other expenditures on vehicles | 4.48 | 4.24 | 4.82 | 5.27 | 5.20 | 4.41 | 3.14 | 2.27 | 2.45 | 1.77 | 45.2 | 4.5 | 5.0 | 3.5 |
| Fuels | –2.86 | 4.40 | 12.99 | –2.19 | –2.77 | 1.73 | 5.91 | 10.21 | 6.70 | 1.06 | 39.5 | 4.6 | –1.1 | 6.4 |
| Home services and maintenance | 2.08 | 2.79 | 5.82 | 2.54 | 0.48 | 3.42 | 2.18 | 4.27 | 5.73 | 2.05 | 36.0 | 3.5 | 2.1 | 4.4 |
| Personal items | –0.80 | 3.49 | 1.49 | 2.56 | 2.86 | 1.84 | 1.71 | 2.16 | 6.82 | 8.60 | 34.9 | 1.4 | 2.4 | 5.3 |
| Transport services | 2.33 | 2.23 | 2.42 | 2.92 | 3.07 | 3.86 | 3.76 | 2.57 | 3.10 | 3.87 | 34.5 | 2.3 | 3.3 | 4.3 |
| Food away from home | 2.30 | 2.01 | 2.63 | 3.27 | 4.28 | 3.78 | 3.32 | 2.53 | 2.32 | 2.85 | 33.4 | 2.3 | 3.8 | 3.7 |
| Public transport | 0.30 | –2.08 | 1.25 | 3.34 | 4.23 | 2.53 | 6.41 | 9.99 | 2.18 | 0.39 | 31.8 | –0.2 | 3.4 | 5.3 |
| Household services | 2.42 | 2.70 | 2.74 | 1.21 | 2.71 | 3.02 | 3.31 | 2.72 | 1.99 | 4.19 | 30.5 | 2.6 | 2.3 | 3.8 |
| Education | 2.21 | 1.93 | 2.41 | 3.03 | 2.85 | 2.82 | 2.28 | 3.29 | 2.56 | 2.21 | 28.7 | 2.2 | 2.9 | 3.3 |
| Clotes and shoes | 2.63 | 2.15 | 2.13 | 2.85 | 2.88 | 2.92 | 2.17 | 1.59 | 1.25 | 1.45 | 24.3 | 2.3 | 2.9 | 2.3 |
| Personal care | 2.44 | 1.55 | 2.07 | 2.29 | 2.85 | 2.43 | 2.21 | 1.52 | 1.34 | 1.71 | 22.4 | 2.0 | 2.5 | 2.3 |
| Furnishing and other articles | 2.20 | 1.33 | 2.00 | 2.19 | 1.95 | 2.02 | 2.35 | 2.23 | 1.99 | 2.08 | 22.3 | 1.8 | 2.1 | 2.7 |
| Small elettric equipment and home accessories | 1.97 | 2.10 | 1.85 | 2.35 | 2.18 | 2.72 | 2.07 | 0.13 | 1.85 | 1.75 | 20.7 | 2.0 | 2.4 | 2.1 |
| Health | 2.47 | 2.49 | 2.78 | 2.36 | 2.29 | 1.27 | 1.90 | 0.28 | 0.84 | 1.70 | 19.9 | 2.6 | 2.0 | 1.5 |
| Beverages | 2.34 | 0.01 | 1.24 | 2.76 | 2.53 | 3.21 | 2.64 | 0.72 | 1.17 | 1.31 | 19.4 | 1.2 | 2.8 | 2.3 |
| Food | –0.23 | 1.03 | 0.64 | 1.61 | 4.23 | 3.71 | 3.28 | 1.97 | –0.09 | 1.83 | 19.4 | 0.5 | 3.2 | 2.7 |
| Vehicles | 2.81 | 0.71 | 2.00 | 1.87 | 2.66 | 1.40 | –0.36 | 2.06 | 1.46 | 1.07 | 16.8 | 1.8 | 2.0 | 1.4 |
| Entertainment and culture | 1.40 | 2.21 | –0.28 | 2.91 | 3.23 | 1.80 | 1.91 | 0.87 | 1.62 | –0.25 | 16.5 | 1.1 | 2.6 | 1.5 |
| Home durable goods | 0.49 | 0.33 | 0.06 | 0.32 | 0.41 | 0.48 | 0.27 | –0.13 | –0.08 | 0.32 | 2.5 | 0.3 | 0.4 | 0.2 |
| Communications | 0.60 | –1.78 | –3.63 | –2.09 | –1.39 | –1.73 | –6.39 | –4.59 | –3.45 | –8.43 | –28.7 | –1.6 | –1.7 | –6.1 |
| CPI | 1.99 | 1.66 | 2.55 | 2.75 | 2.50 | 2.69 | 2.21 | 1.92 | 2.12 | 1.85 | 24.6 | 2.1 | 2.6 | 2.7 |

*Note*: CPI is the official price index.
*Source*: Authors' calculations, based on HES data.

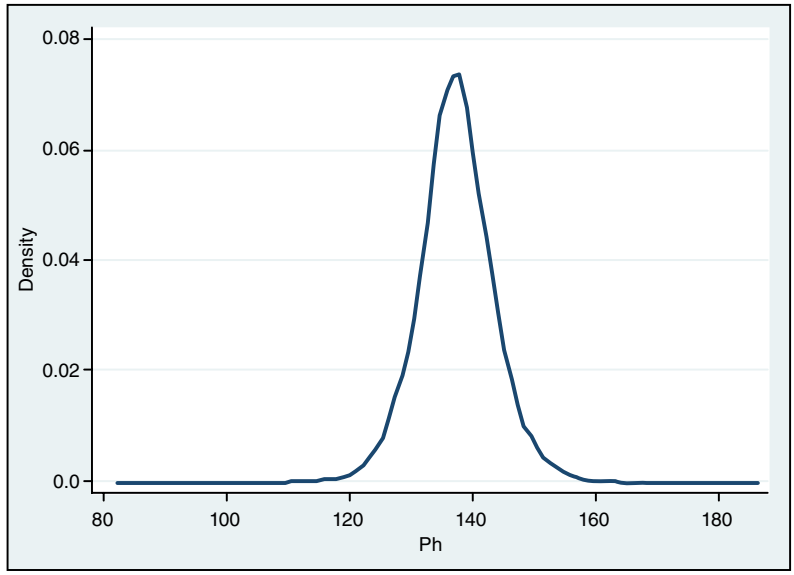



Figure 2. The Distribution of Household-Specific Price Indexes
*Source*: Authors' calculations, based on HES.

Table 4 aggregates this information by deciles of equivalent expenditures and for each year, by converting price indexes into decile-specific inflation rates.[12] Over the period (column A on the far right) there is evidence that inflation has been slightly faster (on average) for the first three and the tenth deciles, while households "in the middle" have experienced lower than average inflation rates in almost any year. Restricting the observation to the lowest and to the highest deciles, there is nevertheless weak evidence that inflation has differentially affected them compared to the most *representative households* of central deciles. Years in which both experience a higher HPI are to some extent compensated by years in which they are associated with a lower HPI.

Rather than across deciles, there is a much stronger evidence that inflation has differentially impacted over time. This information is usefully summarized by grouping years as reported in columns B to D in the bottom panel of Table 4 (1998–2000; 2001–03; 2004–07), broadly corresponding to the *pre-Euro*, the *around*

[12]Many authors argue that equivalent expenditures are a good indicator of well-being and a proxy for permanent income (e.g., Deaton and Muellbauer, 1980). This measure is the most exploited in empirical studies dealing with inequality and distributional issues. Here, the equivalence scale used for the estimation of HPI has coefficient 1 for the first adult, 0.7 for other adults, and 0.5 for children. The use of equivalent expenditures as a proxy of permanent income has also required distribution of the purchase of durable goods in either a five-year or a three-year period regardless of the period in which they have been purchased. The ranking by equivalent expenditures, therefore, includes the flow of expenditures generated by durable goods under the hypotheses made. In what follows the term "expenditure" will be used interchangeably with the term "income."

TABLE 4

Decile-Specific Inflation Rates and Cash Losses, by Deciles of Equivalent Expenditures

| Decile | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 98–07 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | A |
| 1 | 2.2 | 1.9 | 3.4 | 4.1 | 2.2 | 3.6 | 2.4 | 1.7 | 2.8 | 2.5 | 30.3 |
| 2 | 1.9 | 2.0 | 3.8 | 3.9 | 2.1 | 3.4 | 2.5 | 2.0 | 2.7 | 1.9 | 29.5 |
| 3 | 1.9 | 2.0 | 3.8 | 3.5 | 2.3 | 3.6 | 2.3 | 2.2 | 2.6 | 1.9 | 29.3 |
| 4 | 1.8 | 2.2 | 3.7 | 3.6 | 2.2 | 3.5 | 2.4 | 2.3 | 2.7 | 1.6 | 29.0 |
| 5 | 1.7 | 2.2 | 3.6 | 3.5 | 2.5 | 3.1 | 2.6 | 2.2 | 2.7 | 1.8 | 29.2 |
| 6 | 1.8 | 2.0 | 3.7 | 3.5 | 2.2 | 3.3 | 2.6 | 2.2 | 2.6 | 1.8 | 28.9 |
| 7 | 1.9 | 2.0 | 3.5 | 3.7 | 2.3 | 3.3 | 2.4 | 2.2 | 2.6 | 1.8 | 28.9 |
| 8 | 1.9 | 2.1 | 3.6 | 3.4 | 2.5 | 3.1 | 2.5 | 2.3 | 2.3 | 2.0 | 28.8 |
| 9 | 1.9 | 2.2 | 3.5 | 3.5 | 2.3 | 3.1 | 2.6 | 2.4 | 2.5 | 1.9 | 29.1 |
| 10 | 1.7 | 2.4 | 3.5 | 3.3 | 2.6 | 3.0 | 2.7 | 2.4 | 2.4 | 1.8 | 29.3 |
| HPI (*) | 1.9 | 2.1 | 3.6 | 3.6 | 2.3 | 3.3 | 2.5 | 2.2 | 2.6 | 1.9 | 29.2 |

| | Average Change | | | EACL (Euros) | | | ECL/TE | | |
|---|---|---|---|---|---|---|---|---|---|
| Decile | 98–00 | 01–03 | 04–07 | 98–00 | 01–03 | 04–07 | 98–00 | 01–03 | 04–07 |
| | B | C | D | E | F | G | H | I | L |
| 1 | 2.48 | 3.32 | 2.36 | 17.5 | 23.8 | 23.8 | 2.82 | 3.52 | 3.07 |
| 2 | 2.58 | 3.11 | 2.28 | 22.5 | 31.0 | 30.6 | 2.71 | 3.49 | 3.04 |
| 3 | 2.55 | 3.14 | 2.24 | 26.2 | 35.4 | 34.5 | 2.69 | 3.44 | 3.03 |
| 4 | 2.54 | 3.10 | 2.23 | 30.0 | 39.5 | 38.8 | 2.71 | 3.43 | 3.03 |
| 5 | 2.51 | 3.05 | 2.31 | 32.5 | 43.4 | 42.5 | 2.69 | 3.40 | 3.02 |
| 6 | 2.52 | 3.01 | 2.28 | 36.4 | 47.9 | 46.4 | 2.70 | 3.39 | 3.02 |
| 7 | 2.47 | 3.08 | 2.26 | 39.8 | 52.9 | 51.8 | 2.66 | 3.38 | 3.00 |
| 8 | 2.53 | 2.97 | 2.28 | 45.6 | 60.3 | 56.4 | 2.69 | 3.38 | 2.99 |
| 9 | 2.52 | 3.00 | 2.33 | 52.5 | 70.0 | 66.8 | 2.69 | 3.42 | 3.04 |
| 10 | 2.54 | 2.99 | 2.36 | 70.8 | 100.2 | 95.3 | 2.66 | 3.50 | 3.12 |
| HPI (*) | 2.53 | 3.08 | 2.29 | 37.4 | 50.4 | 48.7 | 2.70 | 3.43 | 3.04 |

*Notes*: *HPI is the estimated price index.

EACL, estimated monthly average cash loss; ECL, estimated monthly cash loss; TE, total expenditure.

*Source*: Authors' calculations, based on HES data.

*Euro*, and the *post-Euro* periods.[13] Period-average inflation rates show higher figures in 2001–03; despite the downward pressure exerted by 2002, the peak is now particularly evident and heavy for households in the first decile, with an average inflation rate of 0.84 and of 0.97 percentage points higher than, respectively, in the previous sub-period and in the following sub-period; a difference that is not traceable in other deciles for any of the other sub-periods.

To some extent, the peak (and its particular location in the first decile) would give preliminary support to the widespread perception that inflation accelerated when the lira was abandoned and that this acceleration has been more heavily perceived by low-income households. This latter information is best addressed by

[13]The group 1998–2000 means that inflation has been measured by inflation estimated in 1998 using 1997 as a base year, in 1999 using 1998 as a base year, and in 2000 using 1999 as a base year. The other periods follows the same scheme. This division has been centered on the period *around Euro*, which includes the year before the introduction, to capture anticipations of price movements due to the announcement effect, the year of introduction, and the year after the introduction, to capture lags in price changes.

first computing the *inflation tax* as the average monthly cash loss (columns E, F, and G) and then converting it into percentages of the total expenditures within each decile (columns H, I, and L).[14] As expected, *absolute* cash losses are increasing across deciles in all sub-periods (spending more gives larger absolute losses). These losses are again higher in 2001–03 for all deciles, with the first decile being the only case not experiencing an absolute reduction of the loss in 2004–07. More qualified information on the relative burden of this cash loss can be obtained in the last three columns, where absolute values are normalized on total expenditures of each decile. With the exception of the first sub-period, the average burden tends to be higher in the lowest three and in the last decile; and higher for all deciles in 2001–03. To some extent, the path would support a rather regressive impact of inflation, which is likely to be strengthened if the denominator were "income" and not "total expenditures" (assuming savings are an increasing share of total income when income grows).

The peak occurring in 2001–03 is also visible in Table 5, where estimated HPI by household types (singles; couples with no children; couples with one, two, and three or more children; single parents) are reported. These typologies represent more than 94 percent of all households in the sample in all years, that gives comparable information to the previous one. It is worth noting that households with children are likely to bear higher inflation rates in all sub-periods, even though this is again particularly true in 2001–03. This is indirect evidence that the basket of goods typically consumed by larger households is systematically associated with larger price increases, with the further feature that the introduction of the Euro currency may have exacerbated this impact. Furthermore, increasing the number of children in a household is not likely to systematically reduce the measured inflation, a signal that either economies of scale in rearing babies are small or that prices increase more for non-recyclable goods for children (e.g., food).

Finally, of particular relevance for Italy, it is worth considering how inflation rates vary across territorial areas (North, Centre, South, and Islands). While territorially differentiated across years, inflation rates do not have a clear geographical path. There are years where the North experiences a faster inflation (1998, 2002, 2005) and other years in which this is true for the South and the Islands (not reported in table). Even though the cumulative impact is slightly higher in the North (29.5 percent), the distribution of inflation rates does not always imply an additional burden on those regions.[15]

[14]Similarly to a tax, inflation reduces consumption. Thus, we can interpret each household-specific inflation rate equivalent to a tax rate ($t$) on expenditures, originating an absolute tax of $T$. In a general perspective, for the $h$-th household, the amount of tax is the difference between nominal and real consumption, i.e. $T^h = y_t^h - \frac{y_t^h}{P^h} = y_t^h\left(\frac{P^h - 1}{P^h}\right)$. The overall tax loss for all households would therefore be given by $IT = \sum_h T^h$. It is also worth noting, at this stage, that we consider the inflation tax borne by households in their position of consumers. This implies neglecting the production side, i.e. to disregard whether the household is a net producer of some commodities (for which data are not available, as Istat aggregates auto-consumption with market purchases) and therefore how a price variation may affect its profits. However, since this practice is negligible, results should not be largely affected.

[15]Differences between North and South are more traceable when looking at the *level* of prices rather than to their *variation*.

TABLE 5

INFLATION RATES BY HOUSEHOLD TYPE

| Household Type | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 97–07 | 98–00 | 01–03 | 04–07 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | A | B | C | D |
| Single | 1.7 | 1.7 | 3.2 | 3.5 | 2.0 | 3.2 | 2.5 | 2.0 | 2.7 | 1.9 | 27.2 | 1.7 | 3.0 | 2.3 |
| Couple no children | 1.8 | 2.1 | 3.7 | 3.6 | 2.2 | 3.3 | 2.4 | 2.3 | 2.5 | 1.9 | 29.1 | 2.0 | 3.2 | 2.3 |
| Couple with children | 2.0 | 2.3 | 3.9 | 3.6 | 2.5 | 3.4 | 2.6 | 2.4 | 2.5 | 1.9 | 30.6 | 2.1 | 3.4 | 2.3 |
| - 1 child | 2.0 | 2.3 | 4.0 | 3.6 | 2.6 | 3.3 | 2.6 | 2.4 | 2.4 | 1.9 | 30.6 | 2.1 | 3.4 | 2.3 |
| - 2 children | 1.9 | 2.3 | 3.8 | 3.6 | 2.5 | 3.5 | 2.6 | 2.4 | 2.5 | 1.9 | 30.6 | 2.1 | 3.3 | 2.4 |
| - 3+ children | 1.9 | 2.2 | 3.8 | 3.7 | 2.3 | 3.8 | 2.4 | 2.1 | 3.0 | 1.8 | 30.4 | 2.1 | 3.4 | 2.3 |
| Single parent | 1.9 | 2.2 | 3.5 | 3.7 | 2.4 | 3.2 | 2.7 | 2.1 | 2.8 | 1.9 | 29.8 | 2.1 | 3.2 | 2.4 |
| % of households | 96.4 | 96.5 | 96.7 | 96.5 | 94.2 | 94.1 | 94.7 | 94.4 | 94.7 | 94.7 | | | | |

*Source*: Authors' calculations, based on HES data.

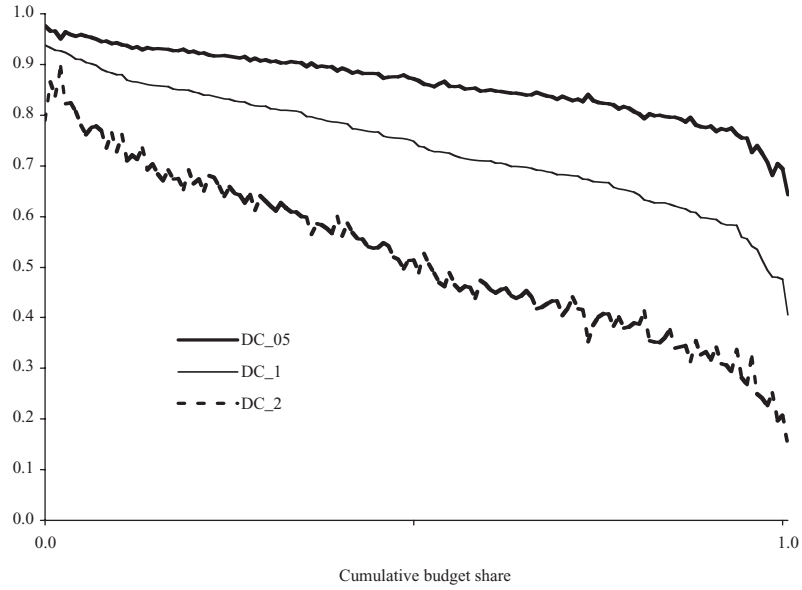



Figure 3. Distributional Characteristics of Goods, 2007
*Source*: Authors' calculations, based on HES.

## 4. Empirical Findings: A Welfare Perspective

### 4.1. *Comparing Distributional Characteristics*

The distributional characteristic ($\phi$) in (9) is one factor affecting the welfare change induced by real relative price changes. Some preliminary details on the impact of inflation on welfare can therefore be gained by looking at its values across goods. Figure 3 reports the path of $\phi$ (see formula (3)) for 2007 (the latest available year) of all goods for three levels of inequality aversion ($\rho = 0.5$, $\rho = 1$, and $\rho = 2$) and plotted against the cumulative budget share of the same goods (ranked by decreasing level at $\rho = 1$).[16]

If the distributional characteristics were all the same for all goods, the graph would be a horizontal straight line. Thus, the decreasing path observed for various degree of inequality aversion means that different commodities are differently consumed by different households. The higher the degree of inequality aversion used, the steeper is the curve in Figure 3, which signals that commodities consumed mainly by richer households deserve less relevance from a social welfare perspective.[17] In Figure 3, one can also identify that the ranking of goods may change when the degree of inequality aversion is changed, and this especially occurs at $\rho = 2$, as represented by the non-monotonic segments of the graph.

Welfare changes over a large time span, however, can also be sensitive to changes of ranking over time. To this purpose, by comparing the ranking of the distributional characteristics in the two extreme years of the analysis (1997 and

[16]To calculate $\phi$, a normalization of social weights has been chosen, such that $\bar{\beta} = 1$.
[17]Distributional-insensitive social weights can be easily obtained by setting $\rho = 0$.

2007) for the same degree of inequality aversion $\rho = 2$, it has been found that although the position of some commodities has widely changed over time, the overall shape of the distribution remains remarkably unchanged (the correlation between distributional characteristics at $\rho = 2$ in 1997 and 2007 is 0.96). It is therefore likely that the goods potentially causing large welfare impacts in 1997 are not greatly different from those causing large welfare impacts in 2007.

Finally, the size of the welfare change depends on whether RRP changes are positively correlated with distributional characteristics. In the positive case, one could expect a negative impact of inflation, as higher prices would impact on commodities consumed mostly by poorer households. The opposite would hold if RRP changes would be negatively correlated with distributional characteristics. Using again 1997 and 2007 (not reported in Figure 3), it is found that the two variables have hardly any correlation ($R^2 = 0.0026$ in 2007 and $R^2 = -0.0012$ in 2007), as high and low RRP changes are associated to both high and low distributional characteristics (almost the same occurs in other years). Hence, the impact of inflation is not yet clearly interpretable in distributive terms; moving toward a welfare analysis could therefore improve our knowledge.

### 4.2. *Welfare Changes*

Since the methodology discussed in Section 2 performs better if small changes in prices are evaluated, the strategy has been that of measuring the welfare impact in every two consecutive years of the period. As we will see below, this method will assure that the price changes analyzed are consistent with a first-order approximation. Each welfare impact of a given year is measured for three levels of inequality aversion (0.5, 1, and 2), taking as a base the prices of the previous year.

The top panel of Table 6 shows the results, reporting the proportional changes in welfare estimated according to formula (9). Consider first the case where all goods are included (columns A, B, and C). The changes occurred in 1998, 2001, 2003, 2006, and 2007 are all characterized by a welfare decreasing impact of RRP changes for all levels of inequality aversion. In all cases, the welfare loss is also increasing with the degree of inequality aversion, implying that the adverse distributional impact is more significant if households in the lowest part of the expenditure distribution are weighted more. Positive welfare changes instead emerge for all other years (with the exception of 2000 where the sign depends on the degree of inequality aversion). The general outcome is that welfare changes do not follow a systematic path over years, as they alternate positive and negative signs, and that sub-periods with homogeneous paths are hardly found over the last decade.

Yet, it is worth focusing on the period 2001–03, i.e. the period around the introduction of the Euro. Within this period, two welfare losses occur (in 2001 and 2003) countervailed by a welfare gain in 2002, which is exactly the year in which the lira was abandoned (definitively in March) and the Euro introduced (since January). Quite interestingly, this latter positive welfare change is of a comparable magnitude to the two negative changes (relatively less with $\rho = 2$). A natural question to investigate is therefore whether something happened in 2002 (when the Euro has been introduced) that did not happen in the previous and in the following

TABLE 6
WELFARE CHANGES

(A) Total Population

| Years | | | Inequality Aversion | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | All Goods | | | Without Gasoline and Gas | | |
| Final | Initial | Baseline | 0.5 | 1 | 2 | 0.5 | 1 | 2 |
| 1998 | 1997 | 1997 | –0.013 | –0.036 | –0.137 | | | |
| 1999 | 1998 | 1998 | 0.005 | 0.008 | 0.008 | | | |
| 2000 | 1999 | 1999 | –0.013 | –0.017 | 0.025 | | | |
| 2001 | 2000 | 2000 | –0.026 | –0.052 | –0.100 | –0.336 | –0.369 | –0.398 |
| 2002 | 2001 | 2001 | 0.047 | 0.085 | 0.141 | –0.603 | –0.571 | –0.497 |
| 2003 | 2002 | 2002 | –0.016 | –0.034 | –0.074 | –0.051 | –0.071 | –0.110 |
| 2004 | 2003 | 2003 | 0.052 | 0.094 | 0.161 | | | |
| 2005 | 2004 | 2004 | 0.022 | 0.045 | 0.102 | | | |
| 2006 | 2005 | 2005 | –0.043 | –0.082 | –0.156 | | | |
| 2007 | 2006 | 2006 | –0.003 | –0.012 | –0.055 | | | |
| 2007 | 1997 | 1997 | 0.028 | 0.027 | –0.045 | 0.717 | 0.724 | 0.628 |
| 2007 | 1997 | 2007 | –0.045 | –0.119 | –0.337 | 0.506 | 0.432 | 0.177 |

(B) Population with Equivalent Expenditures Below 50 Percent of the Median

| Years | | | Inequality Aversion | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | All Goods | | | Without Gasoline and Gas | | |
| Final | Initial | Baseline | 0.5 | 1 | 2 | 0.5 | 1 | 2 |
| 1998 | 1997 | 1997 | –0.343 | –0.375 | –0.472 | | | |
| 1999 | 1998 | 1998 | –0.002 | –0.003 | –0.010 | | | |
| 2000 | 1999 | 1999 | 0.050 | 0.065 | 0.172 | | | |
| 2001 | 2000 | 2000 | –0.177 | –0.180 | –0.167 | –0.465 | –0.452 | –0.385 |
| 2002 | 2001 | 2001 | 0.180 | 0.183 | 0.195 | –0.392 | –0.379 | –0.336 |
| 2003 | 2002 | 2002 | –0.145 | –0.147 | –0.153 | –0.179 | –0.178 | –0.177 |
| 2004 | 2003 | 2003 | 0.253 | 0.253 | 0.255 | | | |
| 2005 | 2004 | 2004 | 0.189 | 0.201 | 0.227 | | | |
| 2006 | 2005 | 2005 | –0.246 | –0.252 | –0.269 | | | |
| 2007 | 2006 | 2006 | –0.122 | –0.135 | –0.171 | | | |

*Note*: All values are on a monthly basis multiplied by 100.
*Source*: Authors' calculations, based on HES data.

year. This means that we need to test whether the result of 2002 is robust to the exclusion of some appropriately selected commodities.

Since we deal with 147 goods, it is worth having some *a priori* on which goods may have significantly affected the size of the positive welfare change of 2002; natural candidates are those goods having the average highest share in total consumption. Given the distribution of aggregate budget shares in 2002, those above the 95th percentile are *gasoline* (6.85 percent), *rents* (3.56 percent), *gas* (3.04 percent), *transport insurance* (3.68 percent), *food away from home* (2.87 percent), and *women's clothes* (3.04 percent). Among them, one must therefore select those goods where a negative real relative price change prevails (this is a sufficient condition to originate a welfare gain) in order to verify whether their exclusion reverts the result. This narrows our selection to *gasoline*, *gas*, *rents*, and *women's clothes*. All other goods have experienced a positive relative price change, which

means that they participate in the total positive change of 2002 and cannot therefore reverse it.

In particular, the highest relative price reductions are for *gas* (–0.076) and for *gasoline* (–0.049), while *rents* and *women's clothes* experience a much lower reduction (–0.0018 and –0.0017, respectively). By replicating the welfare analysis for 2002, excluding these two latter goods does not indeed change the sign of the welfare change; by excluding either *gas* or *gasoline*, the sign is reversed. This implies that individually taken, the exclusion of either of the two is able to neutralize the welfare gain which emerged in 2002. In order to exclude that those same goods may also have affected the previous and the following years, we test the welfare analysis without *gasoline* and *gas* in 2001 and 2003, as in those years *gas* experienced an increase of the real relative price, while the relative price of *gasoline* still shows a negative sign.

Columns D, E, and F of the top panel of Table 6 show the results for the three years in which the analysis has been replicated.[18] As can easily be seen, by excluding those two goods, the sign of the welfare change in 2002 is dramatically reversed, with a large welfare loss appearing, even larger than that associated with 2001 and 2003 in both cases. This gives some evidence that—without *gasoline* and *gas*—the movement of other relative prices was particularly adverse when the Euro was introduced in 2002. Alternatively, the wide positive impact of *gasoline* and *gas* in 2002 may be characterized as an anomaly, as in these years both relative prices show a negative sign (the corresponding prices grew less than inflation), an event that does not occur either in 2001 or in 2003. This result strongly qualifies the empirical evidence that in 2002, inflation in Italy was slightly higher for the rich (Giraldo and Trivellato, 2003; Baldini, 2005). In fact, welfare changes with *all goods* are consistent with these findings, yet welfare changes without *gas* and *gasoline* now clarify that the positive impact must be due to higher negative changes of both relative prices in that year.

The extension of a negative effect in 2003 might also be explained by the fact that in the first two months of 2002, the Euro and the old lira were both legal currencies, with the lira definitively dismissed in March 2002. It is therefore likely that the largest price increases, in 2002, may have occurred in the second part of the year and therefore be fully realized at the end of 2003. This impression is supported by the fact that the measured inflation in January 2002 over January 2001 was an average 2.4 percent, while the same rate measured in December 2002 over the same month of the previous year was 2.8 on average. The wide perception of a negative impact of inflation immediately after the introduction of the Euro currency (2002–03) seems therefore to find some justification in the data.

In order to capture how this effect has impacted on the poorest households, the previous framework has also been adjusted to accommodate a poverty analysis. This would help better locate the position of the welfare change. For comparability of results, the method used is consistent with the social welfare theoretical

[18]The analysis has in fact been replicated in all years. There are no cases (but the 2002 under discussion) where a positive welfare change obtained when considering *all goods* (1999, 2004, and 2005) has been reversed when excluding *gas* and *gasoline*. There are instead two cases (2000 and 2006) where a negative welfare change emerges with *all goods* (in 2000 only for $\rho = 0.5$ and $\rho = 1$) that is reversed when excluding *gas* and *gasoline*.

model and it has been implemented by setting $\beta^h = 0$ for all households above the poverty line (assumed equal to 50 percent of the median equivalent expenditures) instead of using the usual poverty measures. The bottom panel of Table 6 (reporting the total welfare impact and the welfare impact without *gasoline* and *gas* for 2001 to 2003) shows that the sequence of the signs does not change significantly (the only difference being the inversion of the signs in 1999—where the welfare change is now very close to zero from below—and 2000). The exclusion of *gasoline* and *gas*, as before, also reverses the sign of the welfare impact in 2002, and reveals that the two goods are not only important for *total* welfare but also for the living conditions of the poorest households.[19]

### 4.3. *The Marginal Dominance Analysis*

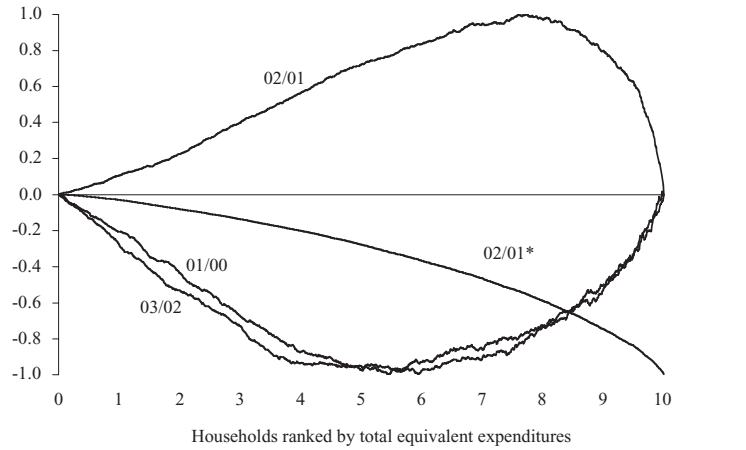
Under a general perspective, *gasoline* and *gas* may therefore command particular attention to understand the distributional impact of inflation, especially when large relative price variations are associated with their high consumption shares (exactly what happened in 2002). Yet, the synthetic indicator used in Table 6 may conceal both information on the distribution of welfare changes across households and a dependence on the exact specification of welfare weights. In order to overcome both issues, the previous analysis may be complemented by a marginal dominance approach. As discussed in Section 2, this approach allows one to derive sufficient conditions for welfare improvements on the whole relevant interval that are robust to the choice of different functional forms for welfare weights, irrespective of their dependence on both prices and income. When an RRP change is considered, the sufficient condition $\sum_{k=1}^{h} dB^k \geq 0$ for $h = 1, \ldots, H$ is checked. This amounts to checking that the positive (negative) marginal benefit of an additional household with lower social weight is always greater (lower) than the net negative (positive) cumulated benefits of all former households in the social rank. The failure of the sufficient condition for some $h$ implies a more demanding structure of social norms, i.e. a detailed specification of households' social weights.[20]

By construction of RRP changes and by expression (8), our application of the marginal dominance implies that $\sum_{h=1}^{H} dB^h = 0$, i.e. society as a whole does not lose or gain by RRP changes. Yet, RRP changes may cause redistribution of purchasing power, with the counterfactual being represented by a distributionally-neutral impact of proportional increases of all prices.

Figure 4 illustrates the outcome of the marginal dominance calculated as a sequence of RRP changes in each year. The figure has three panels, corresponding to the sub-periods defined in Section 1. In all graphs, cumulated changes are normalized with respect to the absolute value of the maximum observed cumulated

[19]As before, the analysis has been replicated in all years and the only significant changes in sign are in 1999 and 2006 (excluding 2002).

[20]To some extent, the marginal dominance has a link with the Dalton (1920) principle of transfers, according to which a given income transfer from a richer to a poorer household would diminish inequality.

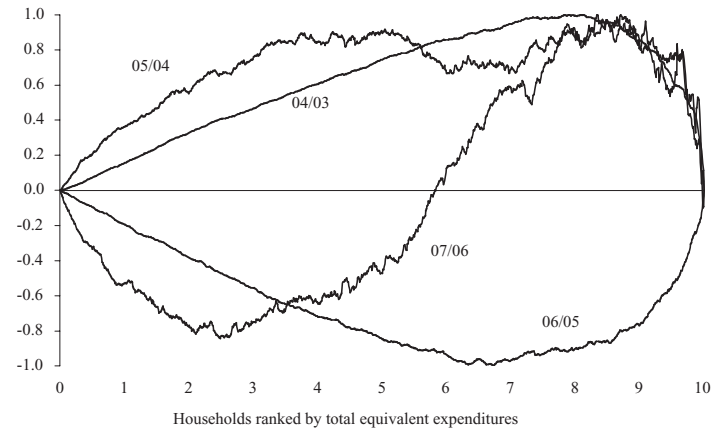




Figure 4. Marginal Dominance

*Source*: Authors' calculations, based on HES.

change, the reason why the scale of the graph extends from –1 to +1. This implies that the relevant information from the graph is the shape and the position of the lines (either in the positive or the negative quadrant) and not their relative heights.

The top graph shows the outcome in the first sub-period (1998–2000). In all cases, the sufficient conditions for a welfare improving change are not verified, as the cumulated sums cross the horizontal axis at some point in all years. This implies that the corresponding results in Table 6 might be welfare-weights-dependent. However, the change which occurred in 1998 (over 1997) is widely negative for the poorest households (compared to the others), as households until the 3rd decile cumulate losses that are not fully compensated until the 7th decile is achieved. In 2000, instead, the poorest households cumulate some gains that are rapidly exhausted at the 2nd decile. Overall, this sub-period is strongly characterized by different value judgments, as not all inequality-averse social welfare functions would provide the same outcome. To some extent, the information drawn by the marginal dominance analysis is therefore much less clear than that originating by Table 6 looking at synthetic welfare changes.

The central graph of Figure 4, instead, clearly depicts the situation surrounding the entrance of Italy into the Euro area (2001–03). The negativity of the curves in 2001 and 2003 provides a sufficient condition for a welfare decrease in both years; while the positive shape of 2002 gives a sufficient condition for a welfare improvement (02/01 in the graph). This outcome strongly confirms the results emerging in Table 6 for 2003 and 2001, by extending both the negative and the positive welfare impacts to a larger class of social welfare functions.

A natural issue to address is therefore whether excluding again *gasoline* and *gas* is a sufficient condition for turning a welfare gain into a welfare loss. The answer is positive. While in 2001 and 2003 (not reported in the graph), the exclusion of *gas* and *gasoline* does not reverse the negative impact, the result drastically changes in 2002. The corresponding curve now lies entirely on the negative quadrant (02/01*); the sequence of welfare losses is pronounced, rather uniform and widespread across all households, confirming the result of Table 6.[21]

It is worth noting that, in 2002 and 2001, netting data by the welfare gains produced by favorable RRP changes of *gasoline* and *gas*, there are no households having any welfare gain originating from the other changes of relative prices, while in 2003 some gains occur at the very top of the expenditure distribution. To some extent, the burden of inflation appears now more widespread in Figure 4 (02/01*) than how it appeared in Table 6, which is the advantage of performing a marginal dominance analysis. This would at least partially explain why the poorest households but also those belonging to the middle deciles may have perceived a rather heavy burden of inflation immediately after the introduction of the Euro.[22]

Finally, the bottom graph shows the most recent welfare performance of inflation (2004–07). In this case, a negative welfare impact is traceable only in 2006,

[21]Note that the cumulated curve without *gas* and *gasoline* does not go back to zero, as it is built by assuming what would have happened if households had not consumed those goods, taking all relative prices constant.

[22]It is worth noting that in the central year (2002), the sign of the welfare change also reverses if either only gasoline or only gas is excluded (not reported in the graph), something that does not happen in 2001 and 2003.

while the poorest households appear to be hit also in 2007 (with the line crossing around the 6th decile). In this case, only the most inequality-averse social welfare functions would classify 2007 as a welfare decreasing change. The other two changes (2004 and 2005) are positive and satisfy sufficient conditions for welfare improvements.

### 4.4. *The Sequential Marginal Dominance*

A further step can be made to distinguish which household types have either suffered or benefited most from price changes, while at the same time checking whether some crossing in the welfare analysis emerges by additionally considering household groups ranked by an indicator of needs.

To this purpose, one can make recourse to a *sequential dominance approach*, by which an additional variable of social judgment (besides income/expenditures) is introduced, extending the Lorenz dominance criterion to a two-dimensional space (Atkinson and Bourguignon, 1982, 1987; Jenkins and Lambert, 1993). This approach has been extended to a *marginal sequential dominance* by Mayshar and Yitzhaki (1996).

The main idea is that households may be ranked according to an indicator of needs (such as household size) that allows their ordinal ranking. In this setting, less able and needier households are assigned a greater welfare weight, and considered more deserving of an income transfer. In the standard marginal dominance approach, these two dimensions usually collapse into the equivalent income (or expenditure). With the sequential approach, a set of sufficient conditions for welfare improving can instead be derived by considering $\sum_{h \in H(\bar{y},\bar{s})} dB^h \geq 0$, where $H(\bar{y},\bar{s}) = \{h | y^h \leq \bar{y}, s^h \geq \bar{s}\}, \forall \bar{y}, \forall \bar{s}$, where $y$ is household expenditure and $s$ is an indicator of needs. The previous formula indicates that dominance is checked by sequentially adding households with a level of expenditure not greater than $\bar{y}$ and with a level of needs not lower than $\bar{s}$. In this framework, and consistently with the standard dominance analysis of the previous paragraph, we still identify needs by household size. It is however worth noting that while in the standard dominance analysis household size is directly embodied into the equivalence scale (and into equivalent expenditures), in the sequential approach total expenditures and household size can be taken into account *separately*. Thus, in this framework, the sequential dominance approach would allow one to skip the controversial issue of equivalence scales. To this purpose, households have been split into six groups: more than five members; more than four (therefore including previous households); more than three; more than two; more than one; and singles. As required by this approach, dominance conditions are then sequentially checked after ranking households by *total* expenditures rather than by *equivalent* expenditures. As before, non-negativity of the resulting curve would imply a welfare-improving RRP change, while the opposite would hold in the presence of a negative dominance.

In line with the previous analysis, Figure 5 contains three graphs corresponding to the three sub-periods for larger households (three or more members).[23] Some

[23]Results for other groups are available upon request, but do not change the interpretation given in the text.

*Households with more than three members*

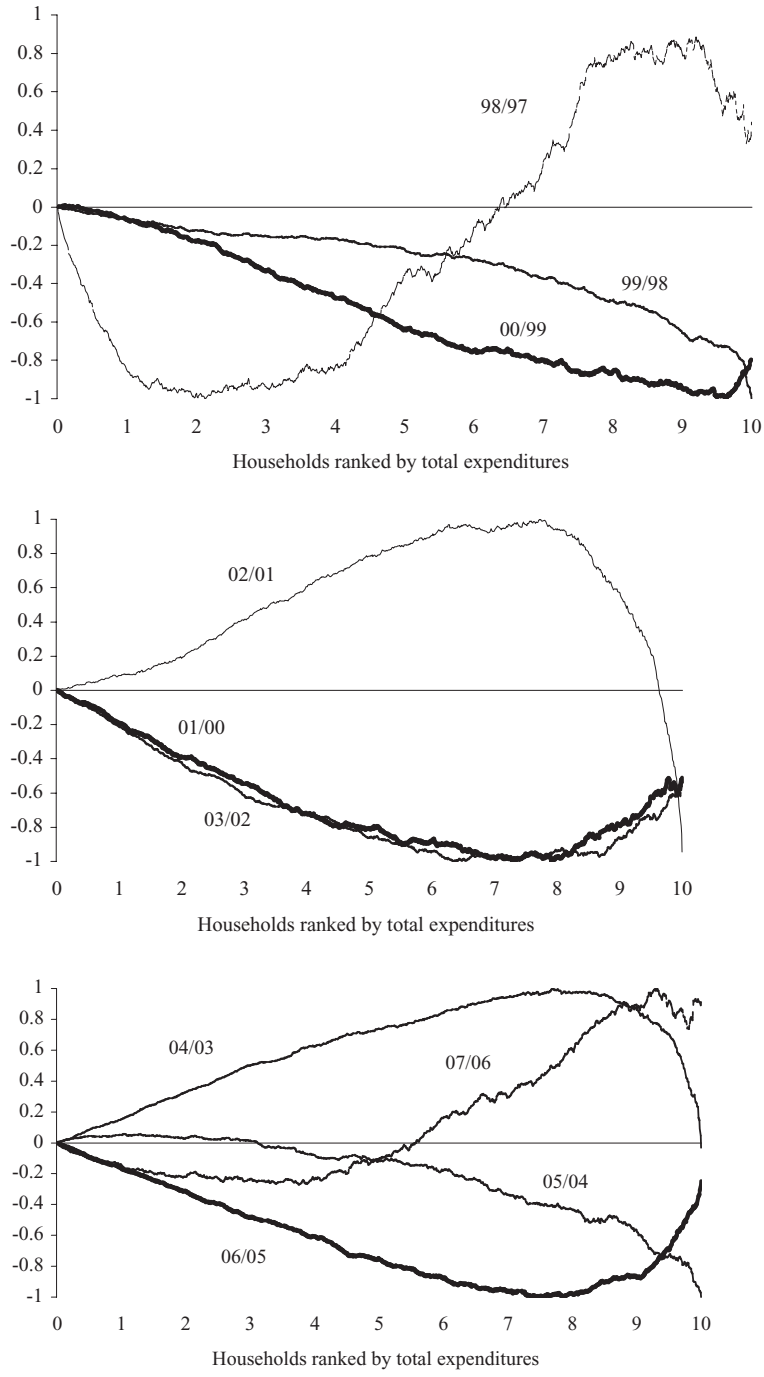



Figure 5. Sequential Marginal Dominance; Households with More than Three Members
*Source*: Authors' calculations, based on HES.

important insights for the welfare analysis emerge. In the top graph, for example, it is shown that in both 1999 and 2000, the impact of inflation is unequivocally negative for larger households (it was not for *all* households in Figure 4). Thus, it must be that the positive welfare impact attributable to *all* households mainly derives from welfare gains attached to singles and households with two members (mainly couples without children). Whether this is a desirable distributive result is a matter of general debate; however, the sequential approach assumes that larger households (with children) are thought to be the neediest ones.[24]

In the central graph, some issues can also be highlighted. While the negative dominance obtained for the total number of households in 2001 and 2003 is strengthened when the attention is confined to larger households, the sufficient condition for welfare improving of 2002 is slightly violated at the very top of the expenditure distribution (implying that social welfare functions strongly inclined to inequality neutrality may not positively evaluate this welfare change). It also implies that the overall positive welfare impact of the price change which occurred in 2002 has interested larger and relatively poorer households, with households from about the 7th decile onwards cumulating welfare losses, eventually originating a crossing at the 9th decile. Overall, the result obtained when considering *all* households appears robust. But also in this case, by excluding *gas* and *gasoline*, the sign of the welfare change is reversed (not reported in the graph), confirming that these two goods are not only important for the poorest households as a whole, but particularly important for *poorer* and *larger* households, a qualification that now characterizes 2001, 2002, and 2003.

Finally, the bottom graph of Figure 5 also introduces some amendments to the general conclusions obtained in Figure 4. In particular, the price change which occurred in 2005 is not now unanimously agreed by all social welfare functions when considering larger households. As a whole, this group of households experience a welfare loss, again signaling that the bulk of welfare gains must be concentrated on singles and small households (two members). Thus, the sequential marginal dominance helps qualify that welfare losses are more likely concentrated, over years, among poorer and larger households, while welfare gains are more likely concentrated among singles and smaller households.

### 4.5. *A Long-Run Perspective*

An aggregate synthesis of our findings can be implemented by widening the perspective of the marginal dominance analysis. To this purpose, along the lines of the welfare analysis of Section 2, one can simply compare the outcome of the dominance by considering the whole period 1997–2007. The obvious method would be to use either a Laspeyres-based or a Paasche-based marginal dominance. However, since both methods are based on the consideration of two points in time only (and since especially the Laspeyres index loses efficiency when the final year is far distant from the initial one), both aggregations would disregard the information on consumption patterns *within* the end points. To remedy this

[24]It is also worth comparing this information with the outcome of Table 6. There, 1999 was welfare-improving, while in Figure 4 it was not unanimously agreed. Now (Figure 6), a welfare loss is unanimously agreed for larger households.

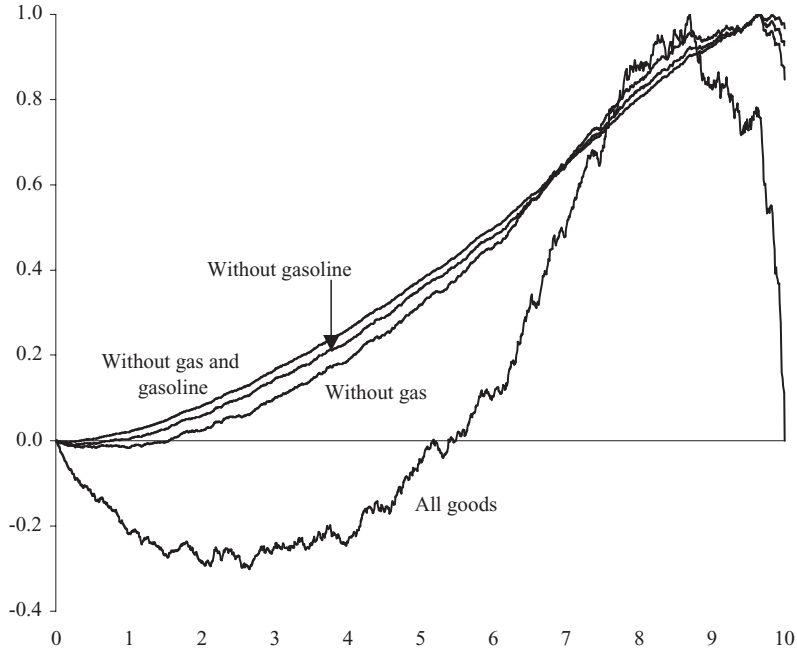



Figure 6. The Cumulative Impact of Inflation

*Source*: Authors' calculations, based on HES.

shortcoming, the marginal dominance approach can be roughly adapted to *cumulate* the whole sequence of yearly changes calculated in the previous section, by algebraically summing all changes for households at the same point in the social ranking over the years and then cumulating the aggregate changes over all households.[25]

This method amounts to use the sequence of $\Delta\pi_i = (\pi_i^t - \pi_i^{t-1})$ with weights $\omega_i^{t-1}$, where $t$ is the final year of the period considered. In this case, however, we first calculate $\theta^h = \sum_t dB_t^h$ and then their cumulated sum, then checking whether $\sum_{k=1}^{h} \theta^k \geq 0$ for $h = 1, \ldots, H$, which is the standard marginal dominance requirement.

Figure 6 shows the results by including the cumulative changes considering all goods and excluding *gasoline* and *gas* (one at a time and both together), reporting normalized values of the welfare changes on the *y*-axis. Remarkably, when considering the *cumulative* change including *all* goods, the curve crosses the *x*-axis (from below) at around the 5th decile. Since the slope of the curve gives the marginal welfare change for each household, this path implies that both the

[25]As the HES does not include a panel, we cannot follow the same households over time. Hence, to approximate this outcome, we need to sum welfare changes for different households at the same point of the social ranking for the various years.

poorest and the richest households have the largest losses from inflation, while middle-income households seem to have better succeeded in protecting themselves from inflation. Overall, the distributional impact of inflation over the last decade is rather uncertain and only the most inequality-averse social welfare functions would record this path as a welfare loss for the society as a whole.

A natural issue to investigate is whether *gasoline* and *gas* can still play a role in shaping this overall judgment. This requires one to compare the previous outcome with the welfare change obtained by alternatively excluding *gasoline* and *gas* (or both). The nearest curve to the $x$-axis excludes *gas*; the nearest one just above it excludes *gasoline* and the curve at the top excludes both. Consider first the exclusion of *gas*. The curve is now much closer to the $x$-axis, yet a negative cumulated welfare loss emerges until around the 15th percentile. This implies that *gas* has had a high distributionally adverse impact over the whole period, as when included the losses extend until the 5th decile.

Almost the same can actually be said of *gasoline*; its exclusion makes the curve even closer to the $x$-axis, with a cumulated welfare loss now confined below the 5th percentile. The impacts of *gasoline* and *gas* are therefore qualitatively very similar and also comparable in size.[26] When excluding both, the cumulative welfare change lies entirely on the positive quadrant, signaling a cumulative welfare gain for all households but the richest ones. This means that, cumulatively observed, *total* welfare changes (net of those imputable to *gasoline* and *gas*) in the last decade would have caused a favorable redistribution of purchasing power. Unfortunately, the burden imposed by *gasoline* and *gas* is particularly heavy (in aggregate over the decade) for the poorest households, generating a cumulative increasing welfare loss until the 3rd decile that is not compensated until the 5th and nevertheless their favorable impact in some of the years analyzed (e.g., 2002).

This means that what happened in 2002 can be considered an anomaly. Measured on the whole period, price changes associated to *gas* and *gasoline* strongly shape the welfare loss (without them, this loss turns to be a gain); while the reduction of their relative prices in 2002 generated an *occasional* large welfare gain corresponding to the introduction of the Euro. This is even truer if one takes into account, as already described above, that in 2002 *gasoline* and *gas* cumulated two reductions of real relative prices, while in 2001 and 2003 the reduction of the real relative price of *gasoline* was associated with an increase in the relative price of *gas*. The occasional nature of this event might explain why inflation was perceived heavy and particularly penalizing. But while the negative impact which emerged in the *around-Euro* period seems to be gradually cushioned in the following years, the impression still remains that *gasoline* and *gas* are two commodities of extreme importance for the lowest part of the income distribution.

Furthermore, it is worth recalling that *gasoline* is a highly taxed good, that *gas* has a highly regulated price, and that both have a higher consumption share and a relatively high distributional characteristic ($\phi$). With regard to this last issue, *gas* and *gasoline* have a comparable $\phi$ in 2007 (0.655 and 0.602 at $\rho = 2$, respectively), but while *gasoline* had a higher $\phi$ (0.785) in 1997, *gas* had a lower $\phi$ (0.560). By the

[26]This latter effect has been verified by using a non-normalized version of Figure 6 (not reported in the text).

definition of $\phi$, the consumption of *gas* has therefore become more concentrated on the poorest households, while the opposite has occurred with *gasoline*. It implies that over the period (and *ceteris paribus*), changes of RRP associated with *gas* were likely to have a higher impact on the welfare change than those associated with *gasoline*.

The policy implication of the analysis is therefore rather strong. Most of the negative impact of inflation over the last decade could have been mitigated by relaxing taxes on gasoline and by strengthening the regulation of gas tariffs to cushion periods of increasing international prices. Of course, such policies cannot disregard that gasoline taxes have both a positive revenue and environmental impact (reducing them in principle reduces both) and that lower taxes on gasoline should be compensated elsewhere (with additional distortions). In the same vein, increasing international prices on the gas market have to be passed through the regulated tariffs at least partially. This prevents the regulator from excessively compressing the profit margins to the benefit of consumers when production prices increase. Yet, the prices of both gas and gasoline need to be carefully monitored.

### 4.6. *Sensitivity of the First-Order Approximation*

Expression (9) is a first order approximation of the welfare change that does not take into account substitution possibilities. For example, ignoring that the consumption of a good whose price is increased can be replaced by the consumption of another substitute good implies that the first order approximation may overestimate the negative impact of the price increase.

In order to learn something about the magnitude of the error, it is worth comparing the differences between the first- and the second-order approximations. Following Ray (1999), and again exploiting the homogeneity of degree zero of the indirect utility function, one can show that when a second-order approximation is considered, the welfare change caused by a variation of the relative price of good *i* is given by:

$$\Delta W_i^S = -\sum_h \beta^h x_i^h \Delta\pi_i \left[ 1 + \frac{\Delta\pi_i}{2\pi_i} \left( \frac{\partial \ln \beta^h}{\partial \ln \pi_i} + \eta_{ii}^h \right) \right], \tag{10}$$

where the first term in the round brackets is the elasticity of households' welfare weights with respect to relative prices, the second term is households' own price elasticities of each good, and $\Delta W_i^S$ denotes that the welfare change due to a variation of the relative price of good *i* is now approximated at the second order. It is thus clear from (10) that the calculation of the second-order approximation introduces at least two additional problems. The first is the dependency of welfare weights on prices; the second is the knowledge of how every individual household reacts to price variations of every good ($\eta_{ii}^h$).

In principle, the solution to both problems entails the estimation of a complete demand system (e.g., Almost Ideal Demand Systems, Linear Expenditure Systems, or the more informative Quadratic Almost Ideal Demand Systems). But the number of goods for which households' elasticities can be empirically derived is usually small, given the large number of parameters to be estimated when the

number of goods increases (ranging from four to six in many applied works). To overcome estimation problems, commodities are usually grouped in broad aggregates (e.g., food, clothing, transport, services). This implies that a second-order approximation may prevent analysis of, say, the welfare impact of an increase in the price of "bread" and force one to approximate it by the welfare impact of an increase in the price of "food." However, it is well known that when estimating an elasticity for an elementary good, it is likely that the elasticity will be higher because a good may have a large number of substitutes. Instead, when estimating the elasticity of a *group* of goods (e.g., food), it is likely that the elasticity will be lower. The size of the estimated elasticity will therefore depend on the breadth of the definition of a good. Introducing a second-order approximation with aggregate elasticities will therefore introduce errors of unknown order when assessing the impact of a price change of elementary goods in the group, even though it tries to remedy the insufficiency of the first-order approximation to take into account substitution possibilities.[27]

Thus, even though more theoretically founded, the second-order approximation is less useful to extract information from complex price movements of more narrowly defined commodities; it also introduces errors on the magnitude of the substitution possibilities. There is therefore a trade-off: more detail on the impact of price movements may require the use of a first-order approximation with a loss of precision on the welfare impact; more detail on households' reactions may imply a loss of precision on the policy implications of price movements.

It is however worth noting from (10) that the whole relevance of both problems depends on the magnitude of the proportional change in relative prices. When $\frac{\Delta\pi_i}{2\pi_i}$ is sufficiently small, the second-order term in square brackets is also close to zero regardless of the size of the two elasticities. This is the reason why the marginal analysis is strongly supported when price changes are small. In this case, $\Delta W^S - \Delta W \approx 0$ supports a safe use of the first-order approximation.

The first question to ask is therefore whether our analysis can reliably make recourse to a first-order approximation. To address this problem, we derive critical thresholds of the households' *average* own price elasticities necessary to "significantly modify" the welfare change. We argue that the goodness of the first-order approximation (FOA) increases with the absolute value of the elasticities. For example, if the calculated "critical" elasticity is very high (and therefore unlikely in the real world), the size of FOA can safely be considered robust to households' behavioral reactions.[28]

This task is easily performed if one considers that the difference between the second-order approximation (SOA) and FOA, assuming price-independent welfare weights, can be expressed by:

[27]For example, it is likely that *rice* has a larger elasticity than *food*. When a change of the price of rice is assessed with the food elasticity, its impact is therefore underestimated in absolute values. But if this evaluation concerns a large number of elementary goods in the group, the gain in precision from having an estimation of the behavioral response is undermined by the loss in precision of applying that same elasticity to all kind of foods (e.g., bread and salmon).

[28]In other words, since we cannot estimate the distribution of the households' own price elasticities, we try to get information on the average value of this distribution.

$$\Delta W_i^S - \Delta W_i \equiv d = -\sum_h \beta^h x_i^h \Delta\pi_i \frac{\Delta\pi_i}{2\pi_i}(\eta_{ii}^h). \tag{11}$$

It is just worth recalling that, in (11), a small $\frac{\Delta\pi_i}{2\pi_i}$ implies that $\Delta W_i^S - \Delta W_i \to 0$ and thus that FOA can safely be used regardless of the size of the own-price elasticity. By replacing $\eta_{ii}^h = \eta_{ii}$, $\forall h$ and by solving equation (11) for this households' *average* value, we get the following expression:

$$\eta_{ii} = \frac{d}{-\sum_h \beta^h x_i^h \Delta\pi_i \frac{\Delta\pi_i}{2\pi_i}}. \tag{12}$$

Since $-\sum_h \beta^h x_i^h \Delta\pi_i \equiv \Delta W_i$, i.e., to FOA, equation (12) can finally be rewritten as:

$$\eta_{ii} = \frac{d}{\Delta W_i \frac{\Delta\pi_i}{2\pi_i}}. \tag{13}$$

Equation (13) suggests that by simulating a given difference $d$ between SOA and FOA (for example, 5 percent) for each good, one can derive the households' average own price elasticity needed to cause that difference. It is easily shown that the value of this elasticity is inversely related to the proportional change of the relative price. If this latter is small, a larger absolute value of the elasticity will be needed to cause a given $d$. This implies that FOA is sufficiently reliable (the intuition is that small price changes would cause negligible behavioral reactions). On the contrary, if the proportional change of the relative price is high, the value of the average elasticity needed to cause a change $d$ will be lower, which makes FOA less safe. The values of the average elasticities may therefore work as a sensitivity parameter of the goodness of FOA.[29]

The analysis is carried out in two steps. First, we check the size of real relative price changes and isolate those cases where $\frac{\Delta\pi_i}{\pi_i}$ is greater than 20 percent, which implies that $\frac{\Delta\pi_i}{2\pi_i}$ greater than 10 percent.[30] As argued by Banks *et al*. (1996), the introduction of a 10 percent tax rate on some goods not previously taxed is likely to cause a bias in the order of 5 percent, but for smaller reforms ". . . suitable first order approximations can work very well" (p. 1238). We therefore use a 10 percent change as a "critical threshold" over which FOA could cause a significant error. Table 7 shows that in our analysis there are very few cases where real relative price changes are (in absolute value) above 20 percent. Overall, the goods involved are 3 out of 147, corresponding to a total of 4 cases trespassing the threshold. Even though the threshold was halved—which means that one has to consider price

[29]In what follows, we develop the approach using FOA with a parameter of inequality aversion $\rho = 2$. Analogous results are obtained when using other values of inequality aversion. Results are not reported in table, but are available from the authors upon request.

[30]Recall that a relative price change, in our case, means that the price of the good has changed by 20 percent more or less than the general inflation rate.

TABLE 7

NON-MARGINAL CHANGES OF REAL RELATIVE PRICES

| | 98/97 | 99/98 | 00/99 | 01/00 | 02/01 | 03/02 | 04/03 | 05/04 | 06/05 | 07/06 |
|---|---|---|---|---|---|---|---|---|---|---|
| Insurance on motor vehicles | 0.115 | 0.143 | | | | | | | | |
| Olive oil | –0.109 | | | | | | | | 0.128 | |
| Potatoes | | 0.124 | | | | | | –0.113 | | 0.130 |
| Liquid fuels | | | 0.123 | | | | | 0.141 | | |
| Other fuels | | | 0.118 | | | | | 0.111 | | |
| Pork meat | | | | 0.123 | | | | | | |
| Other meat | | | | 0.114 | | | | | | |
| Cheese | | | | | –0.101 | 0.104 | | | | |
| Air transport | | | | | | | | 0.155 | | |
| Jewels | | | | | | | | | 0.156 | 0.106 |
| Domestic services | | | | | | | | –0.112 | 0.125 | |
| Ice creams | | | | | | | | | | 0.491 |
| Materials for information processing | | –0.162 | –0.221 | –0.161 | –0.135 | –0.171 | –0.117 | –0.124 | –0.151 | –0.104 |
| Materials for telephone services | | | | | | | –0.252 | –0.222 | –0.168 | –0.168 |

*Source*: Authors' calculations, based on HES data.

TABLE 8
IMPLICIT AVERAGE OWN PRICE ELASTICITIES

| Years | Number of Goods with a Large Average Elastic Demand (e > 3) | Total Number of Goods |
|---|---|---|
| 98/97 | 131 | 145 |
| 99/98 | 129 | 145 |
| 00/99 | 125 | 145 |
| 01/00 | 128 | 147 |
| 02/01 | 123 | 147 |
| 03/02 | 136 | 147 |
| 04/03 | 130 | 147 |
| 05/04 | 126 | 147 |
| 06/05 | 124 | 147 |
| 07/06 | 122 | 147 |

*Source*: Authors' calculations, based on HES data.

changes greater than 10 percent and $\frac{\Delta\pi_i}{2\pi_i}$ greater than 5 percent—the goods involved would be 14, for a total of 34 relevant changes against a total number of changes analyzed equal to 1,464.[31] This is the first evidence that the bulk of price changes are small enough to reduce the relevance of SOA and therefore the distance with FOA described in equation (11). In other words, the number of goods whose price changes may potentially and significantly affect the total welfare change is small and this works in preserving the goodness of FOA.

Then, as a consequence, according to formula (13), one can now calculate the implied "average" own price elasticity that is needed to change the welfare change associated with each good by a magnitude of 5 percent.[32] Table 8 reports a synthetic outcome where it is shown that a large number of goods in each year would require large "average" elasticities across households (>3) in order to shift FOA by 5 percent.

By assuming that elasticities greater than 3 are uncommon, for those goods we can safely assume that the relative price change is sufficiently small to use FOA. Now, even considering all other goods with plausible or semi-plausible elasticities (<3), the change of FOA cannot be greater than 5 percent, as they would be only a fraction of all behavioral responses needed to cause a change of that size.

Overall, we thus think that the FOAs used in the sequence of relative price changes are sufficiently reliable, as they would show, in all years, an error that is largely below 5 percent of FOA for consistent values of average households' own price elasticities. For the same reasons, the corresponding dominance conditions are not reversed, which means that the results are robust to the introduction of realistic possibilities of substitution among commodities.[33]

[31]Note that even by considering relative price changes above 5 percent, the number of such changes would increase to 108, which is still a small proportion of the total number of changes analyzed (7.3 percent).

[32]The 5 percent threshold is again borrowed from Banks *et al*. (1996), who measured a bias in the order of 5 percent when introducing a 10 percent tax rate.

[33]The cumbersome and detailed data on dominance for all years are not reported in the tables. However, they are available from the author upon request.

## 5. Conclusions

On the basis of a wide perception of a mismatch between the official inflation rates and the loss in purchasing power actually experienced by Italian households (especially after the introduction of the Euro), we have investigated the distributional and welfare impact of inflation over a long time span (1997–2007) and over sub-periods. This outcome is new for Italy, as all previous studies have focused either on the total money loss from inflation or on the impact of inflation in single years.

The descriptive analysis carried out in this paper has shown a significant upward step of the inflation burden in 2001–03 (despite the unexpected downward pressure of 2002), and this finding is particularly exacerbated for households at the bottom of the distribution. This result provides evidence of an adverse distributional impact of price changes that is confirmed by the welfare analysis of RRP changes. Although positive and negative welfare variations alternate over years, a greater concentration of welfare losses has been found in the period surrounding the introduction of the Euro, namely in 2001 and 2003, with the anomalous exception of 2002.

With regard to this latter issue, a closer inspection has revealed that the positive welfare impact in 2002 is largely due to the fall of relative prices of both *gas* and *gasoline*, two items with relatively high distributional characteristics, whose prices are heavily affected by governmental tax and regulation interventions. Once the impact of such goods is *neutralized*, the overall effect of RRP changes turns into an unambiguous welfare loss. This evidence suggests that the feeling of a welfare deterioration in the *Euro period* may have been mainly induced by an increase of the prices of market goods, whose impact has also a sequel in 2003, while the benefits associated with *gas* and *gasoline* might have been underestimated by Italian households.

The marginal dominance analysis further discloses that losses are mainly concentrated on households located in the lowest deciles; while the sequential marginal dominance clarifies that, among them, larger households are more severely hurt by inflation. For these latter households, the impact of price increases also tends to be unambiguously welfare-decreasing when the marginal dominance on all households was positive or ambiguous, suggesting that gains are mainly cumulated, on average, by singles and couples. Finally, the comparison between the cumulated welfare change considering all goods and the same outcome obtained by excluding *gas* and/or *gasoline* in the whole period, reveals that those two goods were crucial in reversing the sign of the welfare change (generating positive or less negative benefits on poorest households). This implies that gas regulation and gasoline taxes are two potentially powerful tools to shape the distributional impact of inflation. The sensitivity analysis has further shown that our first-order approximations are good approximations of the welfare changes.

Overall, our findings provide original evidence that, even though the introduction of the Euro currency cannot be assumed as a structural break in the distributional effects of inflation, the overall redistribution of purchasing power over the last decade has been negative for a large proportion of households in the

lowest part of the expenditure distribution. This suggests that the perception of an adverse welfare impact is more grounded on a "*cumulative effect*" that compensates even occasional episodes of large welfare gains. Yet, the adverse impact in the years around the introduction of the Euro currency, even though cushioned in the following period, may have performed as an upward step in the perception of the burden of inflation by a proportion of Italian households, from which a full recovery does not yet seem to have been realized.

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## Supporting Information

Additional Supporting Information may be found in the online version of this article:

**Appendix:** Matching CPI and HES

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