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Third Round of the Euro Area Enlargement: Are the Candidates Ready?

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Third Round Of The Euro Area Enlargement: Are The Candidates Ready?*

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Abstract

In this paper, we study the readiness of Bulgaria, Croatia and Romania to adopt common monetary policy of the ECB in the context of the third round of the euro area enlargement. Following later stages of the Optimal Currency Area (OCA) theory we focus on the coherence of economic shocks between candidate countries and the euro area and analyse the relevance of euro area shocks for key macroeconomic variables in these countries. Our results, based on a novel empirical approach, show that overall importance of those shocks that are relevant for the ECB is fairly similar in candidate countries and the euro area. The cost of joining the euro area should, therefore, not be pronounced, at least from the aspects of adopting the common counter-cyclical monetary policy. This conclusion holds for all three candidates, despite important differences in monetary and exchange rate regimes.

JEL classification: E32, E52, F45

Keywords: euro area enlargement, economic shocks, BVAR, common monetary policy, Mundellian trilemma

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1 Introduction

The euro area enlargement is an ongoing process. After the first eleven countries adopted the euro in 1999 and Greece joined the euro area in 2001, the second round of enlargement started with Slovenia in 2007 and ended with the euro adoption in Lithuania in 2015. Today, euro area counts nineteen countries, with more than 340 million people and contributes with around sixteen percent to total world output.

At the twentieth anniversary of the euro, the EU officials intensified discussion on the third round of the enlargement as Bulgaria, Croatia and Romania started with preparations to join the Exchange Rate Mechanism (ERM II) and the euro area in the near future. The ERM II is a so-called *euro waiting room*, where candidate countries have to prove their ability to keep macroeconomic and fiscal stability for at least two years prior to joining the euro area. Croatia adopted the Strategy for euro adoption in 2017 (Eurostrategy, 2017), Bulgaria sent the letter on the ERM II participation in 2018 and Romanian officials set the date for the euro area membership in 2024 and organised a commission for euro adoption. The three candidates, all small open economies[1], have thus clearly expressed their willingness to join the euro area. On the other hand, there is a lack of more formal evidence in literature on their (in)capability to smoothly adopt the common currency and monetary policy of the European Central Bank (ECB).

The aim of this paper is, therefore, twofold. First, to provide a broader analytical background to the discussion on the third round of the euro area enlargement in general. Second, to address the readiness of the three candidate countries to adopt the euro and common monetary policy of the ECB. Here, we focus on the key aspect of the euro area enlargement for candidate countries and study the potential costs of the loss of monetary sovereignty in these countries. More precisely, we are interested in whether common countercyclical monetary policy of the ECB is likely to be suitable for these countries once they join the monetary union. This question is even more interesting as these countries

[1] Stylised facts on these economies are discussed in Appendix A.

are small open economies with free capital flows and they all have different exchange rate regimes. According to the IMF classification, Bulgaria operates under the regime of currency board (EUR), Croatia implements stabilized arrangement with exchange rate anchor (EUR) and Romania pursues inflation targeting strategy, with (managed) floating exchange rate (EUR).

In order to study the readiness of the three economies to adopt the common monetary policy of the euro area, we focus on the coherence of economic shocks between the euro area and euro candidate countries and, therefore, build on the literature on the Optimum Currency Area (OCA) theory. The similarity of shocks, and policy responses to these shocks, is almost a *catch all* OCA property, or *meta* property, capturing the interaction between several other properties characterizing an optimal currency area, such as business cycle synchronization, similarity of economic structure or flexibility and movement of factors of production (Mongelli, 2000). For that reason we deeply investigate the importance of those shocks that are relevant for the ECB's monetary policy decisions ("ECB - relevant shocks") to macroeconomic developments in euro candidate countries.

Common monetary policy is suitable for all members in a monetary union only if economic shocks and their macroeconomic effects in both joining and participating countries are sufficiently similar. In other words, those shocks that dominantly drive the business cycles in participating countries should also play an important role for economic developments in candidate countries. The counter-cyclical monetary policy of the ECB would then successfully smooth out their business cycles. In that case, the loss of an independent monetary policy should not cause any significant costs, at least from the aspect of the appropriate counter-cyclical monetary policy. However, the costs related to giving up the autonomous monetary policy may well depend on the exchange rate regime. This paper thus formally addresses four main questions:

1. Do standard economic shocks hitting the euro area have similar effects on three candidate countries?

2. How important are shocks relevant for ECB policy making process for three candidate countries?

3. Do monetary policy shocks of the ECB have the expected counter-cyclical effects on euro candidate countries?

4. Does the exchange rate regime matter for the transmission of euro area shocks to candidate countries?

To address these questions we rely on a structural Bayesian VAR (BVAR) model. A number of domestic and euro area structural shocks is identified by imposing a large number of rather uncontroversial short run and long run sign and zero restrictions. Such a model, if sufficiently *rich*, is suitable to assess a relative importance of domestic and euro area shocks for the candidate countries and therefore to address the readiness of these countries to adopt the common monetary policy of the ECB.

The main finding of our paper is that euro area (rather than country-specific) shocks play a dominant role for fluctuations of output and consumer inflation in Bulgaria, Croatia and Romania. Such results indicate that common monetary policy could be suitable for these countries once they adopt the euro. However there are some differences between the three countries. Contribution of common shocks to GDP and inflation is stronger and more similar to euro area in Bulgaria and Croatia than it is the case of Romania. This can, at least partially, be attributed to the fact that Romania is the only country among the three that operates under floating exchange rate regime. However, the contribution of euro area shocks to developments of macroeconomic variables in Romania is far from negligible, suggesting that the cost of the loss of monetary sovereignty could be less pronounced than the standard Mundellian trilemma theory suggests. Regarding the macroeconomic effects of the ECB policy shock, our results show that the effects of monetary policy shocks in Bulgaria, Croatia and Romania are similar to those in the euro area, which additionally supports the view that common monetary policy can be suitable for these countries. Finally, although the main focus of our paper is clearly on the three candidate countries, in order to position our results in a broader context we compare their similarities with the euro area to those of the other non-euro area EU members - Czechia, Denmark, Hungary, Poland, Sweden and the UK. Our results support the view that all the countries under analysis share a large amount of common shocks with the euro area. Contribution of common shocks to developments of both, GDP and inflation, is however less pronounced in those with *floating* exchange rate regimes, which supports the view that floating exchange rates can act like shock absorbers in most of these countries (Farant and Peersman, 2006; Artis and Ehrmann, 2006; Audzei and Bradzik, 2018).

This paper contributes to related literature along several directions. Most importantly, this is the first in-depth analysis of the readiness of the three candidate countries to adopt the common ECB monetary policy in the context of the third round of the euro area enlargement. Secondly, instead of only comparing the correlations of shocks (as in e.g. Bayoumi and Eichengreen 1992, 1993 and 1994) or relative importance of the euro area shocks for candidate countries (e.g. Mackowiak, 2006; Peersman 2011; Hanclova, 2012) we propose a methodology based on historical decomposition to directly compare *the overall importance* of shocks relevant for ECB policy decisions for macroeconomic variables in candidate countries and the euro area. Focusing on the results of historical decomposition, and not only the correlation of structural shocks, we take into account the importance of the transmission mechanisms of structural shocks to the economy. Regarding our identification scheme, in contrast to related literature, it is purposely rather loose - we impose no restrictions onto how domestic variables react to euro area shocks. Such a modelling decision to *make the data speak freely* makes these estimates less dependent on the imposed restrictions and thus clearly more reliable. Finally, we also analyse whether differences in the relevance of external shocks for non-euro EU economies can be explained by their exchange rate regimes thus contributing to the literature on the role of exchange rates as shock absorbers or shock propagators. However, in contrast to a standard approach of

Clarida and Gali (1994) who study the main sources of variation in exchange rates, here we take a different approach. For each country we first estimate the relative importance of foreign shocks for domestic macroeconomic developments and then look at how this statistics differs across countries with different exchange rate regimes and with various degrees of exchange rate volatility. Thus, we contribute to the literature focusing on the relation between transmission of external shocks and exchange rate regimes (e.g. Canova, 2005; Iossifov and Podpiera, 2012).

2 OCA theory, external shocks and exchange rate regimes

The aim of this section is to position our research questions in a broader context of international macroeconomics and explain our choice of methodology to address these questions.

Following the literature in later stages of the OCA theory (e.g. Bayoumi and Einhengreen 1992, 1993, 1994; Frankel and Rose 1997, Mongelli 2002) in this paper we emphasize the importance of coherence of economic shocks in context of the loss of the autonomous monetary policy as the most important cost of euro adoption for joining countries (Eudey 1998). OCA theory postulates that this cost should not be pronounced provided economic shocks within the monetary union are sufficiently coherent. This is because the coherence of economic shocks can be seen as a "catch all" property of OCA (Mongelli, 2002) as it captures the interaction between several OCA properties, such as business cycle synchronisation, mobility of factors of production, similarity of economic structures etc. Thus, coherence of economic shocks suggests that common monetary policy could be suitable for all countries in the monetary union. In addition, the OCA theory posits that the cost of losing autonomous monetary policy is low for those countries in which economic activity is mostly driven by the same shocks also driving economic developments in the monetary union. For example, if a euro candidate country is predominantly affected by the same economic shocks as the euro area and if these shocks affect the two economies in a similar fashion, the common monetary policy can then be adequate for all countries. On the other hand, if economic activity in a joining country is predominantly driven by some country-specific shocks, common monetary policy could be less effective or even counter-productive in that case.

To take these considerations into account we need to be able to isolate domestic (idiosyncratic) shocks from those generated abroad (in a monetary union or globally). Those external shocks are of special interest for this analysis - these are the shocks that the ECB generally reacts to and calibrates the monetary policy accordingly, i.e. the ECB - relevant shocks. We rely on a structural BVAR to study the importance of these shocks for the three candidate countries. First, we study how these shocks affect candidate countries. In case they are also important for their economies we may label them as - common shocks. Once we have the common shocks identified, we compare the overall importance of these shocks for candidate countries to that for the euro area. If the same economic shocks drive both economies in a similar way, we conclude that common monetary policy could be suitable for both countries, just as the OCA theory suggests.

By focusing on the relevance of external shocks we also complement the literature that investigates the role of external shocks for economic dynamics in small open European economies, still outside the euro area. Results in this strand of literature mostly suggest that euro area shocks play important role for economic activity in countries like Czechia, Hungary, Poland and Slovakia (Mackowiak, 2006; Horváth and Rusnák, 2009; Hanclova, 2012) and that the cost of euro adoption would not be pronounced in these countries (Mackowiak, 2006). In this paper we join this discussion but we are taking a step further by asking whether differences in the contribution of external shocks to domestic economies between non-euro area countries can be explained by different exchange rate regimes.

This leads us to the old debate on the characteristics of fixed vs flexible exchange rate regimes (McKinnon 1963; Giersch 1973; Ishiyama 1975). This literature views fixed exchange rates as direct propagators of external shocks to small open economies, while flexible exchange rates can serve as shock absorbers. Standard approach to the examination of characteristics of exchange rates as shock absorbers or shock propagators is based on structural decomposition of exchange rate developments on contributions of real shocks and nominal shocks (Clarida and Gali, 1994; for CEE Audzei and Bradzik, 2018). Although our model allows us to follow this strand of literature, in this paper we take a different approach and compare the contributions of common shocks in Bulgaria and Croatia to those in Romania and study whether the contribution of common shocks is more pronounced in former countries (pegger and quasi pegger) than in the latter (floater). To give more rigor to our conclusions we expand the analysis to some other non-euro area peggers (Denmark) and floaters (Czechia, Hungary, Poland, Sweden and the UK) and analyse whether there is a link between variability of the nominal exchange rate and contribution of common shocks to GDP and inflation. For example, Iossifov and Podpiera (2012) showed that spillovers of euro area inflation are more pronounced in non-euro area countries with more rigid exchange rate regimes.

This literature is also closely related to the Mundellian trilemma that posits that choice of floating exchange rate regime, under free capital flows, allows the country to run an autonomous monetary policy (Obstfeld, Shambaugh and Taylor 2005). However, this propositions can be misleading if external shocks play important role in the economy of the floater. As Gosczek and Mycielska (2019) put it, full monetary policy autonomy in countries with floating regimes can be limited by exogenous factors, primarily global interest rates (fear of float argument) or by endogenous factors, such as strong trade and financial integration and business cycle synchronization which amplify the importance of external shocks in small open economies. Thus we interpret our results through the lenses of this challenging view for the Mundellian trilemma on global level (Aizenman, Chinn and Ito, 2016; Rey 2016) and European level (Gosczek and Mycielska, 2019).

Finally, after the analysis of the overall contribution of external shocks to GDP and inflation in candidate countries, we also focus on the macroeconomic effects of one particularly interesting shock for our analysis - ECB monetary policy shock. Thus, in this sense we also follow growing literature on the international transmission of the ECB monetary policy shocks that points to notable spillovers of monetary policy shocks from the euro area to non-euro area economies (e.g. Feldkircher, 2015; Potjagailo 2017 and Colabella 2019).

3 Methodology

In this section we briefly introduce structural VAR we rely on throughout the analysis. We also discuss the short run and long run sign and zero restrictions we impose in order to identify structural shocks.

3.1 Model - Structural BVAR for a small open economy

3.1.1 Basic facts on Structural VARs

General SVAR with k lags we use can be written in usual form:

$$A_0 y_t = \mu + A_1 y_{t-1} + \ldots + A_k y_{t-k} + \varepsilon_t, \qquad t = 1, \ldots, T. \tag{1}$$

where y_t is an $n \times 1$ vector of observed variables, the A_j are fixed $n \times n$ coefficient matrices with invertible A_0, μ is $n \times 1$ fixed vector and ε_t are structural economic shocks with zero mean and covariance matrix I_n. Reduced form VAR model is obtained from (1) by pre multiplying the equation by $(A_0)^{-1}$:

$$y_t = c + B_1 y_{t-1} + \ldots + B_k y_{t-k} + u_t, \qquad t = 1, \ldots, T, \tag{2}$$

where $B_j = A_0^{-1} A_j$, $c = A_0^{-1}\mu$ and $u_t = A_0^{-1}\varepsilon_t$.

Structural vector autoregression (SVAR) model is normally used to calculate the *impulse response function*:[2]

[2] See Killian and Lütkepohl (2017) for more details about SVARs.

$$\Psi_h = \frac{\partial y_{t+h}}{\partial \varepsilon_t}, \qquad h = 0, 1, 2, \ldots$$

where element $\psi_{jk,h}$ represents average response of variable j to shock k after h periods. The *historical decomposition* in a SVAR decomposes each endogenous variable in a model into contribution of each identified shocks. The contribution of shock k to variable j at period t and can be calculated as:

$$y_{jt}^k = \sum_{h=0}^{t-1} \psi_{jk,h} \cdot \varepsilon_{k,t-h}. \tag{3}$$

3.1.2 Block exogeneity assumption in a BVAR

A crucial assumption implemented in our VAR is that of block exogeneity - shocks originating in big economy (euro area) impact the small economy, but not the other way around.[3] Given the size of the euro area and the three candidate countries block exogeneity assumption seems plausible assumption for our application. To impose this restrictions let y_t^1 be vector of external (big country) variables and y_t^2 vector of domestic (small country) variables so y_t can be decomposed as $y_t' = [y_t^{1\prime}, y_t^{2\prime}]$.

In our applications, external block variables (y_t^1) are the same for all candidates and include: euro area GDP, euro area prices and measure of the ECB monetary policy stance. Monetary policy rate used is shadow rate constructed by Wu and Xia (2016) which corrects EONIA rate by taking into account unconventional monetary policy actions of the ECB. Variables included in domestic block (y_t^2) however depend on the exchange rate regime in the pertaining candidate countries which is discussed in the following section. Details on data used in our analysis can be found in Appendix B. VAR models used in our analysis are all specified in log differences and estimated at quarterly frequency on the period 2003Q1-2018Q2 using four lags. We experimented with several other number of lags which did not

[3] Papers investigating impact of foreign shocks to small open economies using these type of restrictions are Cushman and Zha (1997) and Krznar and Kunovac (2010) among many others.

change our results importantly.

Matrices A_j from (1) now must have block lower triangular form

$$A_j = \begin{bmatrix} A_{11}^j & 0 \\ A_{21}^j & A_{22}^j \end{bmatrix}, \qquad j = 0, \ldots, k, \tag{4}$$

and it can be shown that coefficients matrices B_j inherit this block exogeneity form so that

$$B_j = \begin{bmatrix} B_{11}^j & 0 \\ B_{21}^j & B_{22}^j \end{bmatrix}, \qquad j = 1, \ldots, k. \tag{5}$$

It is important to note that although (4) implies (5) the vice versa is not true. To get (4) from (5) we need additional assumptions on A_0 or equivalently $(A_0)^{-1}$ which is impulse response function at impact. We will impose restriction on $(A_0)^{-1}$ by setting restrictions that shocks originating in small economy cannot affect big economy at $t = 0$. The second part of block exogeneity implementation is to shut down the impact of small economy shocks on the external variables beyond the impact ($h = 1, 2, \ldots$) by implementing (5). To explain this implementation we write (2) in form more convenient for Bayesian simulation of reduced form parameters

$$y_t = X_t' \beta + u_t, \tag{6}$$

where $X_t' = I_n \otimes [1, y_{t-1}', \ldots, y_{t-k}']$ and $\beta = vec([cB_1 \ldots B_k]')$. We want to restrict elements of β that correspond to zero block in coefficient matrices (5). Within the Bayesian framework this can be achieved by assuming an appropriate prior distribution for restricted parameters. Usual choice of natural conjugate (Normal inverse Wishart) prior won't be suitable for this purpose as it assumes that the prior covariance of coefficients in any two equations are proportional to each other (see Koop and Korobilis 2010). However, Independent Normal inverse Wishart prior will serve the purpose because here prior beliefs for

VAR coefficients and error covariance matrix are set independently:

$$\beta \sim N(\underline{\beta}, \underline{V}_\beta), \qquad \Omega \sim IW(\underline{M}, \underline{\gamma}).$$

Conditional posterior distributions $p(\beta|y,\Omega)$ and $p(\Omega|y,\beta)$ for this prior have the following form

$$\beta|y,\Omega \sim N(\overline{\beta}, \overline{V}_\beta), \qquad \Omega|y,\beta \sim IW(\overline{M}, \overline{\gamma}),$$

where

$$\overline{V}_\beta = \left(\underline{V}_\beta^{-1} + \sum_{t=1}^{T} X_t \Omega^{-1} X_t' \right)^{-1}, \qquad \overline{\beta} = \overline{V}_\beta \left(\underline{V}_\beta^{-1} \underline{\beta} + \sum_{t=1}^{T} X_t \Omega^{-1} y_t \right)$$

and

$$\overline{\gamma} = T + \underline{\gamma}, \qquad \overline{M} = \underline{M} + \sum_{t=1}^{T} \left(y_t - X_t'\beta \right) \left(y_t - X_t'\beta \right)'.$$

A sample from the posterior of the reduced form parameters and residual covariance matrix is drawn by using a Gibbs sampler.

Now, to implement (5) we can assume zero mean priors with extremely small variance for all the small country parameters in every equation for the big country block, i.e. if we want to restrict j-th element of β we can set $\left(\underline{\beta}\right)_j = 0$ and $\left(\underline{V}_\beta\right)_{jj} = \varepsilon$ where ε is some small positive number (e.g. $\varepsilon = 10^{-9}$). This will put a dominant weight to the (zero mean) prior parameters when calculating posteriors. In this way sample information is largely ignored as the posteriors of these coefficients will be predominantly influenced by the prior. Other elements of $\underline{\beta}$ and $\underline{V}_\beta$ are set to shrink posterior parameters in spirit of Minnesota prior (see for example Robertson and Tallman 1999). Shrinking hyperparamters of Minnesota prior are set to $\lambda_1 = 100$, $\lambda_2 = 100$, $\lambda_3 = 2$ and $\lambda_4 = 10^4$, which suggests that we use loose priors.

3.1.3 Set-identification of structural shocks

At each step of our Gibbs sampler, given a draw of reduced form parameters, we recover a set of structural models satisfying imposed sign and zero restrictions. The sign and zero restrictions are imposed directly onto impulse response function by using a procedure proposed by Arias et al. (2014.). This algorithm may be efficiently implemented in our application where both block exogeneity assumption and standard sign restrictions are to be imposed. Arias et al (2018) also propose the updated version of the algorithm, but now fully specified under a Normal inverse Wishart prior only. As such, it cannot be adjusted easily to accommodate block exogeneity assumption - a feature of highest importance when modelling interactions between a small open economy and the rest of the world. For that reason we rely on the procedure proposed by Arias et al. (2014.) instead. In order to test whether the choice of the algorithm version (Arias et al. (2014.) or Arias et al (2018)) affects our results we run several specifications, without block exogeneity assumption, and compared the output from the two specifications. The results would always be almost identical, suggesting that the choice of the algorithm is not of a great importance in this case.[4]

4 Identification with sign and zero restrictions

Structural shocks are identified by imposing a number of sign and zero restrictions on the impulse response function in the short run and the long run. Identification strategy is largely based on the mainstream macroeconomic theory and the recent related literature (see for example Forbes et al. 2018, Bobeica and Jarocinski 2017 and Comunale and Kunovac 2017). Each shock belongs to one of the two main groups: external or domestic (country specific) shocks. External shocks by definition (i.e. imposed restrictions) affect the euro area. They may origin either in the euro area or globally (oil supply or global

[4] These are available upon request.

demand for example). For our purpose it is only important that these shocks affect the euro area and are thus relevant for the ECB - we label them jointly as *euro area shocks*. On the other hand, domestic shocks are country specific and are identified by imposing block exogeneity restrictions together with sign and zero restrictions. We impose no restrictions on how domestic variables react to euro area shocks and thus *let the data speak freely* in that regard. If, however, domestic variables do react to external shocks similarly as the euro area does we may also correctly label the external shocks as *common* shocks.

Identified euro area shocks are labelled *aggregate demand*, *aggregate supply* and *monetary policy shock*. In the short run, expansionary aggregate demand shock increases both economic activity and prices in the euro area. Monetary policy then acts counter - cyclically and raises the policy rate. In contrast, aggregate supply shock have the opposite effect on economic activity and prices in euro area - it raises GDP and lowers consumer inflation, while reaction of monetary policy here is left unrestricted. Finally, expansionary monetary policy shock increases both economic activity and inflation. As for the long run restrictions, we assume that aggregate demand and monetary policy shocks do not affect GDP in the long run.

For each of the three candidate countries we also identify several domestic shocks, depending on the monetary and exchange rate regime in these countries. Specifications for Croatia and Romania, in contrast to Bulgaria, which operates under currency board regime, include exchange rate[5] of domestic currency vis-à-vis euro. Also, Romania, in contrast to other two candidate countries, uses reference rate as a key monetary policy instrument and corresponding VAR thus includes domestic interest rate. For all countries of interest (Bulgaria, Croatia and Romania) we identify short run *domestic aggregate supply* and *domestic aggregate demand shocks* in similar fashion as for the euro area: correlation of economic activity and prices is positive in case of demand shock, and negative in case of supply shock. Regarding demand shock, we assume that this shock increases interest rate

[5] Appreciation of domestic currency is represented as decrease of exchange rate level.

Table 1: Restrictions for identification of structural shocks

					Short run			
k	Shocks/Variables	GDP_{EA}	$HICP_{EA}$	MP_{EA}	GDP_D	$HICP_D$	ER_D	MP_D
	External shocks							
1	Demand	+	+	+	?	?	?	?
2	Supply	+	–	?	?	?	?	?
3	Monetary policy	+	+	–	?	?	?	?
	Domestic shocks (BG)							
4	Demand	0	0	0	+	+		
5	Supply	0	0	0	+	–		
	Domestic shocks (HR)							
4	Demand	0	0	0	+	+	?	
5	Supply	0	0	0	+	–	?	
6	Exchange rate	0	0	0	?	+	+	
	Domestic shocks (RO)							
4	Demand	0	0	0	+	+	?	+
5	Supply	0	0	0	+	–	?	?
6	Exchange rate	0	0	0	?	+	+	+
7	Monetary policy	0	0	0	+	+	+	–
					Long run			
k	Shocks/Variables	GDP_{EA}	$HICP_{EA}$	MP_{EA}	GDP_D	$HICP_D$	ER_D	MP_D
	External shocks							
1	Demand	0	?	?	?	?	?	?
2	Supply	?	?	?	?	?	?	?
3	Monetary policy	0	?	?	?	?	?	?
	Domestic shocks (BG)							
4	Demand	?	?	?	0	?		
5	Supply	?	?	?	?	?		
	Domestic shocks (HR)							
4	Demand	?	?	?	0	?	?	
5	Supply	?	?	?	?	?	?	
6	Exchange rate	?	?	?	0	?	?	
	Domestic shocks (RO)							
4	Demand	?	?	?	0	?	?	?
5	Supply	?	?	?	?	?	?	?
6	Exchange rate	?	?	?	0	?	?	?
7	Monetary policy	?	?	?	0	?	?	?

Note: (+) = positive reaction; (-) = negative reaction; (0) = no reaction; (?) = reaction not restricted. All shocks are normalized as expansionary. All restrictions are set at impact. k refers to ordering of shocks in VAR models. Details about variables definition are given in table in the Appendix B.

for Romania as a counter-cyclical reaction of monetary policy. For Croatia and Romania we also identify *exchange rate shock* - exogenous depreciation of domestic currency raises domestic inflation (pass-through effect) in both countries and interest rate in Romania only. We do not impose any restrictions on the effects of domestic demand shocks on exchange rate as the literature related to these effects is inconclusive[6]. Finally, for Romania we identify *domestic monetary policy shock* similar to that in the euro area, additionally assuming that lower domestic interest rate depreciates domestic currency. Summary of our identification strategy is given in Table 1. As for the long run restrictions in the domestic block, we assume that aggregate demand (BG, HR, RO), exchange rate (HR, RO) and monetary policy (RO) shocks do not affect GDP in the long run.

4.1 Relative and overall importance of individual shocks based on historical decomposition

In this paper, importance of external shocks for domestic economies is quantified using several statistics based on the historical decomposition from the estimated VARs presented above. First, from historical decomposition (see (3), where y_{jt}^k represents contribution of shock k to variable j at period t, we define measure of the *relative importance* (in absolute terms) of some shock k to variable j at t as:

$$\widetilde{y_{jt}^k} = \frac{\left|y_{jt}^k\right|}{\sum_{l=1}^n \left|y_{jt}^l\right|}. \tag{7}$$

Now, our measure of *the overall importance* of external shocks ($k = 1, 2, 3$) for some domestic macroeconomic variable j at period t is the sum of contributions of these shocks:

[6] Rising domestic demand can lead to increase of money demand and thus appreciate domestic currency. On the other hand, stronger domestic demand can widen trade deficit, which puts depreciation pressures on domestic currency. With no restrictions on the effect of domestic demand on exchange rate it is hard to separate exchange rate shock from domestic demand shock (correlation between these shocks is pronounced). However, in our analysis we focus on the importance of external shocks and contribution of these shocks to developments of domestic macroeconomic variables is not affected by the structure of domestic shocks.

$$\sum_{k=1}^{3} \widetilde{y_{jt}^{k}}. \tag{8}$$

Second, to measure *the similarity of contributions* of some shock to a domestic (j) and corresponding euro area (j') variable (economic activity or prices) we look at the difference:

$$\widetilde{y_{jt}^{k}} - \widetilde{y_{j't}^{k}}. \tag{9}$$

This measure takes value of 0 if the contribution of respective shock in the euro are and euro candidate country are identical, meaning that all values close to 0 indicate pronounced similarity of these contributions.

5 Results

In this section we present and discuss results from the estimated structural BVARs. First, we report contributions of the euro area shocks to GDP and inflation developments in three candidate countries. After that we compare these contributions to those in the euro area. Based on these results, we elaborate on the adequacy of common monetary policy for euro candidate countries through the lenses of the OCA theory and discuss the differences among countries through the prism of the Mundellian framework. Next, in the context of the international monetary policy transmission, we report how the ECB monetary policy shock affects macroeconomic variables in three candidate countries.

5.1 Relevance of common shocks for candidate countries and similarity with the euro area

Impulse responses of all models together with 68% posterior error bands are given in Appendix B (Figures 6 - 8). They broadly suggest that the three countries do react to euro area shocks in the similar manner as the euro area and, thus, we may label these shocks as

- *common shocks.*

5.1.1 Overall contribution of common shocks to GDP and HICP

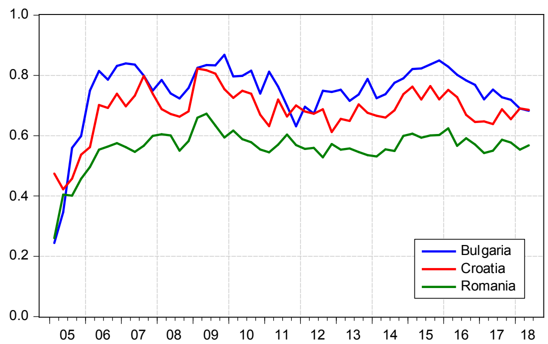
Figure 1 shows the overall contribution of common shocks (euro area AS, euro area AD and euro area monetary policy shock) to GDP (a) and consumer inflation (b) in euro candidate countries[7] calculated with equation (8). These estimates of our overall importance measure point to common shocks as dominant drivers of GDP and inflation developments in all three countries. Average contribution of common shocks to GDP is high and stands at around 70% in Bulgaria and Croatia and 60% in Romania. As for the HICP, share of common shocks is somewhat lower in all countries as CPI developments are determined by many idiosyncratic shocks such as VAT changes, administrative price changes etc. However, contributions are still pronounced as they contribute to HICP developments with around 65%, on average, in Bulgaria and Croatia, and 50% in Romania. In line with OCA theory, these results suggest that common monetary policy could be suitable for these countries once they join the euro area. Less pronounced contribution of common shocks in Romania could be, at least partially, attributed to different exchange rate regime, as discussed in previous sections.

Contributions of common shocks and exchange rate regimes In this section we are interested in potential differences in contributions of external shocks in countries with fixed exchange rate regime in comparison to countries which operate under floating exchange rate regime. Theoretically, one should expect transmission of external shocks to be stronger in countries which use fixed exchange rate or currency board regimes (Canova, 2005) as exchange rate cannot act as an absorber of external shocks. To put our results in a broader international context we also calculate the contribution of common shocks to GDP and inflation in some other EU countries that employ inflation targeting, with

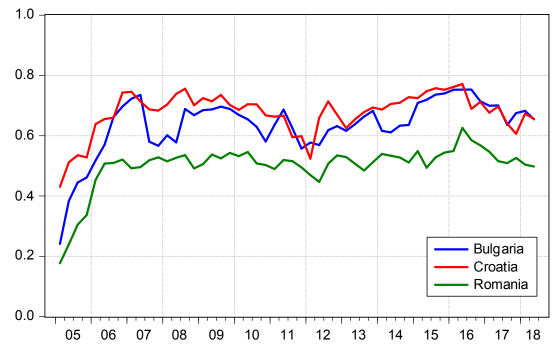
[7] Historical decompositions of GDP and HICP for all countries and 68% posterior error bands for contributions are shown on Figure 9 and Figure 10 in Appendix C.

Figure 1: Contribution of common shocks to GDP and HICP in euro candidate countries

(a) GDP



(b) HICP



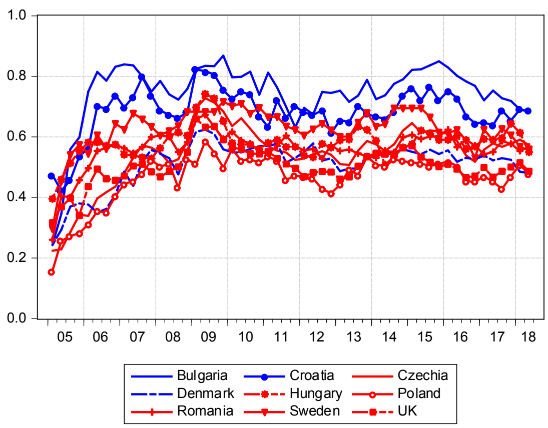
floating exchange rates - Czechia, Hungary, Poland, Sweden and UK and one more pegger, Denmark. Our results show that contribution of common shocks to developments of both, GDP and inflation, is less pronounced in *floaters.* This is illustrated on the lower and upper left panel of Figure 2, with countries which operate under floating exchange rate regimes marked with red lines and countries which operate under (quasi) pegged regimes with blue lines. To get a more insightful view on this matter, on the upper and lower right panel of Figure 2 we present the relation between exchange rate volatility and the relevance of common shocks for GDP and HICP developments in these economies[8]. Fitted line shows that countries with higher standard deviations of quarterly changes in exchange rate (red points) mostly tend to have less pronounced contribution of common shocks to GDP[9] and inflation. These conclusions are broadly consistent with views that floating exchange rates can be seen as shock absorbers in most of these countries (Audzei and Bradzik, 2018). However, although the contribution of common shocks in new EU member state floaters,

[8]Slope coefficients are statistically significant, with p-values standing at 0,06 for GDP and 0,004 for HICP.

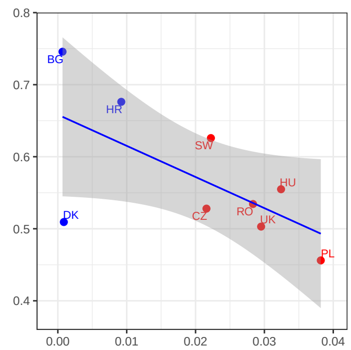
[9]The only outlier in the sample is GDP for Denmark, as contribution of euro area shocks in this *pegger* country is among the lowest in the group. This deviation can be explained by the fact that Denmark experienced volatile growth rates in the pre-crisis period (even with negative quarterly figures) and recorded a technical recession in 2017, due to some idiosyncratic one-offs (primarily some patent payments which increased volatility of the growth rate in first two quarters of the year and temporary bottlenecks in car sales due to changes in tax system in September)

Figure 2: Contribution of common shocks to GDP in (quasi) peggers and floaters

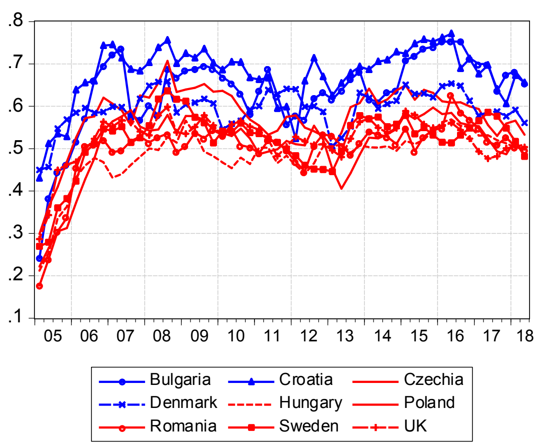
(a) Contributions to GDP



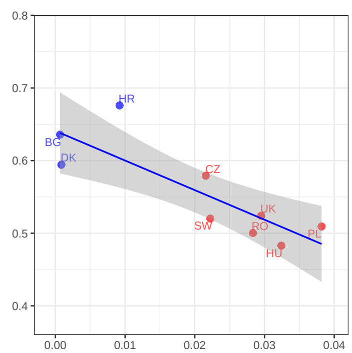
(b) Exchange rate volatility vs contributions to GDP



(c) Contributions to HICP



(d) Exchange rate volatility vs contributions to HICP



Note: Grey shaded area represents 95% error band for linear fit

Poland, Hungary and Czechia, is somewhat less pronounced in comparison to their peers with more rigid exchange rate regimes, Bulgaria and Croatia, this contribution is far from negligible. These findings are in line with related literature (Mackowiak, 2006; Horváth and Rusnák, 2009; Hanclova, 2012) and can serve as a framework for the discussion on euro adoption also in these countries. As Poland, Hungary and Czechia are obliged by their *Treaties of Accession to the European Union* to introduce the euro eventually this issue is relevant for policy makers despite the fact that current political atmosphere in these countries is not pro-euro oriented. Increasing financial and trade integration of these countries with the euro area and ongoing euro area reforms could bring this question on the top of policy agenda in the near future. Our results can be also interpreted in terms of global business (e.g. Kose, Otrok and Prasad 2012; Ductor and Leiva-Leon, 2016) and financial (Rey 2016) cycles synchronization literature which suggests that in the era of globalization and financial internationalization common global economic and financial shocks strongly affect economic developments and economic policy decision making process in small open economies.

5.1.2 Contribution of individual common shocks to GDP and HICP

Overall contribution of common shocks to developments of macroeconomic variables in euro candidate countries is rather informative statistics. However, in order to study the adequacy of common monetary policy in more detail we are also interested in the comparison between contribution of individual euro area shocks in euro candidate countries and the euro area. The reason for that is that the ECB will react only to those shocks with important effects on economic developments in the euro area as a whole. If the contribution of such shocks for a candidate country is very different from that for the euro area, the reaction of common monetary policy to these shocks would not be adequate or could even be counterproductive for a small candidate country. For example, if the ECB reacts to the euro area AD shock it is important that the contribution of this shock for macroeconomic

Table 2: Mean and standard deviations of the difference of contributions of common shocks to GDP and HICP

		BG-EA		HR-EA		RO-EA	
	Shock	mean	std. dev.	mean	std. dev.	mean	std. dev.
GDP	EA AD	-0.05	0.08	-0.10	0.05	-0.11	0.07
	EA AS	-0.10	0.08	-0.10	0.06	-0.20	0.09
	EA MP	-0.10	0.07	-0.10	0.05	-0.11	0.07
HICP	EA AD	-0.13	0.07	-0.13	0.06	-0.21	0.09
	EA AS	-0.10	0.06	-0.05	0.05	-0.15	0.07
	EA MP	-0.14	0.05	-0.11	0.05	-0.11	0.05

developments in the euro area and the euro candidate is as similar as possible. If the contribution of this shock in the euro area is much larger compared to that in a candidate country then the direction and/or intensity of the ECB's reaction may not be adequate for that country. These contributions are, expectedly, more pronounced in the euro area but they seem to be relatively similar across countries and over time (Figures 11 and 12 in Appendix B).

In order to compare the relevance of each shock in the euro area and candidate countries, Table 2 presents the mean and dispersion of the *similarity* of contributions of common shocks to GDP and inflation (see (9)). When the mean is equal to zero, there is evidence suggesting that two contributions of that shock are, on average, identical in the euro area and a candidate country. A negative mean, on the other hand, indicates that contributions of common shocks are, on average, higher in the euro area compared to candidate countries. Reported averages indicate that contributions of all shocks are, expectedly, more pronounced in the euro area in case of both, GDP and inflation. Contribution of common shocks to GDP is lower in the three countries compared to euro area - in Bulgaria and Croatia it is (on average) lower by 10pp and in Romania by 15pp. Maximum difference is found in case of contribution of common AS shock in Romania, standing at around 20pp. As for the inflation, differences are somewhat more pronounced, which is not surprising if we take into account various country-specific tax and administrative price changes that directly affect inflation dynamics in these countries. However, these differences are, in our view, still relatively modest. Contribution of common shocks to inflation is lower by around 12pp in Bulgaria, 10pp in Croatia and 14pp in Romania compared to the euro area. Maximum difference is again recorded in case of Romania, where the average contribution of common AD shock is lower by 21pp, on average, compared to contribution in the euro area. More pronounced differences in contributions of common shocks in case of Romania can also be interpreted in terms of different exchange rate regime compared to other two candidates. In addition to average differences, we also report standard deviations which are in all cases below 0.10, which suggests that dynamics of contributions of common shocks in the candidate countries and the euro area is relatively similar. Figures 11 and 12 in Appendix B show that changes in contributions of common shocks to GDP and inflation over time in euro candidate countries and the euro area are synchronized. Thus, these results also suggest that common monetary policy could be suitable for all countries.

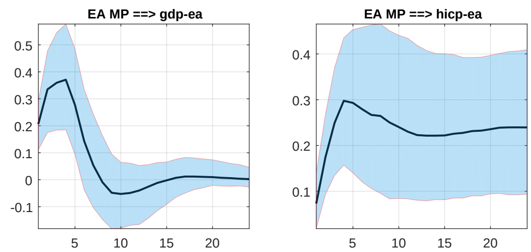
5.2 Effects of the ECB's monetary policy on macroeconomic variables in candidate countries

In previous sections we discussed the adequacy of common monetary policy by focusing on various aspects of the coherence of economic shocks. In this section we focus on the monetary policy and directly compare effects of the ECB policy actions on the euro area and candidate countries.

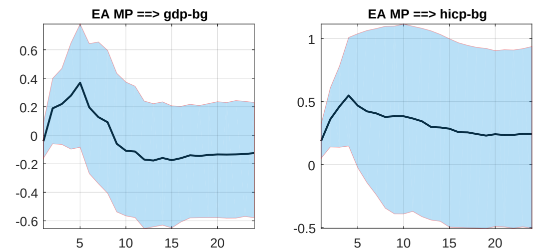
Figure 3 shows the estimated impulse response functions reflecting how expansionary ECB monetary policy shock affects the GDP and consumer inflation in candidate countries and the euro area. Importantly, impulse responses indicate that the effect of this shock among countries is fairly similar and our results are broadly in line with related literature (e.g. Feldkircher, 2015; Potjagailo 2017 and Colabella 2019). Similar response of GDP and inflation in the euro area and euro candidate countries reflects a strong role of the so-called trade channel in international monetary policy transmission (Potjagailo 2017; Iacoviello

Figure 3: Effects of the ECB monetary policy shock on GDP and inflation

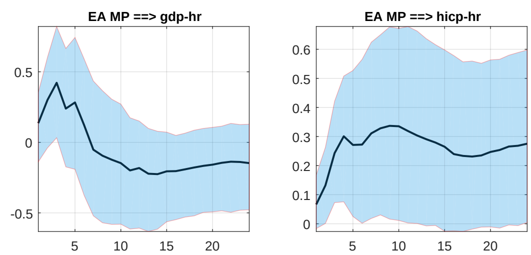
(a) EA



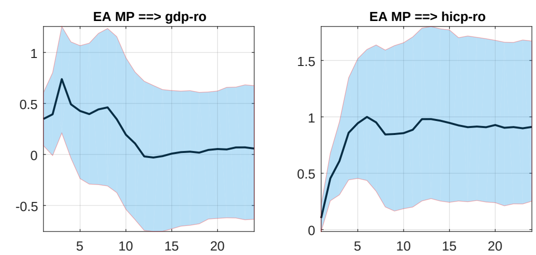
(b) BG



(c) HR



(d) RO



Note: Results are represented with pointwise median and 68% confidence bands.

and Navarro 2018). Expansionary monetary policy shock has positive short term effect on GDP in the euro area and euro candidate countries, while this effect fades away and/or becomes statistically insignificant in the longer run. On the other hand, effects of the ECB monetary policy shock on inflation in all countries is positive and long-lasting. To give our conclusions more analytical rigor, we calculated differences of impulse responses to ECB monetary policy shock between candidate countries and euro area (Figure 14 in Appendix B). In most cases responses of GDP and inflation in candidate countries and the euro area are statistically not different. There are only two cases in which there are statistically significant differences in responses. Firstly, there is short lasting statistically significant difference in responses for GDP between Bulgaria and euro area. Secondly, reaction of HICP in Romania to EA monetary policy shock is constantly significantly higher than reaction of EA HICP, which can, at least partially, be explained by the fact that in the observed period Romania recorded highest and most volatile inflation rates. Comparable reactions of macroeconomic variables to the ECB monetary policy shock indicate that common counter-cyclical policy could be effective in euro candidate economies, especially if we take into account *the endogeneity hypothesis* of the OCA theory (Frankel and Rose, 1998) suggesting that similarity of economic shocks and reactions to these shocks could become even more pronounced once candidates join the euro area.

5.3 Robustness of the results

In order to test the robustness of our main results on the importance of the euro area shocks for the three candidate economies, we challenge our identification pattern. Having in mind that the historical decomposition exercise in a SVAR may depend heavily on a particular combination of restrictions imposed onto the impulse response function, we test weather varying the identification pattern influences our main conclusions. First, when separating between shocks, the most challenging part was to distinguish between the aggregate demand and the monetary policy shocks and, to some extent, also the exchange rate shocks. The pattern of sign and zero restrictions needed for that purpose may overlap, making the reliable identification of structural shocks a rather challenging task. For that purpose we therefore tested several alternative patterns which would indeed slightly affect the relative importance of those shocks on candidate countries. However, this was largely irrelevant for our main conclusions on the overall importance of the euro area shocks for the three candidates. Domestic shocks are separated from those originated abroad by imposing block exogeneity restrictions and the overall importance of the two group of shocks would therefore remain largely unchanged when varying the identification pattern within each group of the shocks (domestic or external). Similarly, instead of having a single foreign block we experimented with a model with separated euro area and global blocks. However, although such a richer structure may help to better explain the sources of shocks hitting the three candidate countries this has not changed our results importantly. For simplicity, but without important loss of generality, our final specification merged both euro area and global shocks into a single block.

6 Conclusion

Returning to the research questions posed at the beginning, results of our empirical approach show that economic shocks hitting the euro area also have similar effects on three candidate countries. Our measure of similarity of contributions shows that differences in reactions to common shocks are rather small between countries, but somewhat more pronounced in Romania. At least partially, this can be explained by the fact that during the observed period Romania recorded significantly stronger variations of exchange rate compared to other two countries. This view was supported by comparison of the contributions of common shocks in Romania and other *floaters* in the EU - Czechia, Hungary, Poland, Sweden and UK with (quasi) *peggers* Denmark, Bulgaria and Croatia. This comparison showed that the share of common shocks in the former group of countries is smaller compared to that in the latter group. However, due to strong trade and financial linkages within the EU, contribution of external shocks in *floaters* is far from negligible. The same therefore holds true for Romania. For that reason, we expect that costs of giving up monetary sovereignty could be less pronounced than standard Mundellian trilemma suggests. As for the introduction of more rigid exchange rate regime in Romania, current developments show that Romanian national bank is making effort to keep the exchange rate relatively stable, which can probably be explained by relatively high level of financial euroisation in the country (Copaciu, Nalban and Bulete, 2015) and relatively pronounced exchange rate pass through effect (Stoian and Murarasu, 2015). Despite the evidence that exchange rate in Romania absorbs part of the real shocks in the economy, absorption capacity is limited by structural characteristics of the economy. Regarding other two countries, monetary policies in Bulgaria and Croatia are already fairly limited as they operate under currency board (Bulgaria) and managed float with a tight margin (Croatia) exchange rate regime. Regarding the adequacy of the ECB's policy for these countries, impulse responses from BVAR point to expected counter-cyclical effects in both, euro area and euro candidate countries. These results are also supporting the view that costs of euro adoption, in terms of losing autonomous counter-cyclical monetary policy, should be relatively modest in all three countries, especially Bulgaria and Croatia.

Finally, it is important to emphasize that there are various other costs of euro adoption which are not addressed in this paper, such as price increase due to currency conversion, one-off conversion costs and one-off costs arising from the participation in the Eurosystem as well as the costs of participation in the provision of financial assistance to other member states. However, as Eudey (1998) points out, loss of the autonomous counter-cyclical monetary policy can be understood as the most important long lasting cost of euro adoption and our results suggest that this cost would not be pronounced in three candidate countries.

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Appendices

A Some stylized facts on Bulgarian, Croatian and Romanian economy

Bulgaria, Croatia and Romania are all small open European transition economies. As new member states, with an obligation to eventually introduce the euro, Bulgaria and Romania joined the European Union in 2007 and Croatia did so in 2013. These countries are strongly connected to the euro area economy, through various trade and financial linkages. Euro area members are the main trading partners of these countries[10], most of FDI flows originate from the euro area, while banking systems are dominated by foreign-owned bank subsidiaries, with *mother banks* mostly located in the euro area countries. Strong trade and financial integration with the euro area is reflected in a high degree of synchronization of both GDP growth and business cycles (Figure 4).

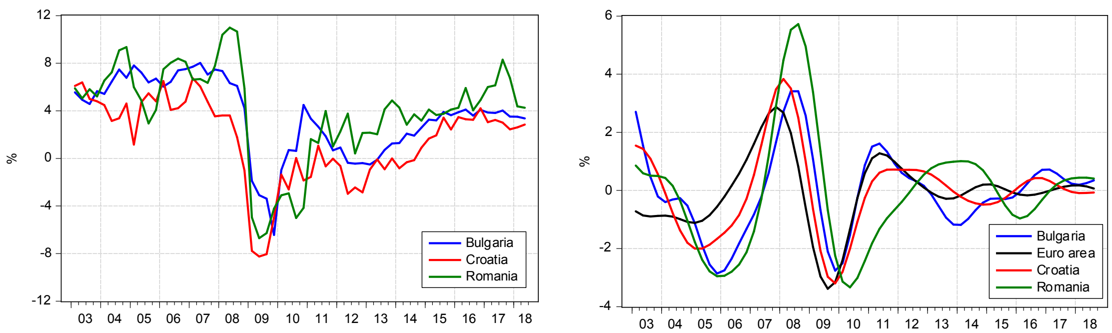
As for the macroeconomic developments, like other peers in the Central and Eastern European (CEE) region, all three countries experienced a boom-bust cycles since the beginning of the 2000s. Growth in the early 2000s was strongly fueled by accelerating domestic and foreign lending and foreign capital inflows. Global financial crisis that spilled over to Europe had similar effects in all countries, resulting with the recession in 2009. On the other hand, dynamics of recovery was somewhat different across countries. Bulgarian GDP returned to the positive region already in 2010, but the economy was drawn in the next recession in 2012 due to the European debt crisis. After that, the real activity started to recover gradually. Croatian economy recorded a prolonged, double deep recession, which lasted from 2009 to 2014. In Romania, after a strong fall in 2009, economy experienced a gradual recovery and acceleration of growth rates from 2011 onwards. Despite different paths of the recovery in these countries, their business cycles stayed fairly synchronized

[10] According to data obtained from national statistical offices share of euro area countries in total exports and imports in Croatia and Romania stands at around 55%-60%, while in Bulgaria 45%-50%.

with the euro area business cycle even after 2009.

Figure 4: Real GDP growth rates and business cycle synchronization

(a) GDP growth rate (b) Cyclical component of GDP

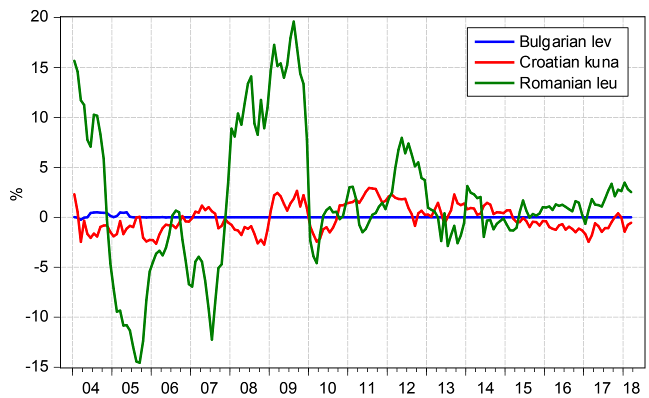


Source: Eurostat; authors' calculations

Note: To extract cyclical components of GDP we applied Christiano and Fitzgerald (2003) band-pass filter with frequency range between 8 and 32 quarters.

Regarding other important characteristics of these economies, the focal point of this paper is related to different monetary and, especially, exchange rate regimes in these countries. The choice of the exchange rate regime was largely shaped by specific historical economic circumstances and a high degree of deposit and credit euroisation in financial sectors (see Dumičić, Ljubaj and Martinis, 2018). Bulgaria introduced a currency board in 1997 as a mean of stabilization after country experienced a prolonged period of a near hyperinflation and several unsuccessful stabilization policies (Gulde, 1999). The choice of monetary and exchange rate regime in Croatia in the early 1990s, namely exchange rate as nominal monetary policy anchor and managed floating exchange rate regime, was motivated by the success of stabilization program in 1993, based on anchoring inflation expectations through credible stabilization of the exchange rate. Due to persistent euroisation and strong exposure of all institutional sectors to FX risk, monetary policy makers in Croatia found such a framework to be the most supportive for maintaining price sta-

Figure 5: Exchange rate vis-à-vis euro



Source: Eurostat

bility and financial stability. Finally, after years of monetary targeting, at the beginning of 2000s Romania, which at that time coped with still high inflation rates, started considering inflation targeting as a more favourable policy option. During the period from 2003 to 2005 Romanian central bank (NBRM), although still in the monetary targeting regime, started to rely more on interest rate as a policy instrument (accompanied with FX interventions). In August 2005 the NBRM finally switched to direct inflation targeting (Popa, 2008). As for the exchange rate regime in Romania, the IMF classifies it as *floating*, while the NBRM as *managed floating*. Regardless the classification, Figure 5 illustrates that Romanian leu has had much stronger volatility over the observed period compared to Croatian kuna. Flexibility of exchange rate in Romania was especially pronounced during the period of the global recession and European debt crisis, when Romanian leu recorded significant depreciation. Such a reaction of the exchange rate suggests that the exchange rate in Romania partially absorbs external shocks. Consequently, this could be reflected in lower contribution of these shocks to domestic GDP and inflation developments. However, strong financial and trade linkages with the euro area suggest that contributions of external shocks in Romania could still be fairly pronounced.

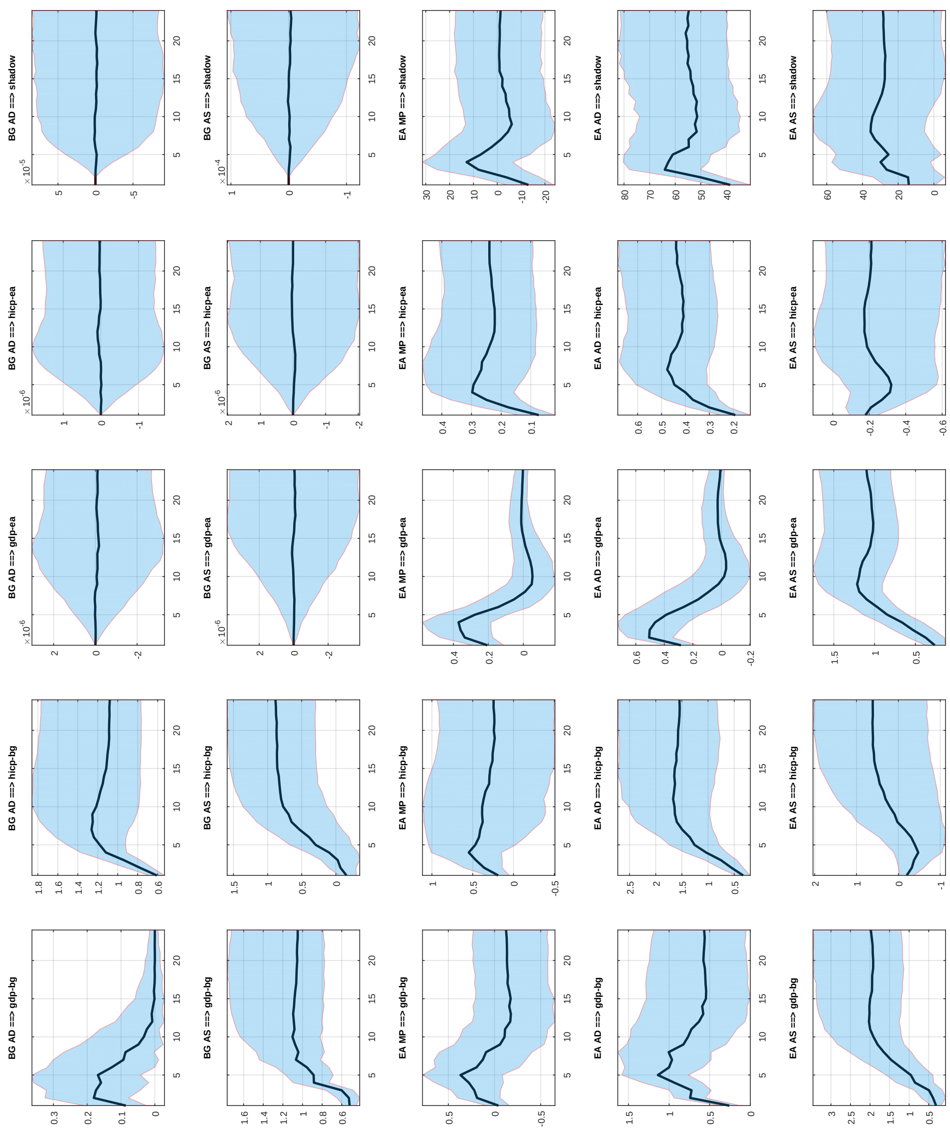
B Data and Figures

Table 3: Data description and sources

Variable	Description	Source
GDP_{EA}	Euro area real GDP, million euro, SA	Eurostat
$HICP_{EA}$	Euro area prices, all items, 2015=100, SA	ECB
MP_{EA}	Wu and Xia shadow interest rate	Cynthia Wu web page
GDP_D	Real GDP for Bulgaria, Croatia and Romania, million euro, SA	Eurostat
$HICP_D$	HICP prices for Bulgaria, Croatia and Romania, 2015=100, SA	Eurostat
ER_D	Domestic exchange rate to euro for Croatia and Romania	Eurostat
MP_D	Reference interest rate for Romania	National Bank of Romania

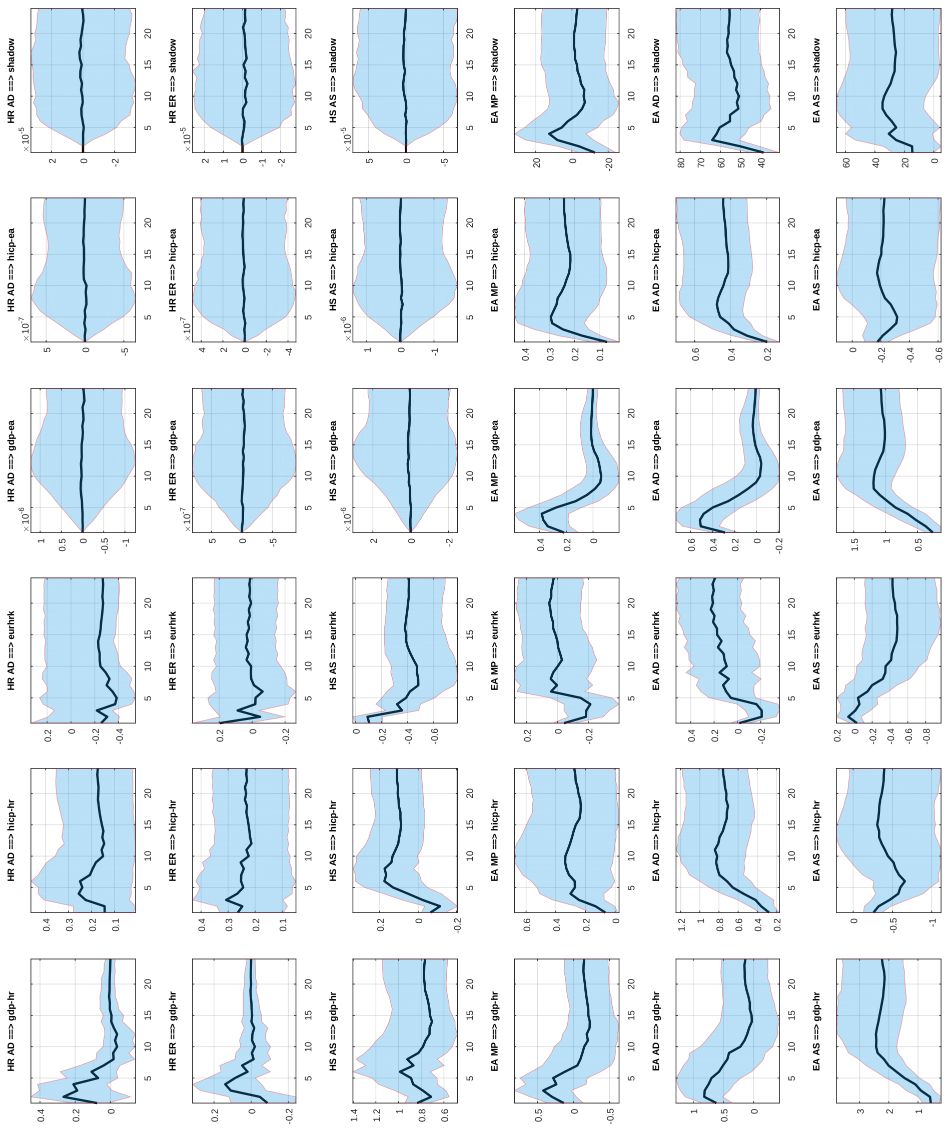
Note: Prices are seasonally adjusted using X-11 procedure.

Figure 6: Impulse response functions for Bulgaria



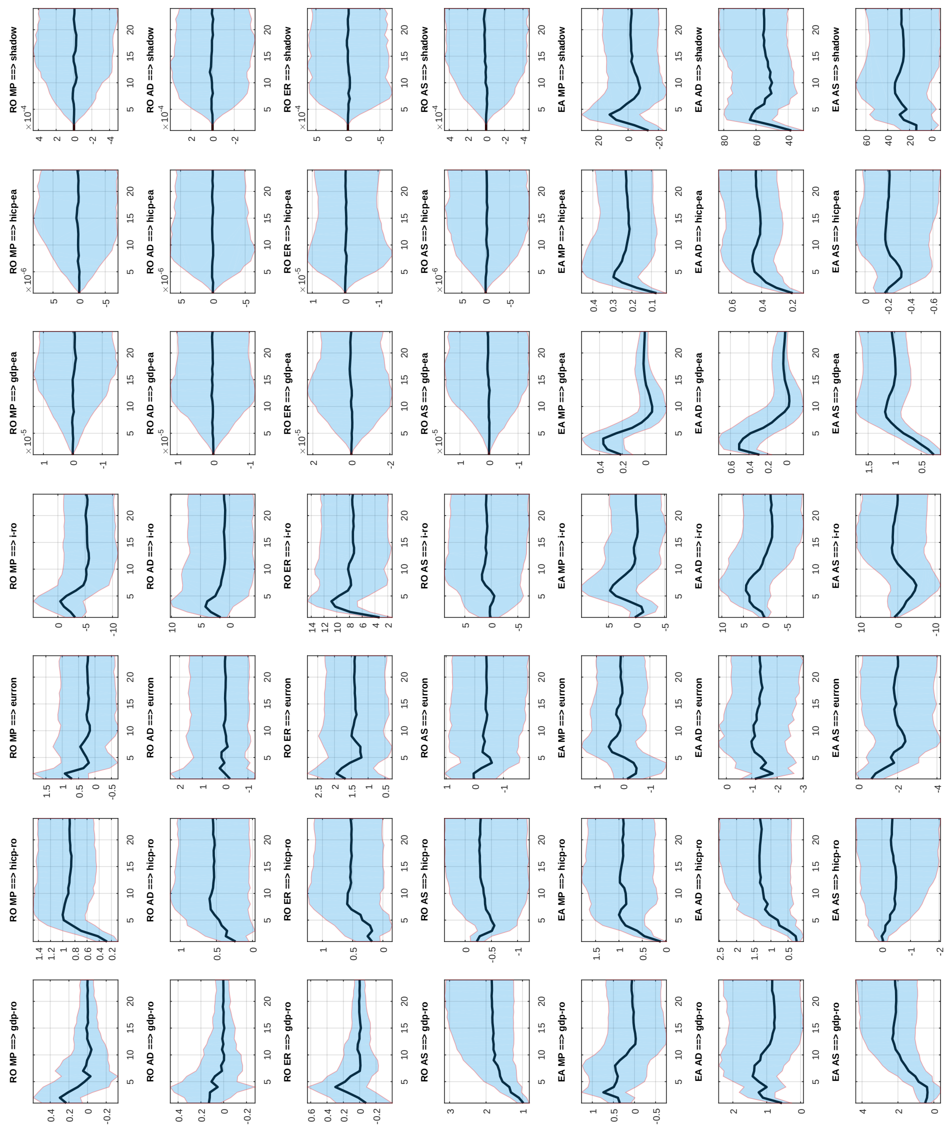
Note: Results are represented with pointwise median and 68% confidence bands.

Figure 7: Impulse response functions for Croatia



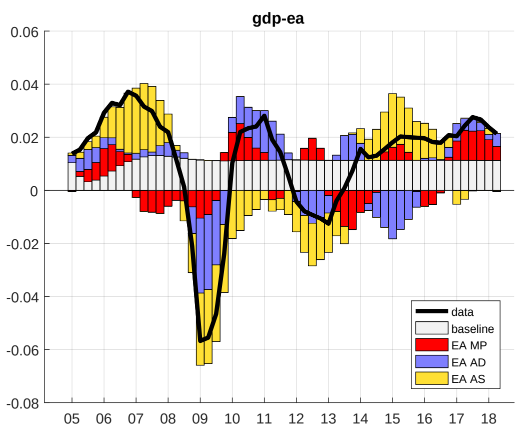
Note: Results are represented with pointwise median and 68% confidence bands.

Figure 8: Impulse response functions for Romania



Note: Results are represented with pointwise median and 68% confidence bands.

Figure 9: Historical decomposition of GDP and HICP for euro area (annual changes)



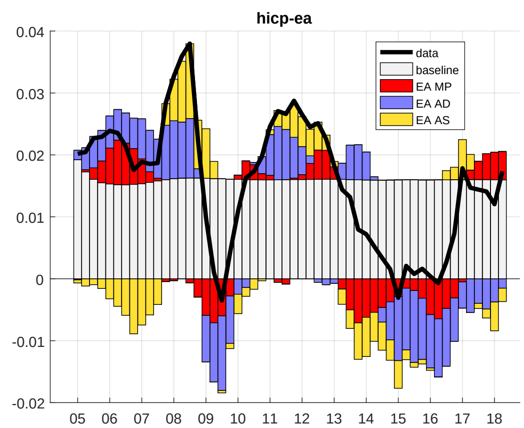


Figure 10: Historical decomposition of GDP and HICP for Bulgaria, Croatia and Romania (annual changes)

(a) GDP (b) HICP

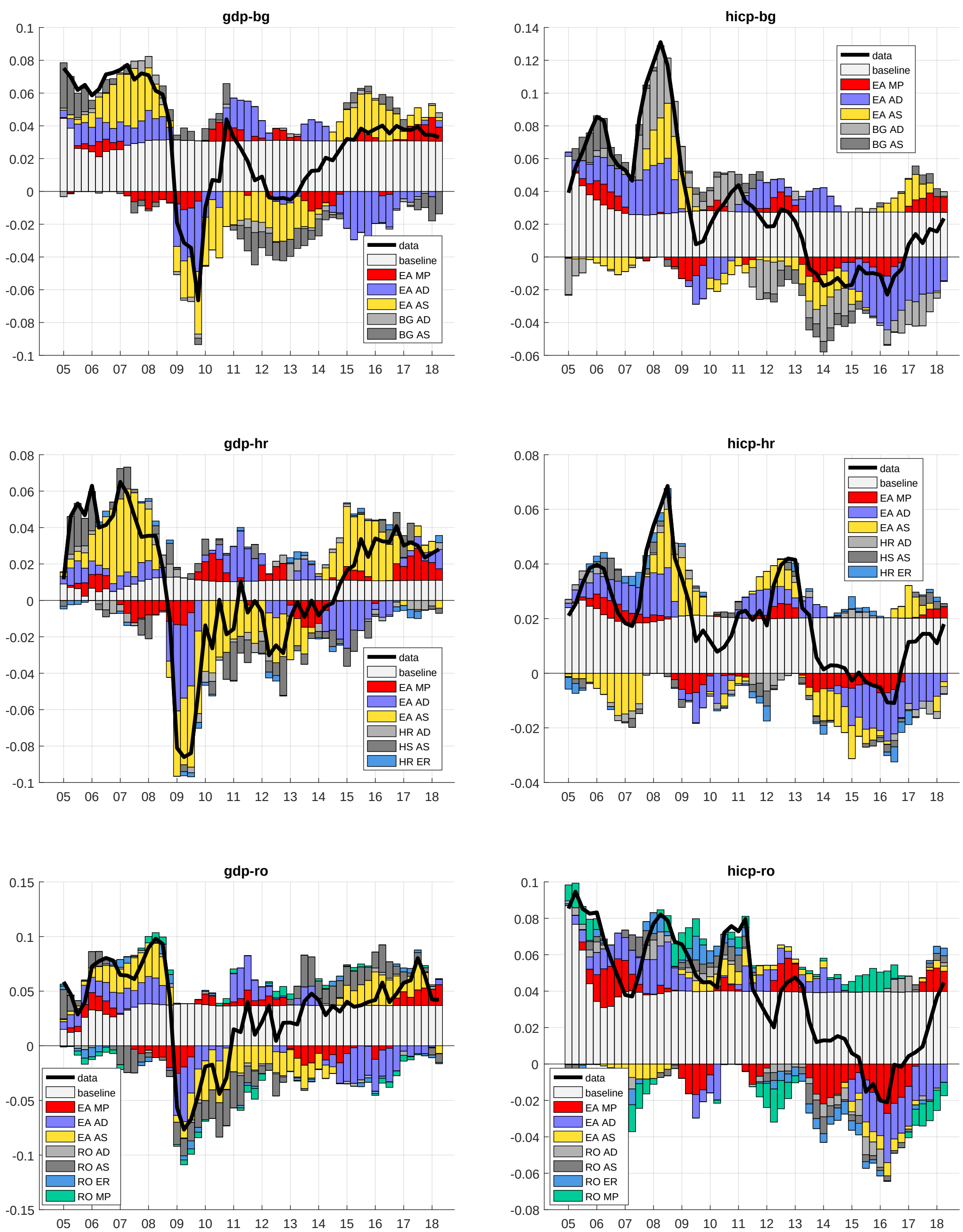
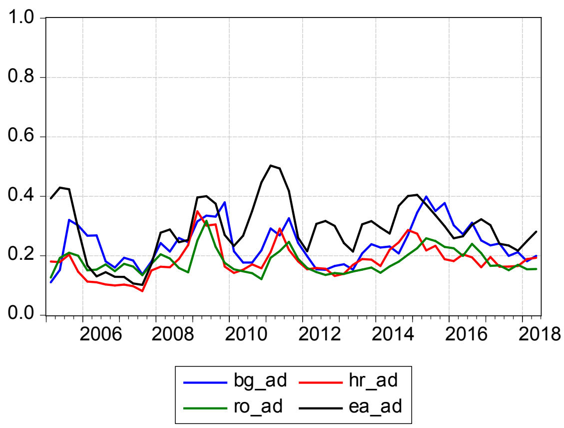
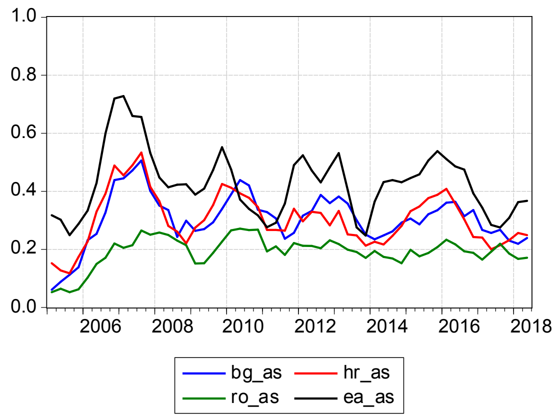


Figure 11: Relative importance of euro area shocks to GDP

(a) Aggregate demand shock



(b) Aggregate supply shock



(c) Monetary policy shock

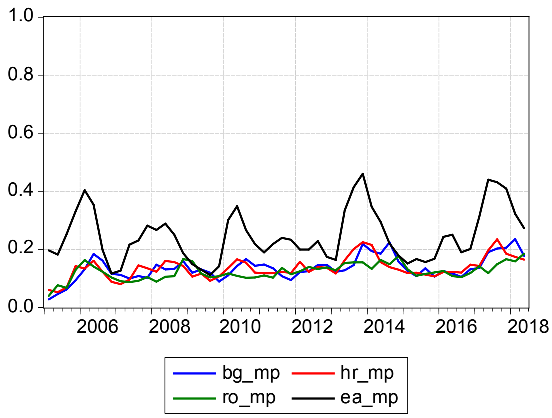
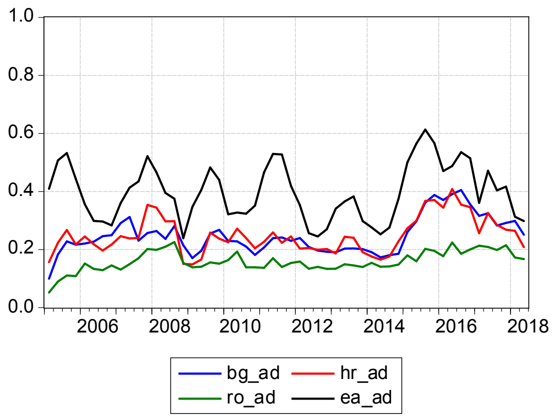
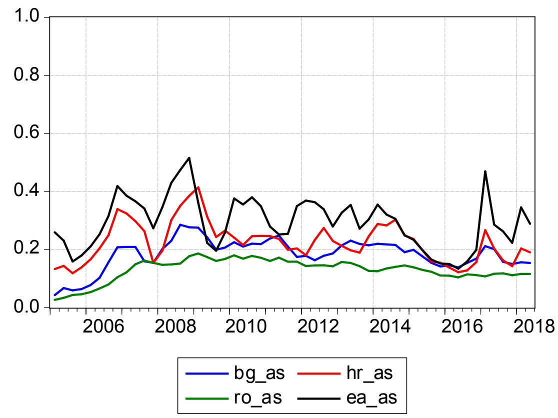


Figure 12: Relative importance of euro area shocks to HICP

(a) Aggregate demand shock



(b) Aggregate supply shock



(c) Monetary policy shock

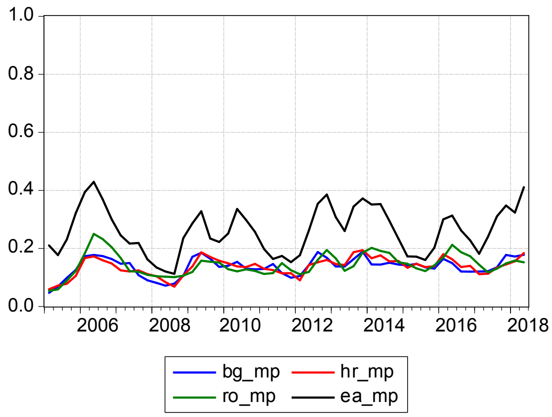
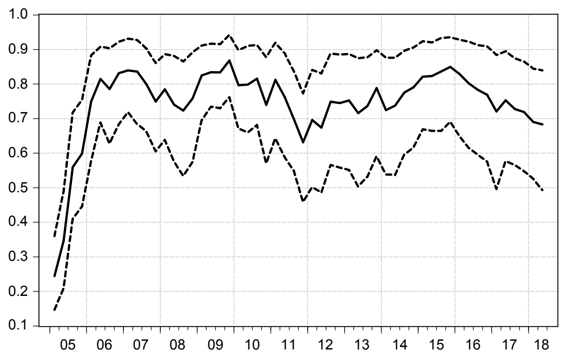
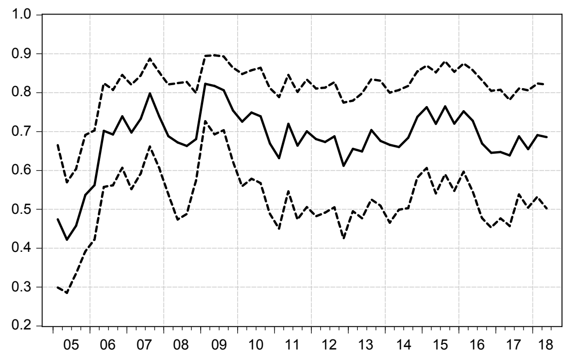


Figure 13: Contribution of common shocks to GDP and HICP (median and 68% confidence bands)

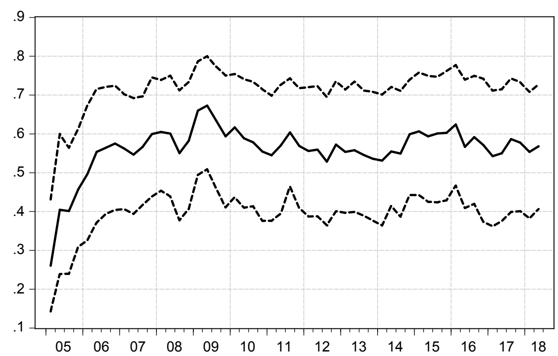
(a) BG GDP



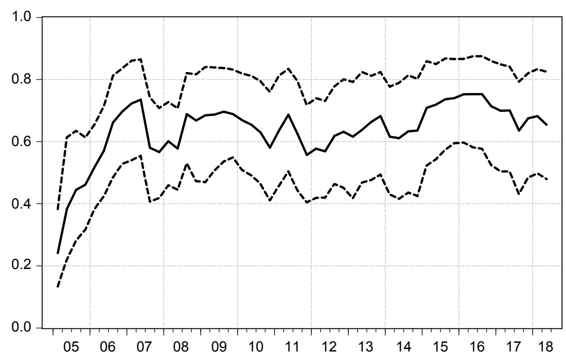
(b) HR GDP



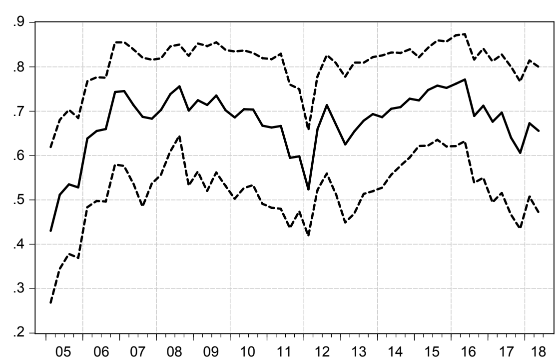
(c) RO GDP



(d) BG HICP



(e) HR HICP



(f) RO HICP

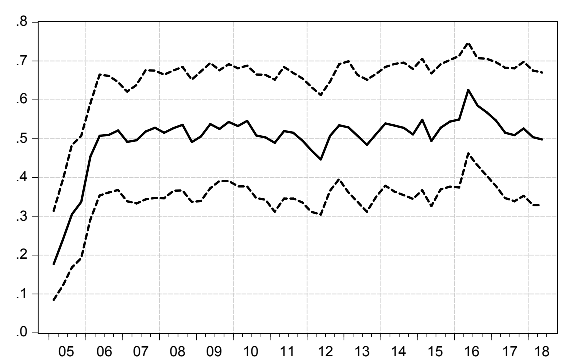
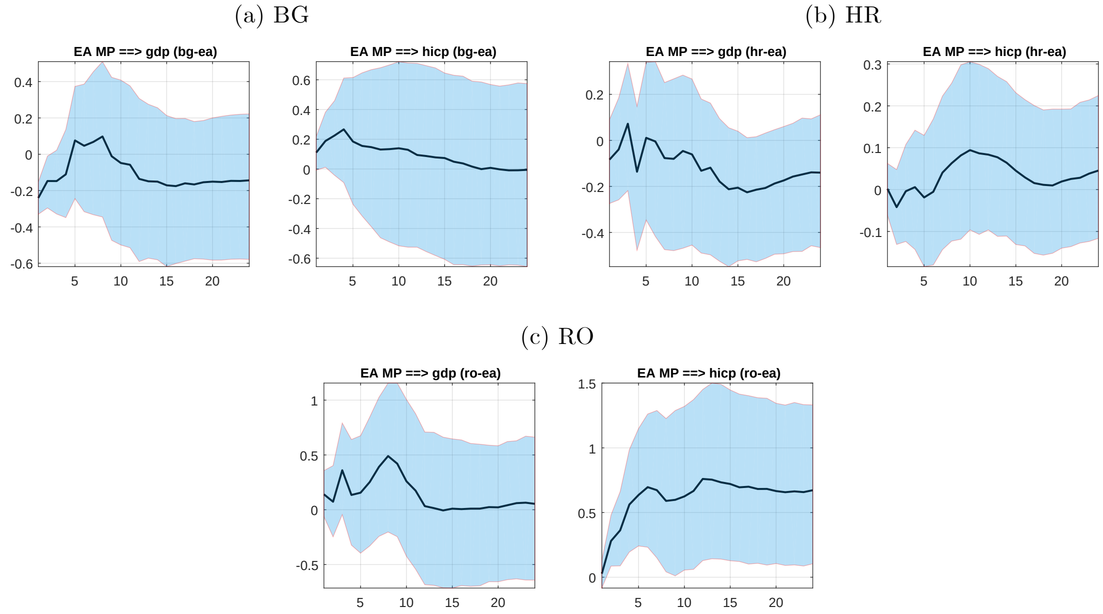


Figure 14: Difference of IRFs of the ECB monetary policy shock on GDP and inflation between euro candidate countries and euro area



Note: Results are represented with pointwise median and 68% confidence bands.