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Origins of Post-COVID-19 Inflation in Central European Countries

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Abstract:
This paper examines the drivers of the post-pandemic surge in inflation in four small open economies: Czechia, Hungary, Poland, and Slovakia. For this purpose, a Bayesian structural vector autoregressive model with sign-zero restrictions and block exogeneity is employed. The results show that both foreign demand and foreign supply shocks have contributed significantly to inflation in the post-2020 period across countries, alongside notable contributions from domestic factors explaining differences among economies. Specifically, supply-side shocks are identified as the primary domestic factor across all countries, whereas domestic demand shocks were much less influential. Exchange rate shocks were pronounced in Hungary only, while monetary policy shocks have had a minimal impact on inflation since 2022 in all the countries considered. Additionally, we provide decompositions of core inflation, highlighting the predominance of domestic factors.

JEL: C32, E31, E32, E52, F41
Keywords: Bayesian VAR, extraordinary events, inflation, sign-zero restrictions, small open economies

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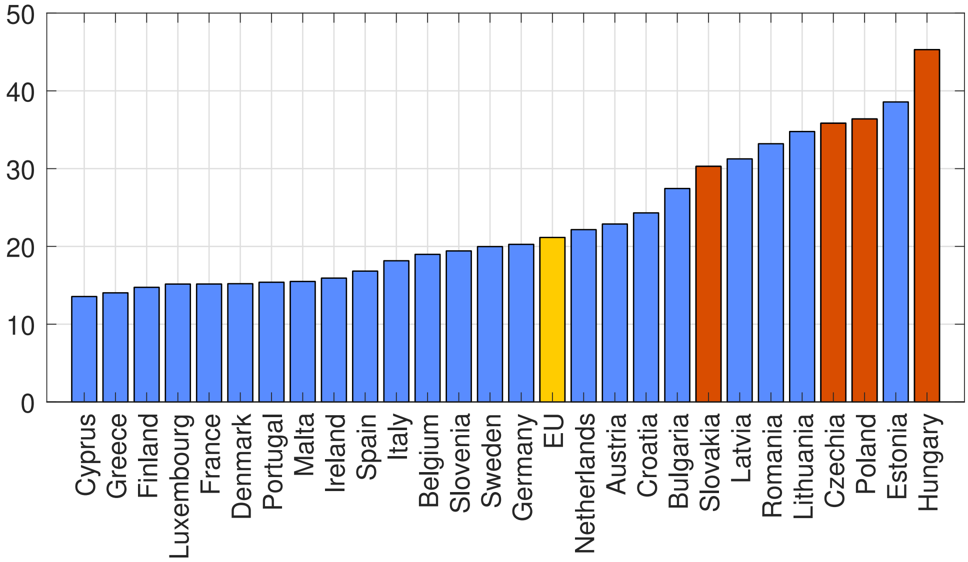
1 Introduction

Understanding what drives inflation, and to what extent, is crucial for policy-making. In most countries, the real economy recovered quickly after the COVID-19 shock, but inflation reached levels not seen in decades. Following the relaxation of most pandemic-related measures, there was a strong recovery in demand. In addition to deferred consumption and forced savings, demand was supported by generous fiscal measures. The supply side faced challenges due to pandemic-induced restrictions on firms, later compounded by disruptions to global value and supply chains. As a result, the production sector of the economy had difficulty meeting the rapidly recovering demand. Russia's invasion of Ukraine amplified the already substantial increase in energy commodity prices, contributing to the energy crisis in Europe.

In this paper, we focus on explaining the post-pandemic spike in inflation in the Visegrád Group countries, namely Czechia, Hungary, Poland, and Slovakia. As depicted in Figure 1, these countries have experienced some of the highest price level increases in the European Union since the outbreak of the pandemic. They share several similarities, including geographical proximity to Russia, lower initial GDP and price levels, less competitive retail markets, and higher energy intensity. Furthermore, with the exception of Poland, they are very open small economies compared to the EU average (Figure 2).[1] Although the countries are similar in many respects, Slovakia is the only member of the euro area, while the others have their own monetary policies.

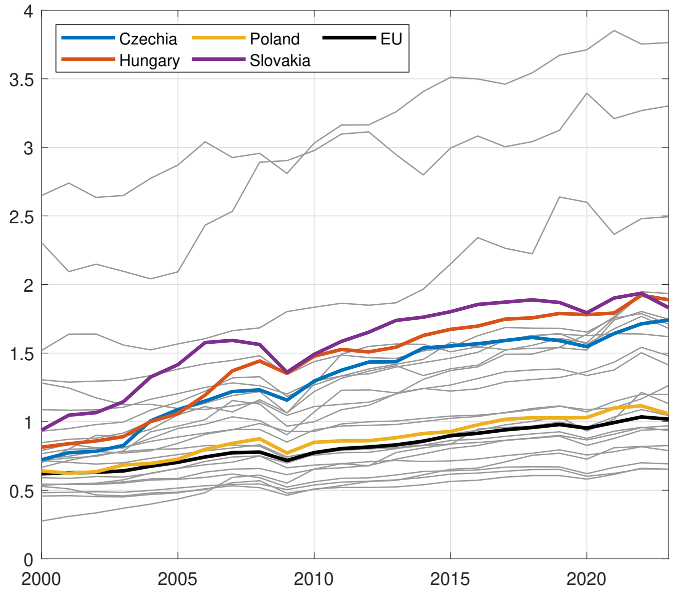
Figure 1: Percentage Change in Price Level in EU Countries from January 2020 to January 2024



Note: The HICP index is used for the comparison of price levels. The data are obtained from Eurostat.

[1] Regarding Poland, even though it is still considered a small economy, its level of openness is rather average, suggesting the possibility of less influence from global factors. For instance, compared to the other countries, it coped relatively well with the Global Financial Crisis of 2008 in terms of real GDP (see Appendix A).

Figure 2: Openness of EU Economies (ratio of exports and imports to GDP)



Note: GDP, exports, and imports in chain linked volumes (2015), million units of national currency. The data are obtained from Eurostat.

This paper aims to examine the origins of the inflation variations in Central European countries through the lens of a Bayesian structural vector autoregression (SVAR) model with sign and zero short-run restrictions, as outlined by Arias *et al.* (2018). Imposing such restrictions with block exogeneity provides sufficient flexibility to capture structural relationships within small open economies. We specifically show how six shocks—domestic demand, domestic supply, monetary policy, exchange rate, foreign supply, and foreign demand—contribute to inflation until mid-2023. The model is estimated separately for each country to account for the differences among them.

Our analysis is interconnected with two strands of literature. First, we contribute to the post-pandemic debate on the relative importance of supply- and demand-side drivers of the inflation surge. We extend this debate to encompass Central European small open economies, as recent research has predominantly focused on the U.S. and the euro area.[2] Two primary approaches are discernible in the literature: model-based (see, for example, Beaudry *et al.* 2024; Gagliardone & Gertler 2023; Rubbo 2024; di Giovanni *et al.* 2023; Ball *et al.* 2022; Bernanke & Blanchard 2023 for the U.S., and di Giovanni *et al.* 2022; Arce *et al.* 2024 for eurozone estimates) and empirical. The former generally aligns with the latter, concluding that both supply- and demand-side shocks mattered, depending on the country and period under examination. The empirical research specifically involves a paper by Shapiro (2022), which shows that demand-driven factors contribute as much as supply-driven factors to U.S. inflation, using a two-equation VAR model with sign restric-

[2]For Central European small open economies, two relevant studies are worth mentioning. Szafranek *et al.* (2024) analyse the drivers of inflation in Poland using Bayesian SVAR with zero and sign restrictions, showing that country-specific energy price and global supply shocks mainly drive the post-pandemic inflation surge. To draw implications for Czech monetary policy, Babecká Kucharčuková *et al.* (2022) examine the global pandemic shock using empirical narrative comparisons and model simulations, and find that the supply nature of the shock dominated from mid-2020. However, their analysis only covers data until the end of 2021 and hence does not address the period of the energy crisis.

tions.[3] Kabaca & Tuzcuoglu (2023) confirm this result for U.S. inflation using an SVAR model that combines sign, narrative, and variance decomposition restrictions. Eickmeier & Hofmann (2022) estimate a factor model utilizing a large number of inflation and real activity series for the U.S. and the eurozone. They find that the inflation surge since mid-2021 has been driven by both supply and demand factors, with the former being the primary contributor in the euro area. They attribute this difference to the energy supply disruptions stemming from the Russia-Ukraine war. Employing a Bayesian SVAR model of the euro area with sign restrictions, Ascari *et al.* (2023) align with previous findings, pointing to a significant role for demand factors in the euro area since autumn 2020. Furthermore, Binici *et al.* (2022), estimating a Phillips curve model of inflation dynamics in a panel setting, find that domestic factors have become influential in determining inflation dynamics across 30 European countries during the post-pandemic period.

Second, our paper contributes to the literature that examines the role of monetary policy and exchange rate shocks in the post-pandemic inflation spike. This is relevant especially because the effects of independent monetary policy can be investigated in the case of Czechia, Poland, and Hungary. Banbura *et al.* (2023) incorporate a monetary policy shock proxy as an endogenous variable in a VAR model to capture the effects of monetary policy in the euro area in their sensitivity analysis.[4] They find that the estimated contribution of the monetary policy shocks to core inflation has been small (and negative) overall. According to them, this may be due to monetary policy mainly affecting core inflation via its systematic component. On the other hand, Neri *et al.* (2023), using a Bayesian SVAR model with zero-sign and narrative restrictions, identify a positive contribution of monetary policy shocks and shocks to long-term inflation expectations. These factors together account for approximately one-fifth of euro area headline inflation in the fourth quarter of 2022. Employing similar techniques, Ascari *et al.* (2024) decompose core inflation into six shocks, including a monetary policy shock and an exchange rate shock. Likewise, monetary policy shocks are found to play a slightly positive role in the decomposition after the pandemic. Moreover, they note that the inflationary pressures in 2022 also stemmed from sizeable depreciation shocks to the exchange rate. Additionally, Cohn-Bech *et al.* (2023) emphasize that exchange rate depreciation contributed to inflation in Hungary following the pandemic.[5]

For all the economies considered, our findings indicate that foreign shocks have played an important role in driving the recent surge in inflation, encompassing both demand shocks, such as deferred post-COVID-19 global consumption, and supply shocks, including disruptions to global value chains and the impact of Russia's aggression in Ukraine. These findings align with the aforementioned literature (e.g., Ascari *et al.* 2023; Eickmeier & Hofmann 2022; Gonçalves & Koester 2022). However, it is essential to recognise that foreign shocks represent only one aspect of the inflationary dynamics, consistent with Binici *et al.* (2022). Domestic factors, particularly those related to the supply side, have also played a considerable role. This domestic dimension explains most of the differences in inflation rates among countries. On the one hand, the exchange rate shock contributes to inflation in Hungary only, consistent with Cohn-Bech *et al.* (2023). On the other

[3]Shapiro's method has been widely replicated on an international scale, including by Gonçalves & Koester (2022) for the euro area. The main findings broadly align, indicating that both demand and supply factors were important drivers of the recent inflation surge.

[4]As a baseline, they estimate a medium-sized BVAR model with a factor structure for the residuals.

[5]They use local projection techniques outlined by Caselli & Roitman (2019) as a benchmark and update the analysis until 2022, indicating an increase in exchange rate pass through to inflation.

hand, the role of monetary policy shocks is minor, suggesting that central banks behaved consistently according to their reaction function even during the extraordinary events of previous years. Nevertheless, central banks have not resorted to further tightening, which could have dampened inflation through monetary policy shocks. Furthermore, a significant proportion of inflation remains unexplained. This might be evidence of possibly less well-anchored inflation expectations.

Various sensitivity analyses are provided. Firstly, sensitivity checks are presented to assess the robustness and reliability of the baseline results. Secondly, headline inflation is replaced by core inflation, because many policymakers emphasize the importance of this index, as it excludes volatile components of inflation such as fuel and food prices. Our estimates reveal that the elevated core inflation in Central European economies was caused predominantly by domestic factors.

The structure of the rest of this paper is as follows. Section 2 describes the data. Section 3 introduces the estimation strategy within the Bayesian SVAR model framework. Section 4 then presents the results and discusses the origins of inflation in Central European countries using historical decompositions. Robustness checks are introduced in Section 5 and Section 6 concludes.

2 Data

The analysis involves the main domestic and foreign macroeconomic variables. The domestic variables include output, inflation, interest rates, and exchange rates, while the external environment is characterized by foreign output and inflation.

Domestic output is expressed in terms of GDP in constant local currency prices. Inflation is measured using national consumer price indices. Monetary conditions are approximated by the country's three-month nominal interest rate.[6] The nominal broad effective exchange rate (NEER), encompassing 64 countries, is used to measure the exchange rate. The NEER is preferred over the bilateral exchange rate because it is able to capture the change of currency in Slovakia, which became a member of the euro area in 2009.

Foreign output is expressed in real GDP. External inflation pressures are represented by foreign producer prices. Producer prices are used instead of consumer prices because, for industrially oriented small open economies, it is essential to know the prices at which they purchase production inputs and also the production prices at which they compete.[7] To characterize the external environment comprehensively, we include foreign output and prices for all countries in the European Union in effective terms. Effective indicators serve as proxies for the effects of foreign economic activity and inflation on each economy analysed. The weights used in the calculation are equal to the shares of the individual EU countries in the total exports of the given Central European economy to the EU.

All variables are transformed into quarter-on-quarter (QoQ) growth rates, with the exception of interest rates, which remain in levels.[8] Positive growth of the exchange rate means appreciation of the currency. Additionally, seasonal adjustment is applied

[6] We use PRIBOR for Czechia, BUBOR for Hungary, WIBOR for Poland, and BRIBOR (until the end of 2008) and EURIBOR (from 2009) for Slovakia.

[7] Our approach is based on the core forecasting model of the Czech National Bank, which also primarily uses industrial prices as an indicator of inflationary pressures from the external environment (Andrle *et al.* 2009).

[8] The data are depicted in Appendix A.

to all variables except for interest rates and exchange rates. The dataset spans from 2000Q3 to 2023Q2. Domestic GDP, inflation, and interest rates were obtained from the FRED database, while foreign GDP and producer prices were sourced from the Eurostat database. The NEER is retrieved from the Bank for International Settlements, while the weights of trading partners were acquired from the World Bank.

3 Methodology

3.1 Estimation Strategy

To discern the origins of inflation, we employ Bayesian Vector Autoregression (VAR), estimating separate models for each country.[9] By estimating separate models, we can address the heterogeneity among Central European economies. This includes adjusting the structural identification in the case of Slovakia, the only economy in our sample that is a member of the euro area and thus does not have its own monetary policy. Furthermore, the VAR model allows us to capture the dynamic relationships in small economies appropriately, even during turbulent times when one-off shocks to GDP growth after the outbreak of the COVID pandemic are not at the end of the sample. We illustrate this by means of a robustness analysis, comparing the estimates from the full sample with the pre-pandemic data up to 2019Q4.[10]

We assume four domestic shocks (demand, supply, monetary policy, and exchange rate) and two foreign shocks (demand and supply). The structural identification of the shocks relies on contemporaneous zero-sign restrictions (Arias *et al.* 2018). Following Brázdik & Franta (2017), Jovičić & Kunovac (2017), and Pop & Murarașu (2018), we also impose block exogeneity on the foreign variables, considering Central European countries as small open economies. This ensures that there will be no undesired spillover of domestic shocks to foreign variables; otherwise, there would be misspecification of shocks, as discussed in Cushman & Zha (1997) and Zha (1999). An additional advantage of this approach is a reduction in the number of parameters that need to be estimated (Cushman & Zha 1997).

When estimating the Bayesian VAR, we use a normal diffuse prior, relying on uninformative beliefs about the error term covariance matrix. The model is estimated with two lags on demeaned data. Hence, it does not include a constant. This ensures a more appropriate and robust historical decomposition (Bergholt *et al.* 2024). The Gibbs algorithm is used to derive the unconditional posterior. For inference, 20,000 iterations of the Gibbs sampler are conducted, with the initial 10,000 iterations discarded as burn-in; the median is used for the analysis. The BEAR toolbox is used to estimate the model (Dieppe *et al.* 2016).

3.2 Structural Identification of Shocks

The application of sign restrictions is motivated by economic theory. It is widely justified by previous empirical research and is implemented in the core forecasting models of central

[9] The model is described in Appendix B.

[10] Additionally, we explored the possibility of estimating the model with stochastic volatility. However, we dismissed this option, as it tends to attribute the inflation surge in the post-COVID period to an increase in stochastic volatility, rather than providing a structural interpretation.

Table 1: Structural Identification of Shocks

Variable\Shock	Domestic Demand	Domestic Supply	Monetary Policy	Exchange Rate	Foreign Supply	Foreign Demand
Real Output	+	−	+	+		
Inflation	+	+	+	+		
Interest Rate	+		−	+		
Exchange Rate	+		−	−		
Foreign Output	**0**	**0**	**0**	**0**	−	+
Foreign Inflation	**0**	**0**	**0**	**0**	+	+

Note: A " + "(" − ") indicates that this variable must respond positively (negatively) to the particular shock. A "**0**" denotes block exogeneity. No sign () implies that the variable is not expected to respond to the specific shock in any particular direction. A positive sign for the exchange rate indicates appreciation. For Slovakia, additional zero restrictions are assumed: it is assumed that there is no contemporaneous response of the interest rate to domestic supply and demand shocks. The structural identification for Slovakia is shown in Table B2.

banks in Europe.[11] The structural identification of the shocks is presented in Table 1.

A positive domestic demand shock increases real output and prices, leading to a tightening of monetary policy and resulting in an appreciation of the exchange rate (Ellis *et al.* 2014; Forbes *et al.* 2018).[12] On the other hand, a negative supply shock leads to higher inflation and a decline in output (Canova & De Nicolò 2003). Monetary policy easing implies currency weakening, as the real return on investment is lower compared to the rest of the world. Easing in both components of monetary conditions contributes to higher inflation and stimulates real economic activity (Hjortsoe *et al.* 2016; Brázdik *et al.* 2020).

The depreciation sparks inflation pressures via an increase in import prices. Domestic production simultaneously becomes cheaper for foreign markets, leading to higher economic growth through an increase in exports. The central bank responds to the higher import prices and stronger demand pressures by raising the nominal interest rate. This partially offsets the initial effect of the currency weakening on prices (Audzei & Brázdik 2018). Since we adopt block exogeneity, foreign variables do not respond to any domestic shock.

We opted for two adjustments to the above-mentioned sign restrictions in the case of Slovakia, which does not have an independent monetary policy after joining the euro area in 2009. We assume that the interest rate in Slovakia does not respond immediately to domestic demand and supply shocks due to the common monetary policy of the euro area. Therefore, contemporaneous zero restrictions are imposed in these cases.[13]

[11]For instance, the Magyar Nemzeti Bank's forecasting model (Békési *et al.* 2016), the Bank of England's COMPASS (Burgess *et al.* 2013), the Czech National Bank's g3+ (Brázdik *et al.* 2020), and the Norges Bank's NEMO (Gerdrup *et al.* 2017).

[12]Despite the exchange rate appreciation that follows a domestic demand shock, inflation still rises. This is because of the assumption that the increase in prices resulting from stronger demand is more significant than the decrease in prices due to the appreciation and cheaper imports (Ellis *et al.* 2014; Forbes *et al.* 2018).

[13]The structural identification of the shocks for Slovakia is illustrated in Table B2.

The foreign shocks are identified in a straightforward way. A positive foreign demand shock increases both foreign output and prices. On the other hand, the higher inflation in the case of a negative supply shock is accompanied by a decline in output. This identification of foreign shocks is sufficient to obtain economically intuitive responses for the small open economies considered. Their output grows and inflation increases in the case of positive foreign demand shocks, while negative foreign supply shocks lead to economic slack with higher inflation. The central bank reacts to higher prices by tightening monetary policy, especially under a positive foreign demand shock.

4 Results

4.1 Drivers of Inflation Variability

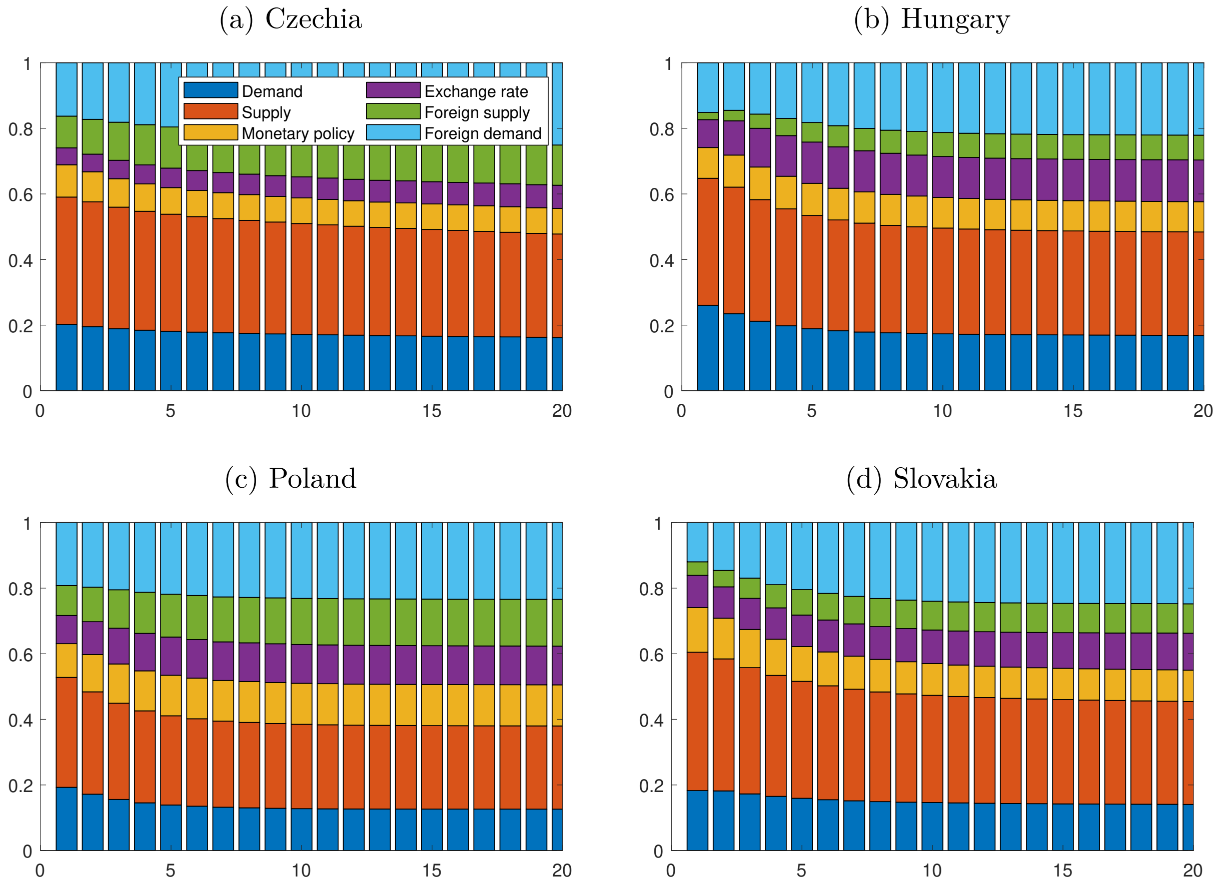
Although Central European countries are small open economies, domestic shocks, especially supply shocks, dominate the variability of the inflation shocks between 2000Q3 and 2023Q2 (Figure 3).[14] This suggests that their inflation developments are not necessarily related to what is happening in the wider world. Foreign shocks—primarily foreign demand shocks—explain only around one-third of the variability in quarter-on-quarter inflation after five years across all four countries. Foreign supply shocks play a relatively minor role in Hungary and Slovakia.

The presence of domestic supply shocks, which account for more than one-fifth of the variation in inflation, not only captures the common variability in supply, but also reflects the real and price convergence of Central European countries towards Western economies.[15] The relevance of domestic demand shocks to inflation is lower; they explain about 15% of the variability in inflation. The role of exchange rate shocks varies to some extent across countries. Their contribution to inflation is negligible in the Czech economy, confirming the findings of Baxa & Šestořád (2019), who observed a rather low exchange rate pass-through to inflation. Conversely, exchange rate shocks are a considerable factor behind the evolution of inflation in Hungary, aligning with the observations of Cohn-Bech *et al.* (2023), who suggest an increasing exchange rate pass-through to inflation for Hungary. Monetary policy shocks play a relatively minor role across economies, plausibly indicating that monetary policy affects inflation mainly through its systematic component.

[14] The properties of the models estimated are provided in Appendix C. In particular, a full overview of the impulse responses for all countries is reported in Section C.1. The complete set of forecast error variance decompositions can be found in Section C.2.

[15] While, on the one hand, faster technological progress and expansion of the production frontier (such as accession to the EU) dampen inflation in converging economies, price convergence—depicted by the Balassa–Samuelson effect—conversely leads to a faster increase in prices of nontradable goods and services. Incomplete price and wage level convergence across all countries is highlighted by Arnoštová *et al.* (2023). Concerning the price levels of GDP, Czechia and Slovakia stood at around 80% and Hungary and Poland at around 60% of the euro area average as of 2022. Wage levels in euro terms are below 60% of the euro area average across all four countries, the lowest being around 35% in Hungary.

Figure 3: Forecast Error Variance Decompositions of CPI Inflation



Note: The x-axis denotes quarters; the y-axis represents the share of the shocks in the variability.

4.2 Factors Behind of Post-COVID Inflation

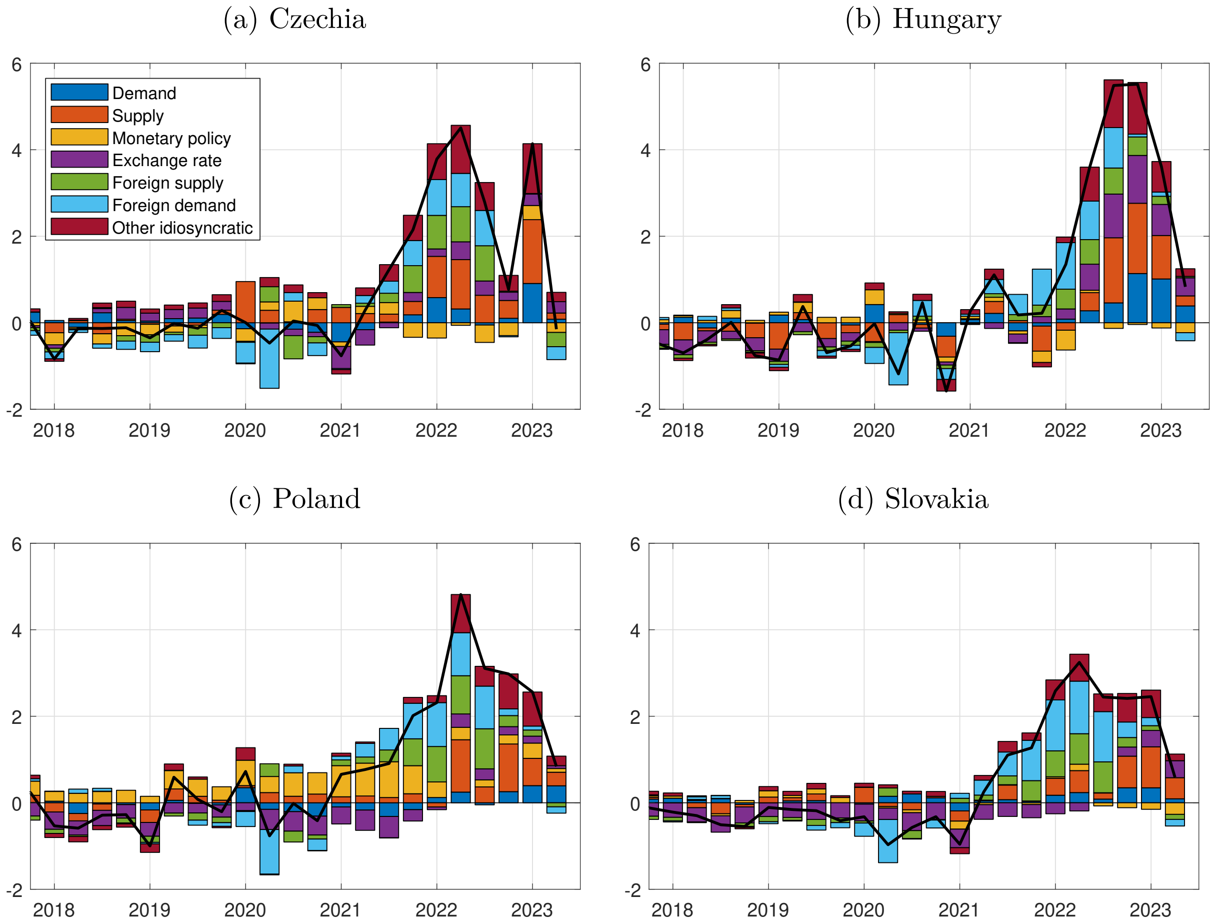
Figure 4 shows the contributions of the shocks identified to headline inflation from the beginning of 2018 until mid-2023.[16] Both foreign demand and foreign supply shocks contribute significantly to inflation in 2021 and 2022,[17] aligning with findings for the euro area (Ascari *et al.* 2023; Eickmeier & Hofmann 2022; Gonçalves & Koester 2022). Foreign demand shocks contribute to inflation more than foreign supply shocks do in the case of Hungary and Slovakia, while the impact of both foreign shocks on inflation is similar in Czechia and Poland. The inflationary effect of foreign shocks faded out in 2023 as energy prices started to decline and the bottlenecks in global value chains eased partially in a situation of satisfied deferred demand. However, it is the domestic dimension that primarily accounts for the variation in inflation rates across countries, consistent with Binici *et al.* (2022). The influence of domestic factors is particularly pronounced in Czechia and Hungary, smaller in Poland, and only minor in Slovakia.

In terms of domestic factors, supply shocks have contributed the most to headline

[16]We demonstrate in Section C.3 in the Appendix that the estimated models accurately capture major historical events through historical decompositions for all the countries considered.

[17]The negative foreign supply and positive foreign demand shocks identified are large from a historical perspective and clearly statistically significant at the 68% level of significance for many consecutive quarters.

Figure 4: Historical Decomposition of CPI Inflation (2018Q1–2023Q2)



Note: Contribution of shocks to the quarter-on-quarter change in the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions.

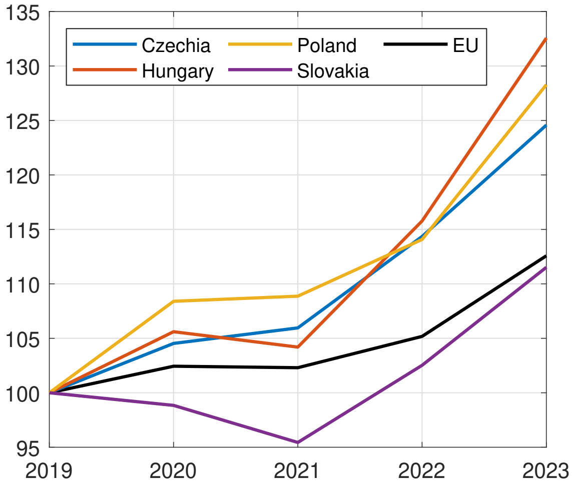
inflation across all countries since 2022. The presence of these shocks is in line with sluggish economic growth amid an overheating labour market. Although GDP declined during both the pandemic and the energy crisis, these downturns were not reflected in the labour market. There was a notable increase in unemployment rates from 2020Q1 to 2020Q2 across all four countries (OECD). However, the increase was short-lived and was not followed by a gradual labour market cooling. Consequently, a relatively stable number of workers produced less output, resulting in reduced labour productivity and increased unit cost of labour for firms. Our interpretation is confirmed by Figure 5, which demonstrates that nominal unit labour cost (based on hours worked) markedly exceeded real labour productivity per hour worked. This pattern is visible in Czechia, Hungary, and Poland.[18] Conversely, the labour cost-to-productivity ratio increased later and much less in Slovakia; it is even below the EU average.[19] This is consistent with the identified less pronounced contributions of negative supply shocks to inflation since 2022, when the

[18] Our results are in line with Szafranek *et al.* (2024), who also find a significant contribution of domestic supply shocks to inflation in Poland in 2021 and 2022.

[19] This aligns with the observation that during 2022, Slovakia maintained an unemployment rate of approximately 6%, whereas in the other countries, it remained at around 2–4%. Hence, the labour market was tighter in those countries.

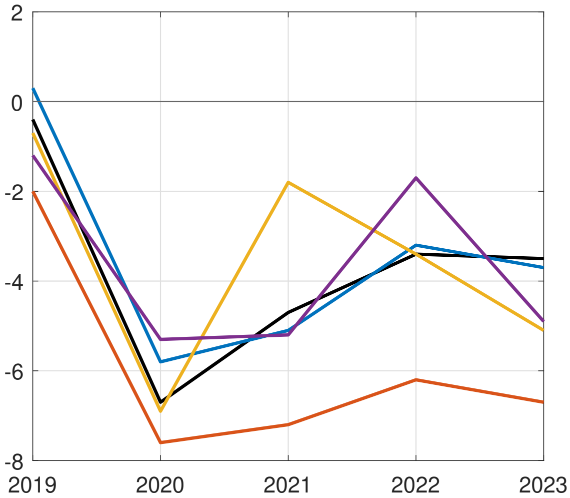
ratio increased.

Figure 5: Labour Cost-to-Productivity Ratio (index, 2019 = 100)



Note: The ratio is calculated as the ratio of nominal unit labour cost based on hours worked to real labour productivity per hour worked. Both indices are normalized to 100 in 2019. The data are obtained from Eurostat.

Figure 6: General Government Surplus/Deficit (percentage of GDP)



Note: Net lending (+)/net borrowing (−). The data are obtained from Eurostat.

The post-pandemic recovery is evidenced by a positive contribution of domestic demand shocks, suggestive of deferred consumption. We also assume that the impact of government spending shocks manifests as demand shocks, particularly given their frequent realization in the form of transfers, social benefits for households, and reductions in labour-income tax. However, the role of domestic demand in explaining the recent spikes across countries seems relatively limited. This implies that neither saving by households during the closures of some parts of economies, nor the COVID-19 fiscal stimulus, was the primary driver of the inflation surge across countries. The exception is Hungary, where a greater role of demand shocks has been observed since the latter half of 2022. This is consistent with the additional round of fiscal stimulus implemented ahead of the April 2022 elections (Lybek 2023). Furthermore, Cohn-Bech *et al.* (2023) elaborate that this fiscal stimulus was provided despite a stronger-than-expected economic recovery from the COVID-19 crisis. Large fiscal expansion in Hungary is also evident from the general government deficit as a percentage of GDP (see Figure 6). While other Central European countries managed to reduce their deficits following the first wave of the pandemic and are around the EU average, the Hungarian government has consistently maintained a substantial deficit since 2020.

Appreciation exchange rate shocks are identified after the outbreak of the pandemic, due to the government support swiftly provided to economies across Europe, which resulted in relatively positive sentiment.[20,21] However, after Russia's invasion of Ukraine in February 2022, there was a sudden depreciation not only of Central European currencies,

[20] Positive sentiment on the financial market implies an inflow of foreign capital into Central European currencies. The opposite holds for a risk-off regime.

[21] In Hungary and Poland, the exchange rate was temporarily supported by central bank interventions to mitigate the immediate impact of the pandemic outbreak.

but also of the euro. This was caused by negative sentiment in financial markets towards Europe, which faced an unexpected security threat and a sharp increase in energy prices affecting its competitiveness with the rest of the world. In 2022, depreciation exchange rate shocks thus contributed slightly to inflation in Central European economies.[22] In Hungary, the impact of exchange rate shocks may have been more pronounced due to a high public deficit relative to GDP. According to Cohn-Bech *et al.* (2023), during 2022, the forint depreciated against the US dollar by more than most emerging markets' currencies globally. Moreover, disputes with the European Union added to risk perceptions and intensified pressure on the exchange rate.[23]

The impact of monetary policy shocks has been relatively low across countries since 2022. Restrictive monetary policy shocks have partially mitigated the high inflation in Czechia since the end of 2021. In the case of Poland, despite accommodative monetary policy until 2021, the subsequent significant increase in interest rates minimized the inflationary effects of policy shocks. Similarly, the influence of monetary policy shocks on inflation was negligible in Hungary and Slovakia. This suggests that central banks behaved mostly in accordance with the economic relationships estimated by the policy rule. A similar explanation is provided by Banbura *et al.* (2023) for the eurozone. This finding is driven by the relatively large importance of adverse supply shocks that emerged after the outbreak of the COVID-19 pandemic. According to the obtained impulse response functions (available in Appendix C.1), the reaction of central banks is more relaxed in the case of supply shocks compared to demand shocks, especially for foreign shocks.[24] However, central banks have not implemented excessively restrictive policies that could counteract other shocks.

The historical decompositions also indicate that following the pandemic, inflation increased beyond what can be accounted for by the shocks identified, attributed to idiosyncratic components. One plausible explanation could be that some relevant shocks are not identified, for example, prevailing higher inflation expectations in the economies. As also mentioned by Banbura *et al.* (2023), the unexplained part can reflect measurement errors or changes in collection methodology. It could also be related to the presence of nonlinearities in transmission during abnormal times, with larger shocks being transmitted more strongly and/or more quickly (Cavallo *et al.* 2023). In any case, the presence of idiosyncratic components confirms the abnormal nature of the episode.

4.3 Synchronization of Shocks Across Countries

Although the economies considered are similar in many respects, there are sizeable differences in the structural shocks identified, as is evident from Table 2, which shows the

[22] Although the central banks in Czechia, Hungary, and Poland intervened to mitigate the depreciation pressure in 2022, depreciation shocks were still identified.

[23] The Hungarian Central Bank responded to the sharp depreciation of the forint by increasing the interest rate to 13% per annum, significantly higher than that of other central banks in the region. On top of that, the three-month interbank rate increased to 17% because of other Hungarian monetary policy tools.

[24] When a supply shock occurs, policymakers face a trade-off between stabilizing inflation and real economic activity, which is often considered the second mandate of the central bank. On the other hand, offsetting inflation pressures from demand shocks is easier for the central bank without additional costs, as deviations in both inflation and output growth are addressed simultaneously.

cross-country correlations of the structural shocks of 2020Q1 and 2023Q2.[25] While the foreign shocks are almost identical due to similarity in the composition of main trading partners, the correlation of the domestic shocks remains mostly positive but considerably smaller. In particular, domestic demand and supply shocks are synchronized between Czechia and Slovakia, which formed one country in the past. Exchange rate shocks are synchronized across Czechia, Hungary, and Poland because these economies are perceived as similar on the world financial market. However, exchange rate shocks are identified differently in Slovakia than in the other countries, as Slovakia has been a member of the euro area since 2009.

Table 2: Correlation of Structural Shocks Across Countries (2020Q1–2023Q2)

Domestic Demand					**Domestic Supply**			
Czechia	Hungary	Poland	Slovakia		Czechia	Hungary	Poland	Slovakia
1	0.109	0.228	0.560	Czechia	1	-0.085	0.047	0.552
	1	0.688	0.119	Hungary		1	0.166	-0.096
		1	-0.055	Poland			1	0.250
			1	Slovakia				1

Monetary Policy					**Exchange Rate**			
Czechia	Hungary	Poland	Slovakia		Czechia	Hungary	Poland	Slovakia
1	0.100	0.304	0.357	Czechia	1	0.471	0.610	0.200
	1	0.385	0.240	Hungary		1	0.581	0.060
		1	-0.056	Poland			1	-0.046
			1	Slovakia				1

Foreign Supply					**Foreign Demand**			
Czechia	Hungary	Poland	Slovakia		Czechia	Hungary	Poland	Slovakia
1	0.986	0.995	0.992	Czechia	1	0.990	0.996	0.992
	1	0.994	0.992	Hungary		1	0.995	0.993
		1	0.995	Poland			1	0.996
			1	Slovakia				1

Note: Structural shocks across countries are compared from 2020Q1 to 2023Q2. The correlations are based on the median of the shock's posterior distribution.

[25] Although some of the correlation coefficients are not statistically significant due to the short period of interest, the main patterns of (un)synchronization of shocks across countries are obvious and mostly consistent with the correlations obtained for the full sample, as reported in Table C1 in the Appendix. In a nutshell, for the overall dataset, the synchronization of foreign shocks is high, whereas the correlation of domestic shocks is much lower, with only two occurrences where the correlation coefficient exceeds one-half. The first occurrence is the correlation of domestic demand shocks between Czechia and Slovakia, and the second is the correlation of exchange rate shocks between Hungary and Poland.

5 Sensitivity Analysis

We perform various sensitivity analyses to assess the robustness and reliability of our results. Firstly, we compare our baseline estimates with the pre-pandemic sample to demonstrate the robustness of our approach. Secondly, we show the robustness of our results through a more detailed structural identification of shocks in the case of Poland. Additionally, a historical decomposition estimation for core CPI instead of headline CPI is conducted, as focusing on the most stable component of inflation is appealing to some policymakers during extreme times. Furthermore, we demonstrate through additional estimations on the Czech example how the results change when we adjust CPI for administrative changes. Moreover, we estimate the baseline model with three and four lags instead of two, concluding that there is no notable difference in the results compared to our baseline.

5.1 Comparison Across Different Estimation Samples

The baseline model is re-estimated using the pre-pandemic sample until 2019Q4. The main reason is to investigate whether our approach is affected by excluding more recent observations from the abnormal period of COVID-19 onwards. The results are broadly consistent with the baseline estimations, with major historical events still adequately captured for all the economies considered (see Appendix D.3). For clarity, we calculate the correlation coefficient for the structural shocks in the period 2001Q1–2019Q4. Table 3 shows that the correlation is consistently high, typically exceeding 90%. This confirms the reliability of the model in extreme times as well as the baseline results.

Table 3: Correlation of Structural Shocks Across Samples

Shock\Country	Czechia	Hungary	Poland	Slovakia
Domestic Demand	0.972	0.977	0.976	0.987
Domestic Supply	0.940	0.895	0.913	0.983
Monetary Policy	0.895	0.936	0.899	0.984
Exchange Rate	0.915	0.938	0.928	0.925
Foreign Supply	0.932	0.923	0.907	0.879
Foreign Demand	0.937	0.945	0.935	0.890

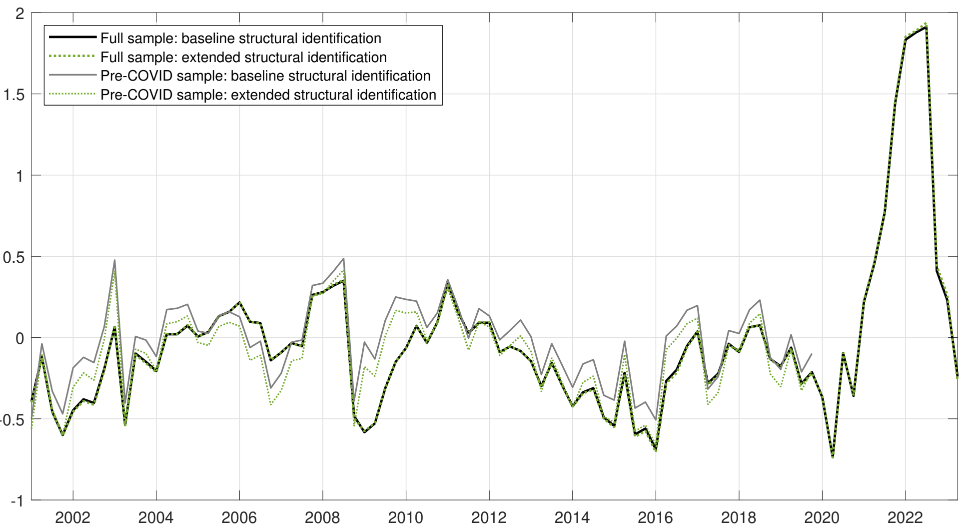
Note: Structural shocks for baseline estimation and the pre-COVID sensitivity check are compared for the period 2001Q1–2019Q4. The correlations are based on the median of the shock's posterior distribution.

5.2 Alternative Structural Identification of Foreign Shocks: The Case of Poland

While the interpretation of the historical data remains largely consistent between the baseline and pre-COVID estimations, it is important to acknowledge notable differences in the impulse responses in the case of Poland. Specifically, when focusing solely on the pre-COVID sample, the reactions of Polish output growth to foreign shocks appear negligible and lack statistical significance at the 68% confidence level. Consequently, we propose an alternative approach employing a more elaborate structural identification of foreign shocks. This sensitivity check is conducted on the example of Poland, since the impulse responses to foreign shocks are broadly intact for other countries when the model is estimated on the pre-COVID sample. Therefore, on top of the baseline identification, contemporaneous sign restrictions are imposed on Polish GDP growth and CPI inflation. Specifically, we assume that domestic GDP growth will decrease while inflation will rise in response to a negative foreign supply shock. Conversely, in the case of a positive foreign demand shock, we expect both GDP growth and inflation to increase.

In the case of the models estimated on the full sample, the contribution of foreign shocks to inflation for both the baseline and extended structural identifications remains intact (Figure 7). Although some differences are visible when comparing estimations for the baseline and alternative structural identifications on the pre-COVID sample, they still tell a similar story about the effects of foreign shocks on inflation in Poland. Therefore, we can conclude that the baseline specification is appropriate for our analysis, especially when focusing on the interpretation of the full sample including the post-pandemic surge in inflation.

Figure 7: Contribution of Foreign Shocks to Inflation in Poland



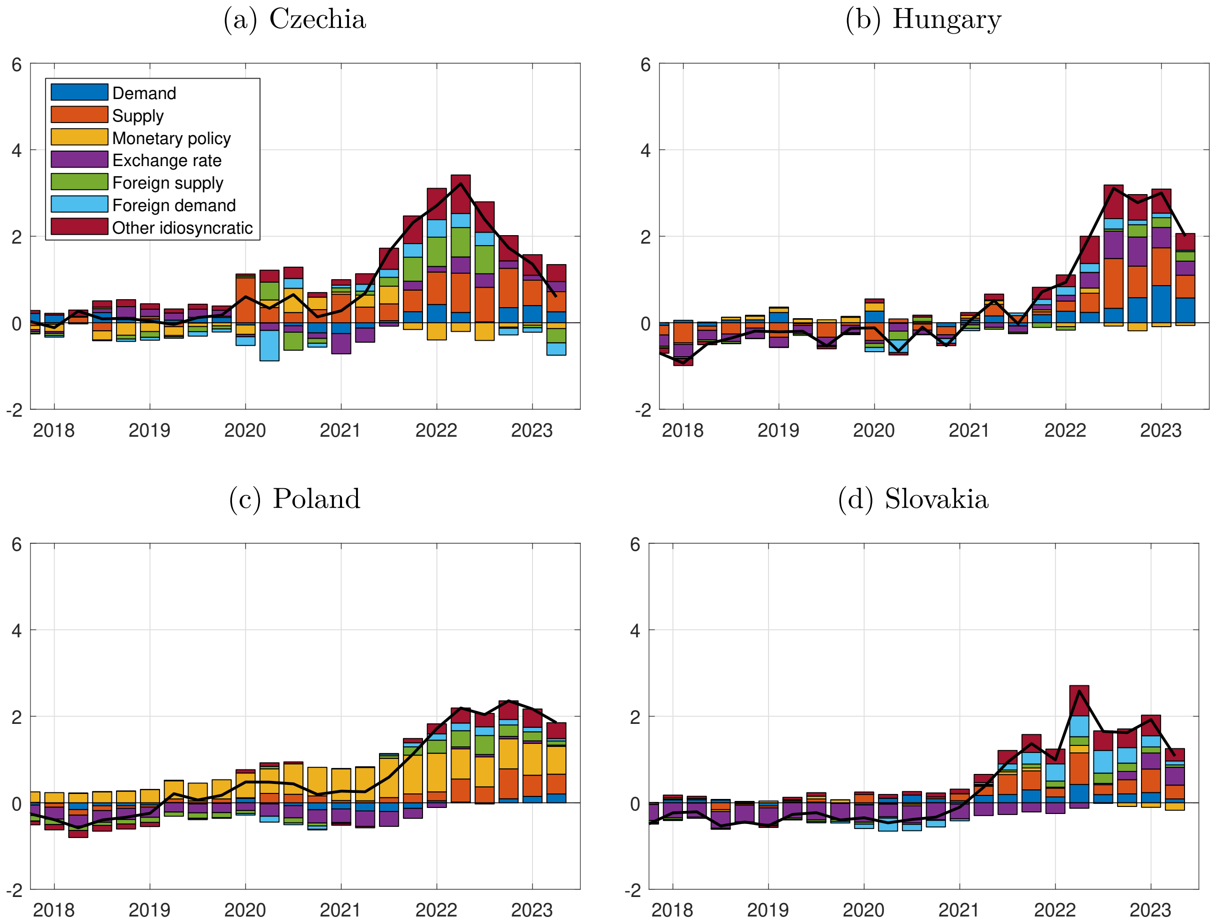
Note: Contribution of foreign shocks to the quarter-on-quarter change in the CPI index, in percentage points.

5.3 Core Inflation Instead of CPI Inflation

Many policymakers emphasize the importance of achieving price stability in core inflation, because core inflation excludes volatile components such as energy and food prices.[26] Hence, we replace headline inflation with core inflation.

[26]At first, policymakers justified the interest rate hike at the onset of the inflation spike by citing core inflation. In April 2022, ECB Governor Christine Lagarde mentioned the level of core inflation and emphasized a data-dependent approach regarding future rate hikes. Similarly, in February 2023, CNB Deputy Governor Eva Zamrazilová pointed to the core component of inflation to justify her readiness to vote in favour of raising interest rates in the future. Since the period of inflation spikes, policymakers have adopted a cautious approach to monetary policy easing, cit-

Figure 8: Historical Decomposition of Core Inflation (2018Q1–2023Q2)



Note: Contribution of shocks to the quarter-on-quarter change in the core component of the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions. The y-axis has the same range as Figure 4 for ease of comparison with the decomposition of CPI inflation.

Comparing the results (Figure 8) with the baseline estimation (Figure 4), it is evident that the elevated core inflation is driven primarily by domestic factors across countries, with the impact of foreign shocks being considerably weaker. However, in the case of Czechia, there are still notable contributions from both foreign shocks. In Slovakia, the foreign impact is mostly from the demand side, whereas in Poland, it stems from the supply side to a limited extent. On the other hand, Hungary's core inflation is mostly driven by domestic factors. This is consistent with the fact that it faced the highest inflation rates among the countries in the region. With the exception of Poland, the relevance of the individual domestic factors remains similar to the baseline model results. Domestic supply shocks are still the primary contributor across the economies, with depreciation shocks being pronounced in Hungary. The impact of policy shocks as a factor behind core inflation is stronger in Poland. The National Bank of Poland started to hike rates later than its counterparts in Czechia and Hungary, even though core inflation was already

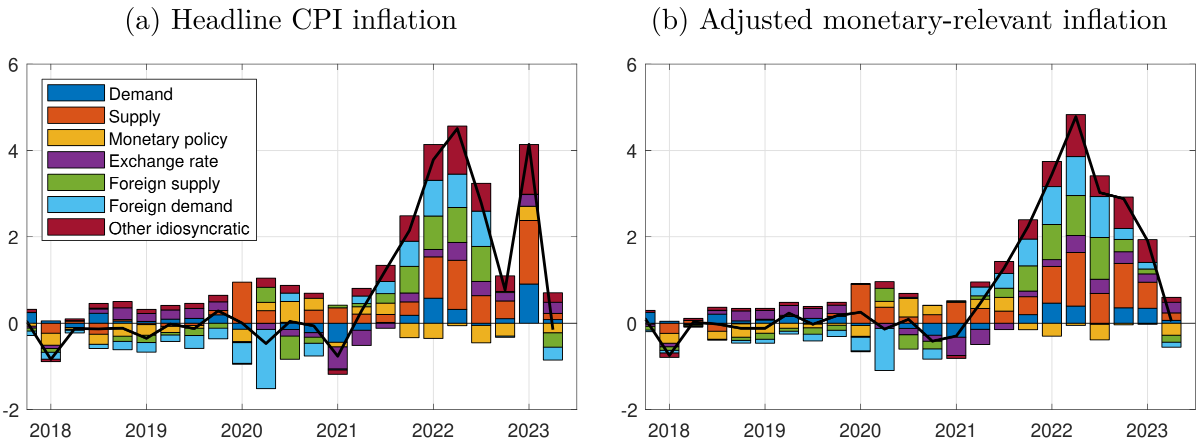
ing elevated or persistent levels of core inflation. In February 2024, CNB Governor Aleš Michl advocated maintaining a hawkish stance amid continued high core inflation, while in April 2024 the NBP Council members kept the interest rate unchanged, also mentioning elevated core inflation. Similarly, Federal Reserve Governor Christopher J. Waller emphasized caution in his speech titled "There's Still No Rush" in May 2024.

elevated in Poland in 2020. The previously accommodative monetary policy, together with its relatively large impact on inflation variability, explains the positive contributions of policy shocks in the decomposition of core inflation.

5.4 Impact of Administrative Changes on the Origins of Inflation in Czechia

As we mentioned during the discussion of the baseline results, the estimates are influenced to some extent by other factors than solely structural shocks. One of them is the introduction of various government measures across countries, which, at least temporarily, reduced consumer inflation in 2022 and 2023 and hence partially offset the sharp decline in real household income. This effect is most obvious in the case of Czechia. In the fourth quarter of 2022, inflation declined rapidly due to a waiver of the fee for renewable energy sources and the introduction of an energy savings tariff, while in the first quarter of 2023, it spiked following the replacement of the tariff with a government cap on electricity prices. However, the cap had a very limited impact on inflation in Czechia, since it was set above the actual prices of most energy providers for households.[27] Therefore, we provide a sensitivity analysis where we replace CPI inflation with monetary policy-relevant inflation (which disregards the primary impacts of changes to indirect taxes) further adjusted for the effects of the energy savings tariff and the waiver of the fee for renewable energy sources.

Figure 9: Sensitivity of Historical Decomposition to Administrative Changes (2018Q1–2023Q2)



Note: Contribution of shocks to the quarter-on-quarter change in the adjusted monetary-relevant price index, in percentage points. Deviations from the mean and from the contribution of the initial conditions.

Although the evolution of adjusted monetary policy-relevant inflation is smoother than that of CPI inflation, the main drivers identified remain the same (Figure 9). In late 2022 and early 2023, the contribution of domestic supply shocks prevails, while the effects of

[27]Various measures were also introduced in other countries. The Slovak government decided to cap energy prices for companies and businesses and reduce VAT on selected goods and services. Similarly, the Polish government introduced an Anti-Inflationary Shield and an Energy Shield in 2022, including measures such as fixed prices for electricity and VAT reductions on various products and fuels. Energy price caps were also introduced in Hungary. For a comprehensive list of measures, refer to the Bruegel Datasets.

previous foreign shocks are already fading (Figure 9b). Hence, the interpretation of adjusted monetary policy-relevant inflation closely aligns with the baseline results, implying that administrative changes have no significant impact on the structural explanation of inflation.

6 Conclusion

This paper examines the factors driving the surge in inflation in Central European countries, specifically Czechia, Hungary, Poland, and Slovakia, following the COVID-19 pandemic and Russia's aggression against Ukraine. The contribution of the paper is twofold. Firstly, it expands our understanding of the elevated inflation in Central European economies, which are typical examples of small open economies. Moreover, these economies were among the most affected by the energy crisis, due to their proximity to Russia and high energy intensity. Secondly, the paper offers a comparison of the impact of monetary policy on inflation between economies with independent monetary policies and those within the euro area.

We employ a Bayesian SVAR model to depict the economic relationships in the small open economies considered. The structural identification relies on contemporaneous sign and zero restrictions, supplemented by block exogeneity to account for the characteristics of small open economies. The origins of inflation are investigated through a historical decomposition.

Our analysis reveals that foreign shocks play a significant role in explaining the heightened post-2020 inflation, alongside noteworthy contributions from domestic factors. In particular, domestic supply shocks emerge as a considerable driver, indicating constraints on the production side. These findings are consistent across the countries examined. Furthermore, while the exchange rate shock significantly stimulates inflation in Hungary only, monetary policy shocks appear to be relatively negligible in all the countries. This suggests that the central banks respond to increases in inflation in accordance with their reaction functions. Interestingly, this pattern persists across economies with independent monetary policies and for Slovakia, a member of the euro area. Thus, central banks have avoided additional tightening measures, which could have mitigated inflation through monetary policy shocks.

Our conclusions are robust to various sensitivity analyses. We demonstrate the robustness of our approach under extreme events such as the pandemic period. Additionally, we show that when headline inflation is replaced by core inflation, domestic factors primarily drive inflation.

While we have identified the main determinants of inflation, a portion of the inflationary developments remains unexplained by our model, despite the incorporation of standard macroeconomic relationships. This prompts us to consider whether elevated inflation expectations could have played a role in the high inflation observed in Central European economies. However, exploring this topic falls outside the scope of our current paper and could be addressed in future research endeavours.

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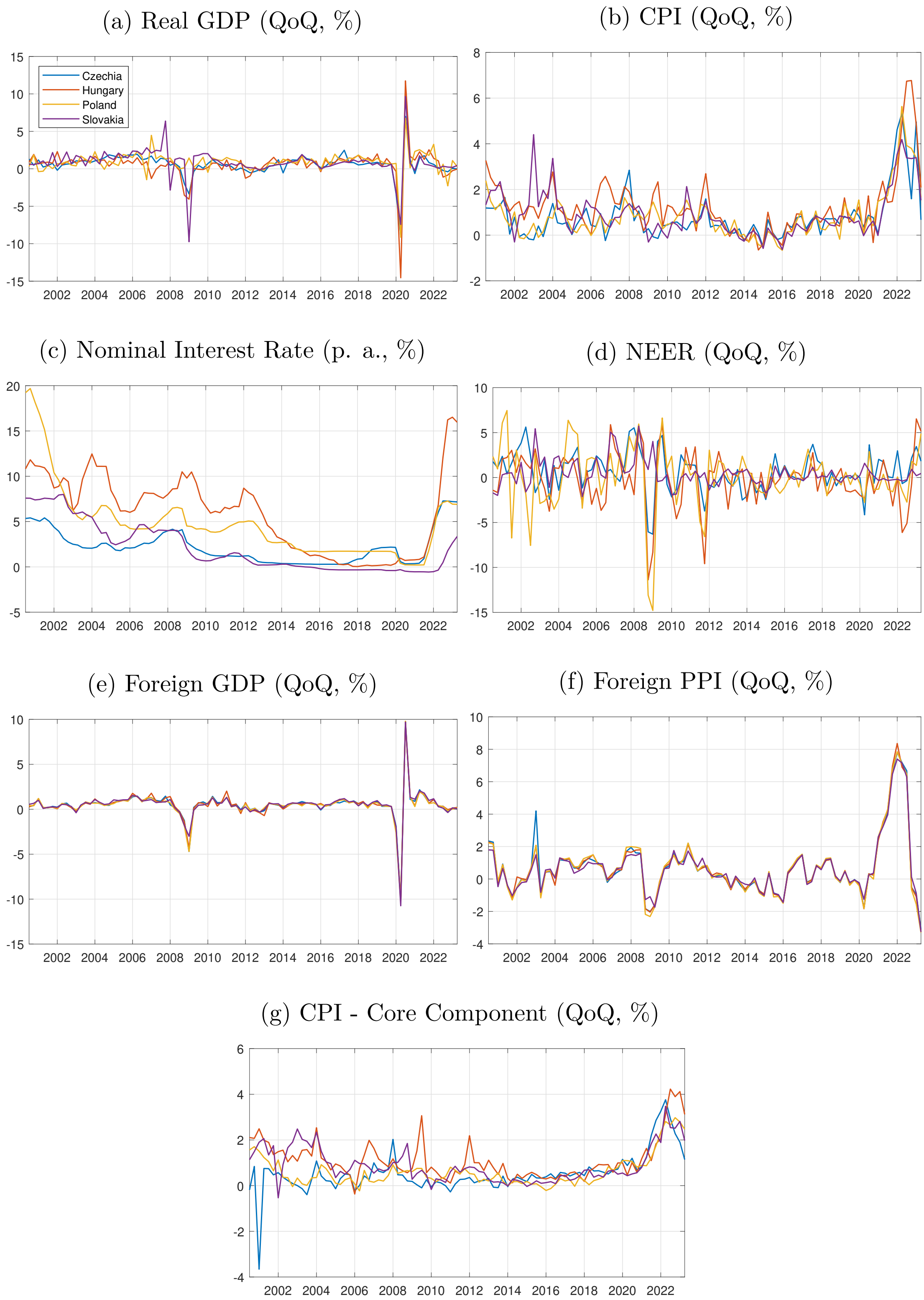
Appendix A: Data

Figure A1: Dataset



Appendix B: Description of BVAR

Consider a traditional reduced-form VAR model with T periods of observations, n variables, and p lags rewritten in matrix form:

$$Y = XB + \mathcal{E}, \tag{B1}$$

where Y is a $T \times n$ matrix of independent variables, X is a $T \times k$ matrix of regressors, $\mathcal{E}$ is a $T \times n$ matrix of residuals, and B is a $k \times n$ matrix of regression parameters, with $k = 1 + pn$ as the number of regression parameters per VAR equation.[28] The matrix of independent variables is constructed as

$$Y = \left[\{y_t\}_{t=1}^{T} \right]',$$

and the matrix of regressors as

$$X = \left[\{x_t\}_{t=1}^{T} \right]',$$

with

$$x_t = [1, \left\{ y'_{t-i} \right\}_{i=1}^{p}]'.$$

To derive the results that will follow, we introduce the vectorized version of the above matrix equation (B1). Let $\otimes$ denote the Kronecker product, and $\text{vec}(\cdot)$ the operator that stacks the columns of a matrix into a vector. Using the vectorization rule that $\text{vec}(ABC) = (C' \otimes A)\text{vec}(B)$, we can derive that

$$y = (I_n \otimes X)\beta + \varepsilon, \tag{B2}$$

where $y = \text{vec}(Y)$ is a $Tn \times 1$ vector of regressands, and $\beta = \text{vec}(B)$ is a $kn \times 1$ vector of regression parameters. Furthermore, $\varepsilon = \text{vec}(\mathcal{E})$ is a $Tn \times 1$ vector of shocks that are distributed according to the normal distribution

$$\varepsilon \sim \mathcal{N}(0, \Sigma \otimes I_T). \tag{B3}$$

For the Bayesian estimation of the model, we rely on the normal-diffuse prior distribution. It assumes an uninformative prior for Σ. The parameters in β follow a Normal distribution, while variance Σ has an inverse-Wishart distribution:

$$\beta \sim \mathcal{N}(\underline{\beta}, \underline{V}), \tag{B4}$$

$$\Sigma \sim \mathcal{IW}(\underline{S}, \underline{\nu}). \tag{B5}$$

The prior beliefs related to β are specified in Minnesota style. This entails a constant value below one (we opt for the commonly used 0.8) for the first own lag of an endogenous variable, otherwise zero. It is assumed that no covariance exists between the terms in β, hence its covariance matrix is diagonal. For parameters relating endogenous variables to their own lags, the variance is given by:

$$\sigma^2_{a_{ii}} = \left(\frac{\lambda_1}{l^{\lambda_3}} \right)^2, \tag{B6}$$

[28] The notation is mostly consistent with Dieppe *et al.* (2016).

where λ_1 is an overall tightness parameter, l is the lag considered by the coefficient, and λ_3 is a scaling coefficient controlling the speed at which the coefficients for lags greater than 1 converge to 0 with greater certainty. For parameters related to cross-variable lag coefficients, the variance is given by:

$$\sigma_{a_{ij}}^2 = \left(\frac{\sigma_i^2}{\sigma_j^2}\right)\left(\frac{\lambda_1 \lambda_2}{l^{\lambda_3}}\right)^2, \tag{B7}$$

where σ_i and σ_j denote the OLS residual variance of the auto-regressive models estimated for variables i and j, and λ_2 represents a cross-variable specific variance parameter. Block exogeneity is assured by setting a zero prior mean on the relevant coefficients and by implementing an arbitrary small prior variance through the hyperparameter $(\lambda_4)^2$, ensuring that they are tight around zero. The hyperparameter values used are summarized in Table B1.

Since the normal diffuse prior distribution is used, the prior scale matrix for Σ is

$$\tilde{S} = (Y - XB)^T (Y - XB). \tag{B8}$$

Table B1: Hyperparameters Used for Prior

Hyperparameter	Description	Value
λ_1	Defines uncertainty about the prior on own lags (overall tightness parameter)	0.1
λ_2	Cross-variable specific variance parameter	0.5
λ_3	Lag decay	1
λ_4	Prior variance on coefficients associated with block exogeneity	0.001

Table B2: Structural Identification of Shocks for Slovakia

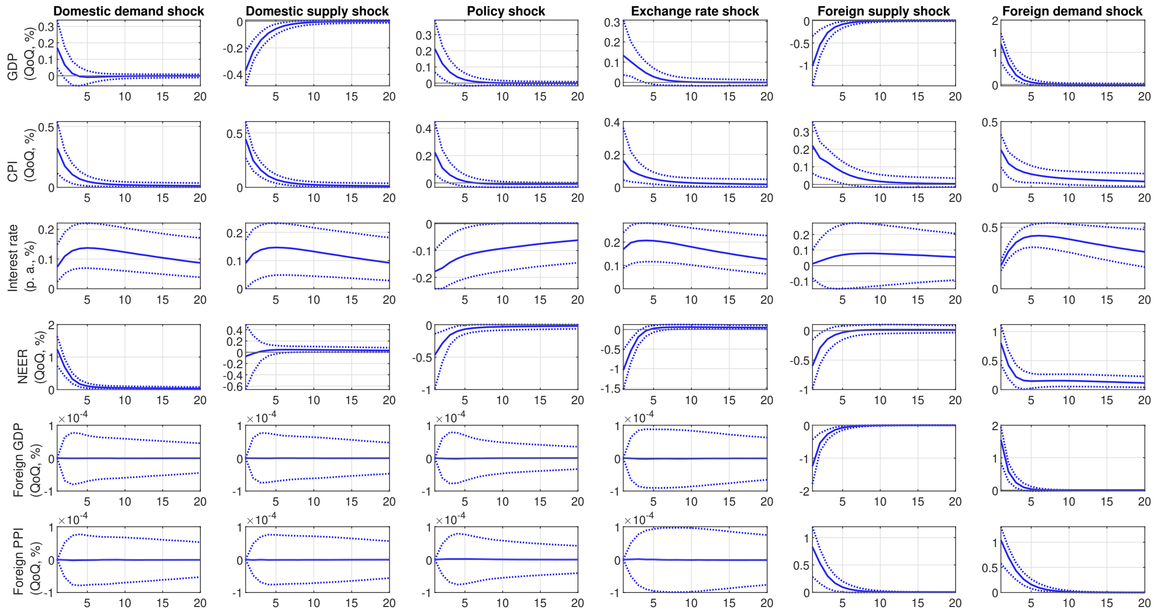
Variable\Shock	Domestic Demand	Domestic Supply	Monetary Policy	Exchange Rate	Foreign Supply	Foreign Demand
Real Output	+	−	+	+		
Inflation	+	+	+	+		
Interest Rate	0	0	−	+		
Exchange Rate	+		−	−		
Foreign Output	**0**	**0**	**0**	**0**	−	+
Foreign Inflation	**0**	**0**	**0**	**0**	+	+

Note: A "0" ensures that this variable cannot move contemporaneously in response to the particular shock. A " + "(" − ") indicates that this variable must respond positively (negatively) to the particular shock. A "**0**" denotes block exogeneity. No sign () implies that the variable is not expected to respond to the specific shock in any particular direction. A positive sign for the exchange rate indicates appreciation.

Appendix C: Additional Results – Baseline Analysis

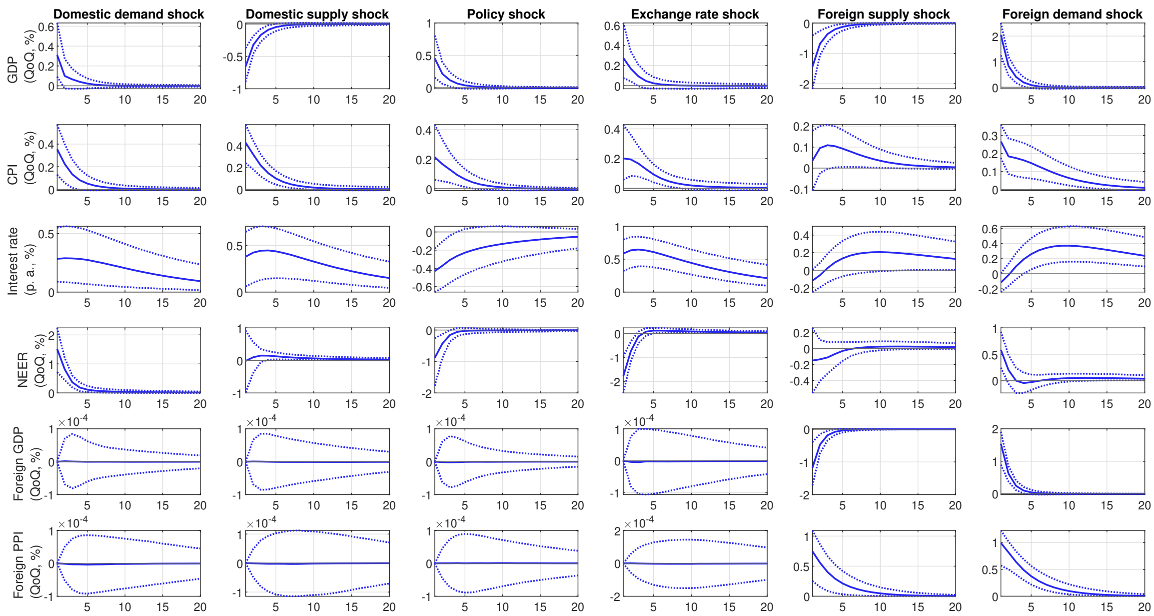
C.1 Impulse Response Functions

Figure C1: Czechia



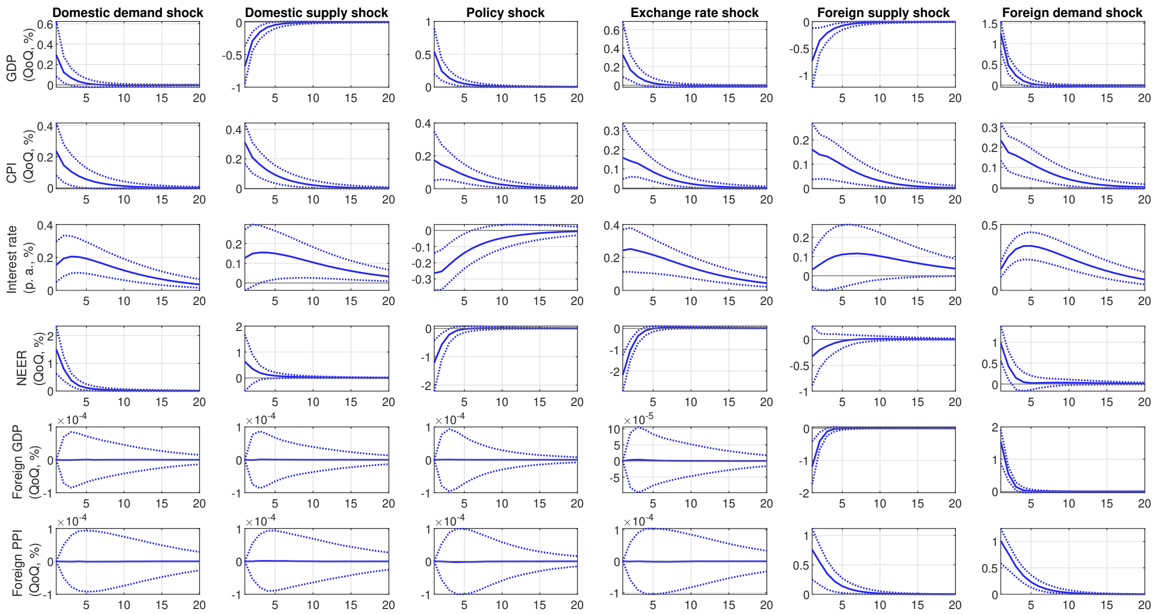
Note: Median responses with 68% credible intervals. The responses correspond to one standard deviation shocks and cover the 20 quarters after the initial shock.

Figure C2: Hungary



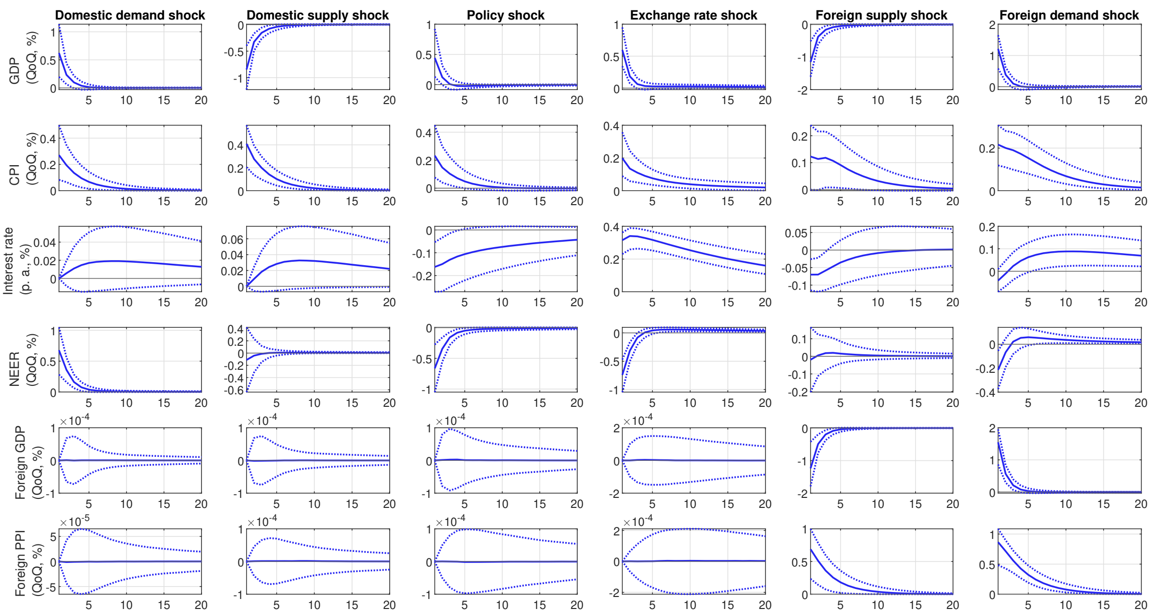
Note: Median responses with 68% credible intervals. The responses correspond to one standard deviation shocks and cover the 20 quarters after the initial shock.

Figure C3: Poland



Note: Median responses with 68% credible intervals. The responses correspond to one standard deviation shocks and cover the 20 quarters after the initial shock.

Figure C4: Slovakia



Note: Median responses with 68% credible intervals. The responses correspond to one standard deviation shocks and cover the 20 quarters after the initial shock.

C.2 Forecast Error Variance Decomposition

Figure C5: Czechia

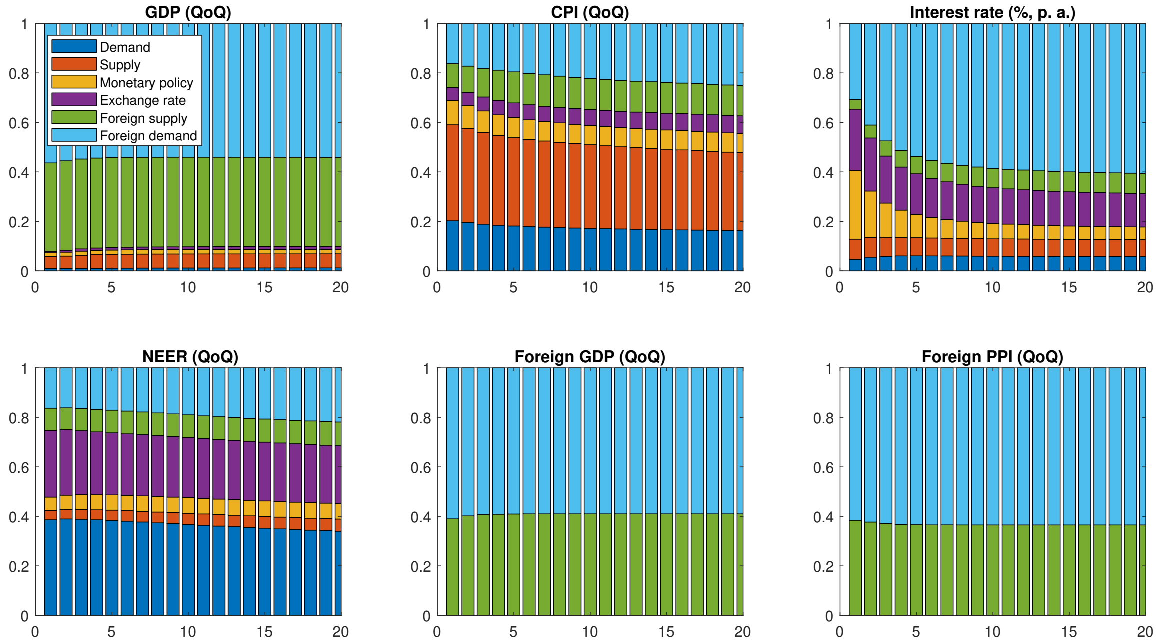


Figure C6: Hungary

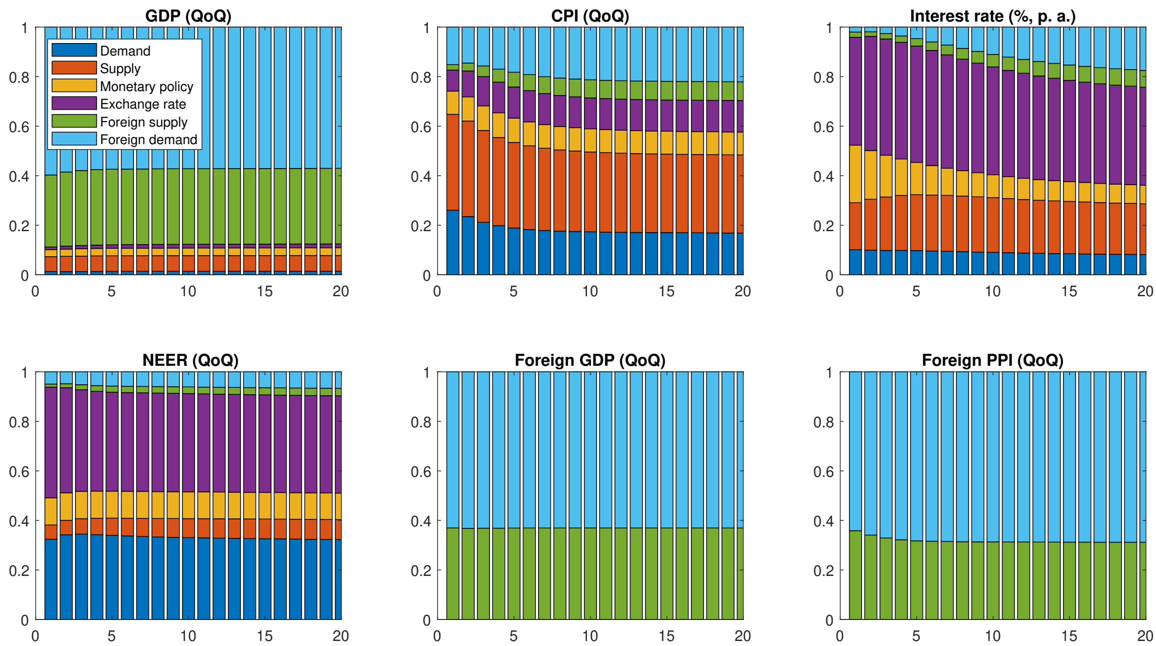


Figure C7: Poland

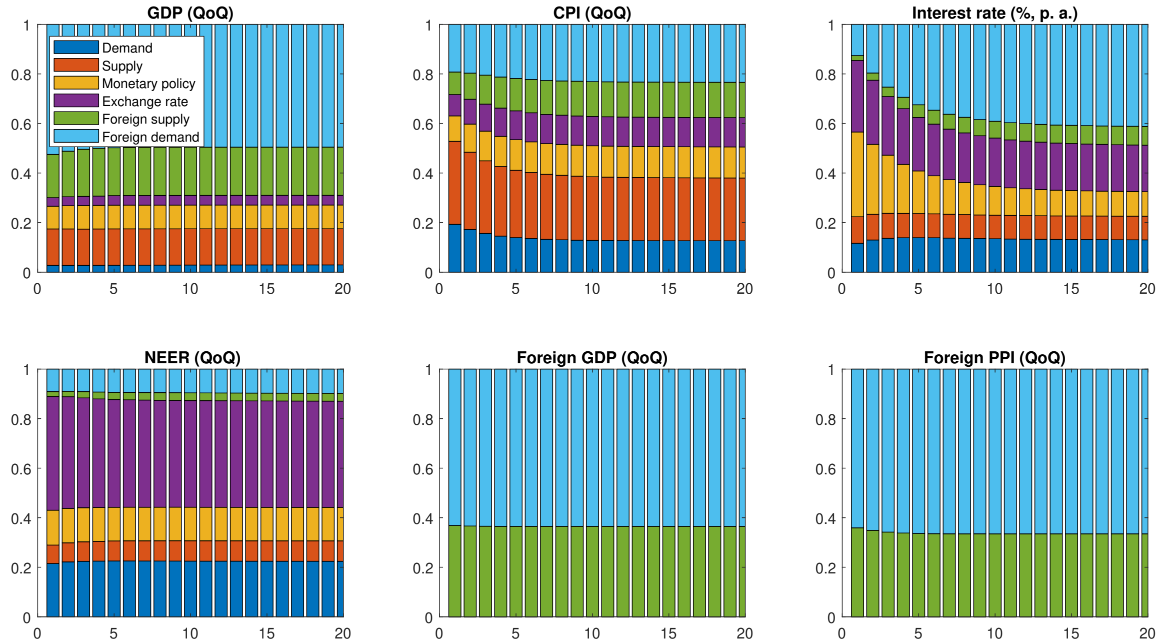
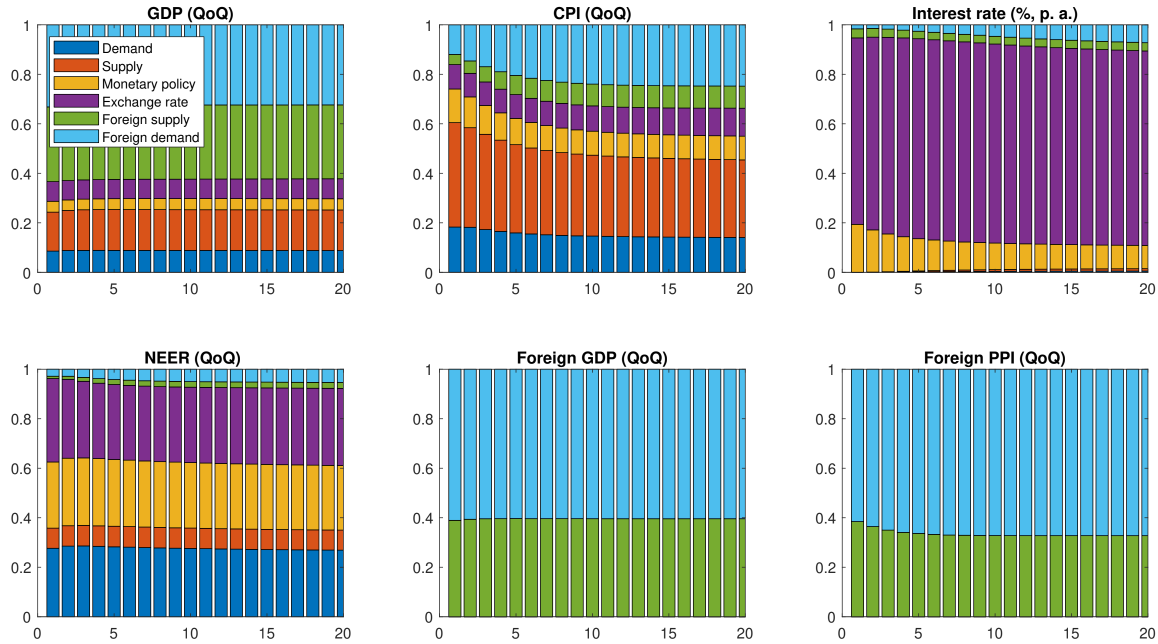
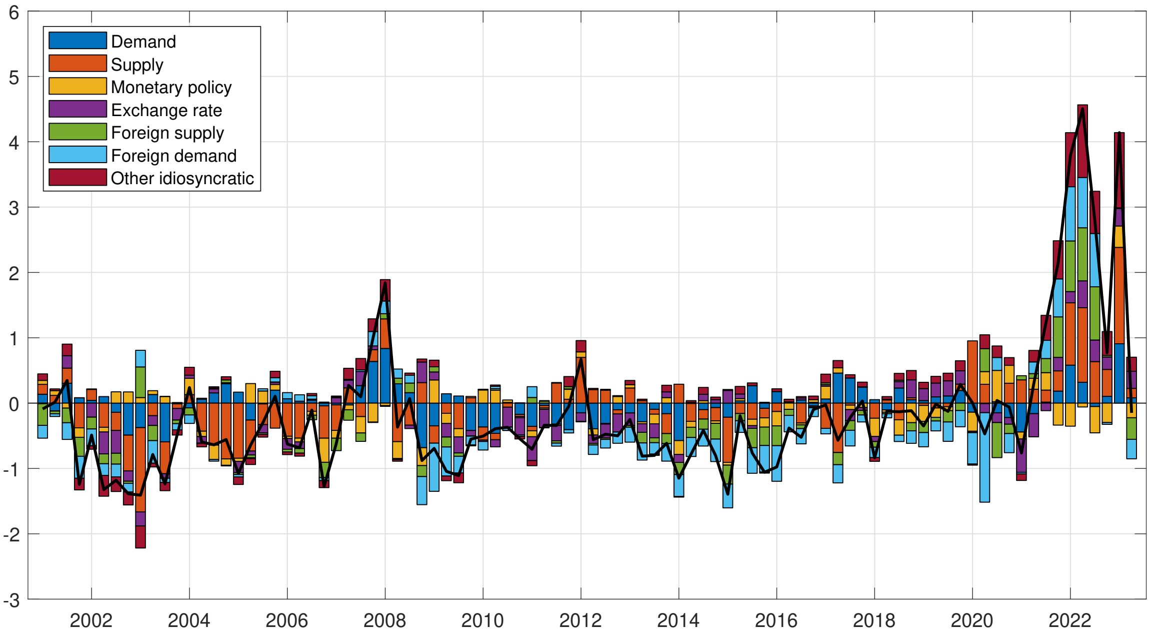


Figure C8: Slovakia



C.3 Historical Decomposition of Headline Inflation

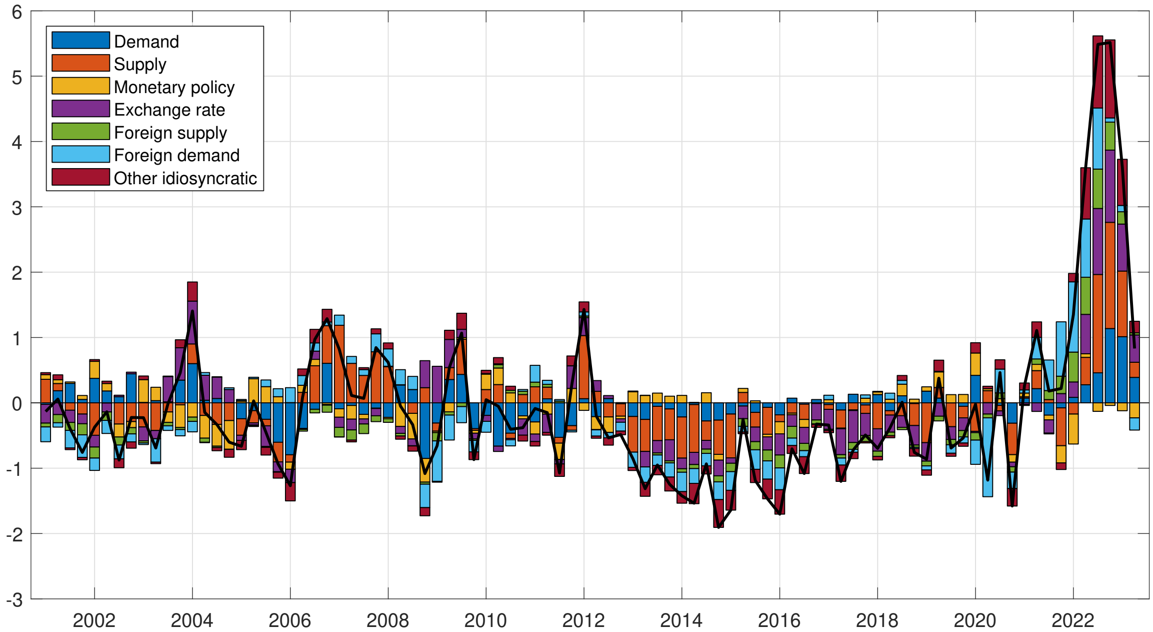
Figure C9: Czechia



Note: Contribution of shocks to the quarter-on-quarter change in the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions.

The period of higher inflation preceding the Global Financial Crisis (GFC) was primarily due to domestic demand, although limited domestic supply and high foreign demand also played roles. In the aftermath of the GFC until 2014, a series of negative domestic demand shocks, such as negative sentiment of households and fiscal consolidation, muted inflation. In 2009 and then also from 2012 until 2021, negative foreign demand shocks counteracted in the same direction. This pattern is evident in other Central European economies as well. It was caused by the economic downturn during the GFC and only slow output growth in Europe after the euro debt crisis. Appreciation exchange rate shocks further contributed negatively to inflation from 2009 to 2013, suggesting that the currency depreciation was smaller than what would correspond to a subdued economy. The introduction of the exchange rate floor in 2013Q4 resolved the issue of an overvalued koruna, leading to the disappearance of exchange rate shocks. The drop in oil prices throughout 2014–2015 was then reflected in a negative contribution of foreign supply shocks to inflation.

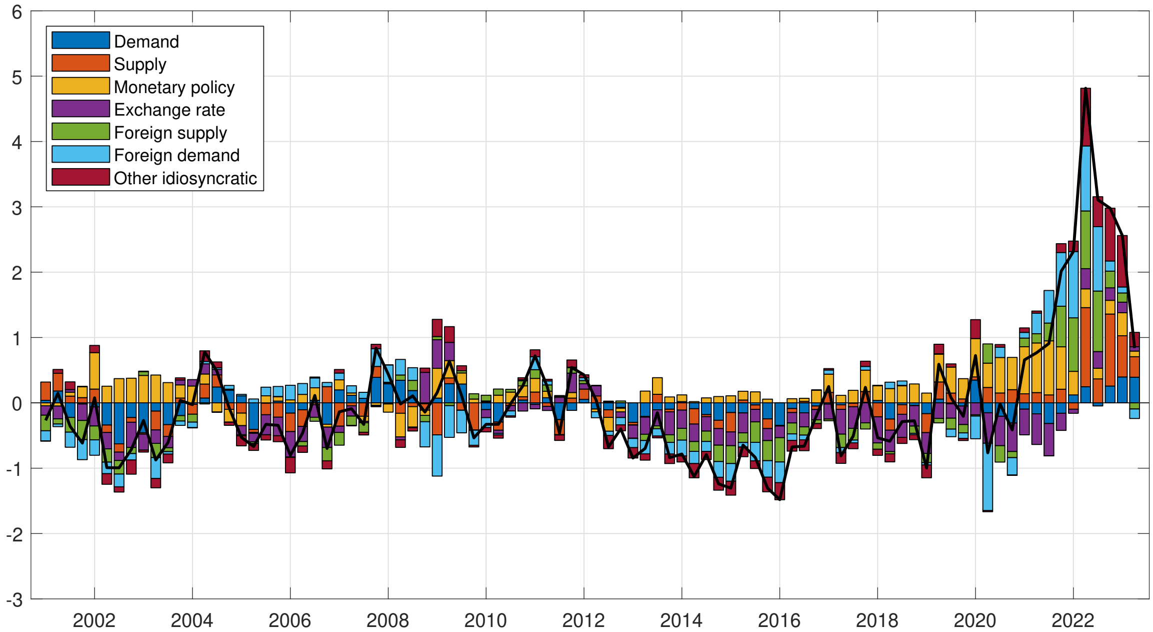
Figure C10: Hungary



Note: Contribution of shocks to the quarter-on-quarter change in the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions.

In the run-up to the GFC, inflation was driven primarily by adverse domestic supply shocks. These shocks were more pronounced than in Czechia. Negative domestic and foreign demand shocks are identified during and after the GFC. Tight monetary policy dampened inflation to some extent in 2009 as well. Despite this, the forint depreciated markedly, so exchange rate shocks stimulated inflation. Positive domestic supply shocks, reflecting renewed economic growth in a situation of slowing price growth, contributed negatively to inflation during 2013–2015. However, prevailing adverse foreign demand shocks also muted inflation. These shocks should have put significant downward pressure on the forint, but that was not the case. Hence, appreciation shocks were present throughout the period 2013–2019. Foreign supply shocks are identified during the decline in oil prices in 2014–2015, albeit to a lesser extent than in other countries.

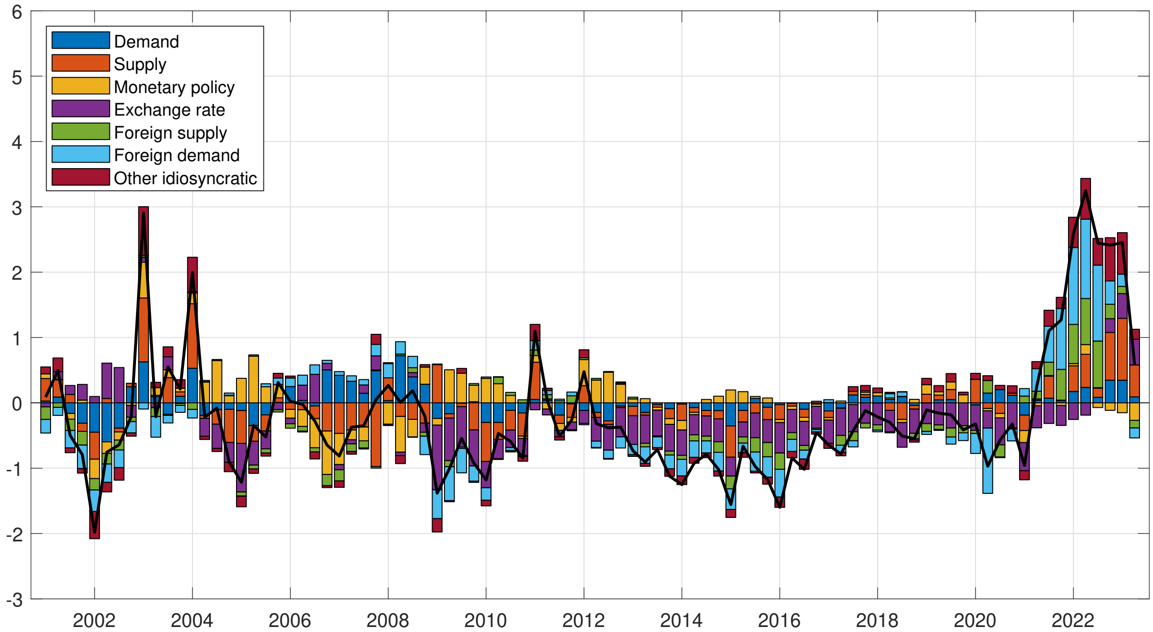
Figure C11: Poland



Note: Contribution of shocks to the quarter-on-quarter change in the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions.

In late 2007 and the first half of 2008, inflation was elevated due to both domestic and foreign demand shocks. However, in late 2008 and early 2009, exchange rate shocks began to contribute to inflation, coinciding with a significant depreciation of the Polish zloty compared to other currencies in Central Europe. This was partially counteracted by the negative impact of adverse foreign demand shocks. Unlike in other countries, domestic demand shocks did not mitigate inflation in Poland during the GFC, as the economic decline was relatively minor. A persistent current account deficit may explain why the depreciation of the zloty was insufficient, leading exchange rate shocks to exert downward pressure on inflation. It is worth noting that the Czech economy also faced an overvalued koruna until the exchange rate floor was introduced. The exchange rate shocks were offset by accommodative monetary policy shocks, which were particularly pronounced from 2017 to 2021. Policy rates remained stable at relatively low levels despite renewed robust output growth and increasing inflation. This response contrasts especially with the approach taken by the Czech National Bank. As output growth resumed and inflation began to rise, the Czech National Bank exited the exchange rate floor and increased its interest rate. Additionally, the National Bank of Poland decided to cut rates during the pandemic, in line with other central banks, further increasing the monetary easing.

Figure C12: Slovakia



Note: Contribution of shocks to the quarter-on-quarter change in the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions.

Monetary policy shocks have been one of the drivers of inflation in Slovakia since 2004. This might be due to the Slovak central bank's adoption of inflation targeting and its participation in the Exchange Rate Mechanism (ERM II). Consequently, policy shocks served to stabilize inflation and mitigate exchange rate fluctuations during that period. Positive domestic demand and supply shocks also influenced inflation before the GFC. In the aftermath of the GFC, both foreign and domestic demand were depressed, acting as anti-inflationary factors. Since the adoption of the euro in 2008, the presence of exchange rate shocks reflects the fact that Slovakia lost the possibility of autonomous monetary easing through the exchange rate after the financial crisis. For the other Central European countries, currencies depreciated, resulting in a strengthening of the euro against the forint, koruna, and zloty from Slovakia's perspective.

C.4 Correlation of Structural Shocks

Table C1: Correlation of Structural Shocks Across Countries (Full Sample)

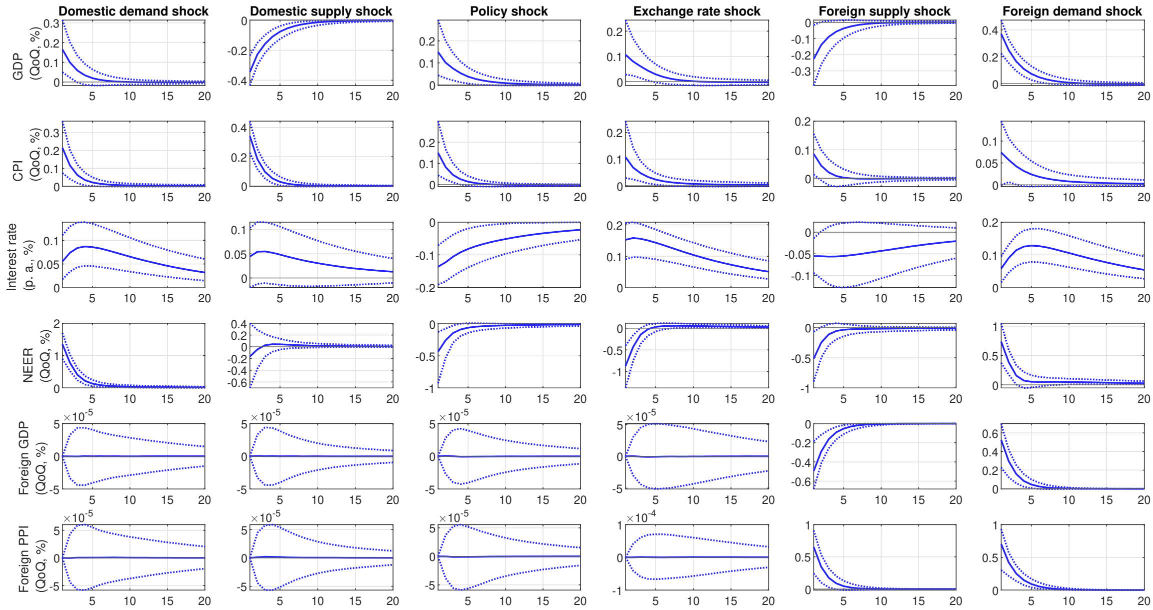
	Domestic Demand					**Domestic Supply**		
Czechia	Hungary	Poland	Slovakia		Czechia	Hungary	Poland	Slovakia
1	0.270	0.323	0.760	Czechia	1	0.170	0.140	0.126
	1	0.314	0.243	Hungary		1	0.231	0.102
		1	0.141	Poland			1	-0.510
			1	Slovakia				1
	Monetary Policy					**Exchange Rate**		
Czechia	Hungary	Poland	Slovakia		Czechia	Hungary	Poland	Slovakia
1	0.235	0.366	-0.250	Czechia	1	0.367	0.394	0.021
	1	0.414	0.110	Hungary		1	0.535	0.173
		1	-0.168	Poland			1	0.075
			1	Slovakia				1
	Foreign Supply					**Foreign Demand**		
Czechia	Hungary	Poland	Slovakia		Czechia	Hungary	Poland	Slovakia
1	0.960	0.975	0.960	Czechia	1	0.974	0.984	0.964
	1	0.985	0.979	Hungary		1	0.990	0.974
		1	0.981	Poland			1	0.980
			1	Slovakia				1

Note: Structural shocks across countries are compared from 2001Q1 to 2023Q2. The correlations are based on the median of the shock's posterior distribution.

Appendix D: Additional Results – Sensitivity Analysis

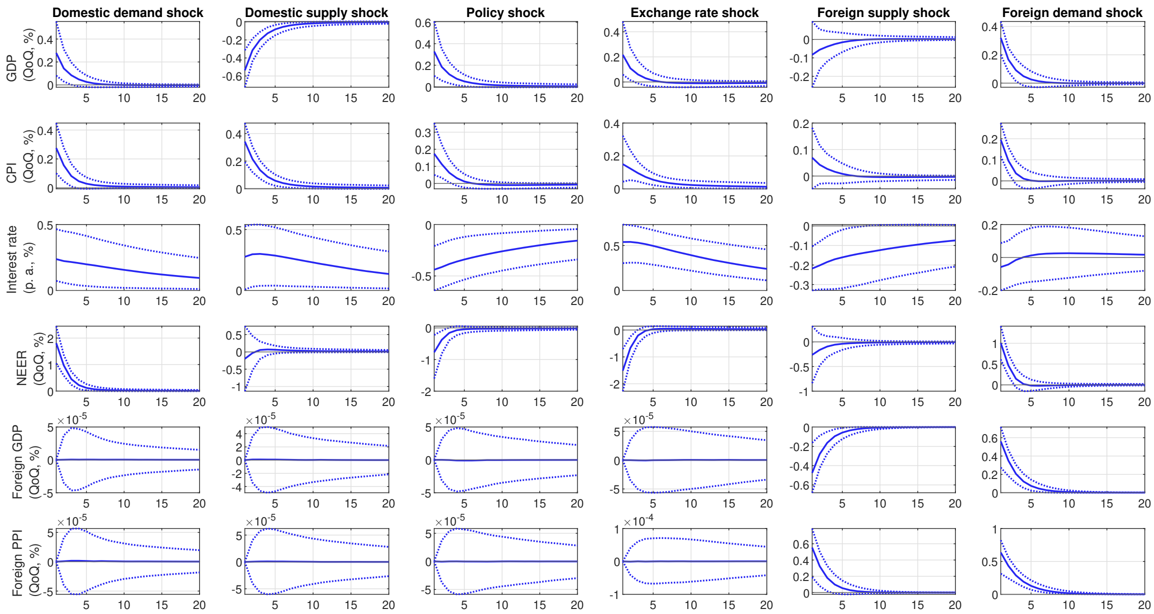
D.1 Pre-Pandemic Sample: Impulse Response Functions

Figure D1: Czechia



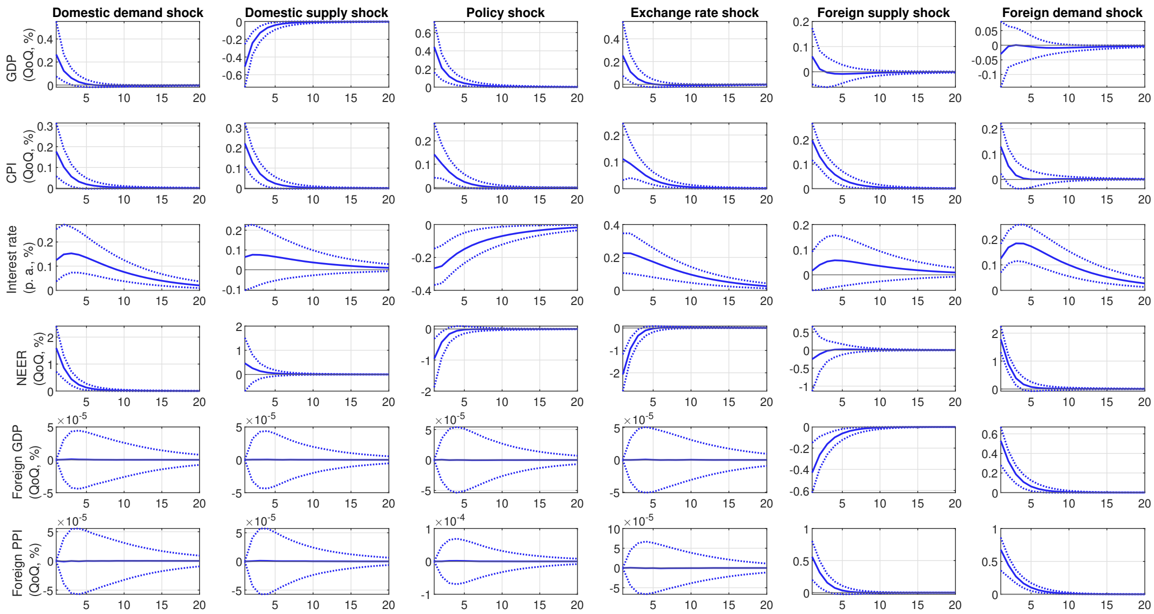
Note: Median responses with 68% credible intervals. The responses correspond to one standard deviation shocks and cover the 20 quarters after the initial shock.

Figure D2: Hungary



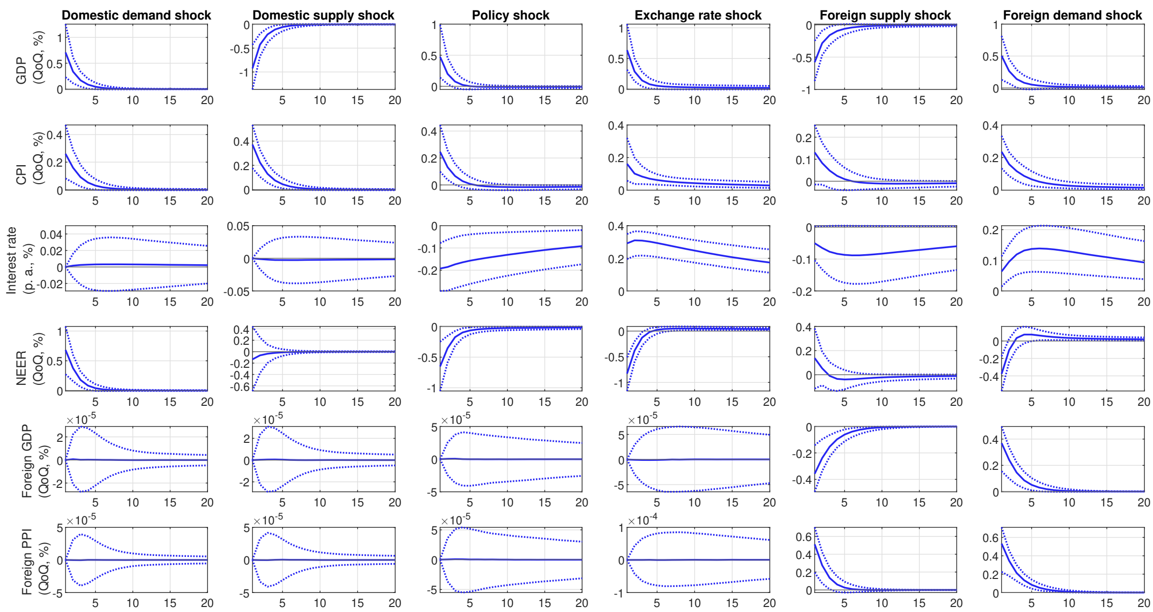
Note: Median responses with 68% credible intervals. The responses correspond to one standard deviation shocks and cover the 20 quarters after the initial shock.

Figure D3: Poland



Note: Median responses with 68% credible intervals. The responses correspond to one standard deviation shocks and cover the 20 quarters after the initial shock.

Figure D4: Slovakia



Note: Median responses with 68% credible intervals. The responses correspond to one standard deviation shocks and cover the 20 quarters after the initial shock.

D.2 Pre-pandemic Sample: Forecast Error Variance Decomposition

Figure D5: Czechia

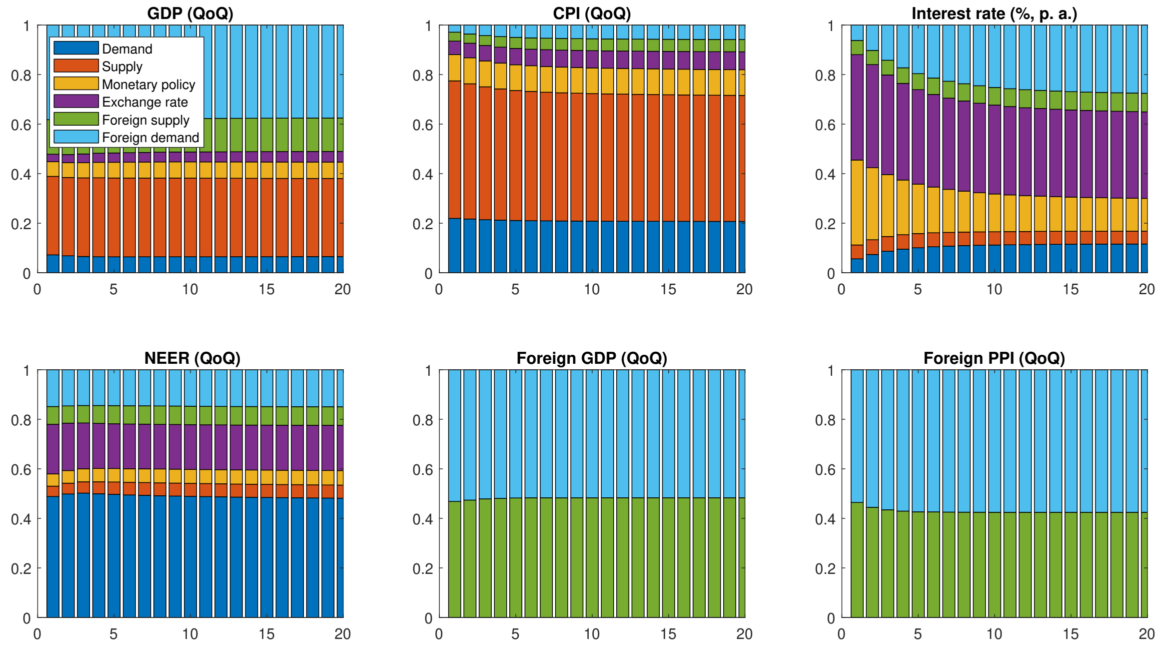


Figure D6: Hungary

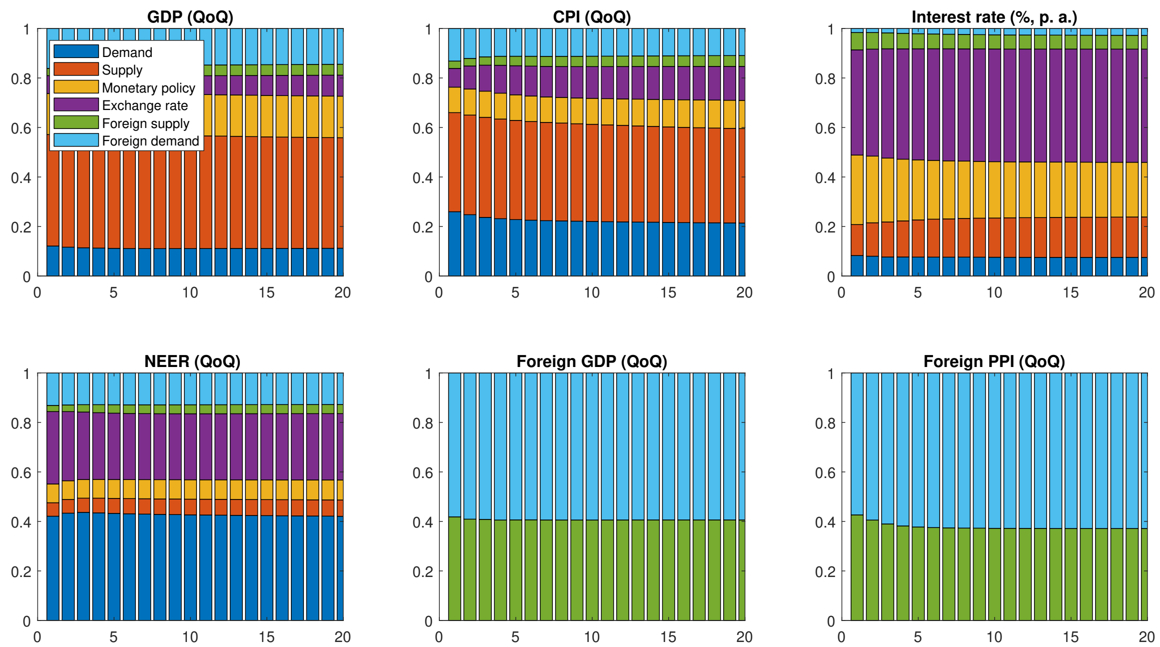


Figure D7: Poland

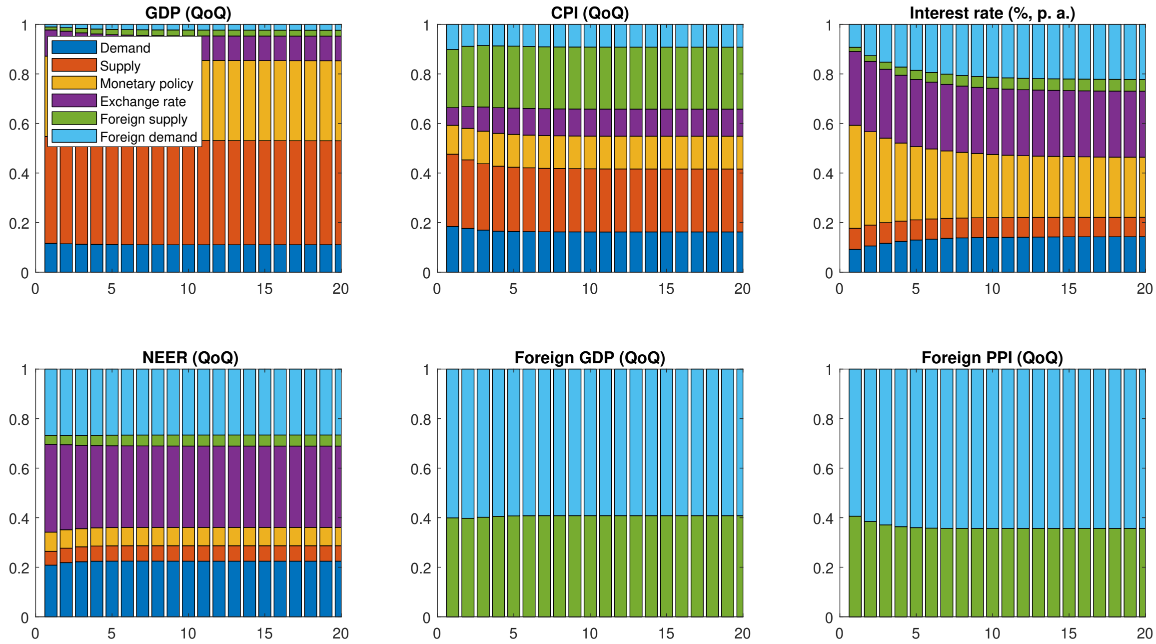
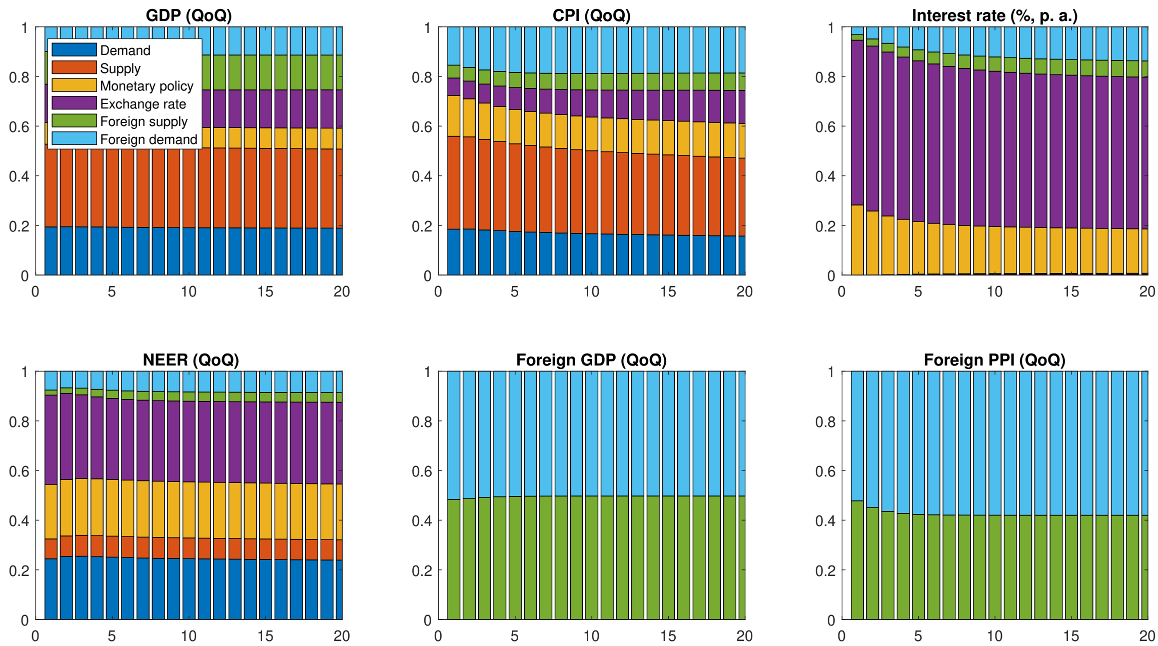
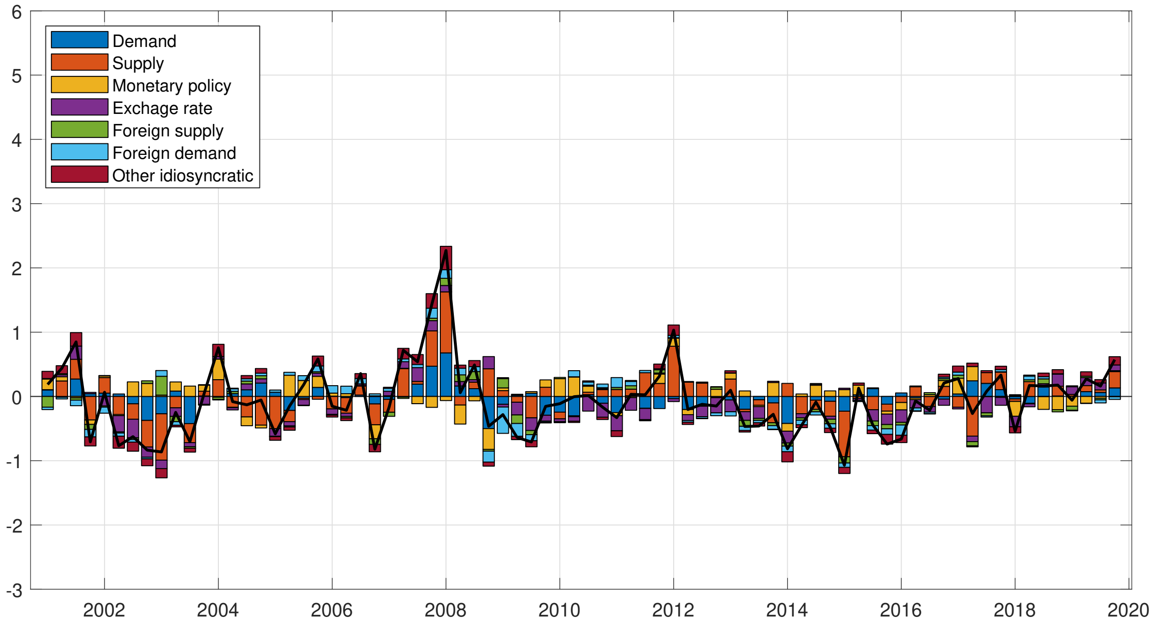


Figure D8: Slovakia



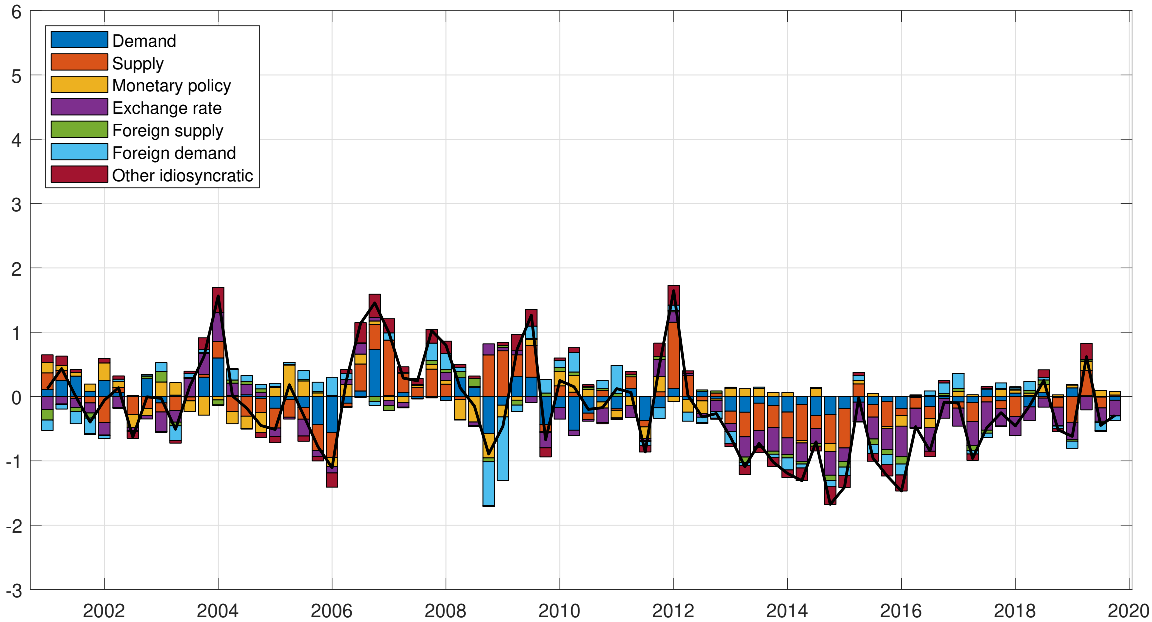
D.3 Pre-Pandemic Sample: Historical Decomposition of Headline Inflation

Figure D9: Czechia



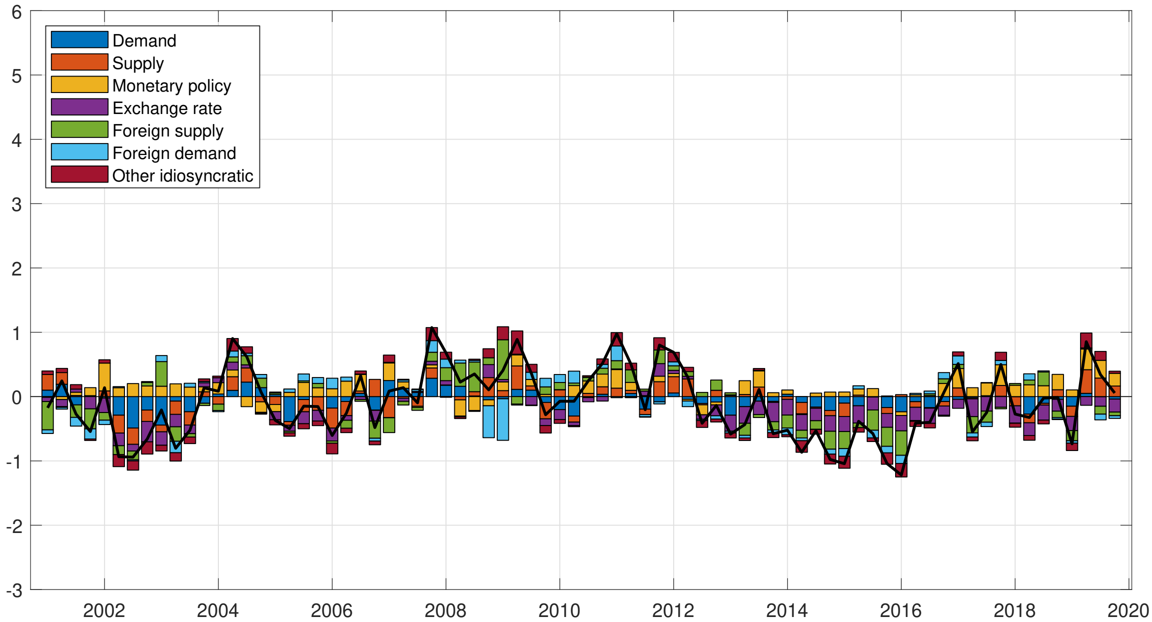
Note: Contribution of shocks to the quarter-on-quarter change in the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions.

Figure D10: Hungary



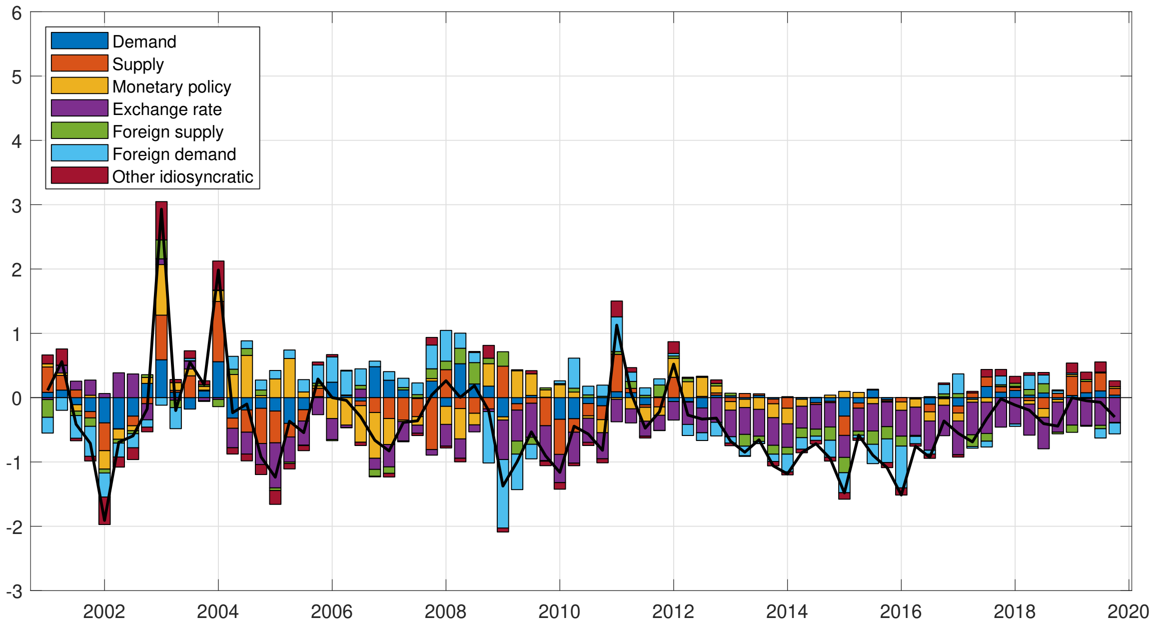
Note: Contribution of shocks to the quarter-on-quarter change in the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions.

Figure D11: Poland



Note: Contribution of shocks to the quarter-on-quarter change in the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions.

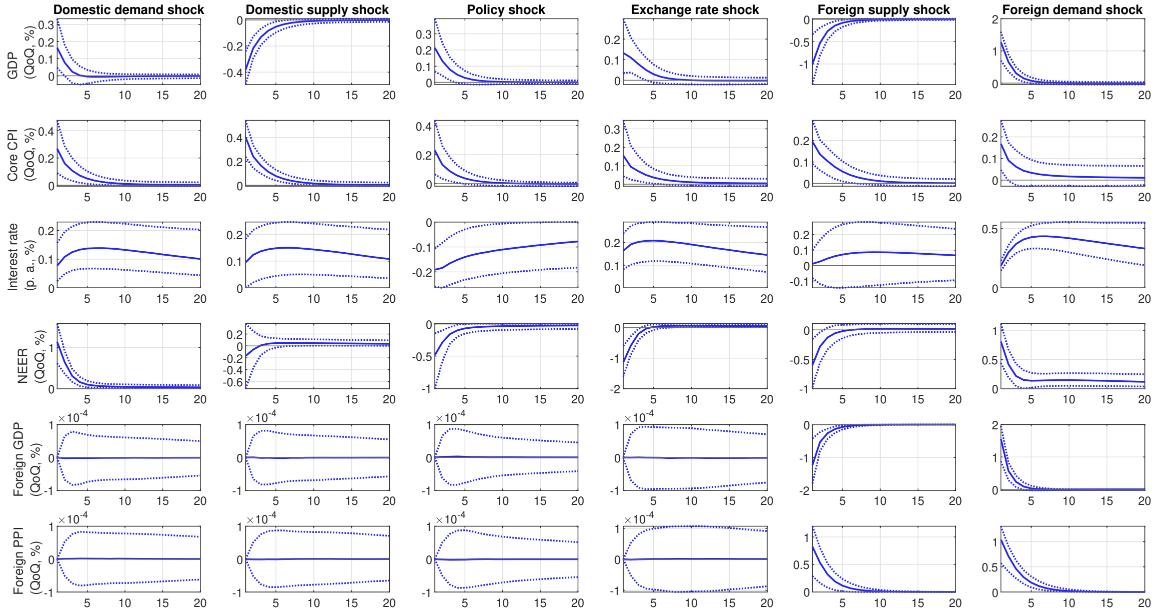
Figure D12: Slovakia



Note: Contribution of shocks to the quarter-on-quarter change in the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions.

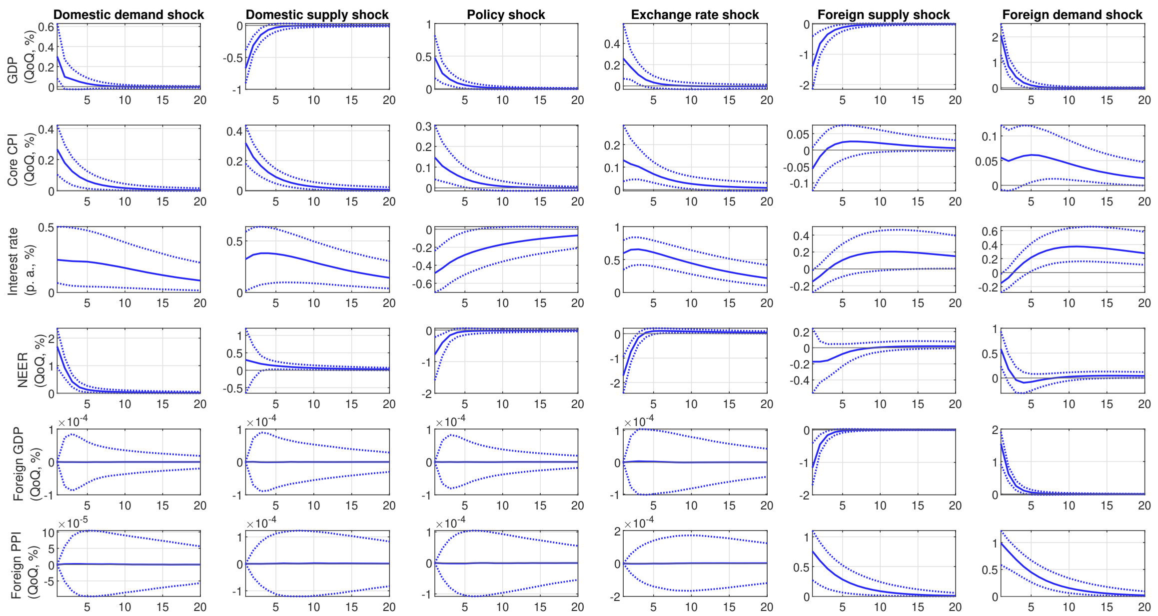
D.4 Core Inflation: Impulse Response Functions

Figure D13: Czechia



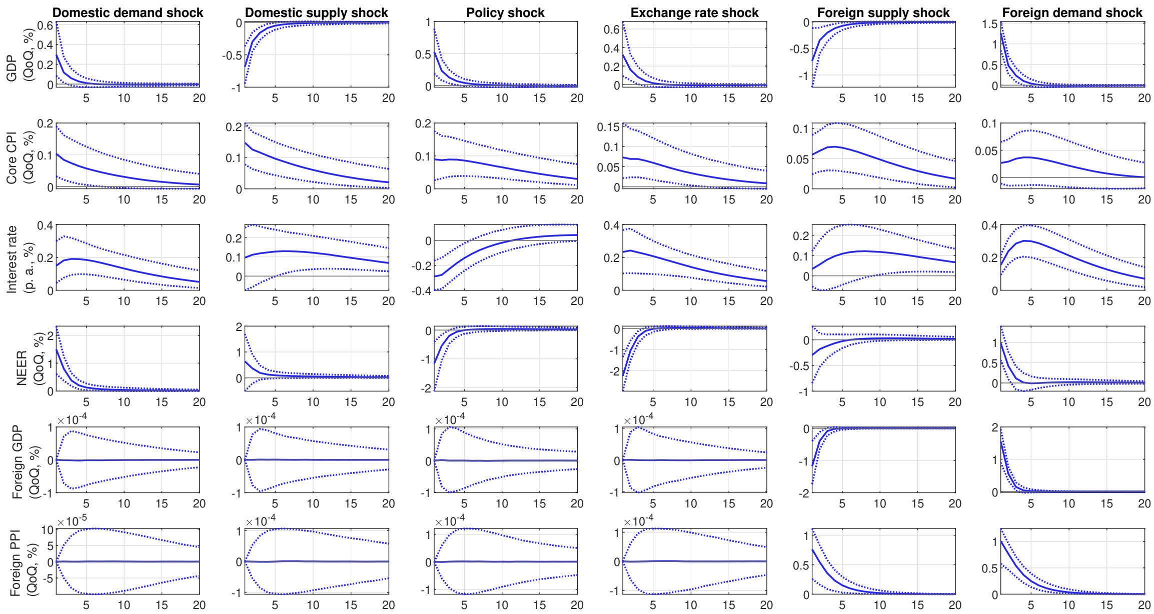
Note: Median responses with 68% credible intervals. The responses correspond to one standard deviation shocks and cover the 20 quarters after the initial shock.

Figure D14: Hungary



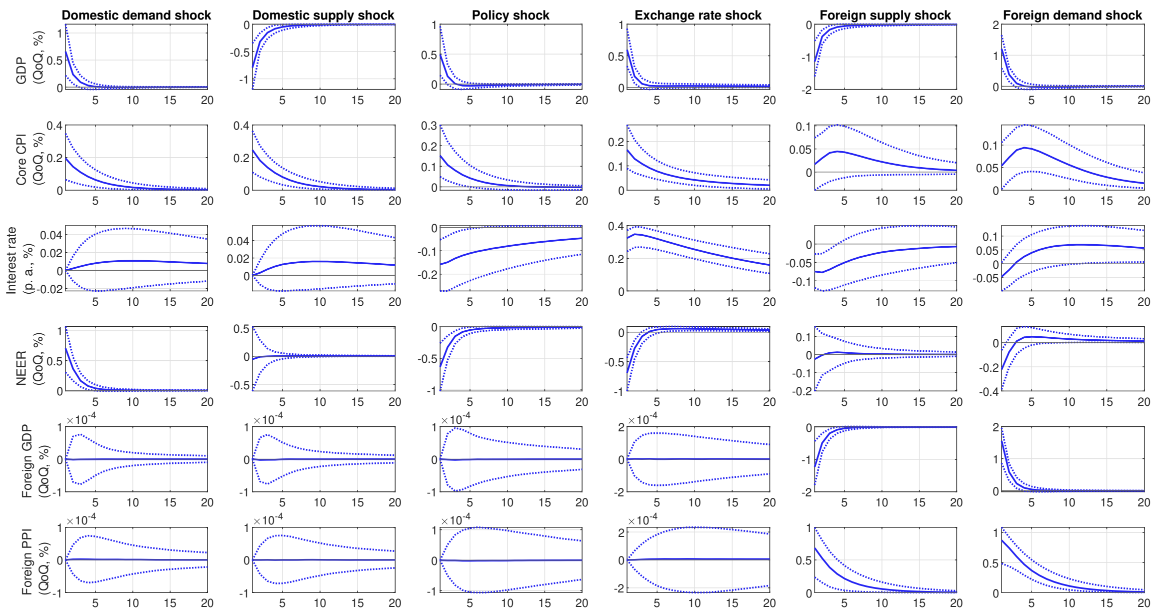
Note: Median responses with 68% credible intervals. The responses correspond to one standard deviation shocks and cover the 20 quarters after the initial shock.

Figure D15: Poland



Note: Median responses with 68% credible intervals. The responses correspond to one standard deviation shocks and cover the 20 quarters after the initial shock.

Figure D16: Slovakia



Note: Median responses with 68% credible intervals. The responses correspond to one standard deviation shocks and cover the 20 quarters after the initial shock.

D.5 Core Inflation: Forecast Error Variance Decomposition

Figure D17: Czechia

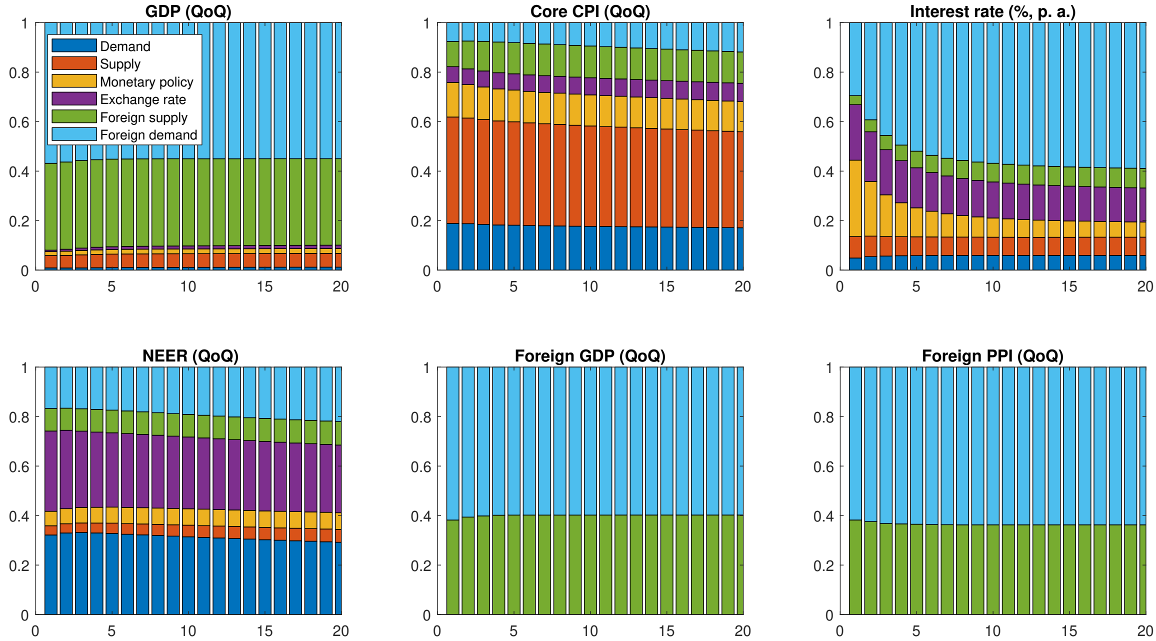


Figure D18: Hungary

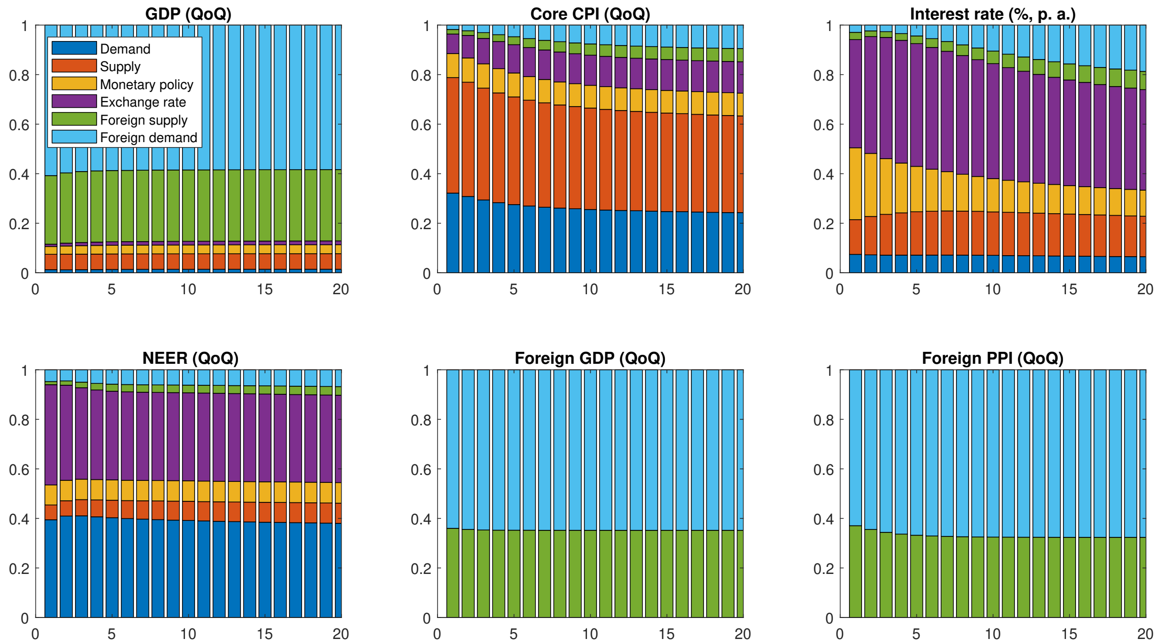


Figure D19: Poland

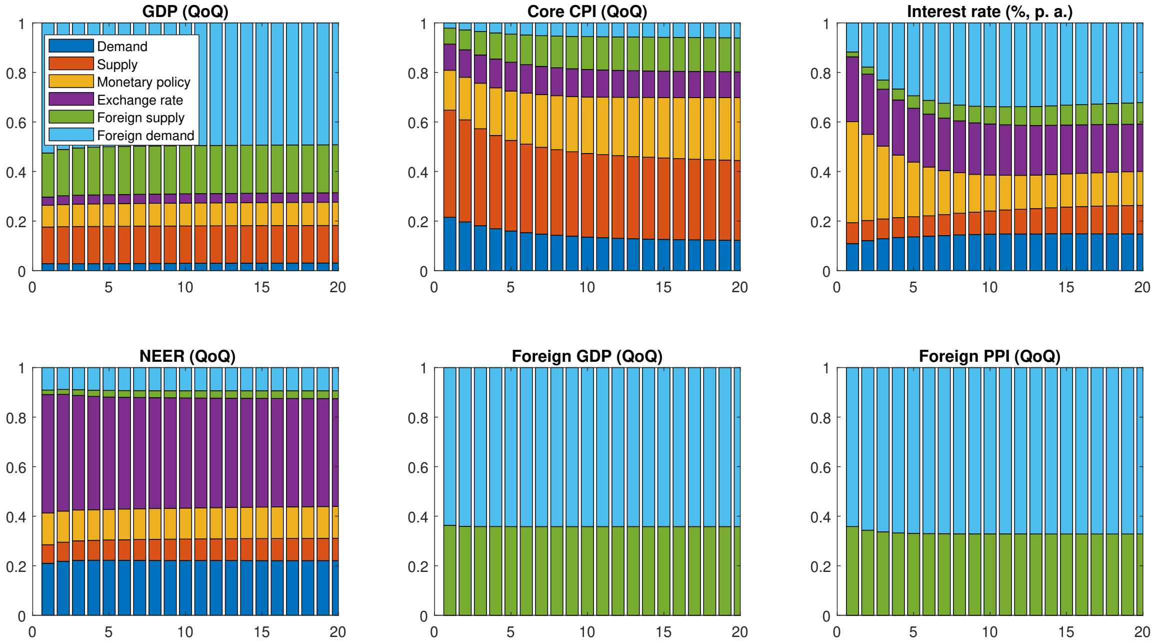
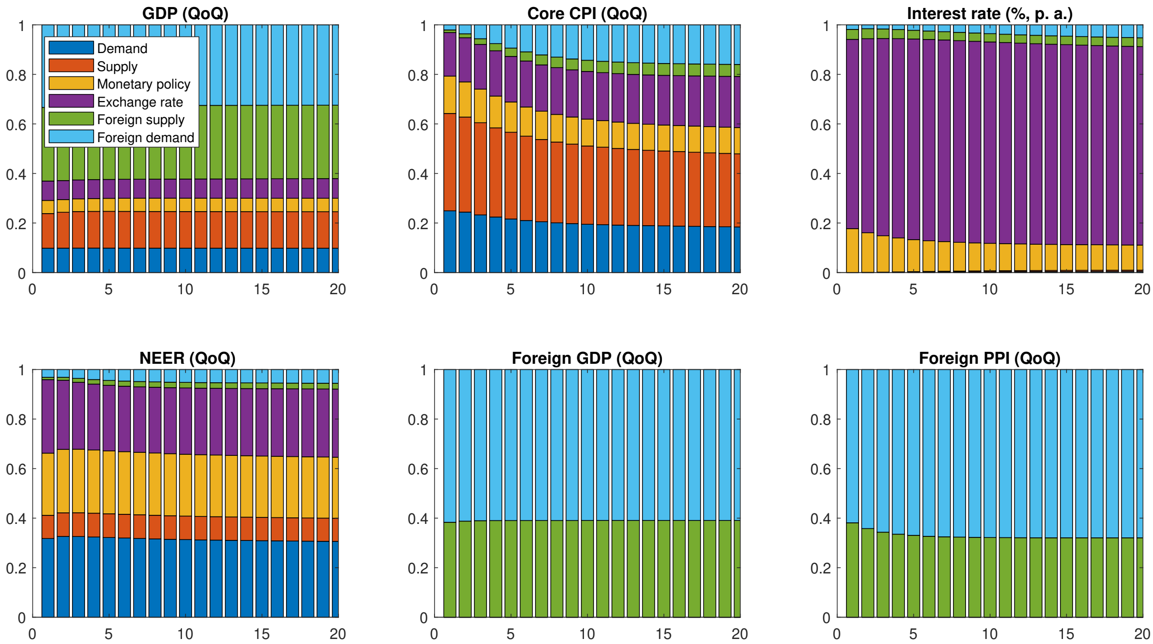
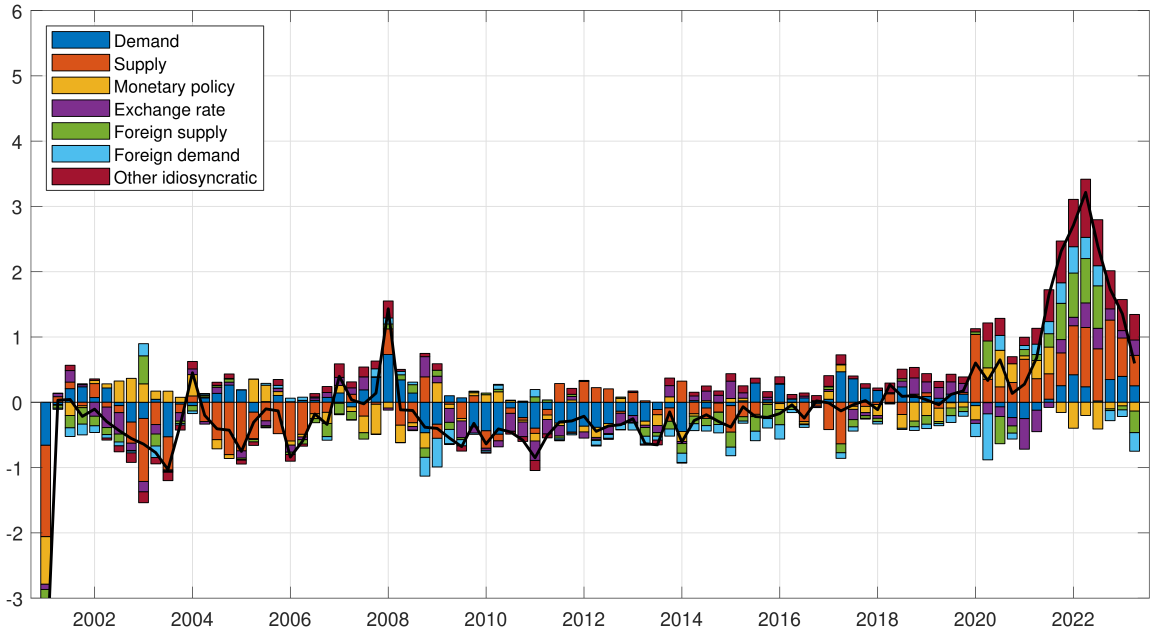


Figure D20: Slovakia



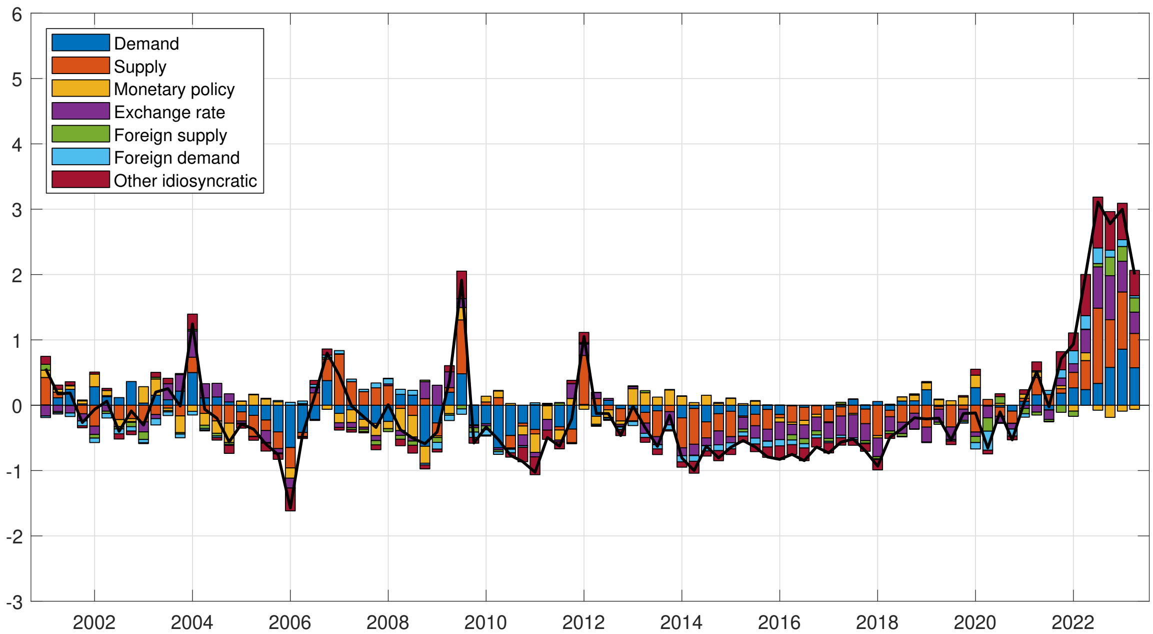
D.6 Historical Decomposition of Core Inflation

Figure D21: Czechia



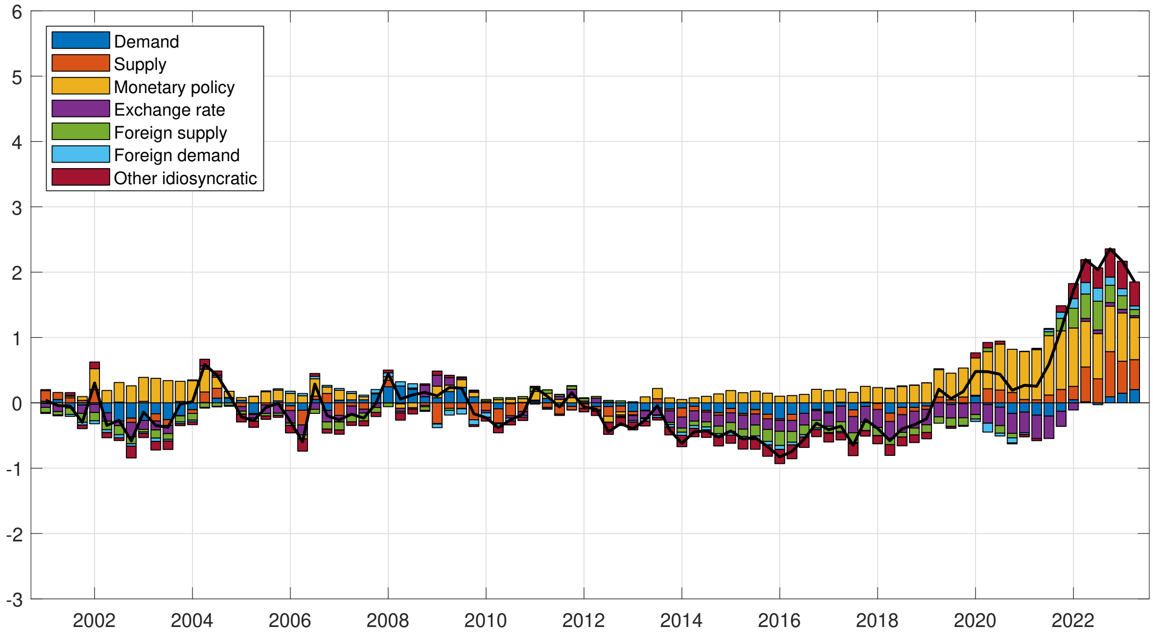
Note: Contribution of shocks to the quarter-on-quarter change in the core component of the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions. The y-axis has the same range as Figures in Appendix C.3 for ease of comparison with the decomposition of CPI inflation.

Figure D22: Hungary



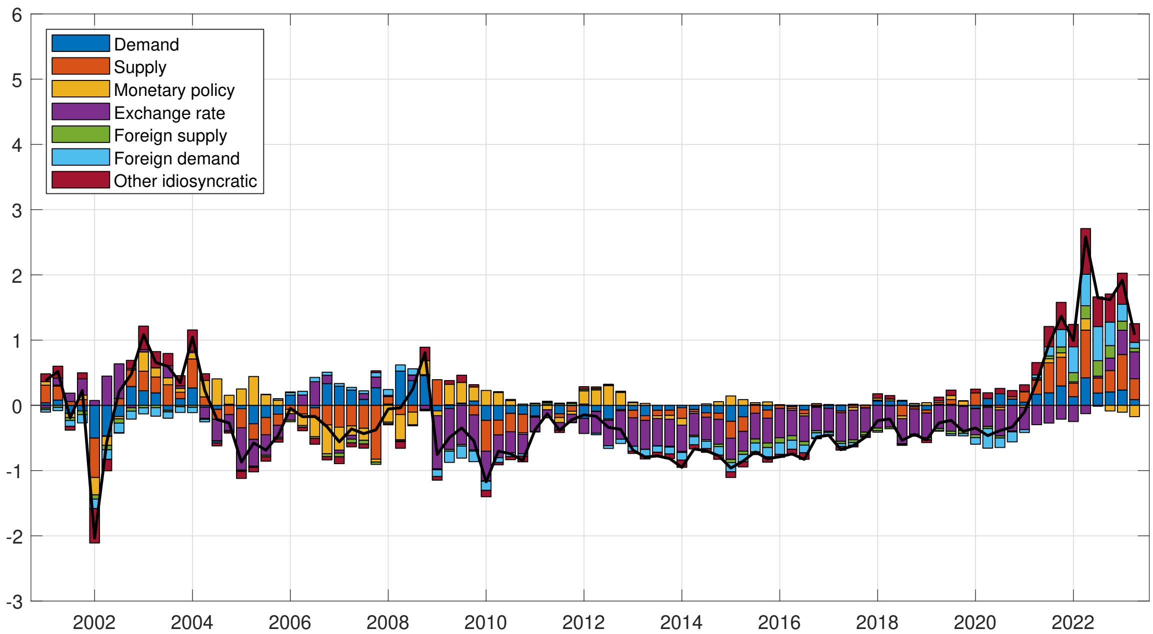
Note: Contribution of shocks to the quarter-on-quarter change in the core component of the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions. The y-axis has the same range as Figures in Appendix C.3 for ease of comparison with the decomposition of CPI inflation.

Figure D23: Poland



Note: Contribution of shocks to the quarter-on-quarter change in the core component of the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions. The y-axis has the same range as Figures in Appendix C.3 for ease of comparison with the decomposition of CPI inflation.

Figure D24: Slovakia



Note: Contribution of shocks to the quarter-on-quarter change in the core component of the CPI index, in percentage points. Deviations from the mean and from the contribution of the initial conditions. The y-axis has the same range as Figures in Appendix C.3 for ease of comparison with the decomposition of CPI inflation.

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