Who pays the price when prices rise?

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We employ microdata from Statistics Austria's 2019/2020 Austrian household budget survey ("Konsumerhebung") and match them with price data from 2020 onward to estimate household-level inflation rates for a representative sample of households in Austria. We focus on three questions: (1) Which households are confronted with the highest inflation rates? (2) Which households are most likely to experience financial distress due to inflation? (3) Which easily observable socioeconomic characteristics convey the most information about inflation exposure since 2020? We find heterogeneity of inflation between households to be large compared to changes in aggregate (weighted average) inflation over time. Whether households live in urban areas or in the country and whether they rent or own their homes, i.e. municipality size and tenure status, are important predictors of inflation heterogeneity given their strong link to energy prices. Our findings question policymakers' exclusive focus on the (harmonized) consumer price index based on a mean consumption bundle in times of diverging price developments, and we advocate monitoring inflation on the basis of a broader range of real household-level consumption bundles. We find that most households have the financial means to afford the overall increase in the price level. The group of households who struggle consists largely of households whose financial situation is also difficult in times of low inflation: the unemployed, the (working) poor and single parents. Consequently, policies aimed at mitigating the impact of inflation should rely on measures of financial distress. Also, stopping subsidizing urban sprawl, preventing further sprawl, and even reversing sprawl is key to making households more resilient to higher and/or more volatile energy prices in the future.

As inflation rates have reached levels above 10%, policymakers together with workers' and consumers' representatives are debating how to best protect people, particularly the most vulnerable, from the loss of purchasing power. "Targeted" is one of the key words in the context of support measures, meaning that relief is to be aimed at those in need. Low-income households spend a comparatively large share of their expenses on food and energy, both necessities[2] with limited possibilities for alternatives (particularly in the short run and if the surge in prices is broad based). That is, the less affluent typically lack possibilities to absorb inflationary shocks through changes in their consumption patterns. Hence, it does not come as a surprise that empirical evidence suggests a negative relationship between income and inflation.[3] This is often ignored in the public discussion, which focuses on

inflation as measured by changes in the (harmonized) consumer price index (CPI). The CPI, which is computed by national statistical institutes, is an aggregate measure representing the overall price level in the economy. It can be interpreted as a weighted average of individual price levels, with the expenses of a household for different goods and services serving as weights. This implies that inflation (measured as the rate of change of the CPI) better reflects the inflation experiences of households that spend more. However, different households consume different bundles of goods and services, and these differences do not only depend on income. Urban households have different spending patterns than rural households. Large households with children do not consume the same goods and services as retired single households and so forth. Thus, the CPI cannot be a perfect indicator of inflation at the individual household level, and an important question is how well the CPI represents the inflation experiences of different groups of households. Hobijn et al. (2009), for instance, show that inflation rates across households are very heterogeneous and find a negative relationship between mean inflation and inflation inequality. Evidence of inflation inequality has led to the construction of alternative measures of inflation and price indices. Argente and Lee (2015) construct income-specific price indices and show that during the Great Recession, inflation rates exhibited substantial differences, with the lowest quartile suffering from higher inflation than the highest quartile. Yet, the sole focus on income conceals the large inflation heterogeneity across households even within income deciles. For the Czech Republic, for instance, Hait and Jansky (2014) show that only around 60% of households experience inflation rates similar to the national average. Furthermore, the higher the level of inflation, the lower the percentage of households that experience inflation rates similar to the national average. These differences in inflation rates across household or income groups raise the question of how representative the CPI is as a one-size-fits-all measure of inflation.

In mainstream economic theory, inflation is defined as a general increase in the level of goods and services prices in an economy and therefore is equivalent to a reduction in the purchasing power of the numeraire good, namely money, in most cases a country's official currency. Bringing this theoretical concept to reality and measuring it using data is challenging, if not impossible. To be able to measure a price change, we need to compare at least two transactions of the same good or service at different points in time – which is hardly feasible. Additionally, goods and services change constantly and are not the same over time and space. Relative prices change due to changes in supply and demand or due to consumers' or producers' expectations. Often it is hard to clearly distinguish changes in relative prices from a general increase in the price level consistent with a reduction in overall purchasing power. Nevertheless, about a hundred years ago, the US Bureau of Labor Statistics started publishing the consumer price index, which became the main measure of inflation[4]. Of course, this way of gathering prices – matching them with consumption bundles, calculating a weighted average, tracking this average and calling it inflation – is a mere convention and can be seen as an attempt to approximate the theoretical concept of inflation by an empirically observable measure. The many revisions of methods and definitions and constant changes over time and across countries illustrate how uncertain and fragile statistical objects

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[4] https://www.bls.gov/opub/hom/cpi/history.htm (accessed on September 23, 2022).

such as the CPI are. One way to deal with this uncertainty about the "measured"[5] aggregate rate of inflation is to acknowledge that households' consumption bundles differ substantially. That does not help with the issue that a lot of assumptions are needed to construct price indices for certain goods and services, but it helps in understanding how different the experiences of rising prices are across the population. The "measured" aggregate inflation rate claims to represent an "average" representative household but is in fact heavily biased toward those households that spend more as the weight of each household is proportional to the households' consumption expenditure.

The aim of this study, which is an extension of Fessler and Fritzer (2013), is to shed further light on inflation heterogeneity across Austrian households with a focus on the current high-inflation period. Using data from Statistics Austria's 2019/2020 Austrian household budget survey ("Konsumerhebung") as well as price data for the years 2020 to 2022 (up to June 2022), we analyze which household types are particularly affected by the current surge in inflation, i.e. who pays the price when prices rise. To be more precise, we focus on three questions: (1) Which household types are confronted with the highest inflation rates? (2) Which households experience the largest financial distress due to inflation? (3) Which easily observable socioeconomic characteristics convey the most information regarding inflation exposure since 2020?

Comparing the year 2020 with its comparatively low inflation rates to 2021 (and 2022), we show that differences in inflation experiences are large and not persistent. While in 2020, low-income households living in cities experienced the highest inflation rates, in the first half of 2022 it was owner-occupiers living in small municipalities[6]. The surge in energy prices particularly affected households that tend to spend more on transport and household energy, such as heating and electricity. The unemployed, (working) poor and single parents experienced the most financial distress due to inflation. While these households do not necessarily experience the highest inflation rates, they consume a comparatively large share of their income. Therefore, an increase in the overall price level may force them to tap into savings, borrow money or reduce consumption. Households with young main earners and pensioners are also more likely to experience financial distress. Direct and high exposure to energy price increases seems to be most closely linked to municipality size and tenure status. These characteristics convey the most information about households' individual exposure to inflation since 2020 and especially in the first half of 2022 within our set of available and potentially interesting variables.

Our results confirm that inflation heterogeneity is large and that the focus on a single aggregate measure such as the CPI cannot adequately capture the inflation experiences of a large group of households. Understanding how inflation is distributed in a society is important for several reasons: First, and at the moment most importantly, it can help policymakers design better targeted relief packages as well as structural policies that decrease the vulnerability of certain household

[5] We put the word measured in quotation marks because the aggregate rate of inflation cannot really be measured as it does not exist in reality as defined in theory but is a rather complex construct.

[6] Note however, that we only take into account the first half of 2022 and it is not clear if this new relationship will be stable and for how long.

groups to future inflationary shocks. Relief packages based on a single aggregate measure such as the CPI may not provide sufficient support for certain household groups while overcompensating others. Second, inflation heterogeneity has redistributive consequences. Gürer and Weichenrieder (2020), for instance, conclude that ignoring differences in inflation rates leads to an underestimation of the Gini coefficient.[7] Third, inflation inequality has implications for the conduct of monetary policy. Cravino et al. (2018) study price stickiness along the income distribution and show that the prices of goods consumed by high-income households are more sticky and less volatile than those of goods consumed by middle-income households.[8] As a consequence, high-income households' consumer price indices react less to monetary policy shocks than those of middle-income households. Finally, policymakers and statistical institutes need to understand and communicate the scope and the limitations of the CPI as individuals might doubt – and reasonably so – that the CPI is an appropriate measure of (their) inflation. Improving the CPI as well as using alternative measures of inflation that can capture inflation heterogeneity may help to foster more equitable and sustainable growth and better understand the economic situation and preferences of individuals.[9]

The remainder of this study is structured as follows: We introduce the data and methods in section 1. In section 2, we answer three questions: who experiences what level of inflation, for whom is it the largest burden and which variables convey the most information about individual inflation levels. In section 3 we discuss the policy implications of our findings and conclude.

1 Data and methods

For the construction of household-specific inflation rates, we use the 2019/2020 household budget survey[10] and price data for the years 2020, 2021 and 2022 (up until June 2022).[11] The household budget survey, which is conducted every five years, delivers the basis for the calculation of consumption baskets used to calculate official aggregate inflation statistics in Austria, such as the CPI or HICP.[12] It is a multimode survey that consists of personal interviews covering general questions and an individual part covering households' detailed consumption expenditures ("Haushaltsbuch"), which households may complete either electronically or on

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[7] Albanesi (2006) shows in a political economy model that inflation is positively related to the degree of income inequality. Balcilar et al. (2018) argue that there exists a nonlinear relationship between income inequality and the inflation rate.

[8] This finding is confirmed by Jovanovic and Josimovski (2021) for North Macedonia.

[9] Tavares (2021), for example, suggests using a Democratic core inflation index.

[10] Roughly one-quarter of the survey took place during the first COVID-19-related lockdown in Austria (from March to June 2020), when consumption possibilities were greatly restricted and interview methods had to be adjusted. We included all households (before and during the pandemic) in our sample to calculate consumption baskets and household-specific inflation rates, which is consistent with the compilation of the HICP by Statistics Austria. For the CPI, Statistics Austria excluded the lockdown period. Using only data from before March 2020 would affect our results quantitatively, but not qualitatively.

[11] For more details regarding the household budget survey or price collection see Statistics Austria: www.statistik.at

[12] For the OeNB as a member of the European System of Central Banks, the Harmonized Index of Consumer Prices (HICP) is the most relevant index, and it differs slightly from the CPI in terms of methodology. The compilation according to harmonized statistical methods ensures that the data for one country can be compared with the data for another country.

paper.[13] Those who opt for the former also complete a second part of the questionnaire online (2,678 households), those who opt for the latter, answer the questions of the second part in personal interviews (4,276 households). A small number of households (185) also completes the first part of the survey online. The gross sample of the 2019/2020 survey consisted of 29,159 households, the final net sample summed up to 7,139 households. The response rate (corrected for neutral dropouts) was 25.3%. Population weights consist of design-, nonresponse- as well as poststratification weights. The nonresponse weights are based on information about all households in the gross sample. We use the population weights provided for all statistics presented in this article. The data represent all households in Austria, estimated to total about 3.97 million.

We combine the data from the household budget survey with price data gathered by Statistics Austria to calculate individual inflation. Each month, Statistics Austria collects around 42,600 prices (and other important quality information) of currently 759 goods and services from 3,600 Austrian retailers and services providers. These goods and services are classified according to the European Classification of Individual Consumption by Purpose (ECOICOP). Only goods and services that have a share of at least 0.1 percent of total consumption expenditure in their ECOICOP four-digit class are included in the consumption basket. Part of the data is collected through a standardized questionnaire about the current price, the price in the last period and a product description. This decentralized data collection is complemented by a centralized collection (either in person, through email, phone or Internet search) by Statistics Austria and since 2015 also by data collected via web scraping. The sample is drawn in two steps. First, the index positions (goods and services) are selected based on the data provided by the household budget survey. Second, for each index position, a sample of shops is chosen, and for each shop the specific products for the index position selected (usually based on revenue or frequency of purchase).

Note that the same household budget survey is used for five years as the basis for the average consumption basket used to calculate aggregate inflation. Changes in the basket during this time emerge from changes in aggregate consumption measures from the national accounts and expert judgement. In our analysis, we keep the individual baskets gathered by the 2019/2020 household budget survey fixed and apply them to inflation for 2020, 2021 and the first half of 2022. It is very likely, though, that households adapt their consumption baskets over time, especially when prices surge. Also, focusing on special sales prices, which are not included in inflation measures, may reduce household inflation dramatically.[14] A recent analysis by the private company "marktguru," an online platform specialized in providing special sales prices, concludes that by buying special offers, German households could offset up to 43% of household food inflation in the first quarter of 2022.[15] It is therefore important to understand that our figures for household-level inflation are presented under the assumption of (1) no change in house-

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[13] For the first time in this wave of the household budget survey, an app was available to track household consumption. We consider this a large improvement.

[14] Kaplan and Schulhofer-Wohl (2017), for example, study inflation rates at the household level in the US and find that only a small share of total variation in household-specific inflation rates stems from differences in consumption bundles; around two-thirds stem from price differences between identical goods.

[15] https://info.marktguru.de/presse/pressemitteilungen/marktguru-lai/ (accessed September 22, 2022).

holds' consumption bundles and (2) no change in the use of special offers and no regional differences in price changes. The major goal of this approach is to illustrate (a lower bound of) heterogeneity and provide a descriptive qualitative assessment of the relationships between household characteristics, consumption patterns and inflation. Exact quantities are far beyond what is reachable when it comes to inflation measurement; this also holds for the official inflation rates.

Box 1

Construction of household-level inflation

We observe a sample of households, $i \in I$, as well as their consumption shares, s_i^c, where $c = 1, 2, \ldots C$ is the set of ECOICOP 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 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 Characterizing inflation profiles among Austrian households

2.1 Distribution of inflation across households shows large heterogeneity

Chart 1 shows household-level inflation rates, which are calculated as described in section 1, box 1, for the years 2020, 2021 and the first half of 2022 (representing yearly percentage changes). Put simply, we just take the consumption bundles of households as measured in the household budget survey, link them to official price indices and calculate household-level inflation based on the assumption that consumption bundles do not change. We make three observations: First, inflation is not the same for all households, but is very heterogenous. While for some households, the price of their consumption bundles decreases, it may increase for others. For some households, inflation may be low, and for others it may be high. Aggregate measures such as the CPI conceal this variation. They deliver a weighted average of these price changes with higher weights for those who consume more. Depending on the price changes, these weights may dampen or increase inflation relative to the median inflation rate.

Second, the heterogeneity of inflation changes from year to year. Not only are inflation rates different for different households, but the extent to which they differ also changes. Hence, "measured" aggregate inflation "represents" different households (if any) every year, and, in addition to that, the distances to all others change from year to year. What is more, in the past few years, the heterogeneity of inflation increased. Whereas in 2020 and 2021, respectively, about 63% and 67% of house-

Chart 1

The distribution of inflation at the household level
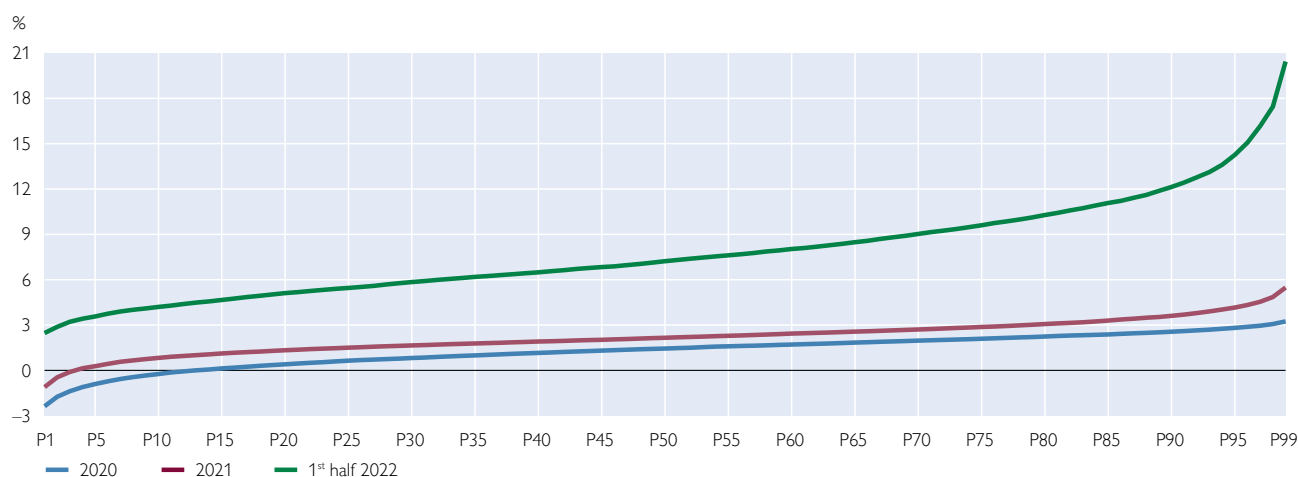
Source: Statistics Austria (2019/2020 household budget survey; price microdata, 2019 to 2022), OeNB.

holds were within 1 percentage point of the mean inflation rate, this number fell to 23% in the first half of 2022. Given that mean inflation was not constant over time, relative deviations are more informative than absolute deviations. The shares of households within one standard deviation from the mean were 72%, 74% and 75% in 2020, 2021 and in the first half of 2022, respectively.

Third, the levels of observed inflation rates increased dramatically in the first half of 2022. There is hardly any overlap with 2021, meaning that only very few households experienced higher inflation in 2021 than any household in the first half of 2022. As can be seen in chart 1 when comparing the years 2020 and 2021, this overlap is usually quite large. The pair-wise correlations between the distributions are −0.16 between 2020 and 2021, −0.66 between 2020 and the first half of 2022 and 0.67 between 2021 and the first half of 2022, all statistically significant at the 1% level. So between 2020 and 2021, many households switched sides in terms of the relative level of inflation (low to high and high to low), even though the level change was less dramatic than in the first half of 2022, when the ranking of households remained more stable.

2.2 Inflation inequality across income groups not persistent over time

As a next step, we examine the relationship of household-level inflation relative to household-level net income. As shown in Fessler and Fritzer (2013), in Austria, lower-income groups experienced higher inflation rates than higher-income groups. This situation changed with the recent surge of prices. Chart 2 shows distributional measures of inflation within net income deciles. Households are arranged according to their income and split into ten groups (from 1 for the 10% of households with the lowest income to 10 for the 10% of households with the highest income). Within these groups we calculate the 10th and the 90th percentiles of inflation indicating the inflation rates at which 10% of households experience lower (10th percentile) or higher (90th percentile) inflation. We also calculate the median, which splits the household population into two equal parts, those with lower and

those with higher inflation rates. The mean is the plain average of household-level inflation rates and is not weighted by consumption.

There are three important points to take away from chart 2. First, while the relationship between inflation and income was (still) slightly negative in 2020, it became slightly positive in 2021 and in 2022. Put differently, lower-income households experienced higher inflation than the average in 2020, but lower than average inflation in 2022.[16] Second, inflation heterogeneity is much larger within income deciles than across income deciles. Other factors apart from income, such as where a household lives (city or country), how a household lives (single-family house or apartment, tenure status, etc.) and who belongs to the household (including number, age, education, occupation of household members), seem to play a more important role for understanding who is particularly affected by high inflation rates. All these factors shape inflation patterns because the socioeconomic characteristics of households determine consumption bundles and possibilities.[17] Third, inflation increased dramatically across all income deciles in 2022. While in the years before, the variation within deciles was larger than variation over time, the level shift in 2022 was much larger than the typical variation within income deciles.

Chart 2

Household-level inflation by net income deciles
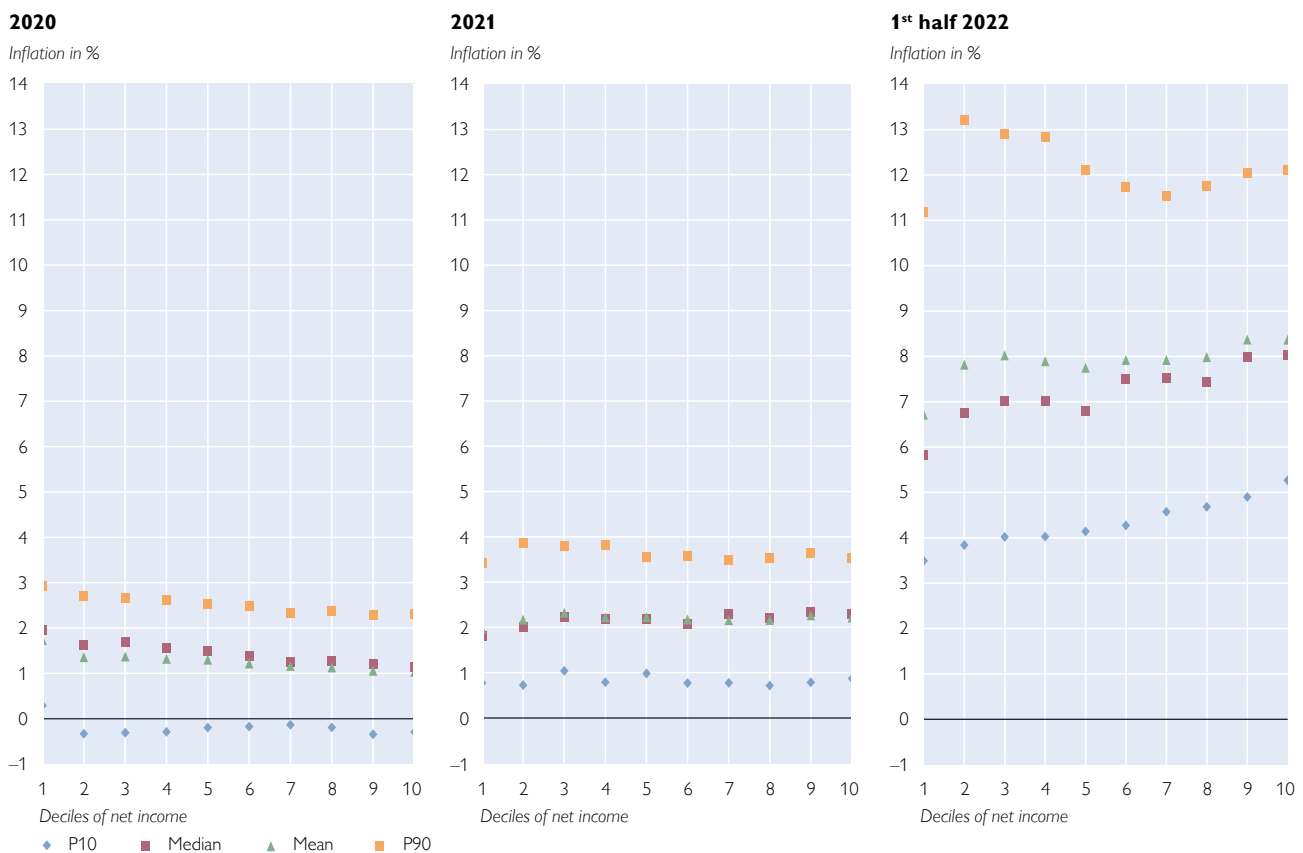
Source: Statistics Austria (2019/2020 household budget survey; price microdata, 2019 to 2022), OeNB.

[16] Mean (median) inflation of the household inflation distribution was 1.3% (1.4%) in 2020, 2.2% (2.2%) in 2021 and 7.8% (7.2%) in the first half of 2022.

[17] We will discuss these factors below in more detail.

2.3 High inflation does not necessarily imply high financial pressure

So does high inflation also mean high financial pressure? As becomes evident when we look at the relationship between income and inflation over time, in general, it does not. To illustrate this fact further, let us distinguish three groups of households:

Group 1 are households for whom the increase of inflation simply means that they can save a little less. Their income would still allow them to buy the same consumption bundle as before.

Group 2 are households whom higher inflation will force to slightly change their consumption bundle, rely more on special offers and sales prices or resort to cheaper alternatives. They may not need to consume less in terms of quantity, but what they consume may be of slightly lower quality or come with slightly more inconvenience (e.g. checking prices).

Group 3 are households whom the increase in the price level not only forces to change their consumption bundle, but to reduce their overall consumption. These are households who spend all of their income, cannot save at all or only very little and were already under financial pressure before the broad-based surge in prices.

In many cases, people from group 1 or 2 will also change their consumption bundles because they want to save regularly and build up wealth, but not because they can no longer afford to buy the same consumption bundles. The distinction of these three groups of households should serve only as an illustration. From the household budget survey data, we cannot infer how many and which types of households exactly belong to each group. Similarly, we do not have any information on the level of indebtedness of individual households, but in general, within these groups there are also homeowners with large amounts of debt who profit from inflation because it reduces their debt in real terms. They may even be net winners from inflation, as their debt decreases rapidly while the price of their house/apartment stays the same or increases. Generally, of course, assets and liabilities in the aggregate are linked. If an asset decreases in value, some debt will also decrease in value.

Unfortunately, in Austria the microdata necessary for identifying the winners and losers from inflation including all these relevant dimensions are not available. Neither can we assess the extent to which households are losers or winners in times of high inflation. What we can do is look at some statistics which convey information about the likelihood of belonging to group 1, 2 or 3, like, for instance, net income. It is an indicator of how much money a household can spend in each month without having to tap into savings. A central assumption in economics is the law of decreasing marginal utility. Consequently, the loss in utility (of course, strictly speaking, utility cannot be compared across households) associated with a decrease in real income is much lower for higher-income households than for lower-income households. Another measure is household consumption as a share of income because it tells us how much of their income a household usually consumes. The closer the amount spent is to net income or the further it is above net income, the more likely it is that this consumption bundle is not sustainable, and the household may already be in, or close to getting into, a financially difficult situation.

In table 1 we show inflation rates (2020, 2021, first half of 2022), net income and the share of net income which is consumed (2019/2020) for households split into different groups according to socioeconomic characteristics. In this way, we

get an idea about who is exposed to what level of inflation and also about the financial pressure that comes with households' individual inflation rates. Note that we use medians for income and consumption-income shares as they are more robust than means and – especially for smaller – groups represent a larger number of households within the group.

Regarding *municipality size,* we learn from table 1 that while inflation was higher for households in larger municipalities in 2020, this changed in 2021 and even more so in 2022. At the same time households in larger municipalities are still the ones experiencing higher financial pressure. Their inflation rates may have increased less than the ones for households in smaller municipalities, but their inflation rates are still higher than in previous years. As the share of income they use for consumption is comparatively large, it is particularly difficult for these households to cope with the current surge in inflation. In Austria, *tenure status* is highly correlated with municipality size. While renters in larger municipalities were exposed to lower inflation rates than homeowners in 2022, they were still the ones experiencing much higher financial pressure. On top of that, they usually have no mortgage debt and therefore miss out on the positive effect on net wealth the reduction of real debt has for homeowners with a mortgage.

When we examine differences in *household size,* we see that smaller households were exposed to somewhat higher inflation rates in 2020 and 2021. In 2022, this was no longer the case. Still, smaller households experienced higher financial pressure, even though we use net income instead of equivalized income, which would decrease the consumption-income share for larger households due to scale effects of consumption, as consumption is not measured per person but also at the household level.

Incomes and consumption-income shares vary markedly across *household types.* Single parents experience the highest financial pressure by far, given their low median income and high median consumption-income share even though they experienced the smallest increase in inflation because of their consumption bundles. The *age of a household's main earner* is loosely related to inflation and financial pressure. It seems that while inflation was somewhat higher for the young in 2020, it was somewhat lower in the first half of 2022. Nevertheless, the young tend to consume a larger share of their income. This fact – while contradicting mainstream economics' ideas about the life cycle hypothesis – is well documented in the empirical literature. The relationship between *education* (of the main earner) and inflation is weak. However, higher education goes along with much larger median income. The *job status* of the main earner shows rather typical patterns. While current inflation is highest for the retired, blue-collar workers and farmers, the financial pressure they experience is rather different. Farmers have a high median income and the lowest consumption-income share by far, and therefore they are more likely to be able to deal with the high inflation they are exposed to. Blue-collar workers, on the other hand, have a fairly low median income, and for pensioners, the consumption-income share is high. The consumption-income share is far the highest for the unemployed.

We draw two conclusions from the information shown in table 1: First, municipality size and tenure status seem to be the two variables which convey the most information that helps explain the variation of the surge in inflation We confirm this finding to be robust to the choice of functional form by means of machine learning (see chart A1 in the annex). Economically, this finding is to a large extent

explained by differences in energy consumption due to the different types of housing and different need for transportation. Second, households which experience the strongest financial pressure from the current surge in inflation are, as expected, the unemployed, the working poor and single parents. This does not mean that other household types do not experience pressure, but their likelihood to do so is much lower.

Table 1

Average household-level inflation by socioeconomic characteristics

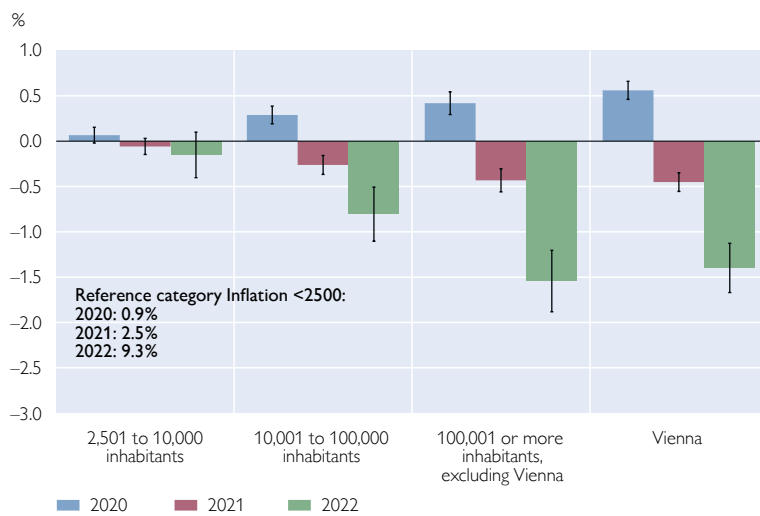|		Population share	Average household-level inflation			Net income	Consump-tion-income share
			2020	2021	1st half of 2022	Median	Median
		%				EUR thousand	%
Municipality size	Up to 2,500 inhabitants	21.5	0.9	2.5	9.3	3.7	74.7
	2,501 to 10,000 inhabitants	31.4	1.0	2.4	8.9	3.5	74.4
	10,001 to 100,000 inhabitants	15.5	1.3	2.2	7.8	3.3	79.8
	100,001 inhabitants or more, excluding Vienna	8.0	1.6	1.9	6.4	3.0	88.7
	Vienna	23.6	1.8	1.8	6.2	2.8	83.1
Household size	1 person	37.6	1.5	2.2	7.5	2.0	87.8
	2 persons	30.3	1.2	2.3	8.2	3.7	77.4
	3 persons	14.7	1.1	2.2	8.0	4.7	70.1
	4 persons	11.3	1.1	2.1	8.0	5.1	69.5
	5 or more persons	6.0	1.0	2.0	8.0	5.2	69.5
Household type	Single	37.6	1.5	2.2	7.5	2.0	87.8
	Couple with children	27.7	1.1	2.1	8.0	5.0	69.2
	Couple without children	27.3	1.2	2.3	8.3	3.9	76.4
	Single parent	1.8	1.4	1.8	6.6	2.0	109.1
	Single parent and other adult(s)	2.6	1.1	2.0	7.9	3.9	72.8
	Other	3.1	1.3	2.3	8.1	3.9	68.5
Tenure status	Homeowner	48.7	0.9	2.4	9.3	4.1	68.9
	Renter, public housing	6.8	1.7	1.8	6.1	2.2	82.6
	Renter, cooperative housing	17.1	1.6	1.9	6.2	2.9	87.8
	Renter, other	18.6	1.7	2.0	6.1	2.6	89.9
	Other	8.9	1.1	2.2	8.7	2.2	80.7
Main earner: age	18 to 29	10.0	1.5	2.0	6.7	2.6	96.7
	30 to 39	15.7	1.4	1.9	6.9	3.5	80.1
	40 to 49	17.5	1.2	2.1	7.7	4.2	73.3
	50 to 64	31.1	1.2	2.3	8.3	3.9	74.3
	65 or over	25.7	1.3	2.4	8.6	2.4	80.0
Main earner: education	Primary	13.5	1.4	2.1	7.8	2.0	77.9
	Lower secondary	48.3	1.1	2.4	8.4	3.3	79.1
	Higher secondary	14.3	1.4	2.1	7.4	3.4	82.1
	Tertiary	23.9	1.4	2.0	7.1	4.2	75.2
Main earner: job status	Blue collar	12.9	1.0	2.4	8.4	3.7	74.4
	White collar	35.9	1.3	2.1	7.4	4.2	74.0
	Civil servant	3.4	1.1	2.3	8.2	5.1	64.0
	Farmer	0.9	1.0	2.1	8.4	5.1	41.5
	Self-employed	5.3	1.2	2.3	8.3	4.1	78.3
	Employed, other	0.6	1.5	2.0	6.9	3.3	80.7
	Unemployed	4.6	1.7	2.0	6.6	1.6	113.3
	Retired	32.0	1.3	2.3	8.5	2.5	82.6
	Not employed, other	4.2	1.7	1.8	6.3	1.5	110.8

Source: Statistics Austria (2019/2020 household budget survey; price microdata, 2019 to 2022), OeNB.

2.4 Municipality size and tenure status are important factors explaining current household-level inflation

As table 1 is merely descriptive, ignoring all the overlaps and relationships between the socioeconomic characteristics, and includes plain conditional means (inflation), we also run descriptive regressions including all socioeconomic variables at once as dummy variables for all subcategories. This does not allow any causal interpretation in the sense that the model tells us why a certain household experiences higher inflation, but it can tell us if the relationship of inflation with a certain variable remains the same, vanishes or changes once we control for the relationships to others. The regression delivers so-called conditional correlations. While we show the regression results for all three years separately in the annex (table A1), here we pick the resulting marginal predictive (not causal) effects for the two most influential characteristics, namely municipality size and tenure status. Again, we pick these two because they convey the most predictive information about (the variation of) inflation in our set of variables, independent of the choice of functional form (see machine learning application in chart A1 below).

Chart 3 shows the marginal effects of municipality size relative to the reference category, which in our case is the smallest municipality size (less than 2,500 inhabitants). We can clearly see that while households in larger municipalities had economically and statistically significant higher inflation rates in 2020 (at the 5% level from the category larger than 10,000 upward), they had economically and statistically significant lower inflation rates in 2021 and 2022 (again at the 5% level from category larger than 10,000 upward) than their peers in small municipalities. The economic size of the effect for cities (above 100,000 inhabitants) is very relevant, with inflation rates almost 1.5 percentage points lower than average, even though all other socioeconomic characteristics (in table 1), including tenure status, are controlled for (see table A1).

Chart 3

Marginal effect of municipality size on inflation

Reference category Inflation <2500:
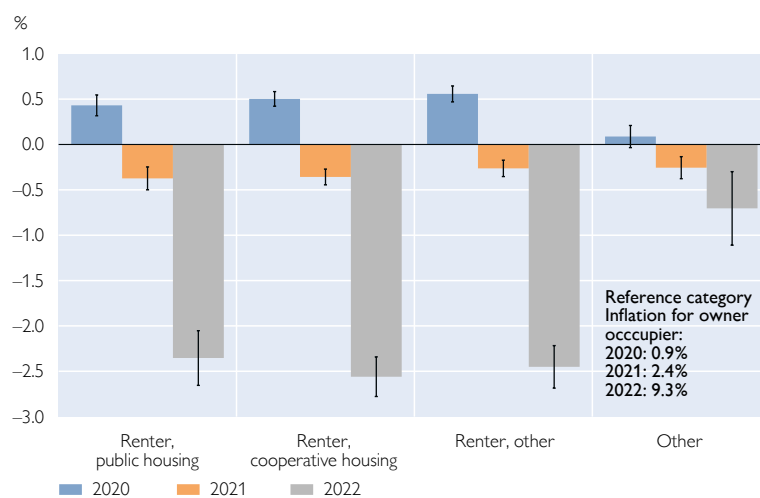2020: 0.9%
2021: 2.5%
2022: 9.3%

Source: Statistics Austria (2019/2020 household budget survey; price microdata, 2019 to 2022), OeNB.

Note: Marginal effects on inflation are relative to inflation for the smallest municipality size (2,500 inhabitants or less).

Chart 4

Marginal effect of tenure status on inflation

Reference category Inflation for owner occcupier:
2020: 0.9%
2021: 2.4%
2022: 9.3%

Source: Statistics Austria (2019/2020 household budget survey; price microdata, 2019 to 2022), OeNB.

Note: Marginal effects on inflation are relative to inflation of owner-occupier.

Chart 4 shows the marginal effects of tenure status relative to the reference category "owner-occupiers". We can see that while renters had economically and statistically (at the 5% level) higher inflation rates in 2020, they had economically and statistically significant (again at the 5% level) lower inflation rates in 2021 and 2022 than their owner-occupier peers. Economic size remains very relevant, with inflation almost 2.5 percentage points lower, even though all other socioeconomic characteristics, including municipality size, are controlled for (see table A1). Note that in larger cities, the share of renters is much higher than in small municipalities (Vienna has an owner-occupier share of less than 20%). Hence, the marginal effects often accumulate to an even larger combined effect. For instance, in the first half of 2022, a renter living in Vienna had an inflation rate that was on average around 3.5 percentage points lower than the inflation rate of an owner-occupier living in a municipality with less than 2,500 inhabitants.

2.5 Robustness check

Currently, among the basic socioeconomic variables we use, municipality size and tenure status convey the most information about inflation heterogeneity. In order to rule out that this is a result of the functional form (strict linearity) that we use for our basic regression analysis, we use a random forest machine learning algorithm to check the relative importance of the socioeconomic characteristics as predictors of household-level inflation rates (see chart A1)[18]. The algorithm is a so-called ensemble tree-based learning algorithm, which we ran a thousand times. Basically, it first selects a bootstrap sample (randomly draws N observations with replacement), then randomly selects a subset of predictors to partition the data (splitting criterion). Therefore, based on information theory, it "learns" the variables that convey the most information to predict the outcome variable, which, in our case, is the inflation rate at the household level. Over-fitting is prevented by "bagging," which means that each tree is fitted on the bootstrap sample rather than the original one. Chart A1 shows the resulting measures of importance, which are standardized so that the most important one is normalized to one for each year. As expected, the algorithm confirms the higher relative importance of municipality size and tenure status, which was especially striking during the recent surge in inflation in the first half of 2022, which, in turn, reflects the different importance of energy in the consumption bundles of households living in cities or in the country.

3 Conclusion: quick relief for financially distressed households now, prevent urban sprawl in the future – and a call for better data

A closer look at the data underlying aggregate official inflation statistics shows that the current surge in inflation does not affect all Austrian households equally. Given that the increase in the price level has been driven to a large extent by the prices for energy (transport, heating and electricity), households that depend on individual transportation and/or live in homes that they own (mostly single-family homes in rural areas) are particularly affected. However, these are not necessarily the households that lack the financial means to cope with higher inflation rates. Rather, single parents, the (working) poor and the unemployed need to consume large shares of their income and are more likely to be in, or get into, financial distress

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[18] We use a classical approach by applying the rforest command in STATA (Zou and Schonlau, 2019).

due the increase in the average price level even though they may currently be facing lower inflation rates than other household types. While untargeted compensation measures for all may be well intended and easy to administer, they come at great costs. In addition to the harmful ecological consequences of subsidizing fossil fuels, the redistributive consequences of untargeted measures may harm particularly the most vulnerable households. Also, transfers to middle- and high-income households stimulate demand and may, in turn, fuel inflation even further. Hence, overly generous fiscal support may turn out to be counterproductive and dampen the effectiveness of monetary policy.

Therefore, in the short term, priority should be given to supporting households who are under financial pressure, such as the unemployed, the (working) poor, single parents and – to a lesser degree – young people and pensioners. Targeted measures aimed at those who are both under financial pressure and also experience particularly high inflation rates (such as e.g. a single parents living in a house in the country) may be more difficult to implement, but would be important to protect the most vulnerable. As our analysis highlights, inflation is distributed unequally across households. Thus, a compensation of average CPI inflation may overcompensate some households but may not be sufficient to cover the increase in expenses for others. It is important to differentiate between households who must be compensated for the increase in their expenses and households who have the means to cover this increase themselves. Note that we are not aware of any economic reason why the state should compensate households for inflation beyond preventing and/or fighting poverty.

In the medium to long term, it is important to implement structural policies to dampen inflation and build up resilience to future inflationary shocks.

A major issue in this regard is urban sprawl. Although it is beyond the scope of this study to quantify the effects of sprawl on vulnerability in the context of energy price increases, we want to summarize the problem shortly.

Urban sprawl comes with a great need for additional infrastructure to supply households with (public) goods and services. Moreover, sprawl increases energy consumption as it usually goes hand in hand with a large share of single-family homes. These homes are typically built for families and hence often underused after children have moved out. Additionally, sprawl usually increases the distances people need to travel between their homes and jobs and hence car dependency and also means extensive land use. The problem of underused assets such as small (mostly elderly) households living in large single-family homes or single person car commuters is substantial in diminishing household resilience to energy costs. The literature on the issue is extensive; OECD (2018) summarizes the main drivers and resulting problems. Preventing or reducing urban sprawl does not only help to increase households' resilience against energy price volatility, but it can also help to fight inequality in general and, additionally, reduces CO_2 emissions by decreasing energy consumption.

Investment in technologies that increase energy efficiency and thereby reduce dependency on fossil fuels can equally help to mitigate inflationary shocks caused by surging energy commodity prices. Furthermore, the increase in consumer prices heavily depends on the possibilities of firms to pass on cost increases (e.g. caused by higher oil prices or wholesale prices for gas or electricity) to consumers. On the demand side, excess savings and pent-up demand from the lockdown periods

resulted in a decreased price-sensitivity for a variety of goods and services, allowing firms to pass on higher input costs to consumers. However, reports from the supply side about record margins in certain industries suggest that inflation could (at least partially) be curbed by controlling market power and fostering competition.

Finally, it would also be important to create datasets which can be used to analyze households' exposure to inflation and its consequences in a more comprehensive framework. This may also facilitate the implementation of targeted measures and relief packages. In particular, we need detailed consumption information (as in the household budget survey), detailed information on income and living conditions (as in the EU Statistics on Income and Living Conditions Survey) and detailed information on assets and liabilities (as in the Household Finance and Consumption Survey) together in a large representative sample of the Austrian household population. Only with such a dataset can we actually identify direct effects on prices and consumption expenditure and more indirect effects, such as lower real debt levels of mortgage holders, higher imputed rents for homeowners or higher rental payments due to the fact that rents are tied to the CPI. Also, information about more complex connections would be highly useful to gain a more comprehensive picture, e.g. with regard to subsidies to firms resulting in their owners' wealth and income being subsidized via a channel in addition to household-level subsidies. It would be necessary to link household-level data with register data on business participations. Given that we are in the midst of the transition to a greener economy and ongoing digitalization, creating a better data basis for evidence-based policy advice and targeted measures seems like a worthwhile endeavor.

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Annex

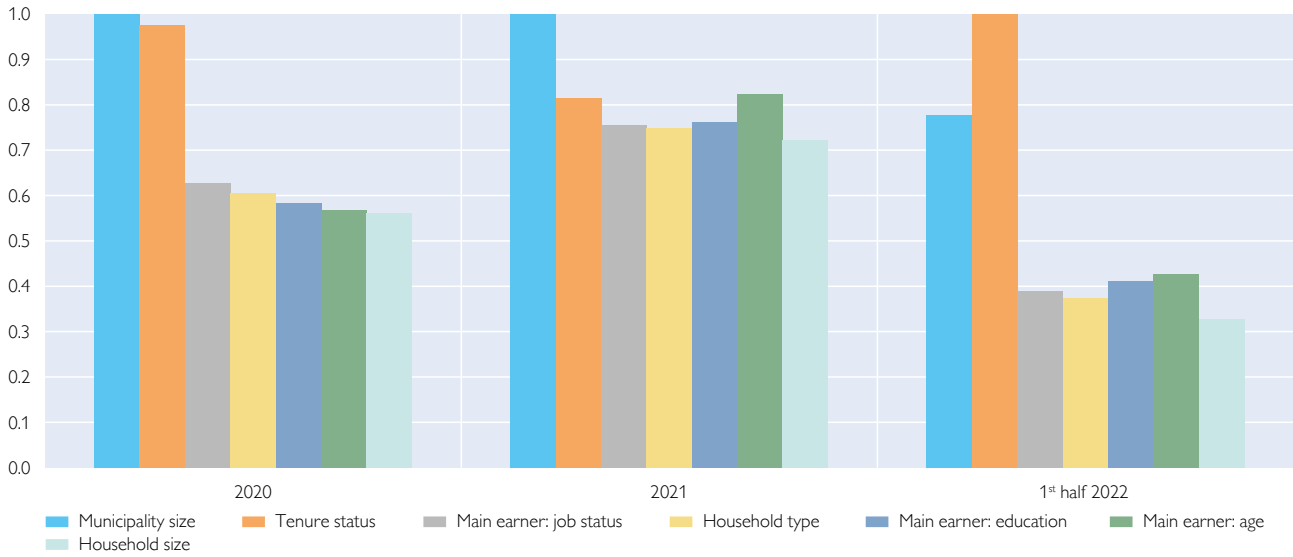### Descriptive regressions of household-level inflation on socioeconomic characteristics

		2020		2021		2022	
		Coefficient	SE	Coefficient	SE	Coefficient	SE
Municipality size	2,501 to 10,000 inhabitants	0.066	0.044	−0.058	0.046	−0.152	0.128
Reference category	10,001 to 100,000 inhabitants	0.289	0.050	−0.262	0.053	−0.805	0.152
up to 2,500 inhabitants	100,001 or more inhabitants, excluding Vienna	0.419	0.064	−0.432	0.065	−1.542	0.173
	Vienna	0.560	0.051	−0.452	0.053	−1.398	0.139
Household size	2 persons	−0.113	0.037	−0.096	0.038	−0.027	0.107
Reference category	3 persons	−0.074	0.046	−0.193	0.050	−0.202	0.130
1 person	4 persons	−0.087	0.053	−0.255	0.057	−0.173	0.145
	5 or more persons	−0.243	0.075	−0.349	0.079	−0.084	0.178
	Single parent	−0.086	0.057	−0.152	0.071	−0.052	0.164
Tenure status	Renter, public housing	0.431	0.059	−0.374	0.065	−2.354	0.154
Ref. Category	Renter, cooperative housing	0.502	0.041	−0.358	0.044	−2.560	0.111
Home-Owner	Renter, other	0.557	0.045	−0.263	0.046	−2.451	0.120
	Other	0.087	0.062	−0.256	0.062	−0.704	0.207
Main earner: age	30 to 39	0.097	0.060	−0.094	0.063	−0.368	0.142
Reference category	40 to 49	0.066	0.060	0.008	0.066	−0.150	0.153
18 to 29	50 to 64	0.086	0.057	0.118	0.062	0.152	0.146
	65 or above	0.149	0.078	0.219	0.082	0.592	0.221
Main earner: education	Lower secondary	−0.060	0.050	0.229	0.051	0.185	0.153
Reference category	Higher secondary	0.021	0.058	0.111	0.061	−0.139	0.173
Primary	Tertiary	0.031	0.056	0.089	0.058	−0.257	0.166
Main earner: job status	White collar	0.175	0.050	−0.246	0.054	−0.726	0.141
Reference category	Civil servant	0.176	0.074	−0.165	0.093	−0.702	0.215
Blue collar	Farmer	0.441	0.160	−0.585	0.161	−1.830	0.471
	Self-employed	0.203	0.077	−0.126	0.084	−0.363	0.216
	Employed, other	0.238	0.297	−0.155	0.230	−0.572	0.636
	Unemployed	0.351	0.072	−0.169	0.077	−0.776	0.197
	Retired	0.303	0.067	−0.295	0.072	−0.901	0.198
	Not employed, other	0.415	0.083	−0.448	0.087	−1.356	0.221
Number of observations			7139		7139		7139

Source: Statistics Austria (2019/2020 household budget survey; price microdata, 2019 to 2022), OeNB.

Machine learning (Random Forest, 1,000 samples): relative importance of characteristics in predicting household-level inflation

1 means most important (others relative to most important within a year)

Municipality size | Tenure status | Main earner: job status | Household type | Main earner: education | Main earner: age | Household size

Source: Statistics Austria (2019/2020 household budget survey; price microdata, 2019 to 2022), OeNB.