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Abstract

This paper separates macroeconomic shocks into external and domestic aggregate demand and supply shocks in European Union's post-transition countries. Small open economies are typically very responsive to external shocks. The standard decomposition into aggregate demand and supply shocks covers up important information on the sources of business cycle fluctuations. Using a Bayesian SVAR model with combined sign and block exogeneity restrictions, we separately estimate external and domestic aggregate supply and demand shocks for GDP growth and inflation. We find that domestic shocks were a dominant source of fluctuations during the transition period in Croatia from 1992 to 2000. However, external shocks increased their importance with the trade and financial sector liberalization after 2000, becoming the dominant source of fluctuations with the Global financial crisis in 2008. In the short run, fluctuations are best explained by domestic shocks in 9 out of 11 analyzed countries, especially domestic supply shocks. However, in the medium run, fluctuations are dominantly explained by external aggregate demand shocks in 8 out of 11 countries. We argue that common sources of fluctuations in the medium run are beneficial for common monetary policy in the Eurozone.

Key words

small open economy, post-transition countries, aggregate supply and demand shocks, external and domestic shocks, Bayesian SVAR

JEL classification

C32, C51, E32, F41

1. Introduction

Post-transition EU countries are considered small open economies and very responsive to external shocks. For example, the last two recessions were imported from abroad, namely, the Global financial crisis in 2009 and the COVID-19 recession in 2020. Furthermore, Družić et al. (2016) argue that all recessions in Croatia since 1991 have had an important external component. Such responsiveness or synchronization with the European Union countries is common for other post-transition countries as well. Policymakers need to understand the sources of business cycle fluctuations to take the appropriate policy measures. To do so, aggregate shocks are typically separated into aggregate supply and demand shocks, but in the case of small open economies, shocks should be further decomposed into domestic and external. This paper takes a closer look at this issue. Blanchard and Quah (1989) popularized the identification of aggregate supply and demand shocks in a structural vector autoregression (SVAR) framework. On the other hand, Cushman and Zha (1997) highlighted the problem of external shocks, which proved to be very important in the case of small open economies. This paper combines both approaches using a Bayesian SVAR model.

Shocks that Croatia experienced soon after its independence, such as the war of independence and the transition from the planned to the market economy, could also be characterized as aggregate macroeconomic shocks. Therefore, we can talk about the role of domestic and external aggregate supply and demand shocks even from the perspective of the transition period, which somehow received little attention in the literature.

In this paper, we use a Bayesian SVAR model to decompose shocks to GDP growth and inflation for eleven post-transition countries into domestic and external shocks driven by aggregate demand and aggregate supply. In the case of Croatia, we go further, and analyze the shock decomposition during the transition period as well. By merging data from several sources with official Eurostat data, we create a long dataset for Croatia, which covers the transition period (1991 to 2000), enabling us to analyze the shock decomposition even during that interesting period. For other EU post-transition countries, we base our analysis on the post 2000s data, due to the lack of reliable GDP and inflation data before 1995. We deliberately keep our empirical model simple, using only GDP growth and inflation to identify external and domestic aggregate supply and demand shocks. Employing more data could allow a richer shock decomposition (see Jovičić and Kunovac, 2017), but it would come at cost. First, transition period could not be analyzed, due to data availability. Second, post-transition economies differ, and using a simple aggregate supply and demand identification allows international comparability.

Analyzing the transition and post-transition period is interesting because it covers several important periods in Croatian history. First, we can observe the effects of domestic and external supply and demand shocks during the transition period, which is sometimes referred to as a negative supply shock (Družić, 2006; Arčabić, 2018). At the beginning of the transition period, the Croatian economy experienced a sharp decline in real GDP followed by hyperinflation. Early 1990s were marked by the war of independence, hyperinflation, privatization, and transition from the planned to market economy. Next, we can tell the effects of Croatian integration into the EU on sources of fluctuations in GDP and inflation and whether domestic or external shocks were responsible for the Global financial crisis in Croatia that lasted for six years. Finally, an international comparison with other post-transition countries of the EU enables us to make broader conclusions and to make certain stylized facts related to these economies.

The paper contributes to the literature by examining the aggregate macroeconomic shocks identified as domestic and external supply and demand shocks. The focus of the paper is on Croatia and ten other post-transition countries; all considered to be small open economies. The shock decomposition is analyzed using the Bayesian SVAR model with sign restrictions, which is a novel and more appropriate approach compared to the previous research. The identification through sign restrictions allows us to decompose supply and demand shocks in an easy and intuitive way, following standard textbook models. To further decompose shocks into domestic and external, we use block exogeneity restrictions recently developed in Deskar-Škrbić et al. (2020), where external shocks coming from a large economy affect small open economies, but not vice versa.

The main findings of the paper could be summarized as follows. Domestic shocks in Croatia were more important in the transition period, but after the liberalization of the trade and financial sector after 2000, external shocks are gaining importance and take the leading role in explaining the variation of Croatian GDP growth and inflation, especially after the Global financial crisis. We confirm that the recession caused by the Global financial crisis was triggered by a huge negative external shock. However, domestic shocks were the main reason behind the prolonged recession in Croatia, which lasted for six years.

When considering results for other post-transition countries, from the economic policy perspective, domestic shocks are predominant in the short run, especially aggregate supply shocks. This result is consistent in 9 out of 11 other post-transition countries. In the medium run, external shocks take over the dominance, with aggregate demand and supply shocks being equally prevalent, which is the case for 8 out of 11 countries. The prevalence of external shocks in the medium run is favorable for the common monetary policy in the Eurozone. In the medium run, countries are more likely to be exposed to similar shocks within the Eurozone, and thus common monetary policy is more likely to satisfy one-size-fits-all criteria and achieve its medium run goals. Furthermore, these results potentially clarify existing literature from which previously it was tough to conclude whether the source of business cycles fluctuations in post-transition countries comes from the supply or demand side and adds a dimension of external and domestic source components.

The paper is structured as follows. In the next section, we review the related literature. Section 3 describes the data and empirical model. In section 4, we discuss the main results, while section 5 concludes.

2. Literature review

The literature on the small open economies claims that they are susceptible to external shocks. However, at the same time, they are too small to affect large economies (Obstfeld and Rogoff, 1996). The aggregate demand and supply shocks in a small open economy can be domestic and external, while external shocks are even more important in higher integration between countries. This emphasizes the importance of external shocks for small open economies in determining business cycle fluctuations. Calvo et al. (1993) were among the first authors that launched the idea that external shocks from large economies are crucial in determining business cycle fluctuations in small open economies. The author examined what drives the inflows of capital into Latin America. The author's results show that variation in capital inflows is significantly explained by situations outside the region, such as the recession in the US and lower world interest rates. Cushman and Zha (1997) examined the impact of world prices and several other US variables on the Canadian economy. Their results show that most of the fluctuation in Canadian economic activity was driven by external shocks. Similar results are presented by Giordani (2004), who also suggests that shocks in the US are significant in a variety of Canadian economic activities. Uribe and Yue (2006) indicate that US interest rate shocks explain 20% of the variance in emerging countries' business cycles.

Furthermore, Maćkowiak (2007) suggests that external shocks explain around 50% of the exchange rate and price level variance in an average emerging market, about 40% in actual output, and approximately 33% in short-term interest rates. Canova (2005) states that shocks in the US significantly affect Latin American countries that are strongly financially connected with the US, with no difference between fixed and flexible exchange rates. Kim (2001) finds out that monetary expansion in the US has positive spillover effects on non-US G7 countries.

Two opposed theories can explain the sources of business cycle fluctuations. The real business cycle (RBC) theory points out the importance of technology shocks in a flexible price framework. According to this theory, employment and work hours should increase due to a positive productivity shock. Such results were presented by Christiano et al. (2003), showing that a positive technology shock increases productivity, output, and employment. In addition, Chari et al. (2008) confirmed these findings, as well

as Francis and Ramey (2005), for the period prior to World War II. On the other hand, the new Keynesian theory points out the importance of demand-side shocks in a sticky-price framework. Evidence for that is presented by Galí (1999), who shows that positive technology shock has a negative impact on working hours, while demand shock has a positive impact on working hours and productivity. Galí (2004) shows similar findings in his later work using updated data for the United States and Eurozone. Shea (1998) also showed that increase in technology that boosts productivity has a negative effect on employment and working hours, thus confirming the findings by Gali (1999, 2004). Furthermore, Basu et al. (2006) provide evidence that technology shock has a negative short-run effect on investments and output.

The discussions about the source of business cycle fluctuations are also meaningful in the context of post-transition countries. These countries are characterized as small open economies and therefore are highly prone to external shocks. Furthermore, the number of papers that have analyzed this issue is scarce.1 Fidrmauc and Korhonen (2003, 2006) observed a correlation of supply and demand shocks between EU countries. Authors found that supply shocks are more correlated with the Eurozone than demand shocks, although correlation varies among countries. Also, they suggest that both shocks have the same importance. In that context, Broz (2010) also concluded that both shocks are equally crucial for post-transitional countries. On the other hand, Ben (2009) concluded that supply shocks are more important. Erjavec et al. (2012) looked at drivers of fluctuations in the Croatian economy. Using the SVAR model, the authors find that supply-side shock is more important in explaining drivers of the business cycle fluctuations in the Croatian economy, leading to permanent output growth. On the other hand, they find no significant impact of a demand shock, while nominal shocks have only a temporary negative effect on output. Arčabić (2016) analyzed the importance of technology and non-technology shocks in European Union post-transition countries using the SVAR model. The author found that non-technology shocks, e.g., demand shocks, are more important in explaining business cycles in post-transition countries, during and after the transition. Maćkowiak (2006), using Germany's interest rate as a proxy for external shock, found that in Hungary, Poland, and Czechia, external shocks are highly important, especially when considering price fluctuations. He points out that external shocks explain about 60-85% variance in price level and around 25-50% in output. Furthermore, Horvath and Rusnak (2008) find that, while external shocks mainly drive prices in Slovakia, Slovakian economic growth was primarily a result of domestic factors. Deskar-Škrbić and Kunovac (2020) examined the cost of adopting the euro, e.g., the loss of monetary policy independence, in Sweden, Czechia, Hungary, and Poland. Firstly, they point out a high correlation and synchronicity in key interest rates and business cycles between the euro area and these countries. Furthermore, their results suggest that the same shocks drive fluctuations in business cycles in these countries as in the euro area. Also, Tica (2020) and Tica and Viljevac (2020) point out that differences in GDP growth rate between the post-transition countries result from shocks in the labor market, as employment rates positively impact the GDP growth rate.

Focusing on Croatia, Krznar and Kunovac (2010) analyzed the importance of domestic and external shocks in explaining Croatian inflation and GDP volatility. Their results suggest that shocks in world prices are most important in explaining inflation fluctuations, while shocks in European union GDP are the primary source of fluctuations in Croatian GDP. Arčabić et al. (2016) showed that the small open economy DSGE model fits Croatian data under the assumption of a fixed exchange rate system. The authors provide evidence that positive external demand shock has a positive impact on Croatian GDP. Dumičić, Palić, and Sprajaček (2014), using SVAR examined the impact of the shocks in the euro area on economic fluctuations in Croatia. Their results suggest that increasing economic activity in the euro area increases Croatian economic activity, increasing price level, and the real exchange rate appreciation. In contrast, the shocks in price levels have short and inconsistent effects. Overall, the authors conclude that fluctuations in the economic activity of the euro area have a significant impact on the fluctuation of the Croatian economy. Similar findings are presented by Jovičić and Kunovac (2017), who used Bayesian VAR to analyze the contribution of individual domestic, euro area-specific, and global shocks on the Croatian economy. Their results suggest that global and euro area shocks explain

[1] On the other hand, other developing countries, such as BRICS (Brazil, Russia, India, China and South Africa), are more often analyzed in the literature, see Jawadi et al. (2014, 2016).

around 40% of fluctuations in GDP growth and about 50% of the variance in inflation. Nevertheless, Botrić and Cota (2006) suggested that the terms of trade and balance of payment shocks were the most important source of inflation in Croatia during the period between 1998 and 2006. In addition, Payne (2002) suggests that from 1992 to the end of 1999, inflation is positively related to wage growth and depreciation of the currency.

It is hard to conclude whether the source of business cycle fluctuation in post-transition countries comes from the supply or demand side. On the other hand, based on the results presented above, it can be concluded that the external shocks are the dominant ones. However, very few mentioned papers distinguish between external and domestic shocks, which could significantly affect the results. Since it is essential to determine the source of business cycle fluctuations for policymakers, this paper investigates whether fluctuations in business cycles are domestically or externally driven and whether they are from the aggregate supply or aggregate demand side in the context of the two mentioned theories.

3. Data and Methodology

3.1. Data

We use real GDP and harmonized index of consumer prices (HICP) for eleven transitional countries (Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia) and EU-27 aggregate. Official data on the real gross domestic product (GDP) and HICP for the period from 2000:Q1 until 2020:Q1 are obtained from Eurostat, as indices with 2015=100. GDP data is seasonally adjusted. Monthly indices for HICP are averaged to quarterly series. Standard Augmented Dickey-Fuller test (ADF) was used to determine stationarity of variables and indicate that both variables are difference stationary. Thus, both variables are natural log-first differences, which is a proxy for quarterly growth rate.

To analyze the supply and demand shocks in Croatia during the transition period, we use extended data starting from 1991:Q1. We call this sample a long dataset to distinguish it from the official dataset starting from 2000:Q1. To tackle the problem of availability of Croatian data before 1995, we used GDP and CPI data from various sources to construct continuous series from 1991:Q1 to 2020:Q1. GDP data from 1991:Q1 to 1994:Q4 are reconstructed from Croatian Bureau of Statistics, Statistical Yearbook 1997 and 1998. For the GDP data between 1995:Q1 and 1996:Q4, we used the International financial statistics database published by the IMF. From 1997:Q1 on, we use the official Eurostat GDP data. CPI data from 1998 onward is from the Croatian National Bank. Data before 1998 is reconstructed using sources explained in Tica (2009).

Data for EU-27 aggregate area are not available before 1995:Q1. Therefore, we used data on GDP and CPI for Germany as a proxy, spanning from 1991:Q1 to 2020:Q1, both obtained from the Federal Reserve Bank of St. Louis.

3.2. Methodology

Consider the following structural time series model in the form of structural VAR:

$$A_0 Y_t = \nu + A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_k Y_{t-k} + \varepsilon_t \quad (1)$$

where Y_t is a vector of variables, A_i are coefficient matrices for $i = 1,2,\dots,k$, ν is vector containing constants, and ε_t is a vector with structural shocks we aim to obtain. As the structural VAR in this primitive form cannot be estimated, we turn it into a reduced form model obtained by multiplying equation (1) with A_0^{-1}, or:

$$Y_t = c + B_1 Y_{t-1} + B_2 Y_{t-2} + \cdots + B_k Y_{t-k} + e_t \tag{2}$$

where $B_j = A_0^{-1} A_j$, $c = A_0^{-1}\nu$, and the error term is $e_t = A_0^{-1}\varepsilon_t$.

To uncover structural shocks from the reduced form model from equation (2), we impose two types of restrictions. For the implementation of block-exogeneity restrictions we closely follow the recent work by Deskar-Škrbić et al. (2020), and for the implementation of sign restrictions we use procedures from Arias et al. (2014).2 First, we impose a small open economy restriction in the form of block-exogeneity where external shocks affect the domestic economy, but not vice versa. To do so, we decompose variables into an external and domestic block, e.g. $Y_t = [Y_t^e \quad Y_t^d]'$. Both blocks contain series on GDP growth and inflation, respectively:

$$Y_t^j = \left[gy_t^j \quad \pi_t^j\right]' \quad j = e, d \tag{3}$$

We estimate a separate model for each post-transition country. In our case, external shocks are captured through the EU-27 GDP growth and inflation, and the external block is common for all of the models. Domestic shocks are individual for each post-transition country we consider.

To achieve block-exogeneity between the external and domestic block, matrices A_j and B_j from equations (1) and (2) take the following form:

$$A_j = \begin{bmatrix} A_{11}^j & 0 \\ A_{21}^j & A_{22}^j \end{bmatrix}, \quad B_j = \begin{bmatrix} B_{11}^j & 0 \\ B_{21}^j & B_{22}^j \end{bmatrix}, \quad j = 1,2,\dots,k \tag{4}$$

For that purpose, we use Bayesian estimation with the Independent Normal inverse Wishart prior, which allows setting priors for VAR coefficients and error covariance matrix independently. For each model, the Gibbs sampler is run until 1000 admissible draws are reached. Independent Normal inverse Wishart prior is required to implement the block-exogeneity restrictions between the external and domestic economy. Following Deskar-Škrbić et al. (2020), we set zero mean priors with small variances for the domestic country parameters in equations explaining the external block dynamics.

Second, to identify supply and demand shocks in the model, we impose sign restrictions on impulse response functions (following Arias et al. 2014). We separately identify external and domestic shocks, but we do not impose restrictions on how domestic variables should respond to external shocks. Instead, we let the data speak freely. We identify (positive) aggregate demand shocks as a shock that increases both GDP growth and prices. On the other hand, (positive) aggregate supply shock increases GDP growth, but it reduces prices. We summarized the imposed restrictions in Table 1. These restrictions are in line with theoretical models and are broadly accepted in the empirical literature, as well. For example, Comunale and Kunovac (2017), Deskar-Škrbić et al. (2020), and the literature within.[3]

[2] All models are estimated using Matlab procedures kindly provided by Milan Deskar-Škrbić, Karlo Kotarac and Davor Kunovac whose assistance we gratefully acknowledge.

[3] See also Mallick and Mohsin (2016) for the identification of other shocks then AS and AD.

Table 1. Identification of supply and demand shocks based on sign restrictions

	External demand	External supply	Domestic demand	Domestic supply
EU-27 GDP gr.	+	+	0	0
EU-27 prices	+	-	0	0
Domestic GDP gr.	*	*	+	+
Domestic prices	*	*	+	-

Note: +, -, and 0 denote positive, negative, and block-exogeneity restrictions, respectively. * indicates that response is not restricted.

All models are estimated using four lags according to four information criteria.4 For more details on the estimation strategy and further technical details, refer to Deskar-Škrbić et al. (2020) and Arias et al. (2014).

4. Empirical results

In this section, we present and discuss the results of our analysis by breaking down the significance of domestic versus external shocks and the importance of aggregate demand (AD) versus aggregate supply (AS) shocks. To do so, we use the impulse response functions (IRF), historical decomposition (HD) and the variance decomposition (forecast error variance decomposition - FEVD) to identify the main sources of business cycle fluctuations in post-transition countries. A similar approach is taken in Cover and Mallick (2012), who analyze sources of macroeconomic and exchange rate fluctuations in the UK.

First, we analyze the significance of domestic and external aggregate demand and supply shocks in Croatia during and after the transition period using the long dataset starting from 1991. Second, we analyze the importance of domestic versus external shocks and the importance of AD versus AS shocks in all post-transition countries (including Croatia) using the official dataset starting from 2000.

4.1. Business cycle fluctuations during and after Croatian transition

Figure 1 shows a breakdown of Croatian GDP growth by type of shock during the transition and post-transition period from 1993:Q1 to pre-COVID-19 levels in 2020:Q1. We refer to this sample as a long dataset to distinguish it from the official dataset starting from 2000. Likewise, Figure 2 shows the same breakdown of inflation. Both figures show year-on-year growth rates based on historical decomposition results from the estimated Bayesian SVAR model. Shaded areas represent recession periods in Croatia.

Domestic shocks were predominant during the war and transition period, especially supply shocks. As Croatia was experiencing hyperinflation from 1991 to 1993 (Anušić et al. 1995), it can be seen that high fluctuations of GDP growth were mainly driven by aggregate supply shocks at the beginning of that period. Inflation started reacting to external shocks only after the stabilization program in 1994. Domination of domestic shocks in explaining both GDP growth and inflation is expected due to the nature of war and its oscillations considering domestic economic, political, and social instability that were dominant in those years. Furthermore, in the early 1990s, Croatia's involvement in international trade was limited due to imposed sanctions. We must emphasize that the economy was hit by many different shocks in these troublesome times, and the standard aggregate supply and demand shock decomposition might be imprecise. The economy opened up completely in the late 1990s and early 2000s. As the war was ending, GDP growth accelerated, and volatility began to reduce. The importance of domestic shocks characterized the transition period, which is in accordance with Tica and Viljevac's

[4] We used Akaike Information criteria (AIC), Hannan-Quinn Information criteria (HQ), Schwarz Information criteria (SIC) and Final Prediction Error (FPE). According to AIC, HQ and FPE, optimal lag is four, and two according to SIC. We also estimated model with two lags, but results did not change significantly.

(2020) findings, who suggested that shocks in the labor market are a reason behind differences in GDP growth rates in transition countries.

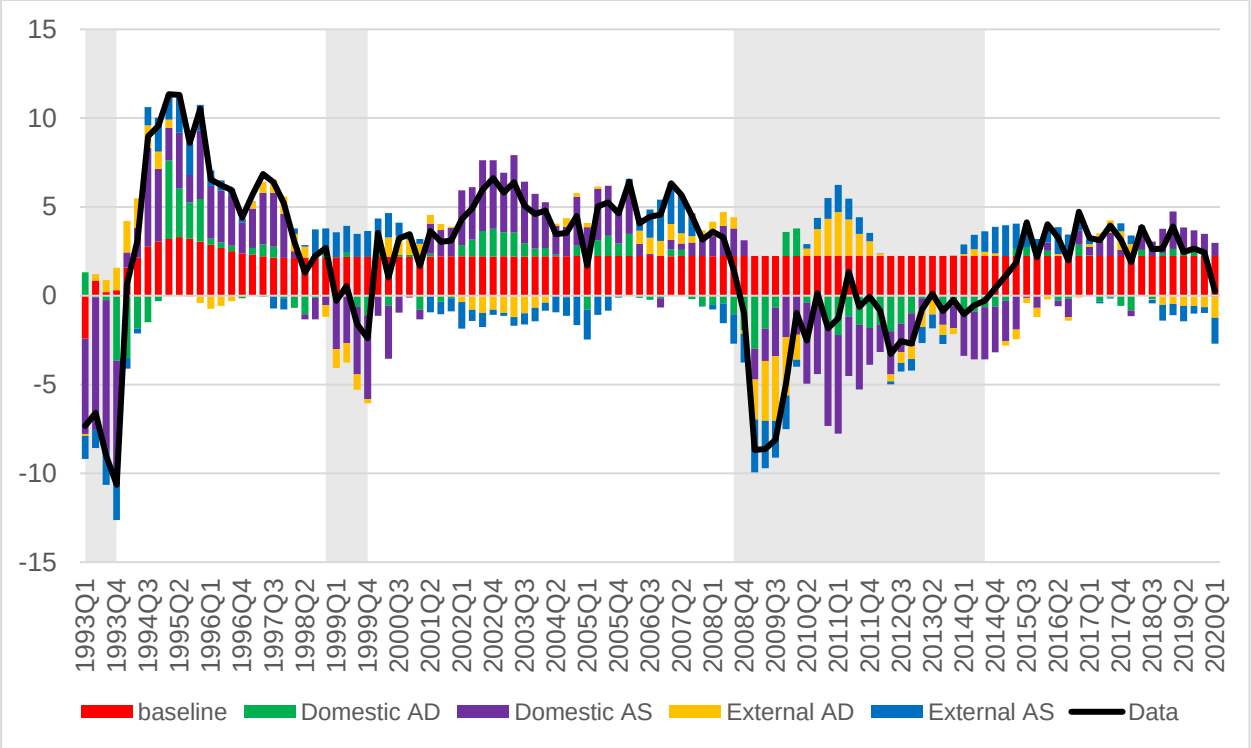


Figure 1. Historical decomposition of Croatian GDP growth using the long dataset

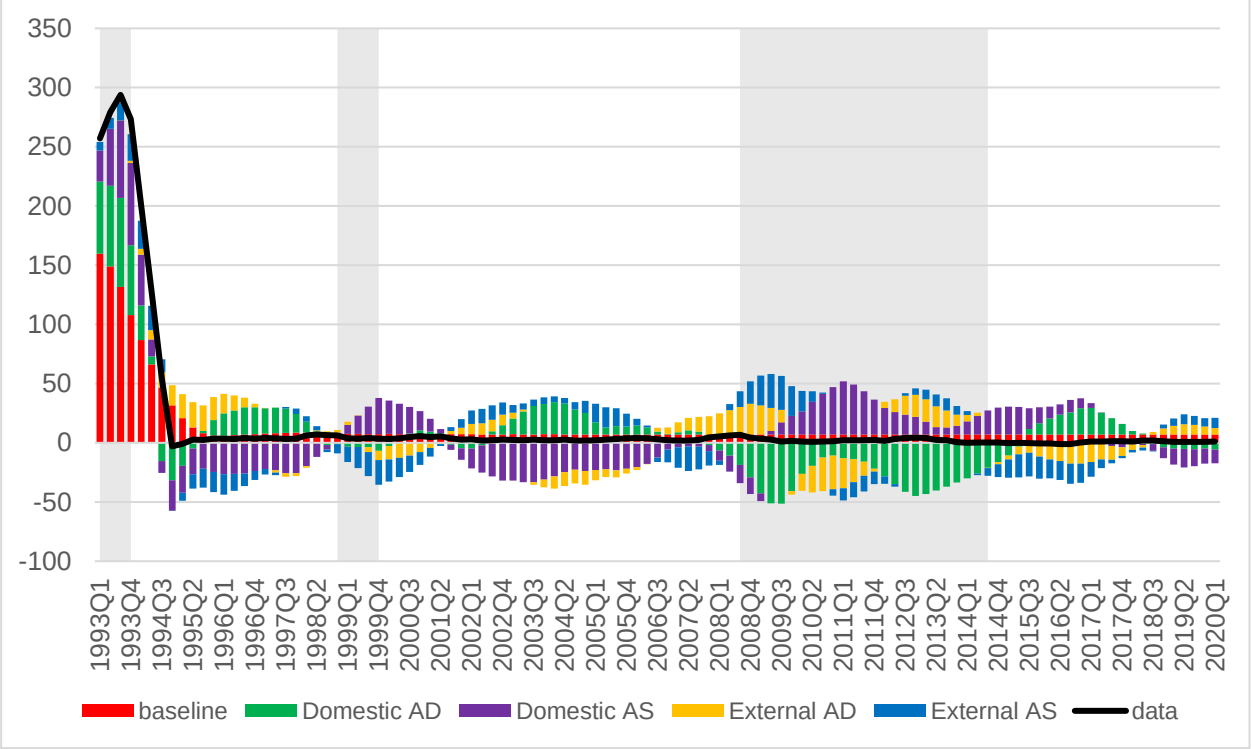


Figure 2. Historical decomposition of Croatian inflation using the long dataset

After the transition period, starting in 2000, external shocks were gaining importance, which is related to the end of the war in Croatia and the liberalization of trade and financial sectors. It caused higher

integration with other countries, which in turn increased the share of external shocks in explaining GDP growth and inflation as a result of being the small open economy.

It is usually argued that in 1998-1999, the conflict in Kosovo caused a recession in Croatia that lasted for a year (see Družić et al. 2016). It can be seen that the recession was mainly driven by disturbances in domestic AS and AD and also external AD caused by the conflict, which geographically was very close to Croatia. It is interesting to point out that external shocks were not the dominant ones in causing the recession in Croatia in that period. This means that the war on Kosovo was only to a small extent the cause of the recession. On the other hand, the second banking crisis in Croatia was taking place at that time, which may be related to the recession (CNB, 2000). Overall, domestic shocks, especially AS shocks, were dominant up to the Global financial crisis in 2008.

The Global financial crisis was an external shock to Croatia and was mainly driven by external AS and AD shocks, which is due to the nature of the small open economy that depends on external conditions. The Global financial crisis that triggered a worldwide recession in 2008 was extended in Croatia and lasted until 2014:Q3. However, the main reason behind that long-lasted recession was primarily due to domestic AD and AS and, to some extent, external AS shocks. That period was also accompanied by high domestic instability because of high uncertainty in Croatia (Sorić and Lolić, 2017) and the eurozone crisis. Low domestic demand pushed inflation down during the Global financial crisis, which is evident from Figure 2, where domestic aggregate demand shocks predominantly take negative values.

In light of the recent paper by Donayre and Panovska (2021), 85% of all recessions in the US take shapes that are weighted combination of L and U recessions. Croatia experienced four recessions since its independence in 1990. The early transition recession from 1990 to 1993 and the Global financial crisis could be characterized as L recessions due to their duration and a strong decrease in GDP. On the opposite, the 1998-1999 recession, as well as the Covid-19 recession have a clear V-shaped form.

Furthermore, Figures 3 and 4 show Croatian GDP growth and inflation breakdown by shocks using the official dataset from 2000:Q1 to pre-COVID-19 levels 2020:Q1. It enables us to compare the two historical decompositions for the official and extended dataset. Up to the Global financial crisis, the results for GDP growth are similar, but after that, they begin to differ, which can be attributed to the high volatility of domestic AS and AD shocks that were persistent in Croatia in the early 90s due to hyperinflation and war. We compare the results using the long and official datasets and find some interesting differences. It can be seen that after 2008, external shocks, especially AD shocks, are gaining on the importance and were gaining even more importance after Croatia joined the EU in 2013. At the beginning of 2020, the first hints of the COVID-19 crisis can be seen, mainly caused by the external AD and AS shocks, where AD shocks are more dominant. Also, external shocks explain most of the inflation fluctuations in the observed period. Large inflation movements before and during the Global financial crisis are primarily explained by external shocks, dominating AD shock. This can also be concluded for the start of the ongoing COVID-19 crisis.

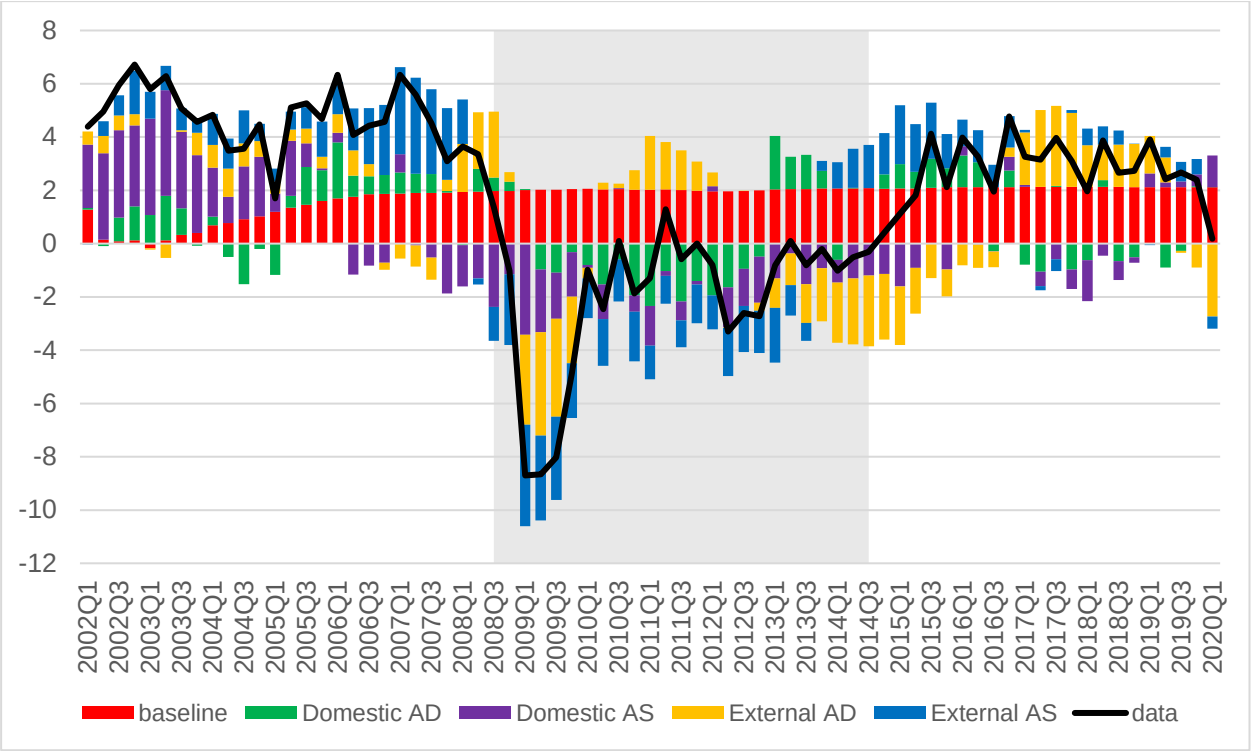


Figure 3. Historical decomposition of Croatian GDP growth using the official dataset

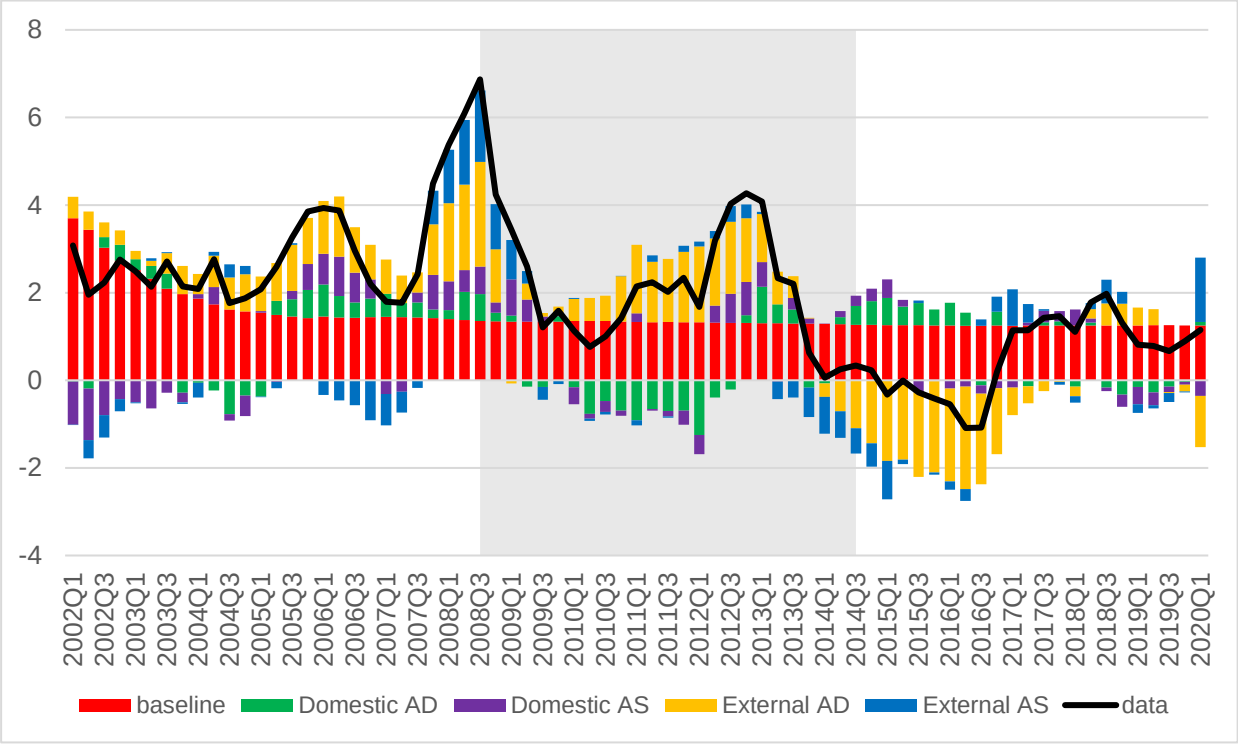


Figure 4. Historical decomposition of Croatian inflation using the official dataset

4.2. Responses and relative importance of shocks

Next, we present the impulse response functions (IRF) of GDP growth and inflation to domestic and external AD and AS shocks using the official dataset from 2001:Q2 to 2020:Q1. The imposed short-run restrictions on GDP growth and inflation assure that positive domestic AD shocks have a positive impact on GDP growth and inflation. In contrast, domestic AS shocks have a positive impact on GDP growth and a negative impact on inflation. However, we toggle our focus on the analysis of the responses to external shocks where we let data speak freely with no imposed restrictions on how domestic variables should react. Figure 5 shows the IRFs of Croatian GDP growth and inflation to external shocks, which are estimated by the model and not subject to imposed restrictions. External AD shocks have a positive and significant impact on GDP growth, when after around the seventh quarter, those shocks become insignificant, showing an expected hump-shaped response. External AD shocks also have a positive and significant impact on inflation throughout the whole period, where inflation slightly increases over time. External AS shocks increase Croatian GDP growth, especially in the first eight quarters, while after that, it stabilizes. On the other hand, external AS shocks negatively affect inflation two quarters after the shock, becoming insignificant after that.

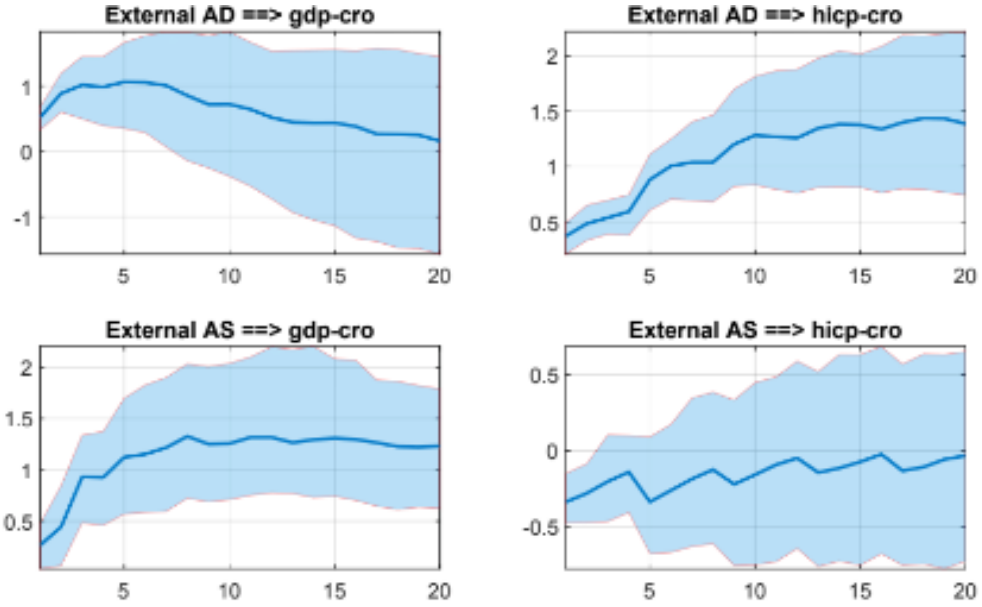


Figure 5. Impulse response functions of GDP growth and inflation in Croatia (external shock)

In Table 2, we present forecast error variance decomposition (FEVD) results of Croatian GDP growth for the first, eighth, and twentieth quarters. Our estimation shows that domestic shocks are highly dominant in the short run, with AS being more important. However, their importance decreases over time, giving space to external shocks until the twentieth quarter, when they become slightly more important than domestic ones, with AD shock being the dominant one. Also, AD and AS shocks are equally prevalent in the first and the twentieth quarter.

Table 1. Forecast error variance decomposition of Croatian GDP growth

Quarters	Domestic AD	Domestic AS	External AD	External AS
1	29,57	41,73	20,25	8,45
8	22,71	28,63	26,01	22,65
20	21,07	26,69	28,85	23,40

These results are in line with Arčabić (2016), who also showed similar shares of aggregate supply and demand shocks in Croatia (the identification of shocks is slightly different, and Arčabić, 2016 refers to these shocks as technology and non-technology, following the work of Galí, 1999). However, further analysis showed that aggregate demand shocks might be more relevant as employment decreases as a response to a positive technology shock, suggesting sticky prices and shock propagation mechanisms explained by the new Keynesian theory.

Table 2. Forecast error variance decomposition of Croatian inflation

Quarters	Domestic AD	Domestic AS	External AD	External AS
1	22,39	21,82	30,16	25,63
8	16,95	16,12	38,20	28,73
20	14,55	13,79	40,46	31,20

In Table 3, we present FEVD results of Croatian inflation for the first, eighth, and twentieth quarter. Results suggest that external shocks are dominant in the short run, with their importance increasing over the long run. In both the short and long run, AD shocks are the dominant ones.

To conclude, results show that during the transition period and up to the Global financial crisis in 2008, domestic shocks were the leading cause of fluctuations in Croatian GDP growth, with dominating AS shocks. The two mentioned crises before 2008 were also dominated by domestic shocks. External shocks caused the Global financial crisis, but the crisis in Croatia was extended until 2014:Q1 mainly due to problems in Croatia and the Eurozone in that period. After 2008 and the Global financial crisis, external shocks are becoming the dominant ones in explaining the fluctuations of Croatian GDP growth, primarily external AD shock. This is even more prominent after Croatia joined the EU in 2013.

On the other hand, fluctuations in Croatian inflation during the transition period were also dominated by the domestic shocks, mainly AS shock. In the post-transition period, most of the fluctuations in inflation are explained by external shocks, mainly by the AD shocks. External shocks were the ones that explained most of the fluctuations during the Global financial crisis and the start of the ongoing COVID-19 crisis. As with the GDP growth, external shocks gained even more importance after Croatia joined the EU.

Results from FEVD analysis indicate that in the short-run domestic shocks are dominant ones, with AS shock being more important, while in the medium run, external shocks are slightly more prevalent, with AD shock taking over the dominance.[5] These results are in line with Globan et al. (2016), who also show that in the medium run external shocks dominantly explain the variation in inflation.

4.3. Shock decomposition in post-transition countries

To compare the obtained results for Croatia, we estimate the same models for other post-transition countries. First, we report results of the impulse response functions of domestic GDP growth and inflation to external AD and AS shocks during the period from 2001:Q2 to 2020:Q1. To save space, we present only Poland's impulse response functions results in the main text, while the full results are given in Appendix A.

[5] Obviously, this result depends on the identification. In a robustness check we further restrict AD shocks not to have a long-run effect on GDP. In that case, restricted domestic AD shocks have a limited effect in the medium run. However, the effect of unrestricted external AD shock on a small open economy still increases in importance in the medium-run. We do not present these results in the paper, but they are available upon request.

Figure 6 shows that external AD shocks positively impact Poland's GDP growth for the first 6 to 7 quarters, after which it becomes insignificant. Furthermore, Poland's inflation reaction is insignificant for the first ten quarters, after which it becomes significant and remains positive. A close look at individual country results reveals that external aggregate demand shock positively affects both GDP growth and inflation in all observed countries, but with different dynamics (see Appendix A).[6] In all observed countries, the increase of inflation due to the aggregate demand shock is stronger and longer than for GDP growth. GDP responses to external AD shocks show an intuitive and expected hump shape, confirming short to medium run effect of AD shocks on GDP growth. It is interesting to emphasize that we obtain such responses without imposing zero long run restrictions on impulse responses. For robustness check, we further implement such zero restrictions, forcing GDP growth response to return to zero in the long run. Results are qualitatively unchanged, as we discuss in the next section.

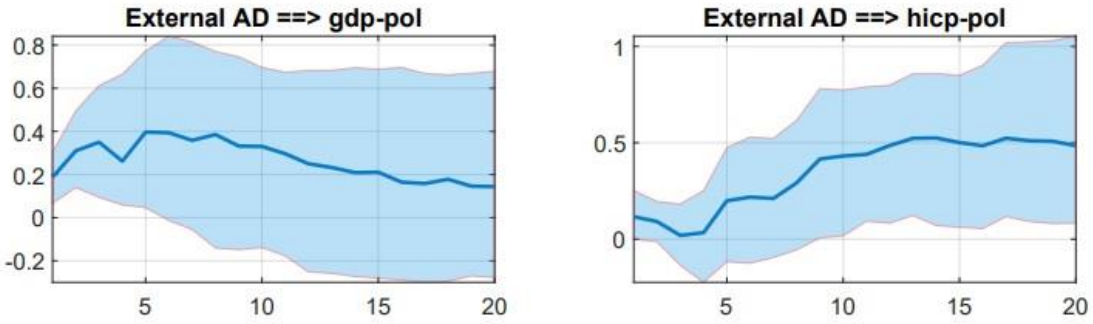


Figure 6. Impulse response function of GDP growth and inflation in Poland to an external aggregate demand shock

Figure 7 shows that external AS shocks have a positive and long-lasting impact on Poland's GDP growth. The same reaction is found in all observed countries, except for Hungary and Latvia, where the response is not long-lasting, but it is only significant around the fourth, fifth, and sixth quarters (see Appendix A).[7]

External AS shocks have a negative impact on inflation in Poland. Again, the response dynamics differ in other countries. A similar effect as in Poland can be seen in Bulgaria, Czechia, and Croatia. At the same time, external AS shock in Lithuania is negative in the first quarter, but after that becomes positive. For Slovakia, it is negative in the first quarter, but after that, it becomes completely insignificant. Lastly, external AS shocks positively affect inflation in Latvia, and the same goes for Estonia, Hungary, and Slovenia, while in Romania, it is completely insignificant throughout the whole period (for all see Appendix A).[8]

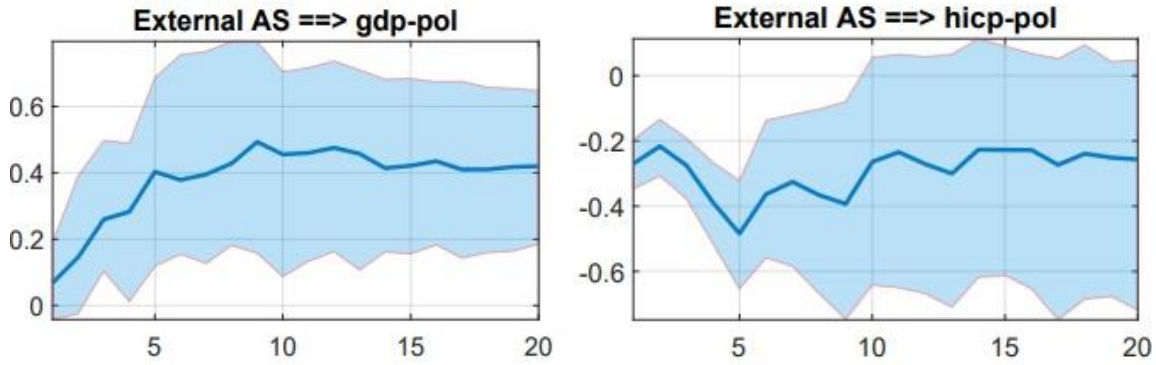


Figure 7. Impulse response function of GDP growth and inflation in Poland to an external aggregate supply shock

[6] Since the results are similar in all observed countries, IRFs for other countries are presented in Appendix A.
[7] Since the results are similar in all observed countries, IRFs for other countries are presented in Appendix A.
[8] All results are presented in Appendix A.

Next, we use FEVD presented in Table 4 and combine it with the previous results to assess the importance of domestic and external shocks over time. Table 4 shows the FEVD of GDP growth for selected observed countries in the first, eighth, and twentieth quarter.

In Croatia, Hungary, Latvia, Slovakia, Estonia, Romania, Lithuania, and Bulgaria, domestic shocks are highly dominant in the short run, but after that, their importance decreases, giving space to external shocks until the twentieth quarter when they become dominant or at least equal as domestic. AD and AS shocks are equally important throughout the period, where one can be slightly higher than the other. It is also noticeable that domestic shocks in Poland are dominant throughout the entire period, with more dominant AD shock. For Czechia and Slovenia, external shocks are more dominant ones, with the importance of domestic shocks shrinking in the short run and continuously falling after that. It can be concluded that in the short-run domestic shocks are prevalent in 9 out of 11 countries, with dominant AS shock, while in the medium run, external shocks are dominant in 8 out of 11 countries, with AD being the prevalent shock. Such findings confirm that the majority of post-transition countries have similar shocks decomposition as we find in the case of Croatia.

Table 3. Forecast error variance decomposition of GDP growth for observed countries

Quarters	Domestic AD	Domestic AS	External AD	External AS
Croatia				
1	29,57	41,73	20,25	8,45
8	22,71	28,63	26,00	22,65
20	21,07	26,69	28,84	23,39
Romania				
1	34,09	47,00	14,06	4,84
8	22,18	31,57	26,22	20,03
20	19,58	28,12	30,82	21,48
Latvia				
1	44,54	42,65	7,00	5,81
8	22,48	29,62	29,38	18,52
20	19,50	25,60	30,81	24,09
Lithuania				
1	29,24	51,03	12,29	7,45
8	15,27	26,13	31,39	27,22
20	14,36	23,52	33,24	28,89
Estonia				
1	30,03	52,20	13,34	4,43
8	24,08	33,13	23,05	19,74
20	21,94	30,57	25,05	22,44
Slovakia				
1	30,99	31,94	24,50	12,57
8	22,82	21,77	29,54	25,86
20	22,58	20,16	30,21	27,05
Czechia				
1	23,14	25,12	28,05	23,70
8	13,78	15,32	35,13	35,77
20	12,60	14,03	37,27	36,10
Hungary				
1	27,21	37,77	28,20	6,82
8	19,68	28,10	33,58	18,64

20	18,76	25,72	35,81	19,71
Bulgaria				
1	36,53	45,40	10,33	7,74
8	14,03	17,73	38,64	29,59
20	12,87	16,23	41,03	29,88
Poland				
1	49,53	41,26	6,42	2,79
8	39,75	33,63	13,75	12,86
20	37,60	31,63	15,92	14,85
Slovenia				
1	19,70	19,49	30,69	30,12
8	11,89	11,56	35,87	40,68
20	11,07	10,71	38,22	39,99

Overall, IRF functions for analyzed post-transition countries presented in Appendix A show that external AD shocks positively impact GDP growth and inflation in all countries. On the other hand, external AS shocks positively impact GDP growth in all observed countries, while its impact on inflation is mixed. External AD shocks have a stronger and longer lasting effect on inflation, while such an effect of external AS shocks is observed for GDP growth.

The variance decomposition results suggest that domestic shocks are more important in the short run, with AS shocks being the dominant one. In the medium run, the significance of external shocks grows over time, and they can explain up to around 75 percent of the variance in GDP growth during the observed period, with AD shock being the dominant one. According to the literature, even if external shocks are dominant in most countries, it cannot be said that those results are applicable for all post-transition countries and that domestic shocks can be negligible. Our results are in line with examined literature, which puts the importance on the external shocks, but our results point out the importance of domestic shocks in the short run, which is not mentioned in examined literature.

Furthermore, we conclude that AD and AS shocks are of similar importance throughout the whole period in most observed post-transition countries. These results are in line with the literature, where it can be said that AD and AS shocks are equally important and that there is no substantial difference between the two. It can also be said that all observed post-transition countries are small open economies and thus dependent on the economic conditions in the EU, which emphasizes the importance of policymakers to focus on the economic environment and adapt their policies accordingly.

Table 4. Forecast error variance decomposition of inflation for observed countries

Quarters	Domestic AD	Domestic AS	External AD	External AS
Croatia				
1	22,39	21,82	30,16	25,63
8	16,95	16,12	38,20	28,73
20	14,55	13,79	40,46	31,20
Romania				
1	43,83	50,20	3,69	2,28
8	29,83	33,67	21,40	15,10
20	26,27	28,81	27,09	17,83
Latvia				
1	39,00	41,18	9,55	10,27

8	15,35	13,36	37,10	34,19
20	13,82	11,63	37,90	36,65
Lithuania				
1	24,13	42,90	11,71	21,26
8	16,62	20,52	34,71	28,15
20	15,60	18,44	35,98	29,98
Estonia				
1	17,43	27,50	40,83	14,25
8	12,51	15,89	41,98	29,63
20	11,96	15,34	42,12	30,58
Slovakia				
1	40,48	45,95	5,75	7,82
8	30,69	29,70	22,20	17,41
20	28,82	25,70	25,31	20,18
Hungary				
1	35,20	41,18	15,43	8,19
8	23,95	27,89	25,99	22,16
20	20,48	23,45	30,22	25,86
Bulgaria				
1	37,44	32,04	18,87	11,66
8	32,18	21,57	31,61	14,64
20	29,26	19,00	33,01	18,72
Slovenia				
1	23,04	18,39	36,03	22,54
8	16,92	13,07	39,39	30,62
20	15,19	11,33	40,42	33,05
Czechia				
1	29,62	39,00	15,10	16,28
8	23,52	27,21	24,17	25,09
20	20,81	23,74	26,84	28,61
Poland				
1	30,65	26,71	11,35	31,29
8	26,50	20,80	21,98	30,71
20	22,12	17,28	26,87	33,73

Table 5 presents the FEVD results of inflation for all countries. It can be seen that in most of the countries, AD shocks are the dominant drivers of inflation, while only in Poland and Czechia the AS shocks are the ones that have a stronger effect on inflation. When referring to the difference between domestic and external shocks, we can cluster observed countries into three groups. The first group consists of Croatia, Estonia, and Slovenia, in which external shocks are dominant in both the short and long run. The importance of external shocks in these countries is increasing throughout the whole period. The second group consists of Romania and Slovakia, in which domestic shocks are more important in both the short and long run, but their importance decreases over time. The third group includes countries in which domestic shocks are more important in the short run, but in the long run, external shocks are dominant ones. The third group countries are Bulgaria, Czechia, Hungary, Latvia, Lithuania, and Poland.

4.4. Robustness check

For a robustness check we use an alternative and more restrictive shock identification scheme and re-estimate the models for all post-transition countries using the official dataset. Our benchmark identification restricts aggregate demand shocks to have symmetric effect on both GDP growth and inflation, e.g., a positive AD shock increases both variables in the short run. For a robustness check, shock identification is augmented with zero restrictions, where aggregate demand shocks in addition do not affect GDP growth in the long run. This is again in line with standard macroeconomic models and empirical literature. This model puts further restrictions to both external and domestic aggregate demand shocks.

The results of both models are qualitatively similar, and our main conclusions hold. We note some differences in variance decomposition, where domestic aggregate supply shocks are more pronounced then demand shocks in explaining GDP variation. The only exceptions are the three Baltic countries, Estonia, Latvia, and Lithuania. The opposite result is obtained when we observe variance decomposition of inflation. In that case, domestic aggregate demand shocks seem to have a greater importance than supply shocks. However, the share of external shocks in explaining total variation for both GDP growth and inflation is qualitatively unchanged.

To save space, we do not report results of the robustness check exercise, but they are available upon request.

5. Conclusion

This paper analyzes macroeconomic shocks decomposition into external and domestic aggregate demand and supply shocks. Distinguishing between external and domestic shocks is especially important for small open economies that are sensitive to international economic conditions. A standard shock decomposition into aggregate demand and supply shocks might cover up important information on the origin of fluctuations (external vs. domestic). In this paper, the analysis focuses on post-transition small open economies in the EU that are especially sensitive to economic fluctuations from other EU countries. Decomposing macroeconomic shocks in that way can help explain the sources of business cycle fluctuations and give important policy recommendations regarding macroeconomic stabilization.

We use a Bayesian structural vector autoregressive (SVAR) model with the sign and block exogeneity restrictions to properly identify aggregate shocks. Sign restrictions allow us to easily and intuitively identify aggregate demand (AD) and supply shocks (AS), where AD shocks increase (decrease) both GDP growth and prices, while AS shocks have the opposite effect on GDP growth and prices. Block exogeneity restriction allows the identification of external and domestic shocks, where we assume that external shocks coming from a large economy affect small open economies, but not vice versa.

We focus on Croatia to assess the sources of business cycle fluctuations during and after the transition period from 1992 to 2000. Our results suggest that domestic shocks in Croatia were more important in the transition period, but after the liberalization of the trade and financial sector from 2000, external shocks are gaining importance and take the leading role in explaining the variation of Croatian GDP growth and inflation, especially after the Global financial crisis. Domestic aggregate supply shocks dominated during the transition, while external aggregate demand shocks were the dominant source of fluctuations after that. We confirm that the recession caused by the Global financial crisis was triggered by a huge negative external shock. However, domestic shocks were the main reason behind the prolonged recession in Croatia, which lasted for six and a half years, and took a clear L-shaped form. During the crisis, domestic demand shocks in the form of low domestic demand were the main factor behind pushing down inflation and keeping the prices low.

When analyzing all post-transition countries, from the economic policy perspective, especially monetary policy, it is crucial to distinguish the source of shocks hitting the economy to take the appropriate measures. In that regard, we find that in the short run, domestic shocks are more pronounced, especially domestic aggregate supply shocks. This finding is consistent in 9 out of 11 post-transition countries. As post-transition

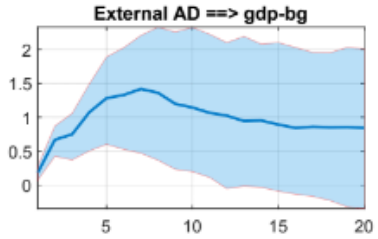
countries were experiencing structural reforms in transition from planned to market economies, they were implementing various reforms such as trade and foreign investment liberalization. These reforms helped boost their productivity and hence were dominant sources of the business cycle fluctuations in the short run. In contrast, as many of these countries integrated into the global market, external aggregate demand shocks were the ones that started to dominate, and they explain the business cycle fluctuations in the medium run, which is found to hold in 8 out of 11 analyzed countries.

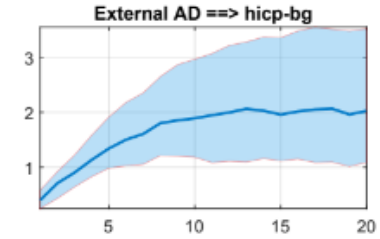
Such results have important implications for the common monetary policy in the Eurozone. The importance of external shocks in explaining medium run fluctuations could make business cycles in post-transition countries more synchronized with the rest of the Eurozone. Therefore, the costs of common monetary policy would be lower as it would be less likely that countries will experience asymmetric shocks.

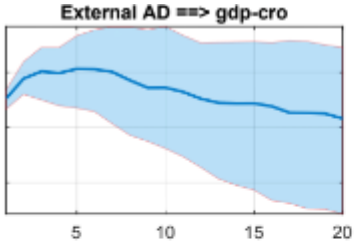
On the other hand, the exposure to external shocks could leave post-transition countries more vulnerable, as they are shown to be more dependent and sensitive to business cycles spillovers (Arčabić and Škrinjarić, 2021). Therefore, economic policy coordination at the EU level is suggested to stabilize these economies (see also Bhattarai et al., 2021).

Appendix A. Detailed impulse response functions for all post-transition countries

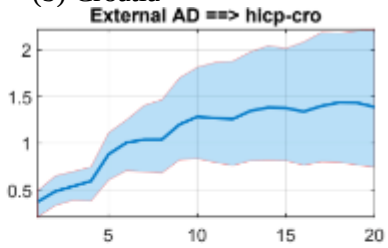
(a) Bulgaria

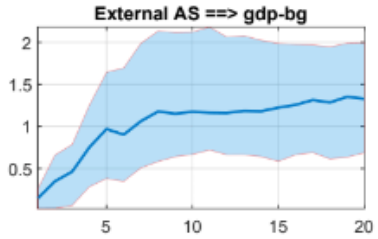


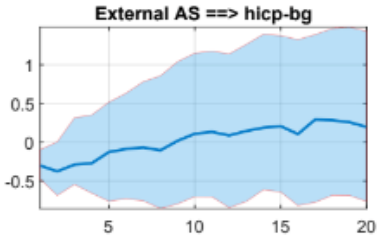


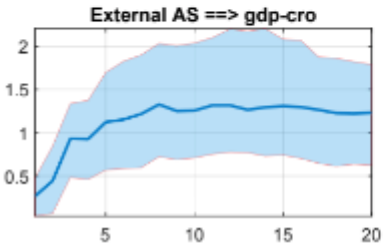


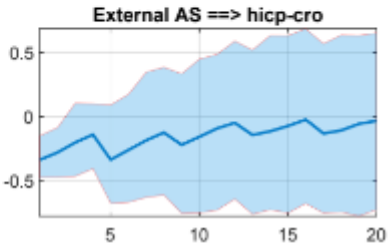
(b) Croatia



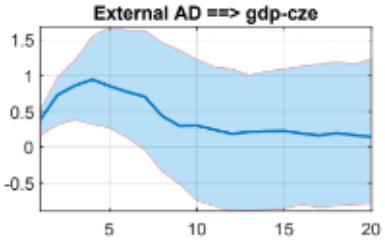


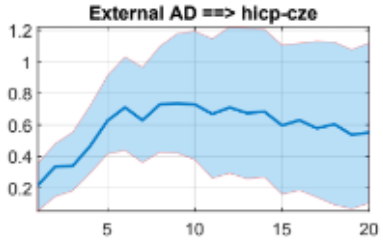




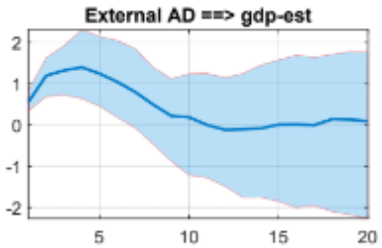


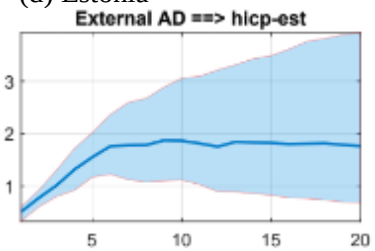
(c) Czechia

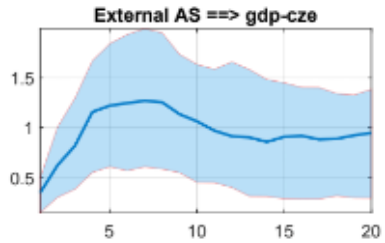


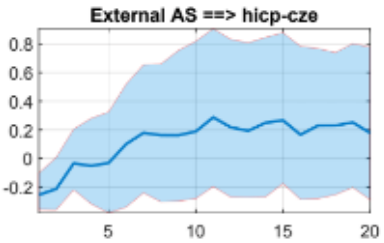


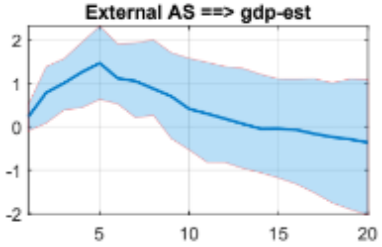
(d) Estonia

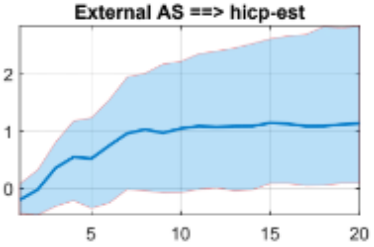




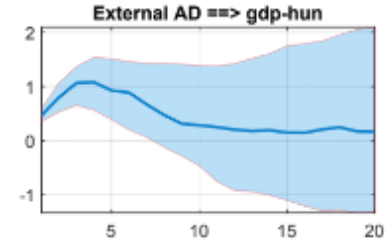


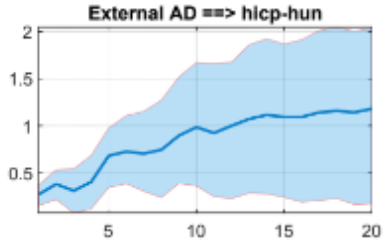


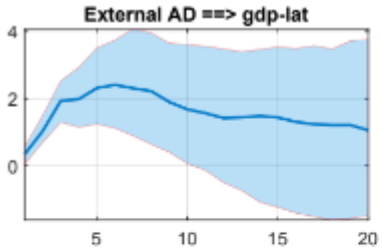




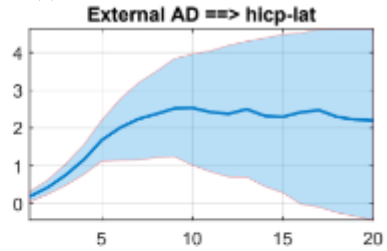
(e) Hungary

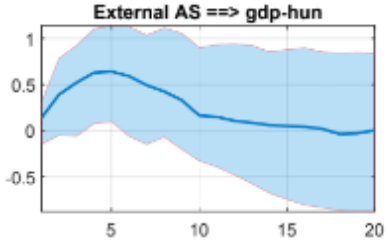


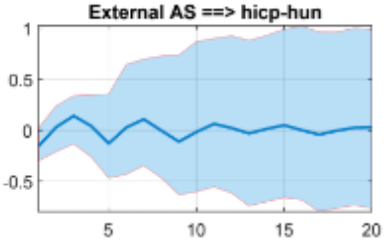


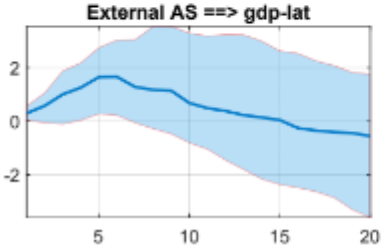


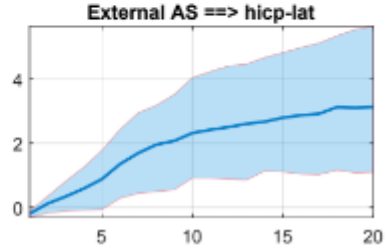
(f) Latvia



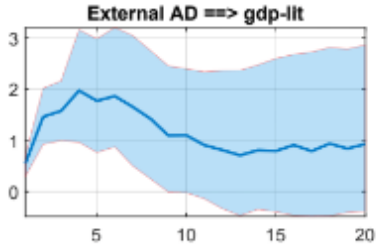


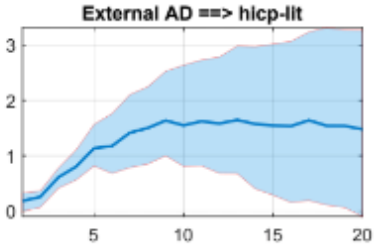


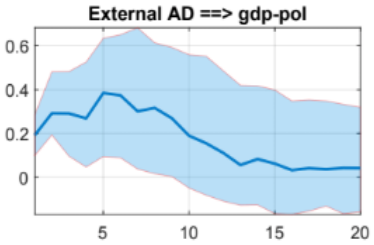




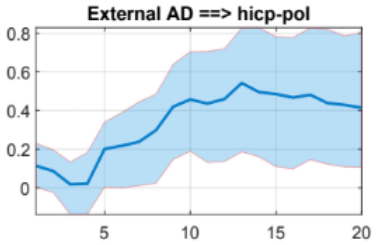
(g) Lithuania

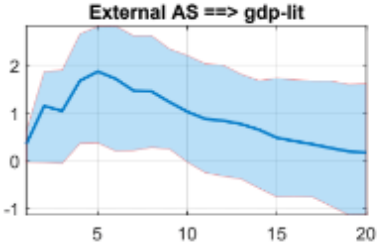


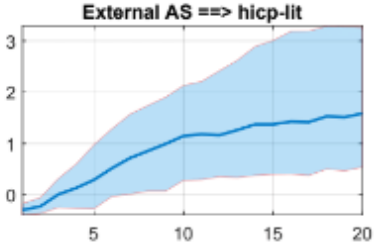


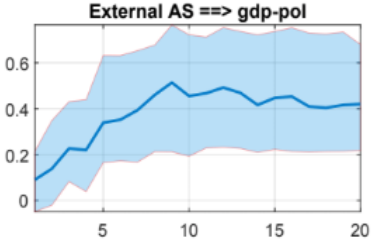


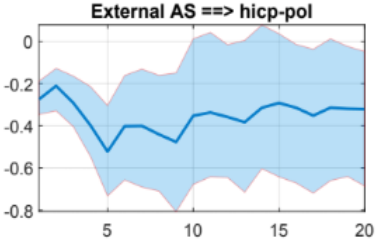
(h) Poland



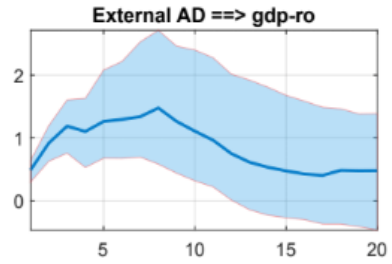


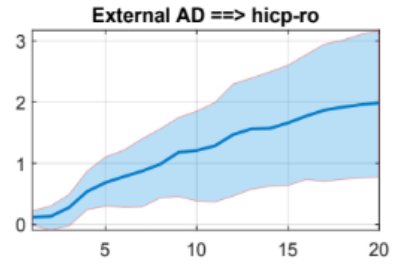


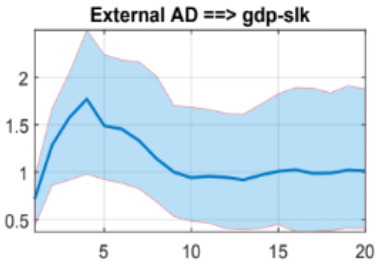




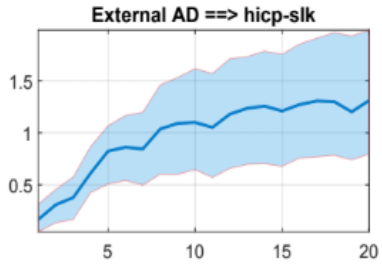
(i) Romania

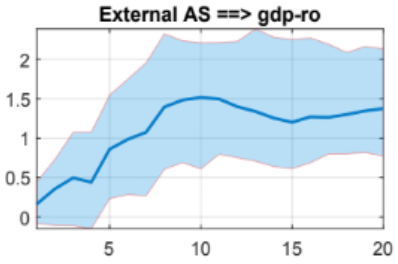


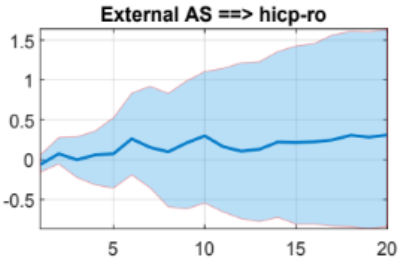


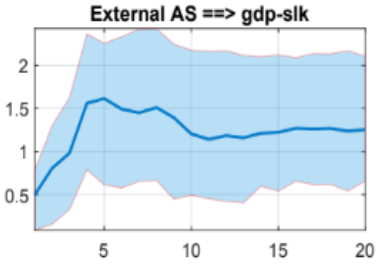


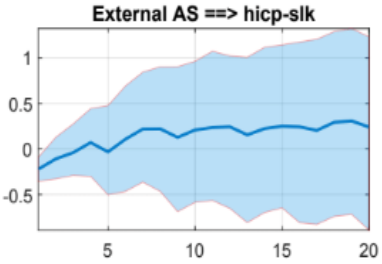
(j) Slovakia



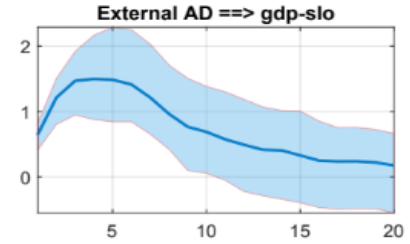


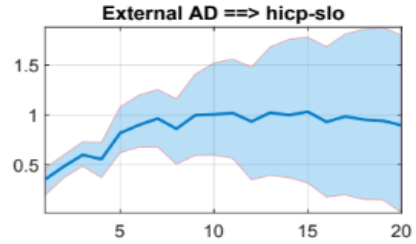


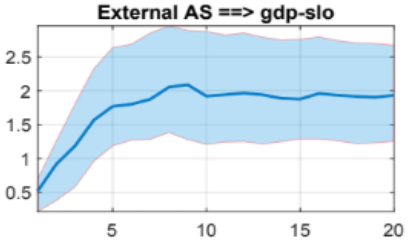




(k) Slovenia







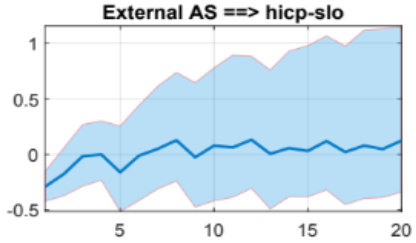


Figure A1. Impulse response function of GDP and inflation to external shock

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