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Shadow of the colossus: Euro area spillovers and monetary policy in Central and Eastern Europe ☆

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ABSTRACT

Closer integration between Central and Eastern Europe (CEE) and the EU has opened up channels facilitating the propagation of economic shocks from the core to the eastern periphery. This paper examines the effects of such shocks to economic activity and monetary conditions originating in the Euro Area (EA) on output, prices, money, and interest rates in 10 CEE countries over the period 2005–2018 using a bilateral restricted VAR framework. In contrast to previous studies, we use Divisia monetary aggregates and compare the effects of EA spillovers to domestic shocks. The results indicate that EA shocks explain the majority of variation across all macroeconomic indicators, with money supply shocks playing the most prominent role. Despite some heterogeneity, the impulse response of monetary aggregates to domestic and EA monetary shocks is almost identical across countries. The impact of the EA shock increases over time and persists, while the domestic shock dies out relatively quickly. Accordingly, we find no meaningful monetary independence in the majority of CEE countries. This is likely to prove detrimental to the effectiveness of monetary policies in CEE.

1. Introduction

Over the past two decades, Central and Eastern Europe (CEE) has deepened its ties with the European Union (EU) in spite of the global financial crisis, the European sovereign debt crisis, and the rise of Eurosceptic populist forces in the region. As small open economies, CEE countries are highly dependent on trade with and investment from the EU. Closer economic and monetary integration with the Common Market, while helpful in reducing vulnerability to external shocks, has also increased exposure to spillovers from the Euro Area (EA). This issue has gained particular attention in the context of the expansionary monetary policies implemented by the European Central Bank (ECB) since 2008. In the absence of synchronized business cycles, the transmission of asymmetric monetary policy shocks within a monetary union becomes more likely, decreasing the effectiveness of stabilization efforts (Altavilla, 2004). While the alignment between business cycles in CEE and the EA has generally increased over time, especially after EU accession and euro adoption, it has also been characterized by heterogeneity across countries (Bencik, 2011; Campos et al., 2019; Fidrmuc and Korhonen, 2006). EU mem-

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ber states in CEE maintaining national currencies and independent monetary policies along with candidate countries from the Western Balkans negotiating to join the EU in the near future are particularly susceptible to asymmetric shocks.

This paper examines the effects of shocks originating in the EA on key macroeconomic variables in CEE countries. In particular, we focus on the impact of shocks to economic activity and monetary conditions on output, prices, money, and interest rates in CEE and conduct the analysis in a comparative context. CEE's response to the external shocks is investigated relative to the reaction to corresponding domestic shocks. Using monthly data over the period 2005M1 to 2018M3, we estimate bilateral restricted vector autoregressive (VAR) models for the EA and each of the 10 CEE countries in our sample. Moreover, we decompose the forecast error variance of the monetary aggregates in CEE to analyze the importance of economic and monetary shocks from the EA relative to domestic shocks. The results are discussed for two distinctive subsamples: EU member states that have not yet adopted the euro and candidate countries from the Western Balkans negotiating accession to the EU. The former have generally floating exchange rates and closer economic ties with the EA, while the latter have lower levels of trade integration with the EA and rely on fixed exchange rate arrangements. This heterogeneity allows us to explore the impact of economic and financial integration on the size of the spillover effect.

The literature on spillovers from the EA has seen rapid growth in recent years. A common feature across most studies that include CEE countries in their sample is the focus on ECB's monetary policy shocks and the application of global VAR (GVAR) models. Earlier studies covering the period before the global financial crisis show that ECB's monetary tightening had large contractionary effects on CEE economies (Benkovskis et al., 2011). The spillovers from the expansionary monetary policies implemented after 2008 have been examined from various angles. One strand of the literature investigates ECB's announcements on unconventional monetary policy measures and their impact on key financial variables in CEE. McQuade et al. (2015) detect substantial effects, especially on sovereign bond yields that declined over time; however the size of the effects varies across ECB's programs. Similarly, Ciarlone and Colabella (2016) show that news related to ECB's asset purchase programs affected various asset prices in the short run but had also long-term consequences by sustaining portfolio capital flows and cross-border banking flows to CEE.

Another group of studies focusing on the spillovers to the real economy has identified several key findings. First, CEE's response to ECB's monetary policy is, on average, comparable to that of the aggregate EA (Babecka Kucharcukova et al., 2016; Hajek and Horvath, 2016; Potjagailo, 2017). Second, monetary shocks from the EA have a stronger effect on CEE's output than on prices (Benecka et al., 2018; Feldkircher et al., 2017; Horvath and Voslarova, 2017; Potjagailo, 2017) or short-term interest rates (Colabella, 2019). Third, trade is shown to be one of the main transmission channels of EA spillovers to CEE, followed by short-term interest rates (Colabella, 2019; Feldkircher et al., 2017). Fourth, there is significant cross-country heterogeneity with some CEE countries, especially in Central Europe, reacting more strongly to international shocks (Feldkircher et al., 2017; Jimenez-Rodriguez et al., 2010) than their counterparts in South-Eastern Europe, where the impact on output tends to be much weaker (Moder, 2017).

We make several key contributions to this literature that distinguish our paper from previous works. First, we explore the monetary dimension of EA shocks in CEE in more detail by studying the reaction not only of short-run interest rates, as is usual in the literature, but monetary aggregates as well. This is important because the interest rate pass-through, and the monetary transmission mechanism in general, in CEE have been hampered by various factors, such as high levels of non-performing loans, substantial amounts of credit denominated in foreign currency, and high concentration in the banking sector (Saborowski and Weber, 2013). Moreover, monetary aggregates are a more suitable indicator in the age of zero-bound interest rates and unconventional monetary policies. Second, we construct Divisia monetary aggregates, which, to the best of our knowledge, is the first time this has been done for most of the CEE countries in the sample. Previous studies on monetary issues in CEE use traditional monetary aggregates, which treat all monetary assests as substitues, thereby disregarding their different degrees of liquidity. Third, we compare the effects of external shocks on macroeconomic variables in CEE to the impact of domestic shocks. The existing literature typically juxtaposes the reaction of CEE economies to EA shocks with the response within EA. Our approach allows us to gauge the effectiveness of domestic (monetary) policies relative to the impact of foreign policy spillovers. Fourth, we add to the literature on structural VARs by providing a new, more efficient computational approach to deal with the combination of zero and sign restrictions for identification where the null restrictions follow a block recursive structure.

The remainder of the paper is structured as follows. The next section provides an overview of the monetary systems and money measurement in CEE. Section 3 describes the methodology and data. In Section 4 we present the results of the empirical investigation and Section 5 provides some concluding remarks.

2. Money and the monetary systems in CEE

2.1. The monetary systems in CEE

The market transition in CEE in the early 1990s posed unique challenges for policy makers in the region. While deep structural and institutional reforms were needed to transform the economic system, they resulted in severe economic imbalances reflected in collapsing industrial output, high inflation, and current account deficits. At the same time, the initial lack of developed financial markets and adequate fiscal and monetary policy instruments prevented governments from implementing effective stabilization measures. With the encouragement of the IMF, most CEE countries responded to these challenges

by adopting a nominal exchange rate peg (usually to a basket of Western currencies) as an external target for monetary policy (for an overview of exchange rate regimes and monetary policy frameworks in CEE, see Figs. 1 and 2, respectively). A fixed exchange rate provided an easily monitored anchor for price expectations that would ease inflationary pressure, allowing inflation to converge to Western European levels. Although inflation was indeed reduced, this mechanism tended to be more effective in some countries like Czechia and Slovakia than in others, such as Hungary and Poland (Lavrač, 1999; Tullio, 1999). However, by the late 1990s, it became obvious that the peg was increasingly unsustainable in the face of growing capital inflows and external shocks.

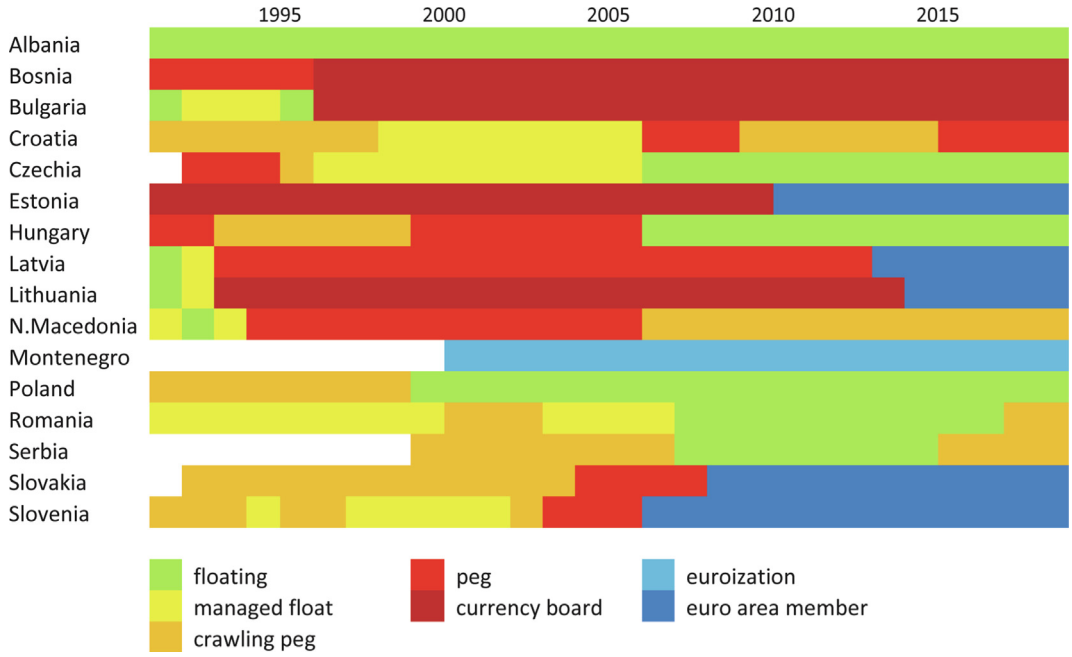

Fig. 1. The evolution of exchange rate regimes in CEE, 1992–2019. *Source:* Roaf et al. (2014) and IMF's AREAER database.

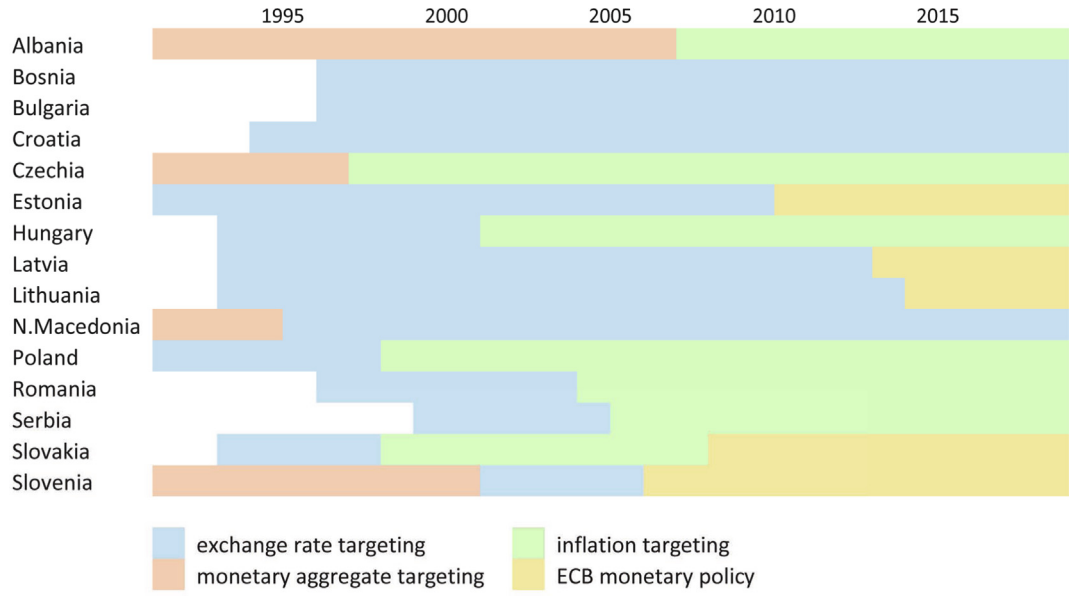

Fig. 2. Monetary policy frameworks in CEE, 1992–2019. *Source:* Various reports by CEE central banks.

As a result, most CEE countries gradually switched to a floating exchange rate, adopting inflation targeting (or, initially, monetary targeting in some cases) as the new anchor for monetary policy. This transition presented its own challenges because inflation targeting requires insitutional credibility and high levels of transparency and accountability. The recently independent central banks in CEE had to deal with short time series, uncertainties about the transmission mechanism, and a rapidly changing macroeconomic and microeconomic environment, making the selection, measurement, and observation of the target extremely difficult (van der Haegen and Thimann, 2002). It is therefore not suprising that the experience with inflation targeting in CEE has not been a straightforward process, although more recent studies show that central banks in the region are pursuing monetary policies that are strongly anchored to inflation stabilization (Feldkircher et al., 2016).

Some CEE countries took a different path than the rest, underlining the heterogeneity across economies in the region. While Slovenia never adopted an external ancor, maintaining a floating exchange rate up to its admission into the Exchange Rate Mechanism (ERM II), some Baltic states and Bulgaria opted for currency boards that remained in effect for decades. The Western Balkans experienced a delay in their transition due to armed conflicts in the 1990s, emerging eventually under various monetary regimes. Serbia kept a flexible exchange rate, adopting inflation targeting in 2006. Bosnia and Herzegovina's central bank has maintained a currency board since its creation in 1997. North Macedonia has been targeting the nominal exchange rate of its currency since the mid 1990s, while Croatia used a less stringent external anchor for its monetary policy based on a managed float. Albania transitioned gradually from a monetary targeting regime to inflation targeting by the late 2000s. Montenegro and Kosovo implemented a unilateral euroization.

Regardless of the monetary regime, the main objective of monetary policy for most CEE countries in the late 1990s and early 2000s shifted from the urgent need for stabilization during the stormy transitional period to the goal of managing inflation in the process of accession to the EU and the adoption of the euro. This involved various external and internal challenges related to the deepening integration between the EU and its eastern periphery. The spillovers from external shocks, especially during the global financial crisis in 2008 and the European debt crisis in 2010, affected CEE disproportionally hard (Feyen et al., 2014). Domestically, underdeveloped financial markets coupled with a strong presence of foreign bank subsidiaries and a substantial share of foreign currency deposits and loans have made it increasingly difficult for CEE central banks to implement effective monetary policies and prevent financial sector fragility (Brown and Stix, 2015). Subsidiaries of foreign banks, which dominate CEE's banking sector, have served as conduits of external shocks because they are part of a cross-border group structure and are thus sensitive to global movements. Only a concerted multilateral effort, called the Vienna Initiative, was able to mitigate the collapse of lending by foreign bank subisdiaries in CEE in the aftermath of the global financial crisis (De Haas et al., 2012; Temesvary and Banai, 2017). For these reasons, investigating the effects of external spillovers on the effectiveness of domestic monetary policy in CEE is a worthy exercise with important policy implications for the eastern periphery and its role in the European unification process.

2.2. Measuring money

Traditional monetary aggregates as reported by central banks over the world in their official statistics implicitly treat all monetary assets included in an aggregate as perfect substitutes. For emerging economies – such as the CEE countries in our sample – where liquidity is not only provided by assets denominated in local currency but also by a fairly large amount of foreign assets, this assumption might be particularly problematic. Excluding those assets would underestimate liquidity, while a simple addition can create aggregation issues.

To shield against this issue, throughout the paper we use Divisia monetary aggregates as pioneered by Barnett (1978) and Barnett (1980). Simply put, Divisia are monetary aggregates where the individual assets are weighted by their degree of liquidity, which is inferred from the opportunity cost (i.e. the sacrifice of the best achievable risk free rate) of holding the respective assets. More precisely, Divisia aggregates are chain weighted indices that measure the "monetary services" provided by the stock of money using a Divisia index number or more precisely its discrete time approximation – a Theil-Tornqvist index.

Especially since interest rates fell to the zero lower bound in several major economies and thus became mostly void of information, Divisia monetary aggregates experienced a renaissance of interest. Belongia and Ireland (2014) and Belongia and Ireland (2015) demonstrate the benefits of Divisia measurement in a DSGE model with heterogeneous monetary assets. Barnett and Chauvet (2011),El-Shagi and Kelly (2014), and El-Shagi and Kelly (2019) show that they could have signaled the crisis in advance. Keating et al. (2014),Keating et al. (2019), and El-Shagi and Kelly (2016) highlight the advantages of Divisia (for example in overcoming several empirical puzzles) in a range of structural VARs using different identification schemes. El-Shagi (forthcoming) illustrates how monetary policy shocks have highly different effects on "simple sum" (i.e. traditional) money and Divisia in particular in turbulent times, with the response of Divisia following the theoretical expectations regarding money. A large range of papers have developed new aggregates, sometimes for countries where they are not reported officially (see, for example, Binner et al. (2009) for the Euro Area, and Barnett and Tang (2016) for China) or to augment the basic indices (see for example Binner et al. (2018) for risk augmented aggregates for the UK and the US).

In this paper, we do not engage in the debate about the advantages of Divisia in detail, but consider the theoretical superiority and empirical advantages as sufficiently established. Throughout the main body paper, "money" is measured as Divisia money unless we explicitly mention otherwise. However, to allow for an easier comparison to the previous literature, we also report results for traditional monetary aggregates in an online appendix.

Most of our Divisia data employed in the analysis are computed by the authors because the majority of central banks do not report Divisia. Notable exceptions are the Federal Reserve (Anderson and Jones, 2011)[1] and the Bank of England (Hancock, 2005). While the ECB evidently collects the data which is used in Stracca (2004), in this paper we use the unofficial aggregates for the EU provided by the Bruegel Institute (Darvas, 2015).

In our CEE sample, only Poland reports official Divisia statistics. However, for all countries sufficiently detailed quantity and interest rate statistics are available to produce Divisia monetary aggregates. For consistency reasons, we compute our own Divisia data for all CEE countries (including Poland). More details are provided in the Data section (Section 3.2).

3. Method and data

3.1. Method

GVAR vs. bilateral VARs In the past years, global vector autoregressive models (GVARs) as pioneered by Pesaran et al. (2004) and Pesaran and Smith (2006) have emerged as standard practice for multi-country time series studies, in particular if a common center (such as the EU in our case) is involved. With some simple assumptions regarding the structure of spillovers, a GVAR approach allows to fully capture the interactions between a large set of countries. Yet, this comes at a cost. Even a moderately sized GVAR is extremely large. In our case with merely eleven countries (ten from CEE and the EA) and a macromodel on the smaller end (including output, prices, interest rates and money) we would obtain 44 equations, rendering structural identification impossible. To overcome this issue, identification in GVARs is typically performed using generalized impulse responses as proposed by Pesaran and Shin (1998). Those have been criticized for their fairly restrictive hidden assumptions, for example by Kim (2013). However, the robust identification of monetary policy shocks for both the EA and each of the CEE countries considered is crucial for our question. At the same time, the interactions between the CEE countries are not our primary interest and anecdotal evidence suggests that they are far less important than the relations between CEE and the EA that we focus on. Therefore, rather than estimating a GVAR, we estimate a set of bilateral restricted VARs, where identification can be done through a combination of zero and sign restrictions.

Stacking the EA and CEE VARs We estimate the reduced form

$$\begin{bmatrix} Y_{EA,t} \\ Y_{i,t} \end{bmatrix} = \mu + \sum_{l=1}^{p} \begin{bmatrix} B_{EA,EA} & \mathbf{0} \\ B_{EA,i} & B_{i,i} \end{bmatrix}_l \begin{bmatrix} Y_{EA,t-l} \\ Y_{i,t-l} \end{bmatrix} + u_t \tag{1}$$

where $Y_{EA,t}$ and $Y_{i,t}$ are column vectors of GDP growth, inflation, money growth, and interest rates for the EA and CEE country i at time t, respectively, and u_t is the vector of reduced form shocks.

Both the EA and each CEE country follow individual autoregressive processes (captured by $B_{EA,EA}$ and $B_{i,i}$). However, while the EA is assumed to affect each CEE country ($B_{EA,i}$), there is no effect of CEE on the EA. This essentially renders our system into two separate VARs. A standard VAR for the EA and a VARX (with the EA being the exogeneous "X" for each CEE country). Economically this is plausible. CEE countries are too small to affect the EA even in total. Technically, this has the advantage of ensuring that the EA we model is always the same, and we do not implicitly have different dynamics for the EA when modelling different CEE countries.

Structural Identification Our structural identification follows the same logic. We combine the idea of block recursive identification as popularized in the seminal Handbook article by Christiano et al. (1999) with sign restrictions in the spirit of Uhlig (2005) in the individual blocks.

If we think of variables in a VAR where identification is achieved through Cholesky ordering in separate blocks of variables, it is a well established result since Christiano et al. (1999) that the order within one block does not affect the identification of shocks in other blocks as long as the order of blocks remains the same. It is less widely acknowledged that this independence of ordered blocks still holds if there is no order at all within the blocks and each variable (within a block) is allowed to affect each other variables (within the same block) as pointed out by Keating (1996).

For our specific problem, this implies that – if there is no contemporaneous effect of the CEE country under consideration on the EA – we can use any identification scheme for this CEE country without affecting shock identification in the EA.

We define $u_t = A\varepsilon_t$, where ε_t is the vector of orthogonal standard normally distributed shocks and $AA' = \Omega$ with Ω being the covariance matrix of u. We then identify A through

$$A = \begin{bmatrix} A_{EA,EA} & \mathbf{0} \\ A_{EA,i} & A_{i,i} \end{bmatrix} \tag{2}$$

and a set of sign restrictions on both $A_{EA,EA}$ and $A_{i,i}$. There are no restrictions imposed on $A_{EA,i}$. Therefore, the identification of shocks in the EA exclusively depends on the upper left quadrant of Ω, i.e. on the covariance of residuals for the separate EA VAR. Again, this is important to guarantee that the EA shocks are identified economically consistently across the bilateral VAR models. The sign restrictions that are applied to both the EA and each country are summarized in Table 1.

[1] Alternative US Divisia data is also made available through the Center for Financial Stability (Barnett et al., 2013).

Table 1
Sign restrictions.

	Monetary policy	Money demand	Supply	Demand
GDP	+	–	+	+
Prices	+	–	–	+
Money	+	+		+
Interest	–	+		+

An expansionary monetary policy shock is achieved through reducing interest rates, and is supposed to boost the economy and prices. Contrarily, increasing money demand will cause interest rates (as the price of money) to increase. Since people want to hold more money, this causes a reduction in aggregate demand, leading to a decrease in GDP and prices. A supply (productivity) shock increases GDP, reducing aggregate prices. This is sufficient for identification, since all other shocks move GDP and prices in the same direction. The demand shock increases GDP and prices. Therefore, money demand is also rising, causing an increase in both money and the interest rate.

Essentially, this leaves us with a combination of zero restrictions (in the upper right quadrant) of A and sign restrictions. Arias et al. (2018) have recently pioneered work in this direction, providing an algorithm that allows to combine sign and zero restrictions without relying on penalty functions (Mountford and Uhlig, 2009) which require information (or assumptions) regarding the relative importance of shocks. In our paper, we propose a new approach that exploits the block recursive structure of our problem and agnosticism regarding the impact of the EA on the periphery country considered.

We know that

$$\Omega = \begin{bmatrix} A_{EA,EA} & \mathbf{0} \\ A_{EU,i} & A_{i,i} \end{bmatrix} \begin{bmatrix} A'_{EA,EA} & A'_{EU,i} \\ \mathbf{0} & A'_{i,i} \end{bmatrix} = \begin{bmatrix} A_{EA,EA}A'_{EA,EA} & A_{EA,EA}A'_{EU,i} \\ A_{EU,i}A'_{EA,EA} & A_{EU,i}A'_{EU,i} + A_{i,i}A'_{i,i} \end{bmatrix}. \tag{3}$$

Since there are no restrictions on $A_{EA,i}, A_{EA,EA}$ simply is a decomposition of the covariance matrix of the EA VAR which is given by $\Omega_{EA} = A_{EA,EA}A'_{EA,EA}$. Due to the block recursive structure, we know that there is no impact of restrictions on $A_{i,i}$ on the identification of $A_{EA,EA}$. Each possible decomposition $A_{EA,EA}$ uniquely determines a corresponding $A_{EU,i} = \Omega_{EU,i}A^{-1}_{EA,EA}$ (where $\Omega_{EU,i}$ is the covariance between the EA data and the CEE country's data, i.e. the lower left quadrant of Ω). This, in turn, uniquely determines $A_{i,i}A'_{i,i} = \Omega_i - A_{EU,i}A'_{EU,i}$. That is, we can separately decompose Ω_{EA} and $A_{i,i}A'_{i,i}$using our set of sign restrictions given in Table 1. Since decompositions matching the sign restrictions are found using random rotations of an initial deterministic decomposition, the probability to draw a matching result decreases exponentially in the number of restrictions. Finding two sequential matches using 10 restrictions each (four of our fourteen signs are no true restrictions but merely normalize the direction of the shocks), is thus computationally substantially easier than finding a match using 20 restrictions simultaneously.

Lag order and stationarity A sample size corrected Akaike criterion suggests a lag order of one. However, this does not yield a stationary model for Poland. We therefore increase the lag order to two for all countries. This confirms stationarity for Poland and is consistent across countries.

3.2. Data

Sample We use monthly data from 2005M1 to 2018M3. The starting point is determined by data availability for Romania, while the final observation is limited by the shadow rate for the ECB. While this is a relatively short period, it should cover about two business cycles, which is sufficient to avoid serious small sample bias (El-Shagi, 2017). Our sample includes two groups of CEE countries. The first one consists of those countries that joined the EU in 2004 (Czechia, Hungary, Poland) and 2007 (Bulgaria, Romania) but have not yet adopted the common currency. The second group is composed of countries in the Western Balkans that have either joined the EU relatively recently (Croatia) or are official and potential candidates for EU accession (Albania, Bosnia and Herzegovina, North Macedonia, and Serbia). CEE countries that have adopted the Euro formally (the Baltics, Slovakia, Slovenia) are included in our EA sample, while those that have done so unilaterally (Kosovo, Montenegro) are not part of the analysis in this paper.

Production To be able to work with monthly data, we use industrial production instead of GDP. Data for the EA is obtained from the ECB for a constant composition of the EA19 (i.e. the 19 current members). This avoids unnecessary structural breaks in the level. Since the members joining the EA after 2005 are diminutive in size compared to the original EA (in total), their impact on growth rates is marginal at best and should not invalidate our results. Data for EU members from CEE is collected from Eurostat, while the series for the four non-EU member countries come from IMF's International Financial Statistics (IFS) and the national statistical agencies.

Prices The price level is measured as harmonized index of consumer prices (HICP) for all countries. The ECB provides data with a time varying composition of the EA. Since price levels are constructed as chained index based on inflation, this does not create a break. Again, regarding the dynamics, adding the fairly small countries should not matter too much. As before, data for the EA is obtained from the ECB and CEE data from Eurostat and IFS.

Money For all countries, we use broad Divisia aggregates. For the EA, we use the broadest aggregate constructed by Darvas (2015). The data uses a time varying composition of the EA but is break adjusted to overcome the level effects. For CEE countries, we construct Divisia ourselves based on data from the central banks on the components of *M*3 (including foreign denominated assets).[2] Missing observations are interpolated through a state space VAR using all available (log) quantities and interest rates. For assets that move to (or from) zero we use a matching procedure and combine them with a similar asset for the period before (or after) the change, i.e. we consider their disappearance (appearance) as change in a wider asset (with a correspondingly larger expenditure share). Our benchmark rate (i.e. the hypothetical rate of a risk free but completely illiquid asset) is approximated as the upper envelope curve of all interest rates included plus a liquidity premium of 100 basis points as is standard in the literature.

Interest rates One of the largest problems is measuring the interest rate. During the European debt crisis, the short run rates in the EA hit the zero lower bound (as the rates of the Fed did earlier during the great financial crisis). For the EA, we therefore use the shadow rate as proposed by Wu and Xia (2016). If the interest rate drops below zero, the shadow rate is the short-run rate implied by the part of the yield curve not restricted by the zero lower bound, assuming the previous correlation structure still holds. If the interest rate is above 25 basis points, the shadow rate equals the observed rate. Since CEE countries did not face problems quite as bad as the EA, their rates did not hit the zero lower bound for prolonged periods, allowing us to simply use the observed short-run interest rate represented by the 3-month interbank offered rate on the local market.[3]

Seasonal adjustment Money, prices, and industrial production are all seasonally (and in the case of industrial production work day) adjusted. Industrial production and the HICP are reported seasonally adjusted. Our Divisia measures are based on non seasonally adjusted data and thus exhibit some seasonal behavior that is adjusted using the standard X13-ARIMA-SEATS procedure commonly used by statistical offices. As is common practice, interest rates are not seasonally adjusted.

4. Results

4.1. Baseline model

The results suggest that the economies of all ten CEE countries in the sample are clearly driven by the EA. Figs. 3 and 4 show the forecast error variance decompositions for two selected countries – one from the group of EU member states (Poland) and the other from the Western Balkans (Croatia) – over the first five years following a shock. Each figure is (relatively) representative for the respective group within the sample. A full set of figures for all ten countries can be found in the appendix (Figures A31 to A40).

With regards to the five EU members, the European shocks (given in blue shades) explain the majority of variation across all four macroeconomic indicators considered (i.e., industrial production, prices, money, and the interest rate). In particular towards the end of the forecast horizon, the share of variation explained by EA shocks is typically above 50%. Money (or liquidity) is driven almost completely by external factors. Within a year of the shock, the EA accounts for more than 80% of the variaton in money. EA's money supply is the dominating component, although in the case of Bulgaria and Romania, EA's supply and demand shocks seem to also play an important role. As for the GDP, the increase in the EA share of the variation is more gradual over time but eventually reaches the range of 70%–80%. The interest rate is affected the least by external shocks with domestic factors claiming about half of the variation in most cases. Prices show the biggest variation across countries, with EA's share ranging from 40%–60% for Poland and Romania to 80%–90% for Czechia and Hungary.

The results for the Western Balkan countries are qualitatively similar but exhibit some key differences. Money is generally dominated by European shocks, with the exception of Serbia, where the impact is still around 50% towards the end of the forecast horizon. However, the variation in GDP is relatively more independent from European shocks, with the share of domestic factors exceeding 60%. Albania is an outlier in that regard with most of its GDP's variation explained by EA's monetary policy shocks. Overall, the findings reveal that Albania is the most and Serbia the least affected by EA shocks in the Western Balkans. Furthermore, we can conclude that EU states are more susceptible to movements in the EA than candidate countries, underscoring their closer integration with the Monetary Union.

What makes the major impact of EA on CEE so stunning is that it is apparently not primarily driven by the identification procedure. One might argue that a substantial impact of the EA is given by construction, since we allow the EA to contemporaneously affect CEE. However, at short horizons the impact of the EA shock is typically limited. The one period ahead forecast errors are primarily explained by domestic shocks. The EA impact is typically 20% or less. Yet, over time the importance

[2] The five countries from the Western Balkans have adopted the ECB definitions of monetary aggregates only very recently. While for *M*1 and *M*2 this is not an issue, data on the M3-specific components as stipulated by the ECB are not available for most of the sample period. At the same time, repos, money market fund shares, and securities issued by MFIs either did not exist in these countries for most of the years covered or the amounts involved were so trivial as to be ignored.

[3] In Albania and North Macedonia, data on the interbank offered rate is available only from 2007 on. Therefore, we use instead the 3-month Treasury bill rate and the interbank deposit rate, respectively, for which longer series exist. The correlation between the series in both cases is 0.96–0.97. For Bosnia and Herzegovina, which has an underdeveloped interbank lending market and does not report any relevant interest rates, we use the overall lending rate for the country published by the IFS.

of the European shock increases dramatically, indicating that this effect is mainly driven by the dynamics of the system (see Figs. 3 and 4).

Figs. 5 and 6 summarize the impulse responses following EA and domestic shocks, respectively, for the five EU member states, while Figs. 7 and 8 do so for the Western Balkans. For visibility, we omit confidence bounds in these figures. More detailed figures (separated by country) with 68% and 90% confidence bands are presented in the appendix (Figures A41 to A60).

For the most part, impulse responses are similar across the five EU members and follow the typical intuition for the behavior of the respective shocks. The EA supply and demand shocks increase aggregate output, with the latter having a markedly stronger and, in most cases, longer-lasting effect.The impact of these same shocks on prices has the expected direction but is very weak in magnitude and it dies out only after two years. An EA demand shock also boosts money and interest rates with the highest effect being observed a year after the initial impulse. In addition, the responses in Bulgaria and Romania are substantially stronger than in the rest of the EU sample. EA money demand shocks do not appear to affect prices and

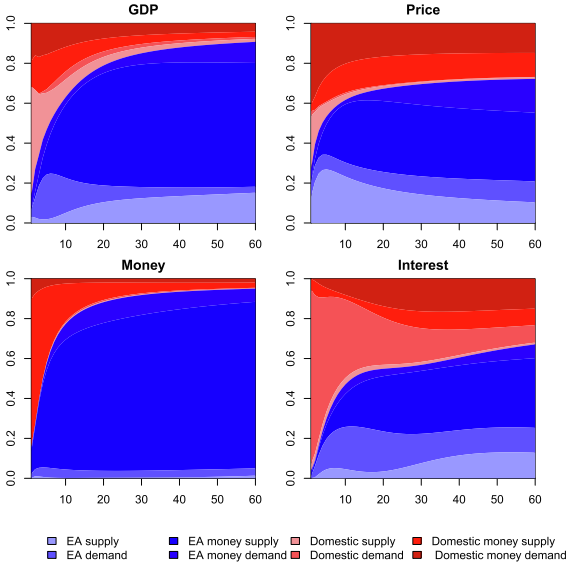

Fig. 3. Forecast error variance decomposition for Poland.

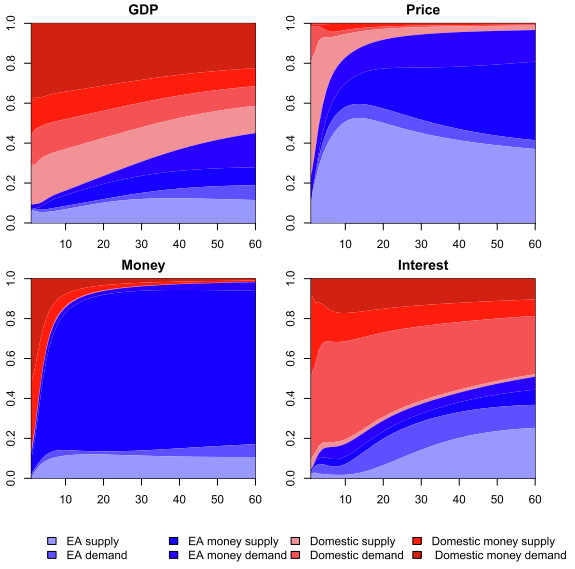

Fig. 4. Forecast error variance decomposition for Croatia.

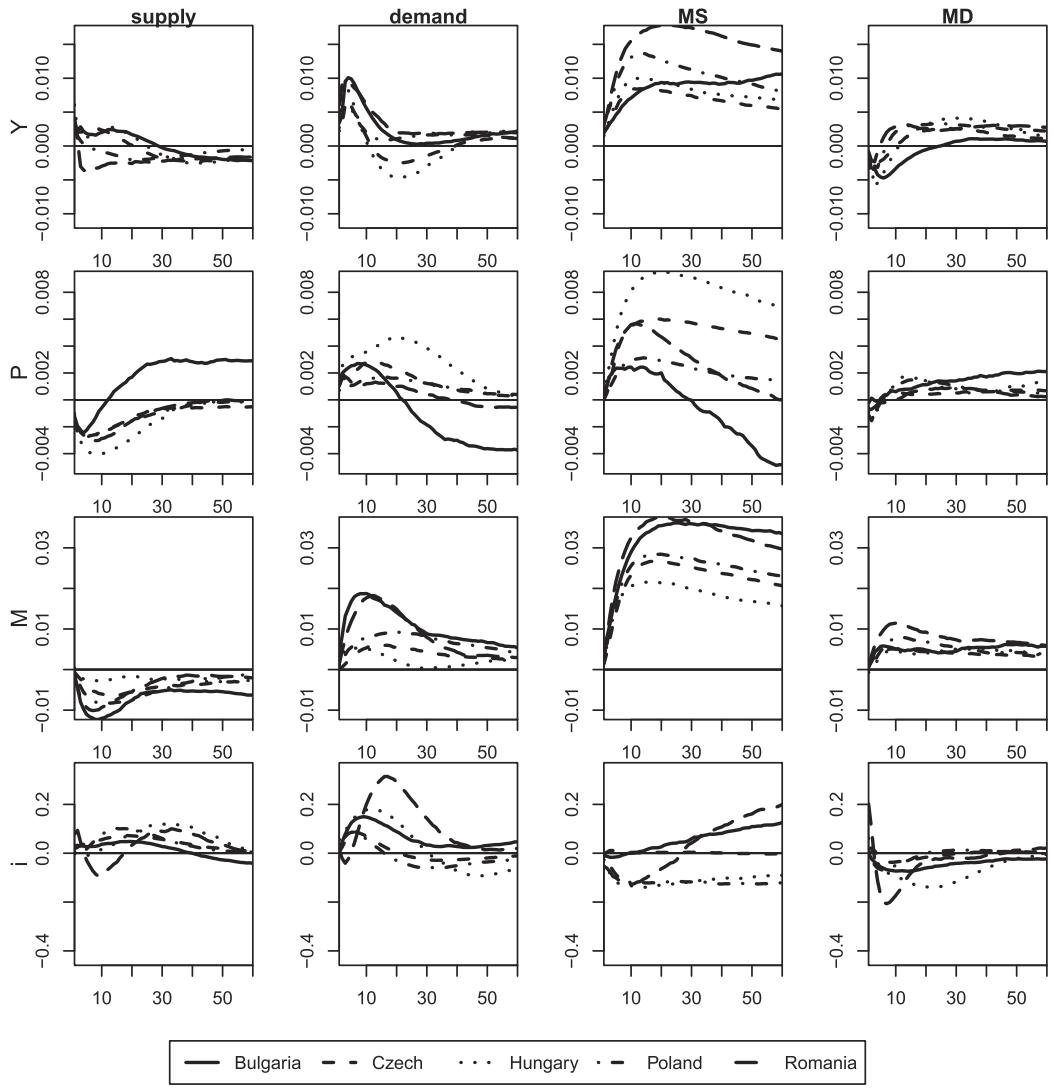

Fig. 5. Impulse response functions following Euro Area shocks (EU members).

have a very short-lived negative impact on output. A comparison between domestic and EA shocks reveals that the former leave a much smaller imprint, underlining the profound influence of EA on CEE. For instance, a domestic demand shock has virtually no effect on money and prices across all five countries. Another key difference is that the contemporaneous effect of domestic shocks is typically the extreme value of the impulse response functions (IRF) or close to it (both in terms of magnitude and time), while EA shocks start at a moderate level and their impact generally becomes more pronounced before dying out, often still being clearly visible in the data after five years.

In the Western Balkans sample, EA shocks have a smaller impact than in EU member states. The effect of an EA supply shock on prices is stronger than on output, which is the opposite of the EU sample. EA demand shocks have a minor effect on output that dies out within a year after the initial impulse, while the impact on prices and money is stronger and can be observed even after several years. Interest rates are the least affected, except in Croatia, while in Serbia they move in the direction opposite to what would be expected. Changes in EA money demand produce a larger response for money than for output or prices. In contrast to the EU sample, domestic shocks have a stronger impact on output and prices but a weaker one on money. At the same time, the Western Balkans are similar to EU member states in that domestic shocks are transmitted faster and are much more short-lived than foreign ones.

Our key variable of interest is money and its response to a monetary policy shock. The third column in Figs. 7 and 8 reveals that EA's expansionary monetary policy has the strongest and most persistent impact on output, prices, and money across all ten countries, when compared to the other three shocks. The effect on output is more pronounced in the EU sample than for the Western Balkans, except for Albania which exhibits the most intense reaction in the entire sample. The strongest

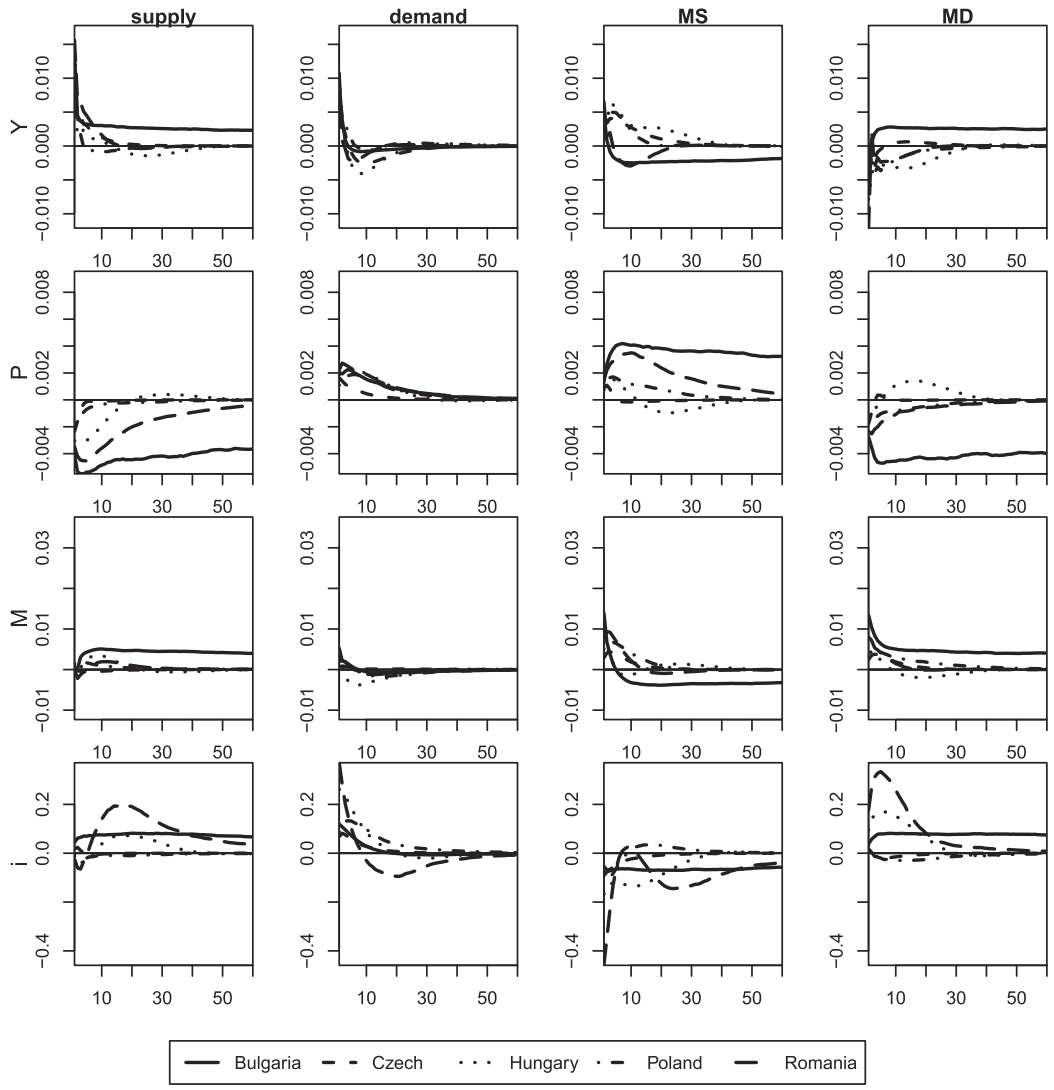

Fig. 6. Impulse response functions following domestic shocks (EU members).

effect on prices can be detected in Hungary and Serbia, while in Bulgaria it is the least persistent, dying out within two years. Interest rates drop and in most cases remain at a lower level for years, with Serbia exhibiting the largest decline. Domestic expansionary shifts in monetary policy exhibit patterns similar to those observed for other shocks. The contemporaneous effect on output, prices, and interest rates is at the maximum value of the IRF but is short lived and much weaker than in the case of foreign monetary shocks. Serbia is again an outlier with its stronger response to a domestic monetary shock compared to the rest of the sample.

For better visibility, Figs. 9 and 10 show a direct comparison of the effects of EA and domestic monetary policy shocks for the EU and Western Balkans sample, respectively (including 68% confidence bounds). In every single case we find the same result. The domestic shock starts stronger than the European shock, but dies out very quickly and the IRF has effectively returned to zero by the end of the first year. Contrarily, the impact of the European shock increases over time, exceeding the impact of the domestic shock after roughly a quarter and exceeding the maximum effect of the domestic shock soon after. While the confidence bounds are relatively wide (compared to the confidence bounds of domestic shocks), this holds true even when comparing the upper confidence bounds of domestic shocks to the lower bounds of EA shocks. In other words, none of the CEE countries in our sample have anything resembling an autonomous monetary policy. Attempts at independent policy are quickly neutralized, allowing European policy to drive the entire macroeconomy.

The fact that the patterns of monetary response are almost identical across the sample is remarkable, given the general heterogeneity across CEE economies. We detect a stronger effect in Bulgaria and Bosnia, which is probably due to their

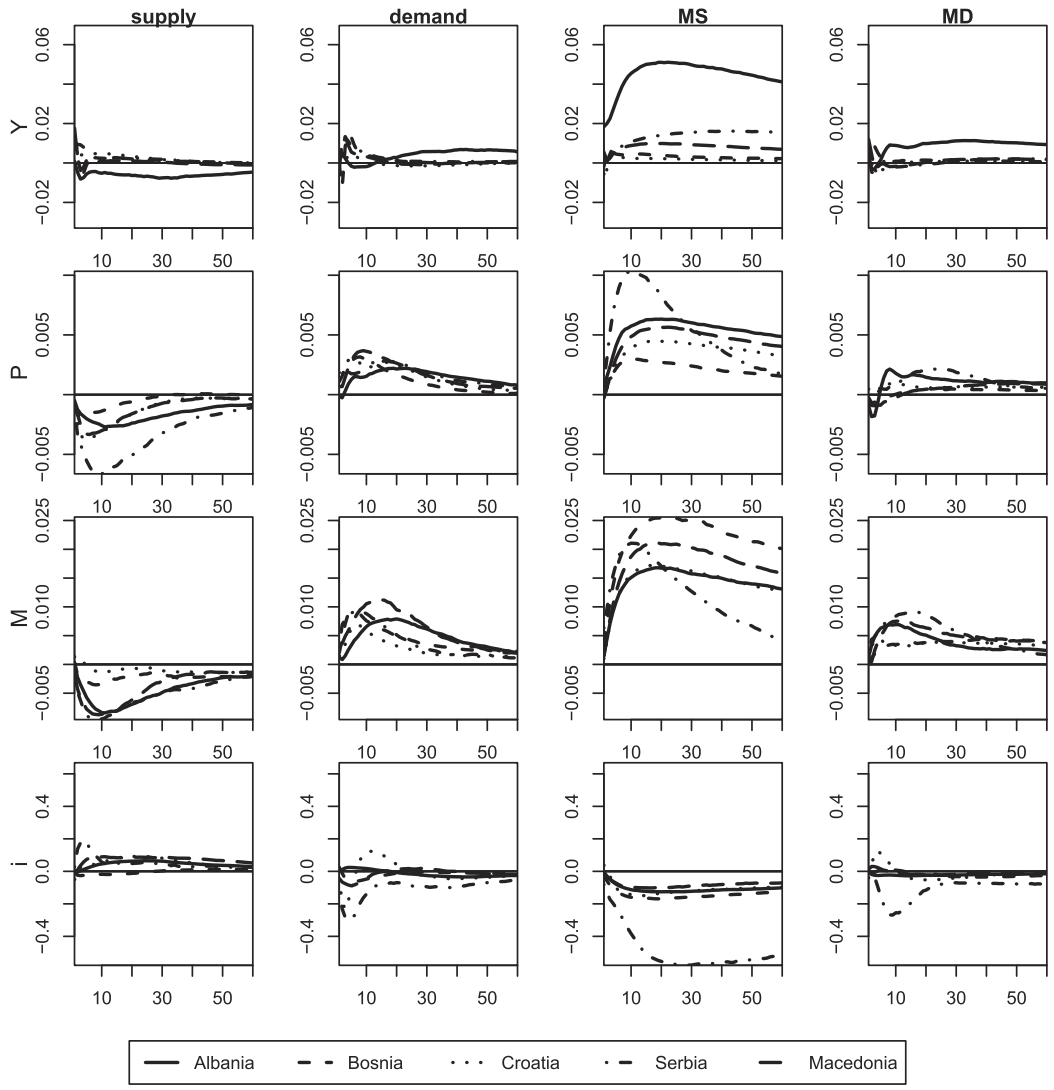

Fig. 7. Impulse response functions following Euro Area shocks (Western Balkans).

currency board arrangements. This monetary regime pegs the currency to the euro and imposes drastic limitations on the scope of domestic monetary policy, depriving countries of a mechanism to mitigate external shocks. Accordingly, currency boards facilitate the smoother transmission of EA monetary shocks in CEE. Furthermore, in Serbia the impact of the domestic monetary shock rivals the foreign one, although the former peaks earlier and fades away faster. But other differences are rather negligible. Previous studies have shown that banks in CEE exhibit a stronger reaction to changes in EA short-term interest rates than to domestic monetary policy shifts (Schmitz, 2004). Our results in the third column of Figs. 7 and 8 indicate that the domestic interest rate in the majority of CEE countries drops in response to the EA monetary shock and persists at lower levels over the sample period.

Due to differences in methodology, sample composition, and the period under consideration as well as our focus on monetary aggregates, our results are not directly comparable to the existing research on the spillover of EU shocks to CEE. Nevertheless, the broad conclusions of our analysis are in line with the literature. For instance, Moder (2017) reports pronounced spillover effects on prices and, to a lesser extent, output but a relatively weak response of the interest rates in the countries of the Western Balkans, which is similar to our findings. In the same vein, Potjagailo (2017) shows that output increases and interest rates decline in a sample of non-EA EU countries from CEE in response to a foreign expansionary monetary shock. However, in her analysis prices either do not respond or even decline, which contradicts our results. Lastly, Colabella (2019) also demonstrates the effects of EA monetary tightening on output and interest rates in a sample of Western Balkan and EU member states in CEE, which concur with the patterns revealed by our investigation.

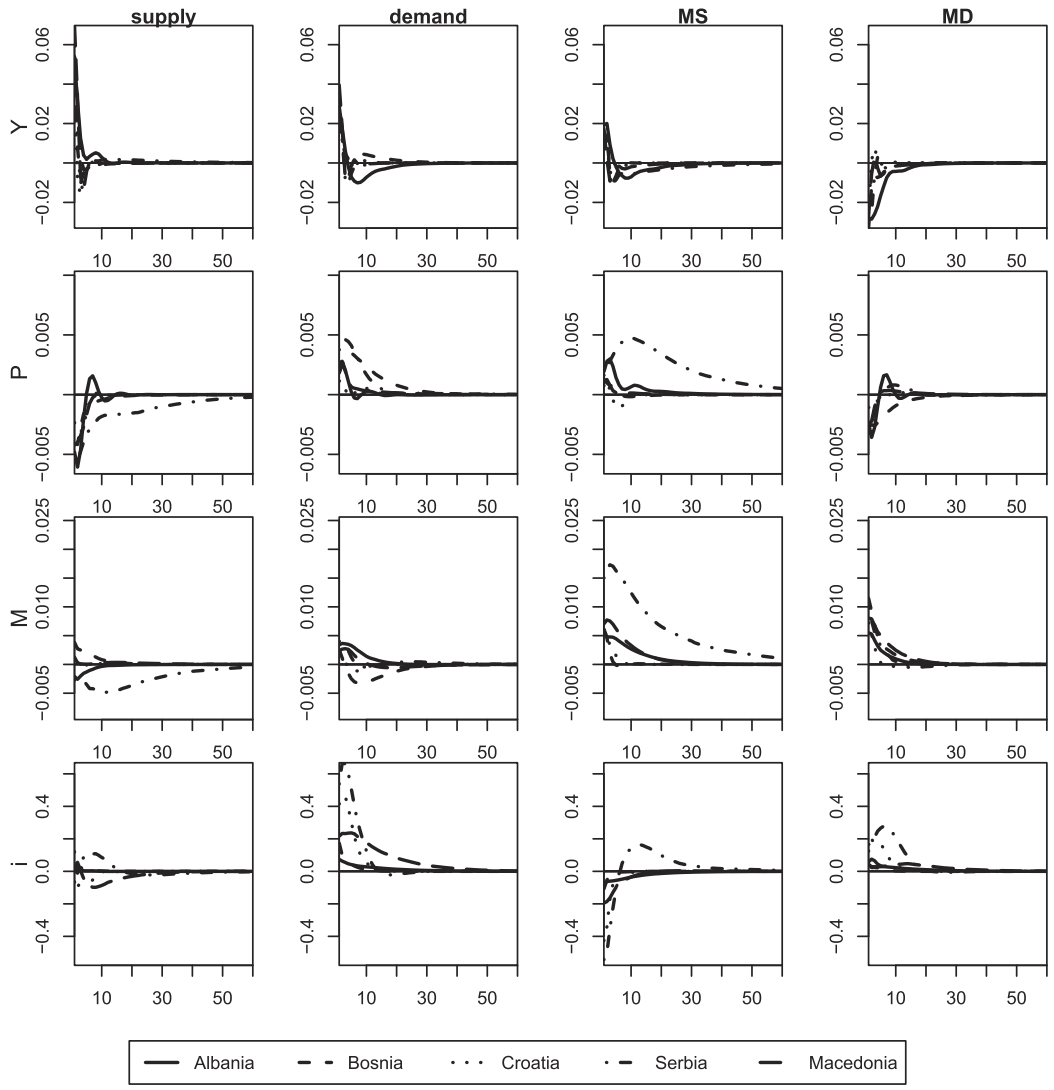

Fig. 8. Impulse response functions following domestic shocks (Western Balkans).

4.2. Transmission channels

The transmission channels for EA spillovers in CEE are a key issue that requires further investigation. In line with the literature, we focus on openness, financial integration, and exchange rate regimes as potential channels facilitating the international transmission of monetary shocks. Our analysis relies on relevant statistical measures presented in Table 2.

Monetary policy affects trade and investment, which in turn have an impact on the economies involved. An expansionary monetary shock in the EA stimulates import demand, boosting exports and output in CEE. In a similar vein, an increase in the EA's money supply may lead to larger outward FDI flows that further promote economic activity in CEE. Accordingly, a more open economy is likely to experience a larger spillover effect. The two measures of openness we use are CEE's trade (i.e., sum of exports and imports) with EA and CEE's inward FDI stock from EA, both expressed as percentage of GDP.[4]

The first two columns of Table 2 indicate that the five EU members in the sample exhibit considerably higher levels of openness vis-à-vis the EA than the Western Balkans. Although most CEE countries are small open economies, EU membership results in trade and investment openness that is on average roughly twice as high. As predicted, the output of EU members in the sample reacts much stronger to a EA monetary shock (Fig. 5) when compared to the Western Balkans (Fig. 7), providing evidence of the transmission properties of trade and investment between CEE and EA.

[4] The EA here is limited to the member states that joined before 2007 (i.e., excludes CEE countries that have adopted the euro). Data on trade flows and FDI stock were obtained from IMF's Direction of Trade Statistics database and the wiiw FDI database, respectively.

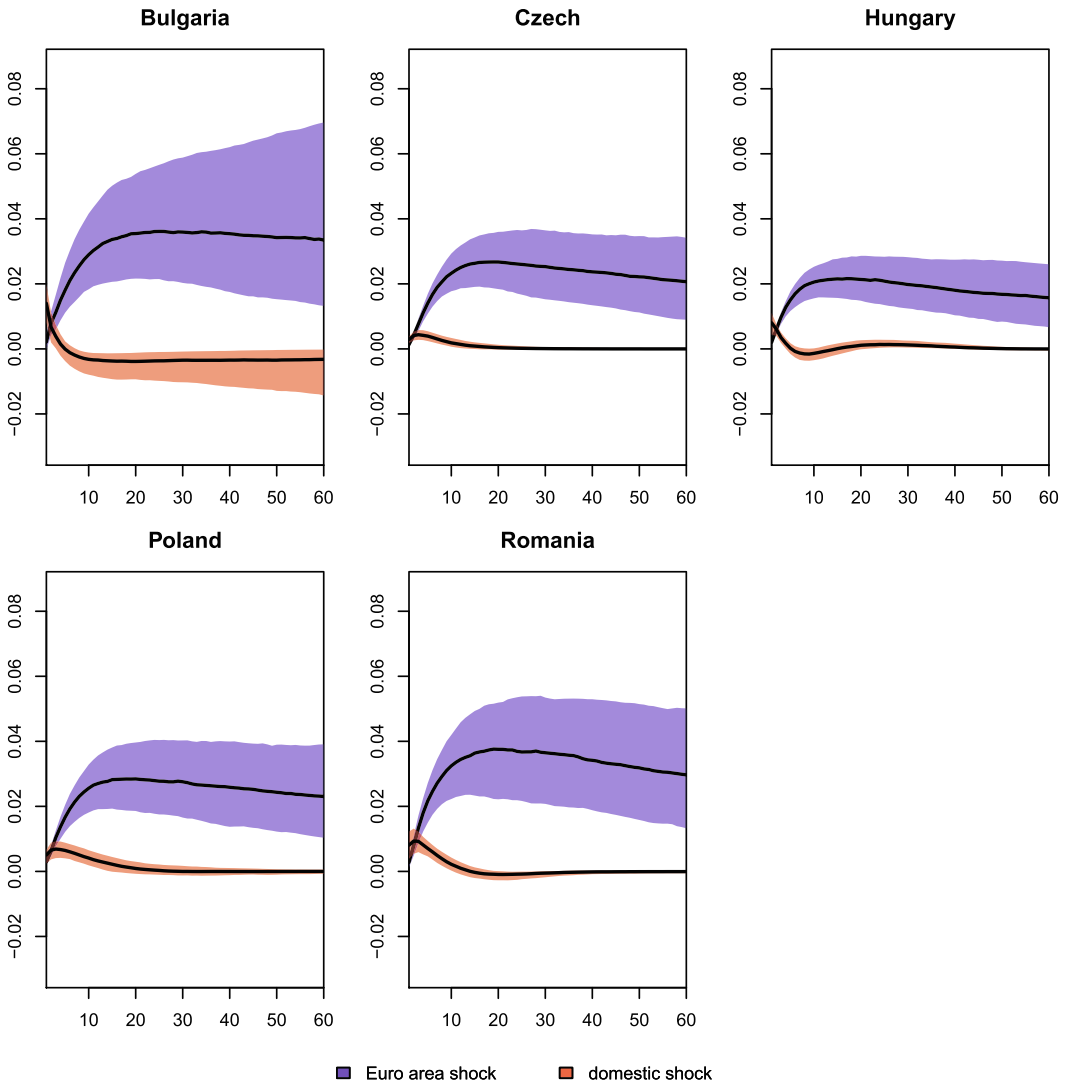

Fig. 9. Impulse response functions of money after monetary policy shocks (EU members). *Note:* Shaded areas reflect 68% confidence bounds.

Exchange rates also play an important role with fixed regimes, in general, facilitating international spillovers while flexible arrangements mitigate their transmission. For instance, EA's growing demand for CEE's goods and investment opportunities triggered by expansionary monetary policy leads to an appreciation of CEE's floating exchange rates, which, in turn, dampens exports and inward FDI flows (Potjagailo, 2017). The last column of Table 2 shows that almost all EU states in the sample have floating exchange rates, while the majority of the Western Balkans have adopted fixed arrangements. The mitigating effect of the flexible exchange rate can be seen in the output's IRFs for Czechia and Hungary in Fig. 5. Being the most open economies in the sample, their output initially surges before a decline sets in after about a year following the shock. By contrast, in Bulgaria, which has a currency board, we observe much more persistent spillovers to output.

The interest rate channel and the bank lending channel are also likely to serve as transmission avenue for the EA monetary impulse. The process is especially facilitated by the fact that the banking sector in CEE is dominated by foreign-owned banks with parent institutions in the EA. These banks are much more responsive to EA monetary policy changes than their domestically-owned competitors (Schmitz, 2004) to the point where the importance of host-country macroeconomic variables is eclipsed by the condition of the parent bank, which is directly affected by EA shocks (Arakelyan, 2018). We use two measure to assess the role of financial intergation: (1) the share of foreign banks in total bank assets, and (2) the sum of claims and liabilities of EA banks, including their subsidiaries and branches in CEE, as a percentage of GDP.[5]

[5] The data on foreign bank assets comes from the World Bank's Global Financial Development database and the Raiffeisen Bank International's CEE Banking Report, while the data on claims and liabilities of EA banks in CEE was obtained from the BIS locational banking statistics.

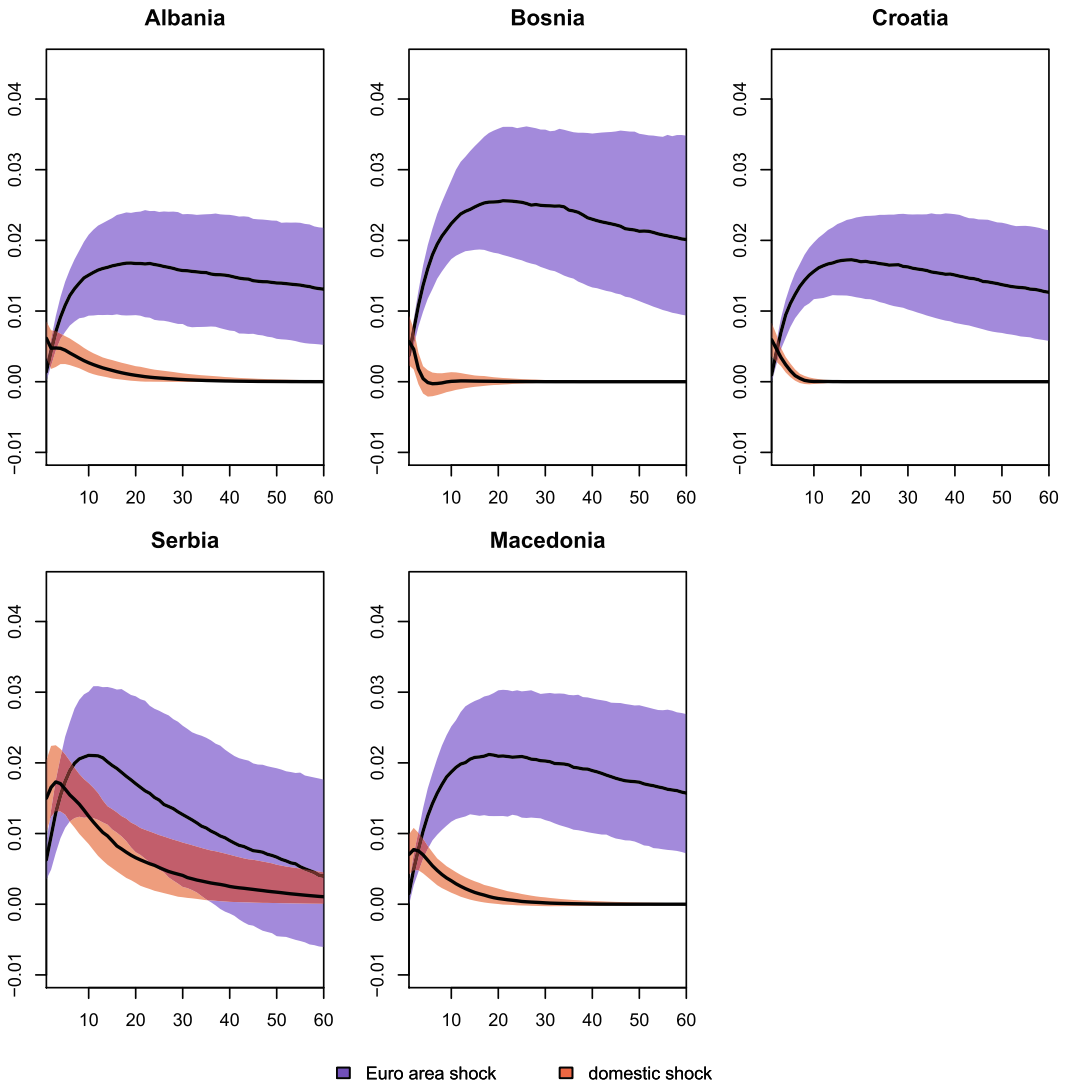

Fig. 10. Impulse response functions of money after monetary policy shocks (Western Balkans). *Note:* Shaded areas reflect 68% confidence bounds.

As the fourth column of Table 2 indicates, foreign banks (the majority of which are from the EA) dominate the financial sector in CEE with an average share of more than 70% of total assets for EU members and more than 80% for the Western Balkans. In terms of claims and liabilities of EA banks as a complementary indicator, EU states exhibit higher levels of financial integration with the EA than the Western Balkans, suggesting that the common market offers additional channels for cross-border financial flows. The IRFs provide some evidence for larger spillover effects on the short-run interest rates for more financially integrated countries. For instance, the effect for North Macedonia and Albania which are the least integrated is smaller than for Croatia or Bosnia, which claim the highest scores on both indicators. However, with foreign bank ownership being high in all our sample countries, this is no conclusive evidence.

With regard to monetary aggregates, the exchange rate regime seems to matter most, as countries with fixed arrangements like Bulgaria, Bosnia, and North Macedonia show the largest increases in response to a EA monetary shock. Given that various transmission mechanisms work simultaneously, Bulgaria and Bosnia also exhibit very high levels of trade and financial integration. By contrast, the weakest monetary response occurs in Hungary and Albania, which are complete opposites in terms of openness towards the EA but share the fact that both have a floating exchange rate.

In general, we find that our results are in line with the transmission channels for spillovers identified in the previous literature (Potjagailo, 2017; Colabella, 2019). While this does not allow us to identify the dominant channel(s) in this specific case, it bears witness to the plausibility of the results we find.

Table 2
Summary statistics of the transmission channels.

	Trade	FDI stock	Foreign banks claims/liab.	Foreign banks assets	Exchange rate
Bulgaria	46.8	49.7	86.4	75.7	fixed
	(4.4)	(6.7)	(28.2)	(5.0)	
Czechia	87.3	44.7	74.8	84.1	float
	(9.6)	(4.1)	(23.9)	(1.6)	
Hungary	82.2	46.9	96.0	57.6	float
	(7.6)	(6.4)	(45.4)	(8.9)	
Poland	43.8	29.7	49.4	68.6	float
	(4.5)	(3.8)	(5.9)	(9.7)	
Romania	37.2	27.9	54.0	83.7	float
	(3.3)	(4.1)	(22.2)	(9.0)	
average	**59.5**	**39.8**	**72.1**	**73.9**	
Albania	32.0	21.3	31.7	87.7	float
	(3.4)	(7.2)	(20.4)	(5.2)	
Bosnia Herz.	36.7	14.0	72.4	87.3	fixed
	(3.1)	(2.5)	(28.1)	(2.5)	
Croatia	34.3	33.8	130.0	90.1	fixed
	(5.5)	(7.5)	(36.3)	(0.5)	
N. Macedonia	45.9	21.8	46.8	64.0	fixed
	(8.3)	(3.7)	(15.2)	(5.4)	
Serbia	28.0	26.2	51.4	76.6	float
	(5.7)	(9.1)	(11.3)	(3.5)	
average	**35.4**	**23.4**	**66.5**	**81.1**	

Note: Averages across 2005–2018 period. Standard deviation in parentheses. Trade with Euro Area (exports and imports), FDI inward stock from Euro Area, and claims/liabilities of Euro Area banks are expressed in % of GDP. Assets of foreign banks are % of total bank assets in the country.

4.3. Robustness

The financial crisis Samples spanning the financial crisis are always prone to the criticism that it is the "outliers" during the crisis that are driving the key results. We therefore rerun our model, dropping the observations from October 2008 to early 2009 when the drop in industrial production happened. Our core results – in particular regarding the variance decomposition and the monetary policy shock – remain virtually unchanged.

Measuring money Similarly, choosing Divisia money as our preferred measure of money (or liquidity) is not the driving force behind the results. Replacing Divisia M_3 by its simple sum counterpart yields similar results both qualitatively and quantitatively.

5. Conclusions

Accession to the EU has been the ultimate acknowledgement of successful economic transition for CEE countries over the past 20 years. The closer integration with the European Common Market has opened up channels that facilitate the propagation of economic and financial shocks from the core EU economies to the eastern and south-eastern periphery. On the one hand, this process is a key component in the creation of a single economic and monetary union. On the other hand, it increases the vulnerability of the relatively small CEE economies to external shocks, making it difficult to implement domestic economic policies.

The literature on the spillovers of EA shocks has shown that economic and monetary decisions in the EA have, in general, a profound effect on the periphery, and CEE in particular. Existing research has focused on comparisons between the effect of a shock on EA itself and the spillover effect on CEE, showing that the impact on certain nacroeconomic variables in the region is even stronger than for EA countries. This paper takes a different approach by comparing the effects of the external shock to the corresponding domestic equivalent, thus allowing us to gauge the influence of domestic policies relative to spillovers from the EA. Moreover, we follow the literature by simulating various shocks and examining the outcomes for different macroeconomic variables, such as output, prices, and interest rates, but our focus is on the effects of external and domestic monetary policy on the macroeconomy in CEE, and on the monetary aggregates in particular. For this purpose, we calculate Divisia monetary aggregates for 10 CEE countries and employ them in a bilateral restricted VAR framework using monthly data over the period 2005–2018.

Our results indicate that EA shocks explain the majority of variation across all four macroeconomic indicators considered (output, prices, money, and the interest rate), with money supply shocks playing the most prominent role. In general, the share of domestic shocks is markedly larger for the Western Balkans than for the EU member states, resulting from the deeper integration with the EA in the case of the latter. Furthermore, in the EU sample, around 80% of the variation in output and money is explained by external shocks, while interest rates seem to be less susceptible to foreign influences. In the Western

Balkans sample, money and prices seem to be dominated by foreign spillovers in contrast to output and interest rates which are mostly determined domestically. The most interesting finding is that despite heterogeneity across countries, the impulse response of monetary aggregates to domestic and EA monetary shocks is almost identical across the sample. The domestic shock starts out stronger than the external one but dies out very quickly, returning to zero by the end of the first year. By contrast, the impact of the EA shock increases over time, exceeding the impact of the domestic shock after roughly a quarter and exhibiting relatively high persistence over the forecast horizon.

Based on our findings, we can conclude that the monetary policy of the ECB has profound effects on CEE economies. In particular, domestic liquidity is determined to a large extent by external factors, while domestic money supply plays a trivial role. Aside from currency board arrangements in some countries, this is most likely the result of foreign-owned banks dominating the domestic financial sector in CEE and serving as a channel for the transmission of EA monetary shocks. This has far-reaching implications, especially for countries trying to conduct discretionary monetary policies aimed at achieving certain economic goals or inflation targets. Our results suggest that this is more or less futile, if domestic monetary policy changes coincide with moves by the ECB. Accordingly, CEE countries will likely have no alternative to an even tighter integration with the EA, in the hope that prospective convergence and business cycle synchronization will dampen potentially adverse effects of EA shocks.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.jimonfin.2021.102501.

References

Altavilla, C., 2004. Do EMU Members Share the Same Business Cycle? J. Common Market Stud. 42 (5), 869–896.

Anderson, R.G., Jones, B., 2011. A Comprehensive Revision of the Us Monetary Services (Divisia) Indexes. Federal Reserve Bank of St. Louis Review 93 (September/October 2011).

Arakelyan, A., 2018. Foreign Banks and Credit Dynamics in CESEE, IMF Working Papers 18/3. International Monetary Fund.

Arias, J.E., Rubio-Ramírez, J.F., Waggoner, D.F., 2018. Inference Based on Structural Vector Autoregressions Identified with Sign and Zero Restrictions: Theory and Applications. Econometrica 86 (2), 685–720.

Babecka Kucharcukova, O., Claeys, P., Vasicek, B., 2016. Spillover of the ECB's Monetary Policy Outside the Euro Area: How Different is Conventional from Unconventional Policy? J. Policy Model. 38 (2), 199–225.

Barnett, W.A., 1978. The User Cost of Money. Econ. Lett. 1 (2), 145–149.

Barnett, W.A., 1980. Economic Monetary Aggregates: An Application of Index Number and Aggregation Theory. J. Econometrics 14 (1), 11–48.

Barnett, W.A., Chauvet, M., 2011. How Better Monetary Statistics Could have Signaled the Financial Crisis. J. Econometrics 161(1), 6–23. Measurement with Theory.

Barnett, W.A., Liu, J., Mattson, R.S., van den Noort, J., 2013. The New CFS Divisia Monetary Aggregates: Design, Construction, and Data Sources. Open Econ. Rev. 24 (1), 101–124.

Barnett, W.A., Tang, B., 2016. Chinese Divisia Monetary Index and GDP Nowcasting. Open Econ. Rev. 27 (5), 825–849.

Belongia, M.T., Ireland, P.N., 2014. The Barnett Critique after Three Decades: A New Keynesian Analysis. J. Econometrics 183 (1), 5–21.

Belongia, M.T., Ireland, P.N., 2015. Interest Rates and Money in the Measurement of Monetary Policy. J. Bus. Econ. Stat. 33 (2), 255–269.

Bencik, M., 2011. Business Cycle Synchronisation between the V4 Countries and the Euro Area, Working and Discussion Papers WP 1/2011. Research Department, National Bank of Slovakia.

Benecka, S., Fadejeva, L., Feldkircher, M., 2018. Spillovers from Euro Area Monetary Policy: A Focus on Emerging Europe, Working Papers 2018/04. Latvijas Banka.

Benkovskis, K., Bessonovs, A., Feldkircher, M., Worz, J., 2011. The Transmission of Euro Area Monetary Shocks to the Czech Republic, Poland and Hungary: Evidence from a FAVAR Model, Focus on European Economic. Integration 3, 8–36.

Binner, J., Bissoondeeal, R., Elger, T., Jones, B., Mullineux, A., 2009. Admissible Monetary Aggregates for the Euro Area. J. Int. Money Financ. 28 (1), 99–114.

Binner, J., Chaudhry, C., Kelly, L., Swofford, J., 2018. Risky Monetary Aggregates for the UK and US. J. Int. Money Financ. 89, 127–138.

Brown, M., Stix, H., 2015. The Euroization of Bank Deposits in Eastern Europe. Econ. Policy 30 (81), 95–139.

Campos, N., Fidrmuc, J., Korhonen, I., 2019. Business Cycle Synchronisation and Currency Unions: A Review of the Econometric Evidence Using Meta-Analysis. Int. Rev. Financ. Anal. 61, 274–283.

Christiano, L.J., Eichenbaum, M., Evans, C.L., 1999. Monetary Policy Shocks: What Have We Learned and to What End? Handbook Macroecon. 1, 65–148.

Ciarlone, A., Colabella, A., 2016. Spillovers of the ECB's Non-Standard Monetary Policy into CESEE Economies, Questioni di Economia e Finanza (Occasional Papers) 351, Bank of Italy, Economic Research and International Relations Area.

Colabella, A., 2019. Do the ECB's Monetary Policies Benefit Emerging Market Economies? A GVAR Analysis on the Crisis and Post-Crisis Period, Temi di discussione (Economic working papers) 1207. Bank of Italy, Economic Research and International Relations Area.

Darvas, Z., 2015. Does Money Matter in the Euro Area? Evidence from a New Divisia Index. Econ. Lett. 133, 123–126.

De Haas, R., Korniyenko, Y., Pivovarsky, A., Loukoianova, E., 2012. Foreign Banks and the Vienna Initiative: Turning Sinners Into Saints?, IMF Working Papers 12/117. International Monetary Fund.

El-Shagi, M., 2017. Dealing with Small Sample Bias in Post-Crisis Samples. Econ. Model. 65, 1–8.

El-Shagi, M., -Shagi, forthcoming. When Does Monetary Measurement Matter (Most)? Macroecon. Dyn. 1–17 (forthcoming). 25 (1), 240–256.
El-Shagi, M., Kelly, L., 2019. What Can We Learn from Country-Level Liquidity in the EMU? J. Financ. Stab.
El-Shagi, M., Kelly, L.J., 2014. Liquidity in the Liquidity Crisis: Evidence from Divisia Monetary Aggregates in Germany and the European Crisis Countries. Econ. Bull. 34 (1), 63–72.
El-Shagi, M., Kelly, L.J., 2016. For They Know Not What They Do: An Analysis of Monetary Policy during the Great Moderation. Appl. Econ. Lett. 1–5.
Feldkircher, M., Gruber, T., Huber, F., 2017. Spreading the Word or Reducing the Term Spread? Assessing Spillovers from Euro Area Monetary Policy, Department of Economics Working Papers wuwp248. Vienna University of Economics and Business, Department of Economics.
Feldkircher, M., Huber, F., Moder, I., 2016. Modeling the Evolution of Monetary Policy Rules in CESEE. Focus Eur. Econ. Integrat. 1, 8–27.
Feyen, E., Letelier, R., Love, I., Maimbo, S., Rocha, R., 2014. The Impact of Funding Models and Foreign Bank Ownership on Bank Credit Growth: Is Central and Eastern Europe Different?. Policy Research Working Paper Series 6783. The World Bank.
Fidrmuc, J., Korhonen, I., 2006. Meta-Analysis of the Business Cycle Correlation between the Euro Area and the CEECs. J. Compar. Econ. 34 (3), 518–537.
Hajek, J., Horvath, R., 2016. The Spillover Effect of Euro Area on Central and Southeastern European Economies: A Global VAR Approach. Open Econ. Rev. 27 (2), 359–385.
Hancock, M., 2005. Divisia Money, Bank of England Quarterly Bulletin. Spring.
Horvath, R., Voslarova, K., 2017. International Spillovers of ECB's Unconventional Monetary Policy: The Effect on Central Europe. Appl. Econ. 49 (24), 2352–2364.
Jimenez-Rodriguez, R., Morales-Zumaquero, A., Egert, B., 2010. The Effect of Foreign Shocks in Central and Eastern Europe. J. Policy Model. 32 (4), 461–477.
Keating, J.W., 1996. Structural Information in Recursive VAR Orderings. J. Econ. Dyn. Control 20 (9–10), 1557–1580.
Keating, J.W., Kelly, L.J., Smith, A.L., Valcarcel, V.J., 2019. A Model of Monetary Policy Shocks for Financial Crises and Normal Conditions. J. Money Credit Bank. 51 (1), 227–259.
Keating, J.W., Kelly, L.J., Valcarcel, V.J., 2014. Solving the Price Puzzle with an Alternative Indicator of Monetary Policy. Econ. Lett. 124 (2), 188–194.
Kim, H., 2013. Generalized Impulse Response Analysis: General or Extreme? EconoQuantum 10 (2), 136–141.
Lavrač, V., 1999. Inclusion of Central European Countries in the European Monetary Integration Process. In: De Grauwe, P., Lavrač, V. (Eds.), Inclusion of Central European Countries in the European Monetary Union. Springer, US, Boston, MA, pp. 105–118.
McQuade, P., Falagiarda, M., Tirpak, M., 2015. Spillovers from the ECB's Non-Standard Monetary Policies on Non-Euro Area EU Countries: Evidence from an Event-Study Analysis, Working Paper Series 1869. European Central Bank.
Moder, I., 2017. Spillovers from the ECB's non-standard monetary policy measures on south-eastern Europe, Working Paper Series 2095. European Central Bank.
Mountford, A., Uhlig, H., 2009. What Are the Effects of Fiscal Policy Shocks? J. Appl. Econometrics 24 (6), 960–992.
Pesaran, H.H., Shin, Y., 1998. Generalized Impulse Response Analysis in Linear Multivariate Models. Econ. Lett. 58 (1), 17–29.
Pesaran, M.H., Schuermann, T., Weiner, S.M., 2004. Modeling Regional Interdependencies Using a Global Error-Correcting Macroeconometric Model. J. Bus. Econ. Stat. 22 (2), 129–162.
Pesaran, M.H., Smith, R., 2006. Macroeconometric Modelling with a Global Perspective. Manchester School 74, 24–49.
Potjagailo, G., 2017. Spillover Effects from Euro Area Monetary Policy across Europe: A Factor-Augmented VAR Approach. J. Int. Money Financ. 72, 127–147.
Roaf, J., Atoyan, R., Joshi, B., Krogulski, K., af et al. (2014). 25 Years of Transition Post-Communist Europe and the IMF.Regional Economic Issues Special Report. Washington. DC: IMF 72.
Saborowski, C., Weber, S., 2013. Assessing the Determinants of Interest Rate Transmission Through Conditional Impulse Response Functions, IMF Working Papers 13/23. International Monetary Fund.
Schmitz, B., 2004. What Role Do Banks Play in Monetary Policy Transmission in EU New Member Countries. University of Bonn, Mimeograph.
Stracca, L., 2004. Does Liquidity Matter? Properties of a Divisia Monetary Aggregate in the Euro Area. Oxford Bull. Econ. Stat. 66 (3), 309–331.
Temesvary, J., Banai, A., 2017. The Drivers of Foreign Bank Lending in Central and Eastern Europe: The Roles of Parent, Subsidiary and Host Market Traits. J. Int. Money Financ. 79, 157–173.
Tullio, G., 1999. Exchange Rate Policy of Central European Countries in the Transition to European Monetary Union. In: De Grauwe, P., Lavrač, V. (Eds.), Inclusion of Central European Countries in the European Monetary Union. Springer, US, Boston, MA, pp. 63–104.
Uhlig, H., 2005. What Are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure. J. Monetary Econ. 52 (2), 381–419.
van der Haegen, P., Thimann, C., 2002. Monetary Policy Challenges in Transition and Toward Accession. In: Tumpel-Gugerell, G., Wolfe, L., Mooslechner, P. (Eds.), Completing Transition: The Main Challenges. Springer, Berlin, Heidelberg, pp. 161–184.
Wu, J.C., Xia, F.D., 2016. Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound. J. Money Credit Bank. 48 (2–3), 253–291.