ECB FORUM ON CENTRAL BANKING

1–3 July 2024

Monetary policy in an era of transformation

The drivers of post-pandemic inflation

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EUROPEAN CENTRAL BANK
EUROSYSTEM

The drivers of post-pandemic inflation

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Abstract

Post-covid inflation was predominantly driven by unexpectedly strong demand forces, not only in the United States, but also in the Euro Area. In comparison, the inflationary impact of adverse supply shocks was less pronounced, even though these shocks significantly constrained economic activity. With output already weakened by these unfavourable supply conditions, any attempt by the European Central Bank to further mitigate the demand-driven inflationary pressures—to maintain inflation near its 2-percent target—would have severely hampered an already anaemic recovery.

1 Introduction

The evolution of post-pandemic inflation has been remarkably similar in the United States (US) and the Euro Area (EA). US inflation has accelerated in the first half of 2021, it has reached its peak in the second quarter of 2022, and it has been falling since. Inflation in the EA has followed the very same path, only delayed by approximately six months. In this paper, we study the causes of this high inflation episode—the first of its kind since the Great Inflation of the 1970s—and the trade-offs confronting the Federal Reserve (Fed) and the European Central Bank (ECB).

Such similar inflation experiences across the Atlantic are unlikely to be mere coincidences. In fact, we find that inflation has been largely driven by demand forces in both regions. At the beginning of the pandemic, both economies were knocked down by large negative supply and demand shocks, severely depressing economic activity. Our empirical results suggest that, as conditions began to recover, aggregate demand rebounded more rapidly than anticipated, outpacing aggregate supply and generating inflation. Figure 1 provides a graphical illustration of this story using a simple diagram with aggregate demand (AD) and supply (AS) curves. Both curves initially bounce to the left, and then move slowly back to their original position. But the AD curve moves back faster than expected and overshoots its original position, due to a possible combination of uncommonly expansionary fiscal policies, unexpectedly strong pent-up demand following the reopening after the pandemic restrains, and unusually loose monetary policies.

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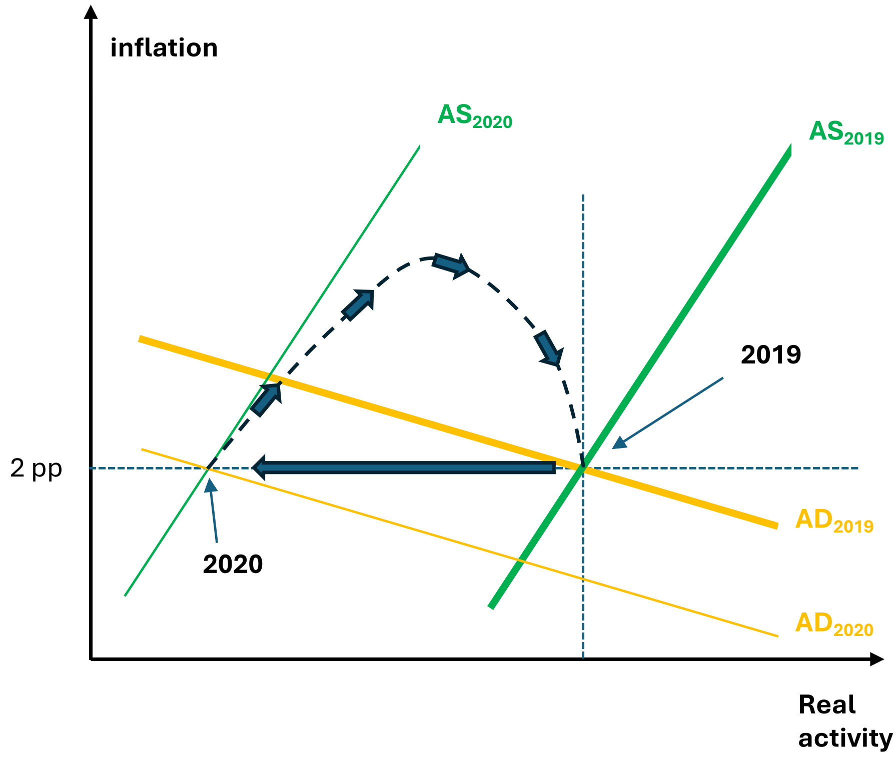
[3] Domenico Giannone started working on this project before joining the IMF. The views expressed here are those of the authors and do not necessarily represent those of the IMF, its Management and Executive Board, or IMF policy.

Figure 1
A simple AS-AD diagram



The result that inflation is mainly demand driven might seem at odds with a widely held view that unfavourable supply shocks have played a major role for the run-up of inflation, especially in Europe. But this popular narrative is difficult to square with all the evidence. The easiest way to understand why is to go back to the simple AD-AS diagram of figure 1. Notice that the AD curve in the figure is quite flat. It is important to realize that the slope of the AD curve is not an exogenous object, but it depends on the systematic conduct of monetary policy. A flat AD curve is exactly what we should expect for economies with Central Banks that have established a strong reputation of (near) inflation targeters, like the US and the EA. But if the demand curve is flat, left shifts in the supply curve depress output but cannot produce much inflation. For inflation to climb, the demand curve must shift upwards, due to demand shocks or temporary deviations from the Central Bank's previous conduct of monetary policy.

This simple argument conveys the essence of the intuition of why adverse supply shocks have significantly reduced economic activity since 2020, particularly in the EA, but their effect on inflation is likely to have been more small. Instead, post-covid inflation must have been largely fuelled by demand shocks—a result that we obtain using a dynamic multivariate statistical model, not simply the AD-AS diagram of figure 1. We use our statistical model to also evaluate the policy trade-offs of the ECB. Specifically, we address the question: Despite inflation primarily stemming from demand shocks, would it have been prudent for the ECB to mitigate their impact on inflation? The answer to this question, of course, hinges on policymakers' preferences for inflation versus output stabilization. We find that striving to maintain inflation close to the 2-percent target would have led to a cumulative GDP loss of roughly 4.5, with economic activity in 2024 being 5 percent lower than actual. This is a significant loss, given that economic activity was already strained by adverse supply conditions.

Finally, we utilize the model to assess the prospects for inflation. At the time of writing, the year-on-year headline HICP inflation in the EA is approximately 2.5 percent. Our model projections, corroborated by professional forecasters, suggest a positive outlook, anticipating a smooth return to target in the coming quarters. Paraphs even more importantly, the ECB has not suffered any significant loss of credibility due to the recent inflation spike. In fact, our findings show that the public believes that monetary policy has already returned to its pre-covid standards.

In the rest of the paper, we will explore all these issues in detail. But before moving to the main body of the manuscript, we note that the recent run-up of inflation is an active area of research. We will put our contribution in the context of this growing literature in section 4, after discussing some of the details of our work.

2 Data and stylized facts

This section summarizes the dynamics of real activity and prices in the US and the EA since the onset of the coronavirus pandemic. We organize the presentation of this empirical evidence around three stylized facts.

Fact 1. The covid recession has been more severe in the EA than in the US, and the recovery has been slower and more incomplete.

Fact 2. The evolution of headline inflation, instead, has been remarkably similar across the Atlantic.

Fact 3. Total energy prices have also behaved very much alike in the US and the EA, although the two components of energy prices, household and transportation energy, have evolved differently in the two economies.

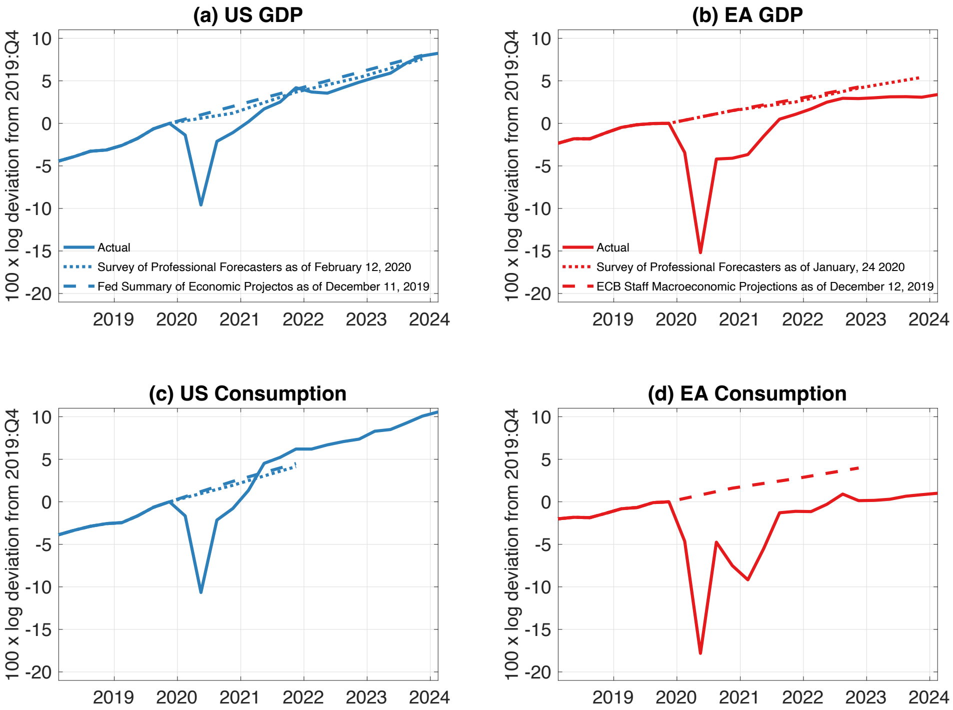
Figure 2 documents fact 1, by showing the evolution of real GDP and consumption expenditure since 2018, both in the US and in the EA. To facilitate the comparison, all the variables are plotted using a logarithmic scale and have been normalized to be equal to 0 in 2019:Q4. The figure makes clear that the collapse of economic activity at the beginning of the pandemic has been particularly pronounced in the EA, where GDP and consumption plummeted by roughly 16 and 18 percent relative to the end of 2019—approximately two-thirds more than in the US. Figure 2 also reports the pre-covid projections of the Fed, the ECB and the Survey of Professional Forecasters for GDP and consumption after 2020 (dotted and dashed lines).[4] Notice

[4] The annual projections are mapped into quarterly assuming a constant quarterly growth rate within each year.

that GDP and, especially, consumption are still below these pre-covid projections in the EA. On the contrary, the recovery has been considerably faster in the US.

Figure 2

Real GDP and consumption expenditure in the US and the EA

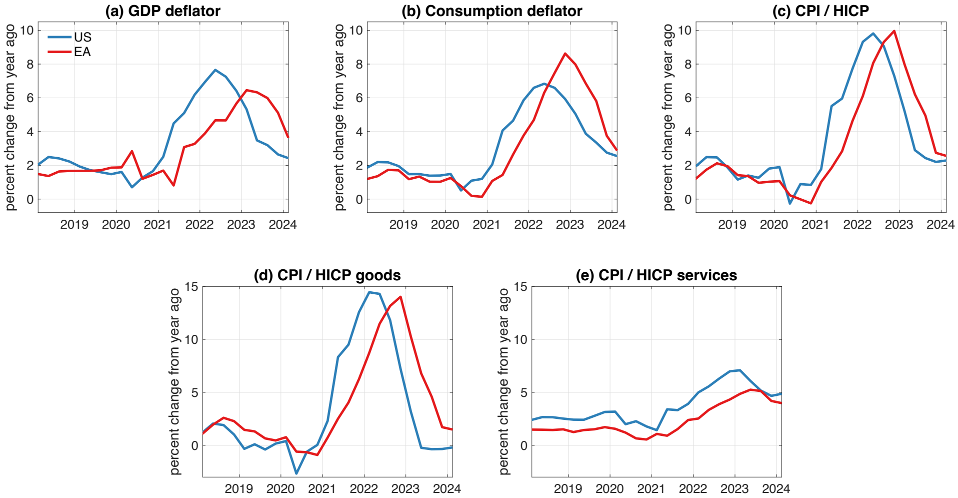


Sources: Data from Eurostat, the European Central Bank, the Bureau of Economic Analysis, the Board of Governors of the Federal Reserve System, and the Federal Reserve Bank of Philadelphia; accessed via Haver Analytics; computations by authors.

Figure 3 provides support for fact 2. Panels (a) and (b) plot year-on-year inflation based on the GDP and the consumption deflators, both in the US and in the EA. Panel (c) focuses on the most widely monitored measure of EA inflation, based on the Harmonized Index of Consumer Prices (HICP), and compares it to the US Consumer Price Index (CPI). To make such comparison more meaningful, CPI inflation in the US has been adjusted to exclude “Owners' equivalent rent of residences,” since the HICP in the EA does not comprise any rent imputation for owner occupied houses. The data in the first row of figure 3 tell a common story: The run-up of prices has been delayed by a few quarters in the EA, relative to the US. But besides such delay, the overall evolution of inflation has been remarkably similar in the two regions, especially if contrasted with the different dynamics of economic activity during the same period. In addition, notice that HICP inflation was already above 5 percentage points at the end of 2021, before the outbreak of the Ukrainian war. Panels (d) and (e) corroborate the similarity of the US and EA inflation experience, by distinguishing between inflation for consumption goods and services. This distinction may be important because goods inflation has peaked earlier and higher than services inflation, as it is well known. But the second row of figure 3 shows that these dynamics too are common to the two regions across the Atlantic.

Figure 3

Inflation in the US and the EA, based on several price indexes

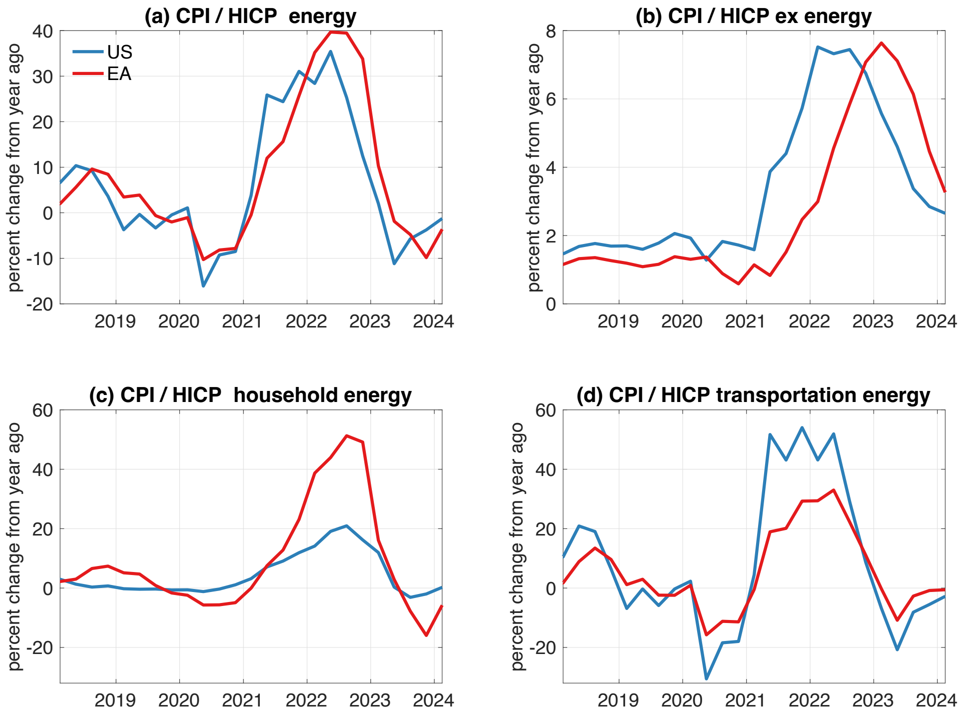


Sources: Data from Eurostat, the European Central Bank, the Bureau of Labor Statistics, and the Bureau of Economic Analysis; accessed via Haver Analytics; computations by authors.

Figure 4 demonstrates fact 3. Panel (a) shows that energy-price inflation has gone up and down in tandem in the US and the EA. It has peaked slightly higher and fallen with a delay in the EA. But this discrepancy seems relatively small, compared to the size of the rise and fall of energy-price inflation since 2020. Panel (b) of figure 4 plots year-on-year inflation excluding energy, which exhibits the usual similar but phase-shifted behaviour in the US and the EA. Despite these similarities, the second row of figure 4 highlights some heterogeneity in the behaviour of the two components of energy prices. Panel (c) shows that the price of household-utilities energy has increased a lot more in the EA than in the US, as also noted by Tenreyro (2023). This pattern is surely due, at least in part, to the greater influence of the Ukrainian war on European electricity and gas prices. On the contrary, the retail price of transportation fuels in panel (d) displays a considerably larger swing in the US, compared to the EA. As it turns out, the differences between the behaviour of household- and transportation-energy inflation almost exactly balance out when considering the aggregate price of energy in panel (a).

Figure 4

Energy-price inflation in the US and the EA, and CPI/HICP inflation excluding energy



Sources: Data from Eurostat, the European Central Bank, and the Bureau of Labor Statistics; accessed via Haver Analytics; computations by authors.

In the rest of this paper, we investigate the drivers of these macroeconomic dynamics, focusing on the causes of the inflation surge. As a preview, we find that the worse performance of economic activity in the EA (fact 1) is due to a higher incidence of negative supply shocks. However, these supply shocks have had little impact on inflation, whose run-up (fact 2) has been largely driven by unusually strong demand forces, both in the US and the EA. Finally, the rapid increase of energy prices (fact 3) is a consequence of strong demand, not a primitive cause of inflation. Understanding the relative contributions of demand and supply shocks is important for the design of stabilization policies. The conventional view, grounded in monetary theory, is that Central Banks should "look through supply shocks," but suppress demand disturbances. In the second part of the paper, we quantify the extent to which leaning against demand would have hampered the recovery.

3 Demand- or supply-driven inflation?

To study the drivers of macroeconomic dynamics, we estimate the following Structural Vector Autoregression (SVAR) model,

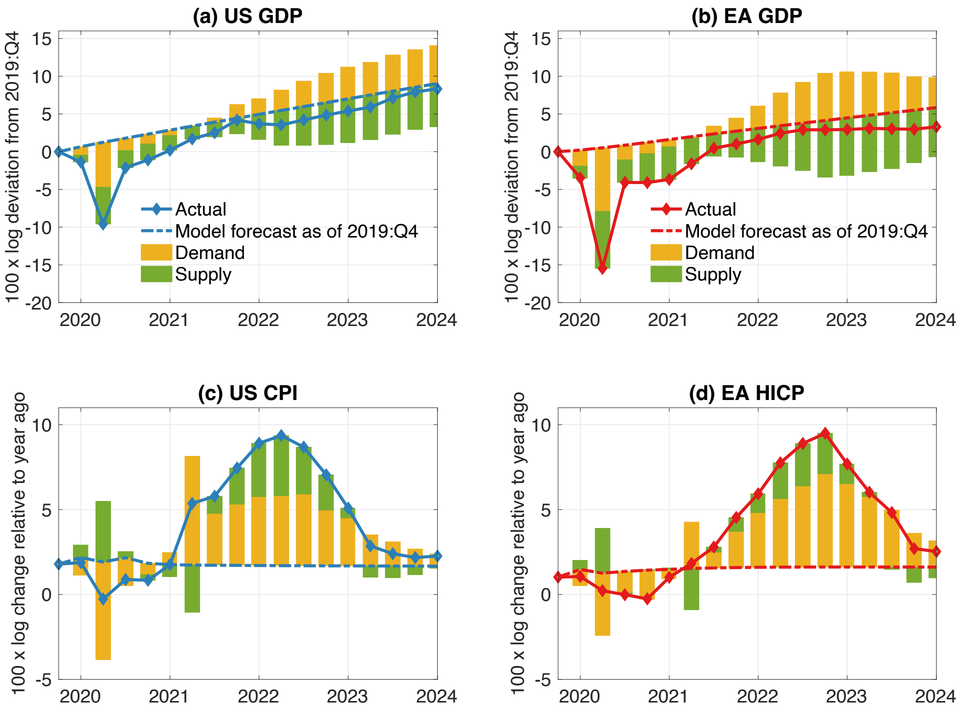
$$y_t = c + B_1 y_{t-1} + \cdots + B_p y_{t-p} + \Gamma \varepsilon_t, \qquad (1)$$

where y_t is an $n \times 1$ vector of macroeconomic variables. They are assumed to evolve as a function of their own lagged values $(y_{t-1}, \ldots, y_{t-p})$ and an $n \times 1$ vector of economically interpretable shocks (ε_t). The vector c and the matrices $B_1, \dots, B_p$ and Γ are objects of conformable dimensions that consist of estimable parameters.

We begin by focusing on the simplest specification of (1) that can speak to facts 1 and 2 of the previous section. More specifically, we set $n = 2$ and let y_t only include (the logarithm of) real GDP and the CPI (in the case of the US) or the HICP (for the EA). We identify demand and supply disturbances using sign restrictions (Uhlig, 2005; Rubio-Ramirez, Waggoner and Zha, 2010), assuming that *demand shocks* generate positive co-movement between real activity and prices, while the co-movement induced by *supply shocks* is negative. The model is estimated using four lags ($p = 4$) and quarterly data from 1997:Q1 to 2019:Q4. The analysis starts in 1997 because of data availability for the EA, and because there is evidence of a change in US inflation dynamics since the 1990s (Cogley, Primiceri and Sargent, 2010; Del Negro, Lenza, Primiceri and Tambalotti, 2020). The estimation sample ends in 2019 because we want to keep a clear distinction between pre- and post-pandemic dynamics. In addition, macroeconomic volatility has been very elevated during the acute phase of the pandemic, and the inclusion of these data might distort inference (Lenza and Primiceri, 2022). To address the curse of dimensionality due to the limited sample length, we adopt Bayesian inferential methods with the Minnesota and the sum-of-coefficients priors, following the technical implementation of Giannone, Lenza and Primiceri (2015). Importantly, the sum-of-coefficients prior helps reducing the estimation uncertainty of the model deterministic component documented by Bergholt et al. (2024).

Using the model estimated on the 1997-2019 sample, we decompose the behaviour of output and inflation since 2020:Q1 into demand- and supply-driven components. The results of this historical decomposition are reported in figure 5, for both the US and the EA. In all four panels, the solid line corresponds to the actual realization of the data, while the dashed-dotted line represents the model forecast for the corresponding variable as of 2019:Q4. It is essential to stress that the GDP forecasts in panels (a) and (b) are *not* measures of potential output. This is because supply disruptions since 2020 have certainly hampered the productive capacity of both economies, reducing potential output relative to these pre-covid output forecasts. As a consequence, the distance between actual GDP and these pre-covid projections *cannot* be interpreted as an output gap. For example, the fact that actual GDP in the EA has been below the dashed-dotted line in figure 5b does not at all imply a persistently negative output gap in the “New-Keynesian sense,” which puts downward pressure on inflation. Instead, the discrepancy between these two lines is simply the forecast error—the extent to which the data have turned out to be different from the pre-pandemic model-based prediction. The estimated model infers the shares of these forecast errors that have been driven by unexpected changes in demand (yellow bars) or supply conditions (green bars).

Figure 5
Historical decomposition of GDP and inflation dynamics



Sources: Data from Eurostat, the European Central Bank, the Bureau of Labor Statistics, and the Bureau of Economic Analysis; accessed via Haver Analytics; computations by authors.

Panel (a) illustrates that demand factors have boosted economic activity since 2021, while supply shocks have been a substantive drag on output. When it comes to US inflation, more than half of its rise and fall can be attributed to demand disturbances, as shown in panel (b). The figure paints a similar picture for the EA, with the difference that supply factors exert a larger negative contribution to the EA GDP. On the contrary, demand shocks play an even more dominant role for inflation in the EA relative to the US.

In simpler terms, at the onset of the pandemic, both economies were severely impacted by significant negative supply and demand shocks, which drastically reduced economic activity. As conditions started to improve, aggregate demand rebounded faster than predicted, and aggregate supply slower than expected. But our results suggest that the former has contributed more to the surge in inflation.

This finding might seem surprising and deserves further discussion, given the popular narrative that negative supply forces have plagued the EA economy and are largely responsible for the rise of inflation. We will explain the intuition of our result about the major role of demand factors for EA inflation in the next section. For now, we stress that this is a robust finding. It holds in many alternative specifications of the model with (i) other measures of real activity and prices (appendix B); (ii) the addition of energy prices (section 5 and appendix C); (iii) the addition of monetary variables (section 6 and appendix D); (iv) the explicit distinction between the price and consumption of goods and services (appendix B).

4 Understanding the dominant role of demand factors for post-covid inflation

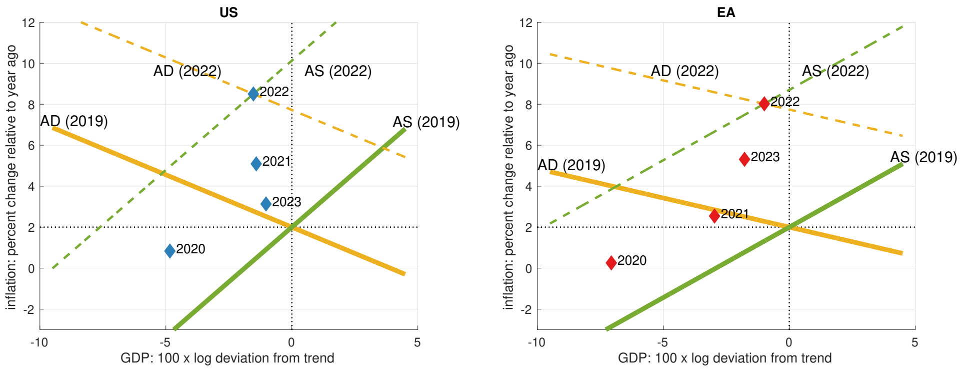
This section explains how to interpret the finding that demand factors have played such a dominant role for the rise of post-covid inflation, including, if not especially, in the EA.

To begin, we highlight an implicit assumption underlying the supply-demand decomposition of figure 5. The approach of section 3, in fact, assumes that covid has not altered the transmission mechanism of demand and supply disturbances, although the size and relative frequency of these disturbances might have changed during the pandemic. This is a standard assumption for analyses based on time-series models, and we will explore its role for our results in the second part of this section. But if we believe this assumption, we can use the model estimated with data from 1997 to 2019 to infer the slopes of the aggregate demand and supply curves determining the equilibrium also after 2019.[5]

Figure 6 depicts the estimated AD and AS curves, in the US and the EA. Initially, they cross at a level of output's deviation from trend normalized to 0, and inflation equal to 2 percentage points. The figure also reports the average level of output's deviations from its pre-covid trend and inflation in 2020, 2021, 2022 and 2023, from figure 5. The first thing to notice is that the AD curve is quite flat in both economies, and more so in the EA than in the US. This characteristic of the AD curve should not be surprising, since it is due to the Fed and the ECB's strong reputation of (near) inflation targeters. To understand why being an effective inflation targeter results in a flat AD, think of the extreme situation of a Central Bank that never lets inflation deviate from a 2-percent target, no matter the cost in terms of output deviations from trend. The resulting slope of the AD curve would be exactly zero. In addition, in such an extreme case, supply shocks shifting the AS curve would have a large impact on real activity, but no effect on inflation. And the only way to experience higher inflation would be through an upward shift in the AD curve, corresponding to demand disturbances that are either accommodated by the Central Bank, or demand shocks that are directly engineered by the Central Bank through unexpected monetary expansions.

[5] The slope of the demand curve is given by the relative change of inflation and GDP in response to supply shocks. Similarly, the slope of the supply curve corresponds to the relative change of inflation and GDP in response to demand shocks. To depict the static version of these curves in figure 5, we use the relative responses of year-on-year inflation and GDP deviations from trend at a 1-year horizon.

Figure 6
AD and AS curves in the US and the EA



Sources: Data from Eurostat, the European Central Bank, the Bureau of Labor Statistics, and the Bureau of Economic Analysis; accessed via Haver Analytics; computations by authors.

The estimated AD curves depicted in figure 6 for the US and the EA are not as flat as in our extreme example of strict inflation targeting that we have just described, but they are not far from that benchmark. For example, the ECB has a single mandate of price stability, and it is intuitive that this priority has resulted into a fairly flat AD curve in the EA until 2019. If this curve has been as flat also during the pandemic, the negative supply shocks experienced by the EA economy since 2020 have likely had a large contractionary effect on real activity, but a limited impact on inflation. This intuition is consistent with the empirical findings of figure 5. Similarly, the only way for inflation to rise to the levels observed in 2022 is for the AD curve to shift upwards, as shown by the dashed yellow line in figure 6, which explains our result that demand factors have played a dominant role for post-pandemic inflation.

The intuition that we have just provided leverages the assumption that the transmission mechanism of demand and supply shocks, and thus the slopes of the AD and AS curves, have not changed after covid. But what if they did? Would our interpretation of the empirical findings of section 3 be different? The answer to this question is “not a whole lot.” Let us understand why in the context of figure 6. First, notice that a change in the slope of the AS curve after 2020 (Eggertsson and Benigno, 2023) would not make much difference, because a shift of the AD curve would still be required to explain the observed high level of inflation.

But what about a change in the slope of the AD curve? Mechanically, a steeper AD curve since 2021 could rationalize the observed dynamics of real activity and inflation with smaller demand shocks, i.e. smaller shifts of the AD. But a steepening of the AD curve would correspond to a weakening of the systematic reaction to inflation by the monetary authority. Therefore, for the purpose of interpreting the recent inflation run-up, a steepening of the AD curve is essentially the same as its upward shift, since both cases involve monetary policy accommodation of inflationary pressures. Put differently, compared to the pre-covid conduct of monetary policy, both an AD curve becoming steeper or shifting upwards translate into unusually strong demand forces, the same forces ultimately driving inflation.[6] In section 7, we will discuss the extent to which such accommodation of the strong post-covid inflationary pressures has represented an appropriate conduct of monetary policy.

4.1 Understanding the differences from the existing literature

Several studies have attempted to quantify the relative roles of demand and supply factors in explaining inflation dynamics since the outbreak of the coronavirus pandemic.

Harding et al. (2022), Benigno and Eggertsson (2023), Jordà and Nechio (2023) and Erceg et al. (2024) discuss how such decomposition might be affected by the non-linearity of the supply curve. In their work, the pandemic brought about a series of large shocks that moved the equilibrium of the economy to region characterized by a steeper supply curve. Relative to these papers, we study the role of the slope of the demand curve, which depends on the monetary policy reaction function.

Gonçalves and Koester (2022) and Lane (2022) estimate bi-variate vector autoregressive (VAR) models like ours separately for many good and service categories, using EU data and a methodology developed by Shapiro (2022 and 2024) for the US economy. Their findings suggest that demand and supply factors have had a comparable role in explaining inflation dynamics. These studies, however, might underestimate the role of demand, since the sectoral demand curves are less flat than at the aggregate level, given that monetary policy responds to aggregate, not sectoral, inflationary pressures.

Banbura, Bobeica and Martines Hernandez (2024) find a large contribution of supply shocks to EA inflation. Differently from us, their VAR includes a richer set of variables and several structural shocks. But their results are likely to overstate the influence of supply factors because their model is saturated with both supply indicators and supply disturbances, and it is estimated using the approach of Korobilis (2022) in which few common shocks drive all the reduced-form residuals. De Santis (2024), Ascari, Bonam and Smadu (2024), and Bai et al. (2024) highlight the impact of global supply chain bottlenecks and disruptions for EA and US inflation. Yet, their impulse responses do not adequately account for the effect of demand shocks on supply chain pressure indexes. This appears inconsistent with the extensive literature cited in section 5, which documents the strong positive correlation between economic activity and commodity prices, shipping costs, and delivery times. Furthermore, the model specifications in these papers do not incorporate priors that discipline the behaviour of the deterministic component and limit its estimation uncertainty (Giannone, Lenza and Primiceri, 2019; Bergholt et al., 2024). As argued by Bergholt

[6] Cuciniello (2024) uses financial daily data to infer the public perception of the ECB responsiveness to inflation, and how it has changed over time. He finds that, if anything, the perceived short-run ECB responsiveness to inflation has increased since 2022, not diminished. This result speaks against a possible rotation of the AD curve and in favour of a shift.

et al. (2024), this omission can significantly affect the results of historical decomposition analyses.[7]

The papers closest to our work are Ascari et al. (2023) and Bergholt et al. (2024), who point to demand shocks as central factors for the rise of inflation. Similarly, International Monetary Fund (2022) and Koch and Noureldin (2024) show that the output and inflation forecast errors in many advanced and emerging economies, relative to the predictions of the World Economic Outlook, display a positive correlation, consistent with a stronger than anticipated demand recovery. Our results on the sources of inflationary pressures are consistent with theirs. In addition, we explain the intuition of these results, and why a chief role for demand disturbances is inevitable if the AD curve is as flat as we would expect for Central Banks who are credible (near) inflation targeters.

Our results are also broadly in line with those of Di Giovanni et al. (2022). They quantify the relative role of demand and supply shocks based on a calibrated two-period multi-sector model with perfectly competitive factors and good markets. Their analysis is limited to the cumulative inflation experience until 2021:Q4, without modelling dynamics. Nevertheless, their calibrated closed-economy model attributes more than 50 percent of the surge of inflation to demand forces, even in the EA.[8]

Bernanke and Blanchard (2023) evaluate the contribution of product- and labour-market shocks for US post-covid inflation. Their approach has been applied by Arce et al. (2024) and Vilmi and Oinonen (2024) to EA data, and by Menz (2024), De Walque and Lejeune (2024), Pisani and Tagliabracci (2024), Aldama, Le Bihan and Le Gall (2024), Ghomi, Hurtado and Montero (2024), Bonam, Hebbink and Pruijt (2024), Haskel, Martin and Brandt (2023), Bounajm, Roc and Zhang (2023), and Nakamura at al. (2024) to data from Germany, Belgium, Italy, France, Spain, the Netherlands, the UK, Canada and Japan. All these articles, whose results are summarized by Bernanke and Blanchard (2024), find a large impact of food and energy prices on aggregate inflation. Similar insights emerge from the analysis of EA data by Lane (2022), and from the study of the behaviour of headline and core inflation in 21 countries by Dao et al. (2024), who build on earlier work of Ball, Leigh and Mishra (2022) for the US and Dao et al. (2023) for the EA. But they all treat food and energy prices, as well as supply shortages, as exogenous variables, making it difficult to map their results into a demand-supply decomposition useful for policy analysis. In the next section we will show that their conclusions are not necessarily in conflict with ours, because energy prices are largely driven by the same fluctuations in aggregate demand that have ultimately generated inflation.

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[7] De Santis (2024) utilizes the dummy-initial observation prior, but this prior is ineffective at correcting the problem highlighted by Bergholt et al. (2024) if imposed on the coefficients of a VAR specified in log levels (Giannone et al., 2019). Bai et al. (2024) do not use any of the priors recommended by Bergholt et al. (2024), but they check the robustness of their results using the prior-robust approach proposed by Giacomini and Kitagawa (2021).

[8] The open-economy version of their model attributes less than one half of EA inflation to domestic shocks. However, this share does not speak to the question whether inflation is demand or supply driven, because it is based on the counterfactual assumption that "domestic goods demanded by Euro Area households can be substituted with the goods produced abroad, and these regions (the US and RoW) have not been hit by expansionary demand shocks or contractionary labor supply shocks, thus keeping prices of their goods (which are reflected in Euro Area import prices) lower than domestic prices in the Euro Area."

5 What about energy prices?

A widely held view is that the run-up of EA inflation was largely driven by supply disturbances and, in particular, by the rise in energy and food prices. For example, Arce et al. (2023) estimate that roughly two-thirds of the EA inflation deviations from the 2-percent target was due to the behaviour of energy and food prices. This result is qualitatively similar to that of Bernanke and Blanchard (2023) for the US, but it appears in contrast with our empirical finding that demand factors played a more important role. How can we reconcile these seemingly conflicting views?

The short answer is that these two views are not necessarily in contrast with each other. In fact, energy (and food) prices are largely endogenous to the world business cycle, and not its main driver or the main primitive cause of post-covid inflation. The fact that fluctuations in energy prices—and, more generally, in commodity prices, shipping costs, delivery times, etc.—are strongly positively correlated with economic activity is widely documented in the literature, to the point that these variables are often used to construct real time indexes of economic conditions (for example, see Kilian, 2009, Kilian and Zhou, 2018, Baumeister and Hamilton, 2019, Alquist, Bhattarai and Coibion, 2020, Delle Chiaie, Ferrara and Giannone, 2022, Baumeister and Korobilis, 2022, and Bernanke and Blanchard, 2023). Therefore, even though energy (and food) prices have increased substantially since 2021, and have thus played a large role for overall inflation in an accounting or reduced-form sense, it is mostly because both the US and the EA GDP have bounced back from the collapse of the first half of 2020, as also argued by Bernanke and Blanchard (2023). The truly exogenous movements in energy prices, those for instance related to the outbreak of the Ukraine war, were limited in comparison.

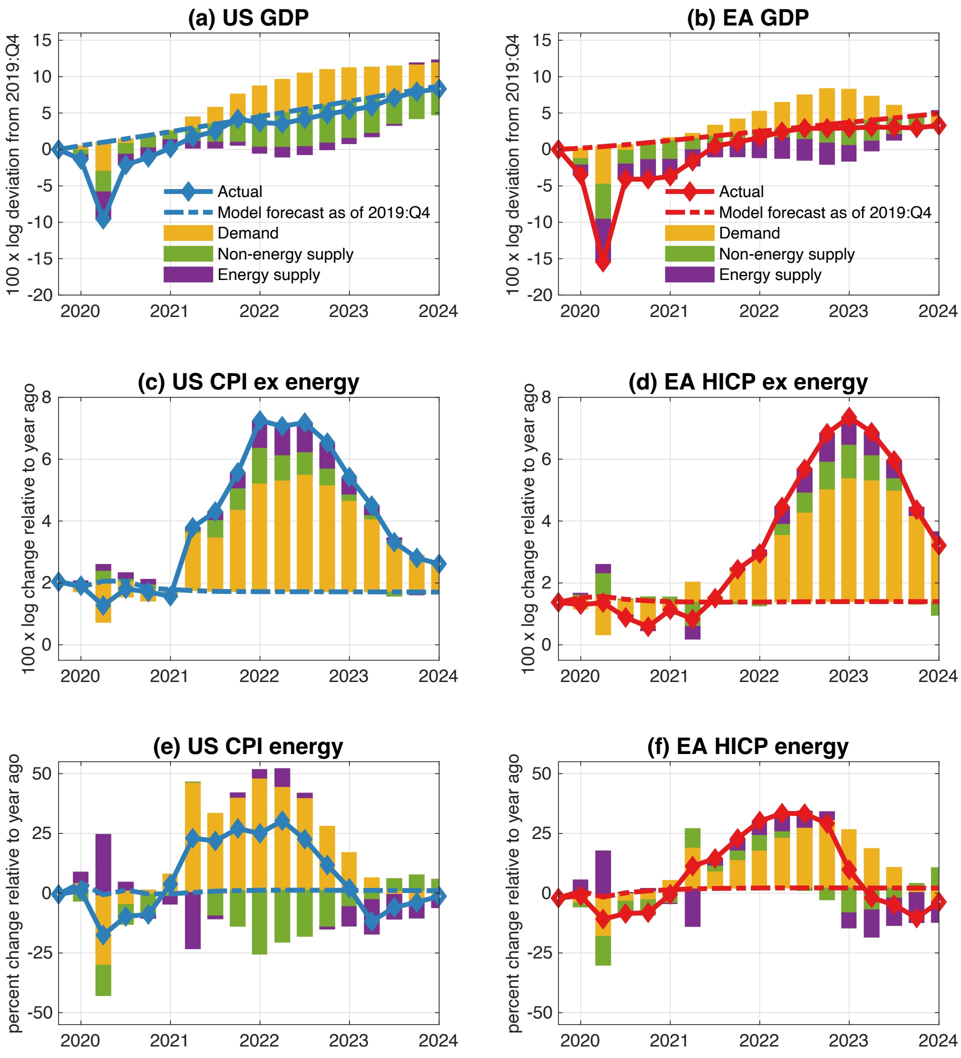
To substantiate these points, and to show the robustness of our results, in this section we estimate an augmented version of our model that explicitly includes energy prices. More precisely, we replace headline inflation in our baseline model with two series measuring energy and non-energy prices. In this 3-variable model, we can now identify three separate shocks: (i) *demand shocks*, which are assumed to move GDP, energy and non-energy prices in the same direction; (ii) *non-energy-supply shocks*, which are assumed to move non-energy prices in the opposite direction relative to GDP and energy prices; (iii) and *energy-supply shocks*, which are assumed to move energy prices in the opposite direction of GDP. Like in section 3, we estimate the model using data from 1997 to 2019, and then use the estimated parameters to decompose the observed evolution of the three variables in the model after 2019.

Before presenting our estimation results, it is important to recognize that the evolution of energy prices in a region of the world does not depend only on economic conditions locally, but also abroad. The way our model catches disturbances in the rest of the world depends on the extent to which they are correlated with those at home. Suppose that demand booms abroad, as an example. If this boom is global—therefore, by definition, correlated with domestic demand—it will be captured by shocks (i), because it stimulates both real activity and energy prices. If the boom abroad is instead uncorrelated with domestic demand, its adverse effect on the home economy through the hike in energy prices is captured by shocks (iii).

Figure 7 presents the results of this decomposition. The first thing to notice is that the increase in energy inflation since 2021 is largely driven by demand shocks, which is broadly consistent with the findings of Baumeister (2023) concerning oil prices. As we have stressed in the previous paragraph, such a large contribution of demand disturbances to energy inflation also captures the role of unexpectedly strong global demand, not just domestic, given the correlation of the two. In comparison, the contribution of energy-supply shocks to the evolution of energy inflation is limited, although it reaches its peak in the first quarter of 2022, around the start of the Ukrainian war.

Figure 7

Historical decomposition of GDP, non-energy and energy inflation dynamics



Sources: Data from Eurostat, the European Central Bank, the Bureau of Labor Statistics, and the Bureau of Economic Analysis; accessed via Haver Analytics; computations by authors.

Second, energy-supply shocks play a sizable negative role for real activity, as expected, especially in the EA. Finally, the contribution of energy-supply shocks to inflation dynamics is substantially smaller than that of demand disturbances, which confirms our baseline findings of section 3. Among other things, this result casts doubts on the narrative that the early, strong recovery in the US has boosted energy prices worldwide, with negative repercussions on inflation in other regions, such as the EA. These developments are captured as energy-supply shocks in the EA model. According to figure 7, they might have contributed to lowering economic activity in the EA, but were not a major driver of EA inflation. Appendix C documents that these insights continue to hold in a more complex model that distinguishes between household- and transportation-energy prices.

6 The role of monetary policy

Our main result is that demand factors have played a crucial role in the recent run-up of inflation, both in the US and in the EA. The SVARs of sections 3 and 5, however, conflate monetary and non-monetary demand disturbances into a single shock. Therefore, these models cannot determine if the unexpected surge in demand after 2020 was due to an unusually loose conduct of monetary policy, relative to pre covid, or to other forces, such as those related to fiscal policy or pent-up demand.

To study this question, we augment our baseline model with a measure of interest rates that can capture the monetary policy stance. This exercise is thorny because the main US policy rate—the federal funds rate (FFR)—has been stuck at the zero lower bound for many years since 2009. For this reason, we have opted to extend the model with the 1-year Treasury rate instead of the FFR. Swanson and Williams (2014) argue that the 1- and 2-year Treasury yields appeared surprisingly unconstrained until 2010, although they had become more constrained since 2011. Consequently, the dynamics of the 1-year Treasury yield might not fully capture the effect of the non-conventional policy measures implemented by the Fed during the early 2010s.[9] This is a potential limitation, but appendix D shows that the results in this section are robust to estimating the model with FFR data that do not include the zero lower bound period. Short-term interest rates in the EA budged below zero in the 2010s and were thus less constrained by the zero lower bound. Nevertheless, we have chosen to use a 1-year rate for the EA as well, for symmetry with the US, opting for the 1-year Euribor since it is available for the entire duration of our sample.

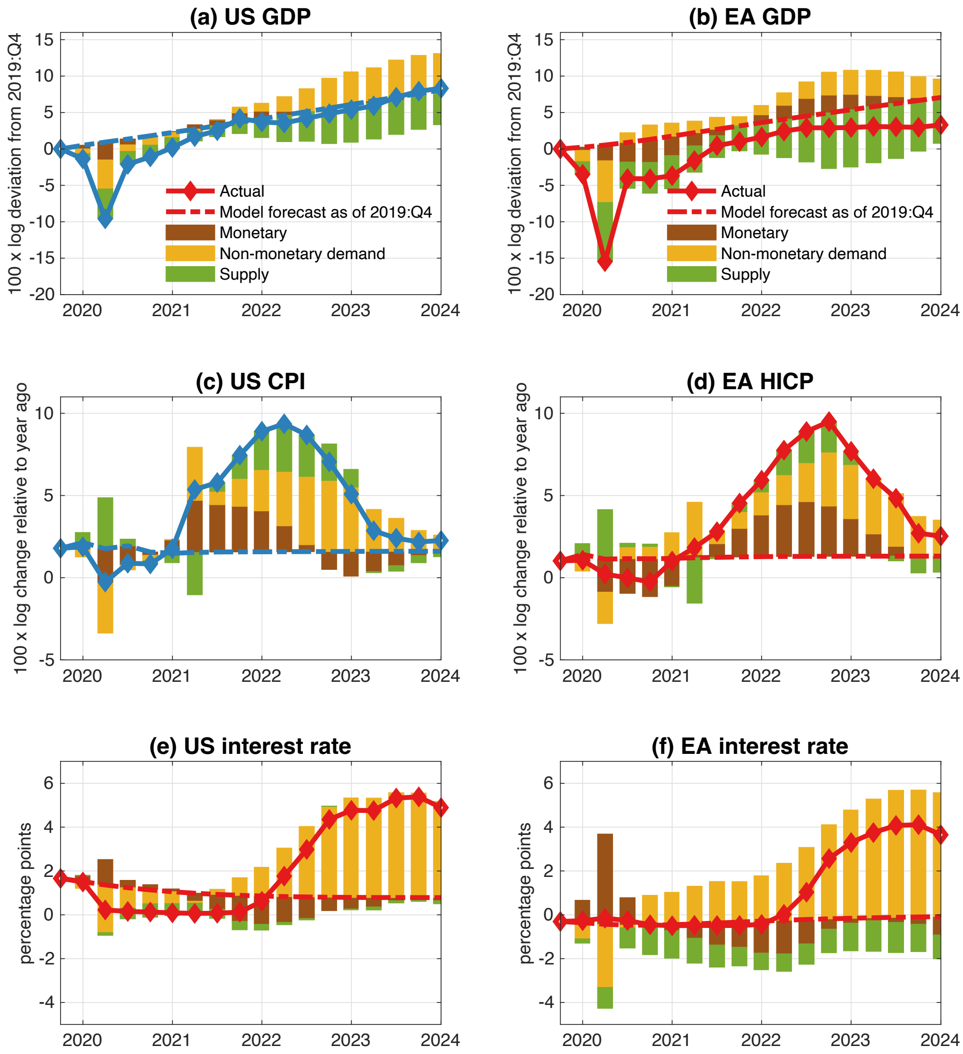
In this three-variable SVAR, we identify three types of disturbances: (i) *demand shocks*, which are assumed to move GDP, prices and nominal interest rates in the same direction; (ii) *supply shocks*, which are assumed to move GDP and prices in opposite directions; and (iii) *monetary policy shocks*, which are assumed to move nominal interest rates in the opposite direction of GDP and prices. The restriction on the sign of the interest rate to identify monetary policy shocks is imposed for four consecutive periods, because we wish to identify meaningful, not just occasional, deviations from the past conduct of monetary policy. As usual, we estimate the

[9] It is unclear in what direction this issue might distort our results on the importance of monetary policy shocks for post-covid inflation. In fact, the reduced sensitivity of the 1-year rate to the state of the economy during part of the estimation sample implies that we might underestimate the size of the monetary shocks after 2020, but overestimate their impact. These two possible biases have an opposite sign.

model using data from 1997 to 2019, and then decompose the observed variation in the data after 2020.

The output of this decomposition is depicted in figure 8. The introduction of interest rates into the model does not change the overall message of the paper that demand factors largely explain the behaviour of inflation. However, we can now gauge the relative role of the two demand shocks—monetary and non-monetary demand disturbances. Panel (e) and (f) show that most of the increase in interest rates was driven by non-monetary demand shocks in both regions. On the contrary, monetary policy shocks have contributed negatively to the behaviour of interest rates since early 2021, suggesting that both the Fed and the ECB have deviated from their pre-2020 rule by keeping rates unusually low. Panels (a) and (b) make clear that these deviations, i.e. monetary policy shocks, have helped GDP recover, especially in the EA. But this faster recovery entails a cost, as evident from panels (c) and (d). These expansionary monetary shocks have played a sizable role in the run-up of inflation, a comparable one to that of non-monetary demand disturbances.

Figure 8
Historical decomposition of GDP, inflation and the 1-year interest rate dynamics



Sources: Data from Eurostat, the European Central Bank, the Bureau of Labor Statistics, the Bureau of Economic Analysis, and the Board of Governors of the Federal Reserve System; accessed via Haver Analytics; computations by authors.

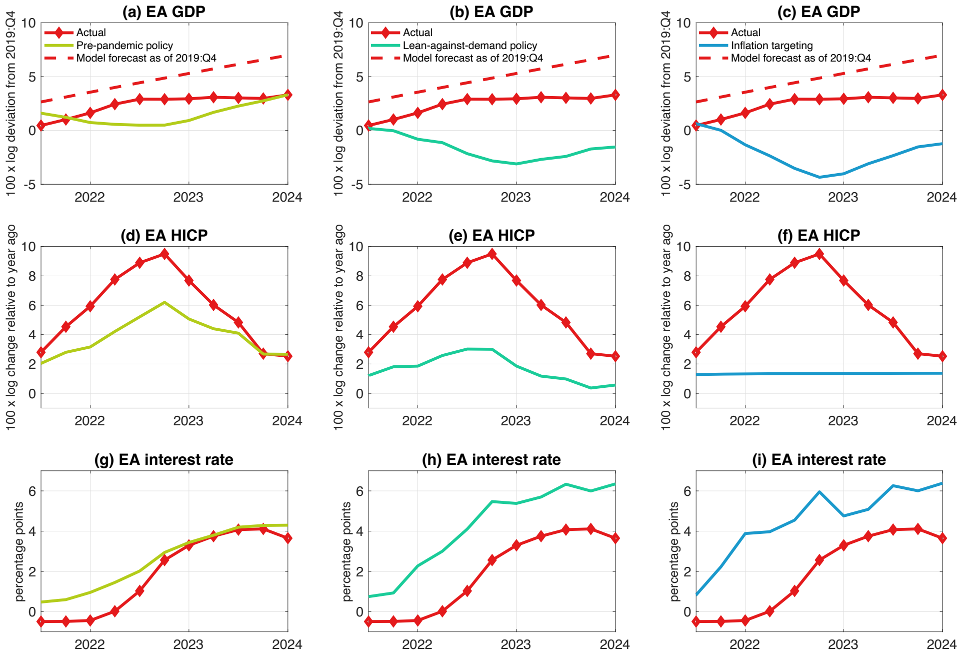
7 The big elephant in the (ECB Governing Council) room

The EA economy has been subject to large unfavourable supply shocks since 2020, but these shocks alone cannot explain the behaviour of inflation. Instead, according to our results, post-covid inflation has been fuelled by surprisingly strong demand forces—a combination of uncommonly expansionary fiscal policies, unexpectedly strong pent-up demand following the pandemic restrains, and unusually loose monetary policies. For example, according to Andersson et al. (2021), the total fiscal response to the pandemic amounted to approximately 10 percent of GDP in the US and 7 percent in the EA (see also Lenza, 2023).

While the dominant source of inflationary pressures emerges clearly from our empirical evidence, assessing whether the ECB has handled these pressures appropriately is more difficult. This section explores the trade-offs confronted by the ECB since the summer of 2021, by computing the counterfactual behaviour of the economy under alternative conducts of monetary policy. The results of this analysis are presented in figure 9.

Figure 9

Counterfactual histories under alternative policies



Sources: Data from Eurostat, the European Central Bank, the Bureau of Labor Statistics, the Bureau of Economic Analysis, and the Board of Governors of the Federal Reserve System; accessed via Haver Analytics; computations by authors.

The first column of the figure shows how EA GDP, inflation and interest rates would have evolved if the ECB had followed its pre-pandemic monetary policy rule. The figure compares these counterfactual paths to the actual realization of the data. This exercise amounts to setting the monetary policy shocks equal to zero for the entire post-covid period. Hence, it is equivalent to removing the "brown" component from GDP, inflation and the interest rate in figure 8. If the ECB had conducted policy in this way, interest rates would have been lifted earlier, although not necessarily by more. As a consequence, inflation would have peaked at 6 percentage points—3 less than in the data—but GDP would have been lower than its actual realization. More precisely, under the ECB pre-pandemic policy, the cumulative loss in production would have been roughly 1 percent (this 1 percent corresponds to the average distance between the red-solid line and the olive line in panel (a)). Put differently, according to our estimates, the ECB unusually loose conduct of monetary policy after 2021, relative to pre-covid, has contributed to the run-up of inflation by roughly 3 percentage points, which represent the cost paid for a faster recovery of economic activity.

Textbook monetary models suggest that Central Banks should neutralize demand shocks, to guarantee both price and output stability. But when a disturbance to the economy originates from the supply side, raising prices and depressing real activity, the optimal policy response is not to stabilize prices, but to strike a balance between price and output stabilization. In their jargon, Central Banks should "look through supply shocks," especially when these shocks affect inflation only temporarily and their second-round effects are limited (see Bandera et al., 2023). The second column of figure 9 depicts what would have happened if the ECB had followed this prescription and completely neutralized the impact of all demand shocks—monetary and non-monetary—on inflation. Inflation would have peaked at only 3 percentage points (the cyan line in panel (e), which corresponds to the size of the green bars in figure 8(d)). However, GDP would have tanked, with a cumulative loss of approximately 4 percent, as shown in panel (b). Even more worrisome, under this alternative policy, GDP would still be 5 percent lower than its actual realization in the most recent quarter of the sample.

Finally, the last column of figure 9 shows our estimates of the counterfactual evolution of the EA economy if monetary policy had been so tight to keep inflation near 2 percent throughout the post-pandemic period, broadly in line with the ECB mandate.[10] To implement this policy, the ECB would have had to suppress the impact of all demand and supply shocks on inflation. Panel (c) documents the large output loss of this counterfactual policy: a cumulative loss in production of roughly 4.5 percent, with GDP still 5 percent lower than actual at the end of the sample.

In sum, the ECB actual conduct of monetary policy appears to have accommodated inflationary pressures in the post-pandemic era. Since economic activity was already strained by adverse supply conditions, such policy has likely helped avoid a substantial further decline in economic activity. We leave it to the reader to judge whether this was worth it, based on the trade-offs and the policy options presented in figure 9, and the reader-specific preferences about inflation versus output stabilisation.[11]

8 The last kilometre, and those after that

At the time of writing, headline HICP year-on-year inflation in the EA is approaching the ECB medium-run target, while EA GDP remains below its pre-covid trend by roughly 4 percent. What is the likely outlook going forward? To answer this question, we project forward the model of section 6, and compare its predictions with those of professional forecasters. This analysis indicates that there are reasons to be

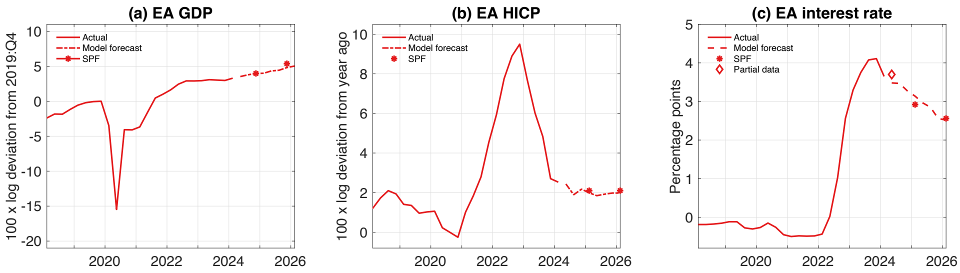
[10] To be clear, the ECB single mandate is more flexible than a strict 2-percent inflation targeting rule. In fact, the 2021 Strategy Review (available at https://www.ecb.europa.eu/home/search/review/html/ecb.strategyreview_monpol_strategy_statement.en.html) states that "The Governing Council considers that price stability is best maintained by aiming for two percent inflation over the medium term," and admits "inevitable short-term deviations of inflation from the target, as well as lags and uncertainty in the transmission of monetary policy to the economy and to inflation." This last point about lags and uncertainty is also a useful reminder that implementing a strict 2-percent targeting rule in real time would have been challenging in practice, especially since the surge in inflation was relatively sudden. For these reasons, we interpret this counterfactual simply as a tool to shed light on the Central Bank trade-offs.

[11] The New-Keynesian model, the workhorse monetary model for policy analysis, maps consumer welfare into the relative weights of inflation and output stabilization. Quantitatively, the inflation objective is substantially more important than real activity for welfare, even in quantitative versions of these models (Justiniano, Primiceri and Tambalotti, 2013). But many researchers are sceptical of the ability of this class of models to capture the most important dimensions of welfare analysis.

optimistic about inflation, both in the immediate and the more distant future. In fact, our model predicts an “easy last kilometre” in the coming quarters. Regarding the medium term, we find that the ECB has not experienced any significant damage or loss of credibility from the accommodation during the pandemic; in fact, the public believes that policy has returned to its pre-covid norm.

The results of this forecasting exercise are reported in figure 10. Our VAR predicts a smooth path of inflation in panel (b), approaching its pre-covid mean just below 2 percent. In sum, inflation is heading back to target according to the model, and the last kilometre does not seem particularly risky or hard, absent unforeseen disturbances. However, GDP is unlikely to return to its pre-covid trend in the next two years, as shown in panel (a).[12] The forecasted path of both inflation and GDP justify the expected gradual decline in interest rates depicted in panel (c).

Figure 10
Model based and professional forecasters



Sources: Data from Eurostat and the European Central Bank; accessed via Haver Analytics; computations by authors.

Notes: Professional forecasters provide predictions for the main refinancing operations (MRO) rate. In panel (c), we use the MRO predicted by SPF for 2025 and 2026 as their implied forecast of the 1-year Euribor for 2025:Q1 and 2026:Q1.

The red diamond in the last panel of the figure represents the 2024:Q2 value of the 1-year Euribor (extrapolated till the end of June), which also depends on the ECB’s recent decision to lower the policy rate by 25 basis points. The fact that it lies almost on top of the dashed-dotted line suggests that EA short-term interest rates are currently in line with the model predictions. Recall that these predictions are based on pre-covid parameter estimates. As a consequence, it appears that interest rates—including their recent cut—are evolving in accordance with the ECB pre-covid conduct of monetary policy.

All panels in figure 10 also display the April-2024 consensus from the Survey of Professional Forecasters (SPF), which closely matches the forecasts of our model. This alignment is both remarkable and reassuring. It is remarkable because our VAR does not use any SPF data, so there is no a-priori reason why the two forecasts should be nearly identical. It is reassuring because it provides a stringent cross-check for our framework, serving as external validation. Additionally, the similarity between the SPF and our model's predictions—based on pre-covid data and thus reflecting pre-covid monetary policy conduct and transmission—indicates that the

[12] Motivated by Schnabel’s (2023) concerns about the last mile, we have also estimated a model that distinguishes between the price of goods and services, obtaining similar results. The only differences are that the return to target of headline inflation projected with this alternative model is marginally delayed, relative to the baseline, and the path of GDP slightly below the baseline projection of figure 10.

ECB's monetary policy has returned to its pre-covid “normalcy,” according to professional forecasters. In essence, the ECB is not suffering from any major scar or credibility loss from the sustained accommodation during the pandemic. The market seems to have viewed these measures as temporary, rather than as a permanent alteration of the monetary policy framework.

9 Appendix A: Adjustments to the US CPI for alignment with the EA HICP

Relative to the US CPI, the EA HICP does not include any rent imputation for owner occupied residencies, classifies energy (electricity, gas and other fuels) as a good, and restaurants as services. Therefore, we have aligned the US CPI with the EA HICP by:

- Removing “owners' equivalent rent of residences (OERR).”
- Shifting “food away from home” from the commodity to the service category.
- Shifting “energy services” from the service to the commodity category.

The CPI price indexes are annual chain-linked Laspeyres-type indexes. They measure price changes by comparing prices in each month of the year to those in December of the previous year. To construct indexes that are different from those officially published by the Bureau of Labor Statistics (BLS), components must be temporarily unchained, aggregated, and then re-chained. For further details, we refer to the publication of Eurostat (2018) and the one of the BLS authored by Perrins and Nielsen.

10 Appendix B: Robustness and extensions of our results

Our baseline model is estimated with (the logarithm of) real GDP and the CPI (for the US) or the HICP (for the EA). This appendix shows that our results are robust to using alternative indicators of economic activity and prices. More specifically, we consider models estimated with:

- Real GDP and the GDP deflator, for both the US and the EA (figure B.1)
- Real consumption and the CPI for the US or the HICP for the EA (figure B.2)
- Real consumption and the consumption deflator, for both the US and the EA (figure B.3)
- Real GDP and the BLS definition of the CPI for the US, which includes OERR (figure B.4). For convenience, figure B.4 also reports the results using the Eurostat definition of the HICP for the EA, which are the same as those in figure 4.

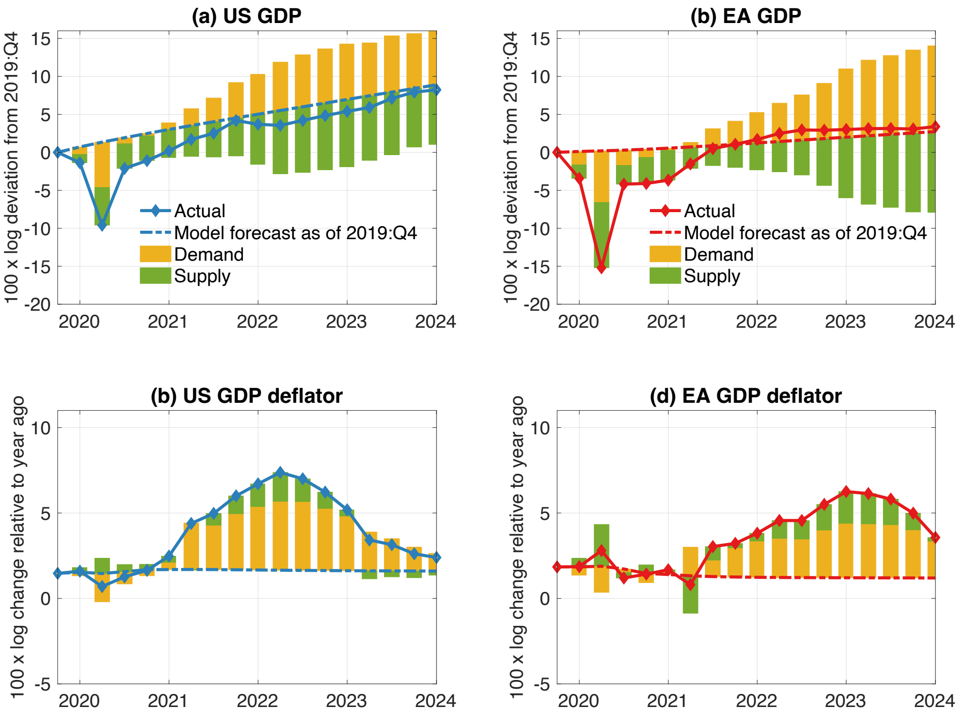
- Real consumption and the consumption deflator of goods and services, for both the US and the EA (figure B.5). In this four-variable VAR, we identify four shocks: (i) *demand shocks*, which are assumed to move consumption and prices of goods and services in the same direction; (ii) *sectoral-demand shocks*, which are assumed to move consumption of goods and services in opposite directions, and both prices in the same direction of the corresponding quantities; (iii) *supply-of-goods shocks*, which are assumed to move consumption and prices of goods in opposite directions, and consumption and prices of services in the same direction; and (iv) *supply-of-services shocks*, which are assumed to move consumption and prices of services in opposite directions, and consumption and prices of goods in the same direction. Observe that the identification of shocks (iii) and (iv) is consistent with the possibility that sectoral supply shocks resemble demand shocks in other sectors, as in Guerrieri et al. (2022). Data on consumption of goods and services in the EA are not available, since this split is missing for certain countries, including Spain. For this reason, we follow the ECB Economic Bulleting (issue 8, 2023) in constructing the goods and services consumption data by aggregating data from the three largest EA countries, i.e. Germany, France, and Italy.

All the charts in this appendix present a decomposition like the one of figure 5 in the main body of the paper. Notice that demand shocks—the yellow bars in figures B.1, B.2, B.3, B.4 and B.5—continue to be the dominant driver of inflation in the EA. This is also the case in the US, with the exception of the model estimated with consumption and the CPI in figure B.2, and the one with goods and services in figure B.5, for which demand and supply factors play a comparable role.

Figure B.1

Historical decomposition of GDP and inflation dynamics

Real activity based on GDP and inflation based on the GDP deflator

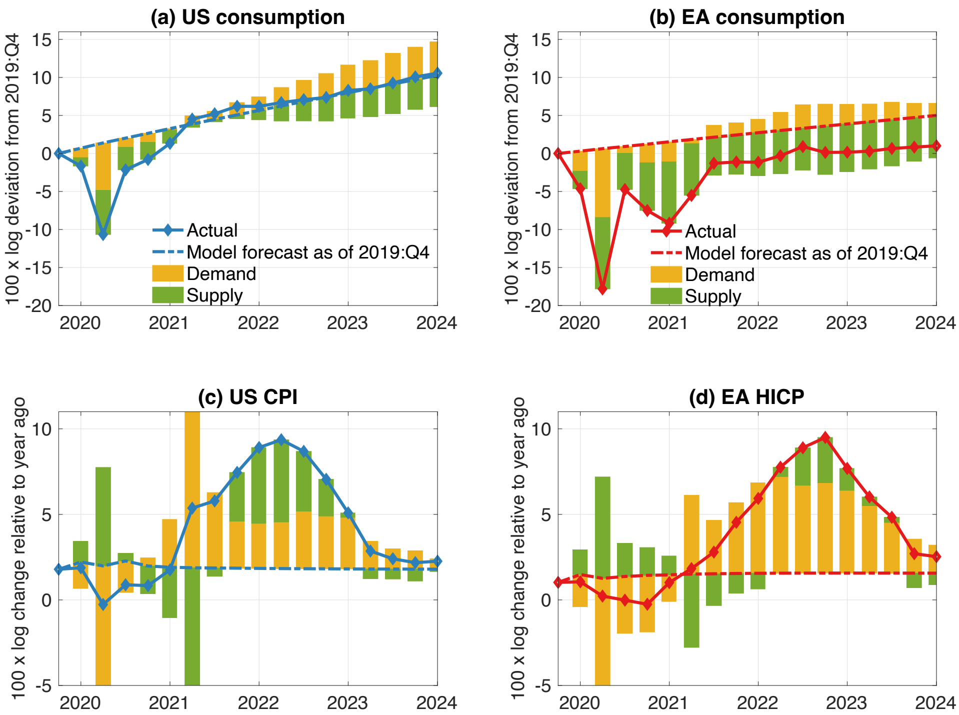


Sources: Data from Eurostat, the European Central Bank, and the Bureau of Economic Analysis; accessed via Haver Analytics; computations by authors.

Figure B.2

Historical decomposition of consumption and inflation dynamics

Real activity based on consumption and inflation based on the CPI / HICP

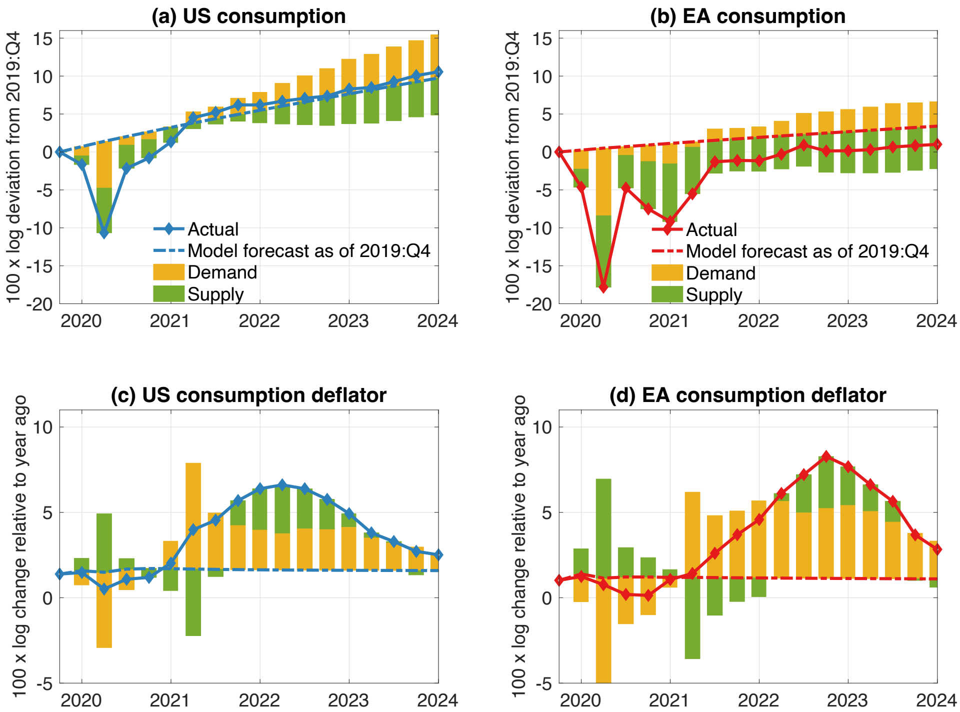


Sources: Data from Eurostat, the European Central Bank, the Bureau of Labor Statistics, and the Bureau of Economic Analysis; accessed via Haver Analytics; computations by authors.

Figure B.3

Historical decomposition of consumption and inflation dynamics

Real activity based on consumption and inflation based on the consumption deflator

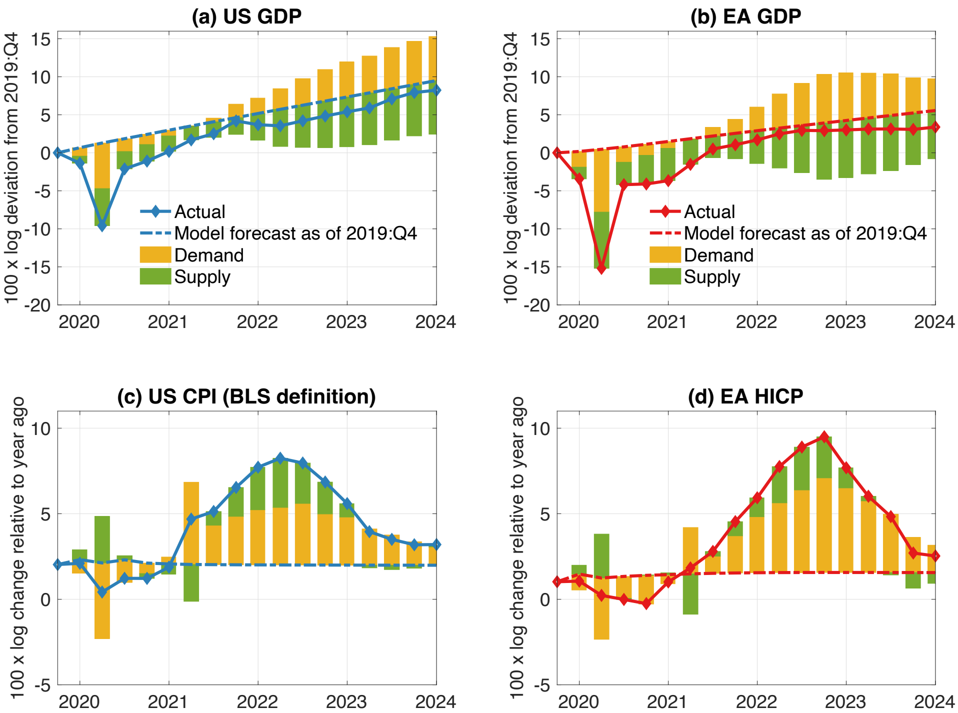


Sources: Data from Eurostat, the European Central Bank, and the Bureau of Economic Analysis; accessed via Haver Analytics; computations by authors.

Figure B.4

Historical decomposition of GDP and inflation dynamics

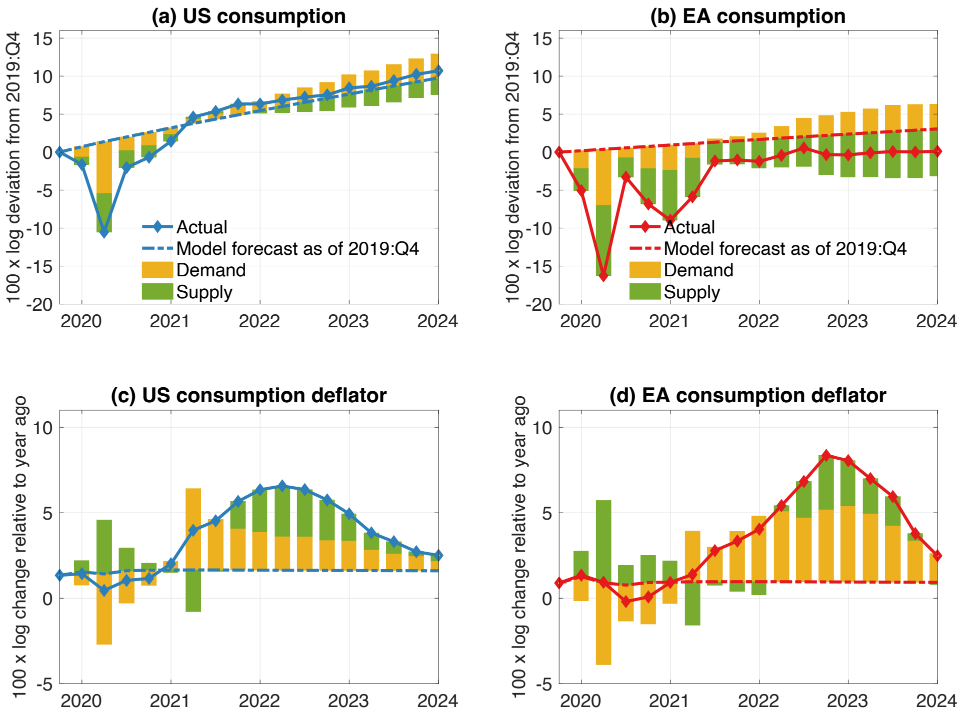
Real activity based on GDP and inflation based on the BLS definition of the CPI (for the US) and the HICP (for the EA)



Sources: Data from Eurostat, the European Central Bank, the Bureau of Labor Statistics, and the Bureau of Economic Analysis; accessed via Haver Analytics; computations by authors.

Figure B.5
Historical decomposition of consumption and inflation dynamics

Model with consumption and the consumption deflator of goods and services



Sources: Data from Eurostat, the European Central Bank, and the Bureau of Economic Analysis; accessed via Haver Analytics; computations by authors.

Notes: Consumption and prices of goods and services have been combined to obtain aggregate consumption and the consumption deflator using a goods' share of 33 percent for the US and 50 percent for the EA.

11 Appendix C: A model with household- and transportation-energy prices

This appendix complements section 5 by presenting the estimation results of a model that distinguishes between household- and transportation-energy prices. This exercise is relevant because shocks to these two components of energy prices might have a different pass-through to the rest of the economy. In addition, they have behaved rather differently in the US and the EA, as we have documented in figure 4.

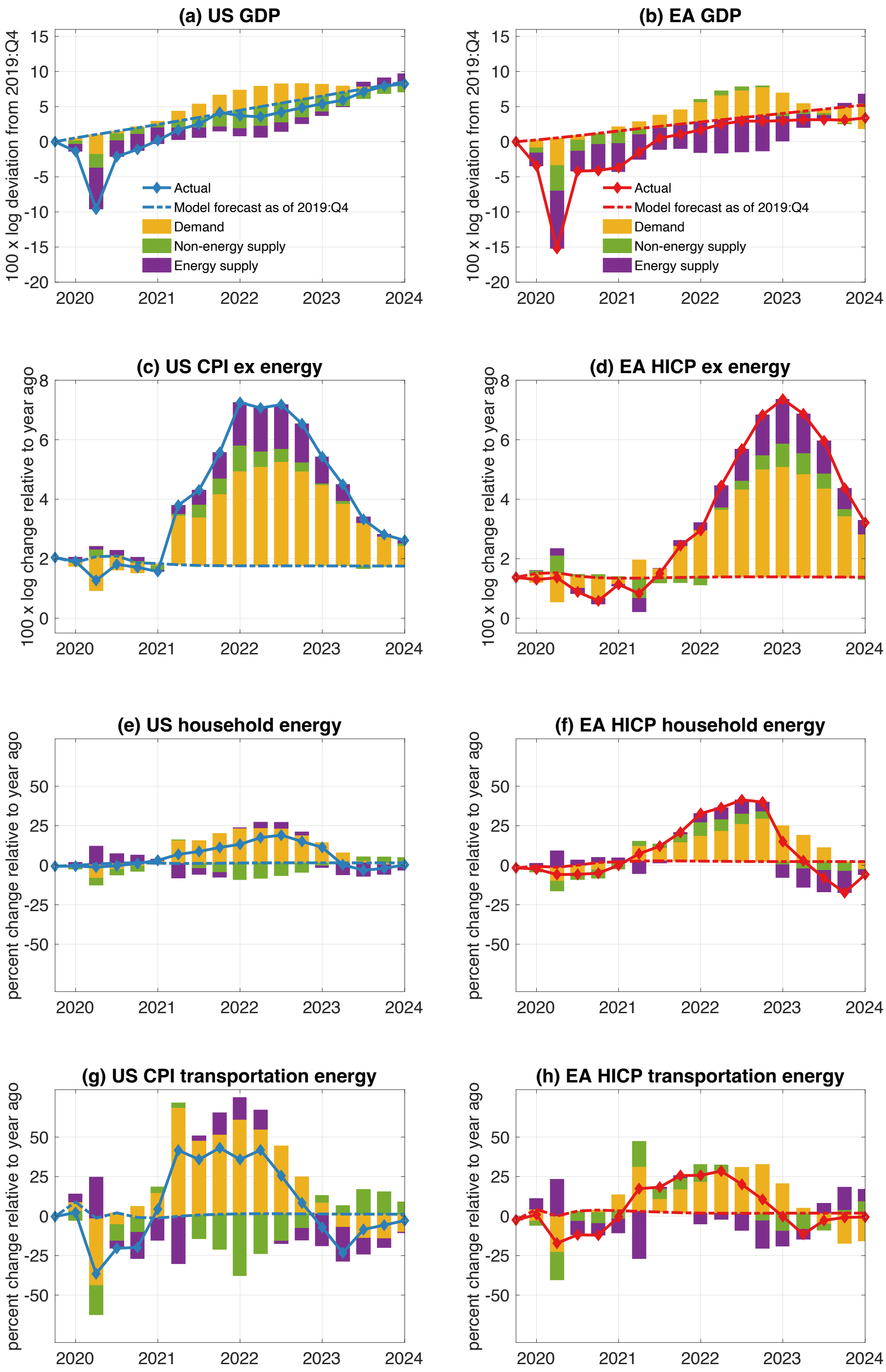
For both the US and the EA, we estimate a VAR with four variables, all in logarithms: real GDP; the CPI (in the case of the US) or the HICP (for the EA) excluding energy; household-energy prices; and transportation-energy prices. For the EA, household-energy prices refer to the HICP category "Electricity, gas and other fuels," while transportation-energy prices correspond to the HICP of "Fuels and lubricants for personal transport equipment." For the US, household-energy prices refer to the CPI category "Household energy," while transportation-energy prices correspond to the CPI of "Motor fuels."

We identify four shocks: (i) *demand shocks*, which are assumed to move GDP, energy and non-energy prices in the same direction; (ii) *non-energy-supply shocks*, which are assumed to move non-energy prices in the opposite direction relative to GDP and energy prices; (iii) *energy-supply shocks of type 1*, which are assumed to move at least one of the two energy prices in the opposite direction of GDP; and (iv) *energy-supply shocks of type 2*, which are assumed to move at least one of the two energy prices in the opposite direction of GDP, and to be different from shocks (iii). Observe that our identification of energy-supply shocks is very agnostic, encompassing a variety of possibilities. For example, it is consistent with the existence of shocks that affect the supply of both energy components simultaneously, and/or asymmetrically. Like in the rest of the paper, we estimate the model using data from 1997 to 2019, and then use the estimated parameters to decompose the observed evolution of the model variables since 2020.

The results of this decomposition are presented in figure C.1. In the figure, the contribution of shocks (iii) and (iv) is cumulated, since there is no meaningful distinction between the two. They confirm the findings of figure 7, which was based on the estimation of a model with a single energy price: The evolution of the two components of energy inflation is mainly due to demand shocks, which are also the leading drivers of non-energy inflation. The only difference from figure 7 is that figure C.1 shows a larger contribution of energy-supply shocks to GDP in the EA.

Figure C.1

Historical decomposition of GDP, non-energy, household- and transportation-energy inflation dynamics

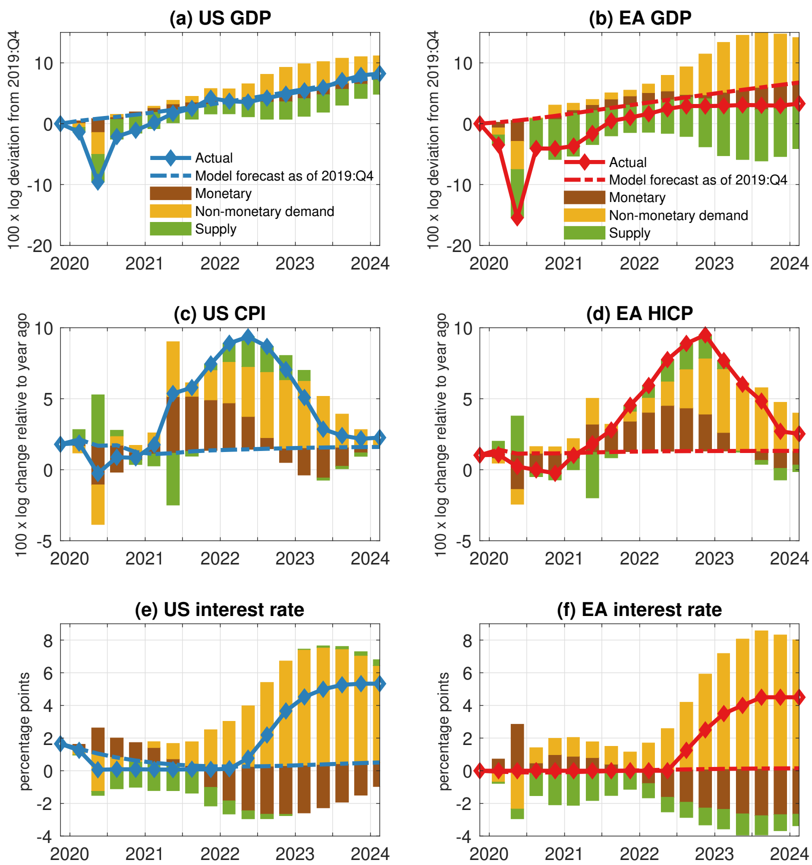


Sources: Data from Eurostat, the European Central Bank, the Bureau of Labor Statistics, the Bureau of Economic Analysis, and the Board of Governors of the Federal Reserve System; accessed via Haver Analytics; computations by authors.

12 Appendix D: A model with the official policy rates

The model of section 6 is estimated using the 1-year Treasury Bill rate for the US and the 1-year Euribor for the EA, to mitigate the potential biases induced by the zero lower bound (ZLB). In this appendix, we re-estimate the model using the official policy rates—the US FFR and the EA main refinancing operations (MRO) rate. We proceed in two steps: (i) We estimate the model with these new variables on the entire sample from 1997 (1999 for the EA, because the MRO data are not available before this date) to 2019, and compute the model predictions for the period after 2019. (ii) We re-estimate the model with data until 2008:Q4 for the US and until 2013:Q4 for the EA, to exclude from the sample the periods in which the FFR and the MRO have been stuck at the ZLB. Based on these latter estimates, we decompose the forecast errors computed in (i) into a monetary, non-monetary-demand and supply components. As shown in figure D.1, the results of this decomposition are similar to those plotted in figure 8.

Figure D.1
Historical decomposition of GDP, inflation and the policy rate dynamics



Sources: Data from Eurostat, the European Central Bank, the Bureau of Labor Statistics, the Bureau of Economic Analysis, and the Board of Governors of the Federal Reserve System; accessed via Haver Analytics; computations by authors.

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