The Distribution of Inflation among Austrian Households

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We estimate the distribution of household-level inflation and show a strong and stable negative relationship between income and inflation that reflects the differences in consumption bundles along the income distribution (2010–2012). Inflation decreases as education levels increase. It is especially high for blue-collar worker households and extraordinarily low for farmer households and shows a u-shaped relationship with age. Our findings question the exclusive focus of economic policymakers on the consumer price index based on a mean consumption bundle in times of diverging price developments. We advocate monitoring inflation of a broader range of real household level consumption bundles, such as inflation across the entire range of household incomes. We use the Austrian consumer survey (2009/10) as well as disaggregated price data to calculate inflation for given consumption bundles at the household level.

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"Any attempt to strike an average for the amount by which purchasing power has changed for a community as a whole necessarily involves equating the purchasing power of money for one class to its purchasing power for a different class, which cannot be done except by an arbitrary assumption. [...] I see no meaning in an assumption to the effect that the purchasing power of money is equal for different classes of the community."

John Maynard Keynes, A Treatise on Money

1 Introduction

In economic theory, inflation is defined as a general increase in the price level of goods and services in an economy over a certain period of time. A higher general price level implies a loss in the real value of money. Relative price changes between goods or services, or price changes resulting from changes in quality or performance, are not part of inflation.

In practice, it is not feasible to measure inflation as it is defined theoretically. Relative price changes between goods cannot be clearly distinguished from price changes resulting from a loss of the value of the medium of exchange, nor can corrections be made for price changes resulting from quality and performance changes. Goods and services change continuously. New goods and services emerge and others disappear. Prices can be observed only if transactions occur. Observing all real transaction prices, or a representative sample of prices, is very difficult for many goods, e.g. housing. When we use the term "inflation" in this article, we refer to its more practical expression, such as a consumer price index, which is a subset of price movements that at the same time considers the full price changes of the goods and services as inflation.

The consumer price index (CPI) commonly computed by statistical agencies can be interpreted as a weighted average of price indices for individual households. Consequently, as long as households consume different bundles of goods and services, the CPI cannot be a perfect indicator of inflation at the individual household level. Consumption patterns among households differ, and if in addition relative prices move, differences between inflation rates among

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households arise. The reliability of inflation measures, i.e. their "representativeness" for all households, might suffer if households experience inflation trends that diverge from the officially published measure. Against this background and with the aim of enhancing public awareness of the scope of CPI measures, statistical agencies have tried to produce additional inflation indicators. For instance, the Austrian national statistical institute, Statistics Austria, has constructed a CPI for senior citizens, which has been published monthly since January 2006 (Kopp and Schimak, 2006). Similarly, the U.S. Bureau of Labor Statistics (BLS) publishes, and experiments with, several consumer price indices: Apart from the CPI for all urban consumers (CPI-U), which represents about 87% of the U.S. population, the BLS regularly publishes a CPI for urban wage earners and clerical workers (CPI-W).[2] The BLS has also constructed an experimental CPI for Americans aged 62 or older (see Stewart, 2008).

Households may also simply perceive that their rate of inflation is above the average or the officially published figure, even if this is not the case. Perceptions of inflation can be heavily influenced by changes in the prices of frequently purchased goods and services. A standard shopping basket might not include items an individual purchases monthly, annually or even less frequently. This could drive a wedge between actual aggregate price developments and perceived price developments. For instance, the price increases of some consumer durables (like audio-visual, photographic and information processing equipment) have been lower than average. On the other hand, the prices of frequently bought items sometimes rise at an above-average rate for prolonged periods. In Austria, the indices for items bought daily ("Mikrowarenkorb") and weekly ("Miniwarenkorb") reflect this phenomenon. The inflation rates for these basket items were higher than consumer price inflation for an extended time. Against this background, perceived inflation might be higher than the actual inflation rate, which could undermine confidence in the reliability of economy-wide measures of consumer price inflation. To make people aware of the scope and the limitations of the CPI, some statistical offices offer "personal inflation calculators" on their websites to allow consumers to interactively check how their consumption pattern affects their own inflation rate. The German, U.K. and U.S. statistical offices range among the institutions which offer this service.

For policymakers, it is relevant to clarify the distribution of inflation among households and to communicate the scope and the limitations of the CPI to prevent monetary policy from losing its efficiency, as individuals might always have some doubt about how appropriate inflation is as the core measure of price stability.

Given the relevance of accurate inflation measures for policymakers, data producers and households, it is surprising that research in this field is relatively scarce. For the U.S. population, Michael (1979) finds above-average inflation rates for the relatively poor with low levels of schooling and for older households. However, this finding is not persistent over time.

[2] *The CPI-U comprises all urban consumers; the CPI-W represents the population that derives more than half of its income from clerical or hourly wage occupations. These households account for about 32% of the total U.S. population.*

Similarly, Hobijn and Lagakos (2005) report higher inflation rates for the elderly and the poor in the U.S.A. during a more recent period. Again, the inflation difference among households is not persistent over time. For Germany, Breuer and Mehrhoff (2009), Brachinger (2008) and Tober (2008) investigate the impact of the recent increase in energy and food prices on the distribution of inflation across households but reach conflicting conclusions. Breuer and Mehrhoff as well as Tober find small differences of inflation across households while Brachinger finds large differences. This discrepancy can be partly attributed to different methodological approaches in constructing household-specific inflation rates. For the Austrian population, Russinger (2004) detects small differences of inflation across households at different income levels. Fritzer and Glatzer (2009) categorize households by their members (men/women, adults with/without children, single parents) and the income of households and find some evidence that lower-income households suffer from higher inflation.

The remainder of this article is structured as follows. In section 2, we describe the data and the methodology used, and we discuss their limitations. Section 3 presents the results based on a number of parametrical and nonparametrical estimates of different statistical objects, such as the unconditional distribution of inflation as well as conditional inflation across different subsets. Section 4 concludes the article.

2 Estimation Strategy

In the following subchapters, we discuss the approach we use to estimate household-level inflation as well as its limitations.

2.1 Data

The construction of our household-specific inflation rates is based on detailed microdata from the Austrian consumer expenditure survey 2009 – 2010 and the price index data for the Austrian national consumer price at the level of the elementary aggregates.

The 2009 – 2010 consumer expenditure survey comprises expenditures of 6,534 households over the period from the end of April 2009 to May 2010. Households had to record their expenditures during a two-week period. The data were corrected for infrequently purchased goods and services like cars or holidays, which might not fall within the two-week period. These big-ticket purchases were determined by way of face-to-face interviews and were incorporated retroactively for the last 12 months. The staggered nature of the data collection in the consumer expenditure survey during the one-year period ensures that seasonal expenditures e.g. for Christmas or at the beginning of the school year were also included.

The consumer expenditure survey is based on a sample frame restricted to dwellings where at least one person has registered the main residence as recorded in the Austrian Central Population Register. This definition excludes a subset of households, namely all households living in dwellings that are not registered as a main residence or that are not registered at all. There are various reasons for households' actual main residences not to be registered as such. For instance, students away from home may keep their main residence at their parents' address even though they are already a household of their own according to the official expenditure survey definition; others may simply have forgotten to register the address at which they actually live as their main

residence (see Albacete et al., 2012; Statistics Austria, 2011). Evidence suggests that the total number of households and the share of smaller households are underestimated as a consequence (see Fessler et al., 2012). The underestimation might be relevant for measuring household inflation, as consumption bundles might differ substantially depending on household size.

The consumer expenditure surveys are the main source for gathering information on the households' consumption bundles, which are then used to compute the weights for consumer price indices. Large revisions of these weights therefore occur only every five years (the frequency of the consumer expenditure surveys). In the interim, smaller changes occur, e.g. when a product disappears and is replaced (Statistics Austria, 2011b).

Price data at the level of elementary aggregates are composed of prices for well-defined products offered in different retail stores in 20 Austrian cities. The Austrian national CPI currently comprises 791 elementary aggregates for which about 40,000 individual prices in about 4,000 retail stores are collected on a monthly basis. The representative goods are revised every five years and are kept up to date annually at a more disaggregated level (Statistics Austria, 2011b).

The consumer expenditure survey is our only source for the weights used to construct the inflation rates at the individual household level. Other sources (for instance the national accounts), which are used as data sources for the economy-wide weights of the Austrian CPI, do not contain any information at the household-specific disaggregation level. However, as these sources do not refer to the same target population as the consumer expenditure survey, relating them to a consumer expenditure survey would be generally questionable even if our focus were on an aggregate measure of inflation for households. For example, people living in retirement homes are part of the national accounts household sector. First, they might have consumption patterns that are structurally different from those of average persons in the consumer survey's reference population of households living in registered main residences, and second, all households living in institutions are excluded from the consumer survey's reference population. Furthermore, the national accounts household sector also includes other entities that do not qualify as households, e.g. the self-employed, nonprofit organizations serving households (such as the Red Cross) and private foundations; they are also likely to have consumption patterns that differ from those of average households.

Price and consumer expenditure data have to be matched to construct inflation at the household level. Household expenditures are classified according to the COICOP (classification of individual consumption by purpose) system. The consumer price basket, however, matches the COICOP classification only at the four-digit level, which is not a breakdown to the elementary aggregate level. For instance, the consumer expenditure item "cheese" has corresponding price data at the level of elementary aggregates for seven varieties (Swiss cheese, gouda, hard cheese, camembert, fresh cream cheese and mozzarella). As a consequence, we decided to construct the price weights at the aggregation level of the four-digit items.

The consumer expenditure data also provide information about household characteristics (such as size), regional information and information about household income and some socioeconomic characteristics of the household members.

2.2 Definition of Household-Level Inflation

We observe a sample of households, $i \in I$, as well as their consumption shares, s_i^c, where $c=1,2,...,C$ is the set of COICOP four-digit consumption categories (henceforth referred to as consumption categories), which sum up to the household's total consumption expenditure,

$$\sum_{c=1}^{C} s_i^c = 1 \; \forall i.$$

Average prices of consumption categories in the set C at time t are denoted as p_t^c, and consumption category inflation between time $t-1$ and t is defined as

$$\pi_t^c := \frac{p_t^c}{p_{t-1}^c} - 1 .$$

Under the assumption that the consumption shares s_i^c stay constant over time, i.e. that households do not adapt their consumption bundles over time, their inflation is the sum of the category inflation rates π_t^c weighted by their consumption shares s_i^c Inflation rates at the household level are consequently defined as

$$\pi_{i,t} := \sum_{c=1}^{C} s_i^c \pi_t^c .$$

2.3 Limitations of the Approach

Of course, the assumption that the consumption shares of households stay constant over time is not realistic, as households will adapt their consumption bundles to price changes, income or other shocks or simply because their preferences change. However, the consumption basket information collected by the Austrian consumer survey is the main source of information on consumption baskets for as long as five years for all CPI calculations produced for official inflation statistics. As we use yearly prices at the COICOP four-digit level, we also take into account all yearly adaptions of the consumption baskets made for the calculation of official CPI below the four-digit level in our analysis. If a certain product (e.g. a specific toothpaste) is exchanged for a similar product (in the same four-digit COICOP category) due to a sharp shift in demand, our analysis reflects this exchange.

Another reason for concern is that consumption patterns of every household are surveyed only for a two-week period that differs from household to household over a full year. This implies that during this two-week period, some households might consume certain goods they do not consume regularly, like cars or other consumer durables; therefore, the resulting estimate of the annual household-level inflation rate is biased toward the inflation rates of these categories. Other households might not consume items in certain categories during the two-week observation period that they normally consume. For such households, the household-level inflation rate is biased toward the goods they do not consume regularly. Even though the consumer survey tries to take this factor into account by asking retrospective questions about the past 12 months, some biases might remain, e.g. the recall bias. However, these biases should offset each other, such that mean inflation over all households is unbiased, which is the concept on which the average consumption basket to calculate the official CPI measure is based. The same will be true for those subsets of the population that are large and homogeneous enough. Official statistics often deliver such averages over certain weighted categories, such as the weekly or daily consumption basket, and less often also averages across certain subgroups, for example the price index for retired persons. However, the bias of the estimate of a yearly mean inflation rate among such a subset of households increases the smaller the

chosen subset is, as the sampling error from the short two-week observation period will rise.

Our goal, however, is not different than that of CPI calculation. After having calculated household-level inflation, we wish to assess its mean among different subgroups, such as occupational subgroups, as well as its relationship to household characteristics such as household income. In that sense, our application can be viewed as a type of decomposition of CPI inflation or the average consumption basket into the different consumption baskets with which certain subgroups are confronted.

3 Results

Once the household-level inflation rate has been calculated, we are interested in several statistical objects, such as its expected value or mean $E[\pi_{i,t}]$ (which should be close to CPI inflation), its quantile function

$$Q(p) = F^{-1}(p) = \\ = \inf\left\{\pi_{i,t} \in \mathbb{R} \mid F(\pi_{i,t}) \geq p\right\} \forall\ p \in [0;1],$$

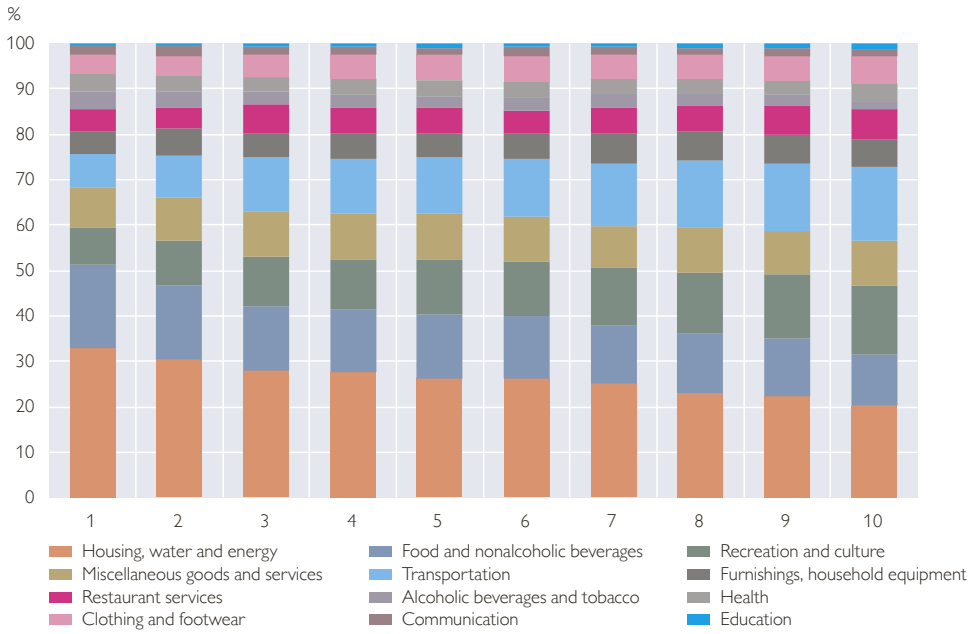
or expected values over certain subsets of the population or consumption categories $E_{i \epsilon J}[\pi_{i,t}]$ or $E_{c \epsilon K}[\pi_t^c]$, where $J \epsilon I$ and $K \epsilon C$ are subsets of the population set I or the set of categories C. In other words, we investigate which type of household is confronted with which level of inflation.

3.1 Consumption Shares

Chart 1 shows average consumption bundles aggregated at the COICOP 2 level across the deciles of household income. Whereas the shares spent for housing, water and energy, food and nonalcoholic beverages as well as alcoholic beverages and tobacco clearly decrease as income rises, those for recreation and culture, transportation, clothing and footwear as well as educa-

Chart 1

Consumption Shares over Household Income Deciles



Source: Consumer Survey 2009/10, Statistics Austria, OeNB.

tion increase. Patterns are less pronounced for the other categories.

As table 1 indicates, the inflation rates of the two-digit COICOP categories already show large variations. It also provides official CPI and HICP figures for inflation and COICOP two-digit share-weighted inflation (official COICOP two-digit inflation weighted with the raw two-digit shares resulting from the mean consumption COICOP two-digit bundle from the consumer survey). Note, however, that within each of the two-digit bundles, there is still a lot more variation, which translates into different household-level inflation rates for the different consumption bundles of households. Within the category nutrition and nonalcoholic beverages, the price e.g. for bread can still increase much more than the price for other items in the category, and households who consume a higher share of bread will experience relatively higher inflation, even if the overall share of expenditure on nutrition and nonalcoholic beverages of those households might be unchanged. To a large degree, we account for this phenomenon by using the COICOP four-digit classes, which themselves disaggregate consumption into 103 categories.

Table 1

Inflation over COICOP Two-Digit Categories

	2010	2011	2012
Food and nonalcoholic beverages	0.5	4.2	3.2
Alcoholic beverages and tobacco	2.0	4.1	2.4
Clothing and footwear	1.1	2.9	1.3
Housing, water and energy	2.6	3.2	3.2
Furnishings, household equipment	1.2	1.7	2.3
Health	1.6	1.9	1.5
Transportation	3.4	5.6	2.6
Communication	1.9	0.9	–0.1
Recreation and culture	0.8	2.0	1.0
Education	–4.7	4.1	4.4
Restaurant services	1.1	3.6	2.7
Miscellaneous goods and services	2.8	3.2	2.9
CPI	1.9	3.3	2.4
HICP	1.7	3.6	2.6
COICOP two-digit share-weighted inflation	1.9	3.4	2.5
COICOP two-digit share consumption-weighted inflation	1.9	3.4	2.5

Source: Statistics Austria, OeNB.

3.2 The Unconditional Distribution of Inflation

Chart 2 shows the quantile function of the household-level inflation rate 2012. Mean inflation was 2.21% and median inflation slightly higher at 2.23%. Roughly 51 % of all households were confronted with higher than average inflation. Whereas the values of median and mean inflation were relatively close together in 2012, meaning that the distribution of inflation among Austrian households is slightly negatively skewed, the dispersion around the median is relatively large. Whereas nearly 40% of the household population experienced inflation of less than 2%, inflation exceeds 3% for around 15% of the population.

The relatively robust P90/P10[3] measure already comes to 2.5, implying that the household at the edge of the 10% of households with the highest inflation experiences an inflation rate that is around 2.5 times higher than the household at the edge of the 10% of households with the lowest inflation. This dispersion around the median is a good measure of how representative CPI inflation is for households. Skewness is also relevant. The stronger the negative skew of the distribution is, the more households there are for which official CPI inflation is only a lower bound, given their consumption bundle.

[3] *The ratio of the 90th to the 10th percentile is a robust (in a Huber 2003 sense) measure of variation (see Cowell and Victoria-Feser, 1996).*

From 2010 to 2012, the distribution was always negatively skewed, and dispersion was decreasing.

However, the fact that household level inflation is heterogeneous does not tell us anything about which households have relatively high or relatively low inflation rates.

3.3 Bivariate Analysis

Chart 3 shows parametric and nonparametric estimates of the relationship between income and inflation. We use a simple univariate linear regression as well as a kernel regression to regress the micro inflation rate on the cumulative distribution function (CDF) of household income.

The income-inflation relationship is negative and stable along the full income distribution, as the kernel regression line resulting from 6,534 local regressions is very close to the linear regression line. At the lower tail of the income distribution, the negative relationship is estimated to be somewhat stronger and at the upper tail somewhat weaker than that of the linear regression. The higher household income is, the lower the inflation that the household experienced in 2012.

Of course, this pattern changes over time depending on the distribution of price changes across different goods. If the prices of goods representing a high share in the consumption baskets of higher-income households would rise relatively faster than other prices, the relationship would be positive.

As table 2 shows, however, the negative relationship was very stable at least from 2010 through 2012. All coefficients are negative and highly signifi-

Table 2

Relationship between Inflation and Income

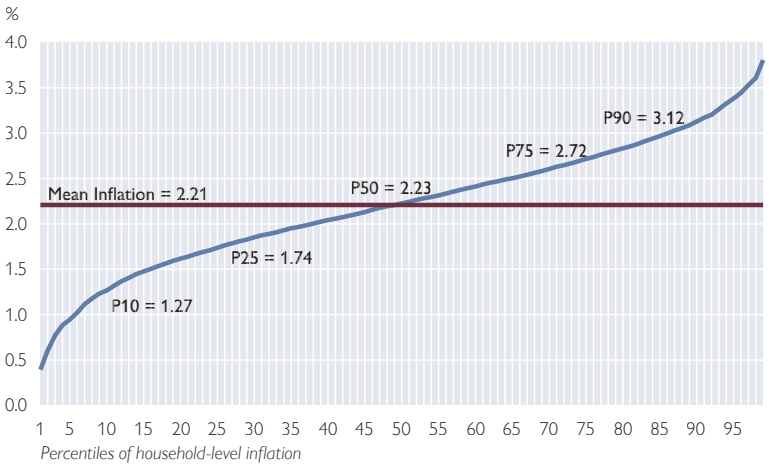
	Coefficient	Standard error
2010	–0.601	0.065
2011	–0.191	0.064
2012	–0.603	0.037

Source: Consumer Survey 2009/10, Statistics Austria, OeNB.

Note: This table shows the coefficients and standard errors of linear regressions (including a constant) of household-level inflation rates on the cumulative distribution function of household income.

Chart 2

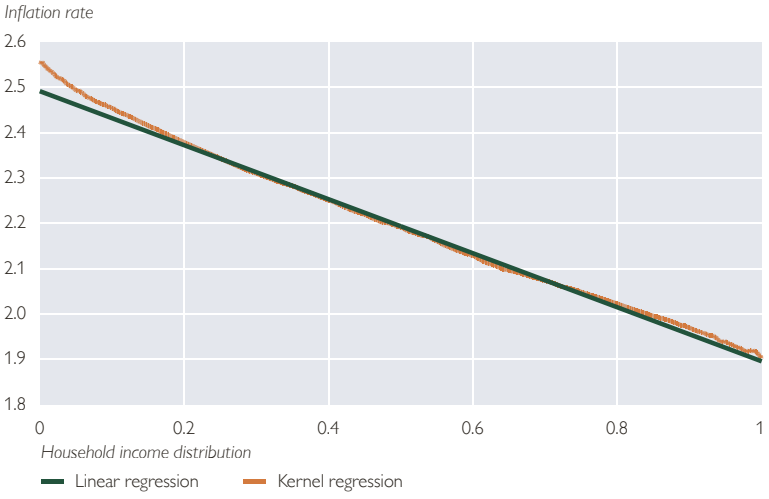
The Distribution of Inflation among Austrian Households (2012)



Source: Consumer Survey 2009/10, Statistics Austria, OeNB.

Chart 3

Parametric and Nonparametric Estimations of the Relationship between Income and Inflation



Source: Consumer Survey 2009/10, Statistics Austria, OeNB.

cant (at the 1% level[4]), implying that from 2010 to 2012, lower-income households where always confronted with higher than average – or official CPI – inflation, whereas higher-income households experienced less inflation, given their consumption bundles. This pattern mainly results from the fact that housing and energy as well as food and beverages, whose prices rose faster than average inflation during the period, represent a higher share in consumption baskets of lower-income households than of higher-income consumers. However, as food prices – at least those at the COICOP 2-digit level – did not rise more strongly than average inflation in 2010, higher food prices cannot be the only reason lower-income households experienced higher inflation.

A coefficient of –0.60 (for 2012) translates into an inflation rate that is around 6 basis points lower for every decile up the income distribution. In the period since the beginning of the crisis (2008 to 2012), this relationship was always negative and came to between 2 basis points (2011) and 8 basis points (2009) for each income decile.

This implies that to keep real incomes stable in 2012, not all incomes should be increased by 2.21%. Lower incomes would need to be increased more, (e.g. incomes at P10 would need to be raised by 2.45%) and higher incomes would need to be raised less (e.g. incomes at P90 would need to be increased by 1.97%). An across-the-board increase in incomes by mean (or official CPI) inflation leads to real income losses for lower-income households and real income gains for higher-income ones.

Table 3

Medians of Inflation by Income Deciles as a Percentage of Overall Median Inflation

	2010	2011	2012
1	125	104	118
2	123	106	112
3	120	105	108
4	102	99	100
5	104	103	101
6	103	102	98
7	91	94	95
8	83	94	93
9	71	93	92
10	74	96	90

Source: Consumer Survey 2009/10, Statistics Austria, OeNB.

Table 3 illustrates this relationship in terms of relative to median household-level inflation rates. It shows the inflation rate for the respective household income deciles measured as a percentage of median inflation. Higher-income households experienced around 70% to 90% of median inflation, compared with around 100% to 120% for lower-income households. The pattern is very stable over all three years in the observation period, even though it was less pronounced in 2011. As households have a tendency to stay in their deciles or to move only slowly, these differences between yearly inflation rates accumulate over the years, further increasing real income divergence.

[4] *Note that all the given standard errors in this paper result from weighted estimations (using given household weights) using the consumer expenditure survey including the merged household-level inflation rates. The survey does not include any information that allows us to take the spatial proximity of households in the consumption survey sampling scheme to those in the microcensus into account. However, only two to three households in the gross sample live close to microcensus households and because the unit response rate is 38%, this number is often even smaller. Therefore, differences for estimation of standard errors are likely to be negligible. The method for imputing income in the consumption survey is such that the true variation is likely to be underestimated. Furthermore, the merged price data is not gathered via probability sampling. All of these factors may contribute to an underestimation of standard errors.*

Table 4 shows mean household-level inflation rates across different household characteristics.

As municipality size increases, so do household-level inflation rates, rising from 2.10% in small villages (fewer than 5,000 inhabitants) to 2.37% in the largest municipality, Vienna. This relationship does not reflect different regional price developments, but rather the different consumption baskets of different household types across municipalities of various sizes have. One-person households (estimated at roughly 36% of all households) have average consumption bundles that correspond to inflation of 2.37%, whereas inflation decreases for larger households, down to 2.10% for households with five or more members. By household type, inflation is especially high in single-parent households that do not include any other adults (2.43%).

Table 4

Household-Level Inflation and Household Characteristics

	Household population share in %	Household-level inflation rate	Standard error
Municipality size			
≤5,000 inhabitants	39.7	2.10	0.02
5,001-10,000 inhabitants	12.4	2.15	0.03
10,001-50,000 inhabitants	13.8	2.24	0.03
50,001-100,000 inhabitants	2.6	2.29	0.07
>100,000 inhabitants	8.2	2.26	0.03
Vienna	23.3	2.37	0.02
Household size			
1	35.7	2.37	0.02
2	28.6	2.16	0.02
3	16.0	2.12	0.03
4	12.9	2.05	0.02
5+	6.8	2.10	0.03
Household type			
One Person	35.7	2.37	0.02
Couple with children	30.3	2.06	0.02
Couple without children	24.6	2.13	0.02
Single parent (the only adult)	3.2	2.43	0.04
Single parent (not the only adult)	3.1	2.25	0.05
Other	3.0	2.08	0.07
Household main residence			
Owner	51.0	1.88	0.01
Renter (public housing apartment)	8.1	2.58	0.04
Renter (housing association apartment)	17.0	2.58	0.02
Renter (private rental property)	15.2	2.57	0.03
Other (free use, cooperation housing, etc.)	8.7	2.46	0.04
Risky assets (at least one household member holds stocks or bonds)			
Yes	23.7	2.03	0.02
No	76.3	2.27	0.01
Vacation (maximum number over all household members in the past 12 months)			
0	43.8	2.39	0.02
1	31.9	2.14	0.02
2	13.4	2.05	0.03
3+	10.9	1.88	0.03
Total	100.00	2.21	0.01

Source: Consumer Survey 2009/10, Statistics Austria, OeNB.

Table 5

Household Level Inflation and Personal Characteristics of the Main Earner in the Household

	Household population share in %	Household-level inflation rate	Standard error
Age			
up to 29	9.1	2.29	0.04
30 to 39	16.9	2.19	0.03
40 to 49	23.4	2.14	0.02
50 to 64	26.2	2.16	0.02
65 and older	24.3	2.31	0.02
Education			
At most primary	17.0	2.40	0.03
Lower secondary	52.2	2.21	0.01
Higher secondary	17.0	2.12	0.03
Tertiary	13.7	2.06	0.03
Occupation			
Other not employed	2.4	2.39	0.07
Unemployed	3.6	2.38	0.07
Retired	32.4	2.30	0.02
Other employed	0.7	2.28	0.19
Blue collar	15.4	2.24	0.02
White collar	31.6	2.14	0.02
Self-employed	5.4	2.12	0.04
Civil servant	6.2	2.04	0.04
Farmer	2.2	1.87	0.06
Total	100.00	2.21	0.01

Source: Consumer Survey 2009/10, Statistics Austria, OeNB.

Inflation is significantly lower for households that own their main residence (1.88%), whereas inflation comes to approximately 2.58% for households that rent their main residence. Holding risky assets as well as a higher frequency of vacation can be seen as indicators of higher household wealth. Households that hold risky assets experience significantly lower inflation rates, and inflation decreases as the frequency of vacations in the household increases. Both signal a negative relationship between inflation and wealth, which is consistent with the income findings.

Table 5 shows household-level inflation across personal characteristics of a reference person. Of course, choosing one person as a representative of the household is always arbitrary. We chose the main earner in the household.

Inflation is higher in households with a very young or retired main earner and therefore shows a clear u-shaped pattern with regard to the age of the main earner. At the same time, these households are somewhat smaller than average. Education is also negatively correlated with inflation. The higher the education level of the main income earner in the household is, the lower the inflation rate is, given the household's consumption bundle.

Broken down by occupation, inflation is highest among nonworking households, i.e. the unemployed (2.38%) and the retired (2.30%). Among households with a working main income earner, blue-collar workers had the highest inflation (2.24%), followed by white collar workers (2.14%) and the self-employed (2.12%). Civil servants (2.04%) and especially farmers (1.87%) experience significantly lower inflation rates than blue-collar workers.[5] Like the income pattern, the occupational pattern was relatively stable over the 2010 to 2012 period. The ranking by household-level inflation was stable from 2010 to 2012 for households with working main income earners.

3.4 Multivariate Analysis

To examine the correlations between household-level inflation and different household characteristics not only with a bivariate but also with a multivariate analysis, we estimate the conditional expectation function (CEF) of household-level inflation $E[\pi_{i,t}|X_i]$, where X_i consists of household characteristics of household i. If the CEF is linear, a multivariate linear ordinary least

[5] *The small but heterogeneous groups "Other employed" and "Other not employed" are included only for the sake of completeness.*

squares regression (OLS) is the best predictor for this statistical object. Even in the likely case that the CEF is not linear, an OLS regression remains the best linear approximation of the CEF. Analogously, we are interested in conditional quantile functions $Q_{\pi_{i,t}|X_i}(p)$ and use quantile regressions for estimations (see Koenker and Basset, 1978). In our case – where due to the nature of the data collection (two weeks per household) outliers of $\pi_{i,t}$ might occur and the mean and median are very close in our dataset – quantile regression for the median is a reasonable robustness check with regard to OLS. Additionally, we estimate quantile regressions for the 20th and 80th percentile to investigate the robustness of the results also along the distribution of household-level inflation. It is important to note that clearly, all these estimations and resulting parameter estimates are purely descriptive and that no causal interpretation is in order.

The resulting parameter estimates and standard errors of the OLS and quantile regressions (P20, P50, P80) are shown in table A1 in the annex. The results of the OLS regression shown in chart 4 illustrate that household-level inflation is lower for higher-income households. While in the bivariate case, inflation decreases by 6 basis points per income decile, it decreases by 4 basis points in the multivariate case and is significant at the 1% level. The household types couples (12 basis points) as well as couples with children (12 basis points) experience significantly lower inflation (at the 1% level) than one-person households, which serve as a reference category. The only household type which has significantly higher household-level inflation (at the 1% level) than one-person households is the single-parent household with no other adult living in the household (11 basis points). With regard to education of the main earner, maximum primary education[6] serves as reference category and lower secondary (9 basis points) as well as higher secondary (17 basis points) and tertiary (18 basis points) are associated with significantly lower inflation (at the 1% level). By occupation of the main earner, civil servants (10 basis points) as well as farmers (29 basis points) have significantly lower inflation than the retired, which serve as a reference category. Further F-tests between the coefficients of the household with a working main earner show that while blue-collar workers are not significantly different from white-collar workers or the self-employed, all other households with a working main earner have significantly higher household-level inflation than farmers.[7]

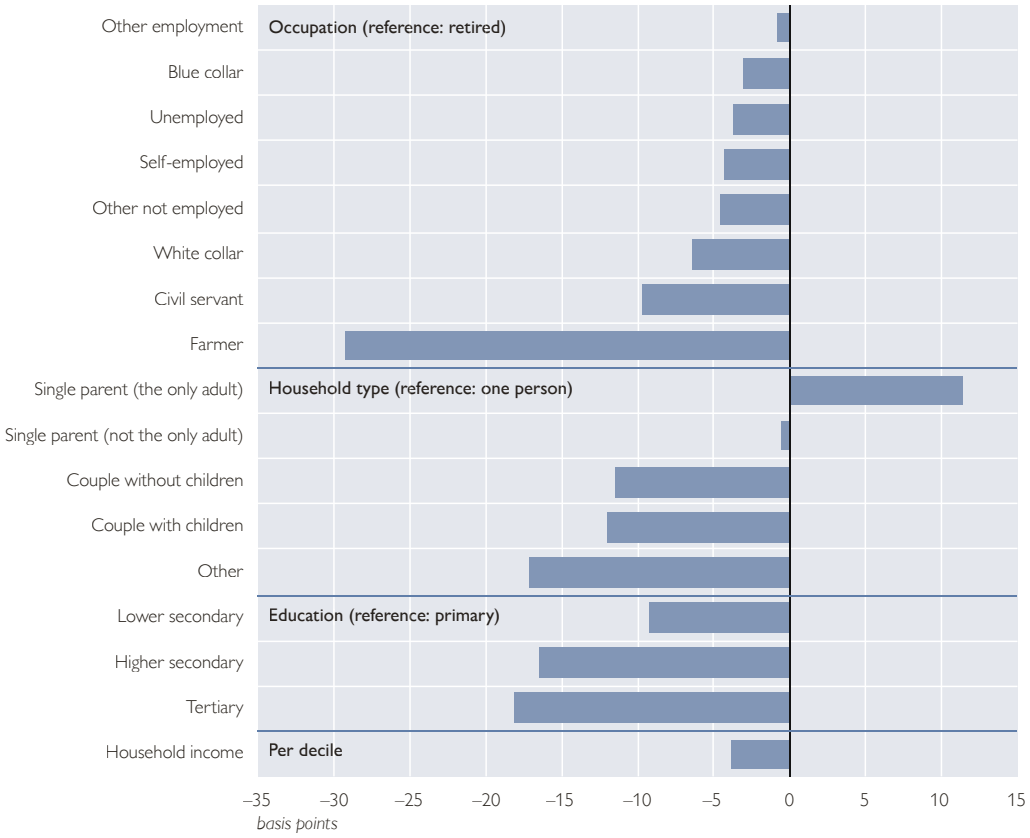
All of the OLS results hold using the more robust quantile regression at the median. Furthermore, the results are even somewhat more pronounced in terms of size and significance of the coefficients. At lower levels of the distribution of household-level inflation (P20), the effects for lower education, couples with children and civil servants lose statistical significance. At the

[6] *Primary education refers to the consumer survey education categories "maximal Pflichtschule"; lower secondary education to "Lehre/Berufschule, Meister- Werkmeisterausbildung, Ausbildung zum gehobenen Dienst für Gesundheits- und Krankenpflege, berufsbildende mittlere Schule"; higher secondary education to "allgemeinbildende und berufsbildende höhere Schule"; tertiary education to "Universität, Fachhochschule und hochschulverwandte Ausbildung, Akademie."*

[7] *Note that we also include age as a further control variable. However, as we include household type and occupation (including the retired), the age control only additionally covers average age effects remaining inside those cells heavily correlated with age and should not be interpreted as an age pattern.*

Chart 4

Conditional Differences in Household-Level Inflation at the Mean (OLS)



Source: Consumer Expenditure Survey 2009/10, OeNB.

Note: This table shows regression coefficients resulting from an OLS regression of household-level inflation on household characteristics. Age control and a constant are omitted. See annex for the detailed results (coefficients and standard errors) as well as the results of analogous quantile regressions.

upper part of distribution (P80), the results are closer to the middle. Results for all households except single-parent households stay significant.

All in all, the results show a robust and highly significant negative relationship between income and inflation (between 3.5 and 4.8 basis points for each income decile) for households that are a couple without children (between 8 and 12 basis points lower than the result for one-person households) or whose main earner is a farmer (between 21 and 36 basis points lower than the result for households whose main earner is retired) or that have an education level higher than primary education (between 1 and 20 basis points). These relationships are significant for the mean as well as for the median and the 20th and 80th percentiles of the distribution of household-level inflation.

Furthermore, age as well as occupation (white-collar workers or civil servants) and household type (couple with children) are significantly and negatively related (OLS and median regressions) in the middle part of the distribution of household-level inflation.

4 Concluding Remarks

In this paper, we calculated household-level inflation rates based on consumption bundles measured by the consumer

expenditure survey used for the official CPI calculations and the price index data at the four-digit level provided by Statistics Austria. This statistical exercise allowed us to look behind the CPI, which is defined as inflation of an average consumption bundle. Even though such a calculation cannot deliver an exact distribution (see section 2.3) of the inflation that households experience, it gives us an idea about (1) the heterogeneity of inflation among Austrian households and about (2) correlations between certain household characteristics and the inflation these households experience.

Although these patterns are likely to change over time and more research over longer time periods would be very interesting, we find the following stable patterns at least since 2010:

Inflation decreases as household income and the education of the main earner increases. It is significantly lower for civil servants and especially for farmers than for other occupation groups. It is especially high for unemployed persons, the retired and blue-collar workers. Inflation is lower for larger households than for one-person households, with the exception of single parents (with no other adults in the household) and has a u-shaped relationship with regard to age of the main earner.

As the primary goal of monetary policy is price stability, it is crucial to know about inflation and its development. In this vein, not only mean inflation, but also other measures, such as the variance or the skewness of inflation among households might be relevant. The higher the variance of inflation is, the larger is the share of households for which CPI inflation might not be a good approximation. The more negatively skewed the distribution of inflation is, the larger is the share of households that experience inflation above the mean. Thus it might be important for policymakers to develop additional measures of consumer prices as well as other forms of inflation measures, like developments of asset prices. If monetary policymakers additionally consider the development of median inflation and the variance of inflation when pursuing their medium price stability objective, wage unions might internalize this behavior in their negotiations, which could lead to improved growth and medium-term price stability. Especially in times when interest rates are close to the zero lower bound and real interest rates are therefore negative for a large class of assets, monitoring median inflation and the inflation of the asset holdings of certain households might reveal wealth and income effects which might otherwise be overlooked. These patterns of wealth and income effects might be rather important, as they are at least partly caused by monetary policy and as they directly translate into different consumption patterns as well as a redistribution of income and wealth potentially unintended by policymakers. Even though these unintended consequences of monetary policy might be difficult to avoid, it might be useful to consider the joint distributions of asset holdings, income streams as well as inflation patterns across households to understand them and take them into account. Further research in this vein is needed.

Analyzing the interplay between consumption and household savings, a particularly relevant relationship is that of inflation and income. From an aggregate point of view, theory suggests, and several empirical studies show, that the propensity to consume out of additional income decreases as income rises. This implies that if the relationship between income and inflation – given all income increases with mean (CPI) inflation – is

negative, aggregate consumption will be lower than if inflation were distributed equally or randomly across incomes. This is the case because households with lower income will experience real income losses, whereas households with higher income will experience real income increases – even though all incomes increase at the mean inflation rate.

Using the CPI as a reference for inflation compensation in wage negotiations might be misleading. Even wage increases above the mean inflation rate might produce real income losses for low-income households. On the other hand, even if nominal income increases at a rate below the mean inflation rate, this might translate into real income increases for higher-income households, given their typical consumption patterns. Differences in wage increases are already considered in many wage negotiations. These mostly come in the form of lump-sum payments for lower income groups, caps on absolute increases or even different increases for different income brackets and are mostly driven by considerations about the needs of certain groups of employees, firm-level and market conditions or union power. However, what is missing is a systematic evaluation and general strategy with regard to different inflation rates. Taking inflation patterns across incomes or other household characteristics into account might lead to more efficient negotiation outcomes, as it would increase information about the true effects of nominal wage increases.

While recent analyses of wage and income developments in Austria (Glocker et al., 2012; Rechnungshof, 2012) show real income losses for lower incomes and real income gains for higher incomes, these results are likely to understate the real level of divergence, as the different inflation rates resulting from the different consumption bundles have not been taken into account. Not taking diverging inflation patterns into account might be especially harmful in times of lower growth because of the negative relationship between the marginal propensity to consume and income. All these arguments call for more research in this area to provide better insights into the dimensions of the heterogeneity of inflation across households and over time.

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Annex

Table A1

Descriptive Regressions of Household-Level Inflation on Household Characteristics

	OLS	Quantile regressions		
		p=0.2	p=0.5 (median)	p=0.8
Age				
Age	–0.002	–0.001	–0.003	–0.001
	(0.001)	(0.002)	(0.001)	(0.001)
Education (reference: at most primary)				
Lower secondary	–0.092	–0.065	–0.124	–0.088
	(0.032)	(0.042)	(0.032)	(0.032)
Higher secondary	–0.165	–0.116	–0.197	–0.16
	(0.041)	(0.054)	(0.041)	(0.041)
Tertiary	–0.181	–0.103	–0.199	–0.18
	(0.042)	(0.058)	(0.045)	(0.044)
Household income	–0.39	–0.346	–0.371	–0.478
	(0.052)	(0.071)	(0.055)	(0.054)
Household type (reference: one person)				
Couple with children	–0.12	–0.041	–0.109	–0.166
	(0.034)	(0.046)	(0.035)	(0.035)
Couple without children	–0.115	–0.076	–0.134	–0.098
	(0.032)	(0.042)	(0.033)	(0.032)
Single parent (the only adult)	0.114	0.207	0.112	0.023
	(0.044)	(0.085)	(0.065)	(0.064)
Single parent (not the only adult)	–0.006	0.043	–0.059	0.011
	(0.055)	(0.086)	(0.066)	(0.065)
Other	–0.171	–0.102	–0.134	–0.174
	(0.070)	(0.088)	(0.068)	(0.066)
Occupation (reference: retired)				
Blue collar	–0.031	0.039	–0.109	–0.043
	(0.045)	(0.063)	(0.049)	(0.048)
White collar	–0.064	–0.053	–0.135	–0.027
	(0.042)	(0.058)	(0.045)	(0.044)
Civil servant	–0.097	–0.033	–0.21	–0.07
	(0.049)	(0.074)	(0.057)	(0.056)
Farmer	–0.293	–0.205	–0.36	–0.29
	(0.076)	(0.108)	(0.083)	(0.082)
Self-employed	–0.043	–0.065	–0.135	0.06
	(0.055)	(0.078)	(0.061)	(0.059)
Other employed	–0.008	–0.083	0.17	0.272
	(0.199)	(0.177)	(0.137)	(0.134)
Unemployed	–0.037	–0.132	–0.027	0.053
	(0.076)	(0.090)	(0.069)	(0.068)
Other not employed	–0.046	–0.03	–0.096	0.088
	(0.082)	(0.111)	(0.085)	(0.084)
Number of observations	6,534	6,534	6,534	6,534

Source: Consumer Survey 2009/10, Statistics Austria, OeNB.

Note: Standard errors are given in parentheses.