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Inflation inequality in Austria: A mid-term view on cost-of-living developments

*Alexander W. Huber**

ABSTRACT

I compute household-specific inflation rates for Austria for the period between 2016 and 2019. Data is provided by Statistics Austria's Consumer Expenditure Survey for 2014/15 ("Konsumerhebung") and contains household expenditures reaching the 3-digit COICOP level. I find a negative plutocratic bias, meaning that common types of measurement tend to understate CPI inflation. In the period covered, the distribution of inflation is characterized by large dispersion, meaning that the standard CPI inflation is not very representative for a large proportion of Austrian households. There is a clear negative relationship between income and inflation that is mainly driven by ownership status. Households living in rental accommodation are affected significantly more by inflation. I further find an urban-rural divide in the sense that households in larger cities are more likely to exhibit higher individual inflation rates than their counterparts in small municipalities. Considering household structures, single households exhibit significantly higher inflation. These effects remain significant even after controlling for ownership status. All in all, the results are strong arguments for paying greater attention to the issue of inflation inequality when it comes to wage setting, taxation or indexations, as there are potentially large distributional effects going unrecognized.

KEYWORDS

Inflation, group-specific inflation, micro-data, distribution

JEL-CODES

E31, C43, C81

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1. Introduction

Economics' efforts to encompass principles of both social and natural sciences have always been accompanied by the search for generally accepted indicators. One of the main indicators the discipline has to offer is the inflation rate. Whether we are aware of it in our everyday lives or not, this one number has large implications on economic processes both on the macro and the micro level. The consumer price index (CPI) is the tool needed to compute the inflation rate. It is described by Pollak (1980) as a powerful index that not only affects individuals' perceptions of price developments, but also influences wage setting, social benefits and economic policy in general. Despite the broad general acceptance of CPI inflation, the question has to be asked how representative a single number, published more or less regularly by statistical agencies, can be for a (probably increasingly) heterogeneous set of households in the economy. Since prices do not change similarly over different groups of consumption goods, the degree by which a household is affected by inflation depends on the shares of its expenditures spent on the different consumption groups. Spending relatively more on goods that exhibit larger price increases will raise a household's individual inflation rate. On the other hand, spending relatively more on goods that are characterized by relatively lower price increases will make a household less affected by inflation. The questions to be asked are first, if there indeed is a disparity in household-level inflation and how large that disparity is. Furthermore, it is of interest what kind of households are either at the top or the bottom of the distribution of inflation and if there are certain characteristics that can be associated with higher or lower inflation rates. Is, for example, a young household living in rental accommodation likely to be affected more by inflation than an older couple who own a house? Are there differences between single households and larger families? These and many more characteristics could potentially result in different consumption patterns for different types of households. Identifying these can help give politicians an idea about the needs of different household groups and how their individual purchasing power is affected by inflation.

I analyse inflation inequality for households in Austria over the period from 2016 to 2019 using the Consumer Expenditure Survey for 2014/15 ("Konsumerhebung") provided by Statistics Austria. Using the so-called "democratic weighting scheme", I compute household-specific inflation rates and compare different groups of households. First, I find that the plutocratic bias is negative for the period covered, meaning that mean inflation is understated by common types of measurement. Second, although mean and median inflation are relatively close, there is a large disparity between the bottom and the top of the inflation distribution. Results further suggest that there is persistence in the households' relative positions in the inflation distribution over the

years covered. Third, the relationship between income and inflation is negative. However, the effect is largely absorbed by ownership status controls. Accordingly, households living in rental accommodation exhibit significantly higher inflation than households that own their main residence. Last but not least, I find an urban-rural divide, meaning that households living in big cities exhibit higher inflation rates than households whose main residence is in a smaller municipality. This divide remains significant even after controlling for ownership status.

The fact that there is a large disparity in household-level inflation and that there are differences across certain groups is of great relevance when it comes to wage setting, indexation, taxes, etc., as there are potentially large distributional implications that are easily overseen when applying the standard measure of CPI inflation.

2. Literature review

Contributions to the issue of inflation inequality go back to the 1950s, with Prais (1959) beginning to question the so-called “plutocratic weighting scheme” that is still being used by many official statistical agencies when it comes to CPI calculation. In this method, consumption categories are weighted according to absolute expenditure volume. Prais argues that this weighting method gives greater weight to luxury expenditures. Along with Nicholson (1975), he suggests a democratic weighting scheme, giving every household equal weight instead of weighting by total expenditure. Studying US households in the early 1970s, Michael (1979) provides one of the first major studies on this issue, first questioning the dispersion between households when it comes to changes in the CPI before analysing the influence of specific characteristics on a household’s inflation rate, as well as asking whether there is persistence in a household’s relative position in the distribution of individual CPIs. While the latter can be answered affirmatively, Michael does not find stable differences between different types of households over time, meaning that in the long run, no household group is likely to be excessively affected by higher- or lower-than-average inflation rates. Hobbijn & Lagakos (2005) analyse US households in the period between 1987 and 2001 and find that elderly households are affected by higher inflation rates due to relatively higher healthcare expenditures and that poorer households’ inflation rates are driven largely by petrol prices. Moreover, they do not find persistence in household-specific inflation rates, meaning that a household facing high inflation one year does not necessarily face high inflation the following year.

Hamilton (2001) finds black-white differences over the period from 1974 to 1991, as the true cost of living for black people fell by approximately 15 per cent relative to that of white people. This was partly due to a decrease in the share of black people’s expenditure spent on food.

With regard to the United Kingdom in the period from 1976 to 2000, Crawford & Smith (2002) find that the average annual inflation rate was higher for the richest 10 per cent of households than for the poorest 10 per cent. Moreover, they find that there is more disparity in the distribution of inflation among households in years where inflation is generally higher.

Instead of restricting their view to consumer behaviour, Kaplan & Schulhofer-Wohl (2017) focus on prices at a granular level and find that inequality in inflation rates stems to a large extent from differences in prices paid for the same products. Jaravel (2021) argues that innovation is more likely to have productivity-enhancing and inflation-lowering effects in the market for high-end and income-elastic products, which benefits the rich more than the poor.

Turning to Austria, there are 3 major recent contributions. The first is from Fritzer & Glatzer (2009), who find that lower-income households were affected more strongly by inflation in the period from 2000 to 2008 and that these households spent a larger share of their income on housing and food than richer households. Fessler & Fritzer (2013) also find a negative relationship between income and inflation in Austria between 2010 and 2012. Moreover, it is unemployed and blue-collar workers who are more likely to exhibit higher-than-average inflation. Regarding family structure, the authors show that those households more likely to be affected by higher inflation rates are single households, single parents and couples without children. Furthermore, inflation rates increase in line with the population size of the municipality where the household's main residence is located and are generally higher for households living in rental accommodation than for homeowners.

The most recent contribution is by Humer & Rapp (2018), who show that a household's consumption behaviour is strongly determined by social and economic characteristics and therefore allows for a group-wise comparison of household-specific inflation rates. The authors find that, between 2000 and 2015, inflation increased more substantially than income for lower-income households, resulting in real income losses. They also show that housing is a main factor in determining inflation, with households living in rental accommodation exhibiting relatively higher increases in the cost of living. Turning to the most recent developments, Vidal & Villani (2022) find that in 8 out of 27 EU countries, lower-income groups are most affected by inflation due to their consumer baskets mainly comprising essential goods which are price-inelastic.

3. Data and methods

The main data source used is the Consumer Expenditure Survey for 2014/15 (“Konsumerhebung”) from Statistics Austria. It has been conducted every five years since 1999, each time over a one-year period. Households taking part in the survey are asked to report all their expenditures for a period of two weeks. In additional interviews, Statistics Austria collects information about household characteristics. These interviews also make it possible to correct for bigger one-time expenditures like holidays or cars. Expenditure categories follow the “Classification of Individual Consumption Expenditures by Purpose” (COICOP). Statistics Austria uses an adapted COICOP version consisting of 13 main categories; however, only 12 of them represent private consumption, which is why the category “not for private consumption” is dropped. These 12 categories correspond to the 2-digit COICOP level. However, for most of the descriptive statistics and computations, data on the 3-digit COICOP level are used, which is the most granular level available in the aggregated version of the Consumer Expenditure Survey. Altogether, it comprises 38 consumption categories (Statistics Austria, 2018).

Information on prices is not included in the Consumer Expenditure Survey, but Statistics Austria provide CPI data on their website. Statistics Austria’s CPI is a Laspeyres-type index, meaning that consumer baskets are kept fixed over a certain time period and only price changes are measured. Consumption categories are also based on the COICOP classification and can therefore be easily matched to the Consumer Expenditure Survey data.

The number of interest when it comes to household-level inflation is the inflation rate π , measuring the yearly rate of change in the CPI indices. It is computed for the period from 2016 to 2019 using formula (1):

$$\pi_t = \frac{CPI_t - CPI_{t-1}}{CPI_{t-1}} * 100 \quad (1)$$

In some tables, I also show results for the years 2020 and 2021. However, I do not include these 2 years in the analysis, since the Covid-19 pandemic led not only to serious shifts in household consumption behaviour, but also to problems in the measurement of price developments for various types of goods and services.

As mentioned above, the way the CPI and the inflation rate are usually computed by statistical agencies is referred to as “plutocratic”. Depending on aggregate spending, weights are assigned to the different consumption categories. The more spent on a certain category in absolute numbers, the larger the relevance of a price change in this category when computing the overall CPI. However, this also means that, when it

comes to the category weights, the spending patterns of households that expend more money on consumption in absolute terms is of greater influence than the consumption patterns of households that spend less. The so-called “aggregate CPI” therefore cannot be seen as a representative measure of inflation for all households, as it is likely to be biased towards higher income households (Fritzer & Glatzer, 2009).

A common way to compute household-specific inflation rates is the “democratic weighting scheme” that is applied, for example, by Fessler & Fritzer (2013), Humer & Rapp (2018) and Fritzer & Glatzer (2009). In this scheme, every household h is given equal weight when computing either mean or median inflation over all households. Therefore, unlike in the plutocratic scheme, it does not matter how much a household consumed in absolute terms. The weights w are based on each individual household’s relative spending on the different consumption categories i . As mentioned before, the 3-digit COICOP classification in the aggregated version of the Consumer Expenditure Survey consists of 38 categories. A category’s weight is simply the share of a household’s consumption expenditure spent on that category. I subsume subcategories for “health” under the 2-digit COICOP level which reduces the total number of categories to 36. Furthermore, I do not take into account the expenditure category for owner-occupied housing. Statistics Austria (2018) computes imputed rents in the Consumer Expenditure Survey due to “international recommendations”. It is argued that this enables a better comparison of housing costs between owners of real estate and renters. However, investments and other costs associated with construction and modification are not part of a household’s consumption expenditures and do not have a direct effect on the household budget. I therefore chose to exclude them from the analysis, which leaves me with a total of 35 consumption categories.

Households with a consumption weight that is greater than 0.75 for a single category are dropped from the sample, which reduces the total to 7,137 households. In a further step, the weights are multiplied by the inflation rate of the consumption categories. Summing up over all categories gives the household’s individual inflation rate for a specific year t .

$$\pi_{h,t} = \sum_{i=1}^{35} w_{h,i,t-1} \left(\frac{p_{i,t}}{p_{i,t-1}} - 1 \right) \quad (2)$$

Subtracting the weighted mean of the democratic inflation rate over all households from the plutocratic measure yields the plutocratic bias. Fritzer & Glatzer (2009) find an annual average plutocratic bias of -0.12 percentage points in Austria between 2000 and 2008. This means that the average inflation rate exhibited by households in Austria is on average understated when applying the plutocratic weighting scheme. They also argue that the plutocratic bias is a good measure for heterogeneity of inflation

among households. On the other hand, Hobijn & Lagakos (2005) find a positive bias of 0.1 percentage points for the United States between 1987 and 2001. Crawford & Smith (2002) do not find any significant difference between the two measures for the United Kingdom between 1976 and 2000.

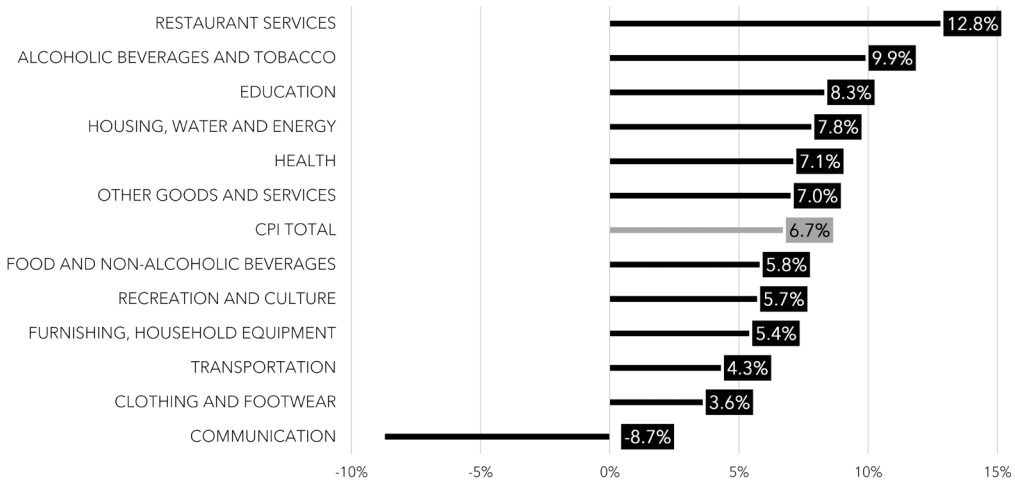
After having computed household-specific inflation rates, the relationship between inflation and income, as well as other characteristics, can be analysed. For the first purpose, a simple bivariate ordinary least squares (OLS) model is used, where cumulated inflation is regressed on the cumulative distribution function (CDF) of equivalized household income, as proposed by Fessler & Fritzer (2013). Furthermore, the authors suggest using kernel regression as a non-parametric estimation technique. This makes it possible to analyse the income inflation relationship based on the information of 7,137 local regressions.

The relationship between inflation and the above-mentioned types of household characteristics is further analysed in a series of multivariate linear regression specifications. As a robustness check for the multivariate case, quantile regression is used, which is also applied by Fessler & Fritzer (2013). The authors argue that this makes it possible to control for possible outliers of household-specific inflation. This technique is based on Koenker & Bassett (1978) and differs from common OLS in the sense that instead of the conditional mean, one may also be interested in the conditional median or any conditional quantile. Here, the regression line is not drawn through the estimated mean, but rather the quantile of interest. I estimate quantile regressions at the 20th percentile, the median and the 80th percentile. Moreover, differences in mean and median inflation are shown for chosen subgroups.

4. Inflation in Austria

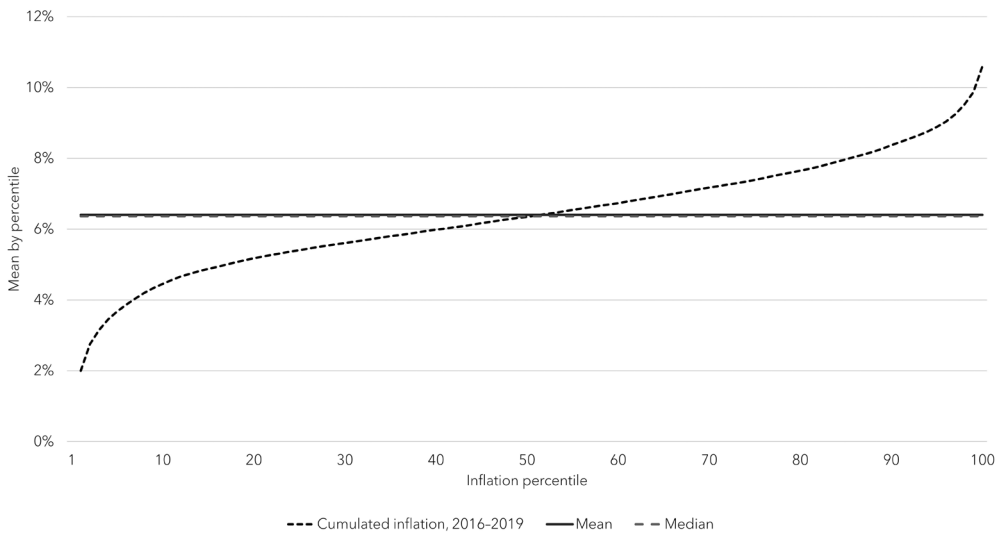
In this chapter, I show what inflation in Austria looked like in the four-year period covered and provide initial results concerning the distribution of household-level inflation. Figure 1 shows cumulated inflation between 2016 and 2019 for the 12 main consumption categories (2-digit COICOP level).

Figure 1: Cumulated inflation by 2-digit COICOP category, 2016–2019



Source: Statistics Austria

What immediately catches the eye is the development in the “communication” category, where prices have declined in the period covered. Furthermore, clothing and footwear as well as transportation have seen only moderate price increases in the period covered. At the upper end, large average inflation can be seen for restaurant services (12.8 per cent) and alcoholic beverages and tobacco (9.9 per cent). Prices for housing, water and energy rose by 7.8 per cent. Computing household-level inflation using the democratic weighting scheme introduced above makes it possible to show the distribution of inflation over all households. Figure 2 shows the average cumulated inflation for the years 2016 to 2019 by percentile. The mean of cumulated inflation is 6.40 and the median 6.36, meaning that over 51 per cent of all households exhibited inflation rates below the mean. The distribution is skewed positively, but only slightly, since mean and median are relatively close together. The latter holds for all years covered (see Table 2), except for 2018 where the difference is 0.14 percentage points. However, there seems to be large dispersion between the bottom and the top, with cumulated inflation of under 2 per cent in the bottom percentile. At the other end of the distribution, the average within the 100th percentile is 10.6 per cent.

Figure 2: Distribution of cumulated inflation, 2016–2019

Source: Consumer Expenditure Survey 2014/15

The 90.10-point ratio for cumulated inflation is 1.86, meaning that inflation at the 90th percentile was 1.86 times higher than at the 10th percentile. The 80.20-point ratio lies at 1.47, also indicating that dispersion of average yearly inflation is relatively high. This also means that official CPI inflation is not very representative for a large proportion of Austrian households.

Table 1: Dispersion measures

	Mean	Median	P10	P20	P80	P90	P90.10	P80.20
2016	0.89	0.91	0.08	0.38	1.43	1.68	22.22	3.77
2017	2.01	2.03	1.43	1.65	2.40	2.58	1.80	1.45
2018	1.87	2.01	0.86	1.33	2.48	2.71	3.15	1.86
2019	1.45	1.46	0.95	1.13	1.78	1.96	2.06	1.57
2020	1.35	1.43	0.43	0.80	1.97	2.23	5.24	2.46
2021	2.73	2.65	1.81	2.08	3.34	3.73	2.06	1.61
Cum. (16–19)	6.40	6.36	4.52	5.21	7.68	8.41	1.86	1.47
Cum. (16–21)	10.81	10.69	8.49	9.21	12.47	13.36	1.57	1.35

Source: Consumer Expenditure Survey for 2014/15

As shown in Table 1, for Austria between 2016 and 2019, I find a negative plutocratic bias. While in 2016, plutocratic inflation was slightly higher than the democratic measure, the difference is negative throughout the following years. The cumulated plutocratic bias amounts to -0.17 per cent, meaning that inflation is understated when applying the plutocratic weighting scheme. The plutocratic bias is larger (-0.26) when consumption weights applied in the plutocratic weighting scheme are not based on equivalized household expenditure (see Appendix). Democratic inflation, however, is not affected by this. Depending on which consumption categories experience higher price increases compared to others, the plutocratic bias differs in size between the years. Taken together with results from Fritzer & Glatzer (2009), this points to a systematic gap that can be observed since the early 2000s between inflation experienced by households with lower total consumption spending and the standard CPI inflation measure.

Table 2: The plutocratic bias

Period	Plutocratic inflation	Democratic inflation	Plutocratic bias
2016	0.91	0.89	0.02
2017	1.99	2.01	-0.02
2018	1.76	1.87	-0.12
2019	1.41	1.45	-0.04
2020	1.36	1.35	0.01
2021	2.79	2.73	0.06
Cumulated 16–19	6.24	6.40	-0.17

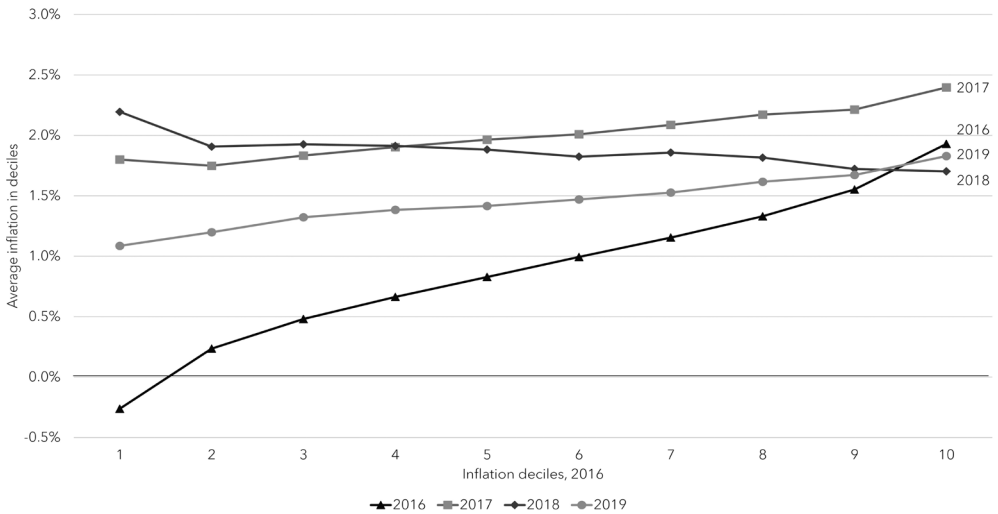
Source: Consumer Expenditure Survey for 2014/15

Before diving deeper into the inflation-income relationship, the question arises if it is always the same households that exhibit high inflation, or if their position in the distribution is likely to change from year to year. In Figure 3, I use a graphical approach, keeping the 2016 inflation deciles constant over the whole time period to check whether the deciles' relative positions change in the following years. Except for 2018, where the pattern is rather unclear, all of the ten deciles from 2016 remained in the same position in the following years. Overall, these results suggest that the distribution of inflation was relatively persistent in the time period covered.

Unfortunately, there is a possibility that these results are partly influenced by the fact that consumption patterns are kept constant over the four-year period. This is one of the drawbacks of the Consumer Expenditure Survey (see section Limitations). However, it seems reasonable to assume at this point that consumption patterns at the household level are not likely to change dramatically from year to year. Also, in Statistics

Austria's measurement of the CPI, consumption weights do not change dramatically over longer periods.

Figure 3: Average annual inflation for 2016 inflation deciles



Source: Consumer Expenditure Survey for 2014/15

5. The income-inflation relationship

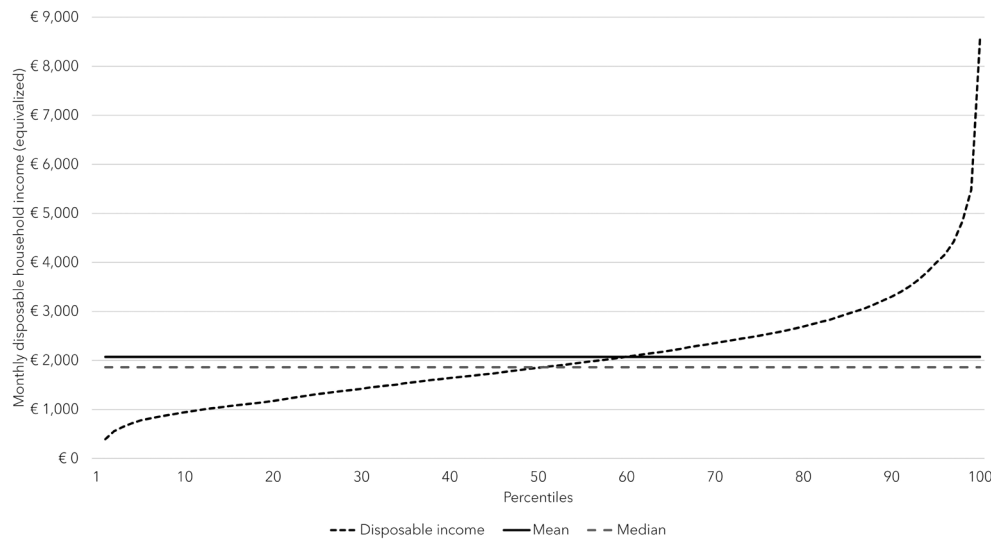
Having shown that for many households official CPI inflation is not a very representative measure, I am now interested in who the households are that are facing higher- or lower-than-average inflation. A good start is to examine the relationship between inflation and income. The income measure chosen is the disposable equivalized household income without imputed rent. Figure 4 shows the distribution of disposable household income in the base year. Equivalized mean income lies at €2,070, median income at €1,860.

Figure 5 visualizes the consumption shares of each income decile, grouping the 12 consumption categories into 3 clusters. The clusters are ordered from top to bottom according to their cumulated price increases in the four-year period. Lower-income deciles spend a larger share of their income on the cluster where price increases have increased the most¹.

¹ For reasons of visualization, not all of the 12 main categories are depicted in the graph. However, the author is willing to provide more detailed information upon request.

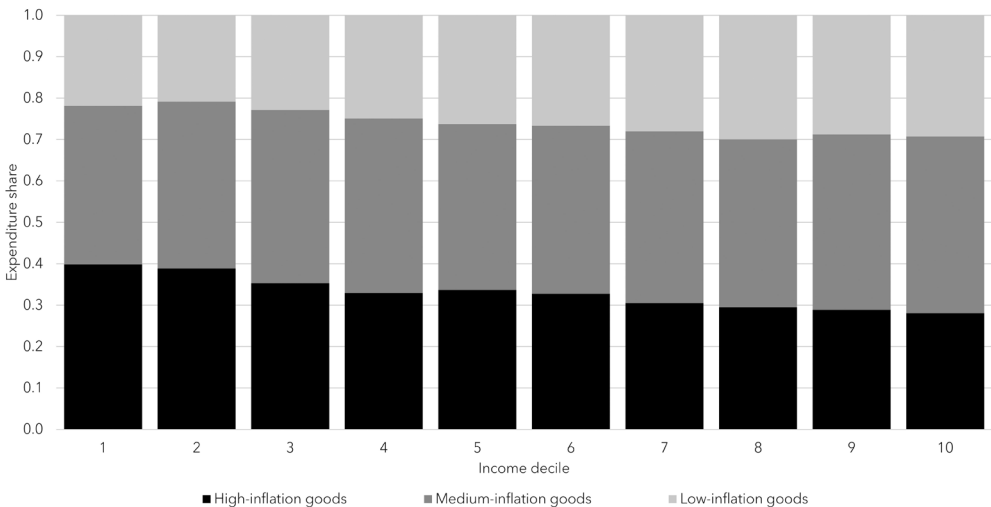
The share of money spent on food and non-alcoholic beverages, as well as housing, water and energy is especially large for lower-income households. However, this share diminishes when moving up the income deciles.

Figure 4: Distribution of disposable household income



Source: Consumer Expenditure Survey 2014/15

Figure 5: Consumption shares by income decile



Source: Consumer Expenditure Survey 2014/15

On the other hand, households from higher income deciles spend relatively more on categories that exhibited the lowest price increases between 2016 and 2019. The larger the share a household spends on these lower-inflation categories, the more weight is assigned to these categories in the computation of the household's individual inflation rate. Comparing this over income deciles indicates that households from lower income deciles might be likely to exhibit higher individual inflation rates, as they tend to spend a larger fraction of their income on goods that became relatively more expensive in the period covered.

The income-inflation relationship is first estimated via OLS. In the first specification, I regress yearly average inflation on the cumulative distribution function (CDF) of equivalized household income, while in column (2) I use the log of equivalized household income. Standard errors are shown in parentheses. The results show a highly significant negative relationship between income and inflation in both cases. Further controls are added in the multivariate case. The separate estimations for each year show that the income-inflation relationship is always negative and significant in the four-year period covered with coefficients between -0.0052 and -0.0006.

Table 3: Bivariate OLS regression

	<i>Dependent variable:</i>	
	Cumulated inflation 16–19	
	(1)	(2)
Income (CDF)	-0.010*** (0.001)	
Log income		-0.005*** (0.0004)
Constant	0.069*** (0.0004)	0.103*** (0.003)
Observations	7,137	7,137
R ²	0.031	0.028
Adjusted R ²	0.031	0.028
Residual std. error (df = 7135)	0.353	0.354
F statistic (df = 1; 7135)	229.326***	207.815***
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01	

Source: Consumer Expenditure Survey for 2014/15

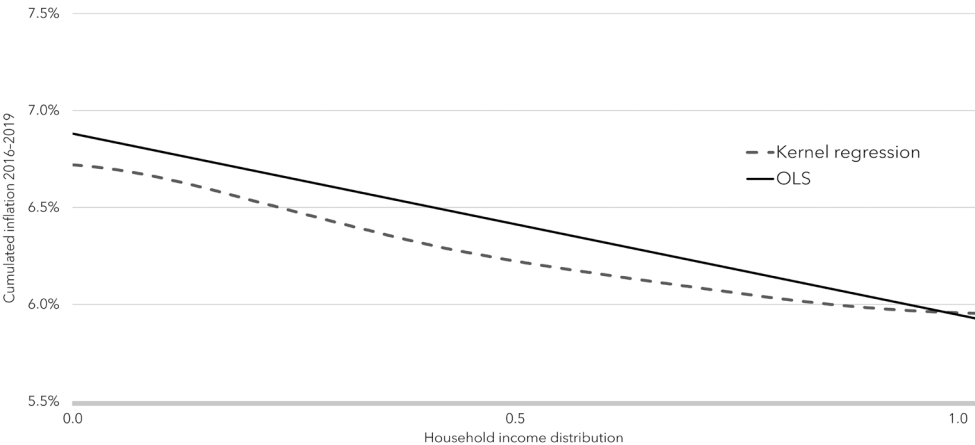
Following Fessler & Fritzer (2013), I also estimate the non-parametric relationship between income and inflation by applying kernel regression. Figure 6 depicts both the linear regression line obtained by OLS and the non-linear regression line from 7,137 local regressions using the second-order Gaussian kernel. The relationship is also negative across most parts of the distribution. However, it is stronger at the lower end, especially between the 2nd and the 4th decile. When moving to the upper end of the distribution, the relationship becomes slightly positive.

Table 4: Income-inflation relationship by year (OLS)

	Coefficient	Standard error
2016	-0.0006	0.0003
2017	-0.0008	0.0002
2018	-0.0052	0.0003
2019	-0.0023	0.0002

Source: Consumer Expenditure Survey 2014/15

Figure 6: Income-inflation relationship

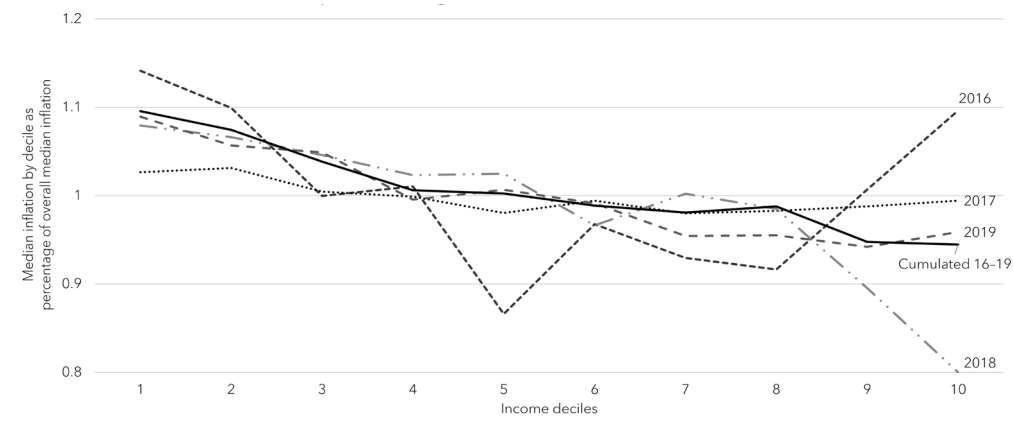


Source: Consumer Expenditure Survey 2014/15

Figure 7 compares the median inflation within each income decile and overall median inflation. Except for 2016, where large jumps between the deciles can be observed, the patterns are relatively stable over the years. Median inflation for the lowest income deciles was 1.1 times the overall median of cumulated inflation, while the 9th and the 10th decile exhibited a median inflation that was only around 95 per cent of the overall median, respectively.

Table 6 provides an overview of mean and median inflation over income deciles. There is a steady decrease in cumulated inflation when moving up the income deciles. While mean inflation in the first decile lies at 6.36 per cent, it is over 0.8 percentage points lower in the 9th and the 10th decile. Median inflation is also characterized by larger dispersion. Overall, the picture that emerges from the first few results clearly shows that lower income households seem to be affected more strongly by both yearly and cumulated inflation in the period between 2016 and 2019.

Figure 7: Median inflation by income decile as percentage of overall median



Source: Consumer Expenditure Survey 2014/15

Table 5: Mean and median inflation by income decile

Decile	Cumulated inflation 16-19	
	Mean	Median
1	6.86	6.97
2	6.85	6.84
3	6.58	6.61
4	6.50	6.40
5	6.38	6.38
6	6.34	6.29
7	6.26	6.24
8	6.21	6.29
9	6.05	6.03
10	6.01	6.01

Source: Consumer Expenditure Survey for 2014/15

6. Inflation and household characteristics

Having examined the relationship between income and inflation, a sufficient analysis of the determinants of household-specific and group-specific inflation requires other characteristics to be taken into account as well. This is achieved by applying multivariate regression, controlling for different sets of characteristics². Table 7 shows the results for five different specifications of a multivariate linear regression. The dependent variable, as in the bivariate case, is cumulated household-level inflation between 2016 and 2019 and standard errors are shown in parentheses. The first striking result is the effect of ownership status. Inflation is significantly higher for renters compared to owners. Being a renter on the private market results in cumulated inflation that is 1.5 percentage points higher than for owners. This strongly points to ownership status being the main driver of household-specific inflation. However, controlling for ownership status does not affect the sign and significance level of income. A higher position in the income distribution can still be associated with lower cumulated inflation. Considering household types, single households face significantly higher inflation than others in all specifications. Significant results are also obtained for couples with children, who experience lower inflation than the base group. Pensioners, employees and the self-employed exhibit significantly lower inflation rates over all specifications. Furthermore, owning a car is associated with significantly lower inflation. This could be due to the fact that the transportation category has a relatively large weight in the overall CPI and an even larger household expenditure weight if the household owns a car. At the same time, transportation was among the 3 categories with the lowest price increases during the period covered.

Spending relatively more on transportation thus reduces household-level inflation. Looking at the population control, one can observe a significant positive relationship. A substantial part of that relationship is connected to ownership status, as the coefficient is largest in column (4) where there are no ownership controls. However, inflation continues to be significantly higher for households in larger cities even after controlling for ownership status, suggesting an urban-rural gap in household-level inflation. No clear conclusions can be drawn by controlling for educational attainment, heating type or migration background. The R^2 and adjusted R^2 in Table 7 reveal considerable differences between column (4) and the other columns. Excluding the ownership status controls from the specification results in an R^2 of 0.153, which is 10 per cent less than in the other columns. This means that without the ownership controls, instead of around 27 per cent, only around 15 per cent of the variation in the dependent variable is explained by the groups of controls. This suggests that ownership status is the most important contributor to the R^2 . This is also confirmed by looking

2 A detailed description of variables used for the analysis can be found in the Appendix under section 10.1 Data wrangling.

at the relative importance metrics in Table 8, referring to the full specification in column (5) of Table 7. Three different measures are applied for decomposing the R^2 . The first, the LMG measure, refers to Lindeman, Merenda & Gold (1980) and averages the contribution of each group of variables over different orderings in the specification. The other 2 columns show the contributions of the different groups when including them either last or first. Contributions are standardized to 100 per cent. The picture that emerges confirms that ownership status is by far the most important group of controls when it comes to explaining variation in average yearly inflation with an LMG measure of 58.7 per cent. Population and household structure are further important contributors to the overall R^2 , while educational attainment seems to explain hardly any variation in average yearly inflation.

As a robustness check, quantile regression is applied (see Table 10 in the Appendix). The results are largely in line with those from the multivariate OLS. Following Fessler & Fritzer (2013), quantile regressions are estimated at the median and at the 20th and 80th percentile of the distribution of conditional cumulated inflation. The negative relationship between income and inflation is strongest at the 20th percentile and could potentially be driven by high income households with comparatively low inflation. No significant results for household structure are obtained at the 20th percentile. The renter-owner divide remains strong over all quantiles, while no significant effect of population size can be found.

The main result from the multivariate regressions was the large part played by ownership status in determining a household's individual inflation rate. In the following figures, owner and renter shares are depicted and related to other household characteristics. The intention behind this is to show that even though the income-inflation relationship weakens when various controls are included in the regression, this does not mean that lower income households do not exhibit significantly higher inflation rates. It is simply the effect of income that remains after controlling for ownership status, occupation, education, etc. To make these differences clearer, Figure 9 shows the different states of ownership for various subgroups. The top-left corner confirms the example above, the largest ownership share in municipalities with fewer than 2,500 inhabitants (70 per cent). The ownership share decreases with population size, down to only 19 per cent in Vienna. Therefore, households living in large cities are likely to be more strongly affected by inflation than households from small municipalities. However, this is only via the ownership status channel. As seen in the regression results in Table 7, there remains an urban-rural divide, even after controlling for ownership status. Looking at household structure, a clear picture emerges: the ownership share is drastically lower for single parents and single households.

Table 6: Multivariate regression

	<i>Dependent variable: Cumulated Inflation 2016-2019</i>				
	(1)	(2)	(3)	(4)	(5)
Age	-0.0001 (0.0001)	-0.0001* (0.0001)	-0.0001* (0.0001)	-0.0002*** (0.0001)	-0.0001 (0.0001)
Age ²	0.00000 (0.00000)	0.00000* (0.00000)	0.00000* (0.00000)	0.00000 (0.00000)	0.00000 (0.00000)
Female	-0.001 (0.0004)	-0.0002 (0.0004)	-0.0002 (0.0004)	-0.001 (0.0004)	-0.0005 (0.0004)
Ownership (base = owner)					
Renter (public)	0.009*** (0.001)	0.010*** (0.001)	0.010*** (0.001)		0.009*** (0.001)
Renter (association)	0.012*** (0.0005)	0.013*** (0.0005)	0.013*** (0.0005)		0.012*** (0.0005)
Renter (private)	0.015*** (0.001)	0.015*** (0.0005)	0.015*** (0.0005)		0.015*** (0.001)
Household structure (base = couple w/o child)					
Couple w/ child	-0.001*** (0.0005)	-0.002*** (0.0005)	-0.002*** (0.0005)	-0.003*** (0.001)	-0.001*** (0.0005)
Single	0.003*** (0.0004)	0.003*** (0.0004)	0.003*** (0.0004)	0.003*** (0.0005)	0.002*** (0.0004)
Single parent	0.00004 (0.001)	-0.0001 (0.001)	-0.0001 (0.001)	0.001 (0.001)	-0.0003 (0.001)
Other	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.003*** (0.001)	-0.001 (0.001)
Educational attainment (base = maximum primary education)					
Apprenticeship		-0.001 (0.0005)		-0.001 (0.001)	-0.0004 (0.0005)
Matura (A-level equivalent)		-0.001** (0.001)		-0.002*** (0.001)	-0.002** (0.001)
University		-0.0002 (0.001)		-0.001 (0.001)	-0.001 (0.001)
Employment status (base = not employed or unemployed)					
Retired		-0.004*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)
Employed		-0.003*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)

Student		0.001 (0.001)	0.0002 (0.001)	-0.002 (0.001)	-0.00001 (0.001)
Other characteristics					
Population over 100k	0.001** (0.0004)			0.005*** (0.0004)	0.001** (0.0004)
Migration background					-0.001 (0.001)
At risk of poverty	-0.0005 (0.001)			-0.001 (0.001)	-0.001 (0.001)
Heating with electricity or gas	0.0004 (0.0004)			0.001** (0.0004)	0.0005 (0.0004)
Car	-0.004*** (0.0004)			-0.004*** (0.0005)	-0.003*** (0.0005)
Income (CDF)	-0.003*** (0.001)	-0.002*** (0.001)	-0.002*** (0.001)	-0.005*** (0.001)	-0.002*** (0.001)
Constant	0.065*** (0.002)	0.066*** (0.002)	0.065*** (0.002)	0.081*** (0.002)	0.068*** (0.002)
Observations	7,137	7,137	7,137	7,137	7,137
R2	0.262	0.258	0.258	0.153	0.266
Adjusted R2	0.260	0.257	0.256	0.151	0.264
Residual std. error	0.309 (df = 7121)	0.310 (df = 7119)	0.310 (df = 7122)	0.331 (df = 7118)	0.308 (df = 7114)
F statistic	168.175*** (df = 15; 7121)	145.909*** (df = 17; 7119)	176.513*** (df = 14; 7122)	71.680*** (df = 18; 7118)	117.097*** (df = 22; 7114)

Note: *p<0.1; **p<0.05; ***p<0.01

Source: Consumer Expenditure Survey for 2014/15

Table 7: Relative importance metrics

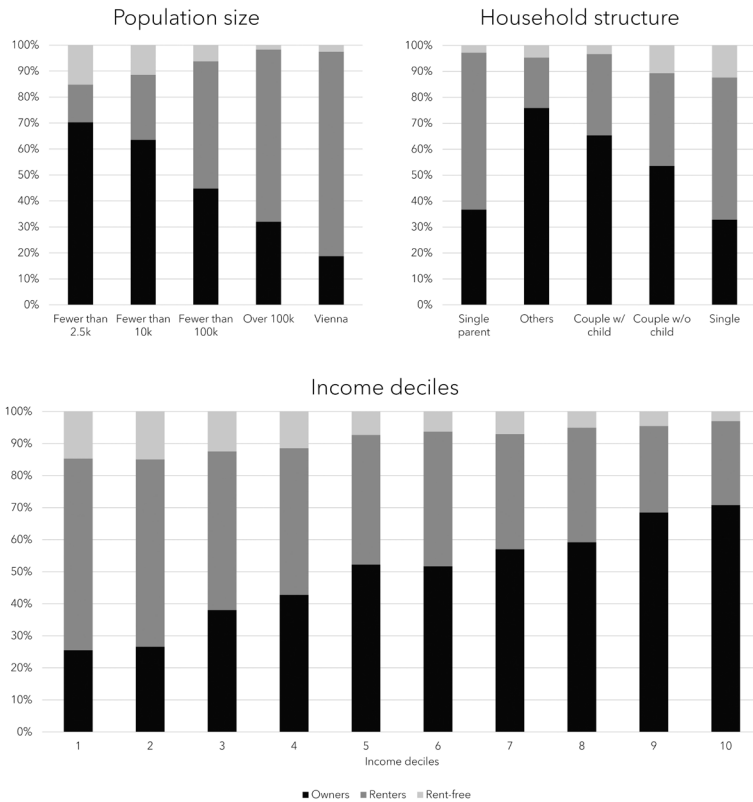
Group	LMG	Last	First
Age	3.9%	1.4%	5.4%
Household structure	8.5%	5.6%	9.3%
Ownership status	58.7%	85.4%	9.3%
Occupation	5.4%	2.6%	8.0%
Education	0.7%	0.6%	0.8%
Others	10.3%	4.6%	14.4%
Population	8.5%	0.4%	12.2%
Income	3.5%	0.6%	5.9%

Source: Consumer Expenditure Survey for 2014/15

As shown in Table 7, single households exhibit significantly higher inflation even after controlling for ownership status.

Ownership status also increases with income. While only around a quarter of the households in the bottom decile own their residence, the ownership share increases to over 70 per cent in the top decile. This visualizes previous results stating that the negative relationship between income and inflation in the bivariate case is largely driven by ownership status.

Figure 8: Ownership status

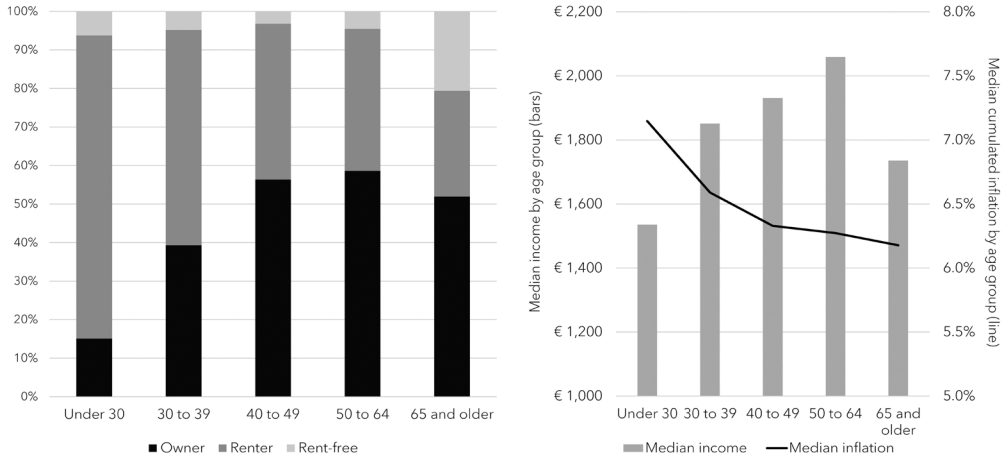


Source: Consumer Expenditure Survey 2014/15

A comparison over age groups (Figure 10) shows that with only 15 per cent the ownership share for households where the main earner is less than 30 years old is drastically lower than in other age groups. Looking at median income and inflation over age groups also shows that median income is by far the lowest for those under 30. At the same time, the median of cumulated inflation declines with age by almost one percentage point, from 7.1 per cent (under 30) to 6.2 per cent (65 and older). The fact that young households experienced the largest price increases while having the lowest

incomes has serious inequality implications. To give a further overview, the chosen subgroups are listed in Table 10 in the Appendix with their mean and median cumulated inflation.

Figure 9: Ownership status by age group **Income and inflation by age group**



Source: Consumer Expenditure Survey 2014/15

7. Limitations

It is important to note that the approach presented above has a few limitations. One of the main drawbacks when using the Consumer Expenditure Survey is that household characteristics and expenditure shares are kept constant over the whole period, as this information is not adjusted until the next version of the Consumer Expenditure Survey. Changes in consumption patterns that might result from price changes for certain goods are therefore not taken into account. Hobijn & Lagakos (2005) argue that this “substitution bias” might be especially high in the second year when expenditure weights decrease for goods that have become relatively more expensive. Furthermore, changes in income could also result in changes in consumption patterns, as Fessler & Fritzer (2013) point out. They also state that Statistics Austria might not be able to fully account for the one-time consumption of certain goods that are not consumed regularly. Households might not report these expenditures correctly for various reasons. However, potential biases should most likely offset each other over the whole sample, the authors state.

Humer & Rapp (2018) argue that equalizing household expenditure might be problematic, since economies of scale could differ greatly between different goods categories. As mentioned before, equalizing expenditure only affects the plutocratic

weights, since the democratic weights for each household do not change when scaling down expenditure. This would only be the case when assigning different economies of scale to each consumption category.

Further, it is important to note that the plutocratic bias is not the only bias present when it comes to differences in official and individual inflation measures. Other biases, such as the “product substitution bias”, the “quality change bias” or the “new product bias” could further contribute to distortions between the standard CPI inflation measure and a household’s individual perception of cost-of-living developments. However, taking these into account would go beyond the scope of this analysis.

8. Conclusion

Summing up, a few major findings have been gained from this analysis. First, the cumulated plutocratic bias for the four-year period covered is negative, meaning that the plutocratic weighting scheme that is part of the official method of measuring inflation leads to mean inflation being understated. I find that there is large dispersion in the distribution of inflation in Austria between 2016 and 2019. The households’ relative positions in this distribution are persistent, meaning that over the period covered, it was mostly the same households that exhibited low or high inflation. Concerning the income-inflation relationship, both parametric and non-parametric estimations suggest that inflation decreases with income. The multivariate analysis reveals that ownership status is the major driver of household-specific inflation. Compared to the base group made up of households owning a house or an apartment, living in rental accommodation increases cumulated inflation between 0.9 to 1.5 percentage points, depending on the type of rent. Moreover, the results imply that there is an urban-rural divide, which remains in place even after controlling for ownership status. Households living in Vienna, or in cities with over 100,000 inhabitants, exhibit significantly higher inflation than those in smaller communities. Apart from ownership status, household structure and consumption of various energy goods also help explain variation in household-level inflation.

As expected, the ownership share decreases as population increases, with the lowest share found in Vienna. However, this does not fully account for the urban-rural divide observed in the OLS results. Furthermore, the ownership share increases with income and with age groups up to those households where the main earner is between 50 and 64 years old.

The large dispersion of household-level inflation between 2016 and 2019, as well as the fact that groups can be identified for which inflation is likely to be particularly high or low, is a strong argument for paying greater attention to the distributional

implications of inflation inequality. These differences concerning characteristics like income, ownership status or household type should be kept in mind not only in times of high inflation but also in the midterm when it comes to wage setting, policy making, taxation, etc. The implications of wage setting are to be addressed when looking at differences over occupation groups. Unfortunately, the Consumer Expenditure Survey only makes it possible to control for differences between blue-collar workers, white-collar workers, civil servants and the self-employed. If additional information were collected on the main earner's occupation and the branch in which they work, it would be possible to relate differences in inflation to collective bargaining outcomes. However, the results give reason to believe that there could be a fair share of households that have experienced real income losses in the past few years if their household-specific inflation rate increased more than their income.

There certainly is room for additional research when it comes to inflation inequality, especially in explaining the urban-rural divide. Even if inflation rates should return to lower levels in the coming years, these differences in the developments of the cost of living should be taken into account. Otherwise, many distributional consequences could potentially be overseen.

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A. Appendix

A.1 Data wrangling

REFERENCE PERSON

A few household characteristics are based on personal characteristics. Although a household often consists of more than one person, only the characteristics of the household's reference person are considered. I therefore assign the personal characteristics of the main earner to the overall household.

OWNERSHIP STATUS

One of the main characteristics of interest is ownership status, which can be divided into 3 types: owner, renter, rent-free. Renters are further split up into public housing facilities, housing associations and the private market. The weighted shares in the population are 49.2 per cent for owners, 7.1 per cent for public housing, 16.9 per cent for housing associations, 16.6 per cent for renters of private facilities.

FAMILY STRUCTURE

The Consumer Expenditure Survey provides information on household members in a separate "personal file" consisting of 16,532 observations. Since it is known from the data whether a single observation from the personal file is the main earner of the household, a child, a grandparent, an in-law, etc., certain household types can be deduced from this. The household can then be identified either as a one-person household, a single-parent household, a couple with children or a couple without children. All other types are labelled as "other".

OCCUPATION

Concerning the occupational status of the reference person, I focus on 3 main types: employed, pensioners and students. The rest is subsumed under "others".

EDUCATION

Educational attainment also refers to the household's main earner and comprises four categories: maximum primary school, lower secondary, upper secondary and tertiary. The categories "apprenticeship" and "vocational or commercial school" ("Fach-/Handelsschule") are subsumed under "lower secondary", while "Matura" (A-level equivalent) also comprises qualifications attained after having completed the "Matura", except for university degrees.

POPULATION

Population refers to the population size of the municipality where the household's

main residence is located. It is divided into municipalities with fewer than 2,500 inhabitants, fewer than 10,000 inhabitants, fewer than 100,000 inhabitants and over 100,000 inhabitants.

INCOME

In the Consumer Expenditure Survey, income is measured as disposable monthly household income in euros and is based on administrative data. Moreover, a statistical model is used for unavailable income components, taking into account the distribution of household income in EU-SILC (European Union Statistics on Income and Living Conditions) (Statistics Austria, 2017). Furthermore, I work with equivalized household income based on the EU scale (modified OECD scale) in order to adjust for household size and members.

OTHER CHARACTERISTICS

Apart from the larger groups of characteristics above, I also take into account a range of other characteristics. The first is a dummy for migration background which applies for all citizenships except Austrians and Germans. Germans are the largest group of migrants in Austria and their average household income is close to that of households where the reference person is an Austrian citizen.

I further employ a dummy for households that are at risk of poverty. This applies for households with an equivalized income that is below 60 per cent of the median.

Two further controls are closely related to household expenditure. The first refers to a household's heating type: I divide households into those heating with electricity or gas and those using other types of heating. The second is a dummy for whether a household owns a car. I employ these controls because they give an idea about the importance of energy and fuel expenditures in a household. Both areas are known to be rather volatile components of the CPI.

A.2 Additional tables

Table 8: The plutocratic bias (expenditures not equalized)

Period	Plutocratic inflation	Democratic inflation	Plutocratic bias
2016	0.87	0.89	-0.02
2017	1.98	2.01	-0.03
2018	1.75	1.87	-0.13
2019	1.39	1.45	-0.07
2020	1.31	1.35	-0.04
2021	2.82	2.73	0.08
Cumulated 16–19	6.15	6.40	-0.26

Source: Consumer Expenditure Survey 2014/15

Table 9: Quantile regression

	Dependent variable:		
	Cumulated inflation 2016–2019		
	p=0.2	p=0.5	p=0.8
Age	-0.0001 (0.0001)	0.00005 (0.0001)	-0.0002* (0.0001)
Age ²	0.00000 (0.00000)	-0.00000 (0.00000)	0.00000 (0.00000)
Female	0.001** (0.0005)	-0.001 (0.0005)	-0.002*** (0.001)
Ownership (base = owner)			
Renter (public)	0.008*** (0.001)	0.010*** (0.001)	0.011*** (0.001)
Renter (association)	0.012*** (0.001)	0.014*** (0.001)	0.013*** (0.001)
Renter (private)	0.014*** (0.001)	0.016*** (0.001)	0.015*** (0.001)
Household structure (base = couple w/o child)			
Couple w/ child	0.001 (0.001)	-0.002*** (0.0005)	-0.002*** (0.001)

Single	0.001 (0.001)	0.002*** (0.001)	0.005*** (0.001)
Single parent	0.0004 (0.001)	-0.001 (0.001)	0.001 (0.001)
Other	0.001 (0.001)	-0.002*** (0.001)	-0.001 (0.001)
Educational attainment (base = maximum primary education)			
Apprenticeship	0.0001 (0.001)	-0.0001 (0.001)	-0.001 (0.001)
Matura	-0.002* (0.001)	-0.001 (0.001)	-0.002** (0.001)
University	0.0002 (0.001)	-0.001 (0.001)	-0.0004 (0.001)
Employment status (base = not employed or unemployed)			
Retired	-0.005*** (0.001)	-0.004*** (0.001)	-0.002** (0.001)
Employed	-0.004*** (0.001)	-0.004*** (0.001)	-0.002** (0.001)
Student	-0.001 (0.002)	-0.002 (0.002)	0.003 (0.003)
Other characteristics			
Population over 100k	0.001 (0.001)	0.001 (0.0005)	0.001 (0.001)
Migration background	-0.002** (0.001)	-0.0003 (0.001)	-0.0001 (0.001)
At risk of poverty	-0.001* (0.001)	-0.001 (0.001)	-0.001 (0.001)
Heating with electricity or gas	-0.0001 (0.0005)	0.001 (0.0004)	0.0002 (0.0005)
Car	-0.003*** (0.001)	-0.002*** (0.001)	-0.003*** (0.001)
Income (CDF)	-0.003** (0.001)	-0.002* (0.001)	-0.0004 (0.001)
Constant	0.057*** (0.002)	0.065*** (0.002)	0.079*** (0.003)
Observations	7,137	7,137	7,137

Source: Consumer Expenditure Survey 2014/15

Table 10: Mean and median inflation over household groups

	Mean	Median	Share
Population			
Fewer than 2.5k	5.89	5.90	0.24
Fewer than 10k	6.16	6.08	0.28
Fewer than 100k	6.47	6.47	0.17
Over 100k	6.91	6.94	0.08
Vienna	7.03	7.08	0.23
Renters and owners			
Owner	5.72	5.77	0.49
Renter	7.29	7.36	0.42
Rent-free	5.99	6.04	0.09
Renters and owners (contract type)			
Owner	5.72	5.77	0.49
Free and appropriate rents (Freie und angemessene Mieten)	7.57	7.65	0.09
Public housing	6.90	6.96	0.03
Housing association	7.18	7.33	0.17
Category rent	6.74	6.79	0.02
Rent-free	5.92	6.00	0.08
Indicative rents (Richtwertmiete)	7.53	7.54	0.09
Family status			
Single parent	6.62	6.74	0.05
Others	5.98	5.90	0.05
Couple w/ child	6.04	6.03	0.26
Couple w/o child	6.22	6.22	0.27
Single	6.83	6.84	0.37
Population and ownership status			
Owners			
Fewer than 2.5k	5.63	5.73	0.17
Fewer than 10k	5.72	5.76	0.18
Fewer than 100k	5.76	5.78	0.07

Over 100k	5.74	5.83	0.02
Vienna	5.99	5.98	0.04

Renters

Fewer than 2.5k	7.14	7.29	0.03
Fewer than 10k	7.35	7.48	0.07
Fewer than 100k	7.19	7.29	0.08
Over 100k	7.47	7.43	0.05
Vienna	7.29	7.32	0.18

Source: Consumer Expenditure Survey for 2014/15