BANCA D'ITALIA

EUROSISTEMA

Questioni di Economia e Finanza

(Occasional Papers)

Relative price shocks and inequality: evidence from Italy

by Leonardo Ciambezi and Alessandro Pietropaoli

October 2024

Number 883

BANCA D'ITALIA
EUROSISTEMA

Questioni di Economia e Finanza

(Occasional Papers)

Relative price shocks and inequality: evidence from Italy

by Leonardo Ciambezi and Alessandro Pietropaoli

Number 883 – October 2024

The series Occasional Papers *presents studies and documents on issues pertaining to the institutional tasks of the Bank of Italy and the Eurosystem. The* Occasional Papers *appear alongside the* Working Papers *series which are specifically aimed at providing original contributions to economic research.*

The Occasional Papers *include studies conducted within the Bank of Italy, sometimes in cooperation with the Eurosystem or other institutions. The views expressed in the studies are those of the authors and do not involve the responsibility of the institutions to which they belong.*

The series is available online at www.bancaditalia.it .

ISSN 1972-6643 (online)

Designed by the Printing and Publishing Division of the Bank of Italy

RELATIVE PRICE SHOCKS AND INEQUALITY: EVIDENCE FROM ITALY

by Leonardo Ciambezi*† and Alessandro Pietropaoli†#

Abstract

Is inflation equal for all? Combining Italian Household Budget Survey (HBS) and Harmonised Index of Consumer Prices (HICP) data, we investigate the heterogeneity of Italian households' inflation experiences over the period 2015-23, depending on their standards of living and other observable characteristics. Following several years of distributional inflation neutrality, we find that the price surge that began in mid-2021 especially increased the cost of living for poorer households and more vulnerable socio-demographic groups, thus contributing to increasing overall inequality. After peaking in the second half of 2022, the aggregate inflation rate declined sharply in 2023, as did the differential exposure of Italian households.

JEL Classification: D31, E31.

Keywords: household-specific price indices, energy price shocks, inflation inequality, Italy.

DOI: 10.32057/0.QEF.2024.883

* CNRS GREDEG, Université Côte d'Azur, Nice.

† Institute of Economics and l'Embeds, Scuola Superiore Sant'Anna, Pisa, Italy.

Banca d'Italia, ARET, L'Aquila.

1 Introduction[1]

Price inflation is traditionally considered an aggregate variable. Any price index commonly built and used by national statistical services, such as the Harmonised Index of Consumer Prices (HICP), is thought to be a measure of the cost of a large bundle of products purchased by a single representative household. Unfortunately, such representative household does not exist. Once one realises that the basket actually purchased by each household may differ from the HICP basket, it becomes clear that each household may experience an inflation that is very different from the official rate. Therefore, measuring inflation through an aggregate index - while natural and appealing - may be misleading because it eliminates the heterogeneity in household consumption patterns and cost of living. An immediate implication of inflation heterogeneity across households is that price changes may contribute to increase overall inequality not only from the revenue side - by depressing real wages - but also from the consumption side. This would be the case whenever the prices of goods and services that are consumed relatively more by lower income households increase faster than prices on average. The so-called *consumption transmission channel* goes unnoticed when using a single aggregate consumer price index.

In this paper, combining information from the Household Budget Surveys (HBS) on annual household expenditure decisions with the monthly updated Harmonised Index of Consumer Prices (HICP), we aim to investigate the distribution of inflation rates across Italian households over the period 2015-2023 and to highlight the most recent developments. As price consumer indices are usually viewed - even in the public debate - as a measure of the cost of living, focusing on a single index rather than on the distribution may provide a fundamentally flawed picture of how living conditions actually evolve across the population. Then, our main purpose is to assess to what extent household specific inflation rates have been diverging from the aggregate rate and whether some income and social groups have been more severely affected by the latest price shocks. We show that until early 2021, during a period characterised by extremely low general price growth, the country inflation index has been a good representation of the inflation exposure of every household, with no significant differences across particular segments of the population. However, following the sharp increase in energy and food prices, poorer households have been exposed to a much heavier increase in the cost of their consumption bundle relative to the richer, with the bottom expenditure decile exposed to an inflation rate that was more than double that experienced by the top decile.

The first request for group-specific price indices dates back to Arrow (1958), when he argued that the poorest were likely to have different consumption patterns relative to the richest. However, it is since late '90s that the growing availability of rich micro data on household spending decisions and disaggregated price dynamics has allowed researchers to evaluate whether traditional aggregate inflation indices are good measures of inflation for everyone (e.g.

[1]We would like to thank two anonymous referees, Giuseppe Albanese, Flora Bellone, Andrea Brandolini, Nicola Curci, Silvia Del Prete, Mauro Napoletano, Roberto Torrini, Simone Vannuccini, as well as all participants to 2023 Bank of Italy ARET Workshop, 2024 Doctoral DESPEG Workshop and 2024 AISRe Conference for helpful comments and valuable discussions. The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the the Bank of Italy.

Garner et al. (1996), Crawford and Smith (2002) and Hobijn and Lagakos (2005)).

One of the earliest works on the topic has been Crawford and Smith (2002) who studied the evolution of the Retail Price Index (RPI) for the UK over the period 1976-2000 and concluded that the average price level had not been a good guide to the actual inflation experienced by individual households. They emphasised that the representativeness of the average rate - measured as the percentage of households close to the mean - tended to decrease as inflation increased. Moreover, they showed that over the whole period, specific subpopulations - such as non pensioners, mortgagors, employed and childless households - had faced higher than average inflation. A few years later, Hobijn and Lagakos (2005) measured the degree of inflation inequality across US households over the period 1987-2001 and provided evidence for substantial differences in individual inflation experiences. They found that the increase in the cost of living was on average higher for elderly and, interestingly, that the cost of living for the poorest was most sensitive to the historically large fluctuations in gasoline prices.

Nevertheless, in the low-inflation economy of the 2000s when the degree of dispersion of individual inflation rates used to be quite low and the aggregate price indices provided a good approximation of the cost of living experienced by the whole population, studying the inequality impact of household-specific inflation rates became less and less appealing. One of the few exceptions has been the paper by Gürer and Weichenrieder (2020) who studied the distributional effects of heterogeneity in expenditure shares and relative price changes in a sample of 25 European countries over the period 2001-2015. They showed that the consumption bundles of lower income households have, on average, become more expensive than those of the richest households in all the countries, with very few exceptions.

However, the debate on inflation inequality and its consequences has recently been revitalised by the abrupt rise in inflation experienced throughout the EU and USA between 2021 and 2022. Furthermore, the latest price increases have more intensely affected particular consumption categories - such as electricity, gas and food - which have traditionally represented a larger share of poorer household expenditures. This circumstance may have contributed to increase the dispersion of individual inflation rates around the official consumer price index. Then, after two decades of subdued price growth, there has been renewed interest in investigating the distributional implications of inflation over the last few years (e.g. Curci et al. (2022), Basso et al. (2023) and Gros and Shamsfakhr (2023)). Our work fits exactly in this strand and it contributes to the existing literature in several ways.

First, to our knowledge, there are no other studies focusing on the distributional aspects of inflation in Italy over the years just before the recent energy crisis and our analysis fills that gap.[2] Furthermore, the works studying the latest national inflation inequality dynamics and their implications for economic policy rely on very different both theoretical and empirical tools or look at the phenomenon from distinct perspectives. For instance, Curci et al. (2022) relying on microsimulation tools have quantified the extent to which Italian government measures mitigated the distributional consequences of the recent inflationary surge. Corsello and Riggi (2023) set up a dynamic stochastic

[2]Gürer and Weichenrieder (2020) investigate the household-specific inflation distribution for several European countries - including Italy - between 2001 and 2015. Our analysis extends to the entire subsequent period.

general equilibrium two-agent model with imported energy in order to identify the role played by monetary policy in the transmission of price shocks and its redistributional impact in a setting where consumption patterns are heterogeneous. Finally, Infante et al. (2023) using a methodology similar to the Distributional Wealth Accounts developed at the European level, have assessed the impact of the 2022 rise in inflation on Italian households' wealth along the joint distribution of income and net wealth. Our work, which explores the determinants and characteristics of inflation inequality in Italy at the micro level and explicitly focuses on the *consumption transmission channel* of relative price changes, complements that strand of literature by revealing testable stylised facts and providing guidance for further theoretical developments. In addition, we do not limit our analysis - differently from above studies - to the inflation gap across income groups and leveraging the rich information from Italian Household Budget Surveys; rather, we test whether observable features other than income (e.g. homeownership, gender, nationality, professional status or education) have played a role in shaping inflation exposures across Italian households between 2015 and 2023.

Second, it is well-known in the inflation inequality literature that exploiting as disaggregated as possible product-price data is crucial to capture the full extent of inflation heterogeneity across the population (Jaravel (2021)). However, traditional empirical research, which relies on survey data and is mainly concerned with differences in spending patterns and price variations *between* categories and not *within* - has often been forced to work with at most 2-digit category data because of the lack of more detailed information (e.g. Hobijn and Lagakos (2005), Gürer and Weichenrieder (2020) and Basso et al. (2023)). In order to handle more granular product-price data with respect to the contributions commonly found in the standard literature, we opt to map first by hand each of the 480 Household Budget Survey items into up to 90 ECOICOP 3- and 4-digit level categories. We show that ignoring such additional information, we would underestimate the measured differential inflation between the opposite deciles of the Italian household consumption distribution by approximately 10% over the whole period and, much more seriously, by almost 20% during the core years of the energy crisis (2021-2022).

Third, the current work has also implications for Consumer Price Index theory, as it highlights how different ways of aggregating household consumption bundles can give back distinct pictures of price dynamics whenever the variability of inflation - both individual and aggregate - becomes relevant. In similar scenarios, we show that aggregating households by assigning to each of them a weight proportional to their total expenditure - the so-called *plutocratic* weighted average of individual price indices - leads to serious underestimation of the inflation experienced by lower consumption deciles and it makes an inadequate cost of living indicator for the large majority of households. More generally, this work puts into question the adequacy of any aggregate price index - both *plutocratic* and *democratic* - at least in a context of highly rising prices and sharp relative price fluctuations, when individual inflation experiences can widely differ across the expenditure distribution, as they did very recently. This last evidence calls for a more widespread adoption of group-specific price indices to inform policymakers whenever significant inflationary pressures are in place.

Finally, an additional contribution stems from the comparison between Laspeyres and Paasche average inflation rates - both through normal times and during recent energy crisis years - which allows us to appreciate the empirical relevance of the theoretical substitution effect. Following an inflationary shock - according to traditional microeconomic consumption theory - rational economic agents are supposed to adjust their expenditure choices by substituting products become relatively more expensive with products now relatively cheaper. This is why a Laspeyres index that uses consumption shares from the previous period - before relative prices change - is assumed to overstate true inflation. On th other hand, a Paasche index which relies on current expenditure shares - after relative prices change - would tend to understate true inflation. We compute both inflation measures until December 2022 and we show that they have essentially coincided between 2015 and 2021, over a period characterised by negligible price fluctuations and consequently by little household consumption substitution. However, since early 2022 right when overall inflation started to grow, the two indices began to diverge, but contrary to theoretical predictions, the Paasche index-based inflation rate has consistently been higher than the Laspeyres index-based inflation rate over the whole year. This puzzling result can be understood by considering the exceptional nature of the recent inflationary shock. Even though both gas and electricity prices have more than doubled over the 2022, their relative weights on household consumption bundles have actually increased since both energy goods are necessities and their demand is known to be particularly rigid to sudden unanticipated price shocks. In other words, in the recent inflationary context driven by energy price fluctuations, income effects rather than substitution effects seem to have prevailed.

The rest of the paper is organised as follows. Section 2 describes the data we use and the methodology we adopt in our empirical analysis. In Section 3, the different results are extensively discussed. Section 4 summarises and concludes.

2 Data and methodology

Computing household-specific inflation rates requires two complementary pieces of information: on one hand, we need micro data on expenditure decisions for a representative sample of Italian households and on the other, updated series of price data for a disaggregated set of goods and services.

We obtain the first piece of information by exploiting the Household Budget Surveys (HBS) yearly conducted by the Italian National Institute of Statistics (Istat) and publicly available from 1986 to 2022. Over time, two deep changes have been introduced in every stage of the survey process, first in 1997 and then in 2014. Consequently, time comparisons between recent and pre-2014 estimates can be made only by using *ad hoc* series reconstructed by Istat. In order to rely on higher quality data and since we are mainly interested in the latest price dynamics, we choose to limit our analysis to the period 2015-2023. The survey is conducted every year on a cross-sectional basis on a very large sample of Italian households, ranging in our study from a minimum of 15013 in 2015 to a maximum of 28608 in 2021. The questionnaire is based on the harmonised international classification of expenditure voices (ECOICOP) - over 480

categories of goods and services - to ensure international comparability and it represents the main informative base for the various consumer price indices and for the official estimates of relative and absolute poverty in Italy.[3]

Because the HBS lacks information on prices, we need to resort to a second data source, i.e. the Harmonised Index of Consumer Prices (HICP) which is monthly calculated by Istat, according to EU regulations, through a chained Laspeyres formula in which both the consumption bundle and the weighting system are annually updated. Since one of the purposes of the HBS is to calculate the weights for the HICP, the disaggregation of consumption expenditure categories is, at least in principle, identical in the two datasets. Then, mapping price information into consumption decisions is a trivial procedure once one constructs a bridging table between expenditure and price categories. Eventually, we partition by hand the over 480 categories of goods and services included in the HBS to 90 expenditure classes given by a combination of 3- and 4-digit products for which price data are available in the HICP.[4]

There are two main alternative ways to accommodate household heterogeneity when computing inflation, i.e. by using either group-specific homothetic price indices or by relying on nonhomothetic cost of living indices (Hochmuth et al. (2022)). In the current analysis, we follow the first approach.

Since Engel (1857), it is well-established that households with different incomes purchase different consumption bundles, i.e. poorer households spend an higher fraction of their income on necessities, while the richest assign a larger share of their resources to luxuries. Then, if the prices of necessities increase faster than the aggregate price index, lower income households end up facing a higher level of inflation than the one computed at the country level. The same logic applies to all those socio-demographic groups that may differ from each other because of their consumption patterns. It becomes clear that an aggregate consumer price index cannot, by construction, capture the heterogeneous impact of changes in relative prices, which can actually vary substantially as they did recently. This is why computing household-specific inflation rates is actually needed.

In principle, inflation can vary across households due to heterogeneity both in the expenditure shares and in the prices paid. However, without scanner data, it is not possible to take into account the effects that differences in quality and variety of the k products may have on the prices actually paid by each household. In the survey data we use, the assumption is that all households face the same price for the same good, it follows that differences in household-specific inflation rates will emerge exclusively because of different consumption choices and not from within-category price changes. Given the exceptional nature of the latest price shocks, we are not worried about this data limitation and within-industry effects are beyond the scope of our analysis.

The most commonly used price indices to compute inflation for a bundle of k goods and services, available

[3] Istat monthly calculates three consumer price indices with different goals: i.e. the Consumer Price Index for the Whole Nation (NIC), the Consumer Price Index for Blue and White-collar Worker Households (FOI) and the Harmonised Index of Consumer Prices (HICP).

[4] The full mapping table between the Household Budget Survey 2021 expenditure codes and ECOICOP 2015 classification can be provided upon request.

at both $t-1$ and t, are the Laspeyres and Paasche indices:

$$1+\pi_{t-1,t}^{Laspeyres,h}=\frac{\sum_k q_{k,t-1}^h \times p_{k,t}}{\sum_k q_{k,t-1}^h \times p_{k,t-1}}=\sum_k s_{k,t-1}^h \times \frac{p_{k,t}}{p_{k,t-1}} \tag{1}$$

$$1+\pi_{t-1,t}^{Paasche,h}=\frac{\sum_k q_{k,t}^h \times p_{k,t}}{\sum_k q_{k,t}^h \times p_{k,t-1}}=\sum_k s_{k,t}^h \times \frac{p_{k,t}}{p_{k,t-1}} \tag{2}$$

where h indicates household groups (e.g. income deciles), $p_{k,t}$ is the price of product k at time t, $q_{k,t}^h$ is the quantity purchased by group h of product k in t and $s_{k,t}^h$ is the period t expenditure share of group h on product k. Then, inflation may differ across groups because expenditure shares usually vary across households and prices vary across goods and services.

The two statistical indices deal differently with the product-substitution decisions taken by rational consumers that are supposed to optimally react to relative price changes across products. The Laspeyres index uses expenditure shares at the previous period $t-1$, it does not allow households to substitute and so it tends to overstate true inflation. This is why the Laspeyres index is usually regarded as the *upper* bound of the cost of living. The Paasche index uses consumption shares at the current period t, it implies that substitution has fully occurred and so it tends to understate true inflation. This is why the Paasche index is usually regarded as the *lower* bound of the cost of living (Schultze (2003)).

Since Italian Household Budget Surveys are run every year, it is possible to track annual shifts in household consumption patterns and both inflation measures can be easily calculated. In our main analysis, we rely on group-specific Laspeyres indices since this allows us to both leverage all the available information and appreciate the differential inflation reduction that started at the beginning of 2023. However, we also compute monthly individual Paasche inflation rates until December 2022 in order to compare the dynamics of the two indices between 2015 and 2022.

Unfortunately, the Italian Household Budget Survey does not collect any direct measure of household income. Therefore, it is crucial to define a good proxy able to capture household living standards since we are particularly interested in studying the heterogeneity in inflation exposures of poorer and richer households. Following Baldini (2005), we adopt equivalent non-durable expenditure as our proxy of choice. To build this indicator, for each household we sum the total expenditure on the over 480 goods and services of the survey and the value of imputed rents on home ownership; then, we subtract expenditures on durable goods and on extraordinary maintenance. [5] The living standards indicator is finally obtained by dividing that amount by an equivalence scale given by the square root of the number of household components. All the results are robust to the adoption of alternative equivalence scales (see Appendix A). Each year, households are then divided into deciles of non-durable equivalent consumption. We are well-aware that non-durable expenditure is not always perfectly superimposable on income, which is usually the variable at the core of

[5] Attributing the expenditure of a durable good exclusively to its purchasing period would make a household appear richer than it truly is in that given year. The correct way of imputing durable good consumption for a measure of household welfare would be estimating the flow of services provided by those goods at each period Amendola and Vecchi (2022). Unfortunately the data available does not allow such exercise, so we opt to exclude durable goods altogether.

any welfare analysis. Households with the same equivalent income may actually exhibit different consumption levels because of household-specific preferences (e.g. different saving propensities) or needs (e.g. healthcare, education). However, at this time, there is no unified dataset merging consumption patterns and income levels for Italian households, even if efforts in that direction have been made (Conti et al. 2017; Dalla Chiara et al. 2019). All in all, we consider equivalent non-durable expenditure to be the second-best solution to proxy living standards across the population of households, under the plausible assumption that, *ceteris paribus*, the consumption function is monotonic in income, i.e. higher income households would tend, on average, to have higher consumption levels.[6]

3 Results

In this section, the main results of our analysis are conveniently summarised and extensively discussed.

3.1 The distribution of households and country inflation rates

So far, we have stressed the importance of computing individual inflation rates since they may substantially differ across the population. Then, it is possible to aggregate the sample household-specific price indices to obtain an inflation measure for the entire country in line with the official Harmonised Index of Consumer Prices.

There are two approaches to calculate a national price index in terms of individual household inflation rates. Usually, statistical agencies compute the official consumer price index by following a *plutocratic* approach, i.e. each household contributes to determine the aggregate index with a weight proportional to its expenditure. In other words, more relevance is given to the inflation experienced by those households spending more, which are likely to be the richest ones:

$$\Pi_{t-1,t}^{Plutocratic} = w^h \times \frac{S_{t-1}^h}{S_{t-1}} \times \sum_{h=1}^{H} \pi_{t-1,t}^h \tag{3}$$

where h indicates the individual household, $\frac{S_{t-1}^h}{S_{t-1}}$ is the $t-1$ weight of household h total expenditure over national expenditure and $\pi_{t-1,t}^h$ is the household-specific Laspeyres inflation rate as previously described.[7] Finally, we rescale the aggregate price index by applying the population weight w^h associated with each of the H sample households as a measure of their population representativeness.

The alternative aggregation approach of individual inflation rates is known as *democratic* since the same weight is assigned to each household:

$$\Pi_{t-1,t}^{Democratic} = w^h \times \frac{1}{H} \times \sum_{h=1}^{H} \pi_{t-1,t}^h \tag{4}$$

where the notation is the same as above.

By comparing (3) and (4) and recalling how individual inflation rates are computed (see equation (1)), it is straightforward to realise that under certain conditions the two alternative indices would coincide:

[6] The dataset analysed during the current study is available in the Household-specific inflation rates for Italy 2015-2023 repository.

[7] A similar relation between individual inflation rates and the country price index would obviously hold for household-specific Paasche indices as well.

- each household ($h = 1, ..., H$) consumes exactly the same amount S^h_{t-1};
- the expenditure share of each household on all goods and services is identical, i.e. $s^h_{k,t-1} = \frac{s_{k,t-1}}{H}, \forall k = 1, ..., K$ and $\forall h = 1, ..., H$;
- the relative price changes $\frac{p_{k,t}}{p_{k,t-1}}$ are the same for all consumption products ($k = 1, ..., K$).

However, the more the actual situation differs from the above conditions, the greater is the difference - known as *plutocratic bias* - between the two price indices. In principle, neither approach is formally superior and the choice often depends on the use that is to be made of the consumer price index. Democratic indices are assumed to be more representative since they weight poorer and richer households equally (Bandyopadhyay and Ramaswami (2022)) and they are preferable when addressing welfare policy questions. On the other hand, for both national accounting and monetary policy purposes, plutocratic indices are better since it is preferable to assign the same weight to each monetary unit.

Figure 1 shows the evolution of the specific inflation experienced by both the bottom and the top consumption deciles of the representative sample of Italian households, together with the weighted-sample democratic and plutocratic indices, between 2015 and 2023.

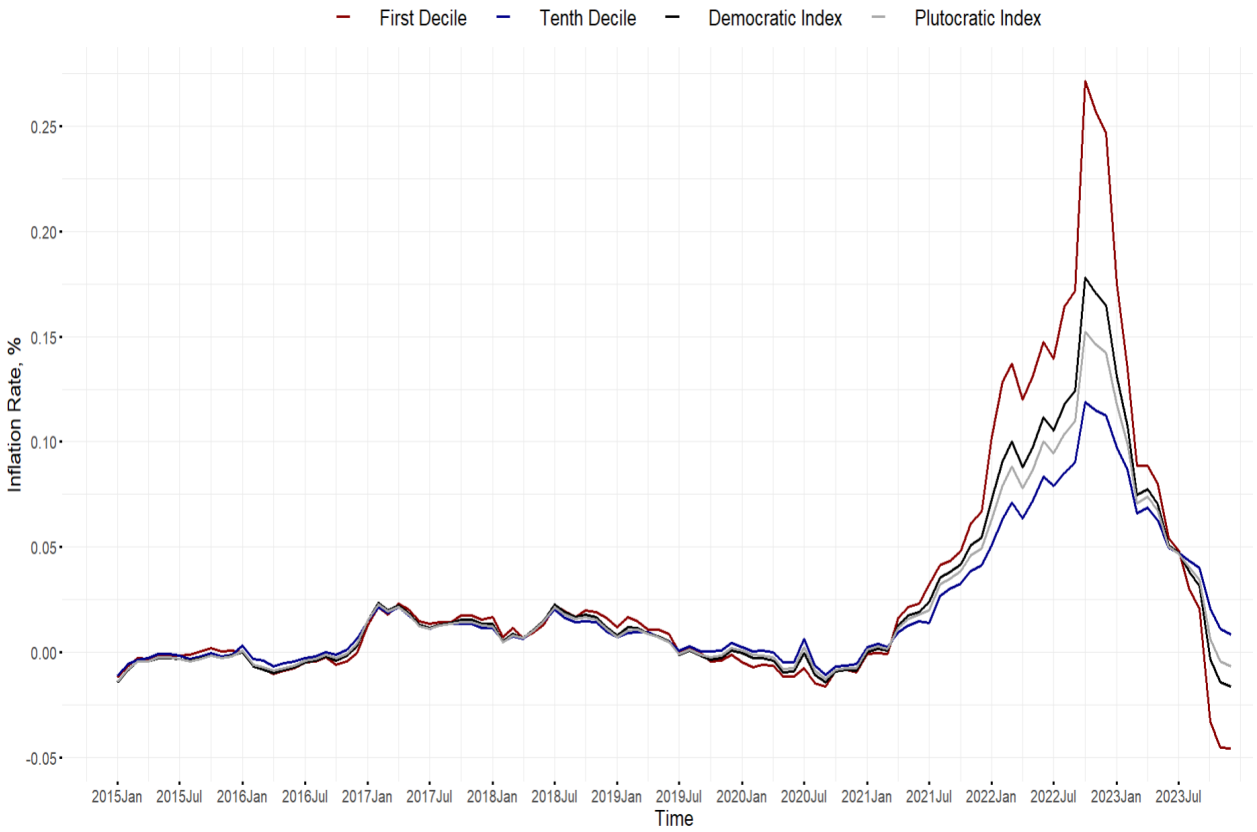

Figure 1: **Bottom and top decile-specific inflation rates, democratic consumer price index, plutocratic consumer price index (2015-2023).**

From 2015 to early 2021, during a period when price growth has constantly been very low, both the plutocratic and the democratic indices have followed an extremely close evolution, with very small deviations ranging from -0.14 to 0.3 percentage points. Furthermore, the poorest- and the richest-specific inflation rates have been very close to each other and to the aggregate inflation indices, as well. Between 2015 and 2020, the top 10% of the population has experienced an average inflation equal to 0.41%, which is slightly higher than the inflation faced by the poorest decile (0.33%). The evidence that inflation has not been traditionally pro-rich in Italy, unlike in the rest of Europe, is in line with the conclusions reached by Gürer and Weichenrieder 2020. They compute household-specific price indices for a sample of 25 European countries over the period 2001-2015 and find that the increase in the cost of living has been on average higher for the poorest across all the countries, with Portugal and Italy as notable exceptions.

The picture completely changes starting from early 2021, following the supply-chain disruptions due to the 2020 global pandemic and later the energy crisis caused by the outbreak of the Ukrainian war in February 2022. Figure 2 focuses on these very recent price dynamics and looks at the specific inflation rates experienced by each consumption expenditure decile.

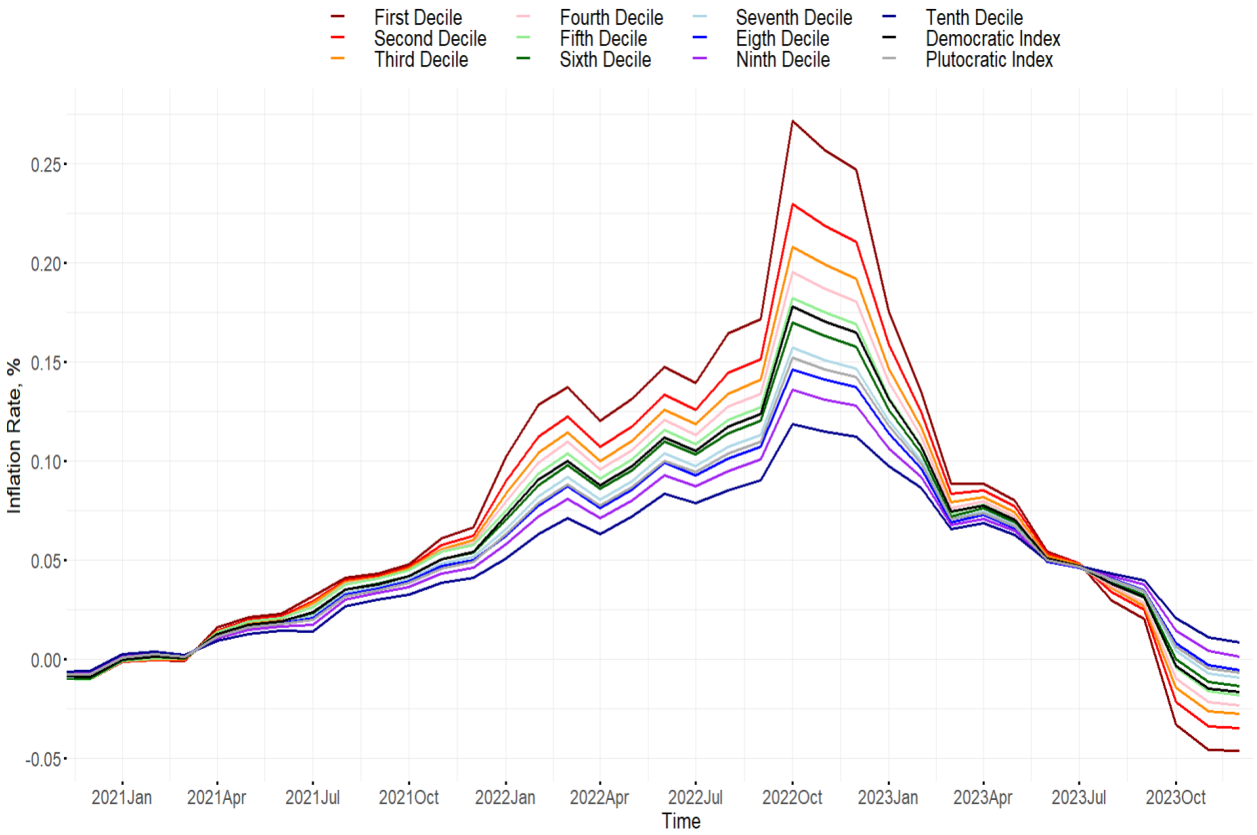

Figure 2: **Decile-specific inflation rates, democratic consumer price index, plutocratic consumer price index (2021-2023).**

The figure reveals the major limitation of using traditional aggregate indices of consumer prices. In a context of low and stable inflation, such as the period from 2015 to March 2021, a single synthetic measure has provided an appropriate

description of the inflation faced on average by Italian households. However, the representativeness of any aggregate index tends to decrease as soon as overall inflation starts to grow, as since April 2021. In particular, the plutocratic index does a better job in tracking inflation for the higher expenditure deciles and it performs worse in tracking the evolution of the cost of living for the lowest deciles. Between 2021 and 2022 - at the heart of the energy crisis - the plutocratic measure has actually been representative of the inflation experienced by the top two quintiles of the population (6.3% and 5.9%, respectively), while it has diverged by the average price increase (8.4%) faced by the median household by more than 2 percentage points. Similarly, the democratic index - equal to 7.1% over the same period - even though more representative of the average price dynamics, it has also suffered from the same drawback. Over the two core energy crisis years, the bottom decile has seen the price of its consumption bundle increase by 9.9%, while the basket of goods and services purchased by the top decile has become only 5.1% more expensive. The maximum gap between the inflation levels faced by those opposed income groups (equal to 15.3 percentage points) has been reached in October 2022. Since the beginning of 2023, as the country inflation rate declined, so did the differential exposure of Italian households and starting in August, we went back to the pro-poor inflation dynamics observed through the pre-crisis period.

The preliminary graphical analysis has shown in a very intuitive way how aggregate price indices - both plutocratic and democratic - have turned out to be good guides to the actual inflation experienced by individual households during normal times, but they have proven to be little instructive when inflation rates have been more widely dispersed throughout the population, as recently happened. In similar scenarios, relying on group-specific price indices seems to be required in order to take accurate policy decisions.

3.2 Overestimating or underestimating household-specific inflation rates?

A careful reader may argue that we are actually overestimating the inflation experienced by individual households because we are computing the price growth of individual expenditure bundles by applying a Laspeyres price index. Following an inflationary shock, relative prices change and rational economic agents are supposed to adjust their consumption choices by substituting products that become relatively more expensive with products that are now relatively cheaper. A Laspeyres index using expenditure shares from the previous period - before relative prices change - does not allow rational households to substitute and so it would tend to overstate true inflation. On the other hand, the alternative Paasche index, which relies on current consumption shares - after relative prices change - implies that rational households have fully substituted and so it would tend to understate true inflation.

Data availability allows us to compute both monthly individual price indices until December 2022; then, we are able to compare their evolution both through normal times and during the recent energy crisis years to further check whether they have differed on average or not and to appreciate to what extent households have actually resorted to substitution in order to react to the latest relative price changes.

The evolution of both the Laspeyres and Paasche average household inflation rates over the whole period is shown in Figure 3.

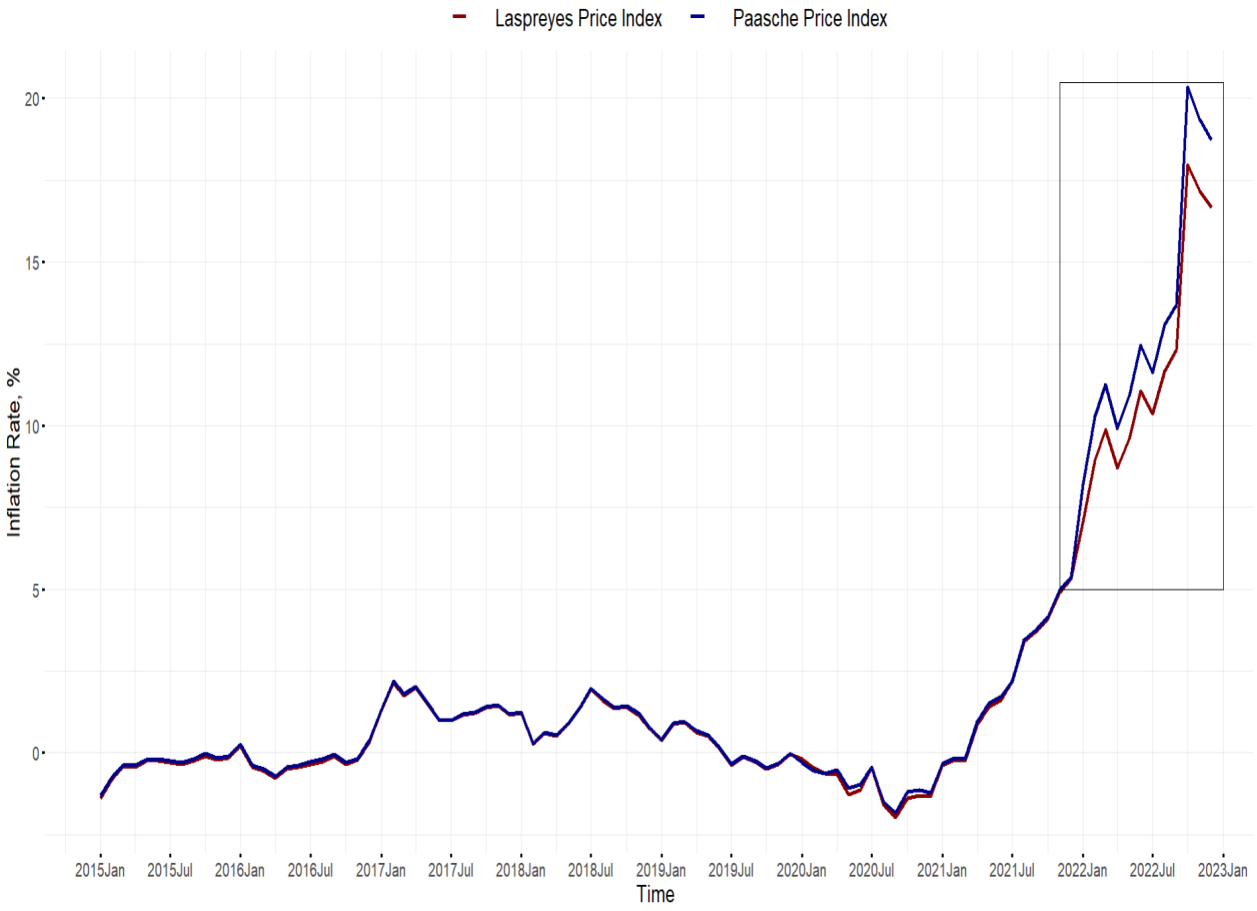

Figure 3: **Laspeyres (dark red) and Paasche (dark blue) democratic inflation rates (2015-2022).**

Until the end of 2021, the two indices have generally coincided, as it emerges from the figure. This circumstance should not be surprising, as until the recent energy crisis, price dynamics had always been subdued and there was no reason to expect any shift in household consumption decisions in response to negligible price effects. However, since early 2022 right when overall inflation started to grow, the two price indices began to diverge, but contrary to theoretical predictions, the Paasche index-based inflation rate - supposed to be the *lower* bound of the cost of living - has consistently been higher than the Laspeyres index-based inflation rate - usually regarded as the *upper* bound of the cost of living - over the whole year. This, at first glance, puzzling result may be solved by considering the exceptional nature of the inflationary shock recently faced by Italian households, which has been mostly driven by the manyfold price increase of very few and peculiar goods, i.e energy goods.

In order to shed light on this empirical puzzle, in Figure 4, we plot the consumption share variations versus the price changes for all expenditure categories over the 2021-2022 period.

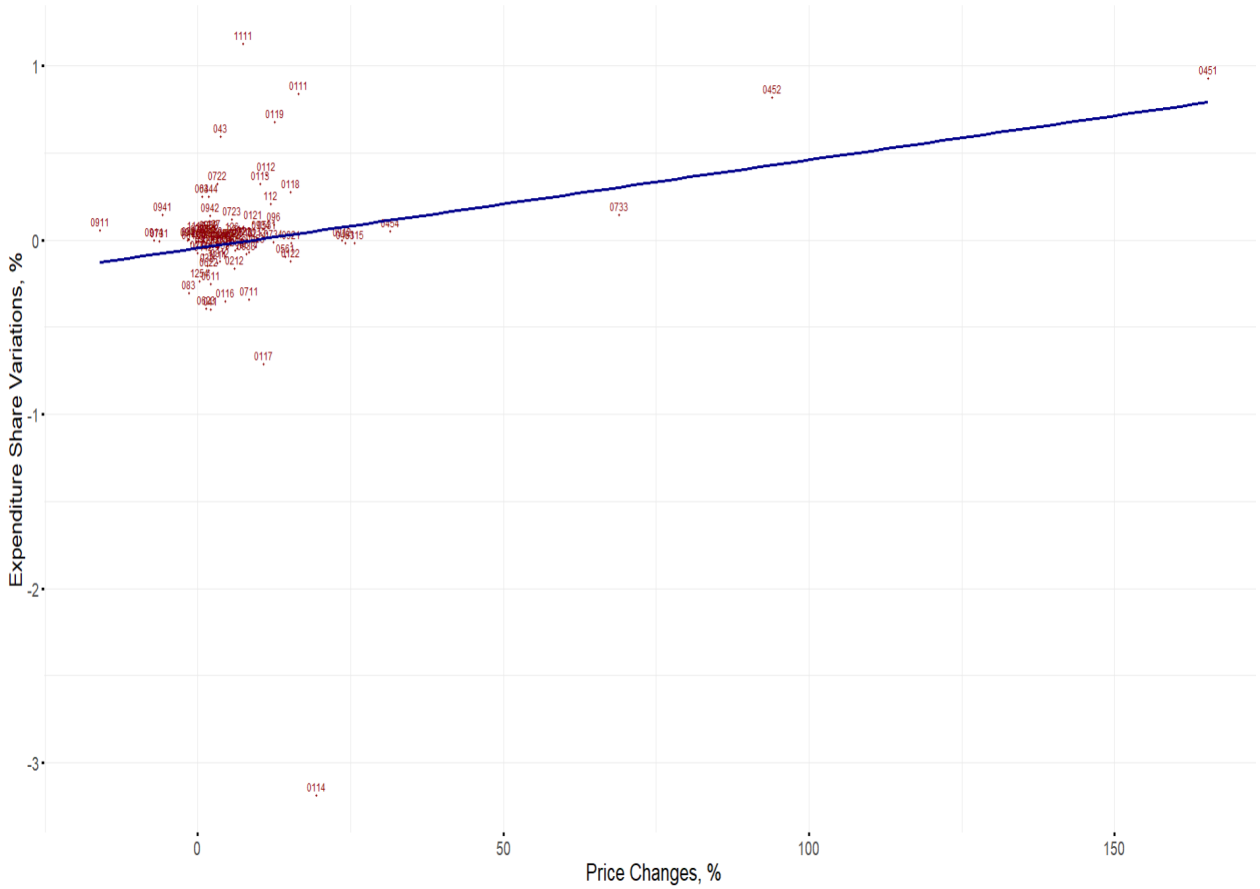

Figure 4: **Consumption share variations and price changes (2021-2022).**

The relationship between changes in quantities and changes in prices appears to be upwards, i.e. a larger price increase between 2021 and 2022 is associated with a larger share in the 2022 consumption bundle for a generic good x. This counterintuitive evidence actually explains why the Paasche price index has been larger than the Laspeyres price index over the whole year. Furthermore, when we exclude the two northeast outliers, i.e. gas (0452) and electricity (0451), the relationship between price changes and expenditure share variations turns out to be slightly downwards, which is consistent with the theoretical - even though weak - substitution effect prediction (see Appendix B).

Finally, Figure 5 draws the consumption share variations of both energy goods for all deciles between 2021 and 2022. Despite both gas and electricity prices have more than doubled over 2022, their relative weights on household consumption bundles have actually increased. This evidence is robust across the entire population and is especially significant for the lower deciles of the expenditure distribution. The observed consumption dynamics are likely explained by the fact that both gas and electricity are necessities rather than luxury goods and their demand is particularly rigid with respect to sudden unanticipated price shocks.[8]

[8]There exists a sizable literature documenting that the short-term elasticity of household energy consumption is generally very low and that households usually take several years to adapt their behavior to energy price shocks (e.g. Boonekamp (2007), Lijesen (2007) and Zhu et al. (2018).

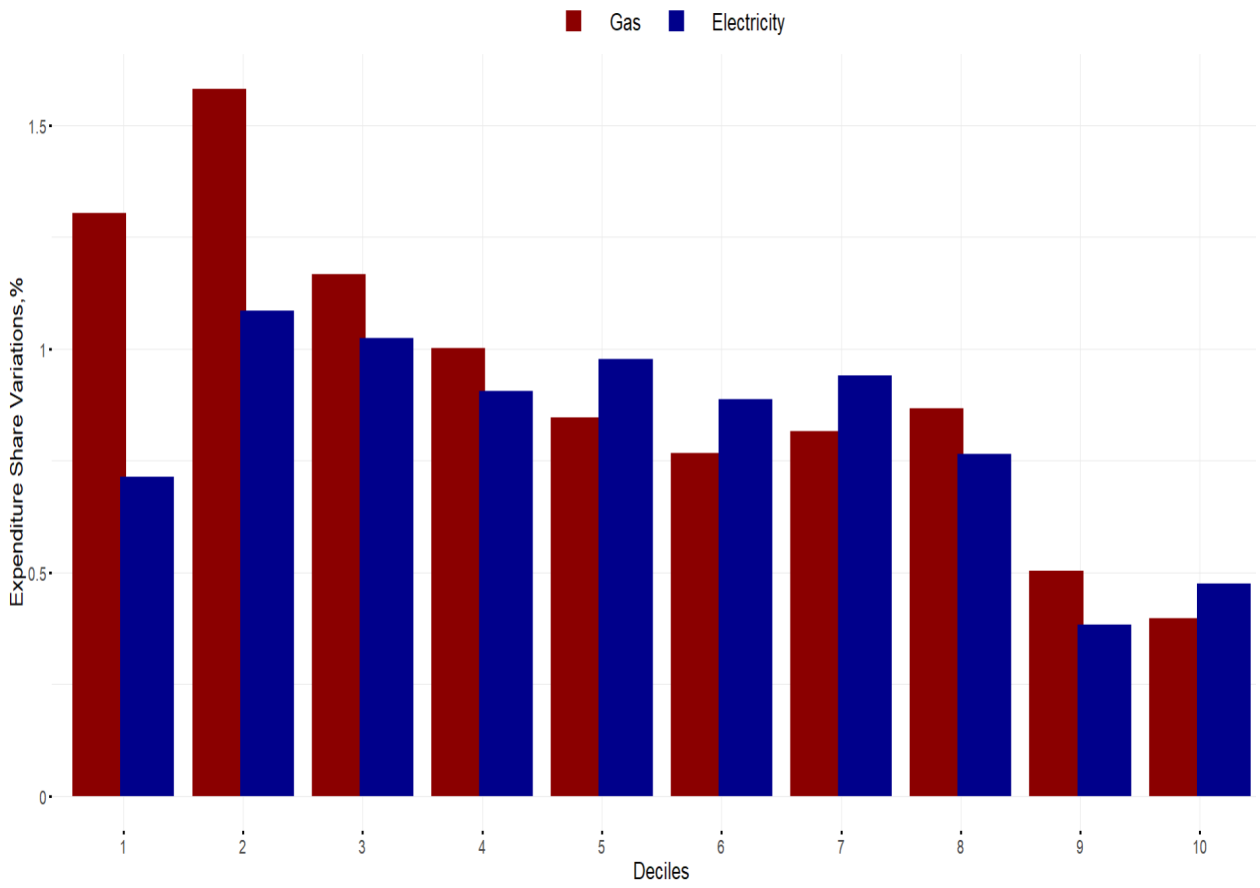

Figure 5: **Consumption share variations of gas and electricity by decile (2021-2022).**

All in all, the recent abrupt inflationary episode seems to have caused, at least temporarily, a relatively small drop in the consumption of energy goods and a larger reduction in the consumption of luxury goods with the net effect of increasing the relative importance of gas and electricity on household expenditure bundles. In other words, in the recent inflationary context driven by energy price shocks, income effects rather than substitution effects seem to have prevailed.

Although we do not find any evidence of substitution effects from energy goods to other expenditure categories, it may still be possible that households have revised their consumption choices in response to inflation dynamics, but that substitution has occurred *within* product categories rather than *between*. Instead of shifting consumption from expenditure categories whose prices were increasing above average to others whose prices were rising less than average, households may have chosen to purchase, for each given expenditure category, products of lower quality and lower variety. Unfortunately, because of the lack of detailed micro proprietary data, we cannot rule out this scenario. As far as between category substitution is concerned, we find no supporting evidence, even in the face of sharply increasing energy prices.

3.3 Disaggregation matters: a simple decomposition of the bottom-top differential inflation

Before considering the main drivers of recent inflation inequality developments, we would like to stress the importance of using as disaggregated as possible data when studying the heterogeneous impact of price growth across the population.

Most of the traditional works investigating the distributional consequences of inflation have been forced to rely on relatively coarse consumption decision-product price information.[9] This data limitation often leads to underestimate the inflation dispersion across households, as most of the variation in consumption lies within large categories rather than between (Jaravel (2019)).

For this reason, a recent body of research exploiting the higher granularity of scanner data is quickly growing (e.g. Kaplan and Schulhofer-Wohl (2017) and Faber and Fally (2022)). Because of data availability, most of these studies focus on USA inflation inequality-related episodes.

It is worth to point out that scrutinising within-industry price effects is beyond the scope of our work and that relying on proprietary data is not crucial in our case, as they cover only part of households' expenditure baskets and would not provide any additional information on energy price dynamics, which is at the hearth of the recent inflation surge in most advanced economies. However, to minimise the typical aggregation limitation of working with survey data, we opt to match first by hand HBS and ECOICOP data in a way to exploit all the available information. We manage at the end to gather up to 90 consumption categories which fall into either 3- or 4- digit price classification levels.

How does disaggregation affect estimates of inflation heterogeneity? The differential inflation between top and bottom income deciles can be decomposed into a *between* and a *within* component. The *between* component corresponds to the differential inflation that would prevail if households differed only in terms of their expenditure shares across product categories and faced the same inflation within each product category. The *within* component corresponds to the differential inflation that would prevail if households differed only in terms of the inflation rate they faced within a product category and had the same expenditure shares across categories. For any category of products G, the differential inflation between two household groups, e.g. the richest and the poorest, can be decomposed as proposed by Diewert 1976:

$$\pi^R - \pi^P = \sum_G s_G^R \pi_G^R - \sum_G s_G^P \pi_G^P = \underbrace{\sum_G s_G^R \pi_G - \sum_G s_G^P \pi_G}_{Between} + \underbrace{\sum_G \overline{s_G}(\pi_G^R - \pi_G^P)}_{Within} \tag{5}$$

where s_G^i is the expenditure share of household group i on product category G and π_G^i the inflation faced by household group i on product category G. π_G and $\overline{s_G}$ are the average inflation rate and the average expenditure share for product category G, respectively.

[9] For example, Hobijn and Lagakos (2005) study the distributional consequences of relative price changes in the U.S. by exploiting only 19 product categories; Gürer and Weichenrieder (2020) investigate inflation inequality in a sample of 25 EU countries by leveraging just 30 expenditure categories; Crawford and Smith (2002) analyse the differences in the inflation rates experienced by different households in the UK by using 69 categories; Basso et al. (2023) estimate household-specific inflation rates at 2-digit level from 2006-2021 in Spain, they only exploit 4-digit level information when they study the most recent inflation surge.

Table 1 shows the between-within decomposition for differential inflation between top and bottom consumption expenditure deciles, over the whole period.

Aggregation level	Differential Inflation Rate	
	Percentage Points	% Explained
3- and 4-digit: N=90	0.96	100
2-digit: N=12	0.87	90.9

Table 1: **Differential inflation and aggregation bias (2015-2023).**

The full differential inflation between the richest and the poorest households is equal to 0.96% when measured at 3- and 4-digit levels of disaggregation, with N=90. The estimated inflation inequality falls by about 9% to 0.87%, when considering only the *between* component at 2-digit level, with N=12. That is, not looking up to 3- and 4-digit product categories, it would underrate the measured inflation difference between the top and the bottom deciles by almost one tenth.

The underestimation becomes even more serious if we focus on the core years of the recent energy crisis. Table 2 summarises the between-within decomposition for differences in inflation exposures between top and bottom consumption expenditure deciles, over 2021 and 2022.

Aggregation level	Differential Inflation Rate	
	Percentage Points	% Explained
3- and 4-digit: N=90	4.81	100
2-digit: N=12	3.95	82

Table 2: **Differential inflation and aggregation bias (2021-2022).**

Looking at 3- and 4-digit product categories (N=90) implies a differential inflation between the richest and the poorest equal to 4.81%. If we would limit our analysis to the standard 12 macro consumption categories, the estimated inflation inequality would fall by almost one fifth to less than 4%. Such an attenuation bias is not negligible, especially when the differential inflation between the two income groups is large, as it has recently been.

3.4 Drivers of Inflation Inequality

It should now be clear that heterogeneous inflation experiences across income and social groups mechanically emerge whenever relative prices change substantially since expenditure shares usually vary across households.
Figure 6 aims to show which kind of goods and services lie behind the recent surge in inflation inequality by plotting the price variation of all 90 consumption categories against the difference in expenditure shares between the poorest and the richest over the 2021-2022 period.

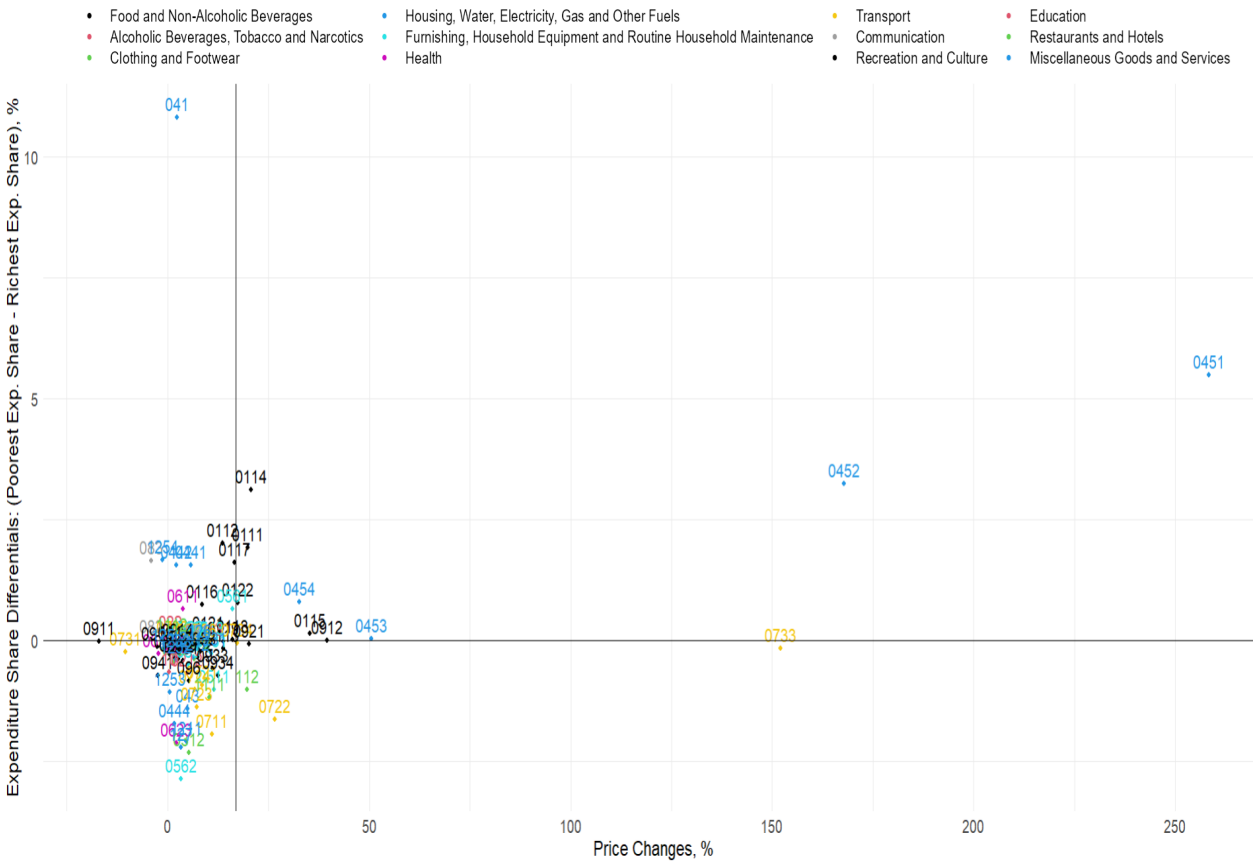

Figure 6: **Expenditure share differentials and price changes (2021-2022).** *Notes*: A numerically ordered listing of the category codes can be found in Appendix C. The x-axis represents the average aggregate inflation between 2021 and 2022. The y-axis measures the expenditure share differentials between the poorest and the richest deciles. Products above (below) the x-axis are more (less) consumed by the bottom 10% of Italian households.

After several years of distributional neutrality, the differential inflation between the bottom and the top deciles became substantial and reached almost 5 p.p. between 2021 and 2022. Figure 6 shows clearly why the consumption basket purchased by the poorest became so expensive relative to the bundle of the richest. The energy crisis following the outbreak of the Ukrainian war led both electricity (0451) and gas (0452) prices to abruptly increase by 258% and 168%, respectively. Expenditure shares on energy goods are traditionally the main difference across income group consumption patterns. In particular, the bottom decile used to devote an higher fraction of its total expenditure to both electricity (+5.5%) and gas (+3.2%) relative to the top decile. Therefore, the large energy price shocks made quite mechanically the poorest to face a much higher increase in the cost of their consumption basket relative to the richest. Few more things are worth mentioning. First, the rents (041) - which exhibited the highest expenditure share differential (+10.8%) for the bottom decile - partially limited inflation inequality since their price grew (2.3%) well below the official price index (17%). Furthermore, it is interesting to note that most of the products mainly consumed by the richest (e.g. domestic and household services, garments, hospital services, hairdressing salons and personal grooming establishments, etc.) were concentrated in the third quadrant, indicating that their prices have increased less than average between 2021 and 2022.

To highlight this last circumstance, Figure 7 shows the unweighted fraction of expenditure above or below the Harmonised Index of Consumer Prices for all deciles.

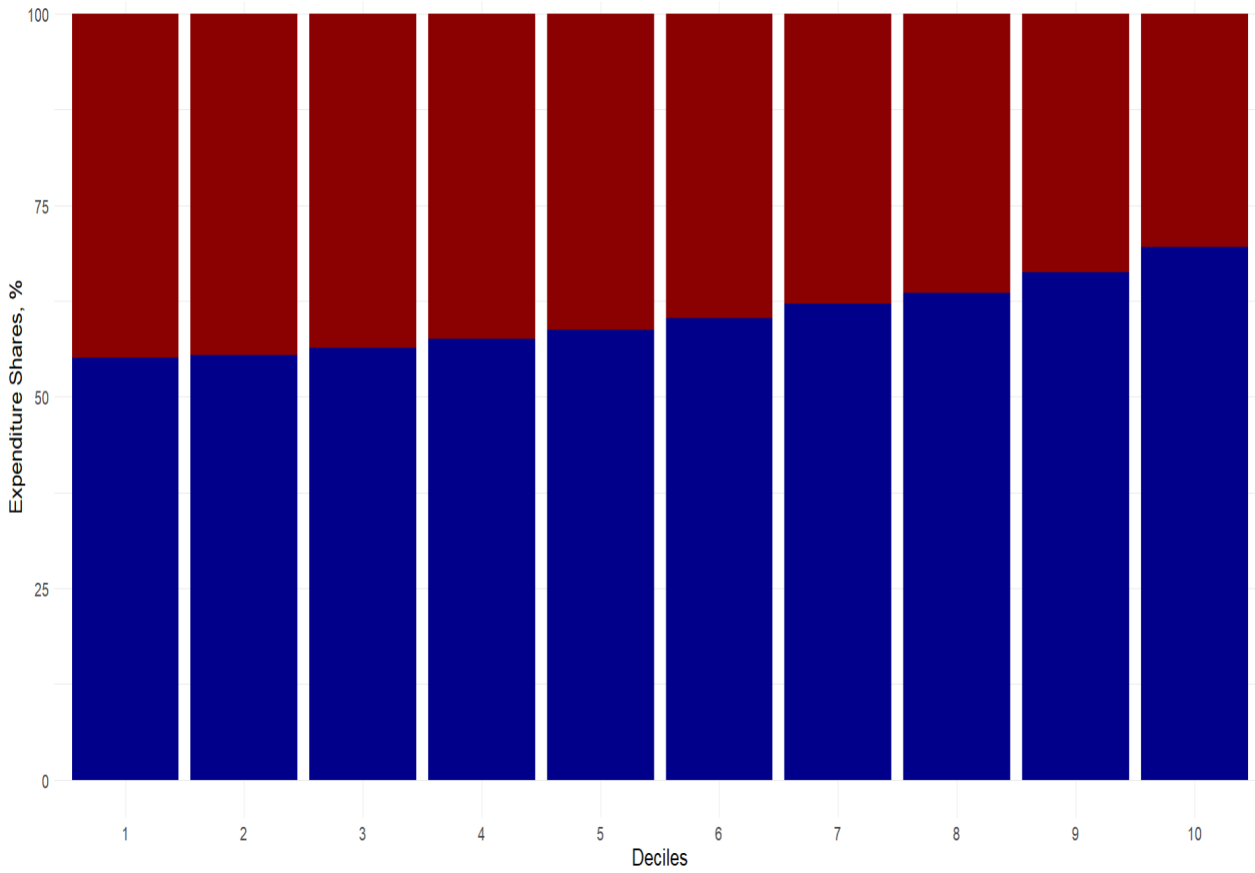

Figure 7: **Expenditure shares above or below the HICP by decile (2021-2022).** *Notes*: Expenditure shares represented in red (blue) had a price increase above (below) the Harmonised Index of Consumer Prices between 2021 and 2022.

Over the period 2021-2022, in addition to the crucial relevance of the expenditure on electricity and gas, slightly less than 50% of the consumption basket of the bottom decile has been exposed to a price increase above the HICP, but at the same time the richest have only seen around 30% of their bundle's price increasing faster than average.

Although energy price shocks have clearly played a primary role in determining the magnitude of the very recent inflation inequality episodes, other factors - such as very different consumption patterns across income groups - have contributed as well.

3.5 Multivariate regression approach

Relative price changes may have a distributional impact not only between income groups, but also across different social categories. A multivariate regression approach - where the dependent variable is the household-specific inflation rate and the explanatory variables are a set of socio-demographic observable characteristics - is a good way to capture

systematic differences in inflation experiences across household types.

We run OLS regressions for each available year and on the pooling of all the yearly cross-sections with the addition of a full set of time dummies. All the estimates are reported in Table 3. Each individual regressor refers to the highest earner in the household and any coefficient has to be interpreted relative to the corresponding reference category.[10] Some interesting regularities emerge.

	2015	2016	2017	2018	2019	2020	2021	2022	2023	Pooled
Intercept	-2.17^{***}	-2.86^{***}	3.40^{***}	3.12^{***}	0.09^{***}	-4.78^{***}	7.39^{***}	45.49^{***}	3.26^{***}	4.61^{***}
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.08)	(0.17)	(0.16)	(0.04)
Homeowner	-0.31^{***}	-0.30^{***}	0.41^{***}	0.30^{***}	-0.02^{***}	-0.45^{***}	0.93^{***}	4.02^{***}	0.58^{***}	0.81^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.01)
Center	0.00	-0.03^{***}	0.17^{***}	0.13^{***}	0.02^{***}	0.03^{***}	0.05^{***}	0.09^{***}	0.02	0.04^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.02)	(0.01)
South	0.06^{***}	0.06^{***}	0.05^{***}	0.10^{***}	0.04^{***}	0.13^{***}	0.12^{***}	0.19^{***}	0.23^{***}	0.12^{***}
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Log(Total Expenditure)	0.21^{***}	0.34^{***}	-0.27^{***}	-0.26^{***}	0.03^{***}	0.57^{***}	-0.75^{***}	-4.93^{***}	0.16^{***}	-0.78^{***}
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.02)	(0.02)	(0.00)
Woman	0.29^{***}	0.12^{***}	-0.12^{***}	-0.15^{***}	0.03^{***}	0.17^{***}	-0.13^{***}	-0.30^{***}	0.09^{***}	-0.04^{***}
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Adult (34<age<64)	0.08^{***}	0.00	-0.02^{**}	-0.04^{***}	0.01^{*}	0.01	0.00	0.55^{***}	-0.04	0.10^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.04)	(0.04)	(0.01)
Over 65 years old	0.43^{***}	0.11^{***}	-0.04^{***}	-0.03^{***}	0.05^{***}	0.08^{***}	0.07^{***}	0.92^{***}	-0.03	0.22^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.05)	(0.05)	(0.01)
Foreigner	0.35^{***}	0.17^{***}	-0.15^{***}	-0.21^{***}	-0.02^{***}	0.20^{***}	-0.41^{***}	-0.68^{***}	0.34^{***}	-0.06^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.05)	(0.04)	(0.01)
Graduate and Postgraduate	0.01	0.05^{***}	-0.00	-0.06^{***}	0.01	0.02^{**}	-0.07^{***}	-0.20^{***}	-0.10^{***}	-0.09^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.01)
Secondary Sector	-0.19^{***}	-0.08^{***}	-0.01	0.01	-0.05^{***}	-0.17^{***}	0.12^{***}	0.04	-0.25^{***}	-0.02^{*}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.05)	(0.04)	(0.01)
Tertiary Sector	-0.13^{***}	-0.06^{***}	-0.00	-0.03^{***}	-0.05^{***}	-0.12^{***}	0.05^{**}	-0.11^{**}	-0.29^{***}	-0.04^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.04)	(0.04)	(0.01)
Blue Collar	0.08^{***}	-0.02^{***}	0.03^{***}	0.05^{***}	0.01^{*}	0.04^{***}	0.07^{***}	0.18^{***}	0.15^{***}	0.07^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.02)	(0.01)
Self-Employed	0.00	-0.05^{***}	0.04^{***}	0.11^{***}	0.03^{***}	-0.04^{***}	0.18^{***}	0.73^{***}	0.08^{***}	0.16^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.02)	(0.01)
Non-employed	0.22^{***}	0.10^{***}	-0.04^{***}	-0.04^{***}	0.05^{***}	0.13^{***}	-0.16^{***}	0.09^{***}	0.22^{***}	0.05^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.01)
R^2	0.09	0.06	0.06	0.05	0.00	0.06	0.04	0.22	0.00	0.59
Adj. R^2	0.09	0.06	0.06	0.05	0.00	0.06	0.04	0.22	0.00	0.59
Num. obs.	186216	167340	171876	186852	202272	207204	286800	321924	316812	2047296

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Table 3: **Socio-demographic characteristics and household-specific inflation - regression estimates.**

[10]The reference categories in the multivariate regression are the following: Tenant (for Homeowner), North (for Center and South), Man (for Woman), Under 34 years old (for Adult(34<age<64) and Over 65 years old), Italian (for Foreigner), Undergraduate or less (for Graduate and Postgraduate), Primary Sector (for Secondary Sector and Tertiary Sector), White Collar (for Blue Collar and Self-employed) and Employed (for Non-employed).

The regression estimates clearly confirm our main conclusion, i.e. richer households as proxied by households spending more have been experiencing lower inflation very recently. In particular, the associated "2022" coefficient is negative and very large (-4.93), it is also statistically significant at 1% level of confidence.

The pooled OLS regression exhibits a very high R^2 because of the inclusion of a full set of year dummies - whose estimates are not shown in the table for the sake of legibility - which are always significant. At the same time, the low R^2 of the year-by-year regressions suggest that a significant portion in the variability of household-specific inflation rates takes place within socio-demographic groups, as well. Then, plotting the estimated coefficients for the most relevant household attributes and for each year is a helpful way to appreciate not only the level but also the changes over time of the relationship between individual characteristics and specific inflation experiences.

Figure 8, for instance, shows the regression marginal effects of the dummy associated with being a homeowner relative to being a tenant on the individual inflation rate experienced across the years.

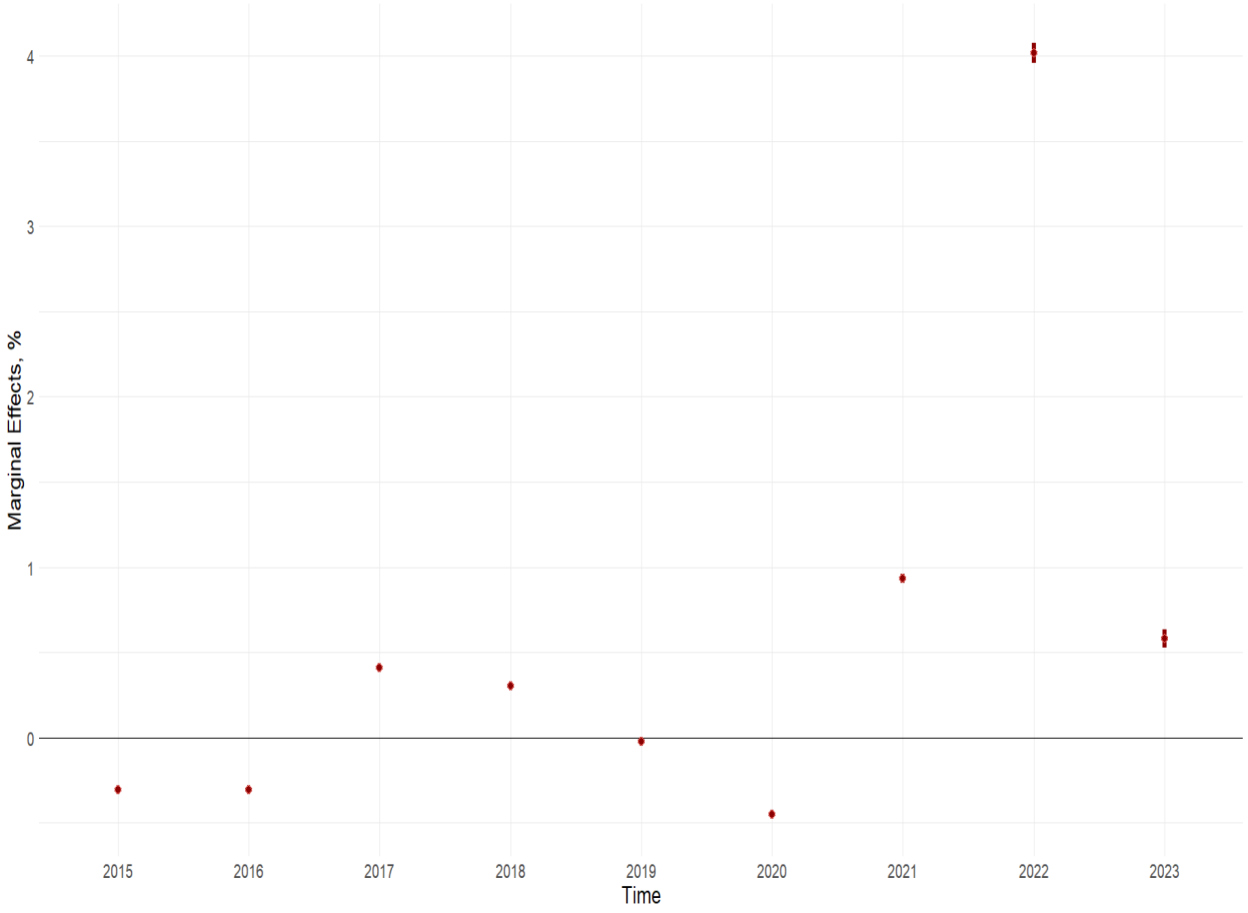

Figure 8: **Marginal effects on the specific inflation rate of the dummy variable "homeowner" (2015-2023).**

In line with our previous discussion, even though slightly counterintuitive at first glance, being a homeowner rather than a renter appears, *ceteris paribus*, to have been positively correlated with higher inflation expo-

sure especially over the last years. In a very recent work, Gros and Shamsfakhr 2023 have shown that rents have provided a partial offset for higher energy prices across the euro area on average, as they use to exhibit lagged inflation. Since rents in Italy have experienced extremely low (close to 0) growth since 2015, this is why - held constant all the other socio-demographic characteristics - homeowners have used to face higher inflation on average.

From our regression analysis, a geographical inflation pattern emerges as well. Households living in the Center and especially in the South (Figure 9) have seen on average their consumption bundle price to increase faster than that of households living in the North, once we control for their standards of living.
In Appendix D we run as a robustness check, the same regression by including regional dummies in place of territorial macroareas, the results are substantially identical (regional dummies themselves are not displayed for the sake of legibility).

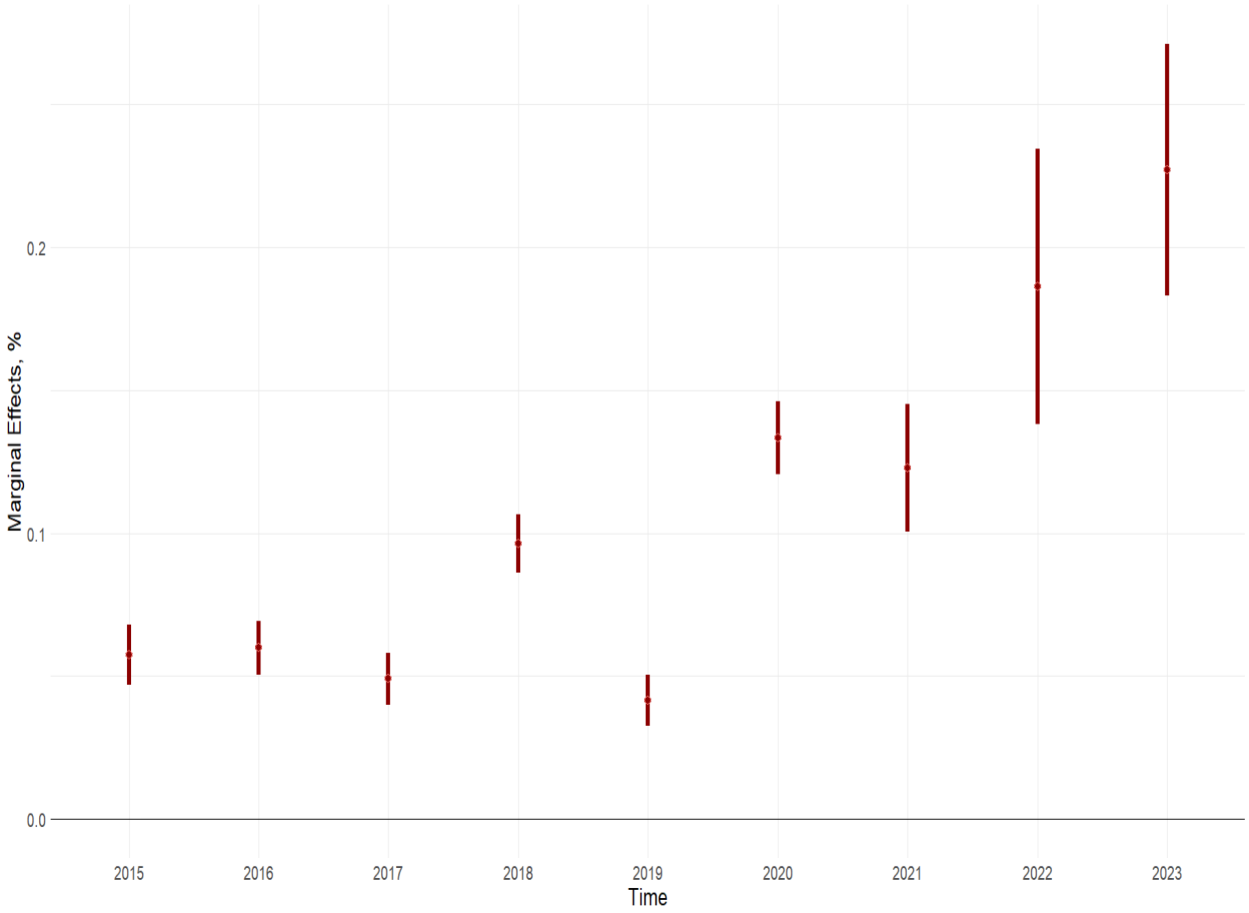

Figure 9: **Marginal effects on the specific inflation rate of living in the "South" (2015-2023).**

Furthermore, the multivariate correlations seem to suggest that the consumption basket of the elderly has been, *ceteris paribus*, consistently more expensive than the bundle typically purchased by younger people, on average, over most years (Figure 10).

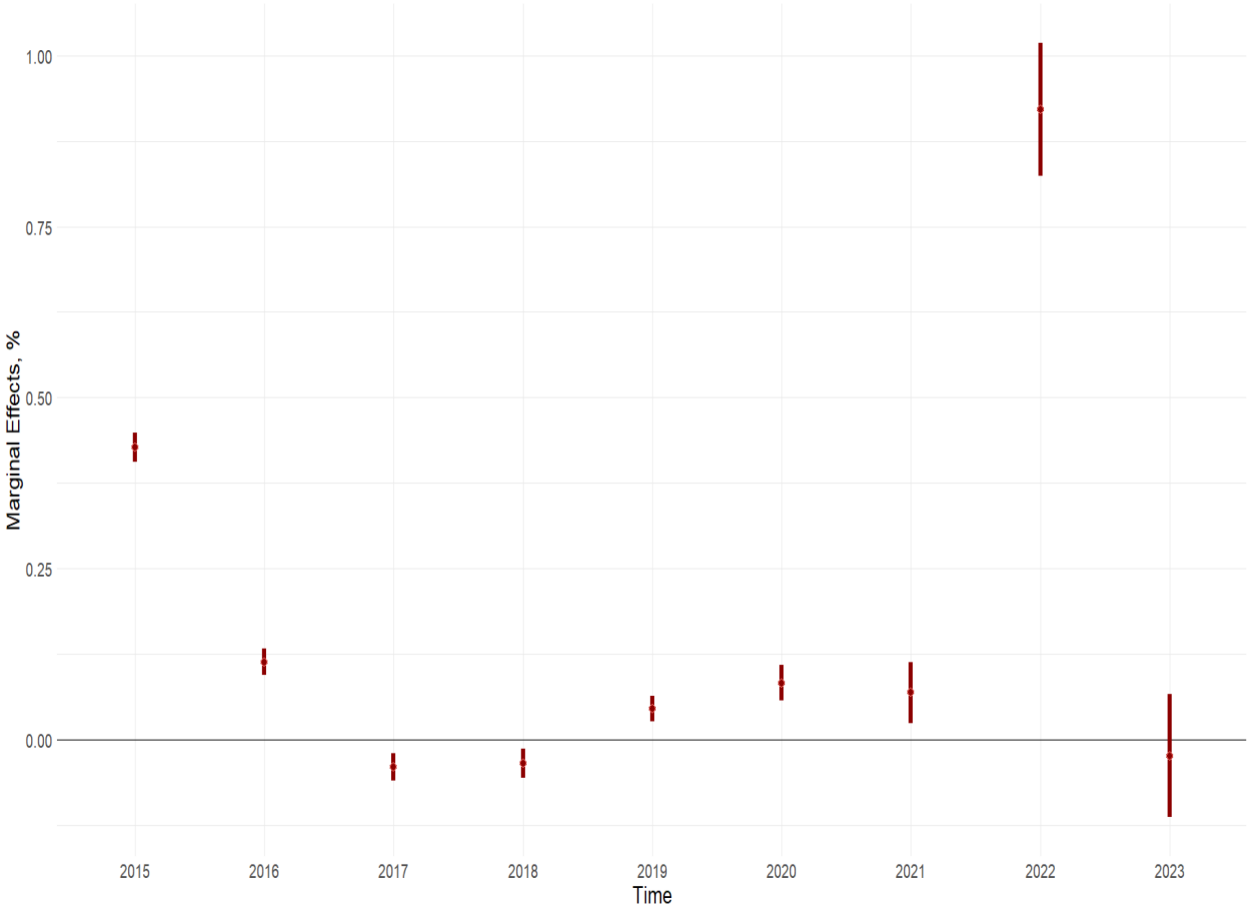

Figure 10: **Marginal effects on the specific inflation rate of "head older than 65" (2015-2022).**

In the life-cycle consumption literature, expenditure behavior during retirement is a highly investigated topic (see Hurst 2008 and Aguiar and Hurst 2013 for some references), but the sign of the association between age and inflation exposure is not clear *a priori*. For example, Crawford and Smith 2002 find that UK households whose head was of pensionable age experienced slightly lower inflation overall; in contrast, Hobijn and Lagakos 2005 conclude that the cost of living increases were generally higher for elderly people, in the USA, in large part because of their health care expenditures. Interestingly, the recent evidence by Basso et al. 2023 who investigate inflation dynamics in Spain between 2006 and 2021 - introducing controls for age, as well - supports our estimates.

Finally, since most of the heterogeneity in inflation experiences across income and social groups has arisen in particular in 2022, we find helpful to collect the single contributions of each household characteristic to individual inflation exposure over the year. Then, Figure 11 shows the estimated marginal effects of each income and socio-demographic attribute in 2022, all the other covariates held constant.

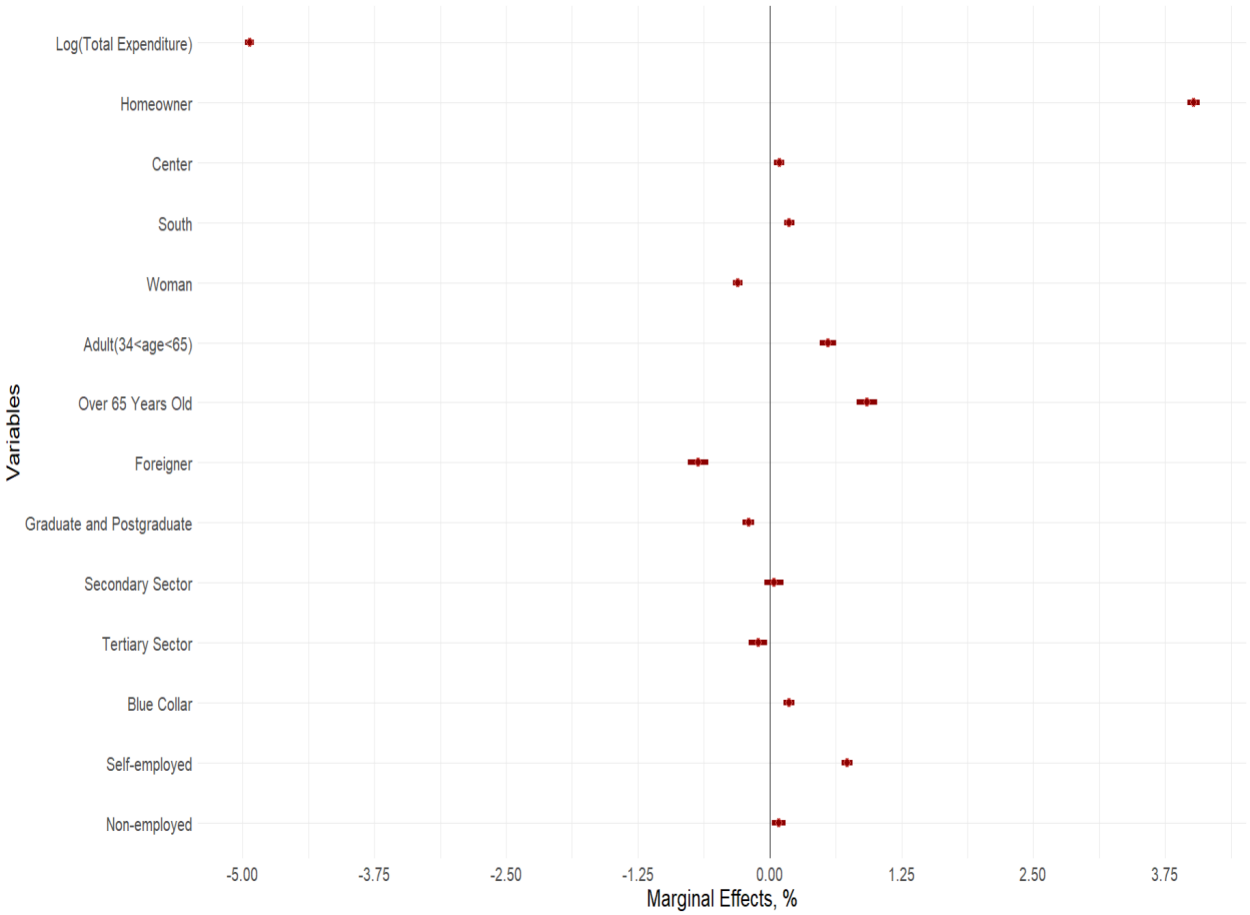

Figure 11: **All marginal effects on the specific inflation rate (2022).**

It is clear that differences in living standards have been crucial in determining household differential inflation, i.e. households with higher levels of equivalent expenditure have faced lower individual inflation rates over the year. On the other hand, being a homeowner - a circumstance usually positively correlated with personal income - has been associated with higher inflation exposure in 2022. Then - mostly due to their sluggish nature - the rent dynamics seems to have partially counterbalanced the inflationary pressure of energy shocks. This effect is likely to reverse over the next few years as rent prices will progressively embed the 2021-2022 inflation. Other socio-demographic characteristics that have contributed to spread inflation experiences across households at the hearth of the energy crisis have been geographical residence, age and professional position (e.g. blue-collars and self-employed have been exposed, on average, to higher inflation than white-collar workers over the year).

4 Concluding remarks

Since expenditure shares usually vary across households, substantial relative price changes may imply significant distributional consequences across the population. By construction, an aggregate price index - measuring the changing cost of a large consumption basket purchased by the representative household - cannot capture the differential effect

that large price shocks may have across households purchasing their own consumption bundle.
Combining the Household Budget Survey (HBS) and the Harmonised Index of Consumer Prices (HICP) data from Istat, we build a novel dataset including up to 90 expenditure categories (a combination of 3- and 4-digit products) for which price information is available. Then, we compute household-specific price indices in order to investigate the distribution of inflation rates across Italian households between 2015 and 2023 and to assess the heterogeneous impact of the latest energy price shocks across income and social groups.

Our analysis suggests that until early 2021 - a period when price growth has constantly been subdued - heterogeneity in household-specific inflation rates has been extremely low and aggregate price indices have been sufficiently representative of living costs for the whole population. However, the picture has drastically changed over the last few years. Following the food supply-chain disruptions due to the 2020 global pandemic and especially the energy crisis caused by the outbreak of the Ukrainian war in February 2022, the differential inflation between the bottom and the top expenditure deciles progressively widened to reach the maximum gap (15.3 percentage points) in October 2022. Over this period, the plutocratic aggregate price index has quite closely tracked the inflation experience of the higher expenditure deciles, but has underestimated the average price increase faced by the median household by more than 2 percentage points. The main drivers of recent inflation inequality dynamics have clearly been the staggering price increases of both electricity and gas, which represent a relatively higher share of lower decile expenditure bundles, but also quite generally different consumption patterns across income groups have contributed to exacerbate the differential inflation exposure. On the other hand, the rents - whose poorer households use to devote a larger fraction of their income - have provided a partial offset for higher energy prices because of their sluggish nature. By means of a multivariate regression approach we also show that relative price changes had a distributional impact not just between income groups, but also across different social categories. In particular, households living in the South, elderly, less educated people, blue-collars and non-employed have been exposed on average to higher inflation over the whole period. Few other interesting results emerge from our analysis.
First, by comparing the evolution of both Laspeyres and Paasche price indices until December 2022, we show that the Paasche index-based inflation rate has consistently been higher than the Laspeyres index-based inflation rate over the whole last year. We rationalise this counterintuitive result through the exceptional nature of the latest inflationary shock, which has been mostly driven by the manyfold price increases of energy goods. Both gas and electricity are naturally considered necessities rather than luxury goods and their demand is particularly rigid with respect to any price shock. These features may explain why, in the recent inflationary context, relying on consumption substitution has been almost unfeasible and income effects rather than substitution effects seem to have prevailed. Finally, by relying on a simple between-within decomposition of the bottom-top differential inflation, we stress the relevance of using the most disaggregated data available when studying the heterogeneous impact of price growth across the population. We find that ignoring 3- and 4-digit level information would underrate the specific inflation difference between the extreme consumption deciles by approximately one tenth over the whole period and by up to one fifth between 2021 and 2022, at the hearth of the energy crisis.

All in all, our work shows how even in a country, such as Italy, where inflation has not been traditionally pro-rich, exceptional circumstances may cause relative price changes to have serious distributional implications. In similar scenarios, aggregate price indices may not be very accurate tools for both the calculation of the actual cost of living for the "great majority of households" and the evaluation of several policy measures.

With all this in mind, future research may rely on individual or group-specific price indices to quantify the effectiveness of government interventions on reducing overall inflation together with their distributional impact. It may also be very interesting to replicate our study for countries characterised by historically higher inflation dynamics since the dispersion in the individual rates is likely to be larger and inflation inequality may actually have structural implications.

Appendices

Appendix A Checking for alternative equivalence scales

In this Section, we build alternative measures of our well-being proxy by using different equivalence scales. In the benchmark specification (see Section2), we scaled back non-durable expenditure by the square root of the number of household components; here, we test for the adoption of two alternative scales. The OECD equivalence scale (Förster and d'Ercole 2012) takes into account the size and composition of households by weighting children and adults differently. The Carbonaro equivalence scale (Carbonaro 1993), which is employed by ISTAT to estimate relative poverty, is based on a log-log estimation of the Engel curve for food expenditure.

In Figure 12 we show the quantile-quantile plots for differently scaled distributions of non-durable expenditure. There is no significant difference between applying the square root and the OECD scales. On the other hand, the Carbonaro-scaled distribution exhibits a larger right-side tail with respect to the other two, as it does not penalise larger families to the same extent.

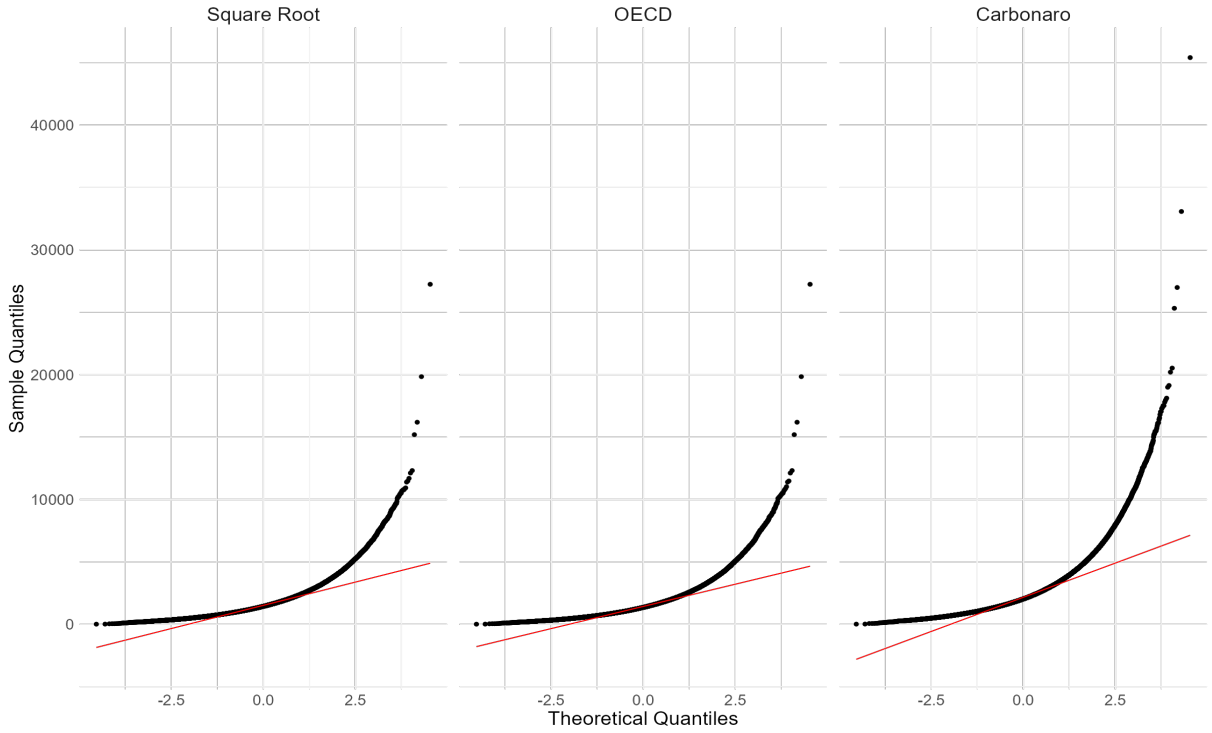

Figure 12: **Quantile-quantile plots for different scaled distributions of non-durable expenditure.**

Next, for each household in the sample, we compute the decile of non-durable expenditure to which they belong to and then we proceed to compute the rank correlation across the different equivalence scales. Results are displayed in Table 4. We adopt both the Spearman and Kendall metrics to assess whether two households would be sorted in the same

decile according to different equivalence scales. The correlations show that the three measures are actually very close in regard to their ordinal association.

Correlation Type	Kendall's Tau	Spearman's Rho
Square Root vs. OECD	0.98	0.94
Square Root vs. Carbonaro	0.96	0.88
OECD vs. Carbonaro	0.97	0.92

Table 4: **Kendall and Spearman rank correlations among non-durable expenditure deciles (2015-2023).**

Finally, we show the household inflation distribution by decile for the three equivalence scales in Figure 13. No qualitative difference between the alternative scales emerges. In all three cases, the pattern of inflation across deciles is the same. While the square root and the OECD equivalence scales track each other very closely, we detect a slightly smaller difference across deciles when using the Carbonaro scale, with the interdecile range of inflation being 2% smaller than what we find with the other two indicators.

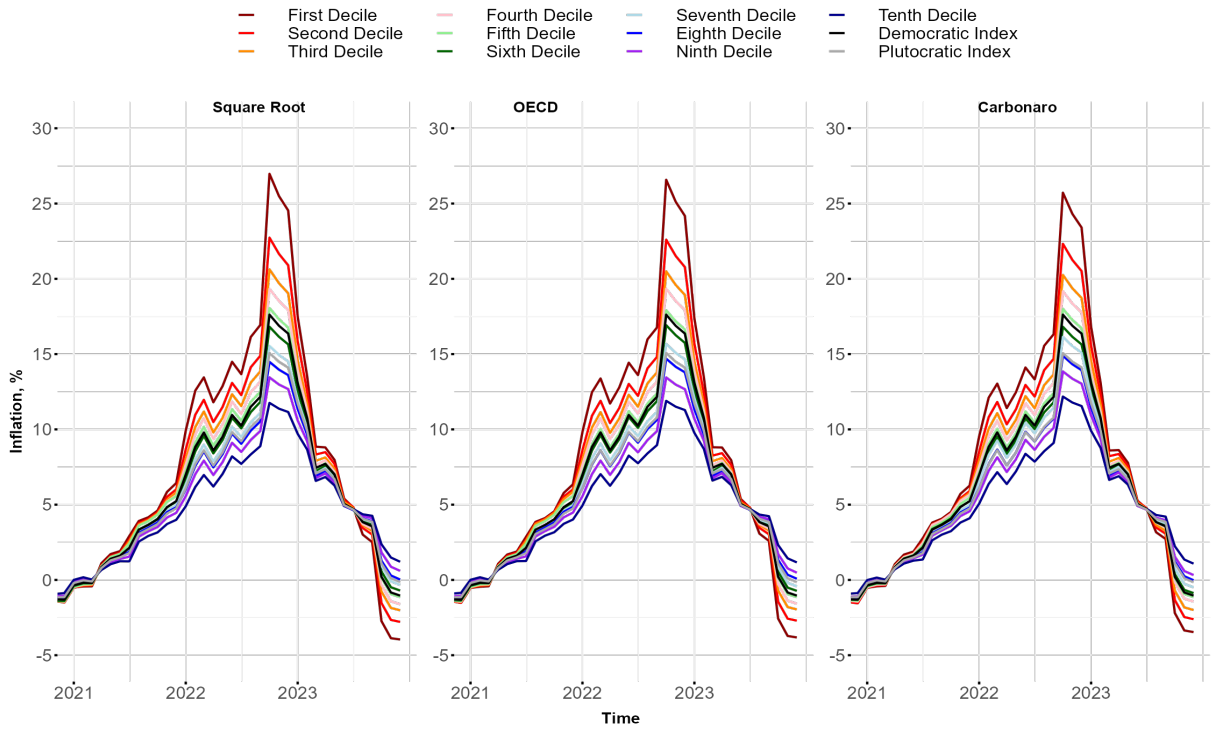

Figure 13: **Inflation rates by expenditure decile for each equivalence scale.**

Overall, our results appear to be highly robust to the adoption of different equivalence scales.

Appendix B Consumption share variations and price changes (2021-2022). No outliers.

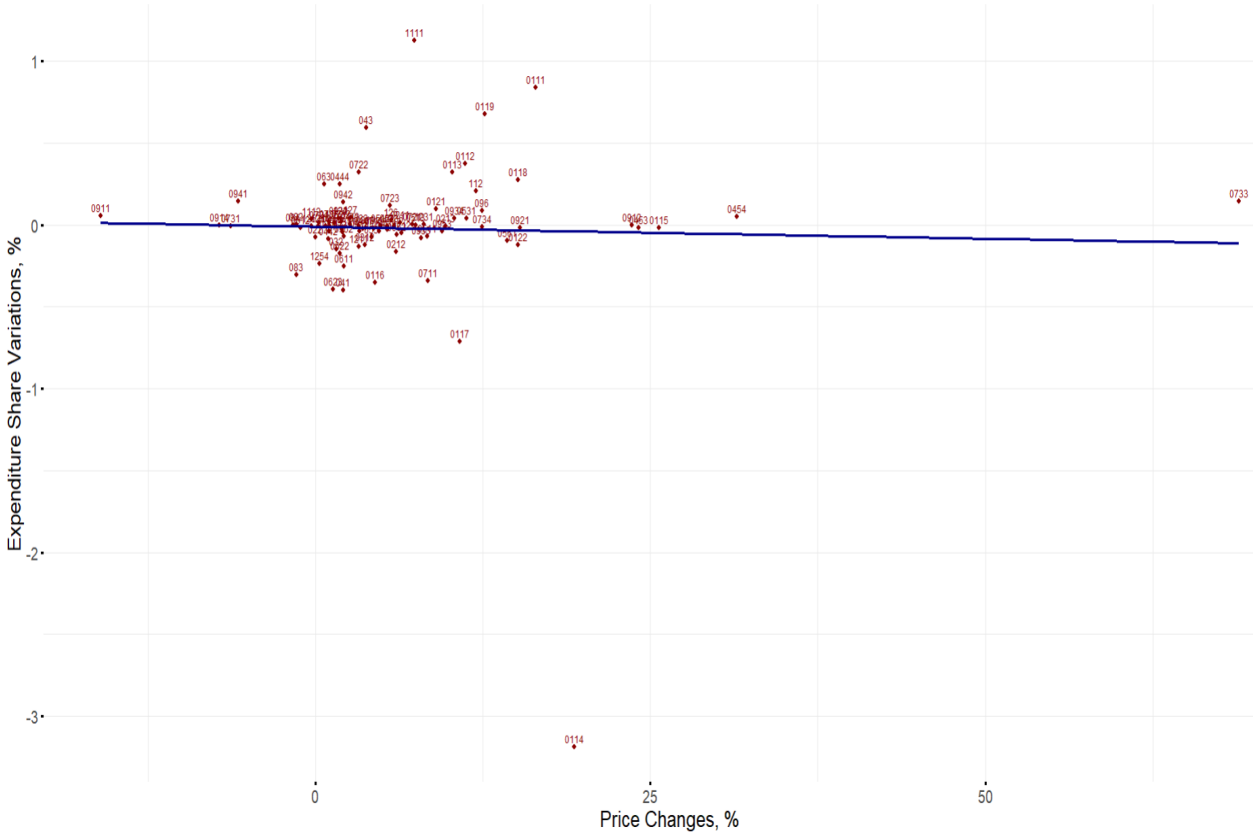

Figure 14: **Consumption share variations and price changes (2021-2022).** *Notes:* Gas and electricity have been ruled out.

Appendix C Expenditure categories and variable codes (ECOICOP classification)

Variable Code	Expenditure Category	Variable Code	Expenditure Category
0111	Bread and Cereals	0712	Purchase of Motor, Cycles and Bicycles
0112	Meat	0721	Spare Parts and Accessories for Personal Transport Equipment
0113	Fish and Seafood	0722	Fuels and Lubricants for Personal Transport Equipment
0114	Milk, Cheese and Eggs	0723	Maintenance and repair for Personal Transport Equipment
0115	Oils an fats	0724	Other Services in Respect of Personal Transport Equipment
0116	Fruit	0731	Passenger Transport by Railway
0117	Vegetables	0732	Passenger Transport by Road
0118	Sugar, Jam, Honey, Chocolate and Confectionery	0733	Passenger Transport by Air
0119	Food Products n.e.c.	0734	Passenger transport by Sea and Inland Waterway
0121	Coffee, Tea and Cocoa	0735	Combined Transport Passenger
0122	Mineral Waters, Soft Drinks, Fruit and Vegetable Juices	0736	Other Purchased Transport Services
0211	Spirits	081	Postal Services
0212	Wine	082	Telephone and Telefax Equipment and Telephone and Fax Numbers
0213	Beer	083	Telephone and Telefax Services
022	Tobacco	0911	Equipment for Reception, Recording and Reproduction of Sound And Picture
0312	Garments	0912	Photographic and Cinematographic Equipment and Optical Instruments
0313	Other Articles of Clothing and Clothing Accessories	0913	Information Processing Equipment
0314	Cleaning, Repair and Hire of Clothing	0914	Recording Media
032	Footwear	0921	Major Durables for Outdoor and Indoor Recreation Including Musical Instruments
041	Actual Rentals for Housing	0931	Game, Toys and Hobbies
043	Maintenance and Repair of the Dwelling	0932	Equipment for Sport, Camping and Open-air Recreation
0441	Water Supply	0933	Gardens, Plants and Flowers
0442	Refuse Collection	0934	Pets and Related Products Including Veterinary and Other Services for Pets
0443	Sewerage Collection	094	Recreational and Cultural Services
0444	Other Services Relating to the Dwelling n.e.c.	0941	Recreational and Sporting Services
0451	Electricity	0942	Cultural Services
0452	Gas	0951	Books
0453	Liquid Fuels	0952	Newspapers and Periodicals
0454	Solid Fuels	0953	Stationery and Drawing materials
0511	Furniture and Furnishings	096	Package Holidays
0512	Carpets and Other Floor Coverings	10	Education
0513	Repair of Furniture, Furnishings and Floor Coverings	1111	Restaurants, Cafes and the Like
052	Household Textiles	1112	Canteens
0531	Major Household Appliances Whether Electric or not	112	Miscellaneous Goods and Services
0533	Repair of Household Appliances	1211	Hairdressing Salons and Personal Grooming Establishments
054	Glassware, tableware and household Utensils	1212	Electric Appliances for Personal Care and Other Appliances, Articles and Products for Personal Care
055	Tools and Equipment for House and Garden	1231	Jewellery, Clocks and Watches
0561	Non-durable Household Goods	1232	Other Personal Effects
0562	Domestic Services and Household Services	124	Social Protection
0611	Pharmaceutical products	125	Insurance
0612	Other Medical Products and Paramedical Services	1252	Insurance Connected with the Dwelling
0622	Dental Services	1253	Insurance Connected with Health
0623	Medical Services and Paramedical Services	1254	Insurance Connected with Transport
063	Hospital Services	126	Financial Services
0711	Purchase of Motor Cars	127	Other Services

Table 5: **Expenditure categories and variable codes.**

Appendix D Household-specific inflation with regional dummies - regression estimates

	2015	2016	2017	2018	2019	2020	2021	2022	2023	Pooled
Intercept	-2.34^{***}	-2.48^{***}	2.86^{***}	2.22^{***}	-0.50^{***}	-5.80^{***}	6.39^{***}	44.57^{***}	3.76^{***}	6.98^{***}
	(0.04)	(0.03)	(0.04)	(0.04)	(0.03)	(0.05)	(0.08)	(0.17)	(0.15)	(0.04)
Homeowner	-0.28^{***}	-0.24^{***}	0.33^{***}	0.21^{***}	-0.08^{***}	-0.53^{***}	0.82^{***}	3.91^{***}	0.58^{***}	0.76^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.01)
Log(Total Expenditure)	0.22^{***}	0.29^{***}	-0.20^{***}	-0.17^{***}	0.09^{***}	0.68^{***}	-0.65^{***}	-4.86^{***}	0.12^{***}	-0.73^{***}
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.02)	(0.02)	(0.00)
Woman	0.30^{***}	0.13^{***}	-0.13^{***}	-0.15^{***}	0.03^{***}	0.17^{***}	-0.13^{***}	-0.32^{***}	0.08^{***}	-0.04^{***}
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Adult (34<age<64)	0.07^{***}	0.00	-0.03^{***}	-0.05^{***}	0.00	-0.01	-0.01	0.51^{***}	-0.05	0.08^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.04)	(0.04)	(0.01)
Over 65 years old	0.41^{***}	0.10^{***}	-0.05^{***}	-0.04^{***}	0.03^{***}	0.03^{**}	0.02	0.85^{***}	-0.07	0.19^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.05)	(0.04)	(0.01)
Foreigner	0.36^{***}	0.18^{***}	-0.14^{***}	-0.22^{***}	-0.04^{***}	0.18^{***}	-0.43^{***}	-0.73^{***}	0.33^{***}	-0.07^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.05)	(0.04)	(0.01)
Graduate and Postgraduate	-0.01	0.04^{***}	0.00	-0.04^{***}	0.01^{**}	0.04^{***}	-0.07^{***}	-0.20^{***}	-0.12^{***}	-0.09^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.02)	(0.01)
Secondary Sector	-0.19^{***}	-0.08^{***}	-0.03^{***}	-0.03^{***}	-0.06^{***}	-0.20^{***}	0.11^{***}	0.02	-0.24^{***}	-0.03^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.05)	(0.04)	(0.01)
Tertiary Sector	-0.15^{***}	-0.07^{***}	-0.03^{***}	-0.06^{***}	-0.08^{***}	-0.19^{***}	0.05^{**}	-0.09^{**}	-0.26^{***}	-0.04^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.04)	(0.04)	(0.01)
Blue Collar	0.09^{***}	-0.01^{**}	0.02^{***}	0.04^{***}	0.00	0.05^{***}	0.07^{***}	0.19^{***}	0.16^{***}	0.07^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.02)	(0.01)
Self-Employed	0.01^{**}	-0.05^{***}	0.04^{***}	0.11^{***}	0.04^{***}	-0.04^{***}	0.19^{***}	0.74^{***}	0.06^{**}	0.16^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.02)	(0.01)
Non-employed	0.23^{***}	0.11^{***}	-0.04^{***}	-0.04^{***}	0.05^{***}	0.13^{***}	-0.15^{***}	0.10^{***}	0.22^{***}	0.05^{***}
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)	(0.03)	(0.01)
R^2	0.10	0.06	0.06	0.04	0.01	0.08	0.04	0.22	0.00	0.60
Adj. R^2	0.10	0.06	0.06	0.04	0.01	0.08	0.03	0.22	0.00	0.60
Num. obs.	186216	167340	171876	186852	202272	207204	286800	321924	316812	2047296

$^{***}p < 0.01; {}^{**}p < 0.05; {}^{*}p < 0.1$

Table 6: **Socio-demographic characteristics and household-specific inflation including regional dummies - regression estimates.**

References

Aguiar, Mark and Erik Hurst (2013). "Deconstructing life cycle expenditure". In: *Journal of Political Economy* 121.3, pp. 437–492.

Amendola, Nicola and Giovanni Vecchi (2022). "Durable goods and welfare measurement". In: *Journal of Economic Surveys* 36.4, pp. 1179–1211.

Arrow, Kenneth J (1958). "The measurement of price changes". In: *The relationship of Prices to Economic Stability and Growth*, pp. 77–87.

Baldini, Massimo (2005). "Inflation inequality in Italy". In: *University of Modena and Reggio Emilia, mimeo*.

Bandyopadhyay, Sutirtha and Bharat Ramaswami (2022). "The representative agent bias in cost of living indices". In: *Bulletin of Economic Research* 74.1, pp. 155–178.

Basso, Henrique S, Ourania Dimakou, and Myroslav Pidkuyko (2023). "How inflation varies across Spanish households". In: *Banco de Espana Ocassional Paper* 2307.

Boonekamp, Piet GM (2007). "Price elasticities, policy measures and actual developments in household energy consumption–A bottom up analysis for the Netherlands". In: *Energy Economics* 29.2, pp. 133–157.

Carbonaro, Giuseppe (1993). "On defining and measuring poverty". In: *International Review of Sociology* 4.1-2, pp. 8–36.

Conti, Pier Luigi, Daniela Marella, and Andrea Neri (2017). "Statistical matching and uncertainty analysis in combining household income and expenditure data". In: *Statistical Methods & Applications* 26, pp. 485–505.

Corsello, Francesco and Marianna Riggi (2023). *Inflation is not equal for all: the heterogenous effects of energy shocks*. Tech. rep. Bank of Italy, Economic Research and International Relations Area.

Crawford, Ian and Zoe Smith (2002). "Distributional Aspects of Inflation". In: *Institute for Fiscal Studies Commentary* 90.

Curci, Nicola, Marco Savegnago, Giordano Zevi, and Roberta Zizza (2022). "The redistributive effects of inflation: a microsimulation analysis for Italy". In: *Bank of Italy Occasional Paper* 738.

Dalla Chiara, Elena, Martina Menon, and Federico Perali (2019). "An integrated database to measure living standards". In: *Journal of Official Statistics* 35.3, pp. 531–576.

Diewert, W Erwin (1976). "Exact and superlative index numbers". In: *Journal of econometrics* 4.2, pp. 115–145.

Engel, Ernst (1857). "Die Produktions-und Ernteerträge und der Getreidehandel im preussischen Staate". In: *Zeitschrift des Königlichen Preussischen Statischen Bureaus* 1, pp. 249–289.

Faber, Benjamin and Thibault Fally (2022). "Firm heterogeneity in consumption baskets: Evidence from home and store scanner data". In: *The Review of Economic Studies* 89.3, pp. 1420–1459.

Förster, Michael F and Marco Mira d'Ercole (2012). "The OECD approach to measuring income distribution and poverty". In: *Counting the poor: new thinking about European poverty measures and lessons for the United States*, pp. 27–58.

Garner, Thesia I, David S Johnson, and Mary F Kokoski (1996). "An experimental consumer price index for the poor". In: *Monthly Lab. Rev.* 119, p. 32.

Gros, Daniel and Farzaneh Shamsfakhr (2023). "Inflation and Inequality. Energy and Food Versus Rents." In: *Monetary Dialogue Papers* June 2023, European Parliament.

Gürer, Eren and Alfons Weichenrieder (2020). "Pro-rich inflation in Europe: Implications for the measurement of inequality". In: *German Economic Review* 21.1, pp. 107–138.

Hobijn, Bart and David Lagakos (2005). "Inflation inequality in the United States". In: *Review of income and Wealth* 51.4, pp. 581–606.

Hochmuth, Philipp, Markus Pettersson, and W Christoffer (2022). "A Nonhomothetic Price Index and Inflation Heterogeneity". In: *Unpublished Working Paper*.

Hurst, Erik (2008). *The retirement of a consumption puzzle*. Tech. rep. National Bureau of Economic Research.

Infante, Luigi, David Loschiavo, Andrea Neri, Matteo Spuri, and Francesco Vercelli (2023). *The heterogeneous impact of inflation across the joint distribution of household income and wealth*. Tech. rep. Bank of Italy, Economic Research and International Relations Area.

Jaravel, Xavier (2019). "The unequal gains from product innovations: Evidence from the us retail sector". In: *The Quarterly Journal of Economics* 134.2, pp. 715–783.

– (2021). "Inflation inequality: Measurement, causes, and policy implications". In: *Annual Review of Economics* 13, pp. 599–629.

Kaplan, Greg and Sam Schulhofer-Wohl (2017). "Inflation at the household level". In: *Journal of Monetary Economics* 91, pp. 19–38.

Lijesen, Mark G (2007). "The real-time price elasticity of electricity". In: *Energy economics* 29.2, pp. 249–258.

Schultze, Charles L (2003). "The consumer price index: Conceptual issues and practical suggestions". In: *Journal of Economic Perspectives* 17.1, pp. 3–22.

Zhu, Xing, Lanlan Li, Kaile Zhou, Xiaoling Zhang, and Shanlin Yang (2018). "A meta-analysis on the price elasticity and income elasticity of residential electricity demand". In: *Journal of Cleaner Production* 201, pp. 169–177.