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Editorial

Gerhard Fenz, Maria T. Valderrama

The years following the Global Financial Crisis up to 2021 were characterized by an environment of low growth and low inflation. From 2012, headline and core inflation in the euro area averaged 1.1% and just 1%, respectively. As a result, during these years, the Eurosystem implemented a very accommodative monetary policy stance aimed at bringing inflation back to a level consistent, by its own definition, with price stability. Besides very low and even negative policy rates, this also included a series of measures aimed at managing inflation expectations, such as forward guidance, and at influencing medium- and long-term interest rates through large asset purchase programmes (APPs).

As the coronavirus pandemic unfolded in 2020, the world economy entered a deep recession, which forced governments and central banks to implement supporting measures and firms and consumers to adapt to the new situation. As the pandemic abated, the economy recovered unexpectedly quickly, not least due to extensive fiscal and monetary support measures around the world. This rebound as well as the shift in spending from services to manufactured goods, and severe disruptions in supply chains led to a strong rise in inflation in all major economies in the course of 2021.

Given the nature of the shocks, global energy and raw material prices rose sharply, which meant that the largest contribution to inflation pressures in the euro area came from "imported" inflation. In such a situation, a tighter monetary policy aimed at reducing inflation by dampening demand is not effective. Furthermore, the uniqueness of the shocks complicated the real-time assessment of the inflation outlook. Given the experience of the years before the pandemic, the initial assessment was that in the medium term, once these shocks subside, there was still a risk of inflation being below the 2% target.

Based on this assessment, toward the end of 2021, the Eurosystem decided to start the gradual normalization of monetary policy by removing some policy accommodation, thereby gradually moving toward a more neutral stance. The Eurosystem's exit strategy followed a precise sequencing, which had been agreed upon already in September 2019. The first step was stopping net asset purchases, to be followed by increasing policy rates. Thus, the date of "liftoff," i.e. the first increase of policy rates, not only depended on the inflation outlook but also on the end date of net purchases. In July 2021, the Governing Council announced that interest rates would remain at their current level unless three conditions were met: (1) inflation reaching 2% well ahead of the end of the projection horizon and (2) durably for the rest of the projection horizon, as well as (3) progress in underlying inflation being sufficiently advanced to be consistent with inflation stabilizing at 2% over the medium term; also, in accordance with the sequencing of policy measures, net asset purchases had to be stopped.

In December 2021, the Eurosystem announced that it would stop purchases under the pandemic emergency purchase programme (PEPP) at end-March 2022, but at the same time announced that monetary policy would remain accommodative. In fact, the Eurosystem even increased the pace of purchases under the APP without announcing a date for its end, which meant no guidance on the date of liftoff. Moreover, as the risk of inflation falling below target was considered to remain high, the Governing Council kept its forward guidance on rates, announcing that

interest rates would remain at the current level because the conditions for liftoff announced in July 2021 had not been fulfilled yet.

Thus, at the beginning of 2022, the Eurosystem continued to pursue an accommodative monetary policy stance. In February 2022, while economists, government and central banks were still debating the nature and persistence of the rise in inflation as well as the best possible policy responses, the Russian invasion in Ukraine exacerbated inflationary pressures further, particularly through unprecedented rises in energy and commodity prices. This made the situation for the Eurosystem even more challenging, as any monetary policy response to these inflationary pressures would inevitably involve painful tradeoffs between stabilizing growth and inflation, while potentially increasing risks to financial stability in an environment of heightened uncertainty.

By the March 2022 meeting of the ECB Governing Council, inflation had already reached 7.4%, and it had become increasingly clear that the overshooting of inflation was not temporary and that inflation would not return to levels consistent with price stability within a reasonable period. In the April meeting, the tone in the Governing Council's communication was notably different: First, it was announced that the net purchases under the APP would be discontinued in the third quarter of 2022, which meant, in line with the announced sequencing, that the date of liftoff had moved closer. Second, while interest rates and forward guidance were kept unchanged, the Governing Council introduced the concepts of optionality, gradualism and flexibility to the conduct of monetary policy.

By the fourth Governing Council meeting of the year in June 2022, headline inflation in the euro area had reached 8.6%, and it became obvious that the surge in inflation was not a temporary supply-side shock that would pass without requiring specific monetary policy action. In addition, the economic fallout of the Russian invasion of Ukraine proved to be milder than expected as there were no significant supply-side restraints in the energy sector. Thus, there was also an increasing sense that decisive monetary policy action was necessary to get inflation under control before there was a de-anchoring of inflation expectations. It became evident that if the Eurosystem were to lose its credibility and economic actors expected high inflation rates in the medium to long term, this would feed into wage negotiations and lead to a wage-price spiral. Thus, in June the process of policy normalization that had been started in December entered a new phase in which (1) the end of asset purchases was announced for the first day of the third quarter of 2022, (2) forward guidance on interest rates was dropped and (3) the Governing Council switched to a data-based and meeting-by-meeting approach to set interest rates.

Thus, in line with the need to remove monetary policy accommodation, the Governing Council implemented a series of measures toward a more restrictive monetary policy stance. By mid-March, interest rates had been raised by 350 basis points since June 2022, bringing the policy-relevant rate slightly above the upper bound of estimated ranges of a neutral stance. While the Governing Council reiterated its data-based and meeting-by-meeting approach to decision-making and, given recent financial market distress, refrained from giving indications of future rate decisions, it is expected, at the time of writing, that interest rates will keep rising and stay in restrictive territory until the Governing Council sees a credible convergence of inflation toward its 2% medium-term inflation target.

Although the normalization of monetary policy started as early as December 2021, monetary policy remained accommodative for the whole of 2022. It was only in 2023 that monetary policy reached a neutral stance and even became slightly restrictive. Since monetary policy affects the real economy and inflation through varying and lagged transmission channels, it will take some months until we see the effects of the changes in the monetary stance on inflation. According to the most recent forecasts, euro area inflation will average 5.3% in 2023, 2.9% in 2024 and 2.1% in 2025; in Austria, inflation is expected to show a similar downward trend but remain slightly above the euro area average. This means that despite the measures taken by the Eurosystem to control inflation, the effects of the current surge will be with us for some years.

Against the backdrop of these developments and the discussion about the nature of the current inflation shock, its duration and its consequences for consumers, firms and the public sector, the OeNB co-hosted (together with SUERF) a conference titled "The return of inflation"[1] in May 2022 and at the same time increased its internal analytical efforts to better understand the nature and implications of the unexpected surge in inflation. This special issue of Monetary Policy & the Economy presents the results of these analytical efforts, contributing to a deeper understanding of the drivers of current inflation.

While the focus of this special issue is on the analysis of inflation developments in Austria, we also cover some important aspects at the euro area level. In their contribution "Aggregate price pressures along the supply chain: a euro area perspective," *Teresa Messner* and *Thomas Zörner* take a closer look at how price pressures affect sectoral and aggregate price indices in the euro area and find that sectoral price developments are informative about headline inflation.

The role of the recent surge in energy prices in consumer price developments is analyzed by *Martin Schneider* ("What is the effect of energy prices on consumer prices in Austria? A production-side decomposition"). Using a production-side decomposition based on input-output tables, he finds a significant "inflation backlog," which signals a considerable time delay in the pass-through of global energy prices to Austrian consumer prices. Changes in the price-setting process are analyzed by *Christian Beer, Robert Ferstl, Bernhard Graf* and *Fabio Rumler* ("Grocery price setting in times of high inflation: what webscraped data tell us"). They use data scraped from online shops to analyze the frequency and size of retail price changes observed in Austria and find that during the current high-inflation period, time-dependent price setting has been replaced by state-dependent price setting.

Teresa Messner and *Fabio Rumler* ("Inflation expectations of Austrian households and firms amid high inflation") use novel and existing survey data on Austrian firms' and households' inflation expectations to better understand the formation and the determinants of these expectations, which is crucial for monetary policy. They find, notably, that households have become more rationally attentive in the current high-inflation environment. Also, firms' expectations of aggregate inflation are somewhat correlated with their own expected selling prices, but firm- or sector-specific factors and cost-related price developments may shape firms' price setting more.

[1] *The return of inflation - Oesterreichische Nationalbank (OeNB)*

Whether the recent surge in inflation has been affecting households differently is analyzed by *Pirmin Fessler, Friedrich Fritzer* and *Mirjam Salish* ("Who pays the price when prices rise?"). They employ microdata to estimate household-level inflation rates for a representative sample of households in Austria. Heterogeneity of inflation between households is found to be large compared to changes in aggregate inflation over time.

Alfred Stiglbauer ("Wages, inflation and a negative supply shock") investigates to what extent wage growth should compensate for inflation. He argues that in case of a negative import-driven supply shock, wages should grow in line with the increase in output prices or core inflation rather than in line with total consumer price inflation.

The extraordinarily high inflation has also prompted governments to adopt substantial fiscal policy measures. In "Fighting (the effects of) inflation: government measures in Austria and the EU," *Doris Prammer* and *Lukas Reiss* show that – in contrast to other EU member states – Austria has stayed relatively true to the approach of relying more on income measures than on mere price measures, adopting broad-based transfers and tax cuts to support all households. The distributional impact of these measures is analyzed by *Susanne Maidorn* and *Lukas Reiss* ("How effective were fiscal support measure in absorbing the inflation-induced rise in consumption expenditures in 2022?"). They find that overall, fiscal measures in Austria did not fully offset the inflation-induced increase in consumption expenditures for households severely affected by the inflation shock across the income spectrum, including those in the bottom quintile. Finally, *Johannes Holler* and *Lukas Reiss* ("Quantifying the impact of the 2021–22 inflation shock on Austria's public finances") show that while the current inflation shock has a small positive short-run effect on the budget balance in Austria, it is clearly detrimental to public finances in the medium to long run.

Nontechnical summaries in English and German

Nontechnical summaries in English

Aggregate price pressures along the supply chain: a euro area perspective

Teresa Messner, Thomas O. Zörner

In this article, we take a closer look at how price pressures affect sectoral and aggregate price indices. The ECB uses the Harmonised Index of Consumer Prices (HICP) as a benchmark to assess price stability. Therefore, it is important, from a central bank perspective, to know how price changes on a more granular level affect the aggregate price index, as sectoral price pressures may cause an overall increase of the underlying aggregate price index. In the euro area, both headline inflation, including all HICP components, and core inflation, which excludes volatile components such as food and energy, have increased at an accelerated pace from end 2021.

Our empirical approach enables us to trace the reactions of a set of prices, price aggregates and macro variables to a specific price shock. We simulate a price shock on the granular level and analyze the dynamic reactions of aggregate price variables over time. This exercise allows us to draw valuable conclusions on how sectoral price dynamics may affect the greater picture.

Our results show that price pressures on a sectoral level impact both sectoral and headline inflation. In other words, if in a certain industry, the prices of input materials rise, we will see an increase not only in sectoral prices but also in aggregate headline inflation. Moreover, our findings indicate that the price pass-through increases at later stages of the production process, and it is nearly one-to-one for changes in producer prices. Put differently, firms operating at more advanced stages of the supply chain pass on much of their input price increases to the next stage. Finally, our analysis reveals that upstream and intermediate energy prices have by far the most sizeable direct effect on sectoral variables. In contrast, food prices appear to be stronger determinants of headline inflation. We conclude that it is important to look at a more granular level in order to obtain a good understanding of aggregate price index developments. In general, our results suggest that sectoral price developments can indeed be informative about headline inflation developments, confirming results of more complex network models.

What is the effect of energy prices on consumer prices in Austria? A production-side decomposition

Martin Schneider

We analyze the role of energy in consumer price developments in Austria on the basis of the cost of inputs needed for producing consumer goods and services using so-called input-output tables. Our results show that in 2018, energy accounted for a share of 7.7% in total consumer spending; by November 2022, this share had more than doubled to 17.7%. In 2018, the share of energy was substantial in consumer spending on housing (29%) and transport (26%), while it was very small (1.0%) in spending on other consumer goods. In addition, we estimate the impact of the increase in energy wholesale prices between January 2021 and November 2022 on consumer prices. Assuming that the increases in energy prices are fully passed on along the production chain, our calculations show that energy prices contributed 14.5 percentage points to headline inflation in the period analyzed; by comparison, the contribution of the energy component included in the Harmonised Index of Consumer Prices (HICP) in this period was much smaller (6.2 percentage points). The difference can be seen as "inflation backlog," resulting from the fact that consumer prices for electricity, gas and district heating are usually adjusted with some delay to wholesale prices. It is difficult to say at the moment whether and to what extent this backlog will materialize; this will mainly depend on the future path of wholesale prices and the lag with which price changes are reflected in end-user contracts. Finally, the Austrian government has implemented a cap on electricity prices ("Strompreisbremse"), which will reduce inflation by 0.9 percentage points in 2023. In 2024, the abolishment of the cap will increase inflation by 0.3 percentage points.

Grocery price setting in times of high inflation: what webscraped data tell us

Christian Beer, Robert Ferstl, Bernhard Graf, Fabio Rumler

The degree of price rigidity in an economy is a major determinant of the speed and extent of the transmission of monetary policy to the real economy. Thus, the analysis of firms' price-setting behavior at the micro level has become a central field of macroeconomic and monetary research. In this article, we complement the existing literature on price rigidity by calculating statistics on the frequency and size of retail price changes in grocery items using data scraped from online shops of Austrian supermarkets. Hence, our results are based on thousands of online prices observed at a daily frequency from January 2021 to August 2022.

To compare results for the period of relatively low inflation before September 2021 with the ensuing high-inflation period, we split our sample into two parts: January to August 2021 and September 2021 to August 2022. We calculate all our results for the cases including and excluding price changes resulting from temporary sales, promotions and discount sales. Depending on the point of view, price changes due to temporary sales, promotions and discount sales could be regarded as an element of price flexibility or as mere short-lived noise that is irrelevant for the propagation of shocks.

Our preliminary findings suggest that prices changed significantly more often in the high-inflation period from September 2021 onward than in the low-inflation period before. Differentiating between price increases and decreases, we also find that the rise in the frequency of price adjustment from the first to the second period was relatively stronger for price increases. This pattern is particularly pronounced when sale price changes are excluded. In contrast, the average size of price changes remained broadly stable over time. Hence, we conclude that the current surge in grocery price inflation has mainly been driven by an increase in the frequency of price changes, in particular of price increases, rather than by changes in the size of price adjustment. If this finding is confirmed in further studies, it might indicate that in the face of a large shock, the frequency of price changes is no longer constant over time – as found in previous studies – but varies with the state of the economy.

Inflation expectations of Austrian households and firms amid high inflation

Teresa Messner, Fabio Rumler

Inflation expectations are a key indicator of monetary policy as they can be used to predict the future evolution of inflation and help central banks assess the credibility of their policies. Furthermore, according to economic theory, inflation expectations determine the perceived and expected real interest rate, thus affecting people's and firms' consumption and investment decisions. We analyze novel survey data on inflation expectations of Austrian firms from the Business Survey carried out by the Austrian Institute of Economic Research (WIFO-Konjunkturtest) and compare these data with Austrian households' inflation expectations as measured by the OeNB Barometer Survey to better understand the formation and the determinants of firms' and households' expectations, especially in the current high-inflation environment. Our results confirm earlier evidence that households' and firms' inflation expectations are rather similar, which is not surprising, given that the respondents in the firm survey, in particular those representing smaller firms, have similar characteristics as a typical household. We also find that expectations among firms vary less than expectations among households.

Furthermore, household and firm characteristics that likely influence inflation expectations, e.g. education and age for households and size for firms, indicate, to varying degrees, how informed, rational and experienced respondents are. For firms, we show that certain characteristics of individual sectors, such as the extent to which firms are exposed to energy price fluctuations and supply chain pressures, as well as firm size affect their inflation expectations. For households, on the other hand, we confirm earlier evidence that relatively older and female respondents have higher inflation expectations than younger household members and men.

Another finding is that overall, firms' inflation expectations are to some extent correlated with their own expected selling prices, but firm- or sector-specific factors and cost-related price developments likely affect firms' price setting more. While we do find that in general, firms that expect to raise their selling prices also expect higher aggregate inflation rates, a large part of firms do not expect to adjust their prices in the near future. The latter could indicate that over the short term, prices tend to remain unchanged ("price rigidity") or that strong competition hampers the swift adjustment of prices to economic conditions. Lastly, differences between the current and previous survey waves suggest that the current high inflation environment may have raised households' awareness of inflation, as we see a decrease in households' subjective uncertainty about inflation expectations.

Who pays the price when prices rise?

Pirmin Fessler, Friedrich Fritzer, Mirjam Salish

Against the backdrop of current high inflation, this study looks into the following three questions: (1) Which households are confronted with the highest inflation rates? (2) Which households are most likely to experience financial difficulty because of high inflation? (3) Which easily observable socioeconomic characteristics convey the most information about inflation exposure since 2020? Our analysis is based on household-level inflation rates for a representative sample of households in Austria which we calculate using microdata from the 2019/2020 Austrian household budget survey and price data from 2020. We show that inflation heterogeneity among households is large compared to the changes in weighted average inflation over time. Whether households live in urban areas or in the country and whether they rent or own their homes – these two factors had a particularly high impact on how much households were affected by inflation in the first half of 2022 because they are closely linked to energy prices. Our results challenge policymakers' exclusive focus on the (harmonized) consumer price index (CPI) in times of diverging price developments, given that it is based on a mean consumption bundle. Monitoring a broader range of real household-level consumption bundles allows us to provide a more differentiated assessment of Austrian households' exposure to inflation. We show that the majority of households in Austria has the financial means to afford the general increase in the price level without having to cut down on spending. The group of households struggling consists of those who are in a difficult financial situation even when inflation is low: unemployed people, low-income earners and single parents. Consequently, policies aimed at mitigating the impact of inflation should rely on measures of financial distress rather than average (harmonized) CPI inflation alone. Furthermore, policymakers could increase households' resilience to higher and/or volatile energy prices by taking measures to prevent, or even reverse, urban sprawl.

Wages, inflation and a negative supply shock

Alfred Stiglbauer

Wage setters are presently faced with the difficult question of how much wages should rise in response to the sharp increase in inflation that we have seen over the past few months. So far, collectively bargained wages have barely reacted to rising inflation, which has resulted primarily from a surge in (imported) energy and food prices. From empirical observations we know that wage growth usually follows inflation, albeit with a lag; this is also attributable, among other things, to the institutional features of wage bargaining. Current forward-looking indicators of negotiated wages also suggest that wage growth can be expected to accelerate. This raises the question as to what extent wage growth should compensate for inflation. We argue that wage negotiations should not aim for a full compensation of consumer price inflation. The implicit aim of collective bargaining is keeping the wage share in an economy's income constant; therefore, at the current juncture, rather than rising in line with total consumer price inflation, nominal wages should grow in line with labor productivity as well as the increase of output prices or core inflation.

Fighting (the effects of) inflation: government measures in Austria and the EU

Doris Prammer, Lukas Reiss

The extraordinarily high inflation in the euro area has prompted governments in all EU member states to take substantial discretionary fiscal policy action. In addition, EU-wide emergency interventions to address high energy prices have come into force, including measures to skim off windfall profits from energy producers. While all EU member states have taken far-reaching measures to curb the effects of inflation, these measures are very different in their design. In contrast to other EU member states, Austria has stayed relatively true to the approach of relying more on income-based measures – broad-based transfers and tax cuts, such as the abolition of bracket creep – than on purely price-based measures, such as subsidies or tax cuts to reduce the costs of "brown" energy such as fossil fuels. The large scale of the overall package prevented a substantial decline in aggregate real household incomes in Austria in 2022.

When adopting such support measures, governments are not only faced with questions of income distribution, but also have to consider two important policy trade-offs. First, some measures could undermine environmental goals by encouraging the inefficient use of energy. Second, measures might curb the effects of inflation for individual households, but at the same time stoke inflation. This is particularly relevant for measures aimed at reducing energy prices, as supply curves for various energy sources are currently steep (i.e. small changes in demand can lead to relatively large price changes). Furthermore, expansive fiscal policy measures in times of high headline and core inflation rates counteract central banks' restrictive policy stance.

How effective were fiscal support measures in absorbing the inflation-induced rise in consumption expenditures in 2022?

Susanne Maidorn, Lukas Reiss

Against the backdrop of the sharp increase in inflation, substantial fiscal measures were implemented in Austria in 2022 to support household incomes. These measures mostly took the form of transfers that benefit all households. Therefore, the analysis of distributional effects performed in this study shows that the overall effect of the support measures was similar for all households regardless of their incomes. We also see that lower-income households were more affected by the inflation-induced increase in expenditures, and they also profited more from the support measures. On average, the 20% of households with the lowest incomes saw a very small overcompensation of the increase in their expenditures, whereas for all other households, fiscal support was lower than inflation-induced additional spending.

The amount of support did not depend on how much households were affected by inflation. As a result, we see that households with less exposure to inflation (i.e. households with district heating that live in more densely populated areas) benefited more from both the increase in the "climate bonus" and, on average, from one-off payments to transfer recipients. At the same time, among the 40% of households with the lowest incomes, those who had been more severely affected by inflation (i.e. households in thinly populated areas that heat their homes with oil, gas or wood) on average received less support. Among households more exposed to inflation, the inflation-induced increase in expenditures was higher than the support received across all income groups.

Quantifying the impact of the 2021–22 inflation shock on Austria's public finances

Johannes Holler, Lukas Reiss

Higher inflation tends to contribute to higher growth in government revenue, but its overall effect on public finances is ambiguous. To assess the impact of the current inflationary shock on Austria's budget balance, we take a closer look at its specific nature: it mainly consists in a strong increase in international energy prices and therefore has a negative impact on real GDP. Taking this into account, we show that overall, the effect of the surge in inflation on public finances will be clearly negative, although there is also a small positive effect in the short term. That said, this positive effect is much smaller than the amount of public funds spent on alleviating the impact of high inflation on households' incomes and firms. As regards the public debt ratio, the surge in inflation again has a favorable effect in the short run, but given its continuously adverse effects on budget deficits, the impact of inflation is expected to drive up the debt ratio from 2026 onward. Furthermore, linking tax brackets and family benefits to inflation, as has recently been introduced in Austria, significantly worsens the response of the budget balance to the current inflationary shock.

Nontechnical summaries in German

Aggregierter Preisdruck entlang der Lieferkette: eine Analyse aus der Perspektive des Euroraums

Teresa Messner, Thomas O. Zörner

Diese Studie untersucht, inwiefern sich der Preisdruck durch Inflation auf sektorale und aggregierte Preisindizes auswirkt. Da die EZB den Harmonisierten Verbraucherpreisindex (HVPI) bei ihrer Beurteilung der Preisstabilität als Referenzwert heranzieht, ist es aus der Perspektive einer Notenbank wichtig zu wissen, wie sich Preisveränderungen auf granularer Ebene auf den aggregierten Preisindex auswirken; Preisdruck in einem bestimmten Sektor kann nämlich einen Anstieg des zugrunde liegenden aggregierten Preisindex zur Folge haben. Im Euroraum ist seit Ende 2021 sowohl die Gesamtinflation, die alle HVPI-Komponenten enthält, als auch die Kerninflation, die volatilere Komponenten wie Lebensmittel und Energie nicht berücksichtigt, deutlich gestiegen.

Der in dieser Studie verwendete empirische Ansatz erlaubt es, die Reaktion von Preisen und Preisaggregaten auf einen bestimmten Preisschock zu analysieren. Die Simulation eines Preisschocks auf granularer Ebene zeigt dann die dynamischen Reaktionen aggregierter Preisvariablen über einen bestimmten Zeitraum. Dadurch können wichtige Schlussfolgerungen über den Einfluss der Preisdynamik in einzelnen Sektoren auf die gesamte Preisentwicklung abgeleitet werden.

Die Ergebnisse zeigen, dass Preisdruck auf Sektorebene sowohl die Inflation in diesem Sektor als auch die Gesamtinflation beeinflusst. Bei einem Anstieg der Vorleistungspreise in einer bestimmten Branche steigen daher nicht nur die Preise in diesem Sektor, sondern es beschleunigt sich auch die aggregierte Gesamtinflation. Des Weiteren deuten die Ergebnisse auf eine höhere Preisweitergabe auf nachgelagerten Stufen des Produktionsprozesses hin. Erzeugerpreise werden sogar fast vollständig weitergegeben. Das heißt, Firmen in nachgelagerten Stufen der Wertschöpfungskette geben höhere Vorleistungspreise stärker an die nächste Stufe weiter. Des Weiteren zeigt die Analyse, dass Energiepreise auf vorgelagerten und leicht fortgeschrittenen Stufen mit Abstand den größten direkten Einfluss auf sektorale Produzentenpreise haben. Im Gegensatz dazu scheinen Lebensmittelpreise einen größeren Einfluss auf die Gesamtinflation zu haben. Daraus lässt sich ableiten, dass eine granularere Betrachtung dabei helfen kann, Entwicklungen des aggregierten Preisindex besser nachvollziehen zu können. Insgesamt lässt sich zusammenfassen, dass Preisentwicklungen in einem bestimmten Sektor wichtige Informationen über die Entwicklung der Gesamtinflation liefern, was auch durch komplexere Netzwerkmodelle bestätigt wird.

Welchen Effekt haben Energiepreise auf die Verbraucherpreisentwicklung in Österreich? Eine produktionsseitige Analyse

Martin Schneider

In dieser Studie wird analysiert, welche Rolle die Energiepreise für die Entwicklung der Verbraucherpreise in Österreich spielen. Grundlage der Analyse bilden die Kosten der für die Produktion von Konsumgütern und Dienstleistungen notwendigen Produktionsfaktoren gemäß so genannter Input-Output-Tabellen. Laut unseren Ergebnissen war im Jahr 2018 Energie für 7,7 % der gesamten Konsumausgaben verantwortlich; bis November 2022 hatte sich dieser Anteil mehr als verdoppelt (17,7 %). Energie spielte vor allem bei den Ausgaben für Wohnzwecke (29 %) und Verkehr (26 %) eine große Rolle, sehr klein war der Energieanteil hingegen bei Ausgaben für sonstige Konsumgüter (1,0 %). Darüber hinaus schätzen wir, wie sich der Anstieg der Energiegroßhandelspreise zwischen Jänner 2021 und November 2022 auf die Verbraucherpreise auswirkte. Unter der Annahme, dass die Energiepreise entlang der Produktionskette in vollem Umfang weitergegeben werden, errechnet sich für den analysierten Zeitraum ein Beitrag der Energiepreise zur Gesamtinflation in Höhe von 14,5 Prozentpunkten; zieht man den Beitrag der Energiekomponente im Harmonisierten Verbraucherpreisindex (HVPI) heran, ergibt sich ein weitaus kleinerer Anteil von 6,2 Prozentpunkten. Die Differenz zwischen diesen beiden Werten kann als „Inflationsrückstau“ interpretiert werden, der daraus resultiert, dass die Endverbraucherpreise für Strom, Gas und Fernwärme in der Regel mit einer gewissen Verzögerung an die Großhandelspreise angepasst werden. Ob und inwieweit diese „aufgestaute“ Inflation tatsächlich zum Tragen kommt, ist im Moment schwer abzuschätzen. Abhängen wird dies in erster Linie von der künftigen Entwicklung der Großhandelspreise und der Verzögerung, mit der Preisänderungen in Endverbraucherverträge übernommen werden. Die von der österreichischen Regierung eingeführte Strompreisbremse wird die Inflation im Jahr 2023 um 0,9 Prozentpunkte senken. Im Jahr darauf wird deren Abschaffung die Inflation wiederum um 0,3 Prozentpunkte anheben.

Lebensmittelpreisentwicklung in Zeiten hoher Inflation: Auswertung von Onlinepreisen

Christian Beer, Robert Ferstl, Bernhard Graf, Fabio Rumler

Das Ausmaß der Preisrigidität in einer Volkswirtschaft ist ein wesentlicher Faktor dafür, wie schnell und wie stark geldpolitische Änderungen in der Realwirtschaft ankommen. Daher hat sich die Analyse des Preissetzungsverhaltens von Unternehmen auch zu einem zentralen Forschungsfeld im Bereich Volkswirtschaft und Geldpolitik entwickelt. Zweck der vorliegenden Studie ist es, die bestehende Literatur zur Häufigkeit und zum Ausmaß von Preisänderungen mithilfe von Lebensmittelpreisen im Onlinegeschäft zu ergänzen, die von den Webseiten österreichischer Supermärkte automatisiert heruntergeladen werden können. Die Datenbasis bilden damit tausende von Onlinepreisen, die im Zeitraum Jänner 2021 bis August 2022 täglich neu erfasst wurden.

Um das Preissetzungsverhalten im Zeitraum mit relativ betrachtet niedrigeren Inflationswerten vor September 2021 mit dem Preissetzungsverhalten im Zeitraum mit den deutlich höheren Inflationswerten danach vergleichen zu können, erfolgt die Datenauswertung für die zwei Zeiträume getrennt. Zudem werden alle Berechnungen einmal mit und einmal ohne Einbeziehung temporärer Aktions- und Abverkaufspreise durchgeführt. Aktions- und Abverkaufspreise kann man je nach Standpunkt als wichtiges Element von Preisflexibilität sehen oder als nur kurzfristig relevante Aspekte, die mittel- bis langfristig bei der Übertragung von Preisschocks nicht weiter ins Gewicht fallen.

Laut den vorliegenden Ergebnissen wurden die Preise seit Beginn der aktuellen Hochinflationsphase, also seit September 2021, deutlich öfter angepasst als in der Niedriginflationsphase davor. Unterscheidet man zusätzlich zwischen Preiserhöhungen und Preissenkungen, so zeigt sich, dass die Preise in der Hochinflationsphase vergleichsweise öfter hinaufgesetzt als gesenkt wurden. Besonders deutlich zeigt sich dieser Effekt, wenn Aktions- oder Abverkaufspreise unberücksichtigt bleiben. Hingegen hat sich am Ausmaß der Preisanpassungen relativ wenig geändert. Daraus ergibt sich der Umkehrschluss, dass die aktuell hohe Lebensmittelpreisinflation weniger auf vergleichsweise stärkere Preisanpassungen als auf häufigere Preisänderungen (insbesondere Preiserhöhungen) zurückzuführen ist. Sollte sich dieses Ergebnis in weiteren Studien bestätigen, könnte dies darauf hindeuten, dass die Häufigkeit von Preisänderungen angesichts eines großen Schocks nicht mehr – wie in früheren Studien festgestellt – im Zeitverlauf konstant ist, sondern von der Wirtschaftslage beeinflusst wird.

Inflationserwartungen österreichischer Privathaushalte und Unternehmen in Zeiten hoher Inflation

Teresa Messner, Fabio Rumler

Inflationserwartungen sind wichtige Indikatoren für die Geldpolitik, da sie die zukünftige Entwicklung der Inflation prognostizieren können und somit Zentralbanken dabei helfen, die Glaubwürdigkeit ihrer Politik zu beurteilen. Des Weiteren bestimmen Inflationserwartungen laut Wirtschaftstheorie den wahrgenommenen und erwarteten Realzinssatz und beeinflussen somit den Konsum und die Investitionsentscheidungen von Personen und Unternehmen. Wir analysieren neue Umfragedaten des WIFO-Konjunkturtests zu den Inflationserwartungen österreichischer Unternehmen und vergleichen diese mit Daten zu den Inflationserwartungen österreichischer Privathaushalte aus der OeNB-Barometer-Umfrage, um ein klareres Bild über die Entstehung und Bestimmungsfaktoren der Erwartungen von Unternehmen und Haushalten – insbesondere während der derzeit hohen Inflation – zu erlangen. Unsere Ergebnisse bestätigen frühere Hinweise darauf, dass sich die Inflationserwartungen von Haushalten und Firmen nicht stark voneinander unterscheiden. Das ist insofern nicht überraschend, als in der Unternehmensumfrage insbesondere die Befragten, die kleinere Unternehmen vertreten, ähnliche Merkmale wie typische Haushalte aufweisen. Außerdem zeigen unsere Ergebnisse, dass sich die Erwartungen der Unternehmen untereinander weniger stark unterscheiden als jene der Haushalte.

Wir stellen ferner fest, dass bestimmte Merkmale von Haushalten (z. B. Alter und Bildungsgrad) und Unternehmen (z. B. Größe), die Inflationserwartungen beeinflussen dürften, bis zu einem gewissen Grad Aufschluss darüber geben, wie informiert, rational und erfahren die Befragten sind. Bei Unternehmen bestimmen offenbar auch gewisse Charakteristika einzelner Sektoren, etwa in welchem Umfang Unternehmen von schwankenden Energiepreisen oder Lieferkettenproblemen betroffen sind, sowie die Unternehmensgröße die Inflationserwartungen. Bei Haushalten hingegen bestätigen wir frühere Erkenntnisse, dass ältere und weibliche Befragte tendenziell höhere Inflationsraten erwarten als jüngere Haushaltsmitglieder und Männer.

Zudem stehen die Inflationserwartungen der Unternehmen bis zu einem gewissen Grad im Einklang mit den erwarteten eigenen Verkaufspreisen; dessen ungeachtet haben unternehmens- bzw. sektorspezifische Faktoren sowie Kostenentwicklungen vermutlich einen größeren Einfluss auf die Preisgestaltung der Unternehmen. Während jene Unternehmen, die damit rechnen, ihre Verkaufspreise zu erhöhen, auch höhere Inflationsraten erwarten, plant ein Großteil der Unternehmen nicht, seine Preise in naher Zukunft anzupassen. Letzteres könnte darauf hinweisen, dass Preise kurzfristig tendenziell unverändert bleiben („Preisrigidität"), oder dass der Wettbewerb eine rasche Anpassung von Preisen an die wirtschaftliche Lage hemmt. Die aktuelle Umfrage zeigt auch, dass die subjektive Unsicherheit bezüglich Inflationserwartungen unter Haushalten seit der vorigen Umfrage abgenommen hat. Dies deutet darauf hin, dass die derzeit hohe Inflation die Teuerung stärker in das Bewusstsein der privaten Haushalte gerückt hat.

Inflation und finanzielle Belastung: eine Analyse von Haushaltsdaten in Österreich

Pirmin Fessler, Friedrich Fritzer, Mirjam Salish

Vor dem Hintergrund der aktuell hohen Inflation befasst sich die vorliegende Studie mit folgenden drei Fragestellungen: (1) Welche Haushalte sind mit den höchsten Inflationsraten konfrontiert? (2) Welche Haushalte geraten aufgrund der hohen Inflation am ehesten in finanzielle Schwierigkeiten? (3) Welche leicht beobachtbaren sozioökonomischen Merkmale enthalten die meisten Informationen über das Inflationsrisiko seit 2020? Unsere Analyse basiert auf Inflationsraten auf Haushaltsebene für eine repräsentative Stichprobe von Privathaushalten in Österreich, die wir mit Hilfe von Mikrodaten der österreichischen Konsumerhebung 2019/2020 und Preisdaten ab 2020 berechnen. Wir zeigen, dass die Heterogenität der Inflation zwischen den Haushalten im Vergleich zu den Veränderungen der gewichteten Durchschnittsinflation im Zeitverlauf groß ist. Die Größe des Wohnorts und der Umstand, ob Haushalte im Eigenheim oder zur Miete wohnen, hatten im ersten Halbjahr 2022 einen besonders großen Einfluss darauf, wie stark einzelne Haushalte von der Inflation betroffen waren, da beide Faktoren eng mit den Energiepreisen verknüpft sind. Unsere Ergebnisse stellen den Fokus der politischen Entscheidungsträger:innen auf den (harmonisierten) Verbraucherpreisindex in Zeiten divergierender Preisentwicklungen in Frage, da dieser auf Basis eines durchschnittlichen Konsumbündels berechnet wird. Die Abbildung eines breiteren Spektrums an realen Konsumbündeln auf Haushaltsebene ermöglicht hingegen differenzierte Aussagen über die Inflationsbetroffenheit der österreichischen Haushalte. Wir zeigen, dass ein Großteil der österreichischen Haushalte über ausreichend finanzielle Mittel verfügt, um sich den allgemeinen Anstieg des Preisniveaus leisten zu können, ohne den Konsum einschränken zu müssen. Die Gruppe der Haushalte, die Probleme haben, besteht vorwiegend aus jenen Haushalten, die sich auch in Zeiten niedriger Inflation in einer schwierigeren finanziellen Lage befinden, nämlich Arbeitslose, Niedrigverdiener:innen und Alleinerziehende. Folglich sollten sich Maßnahmen zur Abfederung oder Eindämmung der Inflation auf Maße der finanziellen Notlage stützen und nicht ausschließlich an der durchschnittlichen (H)VPI-Inflation orientieren. Darüber hinaus könnte die Politik die Resilienz der Haushalte gegenüber höheren bzw. volatileren Energiepreise stärken, indem Zersiedelung verhindert oder im besten Fall umgekehrt wird.

Löhne, Inflation und ein negativer Angebotsschock

Alfred Stiglbauer

In Lohnverhandlungen sieht man sich aktuell mit der schwierigen Frage konfrontiert, wie stark die Löhne angesichts der in den letzten Monaten sehr hohen Inflation angehoben werden sollen. Bis dato spiegeln die Kollektivvertragslöhne kaum die gestiegene Inflation wider, die primär die Folge des starken Anziehens der Preise für (importierte) Energie und Nahrungsmittel ist. Empirische Beobachtungen belegen, dass das Lohnwachstum in der Regel dem Inflationsverlauf folgt, allerdings mit einer gewissen Zeitverzögerung. Dies hängt unter anderem mit der institutionellen Ausgestaltung der Kollektivvertragsverhandlungen zusammen. Aktuelle vorausschauende Indikatoren deuten ebenfalls darauf hin, dass sich das Lohnwachstum beschleunigen wird. Vor diesem Hintergrund erhebt sich die Frage, inwieweit Lohnerhöhungen die Inflation ausgleichen sollen. Wir führen in unserer Analyse Argumente dafür ins Treffen, dass die Lohnverhandlungen nicht auf einen vollen Inflationsausgleich abstellen sollten. Das implizite Ziel von Kollektivvertragsverhandlungen besteht darin, den Anteil der Löhne am Gesamteinkommen einer Volkswirtschaft konstant zu halten. Daher sollten auch in der gegenwärtigen Situation die Löhne nicht gleich stark wie die Verbraucherpreise steigen. Vielmehr sollten die Nominallöhne im Einklang mit der Arbeitsproduktivität und dem Anstieg der Outputpreise bzw. der Kerninflation erhöht werden.

Maßnahmen zur Bekämpfung (der Auswirkungen) der Inflation in Österreich und der EU

Doris Prammer, Lukas Reiss

Die außergewöhnlich hohe Inflation im Euroraum hat alle EU-Staaten veranlasst, umfangreiche Fiskalpakete zu schnüren. Zusätzlich dazu wurden auf EU-Ebene Notfallmaßnahmen im Zusammenhang mit den hohen Strompreisen ergriffen; dazu zählt etwa die Abschöpfung von unerwartet hohen Gewinnen von Stromerzeugern. Die in den einzelnen EU-Staaten umgesetzten weitreichenden Maßnahmen zur Abfederung der Inflationsfolgen unterscheiden sich in ihrer Ausgestaltung stark voneinander. Während manche Länder vornehmlich auf preisbasierte Maßnahmen setzten (etwa zur Reduktion der Kosten fossiler Energieträger über Förderungen oder Steuersenkungen), wurden in Österreich überwiegend einkommensbasierte Maßnahmen – breit angelegte Transferleistungen und Steuersenkungen (einschließlich der Abschaffung der kalten Progression) – ergriffen. Dank des hohen Maßnahmenvolumens konnte ein größerer Rückgang des aggregierten realen Haushaltseinkommens in Österreich im Jahr 2022 verhindert werden.

Bei der politischen Entscheidung, welche Unterstützungsmaßnahmen umgesetzt werden sollen, haben Regierungen nicht nur Aspekte der Einkommensverteilung zu berücksichtigen, sondern auch folgende essenzielle Abwägungen anzustellen: Manche Maßnahmen können umweltpolitischen Zielen zuwiderlaufen, indem sie ineffizienten Energieverbrauch begünstigen. Andere Maßnahmen wiederum schwächen zwar die Folgen der Teuerung für einzelne Haushalte ab, wirken gleichzeitig aber insgesamt inflationsfördernd. Besonders relevant sind diese Überlegungen im Zusammenhang mit Energiepreissenkungen, da die Angebotskurven für verschiedene Energieträger gegenwärtig einen steilen Verlauf zeigen (d. h. kleine Nachfrageänderungen können zu relativ großen Preisänderungen führen). Darüber hinaus konterkariert eine expansive Fiskalpolitik in Zeiten hoher Gesamt- und Kerninflation die restriktive Geldpolitik der Zentralbanken.

Inwiefern konnten Entlastungsmaßnahmen die inflationsbedingten Mehrausgaben privater Haushalte im Jahr 2022 kompensieren?

Susanne Maidorn, Lukas Reiss

Im Jahr 2022 wurden angesichts des beträchtlichen Anstiegs der Inflation umfangreiche fiskalische Maßnahmen beschlossen, um die Einkommen der privaten Haushalte in Österreich zu stützen. Diese Entlastungsmaßnahmen bestanden mehrheitlich aus Transfers, von denen alle Haushalte profitierten. Dementsprechend ergibt die in der vorliegenden Studie durchgeführte Analyse der Verteilungseffekte, dass der Gesamteffekt der Maßnahmen für alle Haushalte unabhängig von ihrem Einkommen sehr ähnlich war. Gemessen am Haushaltseinkommen waren einkommensschwache Haushalte stärker vom inflationsbedingten Anstieg der Konsumausgaben betroffen, und sie profitierten auch stärker von den Entlastungsmaßnahmen. Bei den einkommensschwächsten 20 % der Haushalte kam es im Durchschnitt zu einer sehr geringfügigen Überkompensation, während bei allen anderen Haushalten die Unterstützung im Durchschnitt unter den inflationsbedingten Mehrausgaben lag.

Die Entlastungsmaßnahmen waren darüber hinaus nicht auf die unterschiedliche Inflationsbetroffenheit der Haushalte ausgerichtet. So profitierten Haushalte, die weniger stark von der Inflation betroffen waren (d. h. Haushalte mit Fernwärmeheizung in dicht besiedelten Gebieten), sowohl stärker von der Erhöhung des Klimabonus als auch – im Durchschnitt – von den Einmalzahlungen für Bezieher von Transferleistungen. Demgegenüber erhielten unter den einkommensschwächsten 40 % der Haushalte jene, die stärker von der Inflation betroffen waren (d. h. Haushalte in dünn besiedelten Gebieten, die mit Gas, Öl oder Holz heizen) im Durchschnitt weniger Kompensation aus den Entlastungspaketen. Für stärker betroffene Haushalte aller Einkommensgruppen fielen die Entlastungsmaßnahmen geringer aus als der inflationsbedingte Anstieg ihrer Konsumausgaben.

Wie groß ist der Effekt des Inflationsschocks 2021–22 auf Österreichs öffentliche Finanzen?

Johannes Holler, Lukas Reiss

Höhere Inflation trägt in der Regel zu einem höheren Wachstum der Staatseinnahmen bei, doch der Gesamteffekt der Teuerung auf den Staatshaushalt ist nicht eindeutig. Um festzustellen, wie sich der aktuelle Inflationsschock auf Österreichs Staatsfinanzen auswirkt, berücksichtigen wir in unserer Analyse insbesondere seine spezielle Ausprägung: der aktuelle Preisanstieg ist primär das Resultat des starken Anstiegs der internationalen Energiepreise und hat damit einen negativen Effekt auf das reale BIP. Unter diesen Voraussetzungen kommen wir zu dem Schluss, dass die Auswirkungen der hohen Inflation auf die öffentlichen Finanzen insgesamt eindeutig negativ sind, auch wenn sich kurzfristig ein kleiner positiver Effekt ergibt. Der kurzfristig positive Effekt auf den Staatshaushalt fällt allerdings viel kleiner aus als das Volumen der bereits verabschiedeten staatlichen Unterstützungen zur Abfederung der negativen Auswirkungen der Inflation auf Haushaltseinkommen und Unternehmen. Auch die Staatsschuldenquote geht kurzfristig zurück. Die laufende Verschlechterung des Budgetdefizits infolge der hohen Inflation lässt die Schuldenquote ab 2026 aber ansteigen. Darüber hinaus vergrößert die kürzlich in Österreich eingeführte Abschaffung der kalten Progression und die Indexierung der Familienleistungen die negativen Effekte des aktuellen Inflationsschocks auf den Budgetsaldo.

Studies

Aggregate price pressures along the supply chain: a euro area perspective

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In this article, we take a closer look at how price pressures affect sectoral and aggregate price indices. From a central bank perspective, especially, it is important to know how price changes on a more granular level affect the aggregate price index, which is often used as a benchmark to assess price stability. We employ a vector autoregression with a set of price and macro variables and perform an impulse response analysis. A simulation of a specific price shock enables us to trace its dynamic impact on a variety of price variables over time. Our main findings indicate that (1) sectoral price pressures impact both sectoral and headline inflation, and (2) the price pass-through increases at later stages of the production process, being nearly one-to-one for changes in producer prices. Moreover, (3) upstream and intermediate energy prices have the most sizable direct effect on sectoral variables by far, while food prices appear to be stronger determinants of headline inflation. In general, our results suggest that sectoral price developments can be indeed informative for headline inflation, confirming results of more complex network models.

JEL classification: C32, E31, Q43
Keywords: price pressures, price shock transmission, sector-specific reactions to price shocks

When companies face increases in their input prices (e.g. raw material, energy or intermediate goods prices), they may pass these cost increases on to their buyers. In case of an intermediary producer, it is likely that these increases will be passed on again to the next stage until, eventually, these costs reach the final consumers. Knowing how fast this process – the pass-through of costs along the supply chain to final consumers – evolves is of great importance to policymakers, enabling them to make quick and informed decisions. In particular, it is also crucial to know not only the evolution but also how much of the price increases is actually passed on at each stage of the supply chain, and whether there are sectoral differences. In this article, we estimate the effects of unanticipated changes in a variety of input prices higher up in the supply chain on consumer prices using a small-scale Bayesian vector autoregression.

Our main findings indicate that (1) sectoral price pressures impact both sectoral and headline inflation, and (2) the price pass-through increases at later stages of the production process and is nearly immediate for changes in producer prices. Moreover, (3) (upstream and intermediate) energy prices have by far the most sizable direct effect on sectoral variables, while food prices appear to be stronger determinants of headline inflation. In general, our results suggest that sectoral price developments can be indeed informative about the path of headline inflation,

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confirming results of more complex network models (e.g. Baqaee and Farhi, 2019; or Auer et al., 2019).

1 Motivation and literature

As different producers need different input, some may be more exposed to price increases than others. Quite recently, the ECB's benchmark to assess price stability, the Harmonized Index of Consumer Prices (HICP) for the euro area, showed a broad increasing pattern. Both headline inflation, including all HICP components, and core inflation, without volatile components such as food and energy, increased at an accelerated pace from end 2021 onward as seen in chart 1. In this article, we take a closer look into how price pressures affect sectoral and aggregate price indices in the euro area.

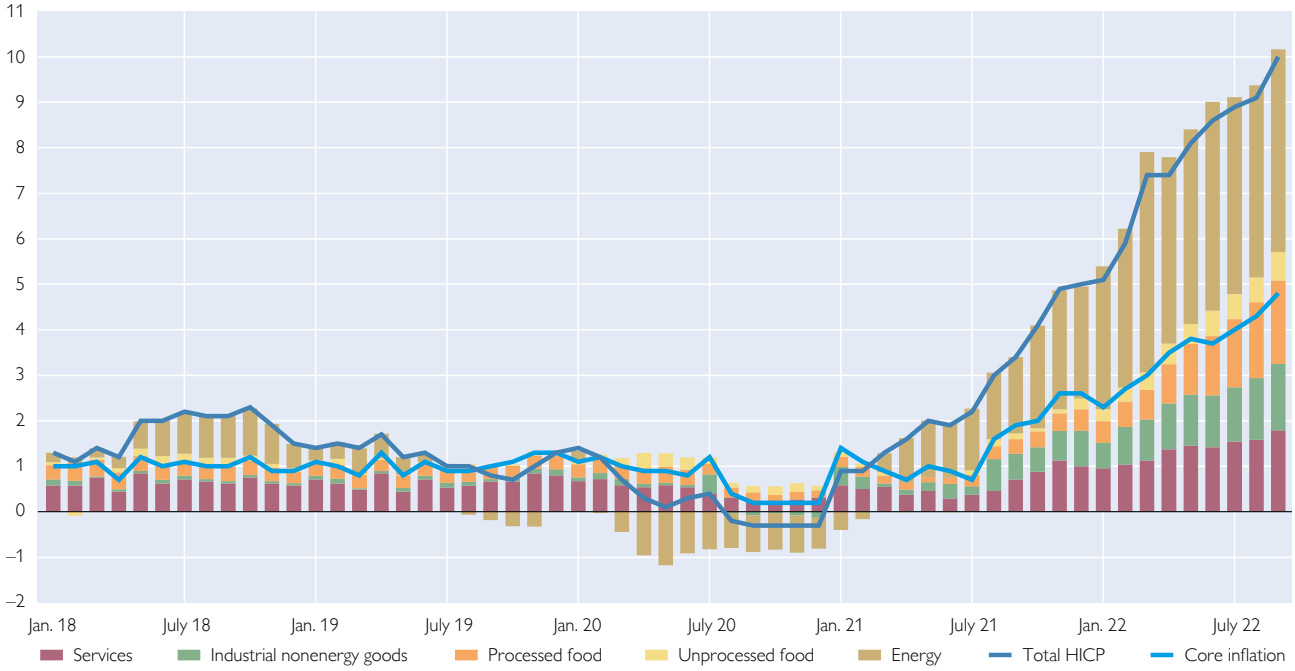
A broad body of literature has studied the role of price dynamics at the sectoral level, trying to disentangle the role of aggregate and local, i.e. sector-specific, shocks. In general, the literature attaches much weight on aggregate shocks as drivers of headline inflation volatility. However, there is also evidence that sectoral shocks determine sectoral inflation developments, while aggregate developments do not play a sizable role. The persistence of headline and sectoral inflation is, however, driven by aggregate factors (see, among others, Andrade and Zachariadis, 2016; Kaufmann and Lein, 2013; de Graeve and Walentin, 2015).

However, these studies appear to not fully address the complex sectoral interlinkages in firm networks. Firms may use and produce intermediate goods that

Chart 1

Euro area: HICP inflation rate and its components

Annual percentage change in %, contributions in percentage points



Source: Eurostat.

Note: Last observation: August 2022.

serve as input at later stages of the production chain, so when assessing the role of sectoral and aggregate shocks as determinants of inflation volatility and persistence, they may not be adequately disentangled (Foerster et al., 2011). More complex approaches make it possible to explicitly model and analyze the effects of price pressures at different sectoral stages. Globalization has made supply chains even more complex, with companies being woven into a tight network of suppliers and buyers (for a prominent example of such a modeling approach, see Baqaee and Farhi (2019) or Auer et al. (2019)). Modeling the *trickling down* of costs for any sequential input for every company involved in each sector of the economy requires, however, an intense effort of data work as demonstrated, for example, in Foerster et al. (2011) or Smets et al. (2018).[2] The latter find that differences in sectoral inflation persistence are to a large extent a result of sectoral differences in price stickiness, e.g. how fast prices of intermediate products can be adjusted and subsequently passed on. Furthermore, sectoral price pressures in different sectors along the supply chain can explain headline and disaggregate consumer price inflation volatility. This evidence would suggest that looking at sectoral price developments further up in the supply chain can be informative not only about sectoral consumer price inflation developments but also about headline dynamics.

In this article, however, we derive conclusions for consumer price changes in the euro area by looking at such supply chain pressures from an aggregate perspective. Such a perspective, i.e. "the broad picture", is necessary in the context of monetary policymaking as central banks in general focus on an aggregate price indicator. While our approach comes at some costs, we see three major advantages in the aggregate nature of our analysis. First, we rely neither on strong assumptions like, for instance, how to model nominal rigidities, nor on an explicit model stance about the underlying production networks. Second, we circumvent issues associated with the availability of data on distinct production linkages across the euro area. As mentioned above, missing data make the use of imputation techniques necessary, which ultimately may affect the reliability of the results. Finally, our analysis provides useful evidence for monetary policymakers, who base their decisions on aggregate price index developments.

In our empirical approach for unveiling aggregate price pressures along the supply chain, we estimate a small-scale Bayesian vector autoregressive (BVAR) model in the fashion of Giannone et al. (2015). For the identification of price shocks, we rely on sign restrictions proposed by Uhlig (2005). Our model predominantly pictures the aggregate supply side of the euro area economy at a monthly frequency. Based on our model estimation, we perform a simulation exercise by means of an impulse response analysis. More precisely, we simulate an unanticipated change of (1) aggregate freight costs and raw material prices (picturing price pressures at the "most upstream," i.e. initial stage of the supply chain) as well as (2) producer prices for food, energy and consumer goods (price pressures at the intermediate level in the supply chain) and trace their effects over time. The dynamics of the resulting impulse response functions (IRF) allow us (1) to gauge

[2] *There are challenges with respect to the treatment of micro price data due to measurement errors, sales and substitution effects (de Graeve and Walentin, 2015), which, taken together, may drive results in favor of aggregate shocks. Furthermore, there may be nonlinearities in how much intermediate prices can be adjusted. Once price pressures reach a certain extent, companies may be more likely to adjust prices considerably (see for example Nakamura et al., 2018).*

the dynamic effects of these particular shocks and (2) compare the shape and magnitude of the reactions of the HICP and its components across the sources of price pressures. In other words, we are interested in the speed and extent of how different price shocks feed into aggregate consumer prices over time.

2 Empirical strategy

Using macroeconomic data, we estimate the responses of aggregate consumer prices to price shocks further up in the supply chain. We want to know how large and how persistent the effects of such sudden shocks on consumer prices are. An example would be how downstream consumer prices react to a rapid increase in upstream crude oil prices or intermediate energy producer prices. Amid the discussion on aggregate- vs. sector-specific effects, as we showed in section 1, we compare the responses of the headline HICP to the responses of specific components of the HICP, such as energy prices.

Our small-scale empirical model sheds light on such macro reactions over time in the euro area as a whole. The empirical application investigates the effects of unanticipated changes in upstream prices in a small-scale hierarchical vector autoregression (BVAR) with a Bayesian stance of estimation.

Figure 1 gives an overview of the model specifications. Overall, we estimate eight models, with an identical set of variables differing only in the (eight) upstream and intermediate cost or price series. All variables are defined in terms of annual rates of changes in percent. For our analysis, we simulate a one-standard deviation shock. The size of the shock in percent can be found in the first column of table 2.

We analyze price pressures in three sectors: goods, energy and food. For price pressures in the *goods sector,* we employ a freight cost shock (change in the Baltic Dry Index as a composite proxy for upstream supply cost pressures) and a shock to consumer goods producer prices (PPI as a proxy for intermediate prices). As far as the *energy sector* is concerned, we model oil and gas price shocks and again an energy producer price shock. Lastly, for the *food sector,* we model a wheat price shock, an overall food commodity price shock and again a shock to food and beverages producer prices. We run these models twice, to estimate the effect on the *respective HICP components* (consumer prices of nonenergy industrial goods, energy and food and beverages including alcohol and tobacco) and on the *headline inflation* (HICP). The BVAR models are specified with 12 lags and use monthly data spanning from December 2001 to February 2020, intentionally excluding the

Figure 1

Simple schematic depiction of sectoral prices along the supply chain

Goods sector	
Freight costs	Baltic Dry Index
Producer prices for consumer goods	PPI
Consumer prices for goods	HICP
Headline inflation	HICP
Energy sector	
Crude oil price	Brent in USD
Natural gas price	S&P GSCI commodity index
Producer prices for energy goods	PPI
Consumer prices for energy	HICP
Headline inflation	HICP
Food sector	
Food commodity prices	HWWI commodity index
Wheat price	S&P GSCI commodity index
Producer prices for food, beverages	PPI
Consumer prices for food, beverages	HICP
Headline inflation	HICP

Source: Authors' compilation.

pandemic period with its pronounced volatility in almost all aggregate variables.[3] A formal representation of the model we use can be found in the appendix.

While the Bayesian approach proves useful in macroeconomic applications where data are usually scarce, the prior choice may be a crucial issue. However, by using the hierarchical approach proposed by Giannone et al. (2015), we opt for a data-based elicitation of our priors. As laid out in Kuschnig and Vashold (2021), who implemented this flexible approach in a convenient R routine, the subjectivity of prior choices and the associated uncertainty is thus alleviated. We identify the shocks through sign restrictions following Uhlig (2005); our specific restrictions can be found in table 1. In this table, + (–) indicates a positive (negative) on-impact reaction of a certain variable to the specific shock, while a blank cell refers to no a priori impact restriction.

Along the lines of Smets et al. (2018), as discussed in section 1 and indicated in the first column of table 1, we assume that all (positive) cost and price shocks will (eventually) push up HICP headline inflation. Apart from differences in price stickiness across sectors, the weights with which the sectoral price indices feed into the headline HICP may also impact the extent to which sectoral shocks determine headline inflation. After services (2022 weight: 42%), goods have the largest weight in the euro area HICP (26%), followed by food (21%) and energy (11%).

As indicated in the subsequent columns in table 1, we assume that (positive) sectoral price shocks result in increases in sectoral inflation. In other words, we assume freight cost, commodity, and PPI price shocks to directly impact the specific sectoral components of HICP inflation. A shock to freight costs and goods PPI prices will thus directly impact consumer goods prices (column 2). Likewise,

Table 1

Sign restrictions in BVAR

	Shock on					
	Variables					
	HICP headline	HICP goods	HICP energy	HICP food	HICP services	Industrial production
Shock of	*Annual rate of change*					
Baltic Dry Index	+	+	+	+		–
Consumer goods PPI	+	+				–
Brent crude price (USD)	+		+		+	–
Natural gas price index	+		+		+	–
Energy PPI	+		+			–
Food raw material price index	+			+		–
Wheat price index	+			+		–
Food and beverages PPI	+			+		–

Source: Authors' compilation.

Note: A (+) indicates a positive reaction on impact of the respective variable in the system, while (-) corresponds to a negative reaction. Blank cells () denote no a priori restriction. The restrictions are imposed for one month.

[3] *This is a common procedure when dealing with the extraordinary dynamics during the COVID-19 pandemic as shown in Lenza and Primiceri (2022). However, to ensure robustness, we reestimated the models for the full sample, ranging from December 2001 to December 2021. The results are qualitatively very similar but exhibit a larger uncertainty due to the pronounced volatility. To conserve space, the results are available from the authors upon request.*

a shock to energy PPI contemporaneously positively impacts HICP energy prices (column 3). The same logic also applies to an unexpected increase in food commodity prices that results in a direct increase in HICP food prices (column 4). The latter has been shown, inter alia, in Baumeister et al. (2014), who find evidence for effects of food commodity price shocks on retail food prices. However, the effects are apparently more prevailing in developing countries. Likewise, Peersman et al. (2021) document an increasing impact of oil prices on food commodity prices since the 2000s. In addition, they also find a reverse relationship between a shortfall of global food commodities and oil prices.

Furthermore, our restrictions assume that freight costs and energy price shocks also affect other components of HICP inflation, as discussed in Kilian (2008). Unexpected freight cost increases are also expected to impact food and energy HICP prices (columns 3 and 4) but not services, while energy price increases are assumed to affect only services and energy prices but not goods or food prices. This is motivated by findings of Baumeister et al. (2014), who document no link between oil prices and increases in food processing costs or food retail prices in the USA. Finally, as shown in the last column of table 1, all shocks are assumed to impact industrial production negatively, such that our shocks carry the notion of supply-side distortions in contrast to demand-specific shocks.

3 Results

In this section, we discuss the results of our empirical strategy and the simulation of a one-standard deviation shock according to table 1. We start with the direct effects on a sectoral level with inflation components and continue with a more aggregate view on headline inflation. Each chart in each panel depicts the dynamic evolution of the respective variable over 50 months after the shock as an impulse response function. After this period, almost all variables have returned to their mean. A numeric summary of our key results can be found in table 2. To conserve space, we only report selected impulse response functions and will provide the remaining results upon request.

3.1 Sectoral (direct) effects

In the left panel of chart 2, we show the shock responses, while the right panel shows the relevant component of the HICP, such as goods, energy and food.

As for the goods sector (chart 2, top panels), both the freight cost and PPI price shocks show a rather similar pattern (left panel), while the magnitude of the shock in percent is far more pronounced for the more volatile freight cost series (77% year on year) than for the PPI price series (0.6% year on year) as seen in table 2.[4] The reaction of consumer goods inflation to the shocks (right panel) is also similar, with goods price inflation increasing by 0.6 percentage points on impact of the freight cost shock and by slightly more, namely 0.9 percentage points to the PPI goods price shock. The comparably modest response can most likely be linked to final consumer goods consisting in different intermediate goods, which results in a very heterogenous supply chain structure that potentially offsets idiosyncratic

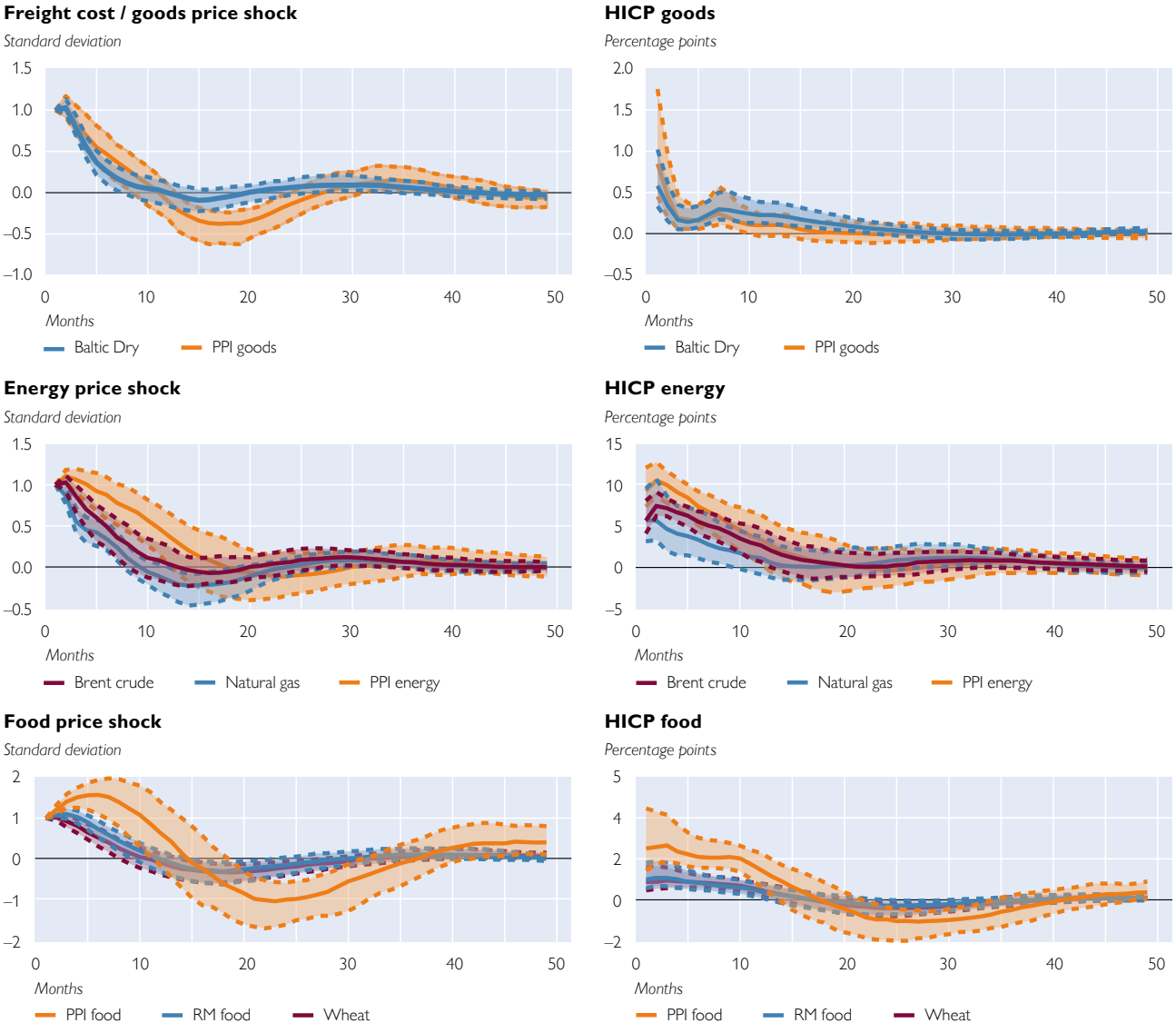
[4] *In general, disentangling a freight cost shock (based on the Baltic Dry Index) from an energy shock (based on the crude oil price) is not an easy task. Following the reviewer's suggestions, we thus re-estimated the effect of a freight cost shock with an augmented variable set that contains the crude oil price. By not imposing any restriction on it, we may infer the nature of the freight cost shock in the reaction of our oil price series. The results are qualitatively very similar to our main specification.*

distortions. Both series swiftly return to their mean, even though the impact of the supply cost shock remains significant twice as long as the PPI shock. As a result, the effect of the freight cost shock is rather long lasting and twice as large as the PPI shock in cumulative terms.

For energy price inflation (chart 2, middle panels), we observe that the shocks triggered by an oil and natural gas price change or shocks triggered by a PPI change reveal subtle differences (left panel). The direct impact on HICP energy price inflation is quite sizable (right panel). On impact, the energy price inflation jumps up by 5 to 9 percentage points. The impact of natural gas prices amounts to 5.4 percentage points (with sizable confidence intervals) and is the least persistent one

Chart 2

Impulse response functions of sectoral inflation



Source: Authors' compilation.

Note: The chart shows impulse response functions of the components of HICP inflation for several shocks in the goods, energy and food sectors. PPI refers to the relevant producer price index. The solid lines correspond to the posterior median of a one standard deviation shock, while the shaded areas refer to the 68% credible sets.

(around 11 months). Given its uncertainty, it might however not be significantly different from the other shocks. This uncertainty surrounding the estimates is most likely due to the nature of our gas price series, which is an index figure that reflects *global* production and the market performance of natural gas contracts (futures).[5] The European natural gas market is a rather local market, consisting of different suppliers and network access. In contrast to crude oil, which is traded globally and therefore has a global price, the price for natural gas in Europe is not determined by one market.[6] Furthermore, gas prices feed into the HICP energy prices less directly (e.g. via heating or electricity prices) than oil prices, for which there is an almost direct link via fuel prices. In addition, it is likely that there are national policies in place shielding consumer prices from direct wholesale price changes.[7] The black line in this panel also shows that the impact of the PPI shock is the largest one (8.5 percentage points) and feeds into HICP energy inflation almost one-to-one, indicating an almost perfect pass-through. The shock persists for about 13 months and hence for about the same period of time as the one for crude oil prices. Taken together, this suggests that changes in the PPI for energy products, such as refined energy products like fuels, feed almost directly and rather persistently into HICP inflation, which is in line with evidence presented by Blair et al. (2017). This leads to a substantial cumulative impact on HICP energy prices.

In the case of food, we similarly conclude from the bottom panels of chart 2 that commodity price changes have a considerably smaller impact on HICP food prices (only around 1 percentage point on impact, illustrated by the purple and blue lines) compared to intermediate producer prices (about 2.5 percentage points

Table 2

Summary of our results

Shock	One standard deviation	Variable	Effect on impact	Duration	Cumulative effect	Variable	Effect on impact	Duration	Cumulative effect
	%		*Percentage points*	*Months*	*Percentage points*		*Percentage points*	*Months*	*(in pp)*
Baltic Dry	76.7	HICP goods	0.6	23	4.5	Headline HICP	0.4	18	3.8
PPI goods	0.6		0.9	10	2.7		0.4	4	0.9
Natural gas	38.2	HICP energy	5.4	11	39.0		0.3	8	1.7
Brent crude	33.7		5.6	14	64.5		0.4	13	3.6
PPI energy	10.0		8.5	13	84.0		0.6	11	4.1
Raw materials food	15.8	HICP food	1.0	13	9.8		0.4	18	5.2
Wheat price	29.9		0.9	14	10.0		0.4	20	6.4
PPI food	2.7		2.5	14	27.9		1.1	19	16.5

Source: Authors' compilation.

Note: This table depicts the key results of our IRF analyses in section 3.1 and 3.2. The first column shows the shocks and column 2 the size of the one standard deviation shock in percent (annual rate of change). Column 3 refers to the HICP component affected by the shock, column 4 shows the effect (posterior median) on impact in percentage points, column 5 shows the duration until the shock turns insignificant (i.e. the lower standard interval crossing zero) in months. The last column shows the cumulative effect of the shock in percentage points over the duration specified in the previous column. The remainder of columns show the same for headline inflation instead of for individual HICP components.

[5] *The specific price series is the S&P GSCI Natural Gas Index. In addition, we checked for different series associated with natural gas, resulting in similar reactions of HICP energy prices.*

[6] *An overview of the important pipelines and storage facilities in Europe can be found via https://transparency.entsog.eu/#/map.*

[7] *Bruegel provides an overview and data of national policies limiting the impact of wholesale energy prices for consumers.*

on impact as shown by the black line). This might also be the result of the different origins of the shocks, with commodity prices being global variables whereas the PPI data are European. As suggested by Ferrucci et al. (2010), the Common Agricultural Policy (CAP) in the European Union may be responsible for the muted impact of food commodity prices on HICP food prices. Both effects level out after about a year.

Hence, these results indicate that the cost pass-through increases at later stages of the production process and is close to be one-to-one for changes in producer prices. This might be due to different market power or contract characteristics in earlier stages of the supply chain as indicated by Gaudin (2016) or Duso and Szücs (2017).[8]

3.2 Aggregate effects

Rerunning the estimations for headline inflation, which includes more volatile elements like energy and food, we observe a striking feature. As seen from chart 3, all sector-specific shocks significantly impact headline inflation in the euro area. However, the effect on headline inflation is substantially smaller compared to the direct sectoral impact. We conclude here that unexpected increases of energy prices, producer prices, food prices and transport cost are reflected only to a smaller extent in the aggregate measures. However, the aggregate nature of our analysis may mask sector-specific heterogeneities in line with Foerster et al. (2011). This includes sectoral differences in price adjustment, substitution effects and the effects of the weights that each component receives, potentially resulting in a less pronounced reaction of headline inflation or even different inflation regimes (see e.g. De Fiore et al. (2022) for a very recent discussion).

Interestingly, the initial impact of freight cost and PPI goods price increases on headline inflation (chart 3, top right panel) is rather muted at 0.4 percentage points despite the large weight attached to goods in the HICP. In line with Furceri et al. (2022), additional freight costs, however, may feed into aggregate HICP inflation rather persistently. Our analysis suggests that the effects may last for about one and a half years. During this period, the supply cost shocks could add almost 4 percentage points to headline inflation. Furceri et al. (2022) argue that import intensity determines the size of the impact of freight cost increases on HICP inflation and the monetary policy regime the duration of the impact.

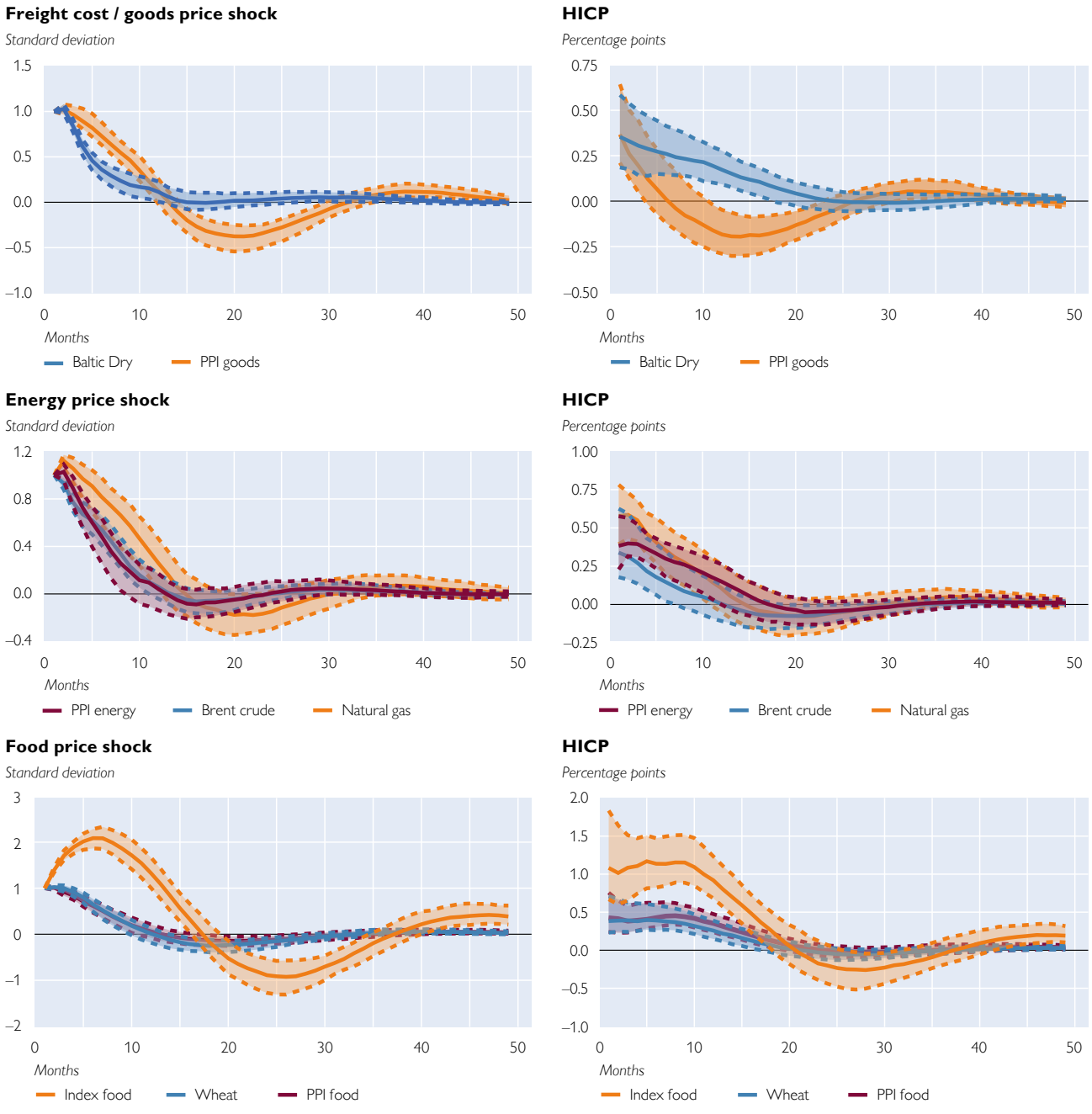
As for upstream and intermediate energy prices, we observe largely the same patterns as for the direct, sectoral responses. In terms of size, however, the reaction of headline inflation to energy prices, which receive a smaller weight in the HICP compared to goods or food items, remains low at 0.3 percentage points to 0.6 percentage points on impact, as can be seen in the middle right panel.

Lastly, food prices further downstream again seem to play a more prominent role for headline inflation (bottom, right panel) than those further up, accounting for 1.1 percentage points compared to 0.4 percentage points on impact. Sizable distortions in producer prices for food (including e.g. processed rather than unprocessed food) can thus lead to strong (cumulative) price increases in headline inflation (see also Ferrucci et al., 2010).

[8] *The Bureau of Labor Statistics provides a Handbook on how firms can deal with price adjustment (escalation) clauses in long-term sales and purchase contracts using the producer price index.*

Chart 3

Impulse response functions of headline inflation



Source: Authors' compilation.

Note: The chart shows impulse response functions of the components of HICP inflation for several shocks in the goods, energy and food sectors. PPI refers to the relevant producer price index. The solid lines correspond to the posterior median of a one standard deviation shock, while the shaded areas refer to the 68% credible sets.

4 Conclusions

In this article, we employed a small-scale model of the euro area's supply side to analyze the question of how a variety of price shocks affect the sectoral and aggregate evolution of price indices. For the euro area, our impulse response analysis shows that sectoral price pressures impact both sectoral and headline inflation. Moreover, the price pass-through appears to increase at later stages of the production process, being nearly immediate for changes in producer prices. Finally, energy prices have by far the most sizable direct effect on sectoral variables while food prices appear to be stronger determinants of headline inflation. In general, our results suggest that sectoral price developments can be indeed informative about headline inflation developments in the euro area. Thus, our analysis reveals the importance of idiosyncratic sector-specific shocks and suggests that a considerable amount of heterogeneity within the sectors may have aggregate implications. However, due to the characteristics of the euro area, our approach may mask a nonnegligible degree of heterogeneity across the individual member countries. A more granular analysis might reveal country-specific price pass-throughs. However, as a detailed analysis would go beyond the scope of this article, we leave this analysis for further research.

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Appendix

Our BVAR consists of the following vectors of observed variables that are given by $y_t^1 = \left[P_{i,t}^{Upstream},\ P_t^{Good},\ P_t^{Energy},\ P_t^{Food},\ P_t^{Service},\ IP_t \right]'$ for the inflation components, and $y_t^2 = \left[P_{i,t}^{Upstream},\ P_t^{Headline},\ IP_t \right]'$, for the headline inflation with $i \in \{Freight,\ PPI^G,\ Oil,\ Gas,\ PPI^E,\ ComFood,\ Wheat,\ PPI^F\}$, all defined as annual rate of change in percent. Thus, our vector autoregressive model reads

$$y_t^j = \sum_{p=1}^{12} A_p y_{t-p} + \epsilon_t,$$

where $j \in \{1,2\}$, A_p is a coefficient matrix associated with lag p and the error term $\epsilon_t \sim N(0, \Sigma)$ with variance-covariance matrix Σ.

What is the effect of energy prices on consumer prices in Austria? A production-side decomposition

Martin Schneider[1]
Refereed by: Bettina Landau, ECB

We analyze the role of energy in consumer price developments in Austria using a production-side decomposition based on input-output tables. The overall share of energy in total private consumption expenditure amounted to 7.7% in 2018 and from then more than doubled to reach 17.7% in November 2022. In 2018, the share of energy was substantial in spending on housing (29%) and transport (26%), while it was almost negligible (1.0%) in spending on other consumer goods. In addition, we estimated the impact of the increase in energy wholesale prices between January 2021 and November 2022 on consumer prices. Under the assumption of a full absolute pass-through of energy prices, our input-output approach suggests a contribution of energy prices to headline inflation of 14.5 percentage points, which is considerably higher than the contribution of the HICP energy component in this period (6.2%). The remaining 8.3 percentage points can be seen as "inflation backlog," which is due to the delayed adjustment of consumer prices for electricity, gas and district heating to wholesale energy prices. The degree to which this backlog will materialize and the adjustment path mainly depend on the future path of wholesale prices and the lag with which price changes feed through to end-user contracts and are therefore subject to considerable uncertainty. The Austrian government has implemented a cap on electricity prices ("Strompreisbremse"), which will reduce inflation by 0.9 percentage points in 2023. In 2024, the abolishment of the cap will increase inflation by 0.3 percentage points.

JEL classification: C6, E31
Keywords: inflation pass-through, inflation backlog, input-output model

Global energy prices have increased at an unprecedented pace for the past two years after having experienced a continuous downward trend over the past decade. A bundle of factors has contributed to this surge since the onset of the COVID-19 pandemic. Besides the post-COVID-19 recovery in combination with supply-side problems, the war in Ukraine and the particularities of the electricity market are the most important drivers.

As a result, Austria has seen a sharp rise in consumer price inflation. In November 2022, inflation as measured by the Harmonized Index of Producer Prices (HICP) reached 11.2%, a level even surpassing the peak during the first oil crisis in June 1974 (consumer price index (CPI): +10.4 %). Between January 2021 and November 2022, consumer prices in Austria increased by 15.8%. Disaggregated HICP data for Austria show that less than half (6.2 percentage points) of the increase since January 2021 is attributable to the energy component of the HICP, which includes household energy (electricity, gas, district heating) and fuels and lubricants for personal transport. Due to the structure of end-user contracts for

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electricity, gas and district heating, where prices are often fixed for one year in advance, it seems likely that there are price pressures in the pipeline which have not materialized yet. Another reason why HICP energy inflation understates the role of energy is that the production of other goods and services needs energy.

In this paper, we address the following questions: Firstly, what is the role of energy prices in consumer price growth beyond the HICP energy component, i.e. are there indirect effects via the production of goods and services consumed by households? Secondly, how strong has been the pass-through of energy prices to consumer price inflation so far? Thirdly, in case of an incomplete pass-through, how big is the inflation backlog that may materialize later? We use a cost-side approach based on input-output tables which we supplement with disaggregated data on energy consumption per industry. This enables us to calculate the energy content of each consumer good category and the impact of energy price increases on consumer prices. In addition, we can estimate the pass-through.

The paper is structured as follows: In section 1, we look into the role of energy in household consumption. In section 2, we present the input-output framework that we apply to decompose consumer prices and the results of this decomposition. Section 3 shows the decomposition of the consumer price increases since January 2021. Section 4 concludes.

1 Energy consumption of households in 2018

Energy consumed by households comes from several different sources. Oil is the most important source, accounting for 38% of total household energy consumption (measured in terajoule), followed by renewables (23%), electricity (17%) and natural gas (15%).

We have estimated household expenditure on energy based on the input-output table for Austria for 2018; at purchasing prices, this expenditure amounted to EUR

Table 1

Energy consumption of households in Austria (2018)

	Goods category		Terajoule	EUR billion				
	CPA	COICOP		Energy consumption at basic prices	Trade and transport margins	Indirect taxes less subsidies	Energy consumption at purchasing prices	% of total private consumption[3]
Total			**399,667**	**7.1**	**1.6**	**4.1**	**12.8**	**7.3**
Primary energy			301,181	3.7	1.6	3.0	8.3	4.8
Fossile energy sources			212,538	3.4	1.5	3.0	8.0	4.6
Mineral oil products	C19	04.53/07.22	152,682	2.6	1.5	2.8	6.9	3.9
Processed gas	D35	04.52	59,050	0.8	–	0.3	1.1	0.6
Coal	B05-07	04.549	805	0.0	0.0	0.0	0.0	0.0
Renewables[1]	A02[2]	04.5	88,643	0.3	0.1	0.0	0.4	0.2
Transformed energy			98,486	3.4	0.0	1.1	4.5	2.6
Electricity	D35	04.51	66,175	2.6	–	0.8	3.4	1.9
District heating	D35	04.550	32,311	0.9	–	0.3	1.1	0.6

Source: Statistics Austria, author's own calculations.

[1] Renewables include firewood (61%), pellets and wood briquettes (14%), ambient heat (8%), solar energy (5%), biodiesel (5%), wood waste (4%) and bioethanol (2%).
[2] Besides A02 (firewood, pellets and wood briquettes), some renewables are attributable to C19 (biodiesel, bioethanol) and D35 (ambient heat).
[3] Excluding imputed rents.

12.8 billion or 7.3% of private consumption (excluding imputed rents) in 2018.[2] This share is very close to the weight of energy in the HICP (7.7%). Expenditure on energy at basic prices amounted to EUR 7.1 billion. Additionally, trade and transport margins (EUR 1.6 billion) and indirect (product) taxes less subsidies (EUR 4.1 billion) were important cost components.

2 An input-output approach to decompose private consumption expenditure into their cost components

There are basically three different types of theories that explain the inflation process: monetary, demand and cost-based theories (Przyblinski and Gorzackynski, 2022). We use a cost-based input-output approach to determine the role of energy in consumer price developments where the consumer price for a good is given by the sum of the costs of the production inputs. From the perspective of a single firm, these cost components are purchases of intermediate goods and value added within the firm (compensation of employees, gross operating surplus, depreciation, indirect taxes less subsidies). Intermediate goods can be bought from other domestic firms or imported. Firms also demand intermediate inputs from other firms and from abroad, generating a network of interindustry linkages. Therefore, we must perform a multiplier analysis to decompose private consumption into its cost components (details can be found in the annex). This decomposition gives us the shares of energy (as the sum of energy imports, valued added and indirect taxes less subsidies of energy goods) and nonenergy goods and services (other imports, value added and indirect taxes less subsidies) at the level of 64 CPA consumer goods categories. Finally, we aggregate the results to the COICOP-45 classification. This allows us to match them with the components of the HICP.

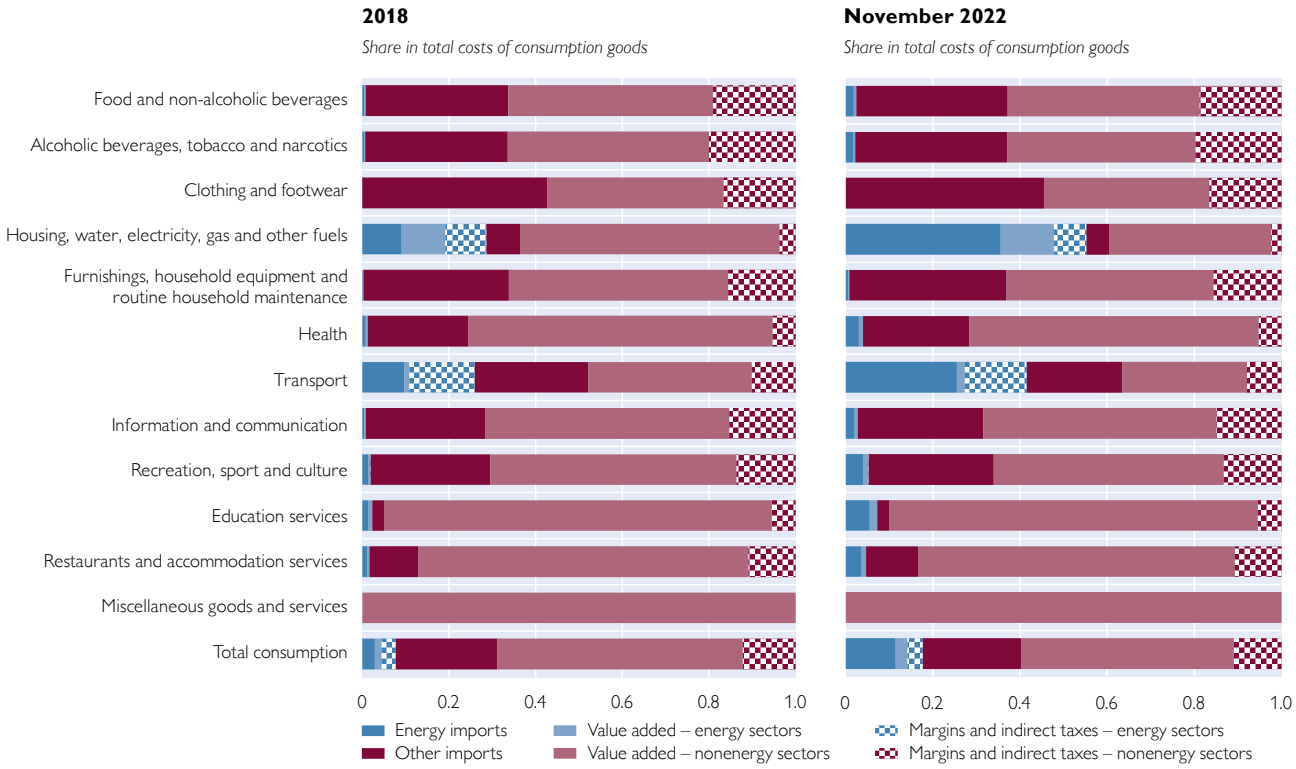
Compared to more common estimation approaches (see e.g. Baumeister and Kilian, 2014; Lopez et al., 2022), our approach has several advantages, including, most importantly, that it is not subject to structural breaks caused by the pandemic and the recent energy price hikes. Instead, we use disaggregated data on the cost structure of the production of consumer goods. The main drawbacks of our approach are that it does not capture dynamic relations and relies on a fixed production structure, i.e. there is no substitution due to changes in relative prices. In addition, we do not include second-round effects via income and employment. Although there are many examples of fully-fledged dynamic input-output models in the literature (see e.g. Kratena et al., 2017), we prefer our parsimonious approach for the sake of simplicity.

Chart 1 depicts the result of this decomposition for total private consumption and the 12 COICOP divisions for 2018 and November 2022. Energy consumption of households is concentrated in two goods categories: 04 (housing, water, electricity and other fuels) and 07 (transport). In housing, water, electricity and other fuels, energy accounted for 32.5% of total production costs in November 2022, in transport, the share amounted to 25.8%. In all other COICOP divisions, the share of energy in production costs was almost negligible at 1.0%. In aggregate private consumption, the share amounted to 7.7%. This is higher than the direct

[2] *We supplemented the input-output tables with data from the energy accounts and energy prices to break down consumption of goods B05–07 and D35 into energy sources.*

Chart 1

Cost structure of private consumption goods



Source: Statistics Austria, OeNB calculations.

share we derived from the input-output tables (7.3%; see table 1). The difference is attributable to the energy content of goods and services other than energy.

To derive the energy share in total costs for the latest available month (November 2022), we calculated the cost shares of the 64 CPA consumer good categories derived from the input-output table 2018 by updating the cost components with the evolution of the prices for production inputs. The cost share of energy more than doubled to 17.7% from 2018 to November 2022.[3] In housing, water, electricity, gas and other fuels, the share rose to 55%, and in transport to 42%. In all other COICOP divisions, the share of energy more than tripled to 3.2%. This is because gas and electricity (which showed larger price increases than petroleum products) are more important in the production of these goods and services than petroleum products.

3 A decomposition of consumer price increases since January 2021

In the next step, we calculated the effects of the increases in energy prices (as well as the prices of other production inputs) on consumer price inflation since January 2021.[4] Wholesale energy prices showed massive increases between January 2021

[3] *We did not consider seasonal variations in consumption patterns in our calculations.*

[4] *In a first step, we updated the cost shares of the 64 CPA consumer goods from 2018 to January 2021 with the prices for production inputs. We used these cost shares as the basis for a second update for the period until September 2022.*

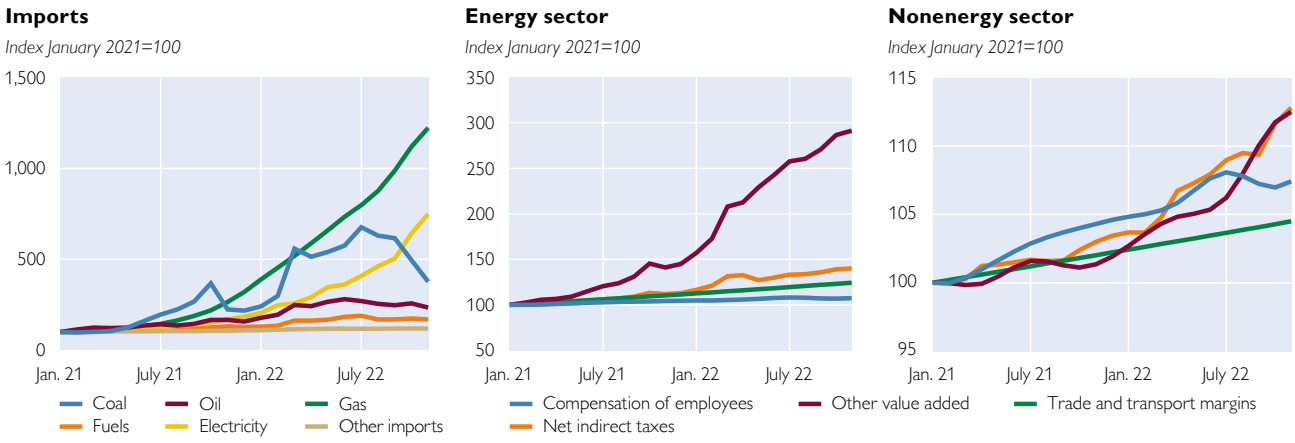
and November 2022 (gas: +1,124%, coal: +216%, electricity: +650%, oil: +96%).[5] As regards the growth of profits in the energy sector, we had to make our own assumptions. Based on the balance sheets of two major energy suppliers, OMV and Verbund,[6] we assumed that profits increased by 150% between January 2021 and November 2022. Wages in the energy sector were assumed to have increased in line with wages in the total economy (+7%) according to the national accounts. For nonenergy imports, we used the import deflator. The prices of nonenergy imports increased by 15% between January 2021 and November 2022, indicating continuing supply-side price pressures,[7] and the value added of nonenergy industries as well as trade and transport margins increased by 7%.[8]

For net indirect taxes, we considered the temporary reduction of both the electricity tax and the tax on natural gas from May 2022 to June 2023. Both tax rates were set to the minimum rate stipulated by EU law, which amounted to a temporary reduction in tax rates by about 90%. Furthermore, the ecological surcharge on electricity prices was set to zero in 2022. The introduction of the carbon tax was postponed from July 2022 to October 2022 (Prammer and Reiss, 2022).

Based on these assumptions about input price developments – and the assumptions of constant real shares – our model indicates an increase in consumer prices by 25.6% between January 2021 and November 2022 (solid blue line in chart 3), which is considerably more than the actual increase in the HICP (15.8%) in the same period (dashed line).

Chart 2

Price growth in production inputs



Source: E-Control, Statistics Austria, author's own assumptions.

[5] *For gas and electricity, we used the price indices issued by E-Control, which serve as a basis for the energy component of consumer prices in many contracts. For coal, we used the ICE Rotterdam coal index (USD), for oil the Brent oil price (USD).*

[6] *OMV's profit increased by 105% in the first half of 2022 relative to the first half of 2021. For Verbund, the increase amounted to +152%. https://www.derstandard.at/story/2000137852348/gas-und-oelpreise-treiben-gewinne-der-energiekonzerne-hoch.*

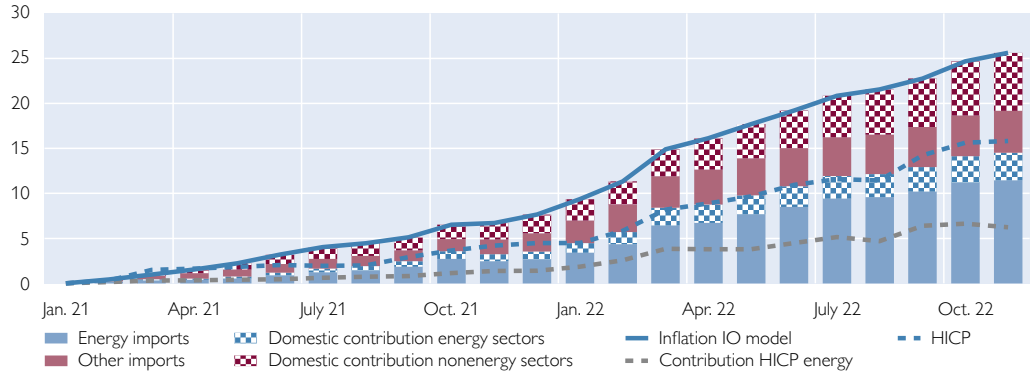
[7] *Note that nonenergy goods and services also include energy as input in their production process. We did not perform a decomposition of import prices since our analysis focuses on Austria.*

[8] *Since national accounts data are available at a quarterly frequency only, we used a cubic spline to interpolate quarterly to monthly series.*

Chart 3

Contributions to HICP inflation since January 2021 according to the input-output model

Percentage points



Source: Statistics Austria, OeNB calculations.

The difference of 8.3 percentage points between the contribution of energy inflation according to our input-output model (14.5 percentage points) and the HICP energy component (6.2 percentage points) can be interpreted as "inflation backlog." In relative terms, only 43% of the increases in wholesale prices was passed through to consumer prices of energy.[9]

The prices of nonenergy goods and services contributed 9.6 percentage points to HICP inflation between January 2021 and November 2022. This is slightly below the contribution calculated using our input-output approach (11.1 percentage points), which indicates that firms did not raise their prices more than input price developments would have suggested.

4 Summary and discussion of the results

In this paper, we analyze the role of energy in consumer price developments in Austria using a production-side decomposition based on input-output tables. We decomposed consumer prices for 2018 and found that the overall impact of energy prices on inflation (7.7%) was higher than the share of direct energy consumption (7.3%). The difference of 0.4 percentage points represents energy contained in the production of nonenergy goods and services. By November 2022, the share of energy in the overall HICP had increased to 17.7%.

In addition, we estimated the impact of the increase in energy prices (and the prices of other production inputs) between January 2021 and November 2022 on consumer prices. We found that only 43% of the cost increases in the energy sector were passed through to consumer prices, implying a substantial inflation backlog of 8.3 percentage points. This is attributable to the fact that price increases in household energy (gas, electricity, district heating) come with a long delay due to the structure of consumer contracts.[10] Although household prices for new

[9] *Note that prices for fuels, which amounted to 42% of households' total energy expenditure in 2022, are passed through without delay. This implies that the pass-through for electricity, gas and district heating is much lower.*

[10] *Typical delays amount to 15 to 18 months for electricity and 12 to 18 months for gas.*

customers were significantly higher, prices for existing customers[11] went up only modestly because in most contracts, prices are fixed for one year.[12]

There are two reasons why we can expect the inflation backlog to materialize only partially. First, wholesale energy prices started to decline in August 2022.[13] Futures for most wholesale prices are trending down, indicating lower prices in the next months. Second, policy measures such as the electricity cap ("Strompreisbremse"), which came into force in Austria in December 2022, will limit consumer price increases. The electricity cap is estimated to reduce inflation by 0.1 and 0.9 percentage points in 2022 and 2023, respectively (Fritzer et al., 2022); in 2024, the abolishment of the cap will increase inflation by 0.3 percentage points.

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Annex: formal representation of the decomposition

We start by decomposing private consumption at purchasers' prices $C_{i,t}^{PP}$ *(i=1..., 64)* into its components for each of the 64 CPA goods categories. Since input-output tables are valued at basic prices, our first step is to decompose $C_{i,t}^{PP}$ into trade and transport margins and indirect taxes less subsidies on products $TTMT_{i,t}$, and private consumption at basic prices ($C_{i,t}^{BP}$).

$$C_{i,t}^{PP} = TTMT_{i,t} + C_{i,t}^{BP} \quad (1)$$

[11] *A list of price changes for existing customers can be found on E-Control's website (https://www.e-control.at/konsumenten/aktuelle-preisaenderungen)*

[12] *Among Austria's large electricity providers, only Wien Energie (September 1, 2022: +144%) and EVN (Sepember 1, 2022: +140%) have recently increased their prices for existing costumers (as of December 2022). According to E-Control, the average electricity price for households increased from 21.4 cent/kwH in the first half of 2021 to 22.2 cent/kwH in the first half of 2022. For gas, only two of the regional providers (Carinthia, Tyrol) increased their prices until December 2022.*

[13] *Due to the construction of these indices, both indices exhibit strong smoothing.*

A part of private consumption at basic prices ($C_{i,t}^{BP}$) is imported directly from abroad. Deducting direct imports $MD_{i,t}$ of consumption goods gives us domestically produced private consumption at basic prices ($C_{i,t}^{BPD}$).

$$C_{i,t}^{BP} = C_{i,t}^{BPD} + MD_{i,t} \quad 2)$$

Combining (1) and (2) gives us the following decomposition

$$C_{i,t}^{PP} = TTMT_{i,t} + MD_{i,t} + C_{i,t}^{BPD}. \quad (3)$$

To produce one unit of good $C_{i,t}^{BPD}$, the following inputs are needed: intermediate inputs from other domestic industries, imports (energy and other imports) used in the production and domestic value added (wages and other value added). The use of intermediate inputs by industry i generates output in other industries of the economy. These industries also demand intermediate inputs from other industries and from abroad, generating a network of interindustry linkages. Therefore, we must perform a multiplier analysis to calculate the economy-wide value added and indirect imports generated by $C_{i,t}^{BPD}$.[14] Using the multipliers $m_{i,t}^{*}$, we calculate domestic value added for the energy sector ($VAE_{i,t}$) and the nonenergy sector ($VANE_{i,t}$) and indirect imports for the energy sector ($MIE_{i,t}$) and the nonenergy sector ($MINE_{i,t}$) generated by consumer demand for good i by multiplying the vector of private consumption by the respective multiplier.[15]

$$VAE_{i,t} = C_{i,t}^{BPD} \cdot m_{i,t}^{VAE} \quad (4)$$

$$VANE_{i,t} = C_{i,t}^{BPD} \cdot m_{i,t}^{VANE} \quad (5)$$

$$MIE_{i,t} = C_{i,t}^{BPD} \cdot m_{i,t}^{MIE} \quad (6)$$

$$MINE_{i,t} = C_{i,t}^{BPD} \cdot m_{i,t}^{MINE} \quad (7)$$

Equation (8) gives us the decomposition of the domestically produced consumption good $C_{i,t}^{BPD}$ into value added for the energy and the nonenergy sector and indirect energy and nonenergy imports.

$$C_{i,t}^{BPD} = VAE_{i,t} + VANE_{i,t} + MIE_{i,t} + MINE_{i,t} \quad (8)$$

Plugging (2) and (8) into (1) gives us (9):

$$C_{i,t}^{PP} = TTMT_{i,t} + MD_{i,t} + VAE_{i,t} + VANE_{i,t} + MIE_{i,t} + MINE_{i,t} \quad (9)$$

[14] *A multiplier m gives the components of value added and imports generated in the whole economy for one unit of final demand. It can be derived as follows: Total demand q is the sum of intermediate demand Aq plus final demand f (q=Aq+f) where A is the matrix of input coefficients of intermediate demand. Solving this matrix equation for q gives us* $q=(I-A)^{-1}f$, *where q is the amount of output of each industry induced by final demand f. We can obtain the multiplier* $m_{i,t}^{*}$ *for each good i by solving this equation for one unit of final demand for this good and by multiplying q with the share of the respective value added (import) component in output per industry.*

[15] *Please note that these four quantities refer to the economy-wide aggregates.*

Finally, we split margins and net indirect taxes and direct imports between energy ($TTMTE_{i,t}$) and nonenergy sectors ($TTMTNE_{i,t}$) and sum up direct and indirect imports. This gives us our final decomposition

$$C_{i,t}^{PP} = TTMTE_{i,t} + TTMTNE_{i,t} + VAE_{i,t} + VANE_{i,t} + MIE_{i,t} + MINE_{i,t} \quad (10)$$

Total energy costs for households are given as the sum of imported energy, value added of the energy sectors, trade and transport margins for energy and direct taxes less subsidies for the energy sector

$$E_{i,t} = TTMTE_{i,t} + VAE_{i,t} + ME_{i,t} \quad (11)$$

Grocery price setting in times of high inflation: what webscraped data tell us

Christian Beer, Robert Ferstl, Bernhard Graf, Fabio Rumler[1]
Refereed by: Lukas Henkel, ECB

We complement the existing literature on price rigidity by calculating statistics on the frequency and size of retail price changes observed in Austria between January 2021 and August 2022, using data scraped from online shop websites. As inflation started going up in September 2021, we split our sample into two parts: January to August 2021 and September 2021 to August 2022. Moreover, we limit our analysis to grocery items, since online supermarkets are a comprehensive and reliable source of daily prices. Our preliminary findings suggest that prices changed significantly more often in the period from September 2021 onward, with about 2.6% of all food prices being adjusted on a given day when we include sale price changes (compared to 1.5% in the period before September 2021). When we exclude sale price changes, we arrive at a daily price change rate of 0.5% (versus 0.2% in the low-inflation period). This corresponds to an average price duration of 38 days including sale price changes (versus 67 days in the low-inflation period) and approximately 200 days excluding sale price changes (versus 500 days before September 2021). While the considerably higher frequency of price changes in the high-inflation period under review affected all product groups observed, the average size of price changes remained broadly stable over time. Hence, we conclude that the current high level of food price inflation is driven mainly by an increase in the frequency of price changes rather than by changes in size. This might indicate that, in the face of a large shock, the frequency of price changes is no longer constant over time – as found in previous periods – but varies with the state of the economy. In other words, it would follow that time-dependent price setting has been replaced by state-dependent price setting.

JEL classification: E31, C82, D22
Keywords: price setting, price rigidity, webscraping, online prices, inflation

Inflation is ultimately the outcome of individual firms resetting thousands of prices. It is a well-established fact that at the micro level prices tend to be rather sticky, meaning that they do not instantly adjust to changes in costs and other disturbances to the economy. The degree of price stickiness is a major determinant of how macroeconomic shocks affect the economy. In particular, together with nominal wage rigidities, the degree of price rigidities determines the speed and extent of the transmission of monetary policy to the real economy.

Knowledge about individual price setting improves our understanding of the inflation process at large. The literature on price rigidity draws mainly on micro price data obtained from consumer price index (CPI) statistics in various countries (see e.g. Nakamura and Steinsson, 2008, for the US; Gautier et al., 2022, for the euro area; and Rumler et al., 2011, for Austria). These papers typically find that overall prices adjust on average every 9 to 12 months and by an amount of approximately 10%. However, there is a great deal of heterogeneity in the price adjustment frequencies across sectors, with prices of fresh food and some energy items (such as fuels) adjusting most often and prices of some (regulated) services adjusting

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only very infrequently. Especially for products with frequent price adjustments, CPI-based statistics come with the drawback that they are based on monthly data by definition. With the rise in e-commerce and the availability of website scraper software for downloading large amounts of data from the internet, the availability of high-frequency micro price data has increased vastly in recent years. Webscraped data can be used to do high-frequency analyses of price trends as e.g. in The Billion Prices Project[2] or to nowcast inflation developments (see e.g. Macias et al., 2022).

Another limitation of the existing literature on price rigidity is that – with very few exceptions (e.g. Henkel et al., 2022) – it covers only the low-inflation period before the second half of 2021. Since summer 2021, however, the inflation process has changed dramatically in most countries, with the potential of altering the ingrained price-setting behavior of firms. After all, rising inflation may be the result of prices changing more often or more significantly, or both. Webscraped data can provide timely information on whether and how corporate price setting may have changed in the current environment.

In this paper we complement the existing literature on price rigidity using data scraped from Austrian online shop websites between January 2021 and August 2022. Specifically, we calculate statistics on the frequency and size of price changes, based on thousands of online prices observed at a daily frequency. To compare the period before the inflation surge with the ensuing high-inflation period, we split the sample into two parts: January to August 2021 and September 2021 to August 2022. As comprehensive and reliable daily price data are available in our dataset mainly from online supermarkets, we limit our analysis to grocery items. The resulting statistics on the frequency and size of price changes are measured on a daily basis and have to be interpreted as such.

This paper is structured as follows: In section 1 we describe the data and methodology used in our analysis. Section 2 presents the empirical results and discusses the implications for price rigidity and the inflation process. Section 3 concludes and draws some policy conclusions.

1 Data and empirical approach

In April 2020, the OeNB started collecting product prices and related information (product name, store-specific product categorization, information on whether a price involves discounts, etc.) as provided by online stores of several Austrian retail chains on a daily basis. Although data are available for a variety of different product groups and store types, in this contribution we focus on groceries. We analyze three COICOP[3] 3-digit categories: food (C011), nonalcoholic beverages (C012)

[2] *The Billion Prices Project was an initiative at the MIT and Harvard using prices collected from hundreds of online retailers around the world on a daily basis to conduct research in macro and international economics. For more information see: http://www.thebillionpricesproject.com.*

[3] *COICOP stands for Classification of Individual Consumption by Purpose. It is a classification developed by the United Nations Statistics Division to categorize consumption expenditures and is used for the computation of the Harmonised Index of Consumer Prices (HICP). For the webscraped data, the individual products are first classified into the finest COICOP category level (elementary indices). For instance, food (C011) is composed of 118 elementary indices (e.g. chicken filet). This classification is accomplished with the help of regular expressions on the product names and shop-specific product categories. Thus, only products that are covered in the COICOP classification enter the analysis. Subsequently, the products are assigned to the higher-level COICOP categories, using the information on the structure of COICOP aggregates and country-specific weights for index compilation as provided by Statistics Austria (2021, 2022).*

and alcoholic beverages (C021). As a fourth category, we include an aggregate for unprocessed food items, consisting mainly of unprocessed meat, fish, eggs, fruits and vegetables.[4]

Table 1

Size of dataset

Category	Number of observations	Number of unique products
Food	3.747.502	9.414
Unprocessed food	423.652	1.438
Nonalcoholic beverages	875.146	2.064
Alcoholic beverages	741.101	1.960

Source: OeNB, authors' calculations.

Given that our dataset was still being built up in the course of 2020, we use data from January 1, 2021, to the end of August 2022 for our analysis. Data are downloaded from the online stores of four supermarkets of which two also have brick-and-mortar stores and two are online only.[5] Table 1 shows the number of price observations that enter the analysis.

To separately analyze and compare price setting in different inflation regimes, we divide our sample into two subperiods. A lower-inflation period until the end of August 2021, when HICP inflation averaged 2.3%, and the ensuing high-inflation period with average inflation amounting to 6.1%. In addition, we also present monthly averages of daily numbers. This allows us to smooth the strong fluctuations present in the daily data while retaining the higher information content of daily data.

There is an ongoing debate in the literature as to whether sale price changes (i.e. the markdown of prices for temporary sales promotions and discount sales) should be considered in the analysis of price rigidity. While the frequency of prices changes goes up, of course, when we include sale price changes, it is not clear whether such price flexibility matters from a monetary policy perspective. For example, Nakamura and Steinsson (2008) argue that sale price changes might at times be more attributable to company-specific circumstances and less so to the general macroeconomic situation. Kehoe and Midrigan (2015) argue that the responses to monetary policy from frequent changes of micro prices during sale periods are only short-lived and the relatively high stickiness of regular prices matters more from the monetary policy perspective. Whether to include sale price changes when calculating the frequency of price changes or not has important implications for economic modeling. Since our contribution is mostly descriptive, we present all statistics for both aggregates, including and excluding sale price changes. In our dataset, sale price changes are flagged as such whenever retailers indicate that a price involves discounts. Our inspection of the data suggests that such flags are a reliable indicator for the presence of sale items for the stores analyzed.[6]

Webscraped data exhibit some differences from other data sources that are used in the analysis of price rigidity (e.g. CPI microdata, scanner data): Data collection is limited to selected stores and restricted to certain store types. In the case of groceries, all webscraped data are retrieved from supermarkets. This could potentially affect our results if different store types show different price-setting behaviors. Yet, supermarkets have a high market share for grocery products, suggesting high representativity of their price-setting behavior for the price-setting process in the whole sector. Furthermore, webscraped data include all products of

[4] *For the exact definition see: Europa - RAMON - Classification Detail List.*

[5] *Due to confidentiality granted to the stores from which prices are scraped, the names of these shops are not disclosed here.*

[6] *Therefore, we do not apply a sale filter as e.g. proposed by Nakamura and Steinsson (2008).*

a certain store, not just a few selected ones (like HICP microdata). At the same time, webscraped data on discontinued products are not mapped to any replacement products a store may add. Therefore, we might miss implicit price changes that occur if products are replaced by similar ones. However, a big advantage of webscraped data is their high frequency and their quick availability and timeliness. Among other things, this allows for almost real-time monitoring of price developments.

The daily frequency of price changes is calculated as the ratio of the sum of observed price changes to the sum of potential price changes. The sum of potential price changes refers to all products for which prices are available on a given day and the preceding day and are thus, in theory, subject to change. To exclude sale price changes, we replace sale prices by the last regular price observed (i.e. the price on the day before the sale started) and recalculate all statistics from this modified price series.

In a first step, price changes and the frequencies are calculated at the level of elementary indices. At this stage, all products enter with the same weight. These frequencies are then aggregated to higher COICOP levels and eventually to the product groups analyzed in this article using the HICP weights provided by Statistics Austria (Statistics Austria, 2022, and equivalent information for 2021).

2 Results

2.1 The frequency of price changes increased markedly in the high-inflation period

Table 2

Frequency of price changes

	Including sale price changes	Excluding sale price changes
	%	
Food		
2021-01 – 2021-08	1.5	0.2
2021-09 – 2022-08	2.5	0.5
Unprocessed food		
2021-01 – 2021-08	3.7	0.4
2021-09 – 2022-08	4.8	0.5
Nonalcoholic beverages		
2021-01 – 2021-08	0.6	0.1
2021-09 – 2022-08	1.9	0.3
Alcoholic beverages		
2021-01 – 2021-08	0.7	0.2
2021-09 – 2022-08	2.8	0.3

Source: OeNB, authors' calculations.

Note: Average daily frequency.

Table 2 shows the average frequency of daily price changes for the selected time span, both including and excluding sale price changes.[7] For example, including sale price changes, 2.5% of the prices of all food items changed on a given day on average in the high-inflation period. Excluding sale price changes, the ratio drops to 0.5%. This would imply that, on average, food prices remain constant for about 38 days and even for 200 days when only nonsale price changes are considered.[8] For all product categories, the frequency of price changes is considerably higher in the second (high-inflation) period compared to the first (low-inflation) period. This already indicates that rising inflation was accompanied by a rise in the frequency of

[7] *Our data also include information on quantity discounts. We do not consider quantity discounts to be general discounts, as they only benefit consumers who purchase at least a certain quantity of a product. Therefore, we do not take them into account when calculating the statistics presented in this study.*

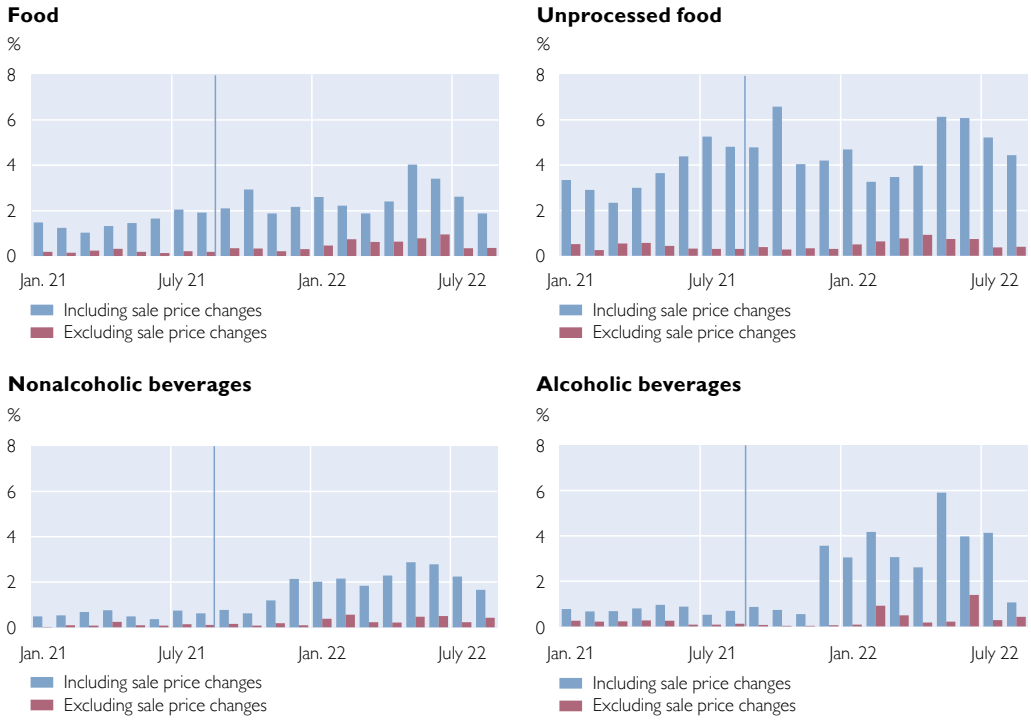
[8] *We convert the average frequency of prices changes (F) into an average duration of price spells (D) with the simple formula D=1/F.*

price changes. By and large, the numbers including and excluding sale price changes show the same pattern, but at different scales. For food, the frequency of price changes more than doubled from the first to the second period when sale price changes are excluded, while the difference was less pronounced when sale price changes are included. In contrast, beverages and in particular alcoholic beverages actually exhibited a rising frequency of price changes when sale price changes are included. Thus, before the inflation surge, prices of food items were altered more often than those of beverages. This pattern obviously changed in the high-inflation period when the frequencies of price adjustments of food and beverages became more aligned.

Chart 1 shows the monthly averages of daily price changes from January 2021 to August 2022. We see that the high-inflation period exhibits considerably higher frequencies both including and excluding sale price changes, as was evident from table 2. But the chart also visualizes variations within the low- and high-inflation periods and similarities and differences across product groups. For instance, the frequency of price changes (including sale price changes) peaked in May 2022 in all product groups except nonalcoholic beverages, before starting to decline again. Or, the increase in the price change frequency of beverages was more abrupt and started later than that for food.

Chart 1

Frequency of price changes



Source: OeNB, authors' calculations.

Note: The vertical line separates the low- and high-inflation periods.

Table 3

Frequency of price increases and decreases

	Frequency of increases or decreases				Share of increases	
	Including sale price changes		Excluding sale price changes		Including sale price changes	Excluding sale price changes
	Increases	Decreases	Increases	Decreases		
	%					
Food						
2021-01 – 2021-08	0.7	0.8	0.1	0.1	47.5	51.9
2021-09 – 2022-08	1.3	1.2	0.4	0.1	55.4	86.5
Unprocessed food						
2021-01 – 2021-08	1.8	2.0	0.2	0.2	47.0	58.1
2021-09 – 2022-08	2.3	2.5	0.4	0.1	48.3	73.0
Nonalcoholic beverages						
2021-01 – 2021-08	0.3	0.3	0.1	0.1	47.9	45.6
2021-09 – 2022-08	1.1	0.8	0.3	0.0	56.0	91.9
Alcoholic beverages						
2021-01 – 2021-08	0.4	0.3	0.1	0.1	51.9	68.5
2021-09 – 2022-08	1.5	1.3	0.3	0.1	53.0	84.6

Source: OeNB, authors' calculations.

Note: Average daily frequency.

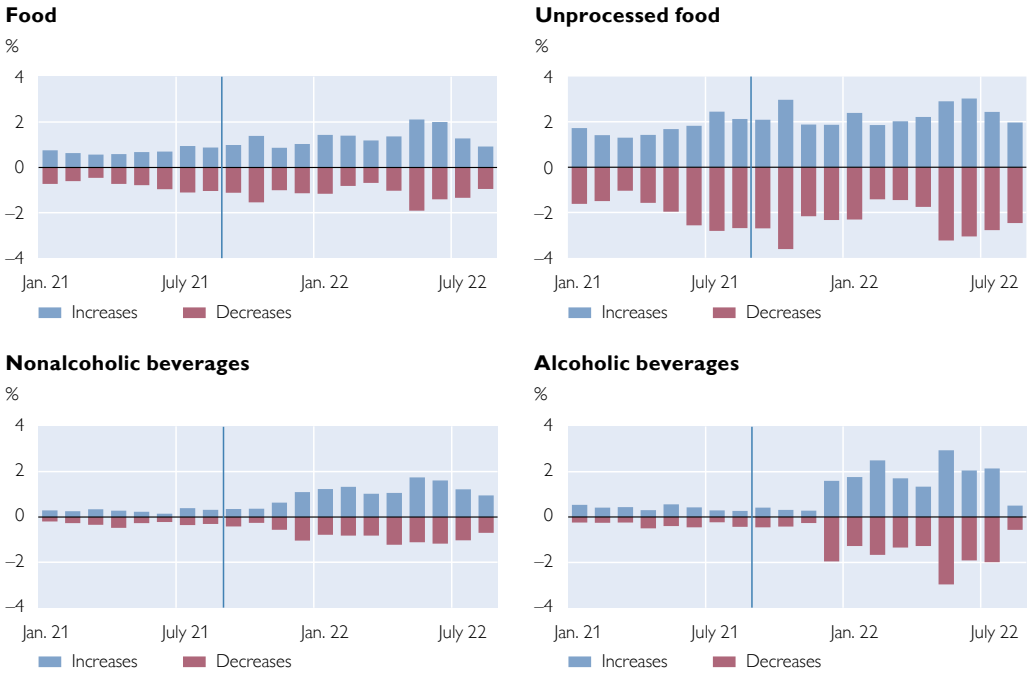
For the evolution of inflation, it is not only the frequency of overall price changes that matters but also the balance of price increases and decreases. After all, the overall frequency of price changes would remain constant if price increases are offset by price decreases. This is why table 3 provides separate breakdowns for the frequency of price increases and decreases. In the low-inflation period, the frequency of increases remained broadly balanced with the frequency of decreases. In other words, the share of price increases in all price changes is close to 50% (last two columns of table 3). This is also the case in the high-inflation period, but only if we include sale price changes. If we exclude sale price changes, the data exhibit a sharp increase in the frequency of increases in the high-inflation period, compared with a broadly stable decrease in the frequency of decreases (or even a drop for nonalcoholic beverages). As a consequence, the share of nonsale price increases is way above 50% in the high-inflation period.

Chart 2 shows the frequency of price increases and decreases including sale price changes, and chart 3 shows the corresponding data excluding sale price changes.[9] Like the overall frequency of price changes visualized in chart 1, the frequency of increases (including sale price changes) peaked in May or June 2022 and dropped thereafter for all categories, while remaining above the low-inflation period levels. The same pattern is visible when we exclude sale price changes: Especially for food, the frequency of both price increases and decreases declined considerably in the last two months, July and August 2022, but price increases continued to be substantial (except for alcoholic beverages in August 2022).

[9] *For graphical reasons, we put the statistics for decreases on the negative y-axis, although it is a positive number.*

Chart 2

Frequency of price increases and decreases including sale price changes

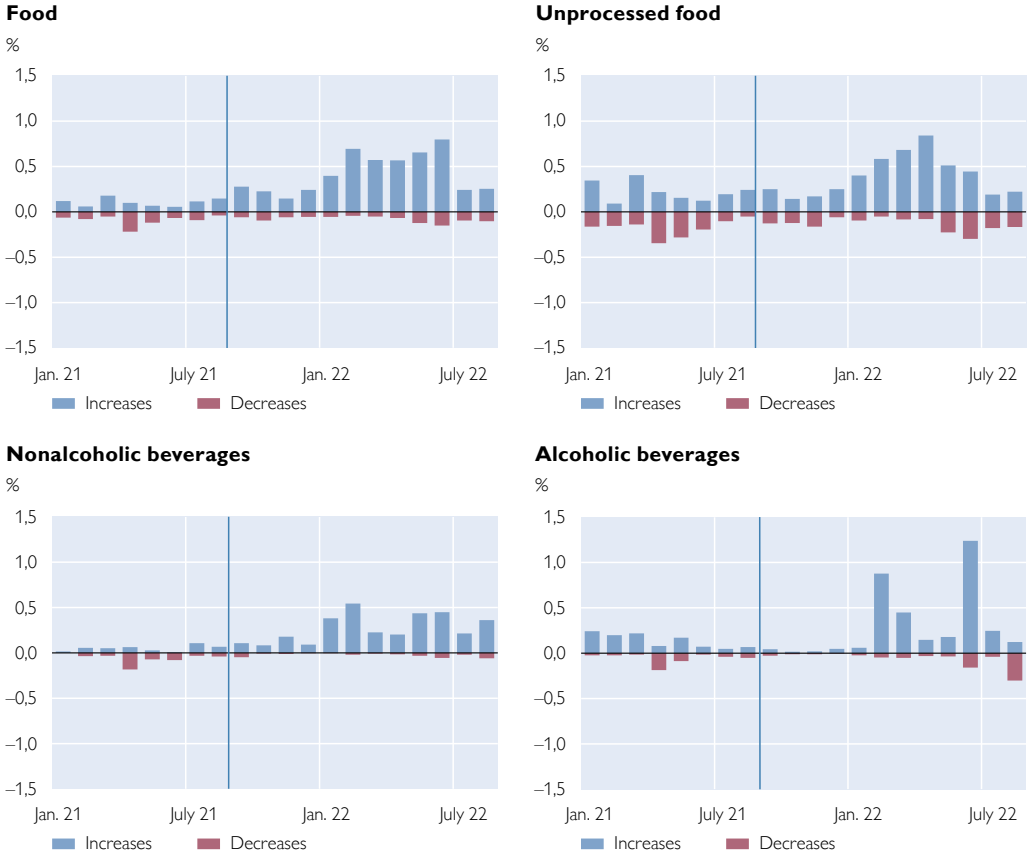


Source: OeNB, authors' calculations.

Note: The vertical line separates the low- and high-inflation periods.

Chart 3

Frequency of price increases and decreases excluding sale price changes



Source: OeNB, authors' calculations.

Note: The vertical line separates the low- and high-inflation periods.

2.2 Little variation in the size of price changes over time

Apart from the frequency of price changes, inflation is also driven by the size of price changes. Judging from menu cost models of price adjustment, we would expect the magnitude of price changes to exceed a certain size given by the menu costs (see e.g. Golosov and Lucas, 2007). Table 4 shows the average size of daily price changes (in log changes compared to the previous day) conditional on a price change. Average price changes are relatively high, ranging from 20% to 30% when we include sale price changes and 10% to 15% when we exclude sale price changes. In other words, retail prices are adjusted relatively infrequently but if they do change, the price changes are relatively large, as suggested by menu cost models. This is broadly consistent with the findings in the literature based on monthly data, where Gautier et al. (2022) find a median price increase of 10% for unprocessed food in the euro area between 2011 and 2017 and a median decrease of 11% (both excluding sale price changes), compared to 9.6% (for increases) and 10.6% (for decreases) in the low-inflation period.

When we include sale price changes, the average size of price changes appears to be broadly symmetric between increases and decreases in both time periods. When we exclude sale price changes, this is no longer the case: price decreases are usually larger than price increases, in particular for beverages. However, we do not find a systematic increase or decrease in either the low-inflation or the high-inflation period. In the high-inflation period, the calculations yielded a lower median size of both price increases and decreases for food items but a somewhat higher median size of price increases for beverages.

Data including sale price changes reflect the typical size of sale price changes (20%, 25% and 30%) and the subsequent price increase after the end of the sale period. From chart 4 we conclude that the average size of price changes is relatively constant over time, without significant differences between the high-inflation and

Table 4

Size of price increases and decreases

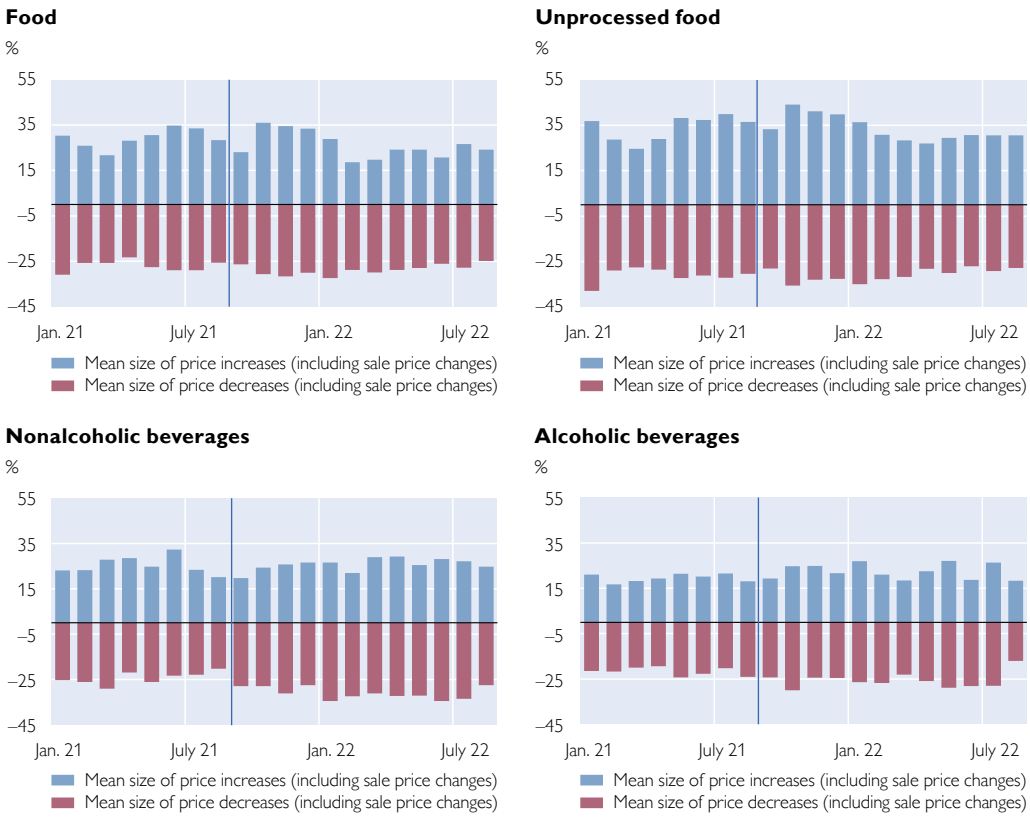
	Mean (including sale price changes)		Median (including sale price changes)		Mean (excluding sale price changes)		Median (excluding sale price changes)	
	Increases	Decreases	Increases	Decreases	Increases	Decreases	Increases	Decreases
	%							
Food								
2021-01 – 2021-08	29.7	27.2	28.6	28.5	11.8	13.4	9.6	10.6
2021-09 – 2022-08	25.7	28.9	22.8	28.8	9.1	13.1	7.3	8.5
Unprocessed food								
2021-01 – 2021-08	35.3	31.3	28.6	28.6	14.0	15.0	10.6	11.8
2021-09 – 2022-08	33.8	31.0	28.9	28.9	11.9	18.2	8.5	14.4
Nonalcoholic beverages								
2021-01 – 2021-08	24.9	24.2	22.4	22.4	8.9	12.1	4.6	9.5
2021-09 – 2022-08	26.0	31.2	28.5	28.8	8.4	13.5	6.9	7.4
Alcoholic beverages								
2021-01 – 2021-08	19.6	21.8	18.2	20.1	9.7	14.7	6.0	10.6
2021-09 – 2022-08	22.8	26.1	28.5	28.7	8.0	12.1	6.5	8.7

Source: OeNB, authors' calculations.

the low-inflation periods. This suggests that the recent inflation increase is driven by a higher frequency of price increases rather than an increase in the size of price changes. A similar result was found by Wulfsberg (2016), namely that in times of high and volatile inflation, the frequency of price changes is a bigger driver of inflation than the magnitude of price changes.

Chart 4

Size of price increases and decreases including sale price changes



Source: OeNB, authors' calculations.

Note: The vertical line separates the low- and high-inflation periods.

Chart 5

Size of price increases and decreases excluding sale price changes

Source: OeNB, authors' calculations.

Note: The vertical line separates the low- and high-inflation periods.

3 Conclusions

The degree of price rigidity in an economy is a major determinant of the speed and extent of the transmission of monetary policy to the real economy. Thus, the analysis of firms' price setting at the micro level has become a central field of macroeconomic and monetary research. So far, this research is primarily based on micro price data from official CPI statistics obtained from statistical institutes. Our addition to the literature is that we use webscraped data (micro price data from online stores) to analyze questions of price rigidity. This kind of data has advantages and disadvantages compared to CPI micro data, the biggest advantage being that the data are available at a higher frequency (in our case daily) than the official (monthly) data.

Based on daily data from online stores of major Austrian supermarket chains, we calculate price rigidity statistics for the period from January 1, 2021, to August 31, 2022. Due to the availability of reliable data that are already categorized into COICOP groups, we limit our analysis to grocery products. For food products, we find that on average about 2% of all prices are changed per day. This implies that, on average, food product prices remain constant for about 50 days. At around 1.5%, the frequency of price adjustments is somewhat lower for (nonalcoholic and alcoholic) beverages. Most of these price changes are, however, attributable to sale price changes (i.e. the markdown of prices for temporary sales promotions and discount sales). When we exclude all sale-related price changes, the frequency of

food price adjustments drops to 0.4%. In other words, we can attribute about 80% of all price changes to sale price changes. While part of the literature on price rigidity argues that sale price changes should be ignored or considered as mere noise in price-setting studies, given that sale prices are usually very short-lived and will be reversed after some time, other studies argue that sale price changes are an important element of price flexibility and should be included in the analysis of price rigidity. Depending on one's standpoint, one can draw very different conclusions on the degree of price rigidity that ultimately feeds into numerical models of the macroeconomy. Part of the large difference between the frequency with and without sale price changes is specific to our analysis based on daily data, given that in studies based on monthly CPI data, sale price changes account for only about one-third of all price changes of food products (see Gautier et al., 2022). This indicates that at a higher observation frequency, sale price changes become an even more important element of retail price setting.

The period under investigation in this study is characterized by a rapid increase in inflation to levels unprecedented in recent decades. However, the whole literature on price rigidity of the past 20 years emerged during a period of relatively low and stable inflation rates. Given the extent of the shift in inflation, it is conceivable that the price-setting process may have changed, putting into question the stylized facts established so far. To see how price setting before and after the inflation shock differs, we calculate all statistics separately for the period of comparatively moderate inflation until August 2021 and the ensuing high-inflation period since September 2021. We can clearly see that the frequency of price adjustments increased substantially in the high-inflation period – for all product groups, both including and excluding sale price changes. Differentiating between price increases and decreases, we furthermore see that the rise in the frequency of price adjustments was relatively stronger for price increases. This pattern is particularly pronounced when sale price changes are excluded. At the same time, the average size of price adjustments changed relatively little over time. This indicates that rising inflation was mainly the result of an increase in the frequency of price changes, in particular of price increases.[10] If this finding is confirmed in other studies, it would indeed change our understanding of the price-setting process, confirming the view that, in the face of large shocks, time-dependent price setting (implying a constant frequency over time) is replaced by state-dependent price setting, which allows the frequency of price changes to vary with the state of the economy (Alvarez et al., 2019).

What are the macroeconomic consequences of our descriptive evidence on changes in the frequency and size of price adjustments? As the degree of price flexibility is a key determinant of the slope of the Phillips curve, time variation in price flexibility, as found in this paper, may have consequences on the pass-through of macroeconomic shocks (Petrella et al., 2019). Specifically, when price flexibility rises, the slope of the Phillips curve gets steeper, making it possibly more difficult for monetary policy to stabilize inflation. Furthermore, there is a possible – but less well-established – link between changes in the frequency of price adjustments and the formation of individuals' inflation expectations and perceptions (D'Acunto et al., 2021). As agents are found to base their inflation expectations and perceptions

[10] *This is, however, only indicative as a numerical decomposition of inflation into the contribution of the frequency and size of price adjustments found in the literature using CPI data (e.g. Gautier et al., 2022; and Klenow and Krivtsov, 2008) is not directly possible with daily observations given that inflation is measured at a monthly frequency.*

primarily on prices of groceries, sudden changes in the frequency of grocery price adjustments can lead to shifts in inflation expectations of consumers and firms affecting their spending, investment, price- and wage-setting decisions. Lastly, the nature of price stickiness can also have important consequences for the welfare costs of inflation (Nakamura et al., 2018). According to the New Keynesian model, a strongly varying size of price adjustments entails large welfare costs of nonzero rates of inflation as it leads to inefficient price dispersion. When inflation is mostly driven by the frequency rather than the size of price changes, as found in Nakamura et al. (2018) and in this paper, the welfare costs of nonzero inflation are much smaller, and the optimal rate of inflation needs to be reassessed.

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Inflation expectations of Austrian households and firms amid high inflation

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Refereed by: Werner Hölzl, WIFO

Inflation expectations are a key indicator of monetary policy as they can be used to predict the future evolution of inflation and help central banks assess the credibility of their policies. Furthermore, according to economic theory, they determine the real interest rate, thus affecting agents' consumption and investment decisions. We analyze novel and existing survey data on Austrian firms' and households' inflation expectations to better understand the formation and the determinants of these expectations, especially in the current high-inflation environment. We find the following five stylized facts: We confirm (1) earlier evidence that households' and firms' inflation expectations are rather similar, and that there is less disagreement among firms than among households. Furthermore, (2) household and firm characteristics that likely influence inflation expectations, e.g. education and age of households and size of firms, point to varying degrees of how informed, rational and experienced respondents are. For firms, we provide evidence that (3) sectoral characteristics, i.e. the extent to which firms are exposed to energy price fluctuations and supply chain pressures, affect inflation expectations as well. Another finding is that (4) overall, firms' expectations of aggregate inflation are somewhat correlated with their own expected selling prices, but firm- or sector-specific factors and cost-related price developments may shape firms' price setting more. Lastly, differences between the current and previous survey waves show that (5) households may have become more rationally attentive during the high-inflation period, as indicated by a decrease in their subjective uncertainty about inflation expectations.

JEL classification: D15, D22, D84, E31, E52
Keywords: inflation expectations, expectation formation, firm survey, household survey

How do firms and households in Austria expect inflation to evolve in the current high-inflation environment and what drives their expectations? Is there any evidence that they form their expectations differently when inflation is high? Are expectations of firms and households similar, or are there structural differences driven by, e.g., different expectations about the general economic outlook or the (un-)certainty surrounding their forecasts? To answer these questions, this paper draws on the first results of the new question module in the Business Survey of the Austrian Institute of Economic Research (WIFO-Konjunkturtest, in the following WIFO-KT) on Austrian firms' inflation expectations from June 2022 and on the results of the OeNB Barometer survey on Austrian households' inflation expectations which was conducted at about the same time.

Inflation expectations are among the most important forward-looking economic indicators for monetary policy. The most common sources used for deriving such expectations are market-based measures, e.g. inflation compensation of market-traded assets, such as inflation-linked swaps, which are available at high frequency, and compilations of inflation forecasts made by professional forecasters

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or economists. Still, it is also worth looking at firms' and households' inflation expectations; their importance for monetary policy has been vastly discussed in the literature. Inflation expectations are key drivers of households' and firms' economic decisions. They affect perceived and expected real interest rates, which, in turn, affect consumption and investment decisions. Inflation expectations should remain stable around the inflation target in the longer term for real interest rates to remain close to their natural level. For this to happen, central banks need to monitor, steer and anchor expectations, e.g. through forward guidance, even though there is some evidence that in a low-inflation environment, monetary policy announcements likely do not affect expectations much (Coibion et al., 2020).

Plenty of evidence suggests that inflation expectations influence households' economic decisions, such as consumption and savings decisions (D'Acunto et al., 2018), whether or not and what kind of mortgage households take out (Malmendier and Nagel, 2015), or whether and how households participate in the stock market (Das et al., 2020). When it comes to how households form their expectations, several aspects have been found to be relevant: (1) What is the content of central bank communication targeting households and firms? For instance, is there a focus on policy targets and objectives rather than instruments (D'Acunto et al., 2020)? (2) What is the source of information, e.g. newspapers or central banks (Coibion et al., 2022a)? (3) Who is the sender of information, e.g. central banks or politicians? It has been found that even the sender's race can influence expectations (D'Acunto et al., 2021a). Furthermore, households are likely to base their inflation expectations predominantly on specific goods (energy, gasoline and food prices) or individual baskets (frequently purchased items; D'Acunto et al., 2021b), and there is also vast evidence for strong differences in expectations across socio-demographic characteristics of survey respondents, such as gender, household size, income, education, etc. (D'Acunto et al., 2021c; D'Acunto et al., 2022).

There is less, but increasing, evidence on firms' inflation expectations. Generally, firms' inflation expectations are found to be similar to households' expectations and to also affect economic decisions, e.g. on price setting and investment (Coibion et al., 2018; Weber et al., 2022, for the US; Coibion et al., 2020, for Italy). On the other hand, Coibion et al. (2022b) find that firms in France have less upward-biased inflation expectations than households and that expectations are less dispersed among firms than among households. Also, the more inflation levels rise, the more inflation expectations converge. Furthermore, inflation expectations of firms differ according to respondents' position in the firm, with CEOs or CFEs having lower inflation expectations than lower-level employees. Similarly, providing firms with additional information on inflation affects expectations and, ultimately, to some degree firms' economic performance (Coibion et al., 2020). Finally, there is evidence that inflation expectations are weakly correlated with wage expectations, whereas changes in inflation expectations do not affect wage expectations at all (Coibion et al., 2022b).

We use inflation expectations derived from novel WIFO-KT survey data on firms' inflation expectations and from data of the OeNB Barometer survey on households' inflation expectations. We aim at drawing a more complete picture of expectations in the current high-inflation environment in Austria. Based on the results obtained, we draw first conclusions on the formation of inflation expectations and economic decisions of firms. We also assess whether Austrian firms, mainly

small and medium-sized companies (SMEs), have expectations that are similar to those of households. Furthermore, we link inflation expectations to firm and household characteristics to see whether explanatory factors often cited in the literature also apply to our data. For firms, we are particularly interested in whether inflation expectations are linked to firms' expectations about their own selling prices, as this can ultimately affect firms' price setting (Coibion et al., 2020). For households, we compare the results of the latest survey wave to those of the previous wave and analyze whether households' uncertainty about their expectations has changed in the current high-inflation environment.

This paper is structured as follows: In section 1, we describe the data and the empirical strategy on which we based our analysis. Section 2 presents the results for firms' and households' inflation expectations and investigates the main determinants of these expectations, and section 3 draws some policy conclusions.

1 Survey data and empirical analysis

We analyze novel data on firms' inflation expectations from the WIFO-KT survey. In June 2022, the WIFO added a module to the survey asking firms about their qualitative inflation expectations ("the price level is going to increase, stay the same or fall") and quantitative inflation expectations (year-on-year rate of change in %) for the next 12 months and the next 3 to 5 years. The exact wording of the questions on firms' inflation expectations can be found in the annex to this study. For the analysis of households' inflation expectations, we use data from the long-standing biannual OeNB Barometer survey.[2]

The survey periods are Q2 2022 (specifically June 2022) for the WIFO-KT survey and H1 2022 (specifically June and July 2022) for the OeNB Barometer survey.[3] The results of a previous survey wave from H2 2021 for households were available for comparison. Therefore, both surveys are roughly comparable in terms of survey period. We analyze a representative sample of approximately 1,700 firms in the goods, construction, retail and services sectors and approximately 1,400 households located in all Austrian provinces. The qualitative and quantitative questions on short- and long-term inflation expectations are phrased almost identically in both surveys so that the answers are directly comparable.[4]

Given the novelty and timeliness of the data, our analysis at this stage is confined to descriptive statistics. We calculate mean and median short- and long-run inflation expectations overall and for different firm and household characteristics. The medians are interpolated according to the method of Cox (2019), which accounts for bunching of expectations at integer values and multiples of five. From interpolated quartiles, we also calculate the interquartile range (IQR), which is a measure of the distribution of the expectations.

[2] *Respondents of the WIFO-KT answer questions in an online questionnaire sent by e-mail. The main questions on the business outlook have been part of the survey for decades and are the basis for the Austrian contribution to the European Commission's business and consumer surveys. The OeNB Barometer survey is conducted through personal interviews (two-thirds of the sample) as well as online questionnaires (one-third).*

[3] *Normally, interviews for the first wave of the OeNB Barometer survey are conducted in May and June each year, but in 2022 the interviews dragged into July due to problems in the sampling.*

[4] *There is one small difference in the question design between the WIFO-KT and the OeNB Barometer surveys: the former asks participants for their expectations for the next 3 to 5 years, eliciting medium- to long-run inflation expectations, the latter asks households for expectations for the next 5 years.*

2 Results

In this section, we present descriptive results of the two surveys introduced above. The outlook for prices at the current juncture is rather grim. We find that households and firms expect inflation to be 8.7% and 8.2%, respectively, in 12 months' time (until Q2 2023) and to average 5.9% and 4.9% p.a., respectively, in the longer run (over the next 3 to 5 years; see first rows in tables 1 and 2), which is far from the Eurosystem's price stability objective. In the following, we first analyze and discuss firms' inflation expectations and their determinants, and subsequently those of households.

2.1 Firms' inflation expectations vary with firm characteristics

According to the recent literature, firms' inflation expectations are rather similar to those of households. As the typical Austrian firm is a small or medium-sized enterprise, respondents answering this survey are not necessarily highly educated managers who monitor economic developments regularly (and, ideally, have fully informed rational expectations; see Coibion et al., 2018); rather, respondents may be following the news less regularly, just like any member of a household. Indeed, in our sample, households and firms have remarkably similar inflation expectations, both in the short and longer run, with firms' inflation expectations being only slightly lower. However, the interquartile range of expectations, a measure for dispersion, is lower for firms (in absolute terms and also relative to the respective medians), both in the short and long run, confirming earlier evidence for France that there is less disagreement in inflation expectations among firms (see Coibion et al., 2022b).

Which household and firm characteristics drive the aggregate results? Tables 1 and 2 provide descriptive results on firms' and households' inflation expectations by different firm and household characteristics. Looking at table 1, we find evidence that firm size matters for firms' inflation expectations. Larger firms (>250 employees) have somewhat lower median inflation expectations (short-term: 7.2%; long-term: 3.7%) than medium-sized firms (50 to 249 employees: 8.0% and 4.7%, respectively) and small firms (<50 employees: 9.1% and 5.4%, respectively). This would corroborate our conjecture that survey respondents of small and large firms may have different ways of obtaining information on inflation. Whether respondents' level of information really plays a role in inflation expectations remains an open question, as we do not have any information on the persons who answered the questionnaire on behalf of their firms. However, the somewhat smaller IQRs (in absolute terms and relative to the median) give the impression that the agreement with respect to their expectations is larger among respondents of relatively larger firms, which could be due to the fact that they are more homogenous in their characteristics.

Table 1 shows that the sectors with the most pessimistic short-term inflation outlook are tourism, with the median year-on-year rate of expected inflation in 12 months' time at 10.6%, retailers and firms producing consumer goods (9.5%), construction (9.3%) and transportation (9.2%). This result is in line with the higher exposure of these firms to the strong increase in energy and food prices as well as to pent-up demand and still hampered supply chains. Firms in other services sectors, on the other hand, have somewhat lower inflation expectations: information and communication technology (ICT) services, business services, and other services (7.7% to 7.8%), just like firms producing intermediate goods (7.4%) or investment goods (8.1%). Not surprisingly, these sectors have been less affected by supply

Table 1

Firms' inflation expectations in Q2 2022

		Short-term expectations				Long-term expectations			
	Number of firms	Share π+	Mean π	Median π	IQR of π	Share π+	Mean π	Median π	IQR of π
		%	%	%	*Percentage points*	%	%	%	*Percentage points*
Overall	1,325	94.4	9.4	8.2	5.5	90.7	6.8	4.9	6.1
Firm size									
<50 employees	934	95.6	10.1	9.1	6.7	92.9	7.5	5.4	6.9
50 to 249 employees	289	93.7	8.7	8.0	5.2	87.5	6.5	4.7	4.2
≥250 employees	102	90.1	7.8	7.2	4.6	86.6	5.2	3.7	3.0
Sector									
Construction	186	94.7	10.1	9.3	7.1	92.5	7.7	5.3	7.0
Services	643	94.6	9.2	8.2	5.6	92.2	7.0	5.1	6.6
Business services	213	95.8	8.9	7.7	5.1	93.5	6.6	4.8	6.0
ICT	78	96.2	9.0	7.8	4.8	96.2	7.5	4.9	7.0
Tourism	105	95.3	11.5	10.6	7.8	91.5	8.3	5.9	6.0
Transportation	93	96.8	10.4	9.2	6.0	92.3	8.0	5.7	7.0
Other	148	89.9	8.7	7.8	5.5	88.4	6.7	5.1	7.0
Retail	205	96.5	10.7	9.5	9.1	94.4	10.2	8.5	12.4
Manufacturing	291	93.2	9.0	8.1	5.2	86.2	5.1	4.5	3.8
Consumer goods	76	93.5	10.6	9.5	6.8	93.4	7.4	5.3	4.7
Intermediate goods	132	93.1	8.6	7.4	5.3	82.4	4.9	3.8	3.6
Investment goods	80	92.6	9.2	8.1	5.3	85.0	5.0	4.7	3.7

Source: WIFO.

Note: This table presents aggregate results of the WIFO Business Survey on inflation expectations conducted in June 2022. Short-term expectations refer to the annual rate of inflation expected in 12 months' time, and long-term expectations refer to the average annual rate of inflation expected over the next 3 to 5 years. Number of firms refers to how many firms in the sample answered the survey questions. Share of π+ refers to the share of respondents in the survey expecting the price level to increase (significantly or slightly); mean π reflects the firm size-weighted average of the expected annual rate of inflation in % (winsorized at the 2nd and 98th percentiles); median π reflects the interpolated median of the expected annual rate of inflation in % (according to the method of Cox, 2019); IQR of π refers to the interquartile range of survey responses on the expected annual rate of inflation in percentage points. Business services refers to the NACE sector M "Professional, scientific and technical activities," which comprises lawyers, architects, consultants, desginers, photographers, etc. Mean values on subsectors are unweighted.

chain disruptions and/or increases in input costs. Also, expectations in services may be influenced by second-round effects of wages. However, for French firms, Coibion et al. (2022b) found that wage expectations and inflation expectations are only loosely linked.

For medium-term expectations, the sectoral pattern looks roughly the same. One exception are retail firms, whose median year-on-year rate of expected inflation in 3 to 5 years' time is substantially higher at 8.5% than the median expectations of all firms (4.9%). This may be related to the heterogeneity of retail firms in the sample (ranging from small corner shops and specialized stores to very large supermarkets), the high share of small firms in this sector as well as the particularly high dispersion of the expectations, both in the short and the long run, as documented by a high IQR.

The data from the WIFO-KT also allow us to look at the relationship between firms' inflation and other economic expectations. Specifically, we are interested in the relationship between inflation expectations and firms' expectations of their own selling prices[5], which could be informative about how likely or feasible it may be

[5] *Selling price expectations are queried in a qualitative manner with three response options: "selling prices are expected to (1) increase, (2) stay the same or (3) decrease in the next three months".*

for firms to change their prices given their expectations of changes in the general price level.

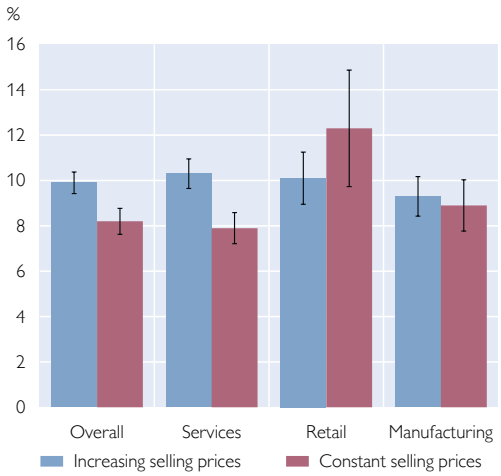
Overall, we find that around 54% of firms in our sample (excluding the construction sector) expect their selling prices to increase in the next three months, while 43% expect them to remain the same. In both cases, a majority of firms (81% and 61%, respectively) expects the aggregate price level to increase strongly in the short run. That is, despite the expectation of strongly increasing overall prices, a large part of the economy will not (or cannot) adjust their prices as swiftly.[6] This points to the existence of nominal price rigidity at the micro level, as documented by Gautier et al. (2022). Quantitatively, however, as can be seen from chart 1, firms expecting to raise their selling prices within the next three months have significantly higher average short-term inflation expectations than those expecting to keep their prices constant (mean inflation expectations in the short run of 9.9% compared to 8.2%, medians: 9.0% compared to 7.4%).[7]

Unlike qualitative inflation expectations, which are rather homogenous across sectors, (qualitative) selling price expectations vary quite a bit across sectors: The share of firms intending to increase their prices in the next three months is the highest in retail (70%), followed by manufacturing (57%) and services (48%). Analyzing quantitative inflation expectations by groups of selling price expectations, we only observe significant differences in the services sector (chart 1): Firms expecting their selling prices to increase have significantly higher short-run inflation expectations than those expecting their selling prices to remain constant (10.3% and 7.9%, respectively), as indicated by the non-overlapping whiskers in the chart. In the manufacturing and retail sectors, mean inflation expectations do not differ significantly among firms expecting increasing or constant selling prices, respectively. In contrast, in the retail sector, the inflation expectations of firms expecting their selling prices to remain constant are found to be higher than those of firms expecting increasing selling prices, but the difference is not statistically significant.

These results indicate that some sectors are more likely to adjust their selling prices than others, despite all

Chart 1

Inflation expectations by selling price expectations for selected sectors



Source: WIFO, authors' calculations.

Note: The whiskers shown for each bar indicate 95% confidence intervals around the means of inflation expectations.

[6] *For longer-run inflation expectations, only 55% of firms which expect their selling prices to increase and 37% of firms which expect their selling prices to remain constant expect a strong increase in the aggregate price level. However, we can hardly presume a correlation or even less a causality, given the different time horizons of the questions (3 months versus 3 to 5 years).*

[7] *With only 22 observations, it is difficult to make any statistically reliable statements about quantitative inflation expectations for firms expecting to reduce their selling prices. Thus, we omit the group expecting decreasing selling prices from chart 1.*

sectors having comparably similar expectations about the overall price level. This, in turn, would suggest that firm- and industry-specific cost developments influence firms' price-setting decisions more than expectations of aggregate inflation. Almost all firms expect the aggregate price level to rise, but a considerably smaller share of firms intends to increase their own prices in the short run. This inconsistency points to price stickiness at the firm level or strong competition among firms impeding immediate price increases.[8] These findings are in line with evidence documented by Gautier et al. (2022).

2.2 Households' inflation expectations are similar, but more dispersed than firms' expectations

Turning to households' inflation expectations, our results shown in table 2 confirm earlier evidence that, on average, older and female respondents have higher inflation expectations than younger and male respondents, both in the short and the long run. The literature explains this fact as follows: Older people may remember episodes of high inflation in their lifetime, e.g. the oil crisis in the 1970s (see, e.g., Malmendier and Nagel, 2015), while women more often do the day-to-day shopping and are therefore more aware of price increases in frequently purchased goods (Bruine de Bruin et al., 2010; D'Acunto et al., 2021b).

Another common finding in the literature suggesting that people with higher education and incomes tend to have lower inflation expectations is only confirmed for long-run expectations in our data. People with higher education are usually better informed, have a better understanding of basic macroeconomic principles and of the inflation process itself and therefore hold more realistic inflation expectations (D'Acunto et al., 2019; Das et al., 2020; Angelico and Di Giacomo, 2022). Household size only appears to play a role for long-run expectations, with people living in one-person households having higher inflation expectations than people living in multi-person households. The professional status, i.e. whether people have or do not have a job or are retired, does not seem to affect inflation expectations in any way.

We find that long-run inflation expectations of Austrian households are consistently lower than short-run expectations, which matches the finding for firms. This indicates that households, on average, expect inflation to decline over the coming years but to remain above the Eurosystem's price stability target of 2%.

Compared to the last round of the OeNB Barometer survey for households conducted in November and December 2021 (table 2), the median rate of inflation expected in the short run climbed from 4.8% in H2 2021 to 8.7% in H1 2022, and long-run expectations from 4.1% to 5.9%. Likewise, the share of people who think that the general price level will rise strongly or moderately over the coming 12 months increased from 85.3% to 93.5%, while the share for long-run expectations, i.e. in the coming 5 years, went up only slightly. The substantial increase in short-run expectations is not surprising, given the surge in actual inflation from around 4% at the time of the previous survey to about 8% at the time of the most

[8] *In principle, the inconsistency could arise from the different time reference of the questions, i.e. inflation expectations referring to a 12-month period and selling price expectations only to a 3-month period. However, at the current juncture, it is unlikely that respondents expect aggregate prices to increase at a considerably lower rate in the first 3 months than in the remaining 9 months of the year.*

recent survey. Longer-term expectations are affected less by the recent surge in actual inflation.[9]

In addition to questions on short- and long-run inflation expectations, respondents of the OeNB Barometer survey are also asked how certain they are about their inflation expectations for the next 12 months ("very certain, rather certain, rather uncertain or very uncertain"). Interestingly, in the most recent survey wave, when the rate of inflation was much higher than before, consumers became substantially more certain about their expectations. The share of respondents who reported to be very or rather certain about their expectations increased by 11 percentage points from 67.7% in H2 2021 to 78.7% in H1 2022. This indicates that in the fall of 2021, when the COVID-19 pandemic was perceived to come to its end

Table 2

Households' inflation expectations in Q2 2022

		Short-term expectations				Long-term expectations			
	Number of households	Share π+	Mean π	Median π	IQR of π	Share π+	Mean π	Median π	IQR of π
		%	%	%	*Percentage points*	%	%	%	*Percentage points*
Overall	1,431	93.5	11.6	8.7	9.3	88.9	11.2	5.9	10.1
Last round: H2 2021	1,404	85.3	7.0	4.8	6.3	86.5	7.2	4.1	7.7
Household size									
1 person	487	93.2	11.3	8.5	9.8	87.8	12.7	6.5	12.7
2 persons	572	94.2	12.3	9.1	9.6	90.1	12.0	6.4	11.7
3 and more	372	93.0	11.0	8.4	6.8	88.4	8.4	5.4	6.4
Age									
Under 30	115	90.0	10.8	7.8	10.4	86.3	12.7	5.6	16.4
30 to 49	378	93.9	12.7	8.9	12.2	91.9	11.8	6.3	9.4
50 to 64	479	95.0	11.6	9.1	7.2	86.4	10.8	5.8	10.6
65 and above	459	93.9	10.8	8.4	7.0	90.8	9.6	5.8	7.5
Gender									
Male	688	93.9	11.1	8.2	9.3	88.9	11.0	5.6	9.1
Female	743	93.2	12.1	9.2	9.4	88.8	11.4	6.5	11.0
Profession									
Not working	85	92.0	11.6	7.6	10.3	88.4	10.0	5.8	7.9
Working	780	94.0	11.7	8.9	9.6	88.6	11.7	5.8	11.5
Retired	566	92.9	11.4	8.7	7.4	89.7	10.4	6.1	8.3
Education									
Primary	824	93.7	12.2	9.1	9.6	88.9	12.2	6.3	11.4
Secondary	377	91.3	10.4	7.9	9.3	88.5	10.2	5.7	9.6
Tertiary	230	97.3	11.5	8.8	6.7	89.4	8.8	5.2	6.8
Income									
Low	420	95.2	12.8	9.2	11.4	90.4	14.2	7.2	16.1
Medium	534	91.9	10.4	8.0	7.0	89.4	10.1	5.7	6.8
High	255	93.1	10.5	8.3	6.0	85.7	7.3	5.0	6.3

Source: OeNB.

Note: This table presents aggregate results of the OeNB Barometer survey conducted in June and July 2022. Short-term expectations refer to the annual rate of inflation expected in 12 months' time, and long-term expectations refer to the average annual rate of inflation expected over the next 5 years. The number of households refers to how many households in the sample answered the survey questions. Share of π+ refers to the share of respondents in the survey expecting the price level to increase (significantly or slightly); mean π reflects the weighted average of the expected annual rate of inflation in % (winsorized at the 2nd and 98th percentiles); median π reflects the interpolated median of the expected annual rate of inflation in % (according to the method of Cox, 2019); IQR of π refers to the interquartile range of survey responses on the expected annual rate of inflation in percentage points.

[9] *As respondents are asked for their long-run expectations for the next 5 years and their short-run expectations for the next 12 months, the implicit average inflation rate for the years 2 to 5 can be calculated. Based our results, the median inflation expectations for that period amount to 5.2%.*

and supply disruptions were expected to ease, people were less certain whether inflation would ease or increase further over the coming 12 months. Compared to the current situation with the ongoing war in Ukraine, there seems to be more agreement that inflation will remain elevated also in the future.

3 Conclusions

In this article, we show that firms and households held a rather pessimistic view about consumer price inflation in the spring and summer of 2022, with short- and long-run inflation expectations having been far from the price stability objective of the Eurosystem.

Analyzing novel firm and existing household survey data, we document the following five stylized facts: First, we confirm earlier evidence that households and firms have rather similar expectations of inflation in the short run (8.7% and 8.2%, respectively) and the medium to long run (5.9% and 4.9%, respectively), with firms showing less disagreement about their estimates than households. This is not too surprising as the respondents in the firm survey, in particular those representing smaller firms, have similar characteristics as a typical household member in the household survey.

Second, as regards the determinants of expectations across agents, we find several firm and household characteristics which indicate that respondents' level of information, rational assessment and experience matter: For firms, we observe that firm size appears to have an effect on inflation expectations, with representatives of larger firms giving lower forecasts of future inflation than representatives of smaller firms. This is in line with the assumption that survey respondents in larger firms may differ in educational attainment or the position they hold (highly educated CFOs or CEOs) from respondents in smaller firms, who may be less required to closely follow economic news. For households, on the other hand, we confirm earlier evidence that relatively older and female respondents have higher inflation expectations than younger household members and men. Household size seems to matter as well, with single households holding higher expectations than larger households. The commonly found relationship of more educated and wealthier respondents reporting relatively lower inflation expectations is confirmed in our data only for long-run expectations, but not for short-run expectations.

Third, for firms, sectoral differences appear to matter for the formation of inflation expectations: Firms with a higher share of energy inputs (e.g. tourism, transportation) as well as those depending on (international) supply chains (e.g. construction, retail and production of consumer goods) on average seem to expect stronger price increases. In contrast, other service and manufacturing firms higher up in the supply chain seem to have a more benign price outlook. This pattern is roughly the same for short- and longer-term inflation expectations.

Fourth, looking at the relationship between inflation and firms' own selling price expectations, we observe that despite an overall grim inflation outlook, many firms do not expect to adjust their prices in the near future. While we do find that in general, firms that expect to raise their selling prices also have relatively higher quantitative inflation expectations, firms differ relatively less in their expectations about the increase in the aggregate price level compared to the expectations about their own selling prices. This indicates that the direct cost channel, which is determined by differences in inputs, energy intensity, supply

chain disruptions, etc., is likely more important for firms' price setting than expectations about future aggregate inflation. The relatively muted outlook for selling prices could also indicate the existence of price rigidity in the short run or strong competition hampering the swift adjustment of prices to economic conditions.

Finally, during high inflation periods, households are likely to be more rationally attentive (see Sims, 2003). We document that the uncertainty of inflation expectations of households is notably lower during a high-inflation period than during a period with more normal inflation rates. Whether this is due to respondents being better informed about inflation when inflation is exceptionally high (due to broader media coverage) or respondents facing markedly higher prices in their daily lives (e.g. gasoline prices, electricity costs, groceries) is difficult to determine and requires further investigation.

Our findings add to the vast literature on firms' and households' inflation expectations, which have been shown to affect agents' economic decisions. The new inflation expectations module in the WIFO-KT can be of particular value, as inflation expectations may be linked to various other economic expectations of firms and can thus be used to investigate the relationship between changes in aggregate (perceived and expected) inflation and firm behavior. For monetary policymakers, the evidence provided in this article can be useful for the analysis of the effects of their policy decisions and effective and well-designed policy communication. Another implication of our results is that (ex ante perceived) real interest rates, which affect agents' spending and investment decisions, can be vastly different across agents and sectors, which ultimately has an effect on the transmission of monetary policy.

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Annex

Questionnaire

Excerpt from the questionnaire of the WIFO Business Survey on inflation expectations (translated from German):

The following questions are about the future overall level of prices for goods and services as measured by the consumer price index. An increase in the overall price level is referred to as inflation, a decrease as deflation.

1 In the next 12 months, the price level is going to...

☐ increase significantly
☐ increase slightly
☐ remain stable
☐ decrease slightly
☐ decrease significantly

1a By how much do you estimate the overall price level to increase/decrease in the next 12 months? (You may provide decimals.)

Approximately _____ %

2 Over the next 3 to 5 years (medium term), the price level is going to, on average, ...

☐ increase significantly
☐ increase slightly
☐ remain stable
☐ decrease slightly
☐ decrease significantly

2a By how much, on average, do you estimate the overall price level to increase/decrease per year over the next 3 to 5 years (medium term)? (You may provide decimals.)

Approximately _____ %

Who pays the price when prices rise?

Pirmin Fessler, Friedrich Fritzer, Mirjam Salish[1]
Refereed by: Christine Mayrhuber, WIFO

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.

JEL classification: E31, C43, C81
Keywords: inflation, household-specific inflation, microdata

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

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[2] *In a recent study, Charalampakis et al. (2022) show for the euro area that households belonging to the lowest income quintile spend a larger share of their expenses on essentials such as food, electricity, gas and heating and less on transport, recreation and restaurants than high income households.*

[3] *See e.g. Michael (1979), Hagemann (1982) or Hobijn and Lagakos (2005) for the US. Gürer and Weichenrieder (2020) show that consumption bundles consumed by poorer households have become comparatively more expensive than the consumption bundles of the richest deciles. Fessler and Fritzer (2013) find a negative relationship between income and inflation for Austria.*

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

[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

[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-

[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 $c = 1,2,..C$ 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

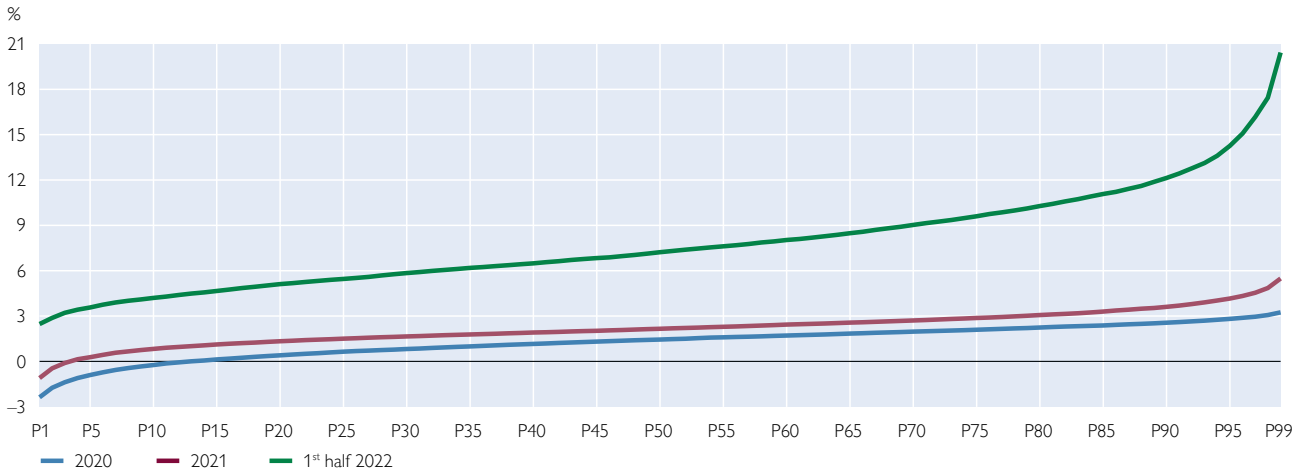
2.1 Distribution of inflation across households shows large heterogeneity

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

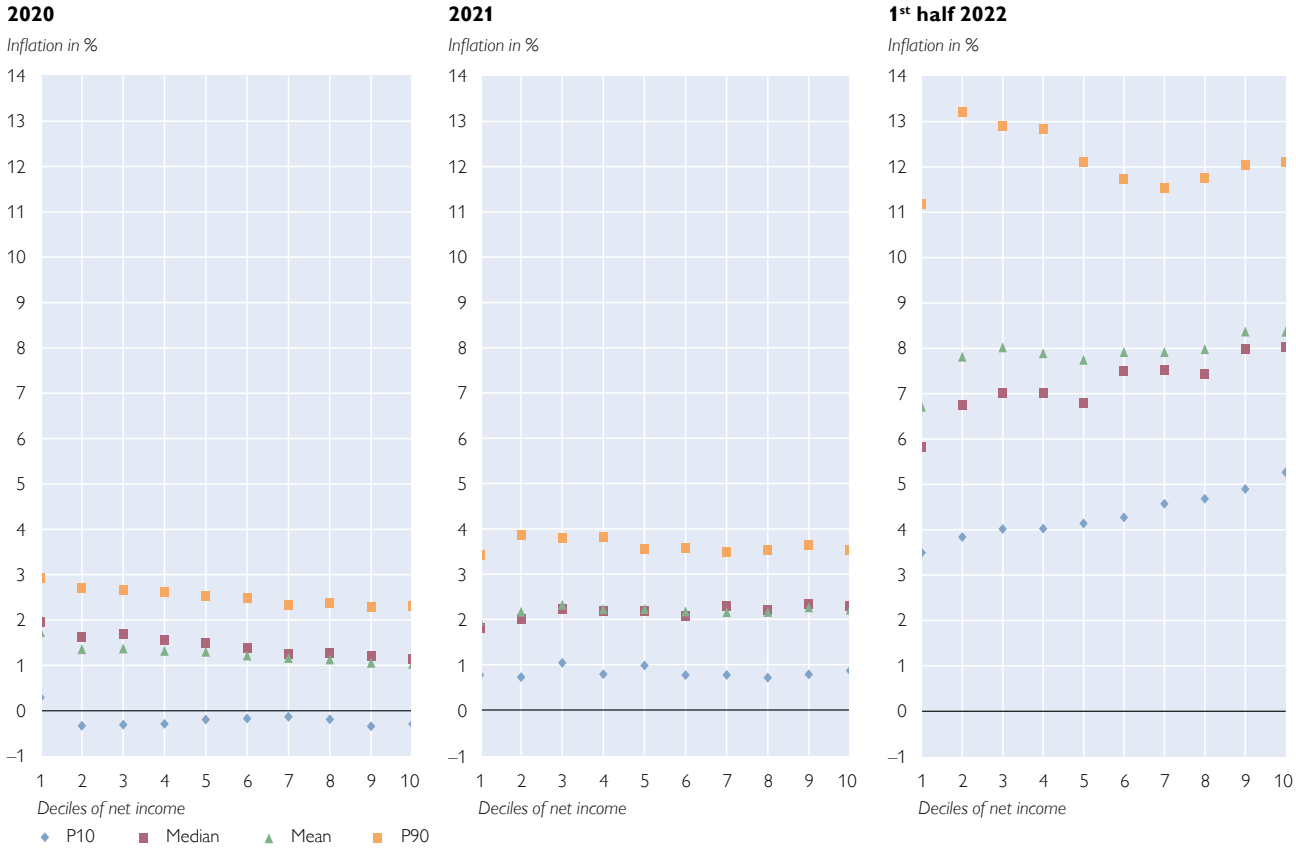
As a next step, we examine the relationship of household-level inflation relative to household-level net income. As shown in Fessler and Fritzer (2013), in Austria, lower-income groups experienced higher inflation rates than higher-income groups. This situation changed with the recent surge of prices. 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	Consumption-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

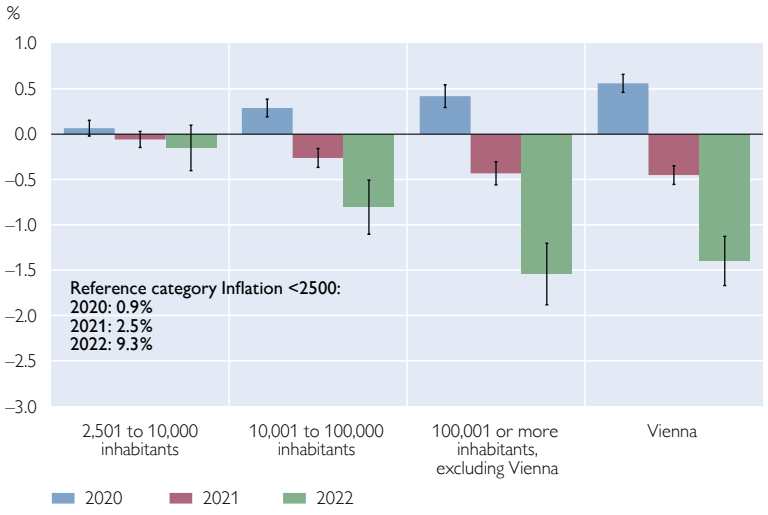
Source: Statistics Austria (2019/2020 household budget survey; price microdata, 2019 to 2022), OeNB.

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

Marginal effect of municipality size on inflation



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

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 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 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

[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

Table A1

Descriptive regressions of household-level inflation on socioeconomic characteristics

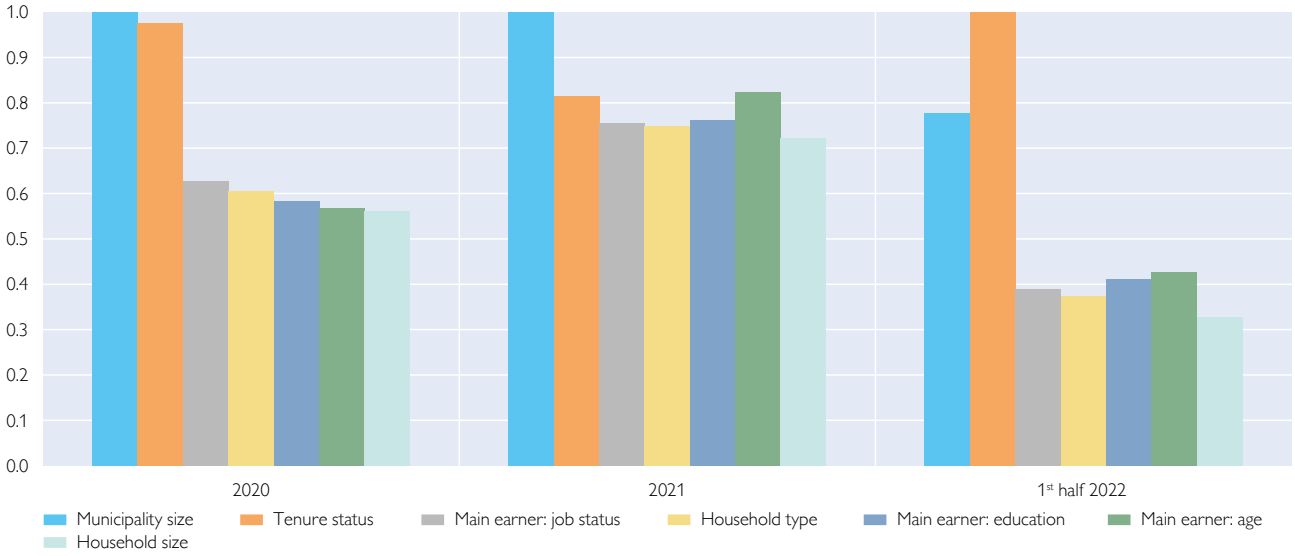
		2020		2021		2022	
		Coefficient	SE	Coefficient	SE	Coefficient	SE
Municipality size	2,501 to 10,000 inhabitants	0.066	0.044	–0.058	0.046	–0.152	0.128
Reference category	10,001 to 100,000 inhabitants	0.289	0.050	–0.262	0.053	–0.805	0.152
up to 2,500 inhabitants	100,001 or more inhabitants, excluding Vienna	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.

Chart A1

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)



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

Wages, inflation and a negative supply shock

Alfred Stiglbauer[1]
Refereed by: Daniel Radowski, Deutsche Bundesbank

The sharp increase in inflation rates to 10% and higher that we have seen over the past months as a result of a negative, import-driven supply shock poses a serious challenge to wage setters. So far, collectively bargained wages have barely reacted to the current rise in inflation. However, given empirical estimates of wage equations and the institutional features of wage bargaining, it can be expected that wage growth will respond to higher inflation with a lag. Forward-looking indicators of negotiated wages also point to higher future wage growth. This raises the question as to what extent wage growth should compensate for inflation. We argue that, based on the implicit aim of collective bargaining of keeping the wage share constant, nominal wages should grow in line with labor productivity as well as the increase of output prices or core inflation rather than in line with total consumer price inflation.

JEL classification: E24, E31, J50
Keywords: inflation, wages, wage-price spiral

HICP inflation has recently reached heights not seen in decades in Austria and the euro area, amounting to 11.0% and 10.0%, respectively, in September 2022. The sharp increase in inflation, which is due to negative supply shocks in imported energy goods and food products,[2] poses a serious challenge to wage setters. In this paper, we analyze the appropriate extent to which wages should react to this inflation increase in Austria and the euro area without jeopardizing price stability. The paper is structured as follows: Section 1 presents some stylized facts about the relationship between wage growth and inflation. Section 2 discusses why collectively bargained wages have barely risen so far and discusses the outlook for wage growth. In section 3, we argue that wage negotiations should be guided by output prices or core inflation rather than full consumer price inflation (CPI). In doing so, distributional conflict would be avoided, and the risks of a wage-price spiral would remain contained.

1 Wage growth and inflation: some stylized facts

Empirical observations and economic theory suggest that aggregate wage growth and inflation are interrelated in a complex way: Typically, employees and unions seek to protect the purchasing power of wages, i.e., they do not want wages, deflated by consumer prices (i.e., real consumption wages), to fall, and hence they argue that when expected prices increase, so should wages. In addition, workers seek to reap the gains from rising real incomes, which implies that wages should also grow in line with labor productivity.[3] Conversely, (productivity-adjusted) wages are an important cost factor for firms[4] and hence affect prices. The ratio of

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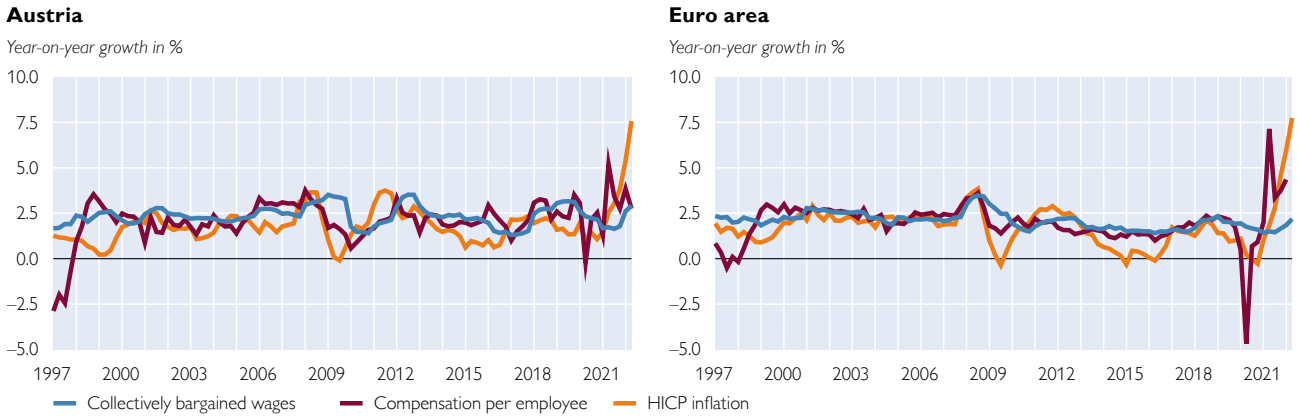
[2] *See OeNB (2022) for details on the evolution of energy and food prices.*

[3] *In addition, cyclical conditions affect the bargaining power of workers and thus wage growth.*

[4] *According to Statistics Austria, the share of the compensation of employees in the total production value of the Austrian economy was 27.5% in 2020.*

Chart 1

Wage growth and inflation from Q1 1997 to Q2 2022



Source: Eurostat, ECB.

Note: The collectively bargained wages series for the euro area excludes bonus payments.

wages to output prices, i.e., the real product wage, is an important determinant of firms' profitability.

How have wage growth and inflation evolved historically? Chart 1 depicts two measures of wage growth and inflation for Austria and the euro area since 1997. The recent surge in inflation (orange lines) is clearly visible. The blue lines represent the growth of collectively bargained wages.[5] There are two further commonly used measures of aggregate wage growth from the national accounts which are based on the compensation of employees. However, these measures have been severely distorted by the COVID-19 shock and pandemic-related policy interventions like job retention schemes.[6] One such measure is compensation per employee (the red lines in the chart). In Q2 2020, compensation per employee fell due to a sharp contraction in working hours (partly mitigated by job retention schemes). After a normalization of earnings, there was a corresponding upward spike in compensation per employees four quarters later. The other measure, compensation per hour, fluctuated even more strongly and is thus not shown in chart 1. Because of these distortions, this paper focuses on collectively bargained wages, which are usually agreed between unions and employer federations. Given that union coverage and hence the share of workers whose wages are subject to collective bargaining is high, negotiated wages strongly affect actual earnings. (In Austria, the union coverage rate is 94%, compared to the euro area average of 75%.)[7]

[5] *Source: the index of agreed minimum wages (Tariflohnindex 2016) published by Statistics Austria and the series for negotiated wages compiled by the ECB, respectively. The latter series is the one without one-off payments, which play an important role in Germany.*

[6] *Due to their different designs, job retention schemes are treated differently in national accounts, therefore compensation-based wage measures are not comparable across countries.*

[7] *According to the adjusted union coverage measure in the OECD-IAS-ICTWSS database (https://www.oecd.org/employment/ictwss-database.htm), bargaining coverage in Austria is 98% (2019). For all euro area countries, the average coverage rate, weighted by the number of employees, is 74.5%. Bilgili (2019) reports the somewhat lower coverage rate of 94% for Austria that is cited in the main text.*

The chart suggests that the growth of collectively bargained wages correlates with past inflation. One reason why wages react with a lag is that inflation expectations in wage setting tend to be backward looking. Based on estimates of a large number of wage Phillips curve specifications, the preferred specifications included lagged inflation as an explanatory variable[8] for both Austria and the euro area as a whole, respectively (Nickel et al., 2019).

How large is the effect of inflation on wages? Estimated wage Phillips curves typically find a coefficient that is positive, but smaller than unity (IMF, 2022; Nickel et al., 2019). These results capture rather short-term effects. According to Fenz et al. (2019), who estimate wage equations for the Austrian economy with an error-correction specification, the short-term effect of inflation is around 0.5. They also find that there exists a long-term one-to-one relationship between wage and price levels.[9]

2 How wages have reacted to high inflation so far

So far, aggregate negotiated wages have barely reacted to the recent increase in inflation (chart 1). According to the latest monthly data on negotiated wages, wage growth was 3.2% in Austria in August and 2.6% in the euro area in July 2022.

2.1 Why negotiated wages react to inflation with a lag

Collective bargaining is often guided by past inflation. For example, in Austria, it is common practice that past CPI inflation forms the starting point of wage negotiations. The backward orientation of bargained wages[10] is reinforced by formal wage indexation and statutory minimum wages, two institutional features that are not present in Austria, but play a role in a number of euro area countries. Wages that are subject to formal indexation and statutory minimum wages are typically adjusted to past inflation. While formal indexation and statutory minimum wages are not governed by collective bargaining, they may have important repercussions for bargained wages as sector- (firm-) and occupation-specific minimum wages have to be adjusted accordingly.[11]

Wages can also be expected to react relatively slowly to inflation because collectively bargained wages are normally only adjusted when collective agreements expire. While in Austria, the usual duration of collective agreements is 12 months, it is more than 24 months in the euro area.[12] Moreover, it has to be considered that wage agreements are staggered – not all agreements are renewed at the same time.

Given that inflation is likely to substantially exceed nominal wage growth in 2022, there will be high real wage losses and, as a result, decreases in the wage

[8] *The specifications also include productivity growth and a measure for labor market slack.*

[9] *The authors find a cointegrating relationship between hourly wages, productivity per hour, prices and trade openness.*

[10] *However, the current high-inflation environment may lead to more forward-looking inflation expectations.*

[11] *Economy-wide formal wage indexation is relevant only in in Belgium and Luxembourg. The share of employees in these two countries amounts to 3.3% of all euro area employees. Statutory minimum wages are relevant for some 5.4% of euro area employees. This number is based on a Eurostat estimate of the share of minimum wage earners in the relevant countries. See https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Minimum_wage_statistics.*

[12] *The employment-weighted average of the individual durations of collective agreements taken from the ICTWSS database is 24.8 months.*

share. For Austria, we expect a real wage loss in the order of 5% for negotiated wages (and somewhat less for wage measures that are based on the compensation of employees) based on the wage projections in the OeNB's June economic outlook and its most recent inflation forecast.

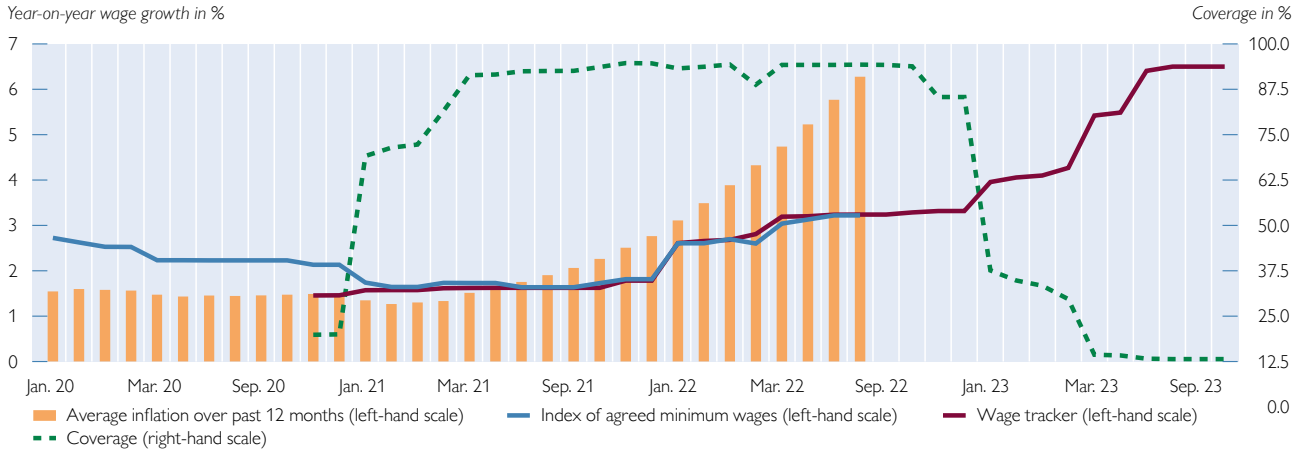
2.2 What is the outlook for negotiated wages?

Aggregate wage growth tends to react slowly to recent wage settlements when their weight in the total wage sum is low. To get a better idea of how wages are responding to the increase in inflation and an indication of how wage growth is likely to evolve in the future, let's have a closer look at the most recent wage agreements.

Chart 2 shows a comparison of aggregate wage growth up to the present and future wage growth implied by recent wage agreements in Austria. The blue line depicts growth in negotiated wages according to the index of agreed minimum wages. Wage growth has been increasing since autumn 2021, when the 2021/2022 wage round[13] started. The red line (the "OeNB wage tracker") represents employment-weighted average wage increases based on 340 collective agreements since autumn 2020. For past values, it follows the wage growth indicated by the blue line reasonably well. It also extends into the future because of recent settlements that expire one year after they became effective (given the usual duration of collective agreements). It should be noted that the further the wage tracker line extends into the future, the smaller the employment weight that forms the basis of the calculated wage increase becomes (this is indicated by the dashed green line that represents the underlying bargaining coverage; this coverage becomes very low for the last months of the time horizon). There was a continuous increase in the growth of negotiated wages, with the latest wage settlements exceeding 6%. This increasing

Chart 2

Current and future growth of negotiated wages: OeNB wage tracker



Source: Statistics Austria, Austrian Trade Union Federation, Ministry of Labor and Economy, OeNB.

Note: Latest data point: Sept. 2023.

[13] *Wage negotiations in Austria follow a rather fixed time schedule: A wage round lasts from the wage settlements in the metals sector (which become effective in November) until October of the following year. Most agreements become effective in January.*

tendency was in line with the usual inflation measure used in collective bargaining, the average CPI inflation rate in the past 12 months prior to the start of wage negotiations (orange bars in the chart).

For the euro area, the ECB and national central banks are jointly developing similar indicators of future wage growth based on negotiated wages. According to this preliminary work, negotiated wage growth can be expected to increase further in the euro area (Lane, 2022), but less than in Austria.[14]

3 What is the "right" increase of nominal wages?

Euro area countries are currently suffering from an import price-driven negative supply shock and associated income losses. How strongly should wage growth respond to the surge in inflation at this juncture? In the following, we argue that for the division of income losses to be fair, wages should increase at a rate that ensures that the wage share remains constant.

3.1 Wage negotiations should not aim for a full compensation of consumer price inflation

A useful benchmark for wage negotiations between unions and employers' representatives is that nominal wages should grow at a rate equal to the sum of inflation of the past year and the (medium-term) growth rate of labor productivity.[15] When this is the case, the wage share (i.e., workers' share in aggregate income) remains constant, a result that can be accepted as fair by both employees' and employers' representatives. However, when applying this rule to wage negotiations, it has to be considered that the relevant inflation measure is not HICP inflation but the change in output prices, i.e. GDP deflator inflation. Starting from the definition of the wage share, it can be shown that a constant wage share implies that nominal wages grow in line with labor productivity and the changes in output prices because it is the relation between wages and output prices that determines the wage (and the profit) share (see annex). The GDP deflator only captures the extent to which the price increases of imports affect output prices.

Table 1 shows that over the period from 1999 to 2020, the difference between HICP inflation and GPD deflator inflation was very small. Hence,

Table 1

Inflation rates in Austria and the euro area

	Austria	Euro area (19 countries)
	%	
Average inflation from Q1 1999 to Q4 2020:		
HICP	1.8	1.6
GDP deflator	1.7	1.6
HICP excl. energy and food[1]	1.8	1.3
Average inflation over the past year:[2]		
HICP	6.8	7.0
GDP deflator	2.8	3.4
HICP excl. energy, food, alcohol and tobacco	4.0	3.3

Source: Eurostat.

[1] The time series is only available from 2001 (Austria) and 2002 (euro area) on.
[2] From October 2021 to September 2022 (HICP measures) and from Q3 21 to Q2 22 (GDP deflator), respectively.

[14] *See also the blog post by Philip R. Lane: https://www.ecb.europa.eu/press/blog/date/2022/html/ecb.blog221125~d34babdf3e.en.html (chart 31).*

[15] *In Austria, this guidance is called the "Benya rule," named after a former Trade Union Federation president. It is based on the implicit aim to keep workers' share in national income constant (Mesch, 2015). Fenz et al. (2019) show that in the early years of monetary union (up to the Great Recession), wage growth was lower than what would have been implied by the Benya rule, leading to a decline in the wage share. After 2008, wage growth matched – or was even higher than – the rate based on the Benya rule, which led to a recovery of the wage share.*

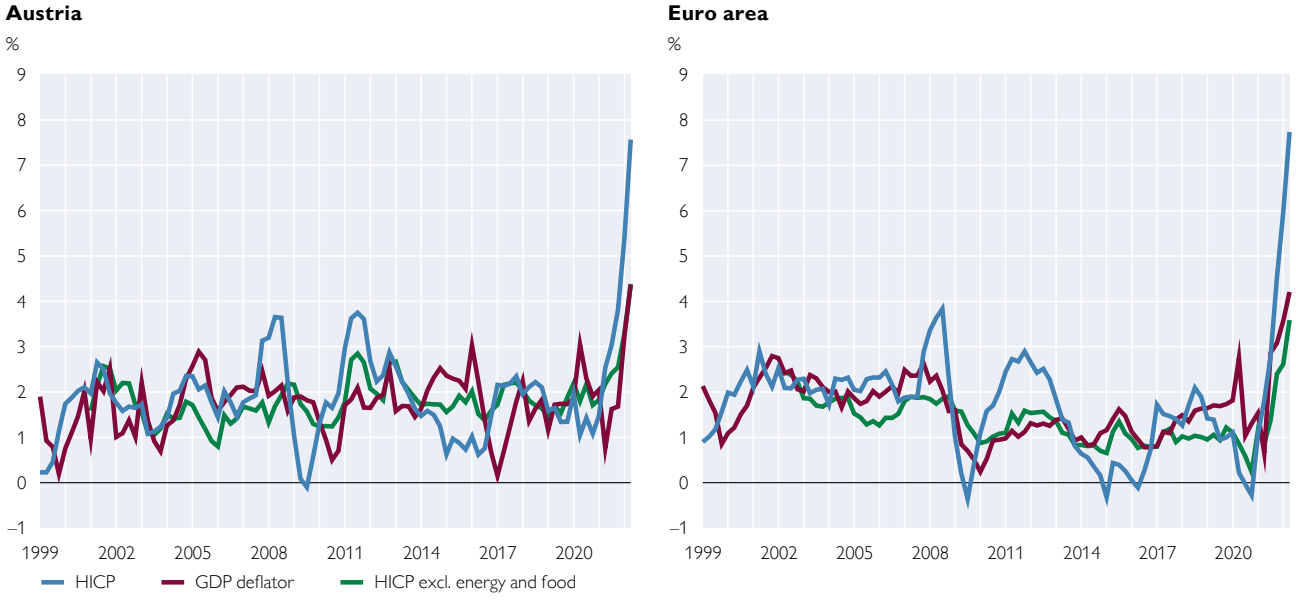
in "normal times," it does not matter much which price index is actually used in wage bargaining. More recently, however, there has been a substantial divergence between both inflation measures, as the table and chart 3 show: GDP deflator inflation has also risen, but not as much by far as consumer price inflation.

The current wedge between consumer price inflation and the growth rate of the GDP deflator is caused by the large increase in energy prices (and other input prices). For energy-importing countries like Austria, this implies a substantial outflow of income abroad. This income loss can be better understood if one keeps in mind that, according to OeNB calculations for Austria, the energy-price related terms-of-trade deterioration over the past 12 months[16] has led to a deterioration of the trade balance by about EUR 8.5 billion or 2.1% of GDP. In the euro area, the costs of energy imports are likely to increase from 1% to 5% of GDP in 2022.[17] Assuming that the negative supply shock is permanent, a "compensation" of total consumer price inflation through corresponding wage hikes would, at least temporarily, increase the wage share. Given the decreases in the wage share in 2022, this may, in part, be justified. However, as a general rule for the medium term, wage negotiations should be guided by GDP deflator inflation rather than by HICP inflation. By taking this rule as a starting point for wage negotiations, it is ensured that the burden of income losses is appropriately shared between workers and firms.[18]

That said, in practice, the GDP deflator is not a very suitable indicator upon which wage negotiations can be based because of its relatively large publication lag

Chart 3

Various inflation measures from Q1 1999 to Q2 2022



Source: Eurostat.

[16] *From September 2021 to August 2022.*

[17] *See Der Standard (2022).*

[18] *De Nederlandsche Bank makes the same point: https://www.dnb.nl/en/general-news/dnbulletin-2022/avoiding-a-wage-price-spiral-requires-effort-from-governments-central-banks-and-social-partners.*

and the frequent revisions that it is subject to. Instead, as a proxy, a measure of core inflation, such as HICP inflation excluding energy and food, could be used, because it excludes prices of items that are subject to the import price shock.[19] This inflation measure is arguably relatively close to GDP deflator inflation (chart 3).

3.2 The danger of a wage-price spiral

What effect will rising wages have on prices? The pass-through of wages to prices depends, among other things, on the degree of competition in product markets and on cyclical conditions. Empirical estimates and model simulation results suggest that the sensitivity of consumer prices to wages is between 0.2 and 0.3 but may be higher in a high-inflation environment (De Fiore et al., 2022). Strong wage increases are thus likely to have sizable second-round effects[20] on prices, thus increasing the inflation rate and inflation persistence.

Does this mean that a "wage-price spiral" is currently imminent? There is no uniform definition of what a wage-price spiral exactly is. It can probably best be described as a process where price and wage increases reinforce each other.[21] While at present, wage growth is likely to accelerate, inflation will probably come down in 2023, which, however, depends very much on how the prices of imported energy and food will actually evolve. If inflation decreases, wages are likely to follow with a lag, given the backward-looking way in which prices affect wages.

However, we currently see several risks to price stability. First, if inflation expectations become de-anchored, inflation may become persistent even after the shocks disappear (Lagarde, 2022). The backward-looking nature of the wage bargaining process could reinforce this process. Second, if distributional conflicts between the partners of collective agreements arise, the danger of a wage-price spiral will increase.[22] Such a conflict may emerge if unions demand a higher compensation for inflation than the GDP deflator or core inflation would imply, as explained above. Price setters could in turn increase their markup over wages to make up for their loss in the profit share. Such a process would in the end benefit neither side, it would only fuel the inflation process.

Given the high real wage losses in 2022, it is understandable that unions are pursuing the goal of strong wage increases. But the current macroeconomic situation implies that some wage restraint is warranted. Such restraint may be helped by the multitude of government measures implemented with the aim of reducing the effects of inflation on disposable household incomes and firms (see Prammer and

[19] *Core inflation is a good proxy for output price (GDP deflator) inflation when the markups by domestic energy and food producers remain constant. However, when markups are raised, the core inflation underestimates the domestic inflation effects. The correlation coefficients between both inflation measures for Austria and the euro area are 0.39 and 0.77, respectively, and highly significant.*

[20] *The ECB gives the following definition of second-round effects: "Second-round effects occur when agents pass on the inflationary impact of the direct and indirect effects [of energy price increases] to wage and price setting […]." See https://www.ecb.europa.eu/pub/economic-bulletin/focus/2022/html/ecb.ebbox202205_02~e203142329.en.html.*

[21] *IMF (2022) adopts a pragmatic definition, defining a wage-price spiral as an episode of several quarters in which both wage and price inflation rates rise simultaneously.*

[22] *See the CORE Team (2017) for a textbook explanation of how inflation arises from inconsistent claims on output by workers and firms. In a similar vein, a study on the increase of inflation in the 1960s conducted by the Austrian social partners (Beirat für Wirtschafts- und Sozialfragen, 1968) notes that wage-price spirals do not benefit either side.*

Reiss, 2022). After all, the negative supply shock we have seen implies a real income loss for the whole economy, which wage negotiations cannot and should not fully compensate. Wage negotiations could result in distributional conflicts that increase inflation even further and would entail stronger disinflationary measures by the Eurosystem.

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Annex

The wage share is equal to nominal compensation of employees divided by nominal GDP at market prices:

$$s = \frac{h \cdot w}{Y \cdot P_Y},$$

with s denoting the wage share, h the number of hours worked, w the average hourly compensation, Y real GDP and P_Y the price index of output (the GDP deflator). A constant wage share implies that $\hat{w} = (\hat{Y} - \hat{h}) + \widehat{P_Y}$ where a hat over a variable denotes the time derivative of the log of this variable. The result is that nominal wages should increase in line with labor productivity growth and GDP deflator inflation. Note that the wage share above is simplified in two ways: (1) It is unadjusted for the ratio between the number of employees and total employment, and (2) it ignores a potentially diverging evolution of nominal GDP and net national income[23] (the usual denominator for the wage share). In the short run, these simplifications should not matter.

[23] *See Fenz et al. (2019).*

Fighting (the effects of) inflation: government measures in Austria and the EU

Doris Prammer, Lukas Reiss[1]
Refereed by: Margit Schratzenstaller, WIFO

The extraordinarily high inflation in the euro area has led to substantial discretionary fiscal policy action to fight inflation in Austria and all other EU member states. Moreover, EU-wide emergency interventions to address high energy prices have come into force, comprising measures to skim off windfall profits from energy producers. In contrast to other EU member states, Austria has stayed relatively true to the approach of relying more on income measures as opposed to mere price measures: It has relied to a lesser extent on subsidies or tax cuts to reduce the costs of "brown" energy such as fuels, and to a larger extent on broad-based transfers and tax cuts to support all households. The large scale of the of the overall package is preventing a substantial decline in aggregate real household incomes in 2022.

JEL classification: E31, H12, H53
Keywords: energy taxes, fiscal policy, high inflation

The extraordinarily high inflation in the euro area has led to substantial discretionary policy action across Europe. These anti-inflation measures have been taken with two objectives in mind. First, to limit price increases (i.e., inflation), and second, to fight the negative effects of high inflation on households and businesses. Governments have various means to fight both inflation and its negative effects and are supported by other institutions such as central banks and social partners. Despite the large variety of potential measures, economists tend to favor swift, targeted and temporary income-increasing measures over price measures, as they deter price signals in the market (see for example IMF, 2022). Moreover, government support to vulnerable households and firms should ideally not increase inflation and should support the green transition (or at least not endanger it).

This article gives an overview of which measures governments have implemented (with a focus on Austria) and elaborates on the various trade-offs concerning such measures. Section 1 discusses the range of anti-inflation measures, distinguishing between fiscal and regulatory measures, and which goals need to be considered when deciding on them. Section 2 then presents the measures taken in Austria. Section 3 compares the Austrian measures to those of other EU economies, with a focus on regulatory measures. Section 4 discusses the Austrian measures from a macro-stabilization point of view. Section 5 concludes.

1 A wide range of trade-offs between the various conceivable policy measures

A wide range of fiscal and regulatory interventions is possible to fight high inflation. Revenue-based fiscal measures can take the form of (temporary) tax cuts on products heavily affected by inflation such as energy products or certain sectors. More

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general income tax cuts can also be implemented to maintain consumer purchasing power in a context of high overall inflation. Expenditure measures comprise transfers to households (potentially targeted to vulnerable households) as well as subsidies to companies, often focused on energy-intense sectors.

Regulatory measures to fight (the effects of) inflation often take the form of caps on wholesale and consumer prices (as in France, see section 3.4). They are often seen as simple and direct instruments which are easy to understand and can be implemented quickly.

The best energy inflation compensation measures should be targeted to vulnerable groups, easy and fast to administer, and time-limited, and they should maintain price signals. In practice, all measures involve trade-offs between inflationary effects, distributive effects, budgetary costs, administrability, market disruptions, EU regulations and ecological incentive effects. Deciding on a particular measure often means weighing and choosing between different objectives, as demonstrated below.

1.1 Trade-offs concerning the impact on inflation

Introducing a price cap via regulatory measures is an effective way to limit price increases and uphold consumer purchasing power, thus fighting both inflation and its negative effects. Price caps are criticized because they change relative market prices and are therefore a source of market distortion, perhaps even endangering trust in the market mechanism in some cases. However, market distortions are only a strong counterargument against price caps if the affected markets are deemed to have been functional beforehand.

Like price caps, tax cuts on certain energy products or sectors, if passed on to consumers, fight inflation but eventually undermine the price effect. Cheaper energy products may reduce the incentive for energy saving, counteracting the downward pressure on demand of higher prices (see section 1.2). Moreover, cuts in indirect taxes may not be fully transmitted to consumers but left (partially) in producers' pockets. Furthermore, temporary measures to limit price increases directly may increase inflation expectations when they expire.

Transfers are effective means to fight the effects of inflation but the less targeted they are, the higher the risk of increasing inflationary pressures in the short term. The additional income provided may increase demand, which cannot be met by additional supply, hence putting pressure on prices.

1.2 Conflicts with environmental goals

High energy prices are one of the main reasons for current high inflation, but they also incentivize energy savings, in turn contributing to environmental goals. Cutting energy-related taxes (i.e., excise duties and/or VAT on energy sources) or subsidies to contain energy prices or cushion their effects are counterproductive in this respect.[2] However, policy measures regarding energy-related taxes have to consider the relative prices between energy sources, as the green transition involves not only cuts to energy consumption, but also a switch from oil, gas, and coal toward electricity from renewable sources. Cuts in taxes on electricity are therefore less problematic from an environmental point of view compared to those on fossil energy. At the same time, excessive short-term interventions on relative energy

[2] *For these reasons, the IMF Fiscal Monitor from October 2022 (IMF, 2022) also argues against such tax cuts.*

prices may lead to inefficient substitutions, such as using electricity instead of natural gas for heating and may dampen overall energy saving incentives.

Direct transfers independent from current energy consumption do not interfere with ecological objectives; the same is true for income tax reliefs (except for targeted reliefs to commuters).

1.3 Conflicts with distributional goals[3]

From a distributional point of view, measures can be analyzed in terms of absolute (in euro) and relative (compared to income pre-intervention) impact on income-poorer and -richer households:

- Transfers to vulnerable persons or households tend to benefit income-poorer households more in absolute and in relative terms.
- Untargeted transfers to all individuals (households) tend to benefit income-poorer individuals (households) the same in absolute terms compared to higher income individuals (households), but more in relative terms.
- Measures to reduce prices of certain consumer goods (via cuts in VAT or excise duties, subsidies, price caps) tend to benefit income-poorer households less in absolute terms, but often (depending on the goods concerned) more in relative terms.[4]
- For income tax cuts, the results depend on the design.

The extent to which support measures should also help income-richer households is a question of political preferences, available fiscal space, macro-stabilization concerns (see section 4), and implementation. Identifying vulnerable groups can be very difficult if the administration does not have (or process) integrated income data for persons or households. Providing transfers to unemployed people might only risk forgetting the working poor; transfers to all pensioners will also subsidize those best off. While true means testing on income and wealth together would avoid that problem, its administration can be resource- and time-consuming and costly. Timely transfers may only be guaranteed if disbursed to everyone. Payment upon registration/demand would have to be scrutinized by the administration, introducing an implementation/effect lag. Ex-ante payment, scrutinized after disbursement, implies a high administrative burden. Fiscal interventions also cause (large) costs which may endanger fiscal sustainability; the more so the less targeted they are. Furthermore, a suboptimal phase-out of means-tested transfers can lead to very high marginal tax rates in lower- and middle-income ranges. However, the precision of lump-sum transfers could be increased by making them subject to income taxes. Thus, high-income individuals would receive lower transfers than low-income individuals, without causing an exceptionally high administrative burden.[5]

[3] *This section focuses on households. For enterprises, an additional consideration is the impact of high input prices on competitiveness insofar as their competitors in other world regions face different input prices.*

[4] *The discussions on measures aimed at prices for consumer goods focus on energy and food. The latter is clearly a good where expenditure increases with income (as income-richer households tend to buy more expensive food), but with an income elasticity below 1. This pattern also tends to hold for household energy, while the picture is somewhat more blurred for vehicle fuels.*

[5] *This suggestion does not tackle the issue of income-poor but wealthy individuals, nor the issue of high-income households with low-income individual earners (there are no joint income tax filings in Austria).*

2 Overview of measures taken in Austria

Table 1 lists the various measures at the federal level[6] passed in 2022 (or late 2021) to dampen the increase in inflation and its effects on households and firms (for more details see Budgetdienst, 2022a and 2022b).

2.1 Temporary cuts in energy taxes and subsidies for energy

The taxes on both electricity and natural gas have been set temporarily (from May 2022 to June 2023) to the minimum rate stipulated by EU law, which amounts to a temporary reduction in tax rates by about 90%. Furthermore, the ecological surcharge on electricity prices has been set to zero in 2022.[7] The introduction of national carbon pricing has been postponed from July 2022 to October 2022.

The largest measure aiming at reducing energy prices is the cap on electricity prices ("Strompreisbremse"), which subsidizes household electricity consumption up to 2,900 kWh per year (from December 2022 to June 2024), namely the difference between the market price and EUR 0.1 per kWh (should the market price exceed EUR 0.4 per kWh, the subsidy is capped at EUR 0.3 per kWh).

2.2 Transfers to households

The government relies considerably on transfer payments. To a large extent, these transfers are subject to very generous means testing criteria or not means-tested at all. The largest transfer is the temporary increase in the "climate bonus" to EUR 250 per adult (EUR 125 per child), supplemented with an "anti-inflation bonus" of another EUR 250 per adult (EUR 125 per child) in 2022. Originally, the climate bonus was intended to range between EUR 100 (for Vienna) and EUR 200 (for rural areas) per adult (and 50% of the respective amount per child). This transfer is not means-tested, but those with very high incomes (taxable income greater than EUR 90,000) are taxed on the anti-inflation bonus. Means testing for the energy vouchers of EUR 150 per person is relatively generous, too, as only households with a taxable income of above EUR 110,000 (EUR 55,000 for one-person households) are illegible. One-off payments of family benefits and the temporary increase in the income tax allowance for commuters are also not means-tested.

The largest strictly means-tested transfer-like measure is the one-off payment of up to EUR 500 to persons with low incomes, which has been implemented as a transfer to pensioners (in 2022), as a reduction in social contributions for the self-employed (including farmers; also in 2022) and as a payable tax credit for employees (payable in 2023 dependent on income in 2022). Recipients of certain social benefits (primarily minimum pensions, unemployment benefits and basic social assistance) have additionally received two one-off payments of EUR 300 each.

2.3 Other temporary measures

While the bulk of measures has been targeted toward households, there has also been support for businesses affected by the strong rise in energy prices. There have

[6] *Some additional measures have been implemented by state governments (e.g., additional transfers to low-income households), but their overall volume is small compared to the federal measures.*

[7] *In normal times, this surcharge is primarily used to subsidize a minimum price for electricity produced from certain renewable sources (e.g., photovoltaics). In 2022, this subsidy was not needed due to high market prices for electricity, so the surcharge was also unnecessary (the comparatively small other expenditure financed out of this surcharge could be financed by use of accumulated reserves).*

Table 1

Overview of measures taken by the Austrian federal government

	2022	2023	2024	2025	2026
	EUR billion				
Temporary fiscal measures concerning energy prices 2022–23	**1.7**	**3.7**	**0.9**	**0.0**	**0.0**
Temporary suspension of ecological surcharge on electricity	0.9	0.5			
Temporary reduction of excise duties on electricity and natural gas by ~90%	0.6	0.5	–0.2		
Postponement of carbon tax from 1 July to 1 October	0.3				
Decrease in tax refunds to enterprises due to postponement of carbon tax	–0.1				
Subsidy of electricity consumption ("Strompreisbremse")		2.7	1.1		
Temporary transfers and cuts in income-related taxes for households 2022–23	**5.2**	**2.4**	**0.1**	**0.0**	**0.0**
Increase in "climate bonus" (lump-sum transfer originally envisaged for redistribution of carbon tax revenue)	2.8				
Vouchers for energy bills	0.6				
One-off transfer to families, bringing forward of increase in familiy tax credit	0.4	0.2			
Increase in commuter allowance	0.1	0.2	0.1		
One-off payments for recipients of certain social benefits	0.4				
One-off payments / tax reductions for pensioners, employees and self-employed with low incomes	0.5	1.0			
2nd one-off payment for pensioners and temporary additional increase in minimum pension		0.7			
Tax exemption for "inflation bonus" paid by employers	0.3	0.3			
Transfers for preventing evictions	0.0	0.0	0.0	0.0	0.0
Other temporary measures	**4.6**	**1.4**	**0.2**	**0.2**	**0.1**
Subsidies to firms (incl. agriculture) for high energy prices	0.6	1.1	0.0		
Subsidies for switch to decarbonized power units	0.1	0.1			
Strategic gas reserve	3.8				
Investment into renewable energy and repositories	0.0	0.1	0.1	0.1	0.1
Higher subsidies for public transport	0.2	0.2	0.2	0.2	
Energy consulting	0.0				
Permanent measures effective from 2023		**2.3**	**4.5**	**6.2**	**7.4**
Indexation of income tax brackets and tax credits		1.5	3.2	4.6	5.6
Indexation of selected social benefits (esp. family benefits)		0.4	0.8	1.1	1.3
Reduction in employers' payroll taxes and social contributions		0.5	0.5	0.5	0.5
Total measures	**11.5**	**9.8**	**5.7**	**6.4**	**7.5**
	Volume in % of GDP				
Total measures	**2.6**	**2.1**	**1.2**	**1.3**	**1.5**

Source: OeNB based on Budgetdienst (2022a and 2022b), BMF, Austrian Parliament.

also been special subsidies for public transport, both to compensate the impact of higher input prices and to extend services.

Furthermore, the reaction to increased uncertainty concerning gas deliveries from Russia led to the decision to build a public strategic gas reserve. This has been conducted by a government-regulated and -guaranteed special purpose vehicle, which spent about EUR 4 billion on purchases and storage of natural gas.

2.4 Indexation of income tax brackets and family benefits

The strong upswing in inflation has reinforced the decade-long discussion on the indexation of the progressive personal income tax and of nominally fixed social transfers. The government decided that from 2023 on, there will be an automatic inflation indexation for most federal cash benefits (primarily family benefits) as

well as a semiautomatic (2/3 fully automatic, 1/3 discretionary) indexation of income tax brackets and the most important income tax credits.

The impact of the expected high increase in agreed wages on aggregate labor costs in the economy in 2023 will be slightly dampened by the permanent decrease in employers' contributions to the family burden equalization fund (by 0.2 percentage points) and to accident insurance (by 0.1 percentage points).

3 Measures taken by Austria in international comparison

As shown in table 2, all EU member states and the United Kingdom have introduced measures to curb the energy price-induced increase in inflation and to protect vulnerable/low-income groups. So far, fiscal measures have been most important: on the revenue side, energy taxes and value-added tax on energy have been temporarily reduced in almost all member states. The countries that did not reduce taxes on energy products provided (fuel) subsidies or price rebates to (vulnerable) households and businesses or regulated the prices for energy and fuel products (section 4.4). However, EU member states are not completely free to cut energy taxes and VAT or support companies, as the EU sets minimum tax rates on energy and restricts state aid to businesses (EU, 2003).[8]

3.1 Austria relied to a large extent on non-means-tested transfers

Apart from Austria, only a few member states have introduced income-independent transfers for almost all households. General relief measures for all households generally take the form of broad energy tax cuts and/or price regulation in some countries. A direct subsidy/reimbursement for electricity costs for households above some threshold along the lines of the Austrian cap on electricity prices has been set up for example in Cyprus, Estonia, the Netherlands, Greece and Lithuania, but is – in some cases, and in contrast to Austria –restricted to vulnerable groups. Germany also plans a price subsidy for gas and district heating ("Gaspreisbremse"), but – in contrast to Austria – the threshold will be based on individual consumption.

Companies are also supported by governments, mainly through subsidies such as a refund of energy costs. Differentiations are made based on the size of the company and on energy consumption (special support for energy-intensive industries). This is also the case for Austria, which provides reimbursements to energy-intensive businesses as well as business under the EU Emissions Trading System (ETS).[9] Regulatory measures often also address energy prices for businesses.

While at the beginning of the current energy crisis, tax cuts and transfers aimed to compensate for high energy prices (energy tax cuts, rebates for energy products), member states recently started to take measures compensating for overall high inflation. Austria stands out in starting to index income tax brackets on inflation for all income brackets, while Finland increased existing indexation of tax brackets. Germany, Latvia and Luxembourg increased basic personal income tax allowances, and the UK increased the threshold for social security contributions. However, unlike Poland and Croatia, Austria has not cut VAT on certain basic food products so far (not displayed in table 2) – another very broad-based measure also discussed in Austria.

[8] *For an overview of EU minimum tax rates and tax rates levied in Austria see OeNB (2022).*

[9] *SMEs (with an annual turnover of up to EUR 700,000) are eligible for the subsidy even if they are not classified as energy intensive. All businesses must set energy saving measures for eligibility.*

Table 2

Measures to fight the effects of (energy price-induced) inflation

	Taxes				Subsidies and transfers			Regulatory measures		
	Reduced energy tax or fees / VAT on energy	Increased tax allowances (to commuters, firms..)	Tax on windfall gains (energy producers)	Income tax cuts	Broad based	Vulnerable groups	Businesses	Price-/ market regulation retail	Price-/ market regulation wholesale	Money for investment in renewable, energy, public transport, etc.
Austria	✓	✓		✓	✓	✓	✓			✓
Belgium	✓					✓		✓		✓
Bulgaria							✓	✓		
Croatia	✓					✓	✓	✓		✓
Cyprus	✓					✓	✓			✓
Czechia	✓					✓	✓			✓
Denmark						✓				✓
Estonia	✓				✓	✓	✓	✓		
Finland		✓		✓			✓			✓
France	✓	✓				✓	✓	✓	✓	✓
Germany	✓	✓		✓	✓	✓	✓			✓
Greece			✓		✓	✓	✓			
Hungary	✓		✓					✓		
Ireland	✓				✓	✓	✓			✓
Italy	✓	✓	✓		✓	✓	✓	✓		✓
Latvia	✓			✓		✓				✓
Lithuania	✓				✓	✓	✓			✓
Luxembourg	✓			✓		✓	✓			✓
Malta						✓	✓	✓		✓
Netherlands	✓					✓				
Poland	✓					✓	✓	✓		✓
Portugal	✓				✓	✓	✓		✓	✓
Romania			✓			✓	✓	✓		✓
Spain	✓		✓			✓	✓	✓	✓	✓
Slovakia						✓		✓		
Slovenia	✓					✓	✓	✓		
Sweden	✓	✓				✓				✓
UK			✓		✓	✓	✓	✓		✓

Source: OeNB based on Sgaravatti et al. (2021) and on national legal and media information.

3.2 Austria did not reduce fuel costs

In contrast to most major euro area economies (i.e., Germany, France, Italy, Spain and the Netherlands), Austria has neither cut taxes on vehicle fuel nor directly subsidized it.[10] Energy tax cuts were primarily concentrated on electricity (compare section 2.1), which is generally a less problematic energy source (taxes on natural gas have been cut, too, but their overall tax reduction was significantly smaller). Many measures for "greening" the economy actually involve a switch from nonrenewable sources toward electricity (e.g., electric cars, heat pumps).

However, Austria has temporarily increased the commuter tax allowance, thereby giving transfers to individuals who tend to consume more fuel than average. However, as this tax allowance is independent of the mode of transport, there is no effect on fuel prices, but it might encourage urban sprawl.

[10] *However, the introduction of the CO_2 tax was shifted from July to October 2022.*

3.3 Austria has not taxed windfall profits so far

So as not to overburden the budget, some member states have introduced special taxes on windfall gains from energy producers, which are currently benefiting from high energy prices. Italy and the UK have introduced temporary tax rates of 25% on energy (oil producing) companies, Romania skims off 80% of excess revenues above a certain reference threshold, and Hungary has set different tax rates for petroleum product manufacturers (25%) and power producers (65%). Greece taxes power generators' windfall profits at 90%, with some exceptions for certain companies producing electricity from renewable sources only. In contrast, Spain taxes only energy producers that do not use gas. Böheim et al. (2022) recently advised against the introduction of a windfall profit tax in Austria on account of the high share of state ownership (which reaps the lion's share of excess profits anyway) as well as a possible negative impact on private investment. Instead, they suggest demanding an extraordinary dividend from (partially) state-owned energy firms and making them contribute to the cost of the electricity price brake.

In October 2022, a Council Regulation was passed on EU-wide emergency measures in response to high energy prices (EU, 2022). In addition to a general reduction in electricity demand by 10%, two measures were included to skim off profits. First, a temporary EU revenue cap of EUR 180/MWh for "inframarginal" electricity producers from, among others, nuclear energy, lignite and renewable energy sources was introduced (revenues above this amount would have to be transferred). Second, a temporary solidarity contribution of at least 33% is to be levied based on surplus profits (defined as exceeding 20% of average profits of 2018–2021) from fossil (fuel) activities. These revenues should be distributed to consumers and used for energy investments without undermining incentives to save energy.

3.4 Austria has not relied on regulatory measures so far

Energy prices for households and businesses can be contained at a certain price level by transferring part of the energy prices back to households/businesses or by directly intervening in the price-setting mechanism of the markets, such as through price caps or fixed margins. The latter are considered regulatory measures, which also tend to reduce inflation in the short term, while the former might even increase inflation. As the Austrian electricity price cap subsidizes electricity producers without capping the market price, it is not considered a regulatory measure (see table 2). Regulatory measures may negatively impact the country's reputation as a business location. Furthermore, price caps may even require governments to rescue energy producers, if the latter must sell their products below cost (as in France). However, regulatory caps may be appropriate if market mechanisms are considerably disturbed by exceptional events. As these measures have not been common in modern economies so far, they are presented for selected member states in more detail.

France: The French government has capped the electricity price increase for end-consumers of state-owned EDF (84%) to 4% in 2022. The government-set rate refers to the basic price plan from EDF, used by about 80% of households. Moreover, EDF has been requested to provide cheap electricity to other electricity providers so that they can pass on lower prices to consumers. While a large part of French electricity comes from nuclear power, the price cap is not without costs. After the necessary recapitalization the French government has now started the

process to fully nationalize EDF. The gas price has been frozen since November 2021, and gas suppliers are subsidized by the state.

Spain and Portugal: Following EU permission to deviate from EU state aid rules, Spain and Portugal (as an energy island) have capped wholesale gas prizes for electricity producers and electricity prices. This is possible as both countries depend less on Russian gas than other countries (due to gas imports from Algeria and a high share of renewable energy) and are less interconnected with the rest of the EU. By lowering the input costs of fossil fuel power stations, the increase in electricity prices has been contained.

Slovakia: The Slovak government has reached an agreement with the partly state-owned (34%) Slovak power utility to guarantee stable electricity prices for households up to 2024. The company has to supply a fixed country-wide volume at fixed prices to households, with any remainder being distributed to hospitals, schools, etc. The agreement was reached in return for the government withdrawing a bill to impose windfall taxes on nuclear power generation.

Several countries (*Croatia, Hungary and Slovenia*) have directly intervened on prices of fuels at service stations. While all three put a temporary per-litre price cap on fuels at the pump, Slovenia also capped traders' margins. The (price) caps usually do not apply to service stations on motorways. These price caps have led to supply reductions, as wholesalers are not willing to sell below cost.

4 Considerations on the timing and size of Austrian measures

The elaborations on the measures in sections 1 and 3 discuss individual measures from an allocational and distributional point of view but, in a macroeconomically volatile situation, policymakers must also consider the combined impact of all measures in terms of macroeconomic stabilization. From that point of view, two points about the fiscal package in Austria (and in other countries) are particularly striking:

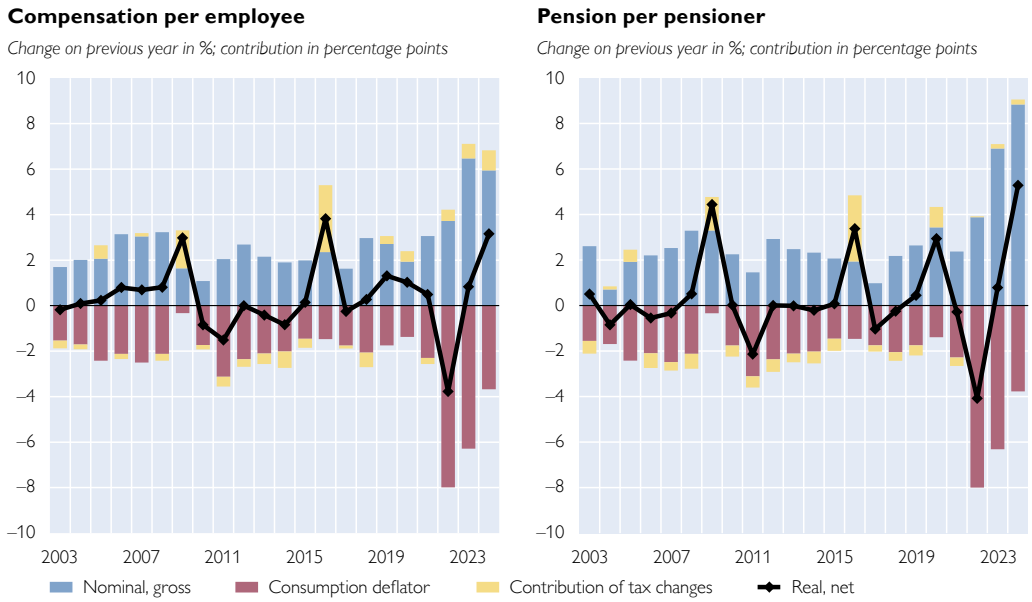
1. A very large amount of expansionary fiscal measures is implemented in a year with (very likely) real GDP and employment growth above the averages of more recent decades.
2. The government relies significantly on temporary measures even though current inflation projections do not assume a reversal to the pre-shock trend in price levels.

4.1 Relatively strong reliance on temporary measures

Concerning the second point, the current macroeconomic outlook implies that the need for large-scale support measures is only temporary. Real net wages and real net pensions are expected to decline in 2022 to an extent rarely observed in the past (chart 1). While increases in average nominal gross wages and pensions in 2022 are somewhat above the average of more recent years (blue bars), inflation (red bars) is very high. However, due to explicit inflation indexation of pensions and basing of wage negotiations on observed past inflation, growth in real net pensions and wages is likely to recover in 2023 and particularly in 2024, reducing the need for fiscal support in those years. This pattern is reinforced by Austria's decision to automatically index income tax brackets and tax credits to past inflation. Otherwise, the contribution of taxes (yellow bars) to the development in average real wages and pensions would have been substantially negative amid this very high growth in nominal incomes.

Chart 1

Decomposition of the change in per-capita net real income



Source: Statistics Austria, OeNB (OeNB June 2022 outlook updated with inflation projection from October 2022 and new fiscal measures).

4.2 Overall, the package is very large

Due to high inflation, the Eurosystem has recently started raising interest rates (i.e., monetary policy has become less expansive). Furthermore, according to the most recent macroeconomic projections, growth in both real GDP and employment is above the historical average in 2022 in Austria and the euro area. Due to imported inflation, consumer prices are increasing much faster in 2022 than the

Chart 2

Effect of anti-inflation fiscal packages on real disposable household incomes

Source: Statistics Austria, OeNB (OeNB June 2022 projections updated with inflation projection from October 2022 and new fiscal measures).

GDP deflator, though. Without the various fiscal support measures passed in 2022, aggregate real household incomes in Austria would have decreased in 2022 (blue bars in chart 2) despite very high employment growth, which would have come on top of the poor development in real household incomes in 2020 and 2021.

The scale of overall measures to support household incomes (red, green and yellow bars) prevents steep declines in real disposable household incomes in 2022–2023, leading to growth rates of around 0 (black lines). This indicates a serious policy trade-off. The support measures were largely necessary to prevent serious hardship for many households, but at the same time such large stimulus may be seen as counterproductive from an inflation stabilization point of view.

5 Conclusions

Even though all EU member states have taken far-reaching measures to curb (the effects of) inflation, these are very different in terms of design. Compared to other EU member states, the transfers paid out in Austria are less focused on vulnerable groups: the most generous subsidies to households (the "climate bonus" and the "inflation bonus") are neither means-tested nor taxable (except for very high earners in the case of the inflation bonus). In absolute terms, the indexation of income tax brackets benefits recipients of high incomes more than those of lower incomes. Furthermore, the measures rely less on cutting indirect taxes such as VAT or energy taxes, and do not aim to directly reduce fuel costs for consumers. The government is not using a tax on windfall profits as a financing source; nor is it relying on regulatory measures to curb energy prices.

In addition to questions of income distribution, governments face two important policy trade-offs when implementing such support measures. First, some measures could undermine environmental goals by inducing inefficient energy use. For example, the subsidy for electricity consumption ("Strompreisbremse") may lead households with previously low electricity consumption to use electricity for heating instead of more expensive (but also more efficient) sources like natural gas. Second, measures may curb the effects of inflation for individual households, but fuel inflation at the same time. This is particularly relevant for measures aimed at reducing energy prices, as supply curves for various energy sources are currently steep (i.e., small changes in demand can lead to relatively large price changes). Furthermore, expansive fiscal policy measures in times of high headline and core inflation rates counteract the restrictive policy stance of central banks.

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How effective were fiscal support measures in absorbing the inflation-induced rise in consumption expenditures in 2022?

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Refereed by: Paul Eckerstorfer and Friedrich Sindermann, Budget Office of the Austrian Parliament

We analyze the distributional impact of the substantial fiscal measures implemented in Austria to support household incomes amidst the sizable increase in inflation in 2022. A large part of these measures were universal transfers benefiting all households. Therefore, when we look at absolute amounts, low-income households profited from the fiscal measures to a similar extent like high-income households. When we look at the ratio of transfers to disposable incomes, low-income households profited much more. Furthermore, within the lower income quintiles, households more affected by the inflation shock received lower additional transfers than those less affected by the inflation shock. Overall, the fiscal measures did not fully offset the inflation-induced increase in consumption expenditure for households severely affected by the inflation shock across the income spectrum, including those in the bottom quintile.

JEL classification: H53, D30, E31
Keywords: fiscal stabilization measures, income distribution, inflation

Due to the exceptionally high consumer price inflation rate, real disposable household incomes would have declined substantially in Austria in 2022 without fiscal support measures (see Prammer and Reiss, 2022). However, there has been an ongoing debate about whether, or to what extent, the comprehensive fiscal "anti-inflation" measures have been targeted. Following an approach similar to that in our study on the distributional impact of the COVID-19 fiscal measures on household incomes (Maidorn and Reiss, 2021), we try to answer the following two questions with respect to the fiscal support measures introduced and effective in 2022: First, to what extent have households with lower incomes profited more than households with higher incomes? And second, within income quintiles, have households subject to larger inflation shocks profited more than households subject to lower inflation shocks?

Our paper is structured as follows: Section 1 gives an overview of the fiscal measures included in our analysis. Section 2 discusses the methodology used, and section 3 shows the distributional effects by income quintiles, while section 4 provides results broken down by households' exposure to inflation, and section 5 concludes.

1 Overview of the analyzed fiscal measures

The focus of our analysis is the combined household-level effect of inflation and fiscal support measures implemented under the various "anti-inflation" packages in 2022. These measures are special in that they are intended to temporarily support

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real household incomes, as in 2023 (and 2024), the high inflation in 2022 and 2023 will entail high (expected) increases in average pensions and agreed wages, and the structural inflation indexation of family benefits and the most important income tax parameters will come into effect; these factors are expected to contribute to an improvement in real household incomes (see also Prammer and Reiss, 2022).

The fiscal measures to support real household incomes in 2022 come in two forms:

- transfers or cuts in income-related taxes to increase nominal household income and
- cuts in taxes on products (like VAT, energy taxes) to directly decrease consumer prices.

Table 1 lists the fiscal measures covered in our analysis and shows the volume of measures deemed directly relevant for households in 2022[2] (for more details on the measures see Prammer and Reiss, 2022, as well as Budgetdienst, 2022a and 2022b). Focusing on 2022 means that we exclude the inflation indexation of family benefits and of income tax brackets and tax credits, which will come into effect in 2023. Furthermore, we also exclude the subsidy on electricity, which comes into effect

Table 1

Temporary measures to support household incomes in 2022[1]

	Official cost estimates		Simulated effect on households
	2022	2023	2022
	EUR billion		
Cuts in energy taxes	*1.7*	*1.0*	*0.9*
Temporary suspension of ecological surcharge on electricity	0.9	0.5	0.5
Temporary reduction of excise duties on electricity and natural gas by around 90%	0.6	0.5	0.3
Postponement of implementation of carbon tax from 1 July 2022 to 1 October 2022	0.2		0.1
One-off payments to recipients of social benefits[2]	*0.4*		*0.4*
Payments in early 2022	0.2		0.2
Payments in 2nd half of 2022	0.2		0.2
Vouchers for energy bills	*0.6*		*0.6*
One-off payments/tax cuts for people with low incomes	*0.5*	*1.0*	*1.2*
Reduction in social contributions for self-employed and farmers	0.1		0.1
One-off payment to pensioners with low pensions	0.4		0.5
Negative income tax for employees with low wages		1.0	0.6
Increase in climate bonus plus inflation bonus	*2.8*		*2.7*
One-off transfer to families	*0.3*		*0.3*
Increase in commuter allowance	*0.1*	*0.2*	*0.3*
Bringing forward of increase in family tax credit ("Familienbonus")	*0.1*	*0.2*	*0.4*
Total of all measures	*6.6*	*2.4*	*6.7*

Source: Budgetdienst (2022a and 2022b), Federal Ministry of Finance, OeNB, Office of the Fiscal Advisory Council.

[1] *Excluding subsidy of electricity prices in December 2022 ("Strompreisbremse") and tax exemption of "inflation bonuses" paid by employers.*
[2] *Recipients of unemployment benefits, minimum pensions, basic social assistance, student assistance.*

[2] *The temporary suspension of the variable part of the ecological surcharge on electricity was quasi-automatic due to high (projected) electricity prices, while the suspension of the lump-sum part was implemented via a discretionary law. We decided to include the full amount as a measure due to the distributive effect of the suspension (certain low-income households are always exempt from this surcharge and therefore did not benefit from the suspension).*

in December 2022 and therefore only has a small impact in 2022.[3] We also exclude the "eco-social" tax reform, which came into effect in 2022 but was adopted earlier and not in response to high inflation.

Measures implemented by the Austrian government that do not directly affect real household incomes (especially the buildup of the strategic gas reserve and the support measures for enterprises) are not considered in this paper. Cuts in energy taxes also benefit enterprises and are therefore only partly impacting energy consumed by households, as can be seen from the difference in the official cost estimates and the simulated effect on households in table 1.[4] At the same time, we assigned some amounts paid out in 2023 to 2022 in our simulations, because economically, they belong to this year. Most importantly, the temporary increase in the negative income tax for employees with low wages in 2022 can only be retrieved after the final tax assessment for 2022. Furthermore, parts of the increase in the family tax credit (family bonus) and the commuter allowance will only lead to payments after the final tax assessment.

2 Methodology

Price increases in consumer goods are calculated with the consumer price index (CPI) for the categories of products provided by the Classification of Individual Consumption by Purpose (COICOP). For Austria, Statistics Austria reports the monthly results of the CPI by detailed COICOP expenditure groups. These expenditure groups match the data of the Household Budget Survey, which covers the expenditures of around 7,000 households; the most recent data are from 2019–20[5].

In order to simulate inflation-induced rising consumption expenditures in 2022, we apply monthly rates of change of the CPI at the 4-digit level to the data of the Household Budget Survey. To capture the excessive rise of costs due to the inflation shock, we use the difference between average inflation rates from January 2022 to September 2022 (as a proxy for the overall inflation rate in 2022)[6] and their averages in the years 2016 to 2021 in each expenditure group.[7] This has somewhat different implications than looking at the levels of inflation, because the historical averages of inflation rates differ substantially among different groups of goods and services. For example, from January to September 2022, price increases were on average slightly higher in hotel and restaurant services than for the overall

[3] *We also exclude the tax exemption of "inflation bonuses" paid out by employers as we lack the information on which kind of employees profit from this measure in 2022.*

[4] *There are also some minor differences in social benefits paid out to all Austrian residents as not all of them live in households (e.g., people in long-term care facilities are not counted as members of households), and as Austrian family benefits and income tax measures also affect some households outside Austria.*

[5] *The data of the Household Budget Survey were sampled between June 2019 and June 2020, therefore around 25% of the sampling took place during the first COVID-19 lockdown. This leads to some distortions of consumption expenditures in relation to the year 2022, mainly for restaurant and accommodation services (which were particularly affected by the lockdowns). However, the average price increases for these services have been close to overall inflation so far in 2022, so these distortions have only a small impact on our analysis.*

[6] *The WIFO macroeconomic projections of September 2022 assume an average CPI inflation rate of 8.3% for January to December 2022, while the average from January to September 2022 is 7.8%. Therefore, our approach slightly underestimates the overall inflation rate for 2022.*

[7] *We included the relatively high inflation rates of late 2021 into the reference inflation, as overall, we interpret them as a normalization of price levels after the very low inflation rates before 2021.*

consumption basket, but as the medium-term average of inflation is higher for restaurant services than for overall consumption, the increase in inflation has been somewhat below average for restaurant services.

For an evaluation of the effectiveness of the fiscal measures in absorbing the impact of inflation, the best method would be to compare the transfers and tax credits for the most affected households to those for the least affected households. Unfortunately, the data in the Household Budget Survey do not include enough information on households to assign the individual measures analyzed in this paper to individual household groups. We therefore use the Office of the Fiscal Advisory Council's microsimulation model (FISKSIM), currently based on AT-SILC[8] 2018 to 2020 household data, to simulate these measures. Households are grouped by quintiles of equivalized disposable household income. The AT-SILC data, in turn, do not contain detailed consumption data that make it possible to identify the households with the lowest and highest inflation rates. Therefore, in section 4, households are additionally grouped within the income quintiles by further characteristics, especially by the population density of the area where their primary residence is located and their heating system. This is a second-best solution that enables us to apply inflation shocks derived from the data of the Household Budget Survey to households grouped by characteristics driving their specific inflation. We then contrast the average cumulated quantitative effect of the fiscal measures on household incomes[9] within these subgroups with these households' average inflation-induced rise in consumption expenditure.

The comparison of the effects of rising prices computed on the basis of the Household Budget Survey and the effects of fiscal measures, which were mostly computed in FISKSIM[10], within income groups required an adjustment of household incomes recorded in the Household Budget Survey to match them with household incomes recorded in the AT-SILC data. In the Household Budget Survey, households report their monthly disposable incomes, whereas AT-SILC data provide yearly incomes. Persons that are unemployed when surveyed, for example, tend to have higher monthly incomes in other months of the year when they are in employment. Disposable household incomes indicated in the Household Budget Survey were adjusted in line with AT-SILC data accordingly. Finally, characteristics of commuting between work and home needed to be simulated in both datasets in accordance with information given by the wage income tax statistics on commuter allowances, income levels and regions.

3 Distributional effect of fiscal measures by income quintiles

We can quantify the distributional effects of the fiscal measures and their effectiveness in absorbing the rising costs of consumption by comparing the increase in disposable incomes to the rise in consumption expenditure due to above-average inflation (assuming unchanged consumption baskets).

[8] *EU Statistics of Income and Living Conditions (SILC) of Statistics Austria with regard to Austrian data.*

[9] *The reduction of energy taxes, while being part of the fiscal measures considered in this paper, did not increase nominal household incomes but decreased expenditures by directly reducing inflation.*

[10] *The reductions in energy taxes for each household were calculated on the basis of the Household Budget Survey.*

Chart 1 shows these effects in relation to disposable household income for the quintiles of equivalized[11] disposable household incomes. Average inflation rates (i.e., the increase in consumption expenditure induced by price increases divided by the previous year's consumption) at household level are relatively similar over the income distribution (see also Fessler et al., 2022). However, the consumption ratio is significantly higher for low-income households, rising above unity in the lowest quintile and increasing the ratio of inflation-induced additional consumption expenditure to disposable income. Overall, the inflation effect decreases with rising incomes. Looking at the averages in each quintile, households in the lowest quintile have to spend about 6% of their disposable income to cover the (above-average) inflation-induced rise in consumption expenditure, whereas households in the top quintile spend only about 2½% (solid blue bars in chart 1). Without the cuts in energy taxes, the increase in consumption expenditure would have been higher by between – approximately – ¼ percentage points (top quintile, dotted blue bars) and about ¾ percentage points (bottom quintile).[12]

The sum of the fiscal measures included in this study (red bars in chart 1) slightly exceeds the additional expenses in the bottom quintile by ½ percentage points (green line). From the second quintile upward, the measures clearly do not compensate the increase in expenditure.

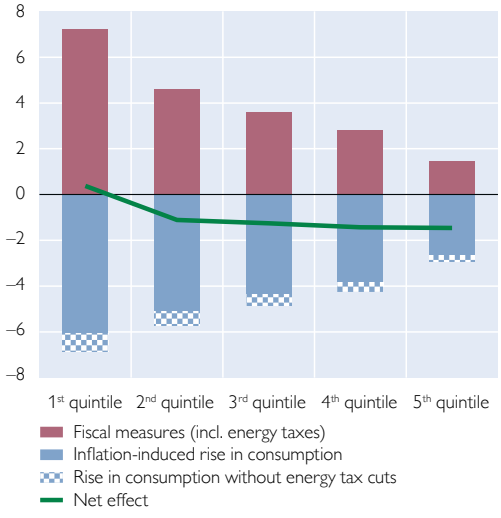
The fiscal measures introduced to absorb the rising costs of living were designed to reach all households (chart 2). Overall, all income groups benefited from the measures to a similar extent in absolute terms[13], so that lower-income households benefited more from the measures only relative to their incomes.

The combined payout of the inflation bonus and the increased climate bonus were the largest measure (pink bars) along the income distribution in our analysis. The bonuses were explicitly targeted at all households, and they accounted for almost 3% of disposable income in the lowest quintile and still around ¾% in the top quintile. Furthermore, the one-off payment of family benefits (orange bars) was not subject to means testing, and the means-tested vouchers for energy bills (dark blue

Chart 1

Distributional effects of the inflation-induced rise in consumption expenditures and fiscal support measures

% of disposable household income



Source: Office of the Fiscal Advisory Council, OeNB.

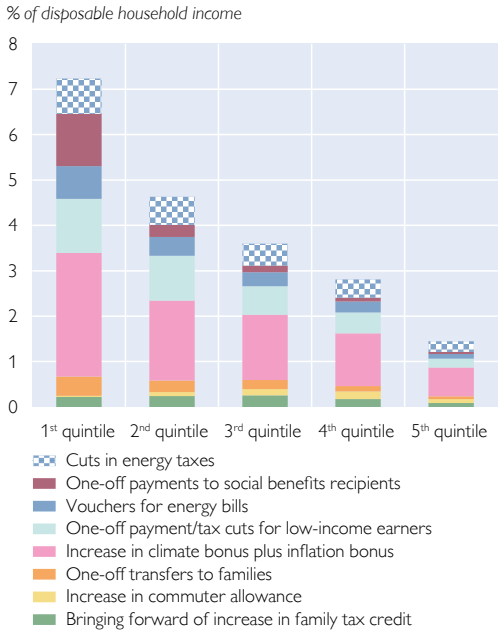
[11] *Equivalized household income is computed by dividing total household income by the weighted number of household members according to the "OECD-modified scale" (1 for the first adult, 0.5 for each additional adult, 0.3 for each child).*

[12] *We add this effect in dotted blue bars to the inflation effect in chart 1 (and also in chart 4). Otherwise, we would not be able to include the energy tax cuts as measures within the red bars.*

[13] *The average sum of transfers and tax credits for households in the top quintile amounted to around EUR 1,400, as compared to around EUR 1,500 for all households on average.*

Chart 2

Distributional effects of fiscal support measures by instruments



Source: Office of the Fiscal Advisory Council, OeNB.

bars) only excluded households at the very top of the income distribution. There have been some measures explicitly targeted at recipients of certain social benefits (purple bars) and recipients of low pension, self-employment and wage incomes (light blue bars); the former group is overrepresented in the first quintile, while the latter three are overrepresented in the first two quintiles.[14] At the same time, however, the increase in the commuter allowance (yellow bars), the increase in the family bonus (green bars) as well as the cuts in energy taxes (dotted blue bars) have benefited higher-income households more in absolute terms.

4 Distributional effect of fiscal measures by exposure to inflation

Overall, the majority of fiscal measures supported households regardless of how affected they were by the inflation shock. We see large differences in the impact of inflation on households within quintiles: The 25% of households in the lowest quintile most affected saw an additional increase in consumption expenditure by around 11% (dark green bar in chart 3), while this increase was only about 3% for the least affected 25% (light green bar in chart 3), that is, we see a spread of 8 percentage points. This spread narrows for higher-income households: In the top quintile, the difference in additional expenditure between the households most and least affected by the inflation shock is only about 2½ percentage points (for a more detailed analysis of inflation rates by income and other socioeconomic characteristics, see Fessler et al., 2022).

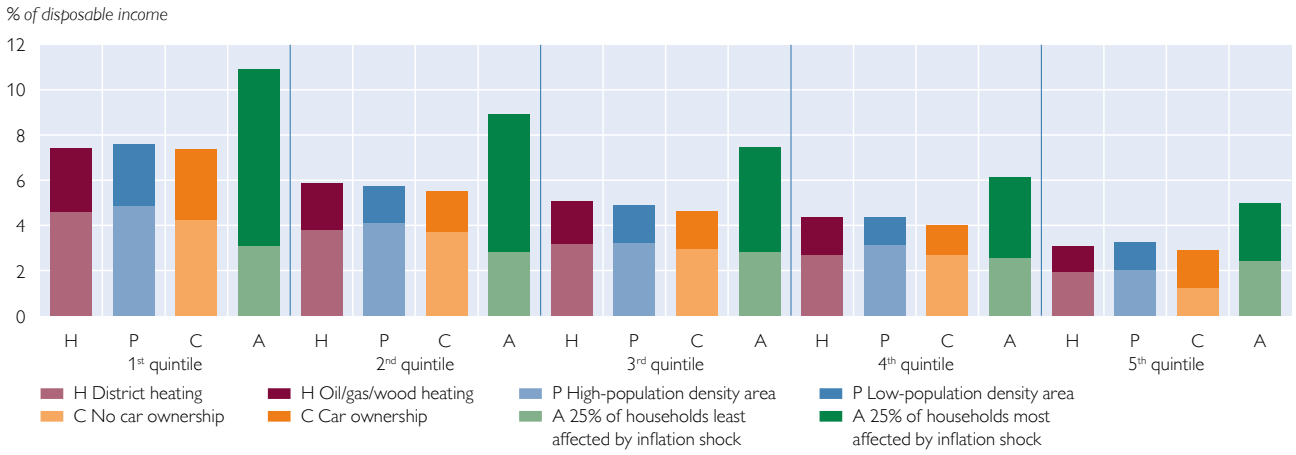
Given that AT-SILC data do not provide sufficient information for computing detailed inflation rates (see section 2), we divide income quintiles by characteristics correlated with the abovementioned inflation differentials, namely the degree of urbanization of where a household lives and the heating system it uses.[15] The former factor is an important determinant of car ownership and – in case of car ownership – of the amount of fuel consumption. Similarly, the average inflation-induced

[14] *The relatively small share of means-tested transfers in the overall package is also due to the fact that Austria currently lacks the means of a quick implementation of means-tested benefits for all households/persons with low incomes.*

[15] *We could have used more pronounced extremes of being severely or less affected by the rise in energy prices, respectively. This would come at the cost of a large reduction in the number of cases involved and households represented by them (e.g., by replacing the degree of urbanization with car ownership). The approach to look at the 25% most and least affected households cannot be applied to AT-SILC data, however, as they do not contain data on consumption expenditures.*

Chart 3

Inflation-induced rise in consumption expenditure by household type



Source: Office of the Fiscal Advisory Council, OeNB.

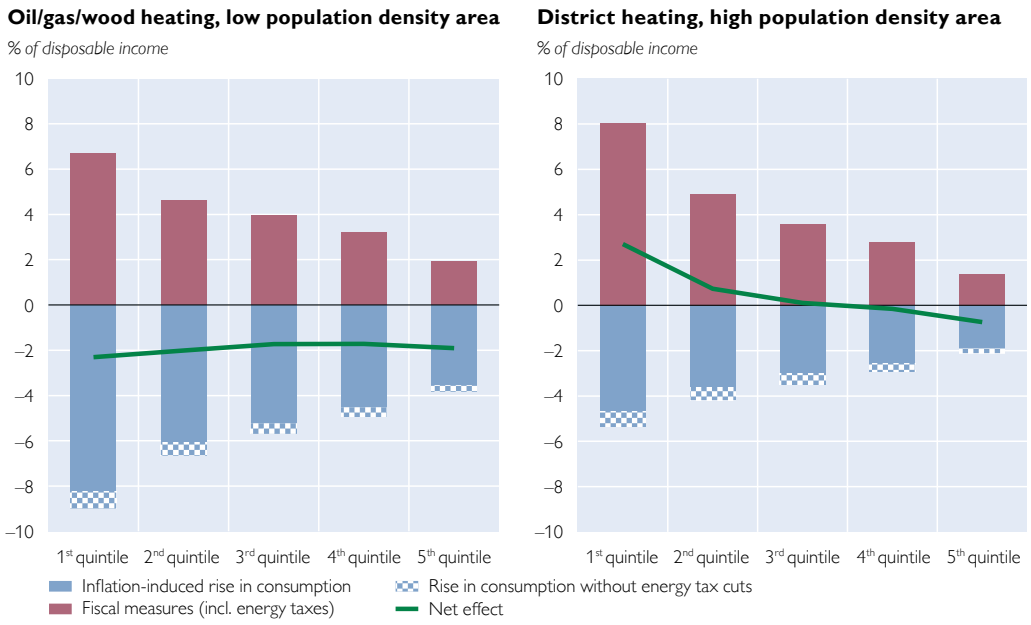
increase in expenditure is around 2 percentage points higher for households dependent on gas, oil or wood heating than for households with district heating, as it is for households living in thinly populated areas than for those in highly populated areas (chart 3). The differences are most pronounced in the lowest quintile, where 21% of the least affected and 76% of the most affected households own a car. Among the least affected households, 9% live in thinly populated areas, whereas it is 59% of the most affected households. In the following, we treat households in thinly populated areas that have gas, oil or wood heating as severely affected by inflation, and households in densely populated areas that have district heating as less affected. The results should not be interpreted as households with district heating not having been affected by rising costs of household energy at all; rather, on average, they felt the impact of significant price increases much later than other households, and therefore the contribution of energy prices to their individual inflation rates will be much lower in 2022.[16]

Chart 4 displays the differences in the rise in living costs and transfers and tax credits received between the households severely affected and those less affected, respectively, within quintiles. It shows that the combined effect of the degree of urbanization and the heating system on the inflation-induced increase in consumption expenditures amounts to almost 4 percentage points of disposable income in the lowest quintile, which falls to around 2 percentage points in the other four quintiles (comparison of blue bars in the left- and the right-hand panels of chart 4). At the same time, households less affected by inflation benefit substantially more from the fiscal support measures in the lowest quintiles of the income distribution (comparison of red bars in the left- and the right-hand panels of chart 4). This also holds, albeit to a much smaller extent, for the second quintile, while we see the opposite effect in the other three quintiles (gray line in chart 5). Overall, house-

[16] *In September 2022, large price increases for district heating in Vienna contributed to a big jump in the price index for this subcomponent, but the year-on-year inflation rate for district heating in September 2022 is still far below the rates for heating with gas, oil or wood in this month.*

Chart 4

Inflation-induced rise in consumption expenditure and fiscal support measures by household type



Source: Office of the Fiscal Advisory Council, OeNB.

holds severely affected by inflation in all income quintiles have not been compensated for the increase in consumption expenditure (green line in left panel of chart 4), while households less affected by inflation in the bottom two quintiles have been overcompensated (green line in the right-hand panel of chart 4).

Chart 5 shows that the main drivers of these differences in the impact of measures in the lower two income quintiles are the increase in the climate bonus (plus inflation bonus) as well as the targeted transfers to recipients of certain social benefits. The original climate bonus was designed to be higher in rural areas, while the bonus actually paid out in 2022 was the same for all adults. This change benefits households in urban areas (which are, on average, less affected by the inflation shock) more than households in rural areas. One should note, however, that the originally intended regional differentiation in the climate bonus would have been hard to justify in 2022: From 2023 onward, this transfer is meant to be a redistribution of the revenue from the CO_2 tax, but in 2022, the sum of the transfers is far higher than the generated tax revenue (as the tax came into effect only on 1 October). Furthermore, before 2022, inflation rates tended to be higher in urban areas (see also Fessler et al., 2022).

The targeted transfers to recipients of social benefits are de facto on average more advantageous to households in urban areas. Within the low-income quintiles, the share of recipients of these benefits (particularly of unemployment benefits and basic social assistance) is higher in urban areas than in rural or suburban areas. Within higher quintiles, the shares of recipients of social benefits are much smaller and roughly the same regardless of the degree of urbanization of their area of residence.

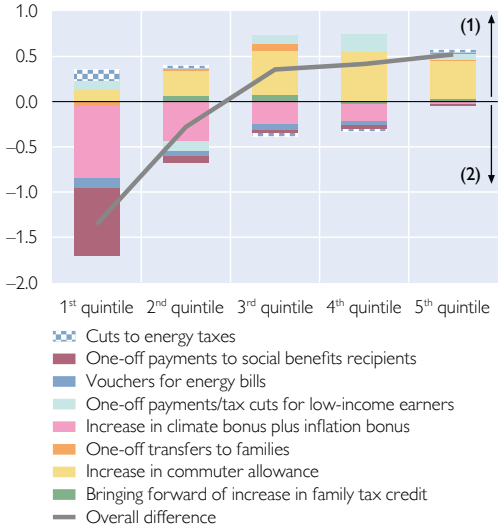
While the increase in the commuter allowance is actually among the smallest measures included in our analysis (table 1), it has, by construction, a larger impact on households more strongly affected by the inflation shock due to their high expenditure on fuel. This indicates an important policy dilemma: on the one hand, the commuter allowance is well targeted by the metric used in our paper, on the other hand, it encourages the environmentally harmful phenomenon of urban sprawl.

The remaining fiscal measures were broadly equally distributed among households regardless of their exposure to inflation, so that they hardly reduced the gap between the net effect of inflation and compensation measures for the most affected and the least affected households. As the cuts in energy taxes only marginally affected fuel prices (via a part of the postponement of the carbon tax by three months), even the cuts in energy taxes had an only marginal impact in this regard.

Chart 5

Difference in impact of fiscal support measures between household types

Effect of measures on households with oil/gas/wood heating in low population density areas minus effect on households with district heating in high population density areas in % of household income



Source: Office of the Fiscal Advisory Council, OeNB.

Note: (1) Households with oil/gas/wood heating in low population density areas benefit more
(2) Households with district heating in high population density areas benefit more

5 Conclusions

In 2022, the Austrian government took a number of substantial fiscal measures to avoid a significant decline in real disposable household incomes amidst the sizable increase in inflation. A large part of these measures were untargeted transfers benefiting all households. Therefore, it is not surprising that the absolute effect of these measures is similar across all household income quintiles, and that low-income households profited much more relative to income.

At the same time, the measures were not targeted with respect to the differences in the effect of inflation within income groups either. Within the lower income quintiles, households more affected by the inflation shock received lower additional transfers than those less affected by the inflation shock. This was largely due to the increase in the climate bonus as well as targeted transfers to recipients of social benefits, which both benefited households in urban areas more than those in rural areas. Therefore, households severely affected by inflation have not been fully compensated by fiscal measures across the income spectrum, including those in the bottom quintile.

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Quantifying the impact of the 2021–22 inflation shock on Austria's public finances

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Refereed by: Maximilian Freier, ECB

Higher inflation tends to contribute to higher growth in nominal government revenue, but its overall effect on public finances is ambiguous. We show that while the current inflation shock has a small positive short-run effect on the budget balance, it is clearly detrimental to public finances in the medium to long run. The decline in real economic growth caused by the current inflationary shock aggravates its budgetary impact further. In addition, our results highlight that the recently introduced inflation indexation of income tax brackets and family benefits substantially contributes to the negative impact of higher inflation on public finances.

JEL classification: H60, E31
Keywords: inflation, budget balance

The recent increase in inflation has contributed to strong growth in government revenue, which, at first glance, can lead to the perception that governments are beneficiaries of high inflation under a no policy-change scenario. A closer look at the budgetary impact of the current inflation dynamics reveals three reasons why this perception is questionable: First, soaring inflation also implies a strong increase in government expenditure. Second, the current inflation shock is clearly detrimental to real economic activity. The corresponding decline in real GDP growth depresses public finances via the effect of automatic stabilizers. Third, the type of shock we see at the moment leads to a large devaluation of personal household incomes, which, in turn, puts pressure on governments to take large-scale expansionary fiscal measures.

In this article, we discuss the effect of inflation on public finances under a no policy-change scenario, i.e. we elaborate on the first two points mentioned in the previous paragraph. The fiscal measures adopted by the Austrian government to ease the financial burden that the exceptionally high inflation rates have created for households and enterprises will not be addressed in this article (for an analysis of these measures, see Prammer and Reiss, 2022). However, our analysis will indicate whether the current inflationary shock has created the additional fiscal space needed for the implemented discretionary fiscal policy measures. In a no policy-change setting, the government budget balance responds to shocks to price developments for the following reasons:

1. Some revenue and primary expenditure items are not necessarily proportionally linked to price developments (elasticity with regard to the price level can deviate from 1, e.g. nominally fixed budget items have an elasticity of 0).
2. The reactions of different government revenue and government expenditure items to price developments vary in their timing. Overall, government expenditure tends to react with a somewhat larger lag than government revenue.

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3. The bulk of revenue and primary expenditure items automatically react to price developments in a proportional way (elasticity with regard to the price level is around 1), but they respond to different indicators (e.g. CPI vs. GDP deflator).
4. Shocks to price developments also impact real macroeconomic aggregates (employment, real wages, real GDP, etc.), which themselves have an effect on tax revenue and unemployment benefits (automatic stabilizers). Furthermore, they affect market interest rates, which in turn influence interest payments on government debt.

In this paper, we extensively discuss the latter two points, which is the most important difference between our paper and previous studies on the budgetary impact of inflation in Austria (e.g. Prammer and Reiss, 2015). In particular, we address the specific nature of the current inflationary shock. The current price dynamics are dominated by an adverse shock to import prices which pushes up consumer prices much more than the GDP deflator and which puts downward pressure on real GDP. Both these effects are detrimental to public finances.

The starting point of our analysis is the identification of the current inflationary shock to reflect the impact of the type of inflationary shock on the relative movement of various price indices and real economic aggregates (section 1). Section 2 describes the various theoretical transmission channels of inflationary shocks to Austrian public finances. Section 3 quantifies the budgetary impact of the current inflation shock in Austria. This is followed by a summary in section 4.

1 The current inflation shock and price dynamics in Austria

At the most aggregated level, the sources of inflation shocks can be split into two categories: cost-push inflation and demand-pull inflation (see also box 1). Inflationary shocks to the aggregate supply curve (cost-push shocks) push output and inflation into different directions, while shocks to the aggregate demand curve (demand-pull shocks) push them into the same direction. Therefore, inflation-increasing cost-push shocks have a negative impact on real GDP, which in turn negatively impacts the budget balance. Inflation-increasing demand-pull shocks have a positive impact on GDP and therefore also on the budget balance.

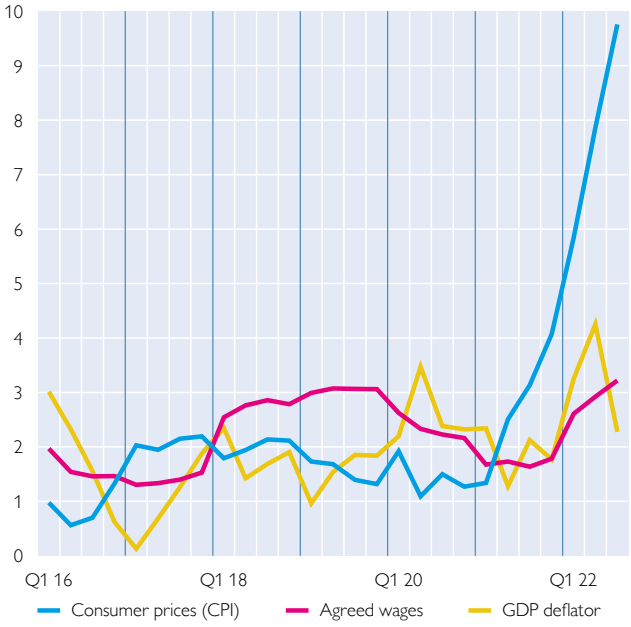
The current inflation dynamics can be decomposed into two major shocks. The first shock was triggered by a combination of a supply and a demand shock driven by supply chain disruptions, the lifting of COVID-related lockdowns and generous fiscal COVID-19 support measures. The second shock was the result of soaring energy and food prices related to the war in Ukraine. Interestingly, price developments in Austria responded to the inflation shocks in very different ways. Consumer price inflation picked up slowly in Q4 2021 and reached almost 10% in Q3 2022 (blue line in the left panel of chart 1), clearly driven mainly by the steep increase in energy prices (blue line in the right panel of chart 1). The GDP deflator (yellow line in the left panel of chart 1) increased less sharply than the consumer price index as the adverse supply shocks can be treated as largely external from an Austrian (or euro area) point of view. The disrupted supply chains and skyrocketing energy prices led to a very strong increase in construction costs, which had already started by the end of 2021 (green line in right panel of chart 1). Despite the dominant contractionary supply shocks, there were also certain demand-shock components. These were attributable to large expansionary COVID-19 measures, and also

Chart 1

Change in price indices in Austria

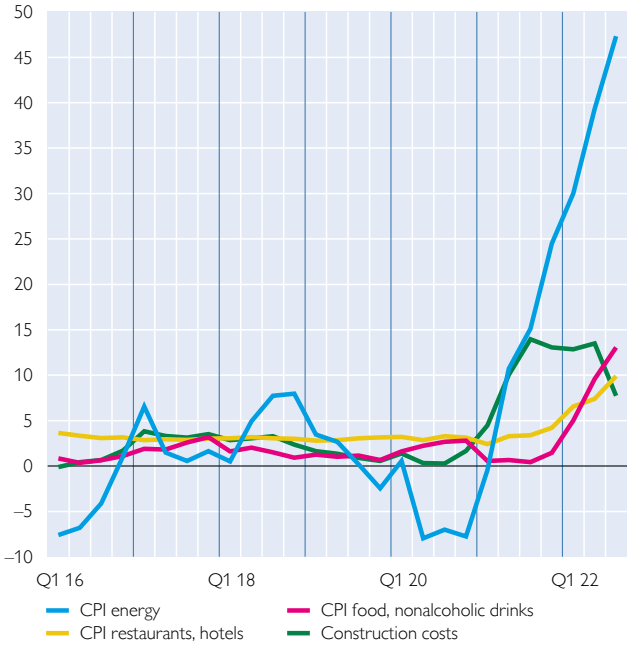
Main price and cost indices

Change on the same quarter of the previous year in %



Important price subindices

Change on the same quarter of the previous year in %



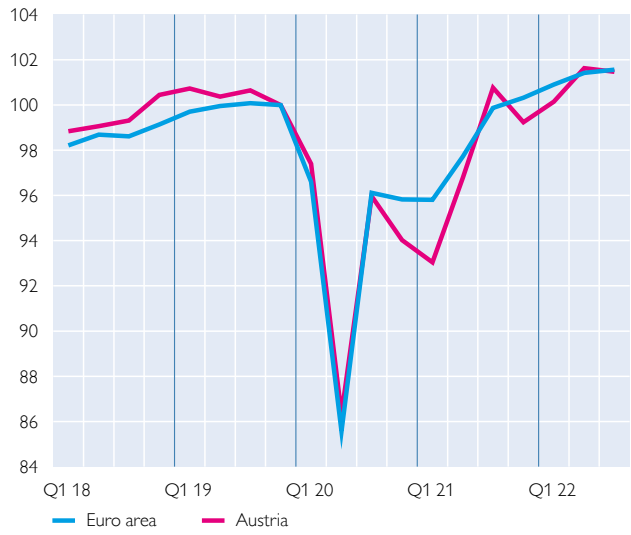
Source: Statistics Austria, WIFO.

Chart 2

Important macroeconomic aggregates in the euro area and Austria

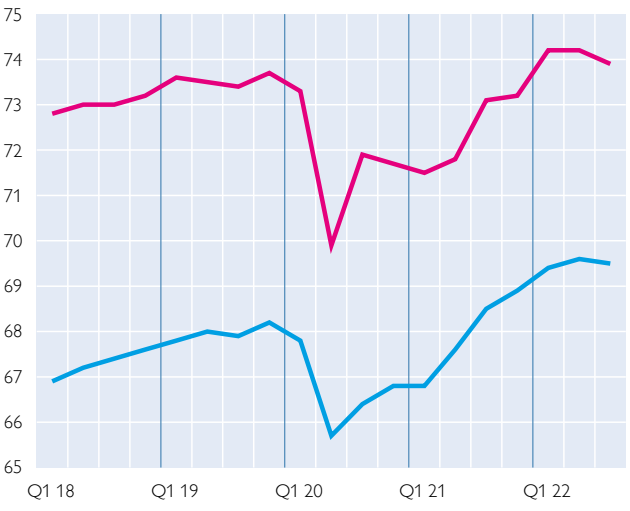
Real GDP per capita

Q4 2019 = 100



Employment-to-population ratio among the population aged 15 to 64

%



Source: Eurostat.

reflect the result of pent-up demand after the complete lifting of COVID-19 restrictions throughout Europe. As a result, employment across the euro area rose to unprecedented levels (right-hand panel of chart 2). Wages have not increased particularly strongly so far (red line in left panel of chart 1), mainly reflecting the lagged reaction of wages to price movements.[2]

Box 1

Measures of inflation and types of inflation shocks

The most commonly used metrics to measure inflation are the ***consumer price index*** *(CPI) and the* ***GDP deflator****. While the CPI measures the price changes in the cost of living by reflecting price changes in a fixed consumption bundle for households in an economy, the GDP deflator is a broader measure of inflation that includes all goods and services produced in an economy. The CPI and the conceptually similar private consumption deflator[3] also include imported consumption goods, but they exclude goods and services produced in the economy which are exported or used as investment or in government consumption. Therefore, shocks to import prices have a much larger first-round effect on the CPI than on the GDP deflator.*

Cost-push inflation *(Perry, 1987a) can be caused by domestic or international factors that trigger opposing reactions in output and price levels (pushing up the domestic aggregate supply curve). Traditionally, cost-push inflation is thought to be caused domestically, e.g. by increases in the bargaining power of workers that lead to higher nominal wages (Schwarzer, 2018). Such increases in bargaining power can be driven by organized collective movements (e.g. in the form of changing union power) or by a lack of labor supply (e.g. a decreasing working population). We refer to the domestically caused types of cost-push inflation as "wage-push inflation." Alternatively, increasing relative prices of imported intermediate goods and commodities also lead to inflation. This may be caused by an increase in international prices or a devaluation of the domestic currency. The oil price hikes in the 1970s are a well-known example of a commodity-driven worldwide increase in prices. This type of inflation is referred to as "input price shock inflation." Besides the first-round effect of input price-shock inflation on the price level, the reduction in real wages resulting from the higher price level can cause multi-round effects via nominal wage increases (built-in inflation) to stabilize real wages. These multi-round effects are often referred to as "wage-price spirals," where the perpetuation of an input price shock increases with the degree to which wages are indexed to prices. In addition to the already mentioned sources of cost-push inflation, certain price policies/regulations can also reduce aggregate supply and lead to inflationary dynamics (e.g. caps on energy prices could lead to a reduction of investment in energy production capacities, which, in turn, decreases future aggregate supply).*

Demand-pull inflation *(Perry, 1987b) is caused by sources that make output and price levels change in the same direction (pushing up the domestic aggregate demand curve). Policy-induced drivers of demand-pull inflation are typically expansionary fiscal policies (e.g. an increase in government consumption) or expansionary monetary policies (e.g. interest rate cuts to levels below those expected based on monetary policy rules). Other important sources of positive demand-pull shocks are increases in domestic consumer or investor sentiment as well as increases in foreign demand.*

The current inflation shock in Austria can be quantified by analyzing revisions to macroeconomic projections. In this paper, we take the revision of the macroeco-

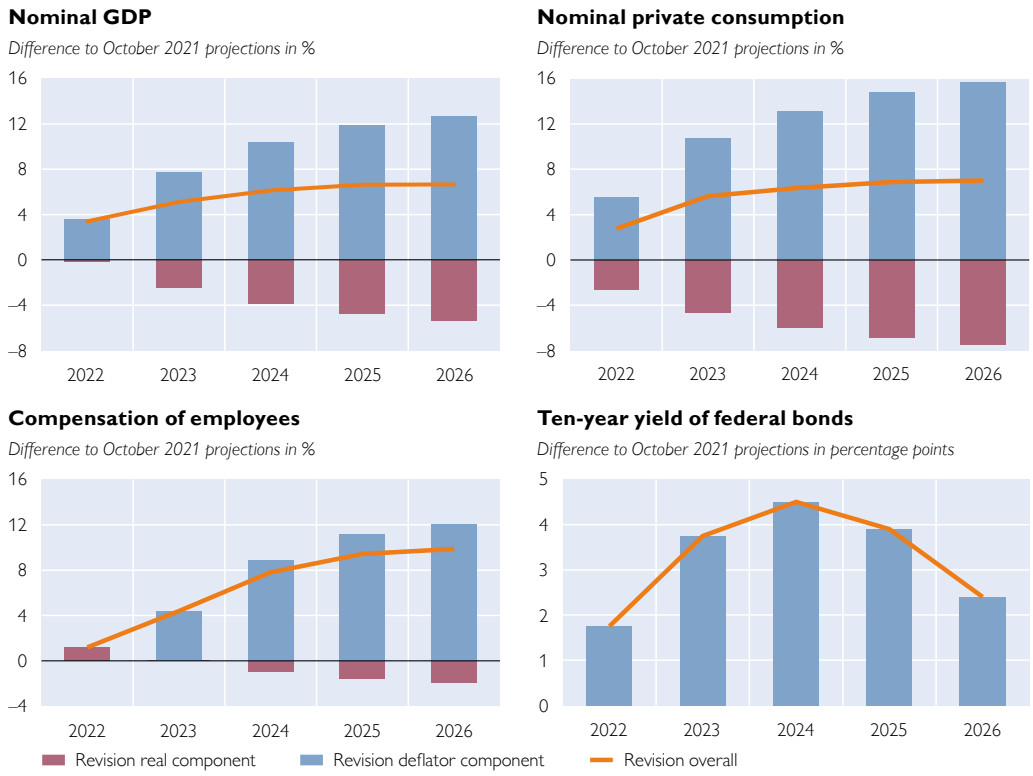
[2] *We only show the index of collectively agreed wages because both wages per employee and wages per working hour are distorted by the statistical impact of short-time work subsidies.*

[3] *The Austrian CPI measures prices of goods and services consumed by Austrian households in Austria, while the private consumption deflator also includes those goods and services consumed by Austrians abroad. Furthermore, in contrast to the consumption deflator, the CPI does not account for imputed rents from owner-occupied housing.*

nomic projections by the Austrian Institute of Economic Research (WIFO), which the Austrian Ministry of Finance and the Austrian Fiscal Advisory Council use for their fiscal projections. Chart 3 shows a comparison of WIFO's macroeconomic projections from October 2022 (Glocker and Ederer, 2022) and October 2021 (Schiman, 2021), revealing sizable upward revisions to the levels of nominal GDP, nominal private consumption, compensation of employees and the ten-year benchmark interest rate on federal government bonds (orange lines). The bars decompose these forecast revisions into real and nominal components, respectively.[4] The forecasts of both real GDP and real consumption were significantly revised downward (red bars). These downward revisions were more than compensated for by large upward revisions to the respective deflators (blue bars). This pattern is very consistent overall with a supply shock; only the initial nonresponse of real GDP (in 2022) and the small size of the response of employment in 2022–23 point to a nonnegligible role of demand. As the current inflationary shock has affected the whole euro area, it also has substantial implications for monetary policy decisions and, hence, for market interest rates, including government bond yields. In general, higher inflation tends to raise market interest rates; this is also the case in the current crisis (bottom right panel of chart 3).

Chart 3

Revision to WIFO macroeconomic projections: Oct. 2022 vs. Oct. 2021



Source: WIFO, OeNB, Office of the Fiscal Advisory Council.

[4] *In the case of compensation of employees, we attribute the revisions to the growth of compensation per employee from 2023 onward to an increase due to higher inflation (i.e. as "revision deflator component"), while revisions to the number of employees as well as wages per employee in 2022 are attributed to the "real component."*

2 The budgetary impact of inflation in Austria – theoretical considerations

Most revenue and expenditure items respond to inflation even in the absence of explicit discretionary policy action as – broadly speaking – most of these items are linked to nominal macroeconomic aggregates (listed in tables 1 and 2), which in fiscal forecasting are often referred to as "macroeconomic bases." Since price level changes influence these nominal macroeconomic bases, they indirectly also affect government revenue and expenditure reactions.

On the revenue side, most taxes are levied as percentages of certain tax bases which are steered by the dynamics of nominal macroeconomic aggregates (either as fixed percentages or at rates varying with the tax base; table 2). Most of these tax bases are income variables (i.e. wages, corporate profits, pensions etc.) or parts of consumption.

On the expenditure side, most social benefits are automatically adjusted to past inflation (table 3). The growth in expenditure on the compensation of government employees is determined by public wage agreements (table 1), which partly depends on past CPI inflation. Significant parts of spending on other current transfers, subsidies and other transfers are also linked to inflation. They are either payments for public services provided by nongovernment entities (e.g. nonprofit hospitals, nonprofit education providers, public transport providers classified outside govern-

Table 1

Macroeconomic bases for government revenue and expenditure

	ESA code	Revenue in 2021		Macroeconomic bases in fiscal projections model of the Office of the Fiscal Advisory Council
		EUR billion	*% of GDP*	
Government revenue				
Taxes on production and imports	D21+D29	56.5	13.9	See table 2
Current taxes on income, wealth, etc.	D51+D59	56.6	13.9	See table 2
Net social contributions	D61	64.2	15.8	See table 2
"Sales"	P11+P12+P131	17.9	4.4	Trend + GDP deflator (partly lagged)
Other revenue	D39+D4+D7+D9	8.0	2.0	Trend + GDP deflator
Government expenditure				
Social benefits in cash	D62	79.1	19.5	Trend[1] + price indices from table 3
Expenditure on personnel[2]	D1+D29	46.5	11.4	Trend + public wage agreements
Intermediate consumption	P2	30.3	7.5	Trend + GDP deflator (partly lagged)
Social transfers in kind purchased from market producers	D632	18.3	4.5	Trend + consumption deflator (partly lagged)
Investment + other net acquisition of nonfinancial assets	P5+NP	14.2	3.5	Trend + GDP deflator (partly lagged)
Interest spending	D41	4.5	1.1	change in debt, structure of maturing debt, interest rates
Subsidies	D3	18.8	4.6	Trend + partly GDP deflator (R&D, transport, labour market, …)
Miscellaneous current transfers	D75	8.4	2.1	Trend + partly GDP deflator (health, education, …)
National contribution to the EU budget	D76	3.5	0.9	GNI, ficitional "harmonized VAT base"
Other transfers	D9+D71+D74+ D5+(D4-D41)	3.7	0.9	Trend

Source: Statistics Austria, OeNB, Office of the Fiscal Advisory Council.

[1] *Except for unemployment benefits, which depend on number of unemployed and lagged average wages.*
[2] *Government expenditure on other taxes on production (D29) largely consists of payroll taxes and is therefore combined with compensation of employees (D1).*

Table 2

Indexation and macro bases of taxes and social security contributions[1]

	ESA code	Revenue in 2021		Indexation	Macro base in projections
		EUR billion	*% of GDP*		
Progressive taxes on income					
Income tax on wages and pensions	D51	31.1	7.7	from 2023[2]	Employees, avg. wages; pensioners, avg. pensions
Assessed income tax	D51	4.9	1.2	from 2023[2]	Gross operating surplus
Income-related taxes with floors and ceilings for tax base					
Social security contributions	D61	62.6	15.6	yes[3]	Total wages
Contribution for promotion of residential buildings	D51	1.2	0.3	yes[3]	Total wages
Fixed-amount unit taxes on goods					
Taxes on beer and alcohol	D21	0.3	0.1	no	Real consumption
Energy tax	D21	0.9	0.2	no	Real consumption
Mineral oil tax	D21	4.2	1.0	no	Real consumption
Tobacco tax	D21	2.1	0.5	no	Real consumption
Property tax A+B	D29	0.8	0.2	no	Trend
Motor vehicle tax	D59/D29	2.7	0.7	no	Real consumption
Public service broadcasting fee (incl. taxes collected with it)	D59/D29	1.0	0.2	no	Trend
Proportional taxes on income					
Corporate income tax	D51	10.2	2.5	n/a	Gross operating surplus
Capital income tax	D51	4.2	1.0	n/a	Gross operating surplus
Employer contributions to the family equalization fund (FLAF)	D29	6.0	1.5	n/a	Total wages
Municipal payroll tax	D29	3.5	0.9	n/a	Total wages
Ad valorem taxes on goods and services					
Value added tax	D21	31.0	7.7	n/a	Nominal consumption
Land transfer tax	D21	1.7	0.4	n/a	Trend
Insurance tax	D21	1.3	0.3	n/a	Trend
Duty on vehicles based on fuel consumption	D21	0.4	0.1	n/a	Nominal consumption
Taxes on gambling	D21	0.7	0.2	n/a	Nominal consumption

Source: Statistics Austria, OeNB, Office of the Fiscal Advisory Council.

[1] *This table excludes taxes payable to chambers, to the deposit insurance fund or to EU institutions.*
[2] *Indexation is based on average CPI inflation from July t-2 to June t-1; two-thirds are automatically, one-third is discretionary.*
[3] *Indexation is based on the average growth in the base for pension contributions from year T-3 to year T-2 ("Aufwertungszahl").*

Note: n/a = not applicable

ment) or consist in public co-financing of a certain share of private expenditure on wages and intermediate inputs (e.g. active labor market policies, premium for R&D, compensation of health providers for input VAT).

A significant share of other revenue and expenditure items are essentially sales or purchases of goods and services, so they also reflect price changes ("sales" on the revenue side; intermediate consumption, social transfers in kind and investment on the expenditure side; table 1).

Despite this responsiveness of both government revenue and expenditure, the current inflationary shock is not neutral on public finances. As mentioned in the introduction, this is due to the partial lack of indexation mechanisms (column 4 in table 2 and column 3 in table 3; section 2.1), due to time lags (section 2.2), due to dependencies on differently evolving deflators (section 2.3) and due to the impact of inflationary shocks on the real economy and interest rates (section 2.4).

Table 3

Indexation of social benefits in cash[1]

	Expenditure in 2021		Indexation[2]
	EUR billion	*% of GDP*	
Pensions[3]			
Old-age pensions	48.2	12.0	yes
Survivor's pensions	6.5	1.6	yes
Disability pensions	3.7	0.9	yes
Federal[4] income replacement benefits (except pensions)			
Unemployment benefits for short-term unemployed	1.9	0.5	no
Unemployment benefits for long-term unemployed	2.2	0.5	no
Continuing education allowance ("Weiterbildungsgeld")	0.2	0.0	no
Maternity allowance ("Wochengeld")	0.6	0.1	no
Sickness benefits	0.9	0.2	from 2023
Rehabilitation / short-term invalidity benefits	0.4	0.1	from 2023
Federal fixed-amount social benefits			
Long-term care benefits	2.7	0.7	yes
Cash family benefits from family burden equalization fund ("Familienbeihilfe")	3.6	0.9	from 2023
Cash family benefits labeled as "tax credit for children" ("Kinderabsetzbetrag")	1.3	0.3	from 2023
Childcare benefits[5] ("Kinderbetreuungsgeld")	1.2	0.3	from 2023
Assistance to pupils and students	0.3	0.1	from 2023
Payable tax credit for one-income families	0.3	0.1	from 2023[6]
Important benefits on state level			
Basic social assistance	1.1	0.3	yes[7]

Source: Statistics Austria, OeNB, Office of the Fiscal Advisory Council.

[1] *Excluding temporary social benefits paid out because of the COVID-19 crisis (e.g. income replacement benefits for self-employed).*
[2] *Indexation to average CPI inflation from August t-2 to July t-1 (except for payable tax credit for one-income families).*
[3] *Sum of pensions paid by pension insurance, accident insurance and pensions for civil servants.*
[4] *Federal government plus social security funds.*
[5] *Most parents opt for the fixed-amount childcare benefit, and the childcare benefit specified as income replacement has a nominally fixed ceiling.*
[6] *From a legal point of view, the tax credit for one-income families is part of the tax system, and therefore indexation is the same as for other major income tax parameters (table 1).*
[7] *Due indexation to the level of the federal minimum pension ("Ausgleichszulage").*

2.1 The role of (non-)indexation of nominally fixed fiscal variables

In Austria, social benefit payments are, in general, either determined by recipients' past incomes or fixed sums per person. The amounts paid under the most important social security benefits in Austria – pensions, sickness, rehabilitation, unemployment and maternity benefits – are determined by the past incomes earned by recipients (table 3). This means that even without inflation indexation, the payments of these wage replacement benefits to new recipients will grow per capita (albeit with a lag) as long as the relevant previously earned wages or self-employment incomes grow. The longer individuals receive such benefits, the more relevant inflation indexation becomes to ensure that the benefits do not erode in real terms over time. Reflecting this fact, long-term payments such as pension payments and basic social assistance are automatically linked to inflation. If benefit duration is short (unemployment benefits for short-term unemployed or maternity benefits), inflation indexation will have little effect on the amounts paid to recipients and on overall government expenditure.[5]

[5] *This is also why the official cost estimates for the recently introduced inflation indexation of sickness and rehabilitation benefits are very low compared to total government expenditure on these two items.*

The largest social benefits besides the income replacement benefits listed above are long-term care benefits and federal family benefits (table 3). They are paid out as fixed amounts per person. Until 2019, none of these benefits was automatically adjusted to inflation. In the absence of discretionary policy action, the real value of these transfers continuously decreased. This was particularly visible in long-term care benefits in the 2000s and early 2010s (Prammer and Reiss, 2015). Since 2020, long-term care benefits have been automatically adjusted to past inflation. From 2023 onward, family benefits are also inflation-indexed (table 3).

Taxes accounting for about one-third of tax revenue, namely taxes on corporate and capital income, payroll taxes and ad-valorem taxes on goods and services, are largely levied as fixed percentages. Under the assumption of no policy change and broadly balanced growth in income and consumption variables (i.e. macroeconomic bases), these taxes can be expected to increase in line with overall price growth over the medium run. Therefore, legal indexation mechanisms are "not applicable" in table 2.[6]

Most personal income taxes and social security contributions are not proportional to their respective tax bases, but the parameters inducing this nonproportionality (i.e. tax brackets and tax credits) are indexed to past inflation or past income growth: For social security contributions, the assessment base is subject to both a floor (below which very little contributions have to be paid) and a ceiling (above which no additional contributions are due). Both these parameters are automatically adjusted in line with the growth in the average assessment base for pension contributions (closely related to growth in average wages) from year T-2. Personal income tax on wages, pensions and self-employment income is progressive, i.e. marginal tax rates increase with income. For unchanged tax credits and tax brackets, an increase in average incomes by about 1% leads to an increase in revenue from these taxes by almost 2%. This would mean that positive inflation has substantial effects on implicit tax rates in the absence of changes to tax parameters. However, from 2023 onward, income tax brackets and the most important tax credits are quasi-indexed to past CPI inflation (table 2).

Furthermore, the rates for taxes on specific goods are set in nominal terms, either as fixed amount per quantity purchased (e.g. liters of fuel) or as fixed amount per quantity owned (e.g. engine capacity of cars). These tax rates are not subject to inflation indexation. Therefore, their real value erodes over time (without discretionary policy action). In 2021, these nonindexed taxes summed up to around 3% of GDP (table 2).

2.2 The role of time lags in response to inflation

The indexation of social benefits and income tax parameters imply that these fiscal items (partly) react to inflationary shocks with a time lag. The same is true for public wages because wage agreements take past inflation as an important reference point. Overall, ex post indexation to past CPI rates is more prominent on the expenditure side, while a significant share of revenue can be expected to react almost simultaneously to inflationary shocks (especially revenue from VAT). Therefore, government expenditure tends to react more slowly to price increases

[6] *Only some relatively minor parameters concerning these taxes are fixed in nominal terms (e.g. minimum corporate tax, parameters concerning property transaction taxes on inheritances and gifts).*

than government revenue. This discrepancy is smaller in the current environment determined by an import price-driven cost-push shock as the reaction of revenue also tends to be slower than during domestic wage-push shocks or domestic demand shocks. Inflationary shocks driven by import price hikes cause average wages to respond to higher consumer prices with a time lag, while in case of a wage-push shock, higher average wages are the source of the inflationary shock. In case of demand shocks, average wages will go up faster than in the case of import price-driven cost-push shocks due to an increase in average hours worked per employee.

2.3 Dependence on different deflators

Due to different nominal macroeconomic bases and reference data series for indexation mechanisms, the relevant deflators for the fiscal variables differ from each other. Overall, the GDP deflator is more relevant for revenue categories, while CPI inflation is more relevant for the expenditure side: A large part of revenues are taxes and social security contributions based on wage and profit income generated in the domestic economy, and the GDP deflator can be thought of as the price index best reflecting these aggregates (even though agreed wage increases tend to be related to past CPI rates, they eventually push up the GDP deflator). On the expenditure side, consumer prices are more relevant as most social benefits in cash are explicitly indexed to CPI inflation. Furthermore, CPI inflation is an important reference point for increases in public wages, and, finally, the government is a consumer itself. These facts imply that an inflationary shock where the GDP deflator increases far less than the CPI (charts 1 and 3) tends to be detrimental to public finances.

Concerning the relevance of consumer prices for government spending on goods and services, one must note that the "consumption bundle" of the government is very different from that of households. For example, the share of food, drinks and restaurant services in government consumption is very low. High food inflation raises the reference index for increases in public wages and social benefits, but it has no significant effect on nonwage government consumption. At the same time, more than one-tenth of public intermediate consumption was spent on energy in 2018 (according to 2018 input output tables), which led to a share of energy in overall government spending on goods and services similar to that of households. Furthermore, as a large share of public investment is in construction, the government is heavily impacted by the current strong rise in construction prices (like households).

2.4 Direct impact via (real) automatic stabilizers and changes in interest rates

Tables 1 and 2 show that the bulk of revenue and expenditure items are somehow impacted by macroeconomic developments. However, most expenditure items only react to price deflators, the most important exception being unemployment benefits, which tend to decrease with higher economic activity.[7] In contrast to that, the bulk of tax revenue is positively correlated to both price deflators and real

[7] *In case of country-specific shocks, contributions to the EU budget would also increase with real economic activity, but this effect is much smaller in absolute value than the expenditure-decreasing effect of higher real activity on unemployment benefits.*

activity. Therefore, it is widely acknowledged that – ceteris paribus – higher real economic activity tends to improve budget balances (only the magnitude of this effect is subject to debate).

This implies that inflationary shocks resulting in higher real GDP and employment (i.e. positive demand-pull shocks) are beneficial for public finances, while inflationary shocks resulting in lower real GDP and employment (i.e. adverse cost-push shocks) are unfavorable. If income tax brackets and social benefits are mostly indexed to inflation (as is the case in Austria from 2023 onward), these effects should typically be larger (in absolute value) than the other fiscal effects of inflation at least in the medium and long run. This is also illustrated in the next section.

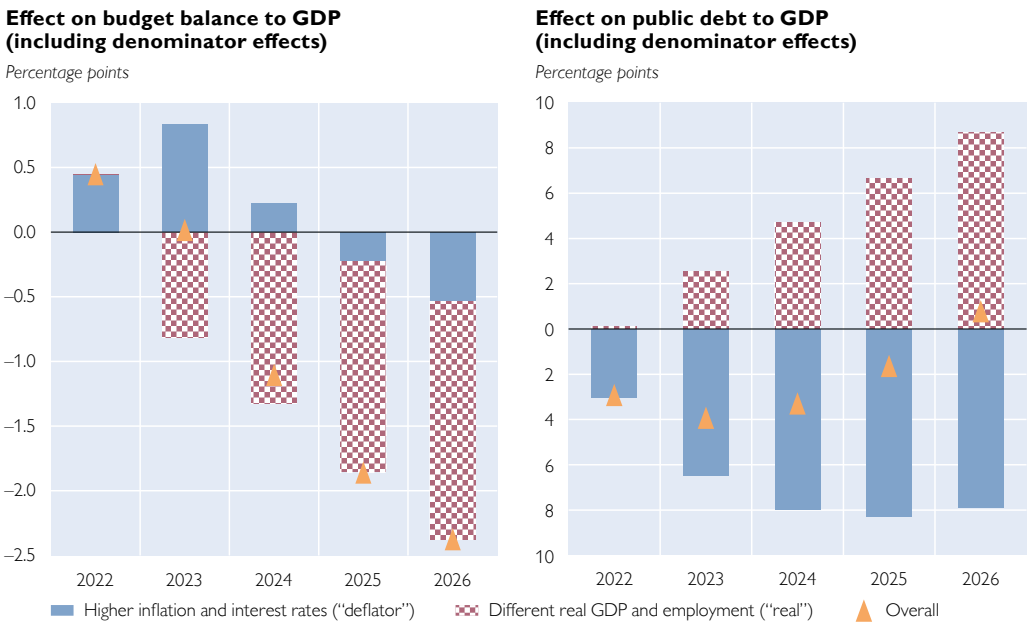
Furthermore, inflationary shocks also tend to affect interest rates and, consequently, interest spending as well as (the relatively smaller) revenue from interest and taxes on interest income. As Austrian government debt has predominantly relatively long average maturity and carries mostly fixed coupon, changes in interest rates translate slowly into changes in interest payments; this also contributes to government expenditure responding to inflation more slowly than government revenue.

3 Simulation of the budgetary impact of the current inflation shock

The current high inflation episode can be described in short as an environment of high aggregate demand hit by especially large input price shocks accompanied by wage-push shocks (section 1). To illustrate the implications of the current inflationary shock, we quantify the impact of the revisions to WIFO's macroeconomic projections (chart 3) using the projections model developed by the Office of the

Chart 4

Effect of revisions to macroeconomic projections on public finances



Source: Office of the Fiscal Advisory Council, OeNB, WIFO.

Austrian Fiscal Advisory Council (Büro des Fiskalrates, 2014).[8] This model uses a granular decomposition of government revenue and expenditure and links their evolution to the macroeconomic aggregates and price indices listed in tables 1 and 2. The macroeconomic projections by WIFO are treated as exogenous inputs such that there is no macro feedback from changes to fiscal variables.

We show that the overall revisions to the macroeconomic projections contributed positively to the budget balance in 2022. Further on, this effect continuously deteriorates and turns negative from 2024 onward (orange triangles in the left panel of chart 4). This development is largely due to the highly negative impact of the inflation shock on real GDP and employment (shaded red bars). Nevertheless, in 2025, the contribution of higher inflation and higher interest rates (blue bars) also turns negative. Due to the GDP denominator effect, the short-term impact of the inflation shock on the debt ratio is negative (i.e. favorable from a fiscal viewpoint), but from 2026 on, continuously increasing accumulated budget deficits lead to a deterioration in the debt ratio (right panel of chart 4).

Chart 5 decomposes the results shown in chart 4 further by highlighting the importance of denominator effects as both the budget balance and public debt are expressed as ratios to nominal GDP. Furthermore, chart 5 breaks down the impact on the budget balance by contributions from expenditure and revenue, and it shows the impact of changes in interest payments on public debt.

The left panel of chart 5 shows that in absolute terms, the effect of lower real GDP on revenue (red shaded bars) is much smaller than the effect of higher inflation on revenue (light blue bars) and expenditure (dark blue bars). However, the latter two effects broadly cancel each other out, leading to a comparatively small effect of higher inflation and interest rates on the budget balance (as shown in the blue bars in the left panel of chart 4). Therefore, the effect of lower real GDP on revenue (i.e. automatic stabilizers; red shaded bars in chart 5) clearly dominates the overall revision to the budget balance (orange triangles in chart 5). Government expenditure reacts with a somewhat larger lag to higher prices than government revenue, which contributes to the positive short-term effect of higher inflation and interest rates on the budget balance.

As regards public debt (right panel of chart 5), denominator effects are the main drivers of the results in the first years, and the debt ratio-reducing effect of the higher GDP deflator (light blue bars) is much larger in absolute terms than the debt ratio-increasing effect of lower real GDP on the denominator (shaded red bars). However, in the subsequent years, the debt-increasing effects of higher primary deficits due to lower real GDP (shaded yellow bars) and of higher interest payments (gray bars) become more important and, ultimately, lead to increasing debt ratios from 2026 onward. Due to the long average maturity of public debt, higher interest rates take some time to feed through to interest payments, but at the same time, this makes the effect on interest payments very persistent. So, if both market interest rates and GDP deflator growth were to jump back to pre-inflation shock levels in 2027, the debt ratio-reducing effect of the higher level of the GDP deflator would remain unchanged compared to 2026, while the debt-increasing contribution of

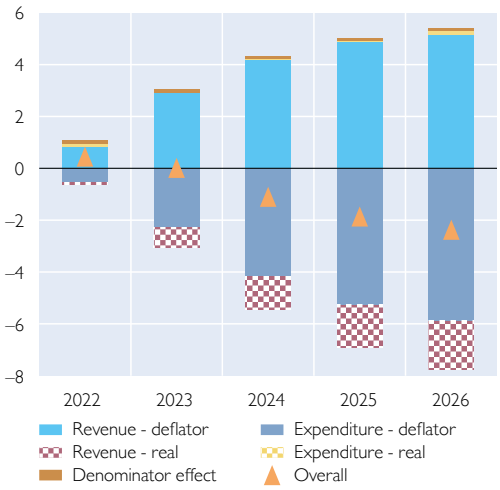
[8] *As mentioned in section 1, the WIFO projections from September/October are also used in the regular budgetary projections by the Austrian Fiscal Advisory Council.*

Chart 5

Further decomposition of inflation effects on public finances

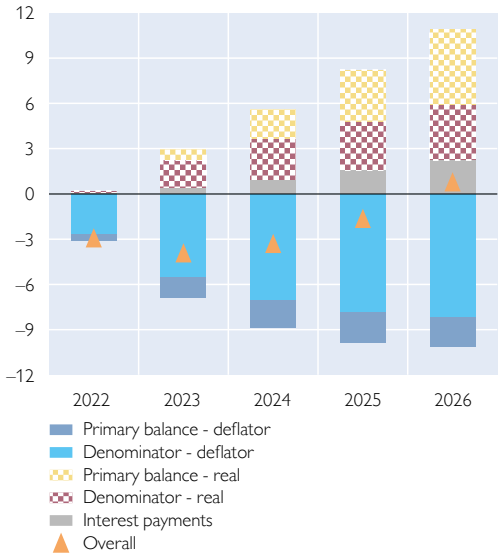
Effect on budget balance to GDP (including denominator effects)

Percentage points



Effect on public debt to GDP (including denominator effects)

Percentage points



Source: Office of the Fiscal Advisory Council, OeNB, WIFO.

higher cumulated interest payments would continue to grow until the debt issued at high interest rates matures.

The detrimental effects of the current inflation shock on public finances are substantially influenced by the recently introduced indexation of income tax brackets and family benefits. Up until 2022, positive inflation improved the contribution of fixed-amount tax brackets and social transfers to the budget balance (first and second columns in table 4). This factor contributed significantly to the consolidation episode from 2010 to 2015. However, from 2023 onward, positive inflation will reduce this contribution, as nominally fixed parameters of taxes on goods (like the mineral oil tax or the motor vehicle tax) are not indexed to inflation (section 2.1). The revisions to inflation projections increase the cumulated reference inflation relevant for tax and benefits indexation by about 12 percentage points until 2026. Given that the introduction of indexation has changed the effects of 2% inflation on the budget balance by about 0.2 percentage points (table 4), this im-

Table 4

Effects of nonindexation of taxes / transfers on budget balance with inflation at 2%

	Until 2019	2020 to 2022	From 2023
	% of GDP		
Progressive income taxes	0.15	0.15	0.00
Fixed-amount unit taxes on goods	–0.06	–0.06	–0.06
Fixed-amount social benefits	0.05	0.03	0.00
Sum	0.14	0.13	–0.06

Source: OeNB, Office of the Fiscal Advisory Council.

plies that the effect of inflation revisions on the 2026 budget balance would have been higher by about 1.2 percentage points under a no policy-change scenario.[9]

4 Conclusion

The recent increase in inflation has contributed to strong growth in government revenue. At the same time, it has substantially increased government expenditure and reduced real economic growth. To evaluate the budgetary effect of the inflationary shock, its composition has to be closely examined. The current inflationary shock mainly consists in a strong increase in international energy prices. Most importantly, this type of shock has a negative impact on real GDP, which in turn has a clearly negative effect on public finances. Furthermore, the current shock raises the CPI more than the GDP deflator. Since government expenditure in Austria is mainly influenced by the CPI, while revenue is more closely related to the GDP deflator, expenditure has increased more strongly than revenue in the current high-inflation environment. This implies that overall, the inflation shock has had a negative impact on the government budget. However, given that expenditure increases with a greater lag than revenue, the short-term impact of the inflationary shock on the budget balance is positive. That said, this positive budgetary short-term effect is far smaller than the size of the discretionary fiscal policy measures implemented to alleviate the impact of the inflationary shock on real household incomes and firms.

As regards the public debt ratio, the inflation shock has a relatively favorable effect in the short run. This is due to a large denominator effect caused by a higher GDP deflator. However, on account of the continuously increasing adverse effects on budget deficits, the current shock raises the debt ratio from 2026 onward. Our analysis further shows that the recently introduced inflation indexation of income tax brackets and family benefits has a large impact on public finance dynamics; before this policy change, revenue reacted more strongly to changes in inflation in the medium run, while the response of expenditure was slightly weaker.

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[9] *However, it would have been politically hard to justify not making any adjustment to income taxes and family benefits when inflation is that high.*