

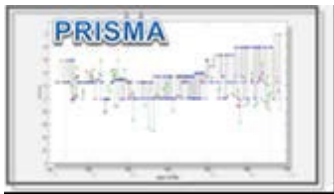


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Georg Strasser, Teresa Messner, Fabio Rumler,
Miguel Ampudia

Inflation heterogeneity at the household level



No 325

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This work is part of a set of papers within the ECB's Occasional Paper Series, resulting from the report of the ECB's PRISMA network, which is summarised [here](#).

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Contents

Abstract	3
1 Questions, concepts and data	4
1.1 Household heterogeneity	5
1.2 Aggregation	7
1.3 New data sources	7
2 Inflation heterogeneity between countries through the lens of household panel data	11
2.1 Inflation rates differ widely between countries in the euro area	11
2.2 Cross-country inflation differentials under the microscope	12
2.3 A single market – for differentiated goods	21
3 Inflation heterogeneity across households	24
3.1 Inflation at the household level	25
3.2 Price or basket heterogeneity?	26
3.3 Inflation by income	29
3.4 Causes of inflation heterogeneity at the micro level	37
4 Monetary policy and inflation inequality	39
5 Conclusion	42
References	43

Abstract

Inflation affects the purchasing power of households. This paper documents large, idiosyncratic inflation differences between households in their everyday shopping. Low-income households have experienced higher inflation in the last ten years, but the difference for richer households has been small and time varying. Household-specific behaviour appears to dominate inflation differences within countries. Between countries, multinational retail chains not only differentiate products by branding, but also charge different prices for identical products. Retailers continue to differentiate prices along national borders, even within largely integrated economic regions. Price changes, however, are broadly aligned across borders within the same retailers.

Keywords: inflation, consumer prices, heterogeneous agents, substitution, inequality.

JEL codes: D12, D3, D43, E31, F15, F4.

1 Questions, concepts and data

The Harmonised Index of Consumer Prices (HICP) aims to capture the inflation experienced by the average household. “The average” household, however, may not exist.

Households differ widely in their consumption baskets and in the prices they pay, which may lead to marked differences in the inflation rates they experience. Persistent inflation differences between households may have a wide range of macroeconomic implications, ranging from inequality due to policy effectiveness to welfare. For central banks, it is important to know whether and how inflation heterogeneity can affect the effectiveness of monetary policy. Whether monetary policy has a direct effect on inflation *heterogeneity* is equally important.

This paper¹ addresses three questions, mainly relying on a household panel at the highest level of granularity:

First: Is aggregate inflation representative for euro area households? If households or household groups experience persistently high inflation, despite aggregate inflation in line with the central bank’s policy target, this may impair acceptance of monetary policy and lead to a divergence of inflation expectations. It might raise subtle political economy questions such as “whom does aggregate inflation actually represent?” or “is monetary policy tailored to a privileged few?”. This paper examines inflation heterogeneity between households and household groups defined by income and country of residence.

Second: What causes inflation differences among households within and across euro area countries? The euro area is economically highly integrated and subject to a single monetary policy. Persistent inflation differentials reveal some underlying heterogeneity, which may give rise to concerns about the degree of integration of the euro area. Last but not least, if monetary policy has a (persistent) effect on inflation heterogeneity between households, it will have distributional consequences and thus side effects on welfare. In this paper, we look for the wedge that separates prices in one country in the euro area from another, and for the determinants of inflation heterogeneity between euro area households.

Third: Does inflation heterogeneity matter for monetary policy transmission in the euro area? Monetary policy may be transmitted to the macro economy primarily through specific household groups. For example, households may experience very different real rates due to time-varying inflation heterogeneity, despite identical nominal interest rates. The literature on heterogeneous agent models (or, more specifically, heterogeneous agent new Keynesian (HANK) models) suggests that any heterogeneity in the impact of monetary policy across agents would affect the overall effectiveness of monetary policy (e.g. Kaplan et al., 2018). Household heterogeneity may improve its effectiveness if the stimulus (inflation) goes hand in hand with a

¹ The authors would like to thank Lorenz Eichberger and Regina Kiss for excellent research assistance and Luca Dedola for comments.

redistribution from households with a low marginal propensity to consume (MPC) to those with a high MPC. In this paper, we examine whether and how ECB monetary policy affects inflation heterogeneity among euro area households.

1.1 Household heterogeneity

Households differ in multiple, economically relevant, ways. Correspondingly, household groups can be defined according to an almost infinite set of dimensions. Dimensions of interest include income or wealth, income risk and liquidity (Kaplan et al., 2018) and a wide range of correlated quantities, such as housing equity (Beraja et al., 2019).

The differences among households feed into differences in their MPCs (e.g. Auclert, 2019) and thereby cause differences in their consumption behaviour. If these differences also entail constraints to substitution, they result in even more divergent consumption behaviour. Another obvious dimension of household heterogeneity is the location of residence, which might entail region-specific preferences and local constraints in arbitrage and in the supply of goods and services. Beyond these, there are many other, more subtle, and nevertheless potentially relevant, dimensions capturing all kinds of household characteristics, ranging from household demographics to habits.

In this paper, we focus on the heterogeneity of households according to residence and income, using a household panel of transactions in grocery stores and drugstores.² The dataset classifies households according to income (or social status) and provides information on the household's residence. This allows us to calculate separate inflation indices by income group, and to study the dispersion of prices and inflation within and across countries and regions. As discussed below, the range of goods in the dataset is limited, but its granularity at the individual transaction level is unparalleled.

At the most granular level, household heterogeneity can be mapped into heterogeneity in transaction prices and in quantities purchased. Transaction costs limit the number of stores a given household can shop at and thus the *prices* it can choose from. Because households differ in their preferences, expenditure shares also differ, and therefore also the product *weights* in their consumption baskets.³

The (changes in) realised transaction prices and quantities purchased are the household-level observational analogues for the price changes and weights underlying the aggregate inflation rate, such as the HICP. To understand the causes of inflation heterogeneity, this paper distinguishes heterogeneity in prices

² The homescan data are provided by the Gesellschaft für Konsumforschung (GfK) and Kantar. The data appendix to this report includes a brief overview of this dataset.

³ Osbat (2022) discusses the implications of heterogenous consumer preferences on the measurement of the cost of living.

from heterogeneity in baskets, i.e. quantities. The main differences in household shopping behaviour, separately for prices and quantities (weights), are as follows:

Prices

Location. Prices of identical products may differ among countries and regions within countries, and even within the same retail chain.

Retailer. Prices of otherwise identical products differ between retailers and sales channels.⁴ If households differ in their shopping preferences, this price heterogeneity directly translates into price heterogeneity between households.

Household. This is further augmented by ad personam price differentiation, such as coupons or rebate cards.⁵ Due to its idiosyncratic nature, distinguishing ad personam price differentiation from sampling variation is empirically difficult.⁶

Quantities

Product category. Households differ in the composition of their baskets according to product categories (e.g. meat vs vegetables). As inflation often differs widely between product groups, this translates into different inflation rates for households.

Product variety. Within any given product category, households differ widely according to the specific products they pick, e.g. due to budget constraints, search effort, quality or brand preference. If the price trajectory differs systematically between varieties, e.g. between budget and high-end products, then heterogeneous household preferences translate into heterogeneous household-level inflation rates.

Substitution. Households differ in their willingness to change their consumption in response to price changes, i.e. in their price elasticity of demand. Households which respond more strongly to prices experience lower inflation than others when price indices take substitution into account.⁷

⁴ Retailers may differ from a household's perspective, not only in terms of the convenience of their store locations, but also their assortments, for example.

⁵ This price differentiation might apply to household groups with similar characteristics, not just a single household. It may be time-varying (e.g. via algorithmic pricing). Because the number of panellists in household scanner data is small relative to the heterogeneity among households (observed and unobserved), a large share of price differentiation between household groups appears as household-specific differentiation.

⁶ For example, a given household might experience the same prices as any other, and buy a certain product at a fixed frequency. At random times, it might be picking up a product for a sale price, which is not due to ad personam price differentiation, but just the coincidence of the purchase and the sale offer. Please refer to the box "Indices from household scanner data: data considerations" for an overview of the limitations and specifics of household scanner data.

⁷ An inflation index based on past quantities, such as the Laspeyres index, would be the same between both groups of households, if a price is available for both periods.

1.2 Aggregation

This paper compares the inflation rates of individual households or groups of households. When calculating an inflation rate for a group defined according to some dimension of interest, such as households within a certain income range, we implicitly assume that this group is otherwise homogeneous. For example, *within* each income group, households are aggregated according to their purchases, so that each income group index is a plutocratic index in itself. However, we refrain from calculating a single summary measure of inflation per country, i.e. from aggregating (and weighting) sub-indices (see, for example, Almas, 2012, and Beck and Jaravel, 2020, for welfare comparisons across countries).⁸

1.3 New data sources

The traditional approach to studying inflation inequality had to rely on household budget surveys (HBSs).⁹ HBSs provide the expenditure shares of product categories (Classification of Individual Consumption According to Purpose – COICOP) for several household groups, typically income groups. These expenditure shares are then combined with the corresponding HICP sub-indices, to calculate inflation rates which take the (category) differences in spending between households into account.

The broad coverage of HBS enables an analysis of price indices that reflects the full consumption spectrum covered by the HICP. It is therefore possible to calculate HICP-style inflation by income group, i.e. an inflation rate that covers not only supermarket items, but also heating and vacation expenses (Hobijn and Lagakos, 2005, and Ampudia, 2020).

An approach that relies on HBS data, however, comes with three limitations. First, it cannot account for differences in the price paid by different households. Second, the quantity information is rather coarse, i.e. only broad product groups are available. Third, the publicly available information is often stale and does not provide information about other household characteristics.

Household panels score here but are limited to typical supermarket items. The households in such panels report their purchases of fast-moving consumer goods (FMCG)¹⁰. For each transaction, the panel contains both price and quantity, and information on the store and the household, together with household characteristics.¹¹ Due to unique product identifiers¹², exact product comparisons are

⁸ See Osbat (2022) for a discussion of the relationship and relative merits of statistical indices versus utility systems. Recent academic literature imposes a tight preference structure, which leads to strong conclusions.

⁹ The household budget survey is a set of national surveys collated by Eurostat. Scientific-use files are available for 26 European countries, most recently for the year 2010. The analogue for the United States is the consumer expenditure survey (CES) of the Bureau of Labor Statistics.

¹⁰ Fast-moving consumer goods primarily consist of food, alcoholic and non-alcoholic drinks and pet food, as well as household cleaning and personal care items.

¹¹ For data limitations: see data appendix.

¹² The most common barcode in the sample is the European Article Number (EAN).

possible, even between countries. Each record represents an actual transaction, not a price quote.

The observation times are, by construction, not synchronised between households. Because shopping trips can occur on any day of the month and because the purchased products differ between trips, any dynamic analysis requires some form of aggregation over time. This paper uses an unbalanced household panel spanning the years 2005 to 2018. Only the years 2013 to 2018 are available for all 16 countries in the sample.

FMCG are a key area of household heterogeneity. Households can choose FMCG from an utterly endless menu of differentiated varieties and brands. Other components of goods consumption are at least equally differentiated but constitute a smaller share of consumption. In the euro area, the consumption of clothing, footwear, furnishings and household items, taken together, for example, adds up to only half of the expenditure on food and beverages.¹³ Therefore, FMCG are likely to provide general insights into the share of consumption comprising highly differentiated goods, which may potentially even extend to differentiated services, including health, communications, recreation, restaurants and culture. The energy component of consumption, in contrast, is a rather homogenous good. Households differ considerably in terms of how much they spend on energy as a share of their income, but are likely to be subject to similar energy prices and inflation. This latter component of inflation heterogeneity is therefore well captured with the HBS approach described above.

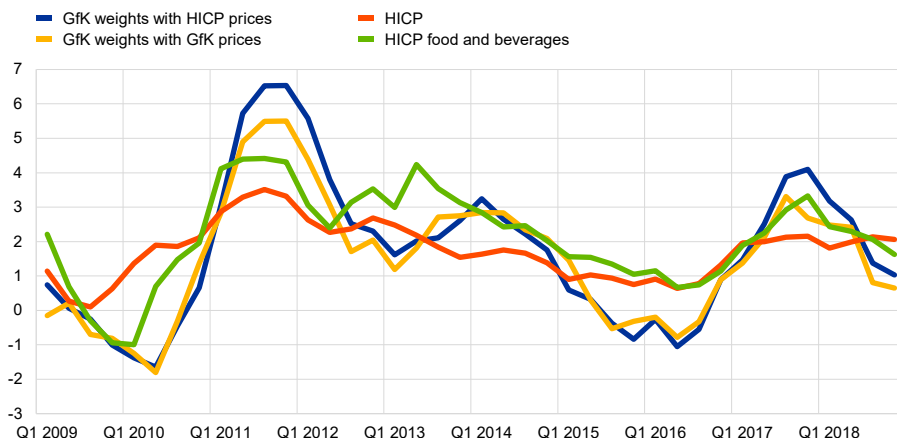
The emerging availability of household panel data allows for some of the longstanding questions on inflation heterogeneity to be revisited. In this paper, we examine whether the conclusions of HBS-based studies can be traced to actual purchases by individual households, and their heterogeneity.

¹³ Based on Eurostat data from the year 2015.

Chart 1

Household panel inflation and aggregate inflation

(Austria, percentages p.a.)



Source: GfK household panel.

Notes: Average of household-level inflation rates with weights derived from GfK data and prices at the COICOP-5 level taken from the HICP statistics (blue line) and from household-level prices in the GfK dataset (yellow line) using all available transactions (i.e. in any product category); Laspeyres indices. HICP refers to headline HICP, and HICP food and beverages to the COICOP two-digit groups 01 "food and non-alcoholic beverages" and 02 "alcoholic beverages, tobacco and narcotics".

A Laspeyres index derived from the transactions reported by the household panel tracks aggregate HICP food inflation closely. They are highly correlated.

Chart 1 shows this in the case of Austria.¹⁴ The correlation between an index based on prices and weights of products available in the household panel is 85% with HICP food and beverages and 76% with headline HICP.

The similarity between the HICP and the index based on the household panel is remarkable, given the conceptual differences between the two. One apparent difference between a price index with a fixed basket, such as the HICP, and an index derived from household scanner data, is that the former follows the same elementary product over time, while in the latter, the composition of elementary products may change over time depending on the availability of the products in the household panel.¹⁵

The panel-based series shows a higher amplitude and, in most periods, a lower inflation rate. Despite the broader set of goods covered, the bottom-up index (blue line) has 1.8 times the variance of the HICP food and non-alcoholic beverage index (green line). The average HICP inflation on food and beverages during this period of 2.1% p.a. was similar to the inflation index calculated from microdata with HICP average prices of about 1.7% p.a.

The microdata-based indices capture time-varying substitution at the household level. When inflation is low in general, household-level inflation is even lower, which points towards substitution at the household level. During episodes of

¹⁴ This report shows results only for selected countries. Further results for Austria are reported in Messner and Rumler (2023) and for France and Germany in Kiss and Strasser (2022).

¹⁵ Calculating a price change between two periods at the household level requires at least one price observation in each period. Thus, although the index is a Laspeyres index, we need at least one household in each period buying that product.

higher inflation, however, household preferences seem to have shifted towards items with disproportionately increasing prices, which is not consistent with substitution (see the discussion in Osbat, 2022). The HICP index cannot capture this time variation due to its slow updating of weights. Overall, the properties of the panel-based series make it a good proxy for studying the micro dynamics underlying the HICP.

The gap between the index with HICP prices and the index based on transaction prices may reflect discontinued products at the household level, i.e. some households suspending the consumption of some products with relative price increases. The Austrian inflation shown in Chart 1, based on HICP average prices, is 1.7% p.a., i.e. marginally above inflation based on GfK average prices (yellow line) at 1.5% p.a. As the chart shows a chained Laspeyres index,¹⁶ this could be due to households not only reducing, but suspending, consumption of products with steep price increases, because only then are such products no longer included in the household-level Laspeyres index (because there is no subsequent price observation for this product for the household). While many or most households suspend consumption of more expensive products, the HICP is still based on on-shelf price observations, which enter the Laspeyres-based HICP based on consumption patterns before price increases.

This paper is organised as follows: after examining inflation heterogeneity between countries in Section 2, we take an in-depth look at inflation differences between households in Section 3. Section 4 studies whether and how monetary policy affects inflation heterogeneity between households, and Section 5 contains the conclusion.

¹⁶ We calculate the annual inflation rate of a given household in quarter t using only products that are bought by the household in quarters t and $t-4$. The price changes between t and $t-4$ of these products are aggregated with the products' share of the overall consumption of that household in quarter $t-4$ (the base period) as weights. Accordingly, in the following period, the composition of the household's basket may change due to substitution, implying an update of the weights. Thus, our index is a period-by-period chained index, which is another difference compared with the HICP, whose weights are updated at most once per year.

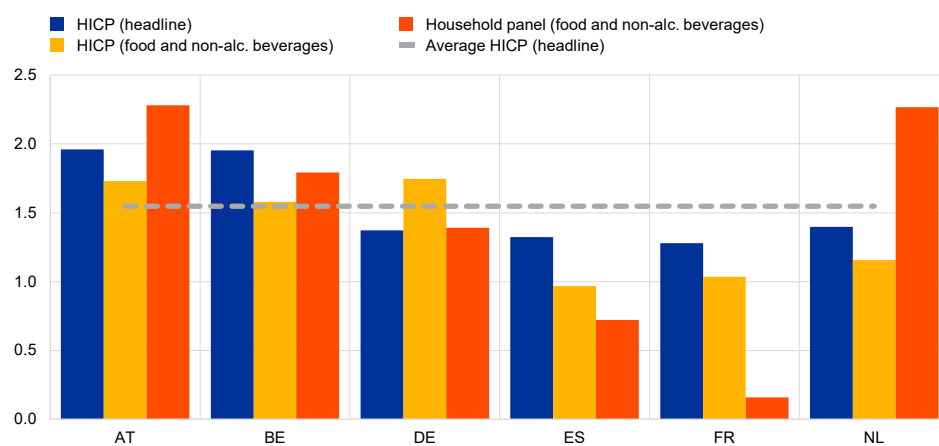
2 Inflation heterogeneity between countries through the lens of household panel data

2.1 Inflation rates differ widely between countries in the euro area

Aggregate inflation rates in the euro area differ considerably between countries. Such differences also persist over longer periods, even decades. Chart 2 shows that headline HICP inflation (yellow bars) in 2009-18 was only 1.3% p.a. in France and Spain but over 1.9% p.a. in Austria and Belgium. Inflation on supermarket items, calculated from actual household transactions (red bars), shows even more marked inflation differences between euro area countries, including rates of less than 0.2% in France and of more than 2.2% in Austria and the Netherlands.

Chart 2
Inflation rates in the euro area

(Selected countries, 2008-18, percentages p.a.)



Source: ECB calculations based on Eurostat data and GfK/Kantar household panel.

Notes: Average annual HICP inflation 2008-18. Household panel inflation is the geometric average of monthly year-on-year Laspeyres inflation rates, based on transactions in food (COICOP 1.1) and non-alcoholic beverages (COICOP 1.2).

Due to regulatory differences and trade barriers, inflation differences between any two countries are not surprising on a global scale. National borders often come with differences in taxes, currencies, preferences, per capita income and obstacles (time, distance) to crossing them, not forgetting differences in monetary and fiscal policies and restrictions on the movement of goods, services and factors of production. Accordingly, prices on each side of a border may differ substantially (Engel and Rogers, 1996; Gorodnichenko and Tesar, 2009).

Directly comparing the same products on each side of the Canada-United States border provides mixed results. Within a single retail chain, Gopinath et al. (2011) and Burstein and Jaimovich (2008) find larger price differences across the

Canada-United States border than within each of the two countries. In contrast, looking at multiple retail chains, Broda and Weinstein (2008) find that the variation of retail prices across and within countries is similar.

Within the euro area, however, one might expect borders to have lost their relevance for final good prices. All member countries are part of the European Union and share the same currency. However, despite a high degree of economic integration and the same currency within the euro area, borders¹⁷ continue to leave their mark on prices: various studies highlight large price differences between countries within Europe, even for identical goods, for example TV sets (Imbs et al., 2010) and cars (Dvir and Strasser, 2018). For grocery store products in 13 euro area countries, Reiff and Rumler (2014) find that cross-country price variation is by an order of magnitude larger than within-country price variation and that neither distance nor tax, consumption or income differences can fully explain this.

2.2 Cross-country inflation differentials under the microscope

The main obstacle to isolating the effect of a purely administrative border is controlling for other factors that differ between two countries.¹⁸ Within the euro area, such factors include differences in language, income, consumption preferences, and so forth. Furthermore, distances and the resulting respective transportation costs, matter: The further two locations are apart, the higher the cost of arbitrage between these locations and the greater the chance for deviating prices (see, for example, Reiff and Rumler, 2014). Beck et al. (2020) document median price differences for identical products between Belgium, Germany and the Netherlands of 15-20%.

If preferences were homogeneous on both sides of the border and if there were no costs of arbitrage, retailers would not be able to price to market. To better understand the microeconomic origin of price and inflation differences, this section zooms into a specific border region that is as close to a region with homogenous preferences as possible.

The Austrian-Bavarian border region is very close to this ideal setting. Making use of the geographical information on the households in our data, we define the region as a tight (approximately 60 km wide) band along the border, consisting of 19 equally sized sub-regions on either side (totalling 703 region pairs, 361 of which are cross border).¹⁹ This border region is not only part of the European Union, Schengen and euro area, but also uses the same language and tight highway and

¹⁷ Comparing online prices from large internationally active companies, such as IKEA, H&M and Nike, Cavallo et al. (2014) find that prices within the euro area are virtually the same, while they differ outside a monetary union, even if the currencies are de facto pegged, as in the case of Denmark. The type of product they compare is, however, notably different from our FMCG purchased at bricks-and-mortar shops.

¹⁸ This section summarises the results of Messner, Rumler and Strasser (2023).

¹⁹ See Messner, Rumler and Strasser (2023) for more information on the composition of the border regions.

railway infrastructure.²⁰ In addition, regional treaties for cross-border labour mobility have been in place for decades. Focusing on this economically and culturally integrated region eliminates most of the factors commonly used to explain the large price differences at borders, including distance, which becomes irrelevant in the limit.²¹ Given that even the local cuisine in the border region is very similar, it is plausible to assume similar preferences for food and beverage products, which dominate our sample of everyday household purchases.

2.2.1 Border effects in preferences, prices and inflation

Retailers can charge different prices for the same product when preferences for a specific product differ. To rule out differences in consumption preferences driving any observed price and price change differences²², we regress the pairwise correlation of the consumption baskets on a region dummy, indicating whether a region pair is within Austria (“AT” row) or across the border (“Border” row).²³

²⁰ In fact, the fastest connection between the Austrian regions of Tyrol and Salzburg is through Bavaria, via the “Deutsches Eck”.

²¹ Distance is significant in similar regressions. The coefficients are, however, very small and the other results remain virtually unchanged.

²² Local costs on both sides of the border are very similar overall and can thus be excluded as a driver of cross-border price differences. Excluding (small) differences in VAT rates (i.e. using net prices rather than gross prices) does not alter the results, the cost of land as well as effective corporate tax rates (once local and federal taxes are considered jointly) are also similar. For additional details, please refer to Messner, Rumler and Strasser (2023).

²³ We regress the pairwise correlation of the consumption baskets, i.e. the annual expenditure shares at the five-digit COICOP level for each of the 703 region pairs on a region dummy, indicating whether a region pair is within Austria (AT) or across the border (Border). Furthermore, we include a time trend (Common or DE trend) and its interaction with the region dummy in the regression (AT trend, Border trend).

Table 1
Border effect

(estimation coefficients)

	(1) Basket correlation (COICOP-5)	(2) Common barcode share	(3) Absolute price difference	(4) Absolute price change difference
Constant (DE)	0.88*** (0.00)	0.16*** (0.00)	8.11*** (0.40)	11.21*** (1.14)
AT (additional)	0.04*** (0.00)	0.08*** (0.00)	2.91*** (0.52)	2.30 (2.02)
Border (additional)	-0.10*** (0.00)	-0.14*** (0.00)	15.31*** (0.70)	4.64*** (1.41)
Common trend (DE)	0.004*** (0.00)	0.001*** (0.00)	0.00 (0.00)	0.01 (0.01)
AT trend (additional)	-0.003*** (0.00)	-0.005*** (0.00)	0.01 (0.01)	0.04 (0.03)
Border trend (additional)	-0.01*** (0.00)	-0.001*** (0.00)	0.01 (0.01)	-0.01 (0.02)
Frequency	Year	Year	Bimonth	Bimonth
Observations	7,733	7,733	333,733	44,294
Adj. R-squared	0.49	0.93	0.12	0.07

Source: Messner, Rumler and Strasser. (2023) based on the GfK household panel.
Notes: Sample period 2008-18. 703 region pairs. This table presents the coefficients with (standard errors in parentheses, columns 3 and 4 robust, barcode-clustered standard errors) based on an Ordinary Least Squares (OLS) regression (3 and 4 include month and retailer controls). Dependent variables: (1) pairwise correlation of COICOP-5 composition of (annual) baskets of each region pair, (2) common barcodes in each region pair as share of all barcodes in the region pair, (3) absolute, within-retailer (log) price difference and (4) year-on-year price change difference of each region pair, bimonthly frequency. DE effect in (1) and (2) is the constant, in (3) and (4) sum of constant + avg. coefficient of retailer controls + avg. coefficient of month controls.

The cross-border correlation of consumption baskets is very high, but lower than within each country. Column 1 of Table 1 reports the estimated correlation of consumption baskets in regions within Germany, Austria and across the border. At the very detailed COICOP-5 level, the estimated within-country correlation is high and approximately equal in both countries (Germany 0.88 and Austria 0.88+0.04). Across the border, the correlation is significantly lower (-0.10). Nevertheless, a correlation coefficient of consumption baskets of 0.78 is still considerable²⁴ indicating that differences in consumption structures, i.e. preferences, may not be very relevant for cross-border price and inflation differences. Interestingly, the heterogeneity of consumption baskets between regions within each country has slightly diminished since 2008.

Households love buying different varieties. Running the same regression specification as before, but for common barcodes in each region pair (as the proportion of all barcodes in the region pair, Table 1, column 2), we find that the share of barcodes consumed by panellists in a given pair of regions and a given year is quite small – even within a country. In a given year, the panellists in any pair of German regions had on average only 16% of barcodes in common. Austria recorded a somewhat higher share of 24%, as reported in column 2.²⁵ Part of this might be due to the somewhat more homogeneous consumption baskets (preferences) in

²⁴ At a more aggregate COICOP-4 level, the cross-border correlation is 0.84.

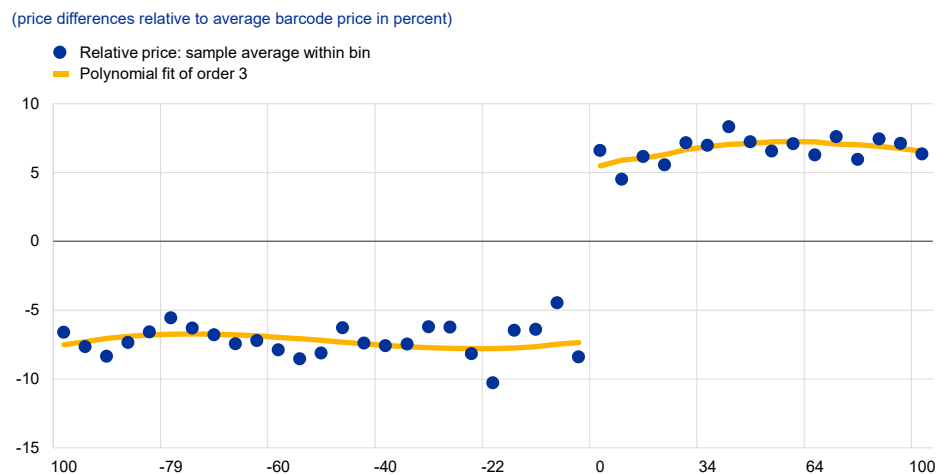
²⁵ This dependent variable is the average overlap in consumption between a random sample of households in roughly equal-sized regions, some of which are adjacent and others far apart. In population, the overlap would be higher, but our sampling indicates that the higher overlap would be driven by “exotic” households which do not have a single counterpart in our sample.

Austria, combined with a potentially somewhat smaller set of products offered in Austria.

Despite the similar consumption baskets and a highly integrated border region, the count of products consumed and available in both countries is small. Although the share of barcodes consumed by households within a country is already small, it is almost wiped out at the border. In cross-border terms, the share of common barcodes drops by 14 percentage points, down to only 2% for the average cross-border region pair. Particularly for fruit and vegetables, which are often loose unpackaged goods, but also beer, for which the region under consideration is famous, with many regional brands, the share of expenditure in common barcodes is small.²⁶

The consumption differences between regions are most pronounced for niche products, while international products tend to be high-volume items. The small share of common barcodes seems to suggest that the markets are largely isolated. This is, however, not the case, as the common barcodes reflect exactly those items with a high transaction volume. Comparing the barcodes available in each country (as opposed to the more granular regions in Table 2) shows that, in the spirits product category, for example, the share of common barcodes is only 8%. The share of transactions in these barcodes, however, adds up to around 26%, and the share of expenditure to around 35%. In the personal care product category, the share of expenditure in common barcodes reaches up to 50%. Below, we restrict our sample to these matched barcodes. We use the categories which are most bought by our panellists: food, non-alcoholic and alcoholic beverages, household maintenance, hobbies/pet food and personal care.

Chart 3
Relative prices in Austria and Germany



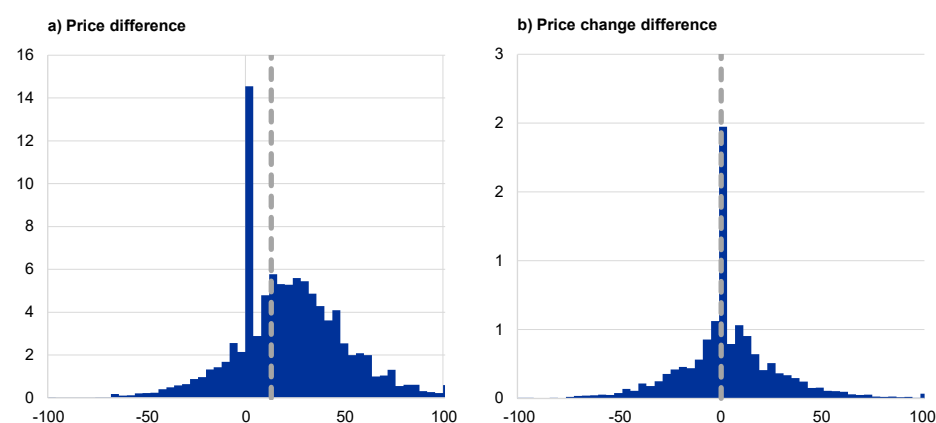
Source: Messner, Ruml and Strasser (2023) based on the GfK household panel.
 Notes: The chart plots relative prices as a function of distance from the border in an RD setting. Y-axis: (log) barcode price relative to average barcode price (703 region pairs) in per cent at bimonthly frequency. X-axis: distance from the border in kilometres, negative values refer to German regions. Restricted to the food, non-alcoholic and alcoholic beverages, household maintenance, hobbies/pet food and personal care categories.

²⁶ Argente et al. (2020) list differences between Mexico and the United States in the varieties and quality of products available as one of the primary sources of bias in international price comparisons.

Distance does not matter for price differences within a country. The results from a regression discontinuity design (RDD)²⁷ analysis, shown in Chart 3, demonstrate that average relative prices within Germany and within Austria are largely constant. At the border, however, there is a large discrete jump in relative prices. The chart also suggests a higher price level on the Austrian side of the border.²⁸

While most of the price differences are indeed zero, they deviate strongly in either direction. For each barcode, we can also define the relative price as the absolute and non-absolute (log) price difference²⁹ at a given store for a given region pair. These (non-absolute) price differences of cross-border region pairs are plotted in the left-hand panel of Chart 4. The chart shows that, while there are large price differences in either direction, the mode of the price differences is at zero.³⁰ This applies to around 14% of observations, which is significantly less than the within-country differences, where this share amounts to over 48% approximately within the Austrian regions and 56% within the German regions. Furthermore, the median price difference (dashed line) is positive, suggesting a somewhat higher price level in the Austrian regions.

Chart 4
FMCG price and price change differences across the border



Source: Messner, Rumler and Strasser (2023) based on GfK household panel.
 Notes: Left-hand panel: within-retailer non-absolute (log) price differences in per cent, and right-hand panel: within-retailer non-absolute year-on-year price change differences (361 cross-border region pairs) in percentage points at bimonthly frequency. Vertical lines represent weighted median. German prices are subtracted from Austrian prices. Restricted to the food, non-alcoholic and alcoholic beverages, household maintenance, hobbies/pet food and personal care categories.

The median absolute price difference is far larger across countries than within each country. While within Austria, the median absolute price difference is about 5%, and zero in Germany, the median difference of cross-border region pairs amounts to 19%.³¹ Revisiting the regression specifications above (the results of which are shown in column 3 of Table 1) also confirms the existence of a significant

²⁷ For similar applications, refer to Gopinath et al. (2011) or Beck et al. (2020). For further details on RDD, see Imbens and Lemieux, (2008).
²⁸ These results confirm the plethora of anecdotal evidence of people living in Austria and crossing the border for cheaper groceries.
²⁹ We always subtract German from Austrian prices.
³⁰ The set of products with the same prices on both sides of the border does not differ in any systematic way (brand, category) from products whose prices differ substantially.
³¹ Mean numbers are slightly higher: AT 15%, DE 10% and cross-border 24%.

border effect, suggesting that there is an additional price difference at the border of almost 15 percentage points.³² The overall size of cross-border price differences (DE effect + border effect) of approximately 23% is roughly in line with what Beck et al. (2020) report for Belgium, Germany and the Netherlands.

Despite the proximity and the similarities in the consumption structure, we also observe differences in inflation rates. Our dataset, which includes prices as well as quantities, allows us to calculate inflation rates from our data based on a common basket of products. When doing so, we find that, between 2008 and 2018, inflation was approximately 1 percentage point higher in the Austrian border region. By comparison, the official HICP inflation of food and beverages was virtually the same in both countries, while the overall HICP was only slightly higher in Austria over the same period.

Price changes are broadly aligned, as most price change differences are close to or at zero: however, there are large deviations in either direction (likely due to sales). Comparing price changes at the barcode level, we also observe that the mode of cross-border differences is at zero (right-hand panel in Chart 4). The symmetric distribution of cross-border price change differences might suggest that the mean difference thereof is somewhat smaller compared with that of price differences. This average, however, conceals (median) differences of 13 percentage points in either direction. Such differences may easily occur when products are on sale at irregular intervals, so that prices vary in both directions, both over time and between regions.

On average, there is a significant, but small, border effect for price changes. The median absolute price change differences within and across countries are rather similar, suggesting that there is no systematic difference at the border. When we regress price change differences on the region dummy and the variables mentioned earlier, the estimated coefficients (Table 1, column 4) suggest that price changes are not significantly more dispersed than within Austria (the additional difference at the border amounts to roughly 5 percentage points), and to a much lesser extent than in the case of price differences.

Cross-border price differences are more persistent than within-country price differences. In order to investigate whether consumers could benefit from price differences across the border, we regress price differences on its lag (one lag amounts to two months) and interact the lag again with the regional dummy, as in the preceding estimations. Overall, price differences appear to be only weakly correlated over time within countries (month-to-month autoregressive coefficient of 0.24), but significantly more so across countries (additional autoregressive coefficient of 0.28).

But their persistence is too small for households being able to fully exploit them. Kaplan and Menzio (2015) argue that US households seem to be unable to time their purchases in order to benefit fully from temporary sales (in a given store), but that some households do very well in assigning their purchases in stores where it

³² We ran alternative specifications, with only three regions in each country, at monthly and weekly frequency, which resulted in approximately the same border effect.

is cheaper on average. To incentivize cross-border arbitrage, price differences for a given product would have to be quite persistent. While our results indicate some persistence in the overall price level difference across the two countries³³, these price differences might not last long enough to be fully exploited by consumers.

2.2.2 Retail network versus national border

The above results suggest that consumers may gain from product-by-product arbitrage, but only little from blindly shopping across the border.³⁴ Such cherry-picking, however, requires careful price comparison. As suggested earlier, an overall autoregressive coefficient of 0.52 might be too small to justify a cross-border shopping trip. In other words, the incurred information cost (price comparison and keeping up with promotions across the border) might render cross-border arbitrage sufficiently unattractive for consumers (along the lines of Reis, 2006, and Nevo and Wong, 2019) and allow retailers to maximise their margins separately on each side of the border.

To analyse the role of retailers in cross-border price differences, we restrict the dataset to those supermarket chains which either exist on both sides of the border or use a common international sourcing service provider. This results in a set of six retailers active in both countries.³⁵ As noted in Nakamura et al. (2011), price setting varies strongly across retailers, and Burstein and Gopinath (2013) also argue that the differing results in Burstein and Jaimovich (2008) and Broda and Weinstein (2008) might stem from the differences in pricing across retailers. This raises the question of whether there are systematic differences between within-chain and across-chain cross-country price and inflation differentials.³⁶

³³ This also holds when using lags of different length. Due to data limitations, we cannot include several lags in one regression in this specification. Using bi-monthly data at higher regional aggregation (15 region pairs) this becomes possible. All autoregressive coefficients become even smaller, but nevertheless increase and almost double at the border.

³⁴ Large price differences are particularly evident among personal care products.

³⁵ See Messner, Rumler and Strasser (2023) for details.

³⁶ Beck et al. (2020) report that, in their sample for Belgium, Germany, and the Netherlands, the differences in retailer composition are minor.

Table 2**Border within retailers – price differentials****Absolute price difference in percent**

(estimation coefficients)

Retailer	Within Germany	Within Austria (additional)	Cross-country (additional)	Test cross-country = max. within country (p-value)
Supermarket A	9.9***	3.3***	16.4***	0.00
Supermarket B	11.6***	4.7***	16.5***	0.00
Discounter C	0.5	1.0	18.1***	0.00
Discounter D	6.2***	1.9**	15.1***	0.00
Discounter E	3.0***	3.2**	8.7***	0.00
Discounter F	7.5***	2.8**	13.0***	0.00

Notes: The table shows within-retailer country and border effect coefficients from OLS regression with region and retailer interactions, time trends (barcode-clustered standard errors), without constant. Period 2008-18. Dependent variable: absolute, within-retailer log price difference at a bimonthly frequency. Observations: 333,733. Adjusted R-squared: 0.46. Last column tests the null hypothesis that the border price difference equals the larger of the two country effects.

The border effect remains significant even within retailers. We can run an adapted specification of the above regressions, including interaction terms between the retailer variable and the above specified dummies, in order to obtain the within and across-country effects for each retailer separately. The results are presented in Table 2 which shows that this additional border effect (column 3) is present *within* all international chains, no matter whether these are discounters or supermarkets.

Within-retailer price differences within each country are small compared to within-retailer price differences across the border. The within-country price difference within a given retailer (in columns 1 and 2) can be explained by the asynchronous occurrence of sale offers in the different regions. If households arrive at stores at random times, those arriving earlier in the week or month might obtain a different price from those arriving later. This, combined with ad personam offers (rebate cards and discounts), generates a basic price dispersion within a chain-country even if prices are compared at a higher frequency.³⁷ The basic dispersion is smaller for discounters (between zero and 8 percentage points) than for supermarkets (up to 12 percentage points). Within Austria, this basic dispersion is about 3 percentage points higher. Interestingly, independent supermarkets using a common sourcing provider do not have more dispersed prices than other supermarkets. On average, prices differ additionally by more than 15 percentage points across the border. That is, for an identical product within a given retailer, the cross-border price differences are at least twice as large as within a country.³⁸ It is evident from Table 2 that the national retail subsidiaries set their prices – and promotions – rather independently.

The additional price differences at the border are largest and most persistent for personal care items. Similar regressions, replacing retailers with product

³⁷ In our case, it is further elevated because we do not distinguish supermarkets (e.g. Billa versus Merkur), but only channels (e.g. discounter Penny versus Rewe supermarkets) within a chain. We also ran this regression on our spatially more aggregated data, at a higher frequency (i.e. monthly and weekly). When doing this, we find that the basic dispersion is slightly lower.

³⁸ This is a lower bound, based on the (higher) price differences within Austria.

categories, show that cross-border price differences are, overall, similarly large in all COICOP-3 product groups (between 18% and 25%). The additional price difference at the border is particularly large for personal care items (an additional 21 percentage points), followed by gardening equipment and pet food products (16 percentage points). Recalling that (common) personal care products in our sample are the ones with high turnover, it is interesting that the cross-border price differences within this category also tend to be the most persistent (additional autoregressive coefficient across the border 0.5, overall 0.7).

Retailers differentiate prices – always and everywhere, also within each country –, but most extensively across the border. Recalling that the border in this example does not reflect major differences in preferences, this points towards a high cost of arbitrage. Since crossing this border imposes virtually no additional cost to the shopper, the cost of arbitrage across the national border should be similar to the one across any pair of within-country regions. Thus, the cost of spatial arbitrage must be non-negligible, even with a country. Retailers differentiate prices to maximise their margins, and they do so within a country, but in particular across the border. In terms of profits, they could have differentiated prices according to any random line on the map, but most probably due to their existing logistics network, they chose to follow the national border. In effect, they appear to maximise margins separately on either side of the border.

Table 3
Border within retailers – price change difference

Absolute price change difference in percentage points

(estimation coefficients)

Retailer	Within Germany	Within Austria (additional)	Cross-country (additional)	Test cross-country = max. within country (p-value)
Supermarket A	11.3***	5.2*	5.6*	0.87
Supermarket B	18.9***	1.0	2.1	0.52
Discounter C	1.0	0.5	6.1**	0.04
Discounter D	11.3***	-1.2	3.5*	0.05
Discounter E	6.2***	-3.8	-0.7	0.20
Discounter F	10.5***	1.2	5.1**	0.15

Notes: The table shows within-retailer country and border effect coefficients from OLS regression with region and retailer interactions, time trends (barcode-clustered standard errors), without constant. Period 2008-18. Dependent variable: absolute, within-retailer year-on-year price change difference at a bimonthly frequency. Observations: 44,294. Adjusted R-squared: 0.47. Last column H0: - country effect + border effect = 0.

Overall, inflation is less dispersed across the Austrian-Bavarian border than prices. In Table 3, we can see that in the case of inflation differences, the additional dispersion at the border compared with the basic dispersion within countries is small, and significant within only two of the chains. In other words, while retailers maintain differences in price levels between both countries, we cannot find evidence that they systematically deviate from a common price trend.

Price differences in specific products disappear within one year. Differences across the border in the price of specific products decay rather quickly.³⁹ The autoregressive coefficient of the absolute cross-border price differentials is 0.54 over two months, i.e. they decay to less than 0.05 within one year. Therefore, large arbitrage opportunities for consumers in individual products are not very persistent, price changes can thus offset each other, leading to less dispersed aggregate inflation.

We find widespread failure of the absolute law of one price (LOP) within this region, but the LOP in a relative sense appears to hold approximately. Overall, we show that even borders without relevant trade frictions can entail large price differences, and that these price differences are rooted deeply in deliberate price differentiation by retailers. In other words, price and inflation differentials appear to be neither a result of different cost structures nor of different preferences. Rather, they reflect regional market power in the consumer market, and product-specific cross-country price discrimination.

2.3 A single market – for differentiated goods

Most products in Europe are marketed in just a few countries. Very close substitutes, or de facto physically identical products, are marketed under different brand names and product identifiers in each country. This complicates a product price comparison across countries not only for researchers, but even more so for consumers. In effect, marketing limits arbitrage and thus price equalisation.

³⁹ We also find that price differences within a given retailer are only weakly correlated over time and more persistent across the border than within a country. The extent of persistence within and across countries differs notably across retailers, without a clear pattern.

Table 4
Common FMCG barcodes

Expenditure in common barcodes as share of home expenditure (2014-18)

(percentages, home country in rows)

	AT	DE	NL	BE	FR	IT	ES	PT	SK	CZ	HU	PL	RO	DK	SE	UK
AT		31	22	20	11	9	7	4	28	20	16	15	13	6	5	3
DE	29		38	30	10	5	5	3	15	36	13	16	8	7	3	3
NL	5	8		81	6	3	4	3	3	5	3	4	2	4	3	3
BE	7	9	50		21	6	7	5	4	6	4	6	5	4	3	4
FR	4	5	10	63		5	11	9	3	4	3	7	4	2	2	2
IT	7	6	7	13	11		8	7	5	6	6	7	12	3	3	3
ES	3	3	5	5	9	5		33	2	3	3	3	3	2	3	3
PT	3	4	5	9	12	8	31		3	4	4	5	4	2	4	4
SK	6	13	6	5	4	4	3	3		71	30	24	14	2	2	3
CZ	7	13	7	6	4	4	3	3	79		26	28	14	3	2	3
HU	6	8	8	5	4	5	3	2	46	27		14	33	2	1	3
PL	6	6	7	6	4	3	3	2	28	32	14		13	2	4	8
RO	8	6	6	7	5	7	7	3	16	15	15	20		2	2	3
DK	3	6	6	6	4	3	3	2	3	4	2	3	2		12	2
SE	4	4	6	5	5	3	4	3	3	3	3	4	3	22		3
UK	3	4	6	6	5	3	6	4	3	5	3	5	3	2	3	

Source: ECB calculations based on the GfK/Kantar household panels.

Notes: Green shading highlights a high expenditure share of products available in both countries, and red shading a small share. The omitted diagonal cells are 100% by construction. Only COICOPs 1.1, 1.2, 2.1, 5.6, 9.3, 12.1, excluding fresh meat, fresh fish, wine and products without a Global Trade Item Number (GTIN) or chain-specific barcode.

The share of expenditure in barcodes available in more than one country in Europe is generally small. Table 4 shows the share of expenditure by country spent on products also consumed in another country during 2014-18. Most country pairs – even within the European Union – have less than 10% of FMCG products in common. The product overlap of the United Kingdom is particularly low, with expenditure on common barcodes rarely exceeding 3% of total expenditure.

A few country pairs stand out with more product commonalities.⁴⁰ One group contains Austria, Germany, the Netherlands, Belgium and France, where the first four and the last three show even higher overlaps among themselves. Another group consists of the Eastern European countries in the sample, plus Austria and Germany, in which the Czech Republic, Slovakia and Hungary have most pairwise common products. Other notable pairs are Spain-Portugal and Denmark-Sweden. More than 80% of expenditure in the Netherlands, for example, is on products also available in Belgium. This does not apply vice versa, because Belgian stores also stock many French items, which are not available in the Netherlands.

The share of common products is less than 10% for the typical euro area country pair. This is less than the corresponding expenditure share, indicating that products available in multiple countries tend to attract disproportionate expenditure.

⁴⁰ According to Table 4, euro area countries appear to be no different than other countries of the European Union.

Among the 16 countries in the sample, only the Czech Republic and Slovakia have more than 40% of products in common. Next in line are Austria, where 38% of products are also available in Germany, and the Netherlands, where 38% of products are also available in Belgium. In contrast, only 5% of products in France are also available in Germany, both by count and by sales volume. This observation is not limited to the euro area. For the United States and Canada, for example, Broda and Weinstein (2008) report that only 7.5% of barcodes are available in both countries.

3 Inflation heterogeneity across households

Households are very heterogeneous in many dimensions. This section studies whether there are policy-relevant dimensions of household heterogeneity that result in systematically different levels of inflation.⁴¹ It examines whether such differences are stable over time and what their causes might be. It focuses on unconditional inflation differences (due to price or basket differences), whereas the next section will study their response to an exogenous (monetary policy) shock.

The empirical literature on heterogeneity of inflation is limited, but nevertheless suggests pronounced inflation inequality across households.

This literature has been growing only recently, since microdata on prices and/or consumption of households became available to researchers. Studies are either based on data from Consumer Expenditure Surveys (CES) combined with disaggregate (but not micro) price data from the CPI, or on household scanner data (Table 5). The first group of studies calculates household expenditure weights from the CES and uses item strata CPI prices to calculate (household) group-specific inflation rates (Hobijn and Lagakos, 2005, for the United States, Fessler and Fritzer, 2013, for Austria and Gürer and Weichenrieder, 2020, for EU countries). They commonly find considerably higher inflation rates for less privileged households. The second group of studies uses the prices actually paid by households obtained from scanner data to calculate household inflation rates (Kaplan and Schulhofer-Wohl, 2017, Jaravel, 2019, and Argente and Lee, 2021, all with US data). These studies generally find even stronger heterogeneity of inflation rates across households than previous studies. However, the relationship between income and household inflation is not always clearly established in these studies.

⁴¹ As well as rich versus poor, many different household groupings have been analysed in the literature. For example, black versus white (Hamilton, 2001) or old versus young (Berndt et al., 1997).

Table 5
Studies on inflation heterogeneity (across households)

	Countries	Products	Data source	Results
Hobijn and Lagakos (2005)	United States	Broad coverage	Consumer Expenditure Survey and price data from CPI	Substantial differences in inflation rates across households with higher inflation for elderly people and poor households
Fessler and Fritzer (2013)	Austria	Broad coverage	Consumer Expenditure Survey and price data from CPI	Strong and stable negative relationship between income inflation at the household level reflecting differences in consumption
Kaplan and Schulhofer-Wohl (2017)	United States	FMCG	Kilts-Nielsen Consumer Panel	Inflation rates at the household level have an Interquartile Range (IQR) of 6.2 to 9.0 percentage points and most of the heterogeneity comes from variation in prices paid for the same good
Jaravel (2019)	United States	FMCG	Nielsen Homescan Consumer Panel, Nielsen Retail Scanner data and Consumer Expenditure Survey	In 2004-15, inflation was 0.7 percentage points p.a. higher for the bottom-income quintile relative to the top quintile, increasing to 0.9 percentage points when changes in product variety are included
Argente and Lee (2021)	United States	FMCG and few durable goods	Kilts-Nielsen Consumer Panel	During the global financial crisis, inflation rates at the lower and higher end of the income distribution diverged substantially as richer households are able to substitute to cheaper products
Gürer and Weichenrieder (2020)	25 EU countries	Broad coverage	European Union HBSs and price data from HICP	On average over all countries and the period 2001-15, the lowest income decile experienced 11.2 percentage higher inflation than the highest income decile

3.1 Inflation at the household level

Households experience very different inflation rates, even within the same country. Kaplan and Schulhofer-Wohl (2017) report for the United States an interquartile range of annual inflation of up to 9 percentage points during the Great Recession. But as the bottom row of Table 6 shows, this range never shrank to less than 6 percentage points.

Table 6
Dispersion of household-level inflation rates

(interquartile range, percentage points)

Country	Avg. 2015-18	Avg. 2008-13	Min. full sample	Max. full sample
Austria	6.2	6.1	5.3	7.5
Belgium	4.0	4.3	3.6	4.8
France	3.6	3.6	3.0	4.3
Germany	4.8	4.9	4.0	6.7
Netherlands	4.8	4.9	4.1	6.0
Spain	3.1	4.1	2.8	6.5
United States	n.a.	about 7.5	6.2	9.0

Source: ECB calculations based on the GfK/Kantar household panels.
Notes: Laspeyres inflation rate for food, beverages, personal care, household, pet and hobby items (COICOPs 1.1, 1.2, 2.1., 5.6, 9.3, 12.1). Quarterly volume-weighted average prices for a given household. Information on United States from Kaplan and Schulhofer-Wohl (2017), Chart 4a.

Inflation is a less dispersed between households in the euro area than between households in the United States. The third column of Table 6 shows that the typical interquartile range in a euro area country is less than 5 percentage points, only two-thirds of the US value during the same period. Austria shows the widest dispersion. With more than 6 percentage points, Austrian dispersion is closest to the US value. On the opposite end, dispersion is smallest in France and, more recently, Spain, with an interquartile range of less than 4 percentage points, and similar in other euro area countries in the sample. The two right-hand columns show that dispersion within any given euro area country varies from period to period. But even the full-sample peak dispersion in the euro area barely reaches the US six-year average of 7.5 percentage points.

Because consumption baskets differ systematically between household groups, inflation heterogeneity is visible even in aggregate data. Hobbijn and Lagakos (2005), for example, trace heterogeneity in the CPI among US households to basket differences. They find that both age and income increase the expenditure shares of categories whose inflation dynamics often deviate from the headline CPI. In their US sample, age increases exposure to health care expenses, while lower income increases exposure to gasoline prices.⁴²

3.2 Price or basket heterogeneity?

The large inflation differences between households may stem from households consuming different products or from paying different prices for the very same product. Disentangling these two possible causes requires granular information on both prices and quantities, which only a household panel provides. The commonly used match between HICP and household expenditure data, for example, allows only a comparison based on product aggregates, but not individual prices. Web-scraped data – despite being very detailed and comprehensive on prices – lack quantity information.

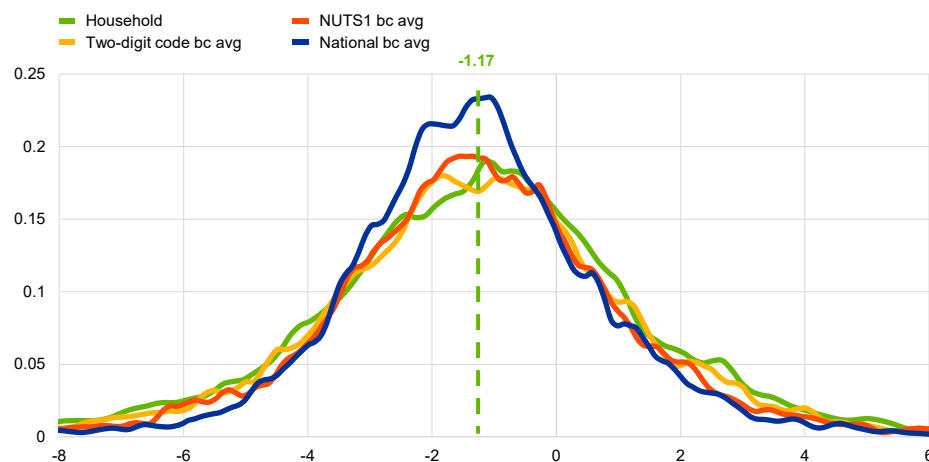
⁴² In the euro area, the exposure to transportation expenses is higher for high-income households, while the exposure to the cost of electricity and heating is higher for lower-income households.

Chart 5

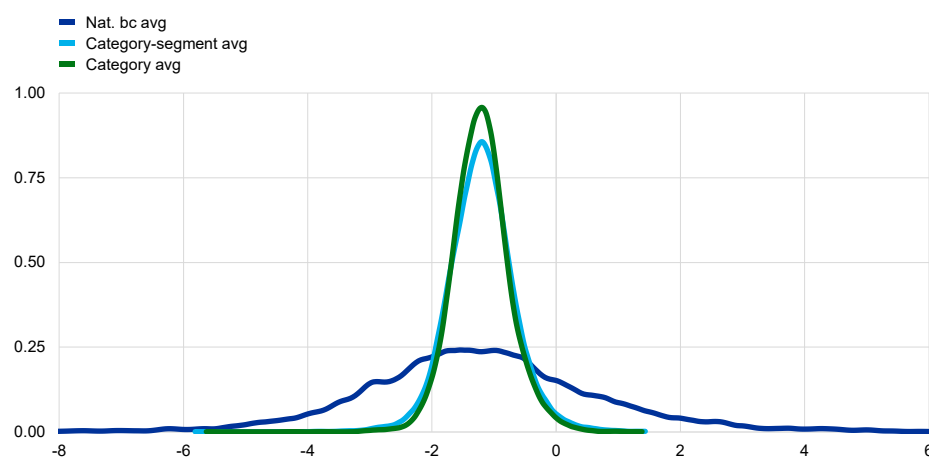
Distribution of household-level inflation rates

(France, 2016/2015, density, inflation in percent p.a.)

a) Impact of household-specific prices



b) Impact of household-specific baskets



Source: Kiss and Strasser (2022) based on the Kantar household panel.

Notes: Distribution of household-specific Laspeyres inflation rate 2016Q4 vs 2015Q4. The green line in panel a) uses the actual transaction prices, the yellow line the average price paid (by any household) in the households' two-digit postal area, the orange line the average price paid within the respective NUTS1 region, and the blue line the average price paid in France. In panel b), prices are replaced by the price indices within a product category (green) or within a quality segment within a product category (light blue). The two quality segments are defined within each product category based on the price per volume.

Differences in the price of the same product paid by different households is only a secondary determinant of price dispersion. Panel a) of Chart 5 compares the distribution of household inflation based on actual transaction prices (green line) with the counterfactual inflation distribution that households would have experienced if they had paid the median price in their two-digit postal area (yellow line) or the median price in their NUTS1 region (orange line). The interquartile range only shrinks from 3.2 to 2.8. In other words, the inflation differences between households only change a little, even if large groups of all households pay the same price. In other words, at the regional level households experience very different inflation rates, and this would not change even if all households in that region expended the same effort on comparing prices for a given set of products.

In many countries, even a nationally uniform price for each product would remove only a minor component of inflation heterogeneity. The blue line in Chart 5 plots the counterfactual inflation distribution if all households paid the national median price for each product. Comparing the green line based on household-specific transaction prices with the blue line in the top panel shows that a uniform price reduces inflation heterogeneity only a little, with a remaining interquartile range of 2.4. This observation is not limited to the example shown for France, but there are exceptions.⁴³ Typically, just one-third of the inflation dispersion is due to price differences for the same product between households.

More than half of the dispersion stems from households buying different products within a broader product category. Panel b) of Chart 5 shows the effect of eliminating product choice within a product category on household inflation heterogeneity. The dark green line shows the dispersion which would be obtained if all households paid a common price for a (counterfactual) composite good in each of about 300 product categories. As households split their consumption differently across categories, some inflation heterogeneity remains, reflected in an interquartile range of about 0.5. Most of the dispersion present in the distribution based on barcode-average prices (blue line), however, has disappeared.

The effect of differences in quality choice within a category matters little compared with the effect of differences in product (barcode) choice. The light blue line in the panel b) of Chart 5 splits each product category into a high-price and a low-price sub-category, using the price per volume as the criterion. Again, we assume that all households pay the median national price within each sub-category. Although the number of prices doubles, the inflation dispersion increases relatively little. Therefore, the household's product choice within narrowly defined categories is the primary determinant of inflation differences between households for typical supermarket items.

In the United States, but also in some European countries, such as Austria, price differentiation between households is more pronounced. In the United States and Austria, price dispersion between households explains almost two-thirds of the inflation variation across households (Kaplan and Schulhofer-Wohl, 2017; Messner and Rumler, 2023).⁴⁴ If all European households were combined, i.e. if cross-country variation were included, then the observations in Section 2 suggest that European price variation could match and even exceed the US level. Nevertheless, a key takeaway is that *within* several countries in Europe, prices matter less for inflation heterogeneity between households than their basket composition.

⁴³ Kiss and Strasser (2022) report similar results for Germany. However, in Austria, the interquartile range is reduced by two-thirds if household-specific barcode average prices are used instead.

⁴⁴ One possible reason is that the individual countries in Europe are smaller and more homogeneous than the United States, but this does not explain the Austrian counter-example.

3.3 Inflation by income

3.3.1 Cross-country comparison

Inflation may differ between income groups, either because the groups consume different products or because they pay different prices. If we are willing to abstract the latter, i.e. if one assumes that all households experience identical prices, it is possible to calculate income-group-specific inflation rates based on aggregate data. The HBS provides expenditure weights at a (coarse) category level⁴⁵ by income group (and other demographic characteristics of survey participants). Joining these weights with the corresponding HICP sub-indices for these product categories yields an inflation rate based on income-group-specific expenditure weights.

Due to the differences in their consumption baskets, low-income households have experienced slightly higher inflation rates than high-income households in the last 15 years. Ampudia (2020) shows this for the euro area using the HBS-based approach described above. Although the cumulative difference between the top and the bottom-income quintile adds up to less than 3 percentage points over the entire 15 years for most countries, this top-down calculation establishes an important role for basket heterogeneity at the *category* level for heterogeneity in aggregate HICP inflation.

This difference might become considerably larger in the tails of income distribution. For the slightly earlier sample period of 2001-15, Gürer and Weichenrieder (2020) calculate an impressive 0.7 percentage points p.a. inflation difference between the top and the bottom-income decile for 25 European countries.

This overall result conceals large differences between countries and over time. Based on the consumer expenditure survey, Fessler and Fritzer (2013), for example, find that inflation in Austria in 2010-12 decreased mildly with the income level. Garner et al. (1996) report for the United States in the early 1980s and 1990s only small differences between the price indices calculated for the poor (based on the consumer expenditure survey) and the aggregate. In contrast, Crawford and Smith (2002) report 0.3 percentage points p.a. higher inflation for *high-income* households in the United Kingdom in 1976-2000, with large differences between households and large variations over time.

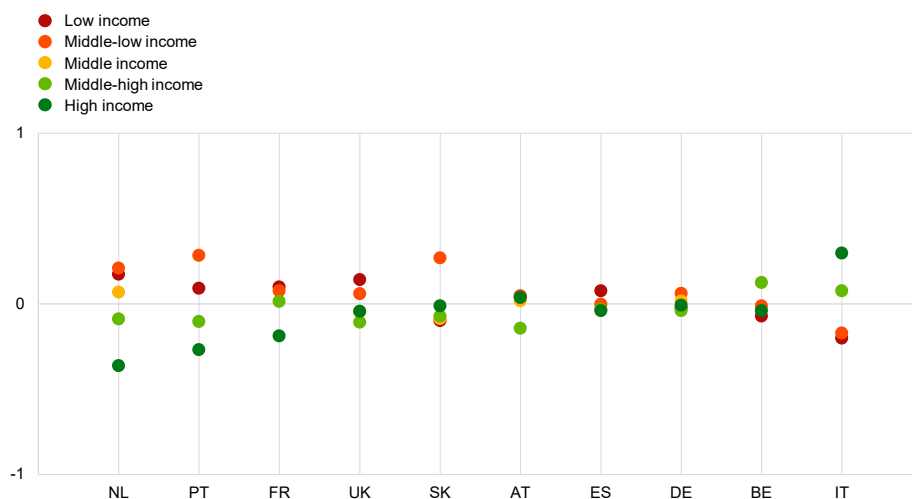
An analysis of heterogeneity in prices requires a detailed household panel. Such a panel is unfortunately not available for the full range of products and services covered by the HICP, but has recently become available for the FMCG sub-set. Thus, the following results may not necessarily be generalised to the full basket of goods and services that households consume. Nevertheless, as explained in the

⁴⁵ These are the top-level (two-digit) COICOP categories: (1) food and non-alcoholic beverages, (2) alcoholic beverages, tobacco and narcotics, (3) clothing and footwear, (4) housing, water, electricity, gas and other fuels, (5) furnishings, household equipment and routine household maintenance, (6) health, (7) transport, (8) communications, (9) recreation and culture, (10) education, (11) restaurants and hotels and (12) miscellaneous goods and services.

introduction, they do represent an important part of discretionary spending in heterogeneous product categories. Our panel allows us to distinguish at least four income groups in each country.

Chart 6
FMCG inflation by income group

(percentages p.a., 2014-18)



Source: ECB calculations based on the GfK/Kantar household panels.

Notes: Laspeyres inflation rate based on food and beverage items, average year-on-year inflation rate 2014-18, de-measured by country. Income-group definition differs between countries. Countries ordered by inflation difference between highest and lowest income group.

The inflation difference between high and low-income groups is statistically significant. On average, inflation differs most between the highest and the second-lowest income group, not the lowest-income group. The average inflation difference within the ten European countries shown in Chart 6 between these two groups during the entire sample period is about 0.21 percentage points p.a.⁴⁶ This is only a third of the inflation differences that Kaplan and Schulhofer-Wohl (2017) report for the United States based on household-level prices in the period 2005-13.

The inflation difference between income groups varies substantially between countries. Chart 6 shows the average deviation of annual inflation by income group from the national average in selected countries in 2014-18. In particular, the Netherlands, Portugal and France displayed significantly higher FMCG inflation for low-income groups (red symbols) in this period. The United Kingdom and Germany show a weaker, but similar order in the period. In contrast, in Belgium and Italy, higher income groups experienced higher inflation.⁴⁷

Cross-country inflation variation dominates cross-income group variation. The FMCG inflation gap between income groups is only a fraction of the differences in average inflation between countries. For FMCG products, there appears to be no

⁴⁶ The estimation uses the 2006-18 unbalanced sample with time and country fixed effects. The estimate is significant at the 1% level.

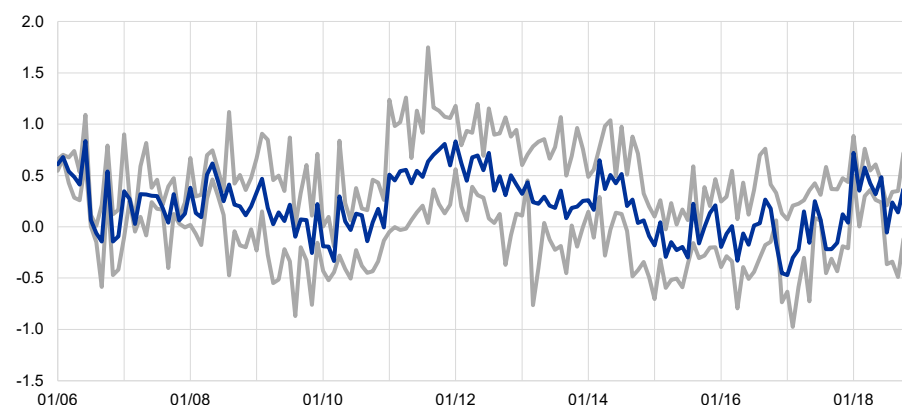
⁴⁷ These inflation differences are similar in magnitude to the top-down results of Ampudia (2020). Both studies distinguish about the same number of income groups, but the top income group in the household panel may not capture the top incomes in the population. Thus, the additional heterogeneity in prices captured by the household panel may be offset by its lower dispersion of income.

systematic cross-country relationship between the level of the FMCG inflation rate and inflation heterogeneity between income groups. This might be different in the full HICP, however. Based on aggregate (HBS) data for the longer sample period 2005-17, Ampudia (2020) finds that countries with high inflation on average also experienced higher levels of inflation heterogeneity along the income dimension.

Chart 7

FMCG inflation differential between country-income groups

(nine euro area countries, percentage points p.a.)



Source: ECB calculations based on the GfK/Kantar household panels.

Notes: The blue line shows the cross-country average of inflation in the bottom-income group minus the cross-country average of inflation in the top-income group. The income group definition varies between countries. Laspeyres year-on-year inflation index based on food and beverage items, differences in percentage points p.a. The sample covers Austria, Belgium, France, Germany, Italy, Netherlands, Portugal, Slovakia and Spain. It starts with two countries, increasing to six in 2009, seven in 2011, eight in 2013, and finally nine in 2014. The grey lines report the 25th and 75th percentile of the within-country difference between the respective bottom-income and top-income inflation.

The FMCG inflation experienced by low-income households was higher in many euro area countries in 2011-14, but not in more recent years. The blue line in Chart 7 shows that the difference between the country average of inflation in the lowest and the average in the highest income groups (countries weighed equally) in the euro area is generally small. Between 2011 and 2014, the lower income groups in the euro area experienced higher inflation on average, peaking at a difference of around 0.8 percentage points. In all other periods, the difference oscillated around zero, within a typical plus/minus 0.5 percentage point range.

At any point in time, euro area countries differ in their heterogeneity in terms of income, but share common dynamics. The grey lines in Chart 7 show that many countries in the euro area share similar short-term trends in heterogeneity. But while on average in the euro area, low-income inflation was slightly higher in most periods, the chart also shows that – with the exception of 2011/2012 – there has always been at least one in four countries where the opposite was the case.

3.3.2 Substitution and inflation heterogeneity

If households had not responded to price increases, then low-income households – with exceptions – in the euro area would have experienced higher inflation in the last decade. The Laspeyres inflation concept assumes that consumption within an income group does not change between periods. As the fifth

column of Table 7 shows, the difference between the highest and lowest income groups identifiable in the sample ranges from more than 0.6 in the Netherlands, down to approximately zero in Austria. This gives an average inflation wedge for the six euro area countries shown in Table 7 of about 0.2 percentage points per year in this period.

Table 7
Inflation rates by income class

(2009-18, percentages p.a.)

Country	Low income (Laspeyres)	Mid-income (Laspeyres)	High income (Laspeyres)	Low-high income (Laspeyres)	Low-high income (Paasche)
Austria	1.65	1.67	1.67	-0.03	-0.01
Belgium	1.55	1.56	1.48	0.07	0.04
France	0.18	0.11	-0.16	0.33	0.36
Germany	0.94	0.87	0.73	0.21	-0.03
Netherlands	1.77	1.74	1.14	0.63	-0.15
Spain	0.62	0.52	0.49	0.13	0.03
Average	1.12	1.08	0.89	0.22	0.04

Source: ECB calculations based on the GfK/Kantar household panels.

Notes: Inflation rate for food, beverages, personal care, household, pet and hobby items (COICOPs 1.1, 1.2, 2.1., 5.6, 9.3 and 12.1). (Geometric) average of annual rates in 2019-18. Expenditure weighted within income groups. Income-group definitions and COICOP sub-group coverage differ between countries.

On average, all income groups reduce their effective inflation through smart substitution. In textbook models of consumer choice, households substitute away from products that are becoming relatively more expensive. The difference between the Paasche index, i.e. the index based on the quantities chosen after the price change, and the Laspeyres index, i.e. the index assuming an unchanged basket, can be viewed as an upper bound on the effect of this substitution. In the six countries – Austria, Belgium, France, Germany, the Netherlands and Spain – in 2009-18, Paasche inflation is, on average, about 0.18 percentage points lower than Laspeyres inflation.

After product substitution, there are no substantial inflation differences between income groups in the last decade. In fact, the Paasche inflation concept considers only products purchased after the price change, i.e. after consumers have reoptimised their consumption basket in response to the new prices. The last column of Table 7 shows that – unlike in column 4 – the inflation difference between income groups after substitution is small. In this sense, a (single) Paasche index is more representative for all income groups than a (single) Laspeyres index.

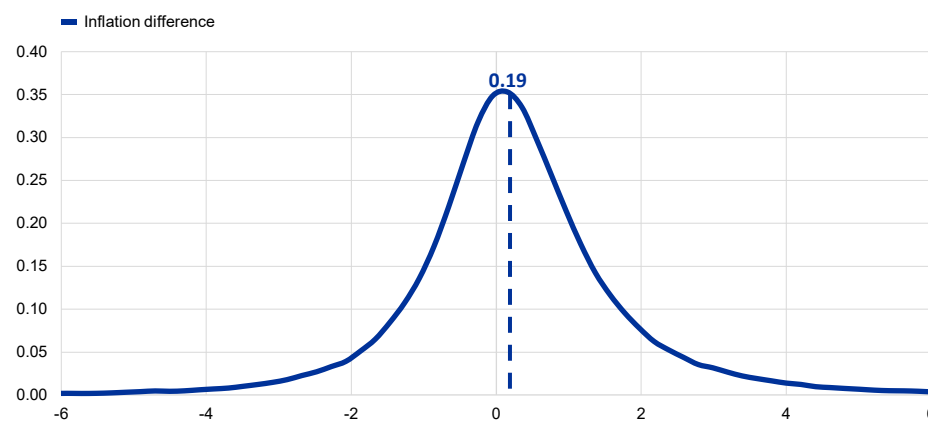
Substitution away from products becoming relatively more expensive reduces low-income inflation more than high-income inflation. Among the six countries, this is most notable in Germany, the Netherlands and Spain. Assuming that low-income households have fewer opportunities for substitution, and in particular fewer lower-priced varieties to substitute into, this points towards a much stronger pressure to substitute for low than for high-income households. Products disproportionately consumed by low-income households might have been subject to larger price

increases (column 1), but these households were able to switch to substitutes whose prices increased less.⁴⁸

Chart 8

Laspeyres minus Paasche gap at the household level

(example: France 2015/2016, density, inflation in percent p.a.)



Source: ECB calculations based on the Kantar household panel.

Note: Inflation rate for food, beverages, personal care, household, pet and hobby items (COICOPs 1.1, 1.2, 2.1., 5.6, 9.3, 12.1).

Individual households differ in their ability to successfully substitute away from products that are becoming more expensive. Chart 8 revisits the difference between Laspeyres and Paasche inflation in France, the country for which Table 7 suggests a fairly similar substitution behaviour on the part of all income groups. This homogeneity across income groups does not extend to individual households: the example in Chart 8 highlights strikingly large differences between Laspeyres and Paasche inflation for many households, with typical values spanning a 5 percentage point range.

Many households, on average, do not substitute away from products that are becoming more expensive. In other words, at a given point in time, almost half of the households appear to substitute in the “wrong” direction, i.e. they buy more of precisely those goods that are getting more expensive, which confirms a similar observation made by Kaplan and Schulhofer-Wohl (2017) for US households.

This may reflect non-homotheticity at the household level. As Table 7 has reassured us, households do substitute in the “correct” direction more often than not. All income groups substitute – to different degrees – on average towards those products that are getting relatively less expensive, in line with homothetic preferences, holding up better in the aggregate. Chart 8 casts doubt as to whether this holds true at the household level. At the household level, non-homothetic preferences, combined with the household’s idiosyncratic love of time variation in

⁴⁸ In France, the inflation wedge between the high and low-income groups remains largely unchanged across the two indices. This by no means implies that French households do not substitute: Paasche inflation in France is about 0.7 percentage points per year lower than Laspeyres inflation for all income groups. Rather, it indicates that all income groups in France were similarly successful in mitigating inflation by adjusting their consumption baskets.

variety and its mood swings, potentially buttressed by advertising campaigns, seem to dominate.

Table 8
Repeat purchases within income group

Share of food and beverage expenditure (2014-18)
(percentages)

Country	Low income	Mid-income	High income
Austria	56	61	63
Belgium	56	55	56
France	47	48	48
Germany	68	71	72
Netherlands	63	70	73
Spain	74	75	75

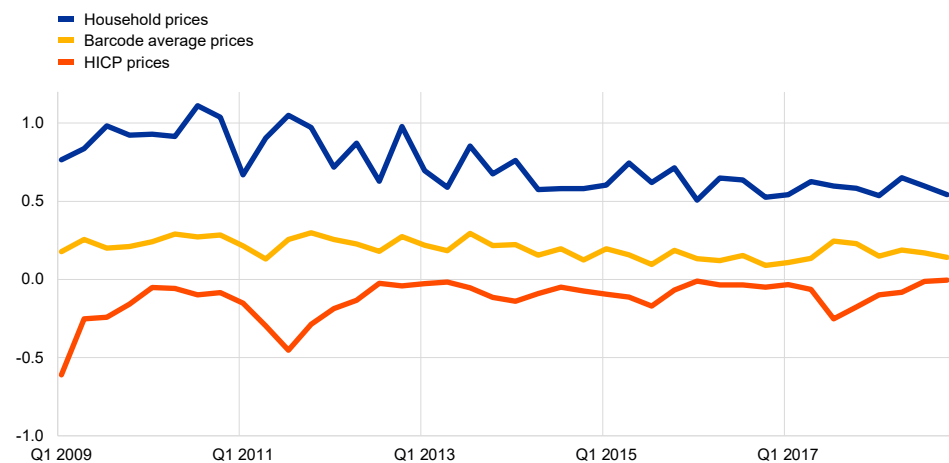
Source: ECB calculations based on the GfK/Kantar household panels.
Notes: Share of expenditure on food and beverages spent on products purchased a year ago by members of the same household group. Average of monthly rates in 2014-18. Income-group definition differs between countries.

Low-income groups in some countries tend to switch products more often.

Low-income households in Austria, Germany and the Netherlands switch food and beverage products more frequently than higher income groups. Table 8 shows for Germany, for example, that in a given month low-income households spent 68% on barcodes that they had also purchased one year earlier. This is 4 percentage points below the repurchase rate of high-income households. The implied substitution might explain some of the strong decline in inflation for low-income households in Germany and the Netherlands reported in Table 7. In the other three countries, the repurchase rates look more similar.

Chart 9
Mean differences of Laspeyres and Paasche inflation rates

(example: Austria, percentages p.a.)



Source: ECB calculations based on the GfK household panel.
Note: Mean differences of Laspeyres and Paasche-type household inflation rates with household prices (blue line), barcode-average prices (yellow line) and HICP average prices at the COICOP-5 level (red line).

In some countries, the importance of substitution seems to have peaked in the aftermath of the financial crisis of 2008/2009. For Austria, Chart 9 shows, in the household microdata, a downward trend in the difference between Laspeyres and Paasche inflation. After 2014, substitution was 40% lower than in the earlier part of the sample.

The effect of regional sale offers is not visible in the HICP. The trend in the example given by Chart 9 is not visible if we assume (counterfactually) that households pay the national average price for the product. The higher substitution in the earlier part of the sample therefore stems from households utilising regional sale offers⁴⁹, which are averaged out in the HICP.

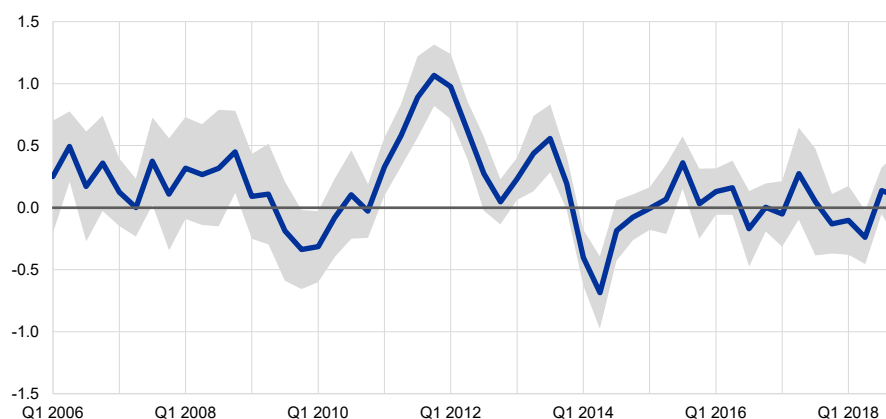
3.3.3 Time variation

For the set of goods covered in the panel, all income groups within each country share the same main inflation fluctuations. In the same vein, the difference between income groups is small compared with time variation in inflation. Nevertheless, if the inflation differentials between income groups persist over prolonged periods, then the cost of living, and thus living standards, diverge (e.g. Beck and Jaravel, 2020).

Chart 10

Inflation difference between low and high-income households

(example: Germany, with 95% confidence intervals, percentages p.a.)



Source: Kiss and Strasser (2022).

Notes: The graph shows the contrast of the predictive margins of a linear regression with German household-level Laspeyres inflation as a dependent variable. Regression with income group, region, and quarter effects, and age and household size controls. Positive values correspond to inflation in the bottom-income group exceeding inflation in the top-income group.

At the income group level, inflation differentials have been serially correlated. Hobijn and Lagakos (2005) show in aggregate data for the United States that these differentials between income groups are not too persistent. The same applies in Europe. For Germany, for example, Chart 10 shows large swings in the difference between low and high-income inflation rates. During recessions, the inflation rates of

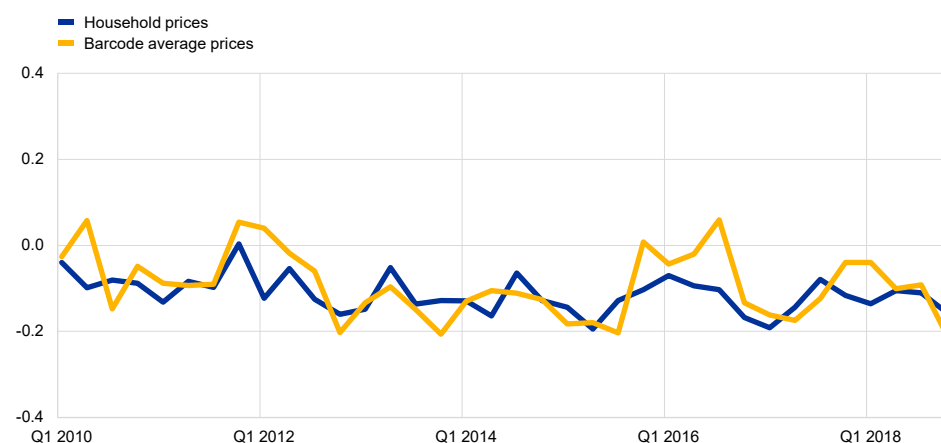
⁴⁹ It is not possible to tell from the data whether this is due to a decline in regional (as opposed to national) sale offers, or due to a decline in the elasticity of substitution.

poorer households tend to be higher relative to richer households. During the two recessions covered in the Chart 10 sample, this is most pronounced in late 2011, i.e. at the beginning of this recession.⁵⁰ In early 2014, however, the opposite was the case: high-income households briefly experienced inflation 0.5 percentage points higher than that of low-income households, which might reflect a reversal of the temporarily elevated shopping efforts of the high-income group after the end of the recession, in line with Argente and Lee (2021). Overall, there is little evidence for a “permanent” deviation of the inflation of an income group from the national average, but at times differences between income groups may persist for two years or more.⁵¹

Chart 11

Within-household serial correction of household Laspeyres inflation rates

(example: Austria, percentages p.a.)



Source: GfK household panel.

Notes: Quarter-by-quarter cross-sectional correlation of household inflation rates in quarters t and $t-4$. Rolling set of households with an inflation observation in both quarters and within the 1st and the 99th percentile of the distribution. The blue line is based on household prices and the yellow line on barcode-average prices.

At the household level, inflation is very volatile and not persistent. Chart 11 shows that household-level inflation in Austria was actually negatively correlated over time during the entire sample period. The cross-sectional correlation coefficient of household-level inflation rates between a pair of quarters one year apart oscillated around -0.15. This means that a typical Austrian household experiences neither above-average nor below-average inflation for extended periods. Since the correlation is about the same for transaction prices (blue line) and barcode-average prices (yellow line), the negative correlation over time must be due to households adjusting their consumption baskets.

Overall, the ranking of income groups by inflation varies gradually over time in most countries, whereas the ranking of households changes frequently. In effect, in many countries there are periods in which income groups on either side of the distribution experience notably higher or lower inflation. During the 15 years of

⁵⁰ Recessions within the sample period are, according to the Euro Area Business Cycle Dating Committee, the periods from the first quarter of 2008 until the second quarter of 2009 and from the third quarter of 2011 until the first quarter of 2013. Argente and Lee (2021) make a similar observation for the United States during the Great Recession (2008-13).

⁵¹ Hobijn and Lagakos (2005) report a similar finding for the United States, based on CPI data.

data in our sample in the euro area, it was, on average, the high-income households that experienced a somewhat lower inflation rate.

3.4 Causes of inflation heterogeneity at the micro level

The average inflation differences between income groups, however, are small compared with the differences between individual households.⁵² One might therefore wonder whether there are other groupings of households (besides grouping according to income as in the previous section) that are more strongly correlated with inflation differentials. Are some households able to partly detach their consumption from aggregate inflation? If so, why are they doing better?

Research on the origin of inflation differentials has a long history. But already, Michael (1979) documents for the United States, based on CPI data, that inflation is widely dispersed even within groups with similar demographic characteristics. Another common finding is that income explains only small part of household inflation heterogeneity.

Adding additional household characteristics does not even come close to explaining the inflation heterogeneity between households. Kiss and Strasser (2022), for example, explore a wide range of household demographic and behavioural variables to explain these differences. On top of standard household demographics (age, income and household size) they derive proxies for the household's product preferences, shopping behaviour and other indicators of the current household situation. Product preferences include, for example, a revealed preference for certain brands or certain categories (e.g. alcohol). Shopping behaviour includes the frequency of shopping trips and preferred shop types.

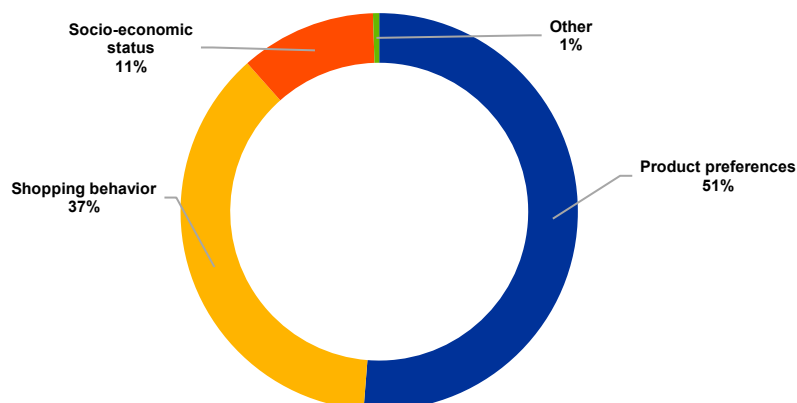
This only explains between 1% and 5% of the total variation across households in France and Germany. The situation is similar in Austria (Messner and Rumler, 2023). As explained in Section 3.1.2, a main determinant are the differences in consumption baskets between households, which translate into their differential exposure to inflation, which then, in turn, may lead to consumption inequality. The low explanatory power of household characteristics suggests that these basket differences – at the barcode level – are themselves largely idiosyncratic, i.e. orthogonal to household characteristics.

⁵² Average inflation differences between income groups were documented in the previous section, and differences between households in Section 3.1.

Chart 12

Determinants of household-specific inflation

(decomposition of coefficient of determination, France and Germany, percentages)



Source: Based on results in Kiss and Strasser (2022).

Notes: Shorrock-Shapley decomposition of R-squared. Average of results for France and Germany.

Among all household characteristics, standard socioeconomic variables explain only a small share of the variation in inflation differences.

Chart 12 shows that, in France and Germany, income, age and household size jointly explain only about one-tenth of the variation related to observed household characteristics. Instead, product preferences and shopping behaviour dominate price and inflation differences. In effect, inflation differs significantly between income groups, but this is secondary compared with the variation due to other household characteristics, and negligible compared with the unsystematic price variation.⁵³

Inflation at the household level is not random. Kaplan and Menzio (2015) point out that households seem to be unable to exploit time variation in prices systematically, despite the fact that some households indeed choose stores that are cheaper on average. They note that, in the United States about half of the dispersion of prices that households pay for an identical basket is due to them visiting different stores with a similar overall price level. The other half is due to the variation of prices for a given product in a given store over time. This suggests that sales play a big role, too, which for some households coincides with their current shopping plan, but not for others – which then buy the product at full price. How flexibly households utilise sale offers is determined first and foremost by their shopping behaviour and product preferences, in line with Chart 12. Retailer-specific sales, combined with many households infrequently switching stores, can thus explain the marked heterogeneity in prices and inflation observed in the data.

⁵³ For Austria, only age, shopping frequency, and region mattered for inflation in 2009-18. Inflation decreased with the number of shopping trips, increased with age and was higher in Vorarlberg, Tyrol and Salzburg than in the rest of Austria (Messner and Rumler, 2023).

4 Monetary policy and inflation inequality

Monetary shocks may have distributional consequences, if they generate systematic and persistent inflation differentials between income groups. This could happen, for example, if the products consumed by different household groups differed in their price stickiness. Cravino et. al (2020) find that, in the United States, the prices of the products consumed by high-income households respond less to monetary policy shocks than those consumed by the middle class. This applies at any horizon, but reaches significance (at the 10% level) about three years after the monetary shock. The response of the inflation differential is rather small. After three years, the cumulative inflation differential adds up to less than 0.05 percentage points after a shock of 10 basis points.

In Europe, income inequality is lower than in the United States. It is therefore not obvious that ECB monetary policy shocks affect income groups differently. This section⁵⁴ studies the effect of monetary policy shocks on the inflation differential between income groups for everyday purchases such as food, beverages and personal care products. We use the (pure) monetary policy shocks constructed by Jarocinski and Karadi (2020)⁵⁵ in a set-up analogous to Cravino et. al (2020). These shocks enter the set of regressions underlying the local projections method (Jorda 2005) as an exogenous variable. The resulting impulse responses show the change in high versus low-income group Laspeyres inflation differentials after a contractionary monetary policy shock of 10 basis points.

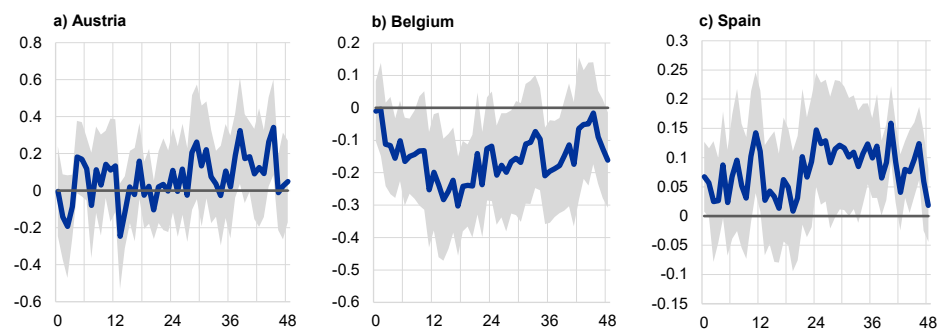
⁵⁴ This section summarises some of the results of Ampudia et al. (2022).

⁵⁵ Policy shocks are the unanticipated component of a policy action, captured by the instantaneous response of stock and bond prices after a policy announcement. Pure monetary policy shocks are defined as the subset of shocks that entail a textbook-style response from prices, i.e. a simultaneous drop in stock and bond prices after a monetary policy tightening. The standard deviation of ECB pure monetary policy shocks is less than 3 basis points.

Chart 13

Inflation differential between high-income and low-income households after a monetary policy tightening (10 bp)

(percentage points, p.a.)



Source: GfK/Kantar household panels.

Notes: Cumulative inflation differential between high-income and low-income group after a monetary policy tightening of 10 basis points. Monetary policy shocks as constructed by Jarocinski and Karadi (2020) based on "poorman's" sign restrictions. Local projections with 90% confidence bands, including the one-year OIS rate as control variable. Monthly Laspeyres inflation based on a rolling basket of repurchased food and beverage items (FMCG). Details are described in Ampudia et al. (2022).

The effect of monetary policy on in-country income-related inflation inequality varies across euro area countries. Chart 13 presents three examples of the effect of monetary policy tightening. In Austria, no effect of monetary policy on FMCG inflation differentials between high and low-income households is visible. In Belgium, however, the inflation experienced by high-income households declines significantly more than that experienced by low-income households. In Spain, conversely, it is the low-income inflation that declines more.

After one to two years, the relative responsiveness of low-income inflation increases gradually. As an effect, the initially more negative response of high-income inflation in some countries, for example in Belgium, becomes insignificant after two years. While the typical inflation differential after two years does not exceed 0.2 percentage points in either direction, this is still four times the magnitude of the US effect shown in Cravino et al. (2020). Importantly, however, the different impact in the various euro area countries cautions against generalising the results of Cravino et al. (2020) to the entire euro area. To compare this with the inflation response of the entire basket underlying the HICP, we revisit the HBS data, i.e. we abstract household-specific prices and product choice and rely only on inflation differences between coarse product categories. These estimates point in most countries to a somewhat stronger inflation response for low-income than for high-income households, i.e. the product groups that low-income households consume tend to be more sensitive to monetary policy.

Taken together, the evidence suggests that ECB monetary policy has heterogenous distributional consequences via inflation across Europe, most of it with substantial lags. It is well-known that (aggregate) inflation has redistributive effects, due to the heterogeneity of households in terms of their asset holdings (e.g. for the euro area, Adam and Zhu, 2016), which in turn affects household consumption. This section suggests that monetary policy may also have a direct, but small, effect on consumption heterogeneity, as it may generate

heterogeneity in inflation rates among households. The cause of the differential impact in euro area countries is the subject of ongoing research.

5 Conclusion

At any point in time, households in Europe experience very different inflation rates. Most of these differences are idiosyncratic to the specific household. They often originate from price differentiation by retailers. Households barely differ in terms of the product categories they consume, but massively in terms of specific products and brands.

Cross-country price-level heterogeneity is a lasting feature of the euro area, whereas cross-country inflation differences are less persistent. Retailers segment markets along national borders and household characteristics. In addition to price-level differences, this generates large, but only transient, inflation differences between households.

In the last ten years, low-income households in the euro area experienced somewhat higher inflation overall. The differences according to income are small and time varying and respond to monetary policy with a delay of more than one year. Combined with the variation in cross-country inflation differentials, inflation differences between different household groups in different countries may become large.

Households differ in their responses to inflation. Low-income households tend to substitute, adjusting their baskets in response to inflation more than high-income households. High-income households tend to adjust later, and primarily by intensifying the search for discounts.

From this we can draw (at least) two important implications for monetary policy: first, monetary policy may have distributional consequences.

Households differ in many ways, including by wealth and income. This heterogeneity forms the basis for the redistributive effects of monetary policy. Households differ in their exposure to inflation, not only due to their heterogeneous asset holdings (Auclert 2019), but also due to their heterogeneous baskets and willingness to substitute. Monetary policy can directly affect inflation differences between income groups, even more when combined with cross-country differences between income groups.

Second, inflation heterogeneity varies over time, resonating with a periodically intensifying debate. Averaging over longer periods, inflation heterogeneity according to income is small, but it can be large during sub-periods. This also applies to the current situation, in which rising energy prices increase inflation heterogeneity (Claeys and Guetta-Jeanrenaud, 2022). It may also lead to some divergence in inflation expectations during these periods. In the same vein, the response of aggregate inflation to monetary policy masks its heterogeneous effect on households.

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Georg Strasser

European Central Bank, Frankfurt am Main, Germany; email: georg.strasser@ecb.europa.eu

Teresa Messner

Oesterreichische Nationalbank, Vienna, Austria; email: teresa.messner@oenb.at

Fabio Rumler

Oesterreichische Nationalbank, Vienna, Austria; email: fabio.rumler@oenb.at

Miguel Ampudia

European Central Bank, Frankfurt am Main, Germany; email: Miguel.Ampudia@bis.org

European Central Bank, Frankfurt am Main, Germany; email: Miguel.Ampudia@bis.org

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Postal address 60640 Frankfurt am Main, Germany

Telephone +49 69 1344 0

Website www.ecb.europa.eu

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