EUROPEAN CENTRAL BANK
EUROSYSTEM

Working Paper Series

Isabella Moder

Spillovers from the ECB's non-standard monetary policy measures on south-eastern Europe

No 2095 / August 2017

Abstract

This paper is the first to comprehensively assess the impact of the euro area's non-standard monetary policy measures on south-eastern Europe. By employing bilateral BVAR models, I am able to estimate the response of output and prices for each country, as well as to shed more light on potential shock transmission channels. The results suggest that the ECB's non-standard monetary policy measures have had pronounced price effects on all south-eastern European countries, and output effects on approximately half of them. While I also find exports to be a relevant transmission channel in most cases, the interbank market rate responds significantly only in a few cases as the region was subject to significant cross-border bank deleveraging after the crisis. Furthermore, the results suggest that the exchange rate regime does not play a role in determining the sign and magnitude of price level and output responses. This is in line with the absence of distinct exchange rate responses in the model output, suggesting that exchange rates did not act as buffers for spillovers of euro area non-standard monetary policy measures on south-eastern Europe.

Keywords: Unconventional monetary policy, international shock transmission, BVAR, EU integration

JEL-Classification: C11, C32, E52, F42

Non-technical summary

In this paper I investigate the international effects of the ECB's monetary policy. More specifically, I am interested in the period between 2008 and 2015, during which the ECB has introduced several new instruments for conducting monetary policy under special circumstances. The geographical focus are eight countries of south-eastern Europe (namely Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Romania and Serbia). With this focus I seek to fill a gap in the literature, which has not comprehensively assessed the impact of the ECB's non-standard monetary policy measures on this region yet.

The nature of international effects of ECB monetary policy is of great interest for policy makers in small countries in order to design optimal policy responses. South-eastern Europe is connected with the euro area in several ways. Firstly, the euro area is the most important trade partner for these countries, both on the export as well as the import side, which constitutes a real channel of shock transmission. Secondly, a large part of investment in south-eastern Europe stems from the euro area, which creates a financial link between those two regions. Moreover, a significant number of euro area banks operate in the countries of south-eastern Europe and correspondingly the official and unofficial use of the euro is widespread in the region. Despite their similarities, the south-eastern European countries operate under different exchange rate regimes, which makes this an interesting test case for investigating whether the exchange rate regime shapes the response to a euro area monetary policy shock.

I conduct separate estimations for each country in the period between January 2008 to December 2015 by employing BVAR models with monthly data. Besides a number of euro area variables that measure ECB monetary policy and its implications for the euro area itself, I include a number of variables for each south-eastern European country. I do not only test the response of macroeconomic variables like output and prices, but also aim to develop an understanding on how the mechanism of international transmission works.

The results suggest that each country in south-eastern Europe has been affected by the ECB's non-standard monetary policy measures. The price response to an expansionary non-standard monetary policy shock is positive for all countries and in some cases the inflationary effect is even stronger than for the euro area itself. Similarly, in approximately half of the countries output responds positively to such a shock. Moreover, I find evidence for the existence of an

export transmission channel, while the interbank interest rate clearly responds to the shock only in two countries, which is related to the significant cross-border deleveraging these countries experienced after the crisis. With respect to the exchange rate regime, I find no evidence that it influences how a country reacts to the non-standard monetary policy shock, which is in line with the ambiguous response of exchange rates in the model output and might be driven by relatively stable exchange rates during the sample period.

1 Introduction

Since October 2008 the European Central Bank (ECB) has introduced a number of non-standard monetary policy measures, which are unprecedented in nature, scope and magnitude; and have ranged from significant changes in the operational framework to large bond purchasing programmes. Assessing potential spillovers from monetary policy measures of advanced economies has become important in a globalised world; and it does not only incorporate potential spillovers via real channels like trade links and remittance flows, but more and more also the impact of financial spillovers, as monetary policy measures often generate sizable changes in capital flows and exchange rate dynamics. This mechanism could be very well observed in the so-called 'taper tantrum episode' in mid-2013, when the Fed announced to gradually turn off its bond-buying programme, which provoked a pronounced shift in market sentiment vis-à-vis emerging markets (see Sahay et al., 2014). Quantifying the direction and magnitude of international spillovers caused by advanced economies' monetary policy measures – and identifying the main transmission channels – is thus of utmost importance for policy makers in order to design optimum policy responses, both to spillovers from the introduction of such measures as well as to spillovers from their potential reversal.

The focus of interest for this paper lies in potential spillovers of ECB monetary policy measures to European countries that are not yet part of the euro area, or are in the process of EU accession. More specifically, this paper deals with the countries of south-eastern Europe (SEE)[1], that can be regarded as transition countries with respect to their economic development stage[2]. SEE countries are interlinked with the euro area through various channels. High trade integration and sizable remittance flows constitute potential real transmission channels, while the presence of a number of euro area headquartered bank subsidiaries and (correspondingly) a high degree of euroisation[3] represent financial links.

Additionally, the heterogeneous monetary policy regimes of SEE countries provide an interesting case for cross-country comparisons with regard to the role of exchange rate regimes in shaping spillovers: exchange rate regimes in SEE range from inflation targeters with (managed)

[1] Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Romania and Serbia

[2] In contrast to Baltic and central European countries, where convergence towards the 'old' EU member states progressed further than in SEE countries.

[3] Either through high unofficial asset and liability euroisation of the banking systems or, in the case of Montenegro, through the use of the euro as the legal tender, see European Central Bank (2016) for more information.

floating exchange rates (Albania, Romania and Serbia), to stabilised arrangements with the euro as a reference currency (Croatia and the former Yugoslav Republic of Macedonia), to euro-based currency boards (Bosnia and Herzegovina as well as Bulgaria), to the unilateral adoption of the euro as the sole legal tender (Montenegro).

The aim of this paper is thus to answer three questions: First, in what direction and to which magnitude have the ECB's non-standard monetary policy measures been affecting the SEE countries? Second, through which channels are these shocks transmitted to SEE? Third, do different exchange rate regimes play a role in shaping the SEE countries' responses to a non-standard monetary policy shock?

The main contribution of this paper to the literature is the systematic examination of spillovers from the ECB's non-standard monetary policy measures to the whole SEE region. While its three EU countries (Bulgaria, Croatia, Romania) have already been covered to a certain extent in the spillover literature, no research has been undertaken yet for the remaining countries, which are five candidate and potential candidate countries to the EU[4]. By employing impulse response functions in a structural BVAR setting, the effect of non-standard monetary policy shocks on each country's output, price level, exchange rate and key policy rate (if applicable), short-term interest rate, exports and trade partners' output is estimated.

The results show that the price level of all countries is positively affected by an expansionary non-standard monetary policy shock originating in the euro area, and for approximately half of the countries output also responds positively. Furthermore, spillovers seem to be mostly transmitted via exports, while only in a few cases via a financial channel (as measured by interbank interest rates). Additionally, the results suggest that the exchange rate regime does not play a role in determining spillovers, which is in line with the muted exchange rate responses in the model output that might be driven by relatively stable exchange rates during the sample period.

The structure of the paper is as follows: Section 2 provides an overview of the literature, while section 3 introduces the methodological approach. The corresponding results and potential transmission channels are discussed country by country and from a cross-country perspective in section 4. Section 5 documents robustness tests undertaken in order to cement the results. Section 6 concludes.

[4]Due to data limitations, the remaining prospective EU member Kosovo cannot be included in the empirical analysis.

2 Related literature

A vast amount of literature on cross-border monetary policy spillovers has emerged in the past decades, which in the beginning focused mostly on spillovers between advanced economies. Canova (2005) was among the first ones to investigate monetary policy spillovers from an advanced economy (the US) to emerging economies (eight countries in Latin America), followed by other papers modelling spillovers from US monetary policy to Latin America, Canada and Asian economies (see e.g. Maćkowiak, 2007), and from euro area monetary policy to other European countries (both emerging and advanced, see e.g. Maćkowiak, 2006; Jarociński, 2010; Benkovskis et al., 2011). On SEE countries, the literature of conventional monetary policy spillovers is less abundant, which is mainly related to the short time series available. Nevertheless, available results are very heterogeneous and seem to depend on the model and specifications used (see Jiménez-Rodriguez et al., 2010; Minea and Rault, 2011; Feldkircher, 2015; Hájek and Horváth, 2016; Petrevski et al., 2015; Potjagailo, 2017, using near-VAR, VAR, GVAR, SVAR and FAVAR models). Moreover, to the best of my knowledge, four SEE countries[5] have not yet been covered in the spillover literature at all.

The introduction of non-standard measures in October 2008 and the continuous ongoing expansion of several different unconventional instruments brought a new angle into the academical and policy discussion of euro area monetary policy spillovers to countries outside the euro area[6]. However, given that the global experience with non-standard monetary policy is restricted (with a few exceptions) to the aftermath of the global financial crisis, the literature on spillovers from advanced economies' non-standard or unconventional monetary policy measures to emerging markets is relatively scarce. It can be divided into two categories: One strand investigates the impact of monetary policy *announcements* (and in some cases also actions) on high-frequency financial indicators (e.g. sovereign bond yields, stock market indices, CDS spreads or exchange rates); see for example Fratzscher et al. (2016) for spillovers of US, and Georgiadis and Gräb (2015) as well as Falagiarda et al. (2015) for spillovers of euro area non-standard monetary policy. The latter examine the effects of more than seventy announcement-related events on financial assets of four non euro area EU countries. For Romania, which is the only SEE country covered, they find a significant effect on the short-term money market rate and an especially pronounced

[5] Namely Albania, Bosnia and Herzegovina, Montenegro and Serbia.

[6] For the purpose of this paper only spillovers outside the euro area are discussed. For an assessment of the effects *within* the euro area see e.g. Peersman (2011); Boeckx et al. (2017); Burriel and Galesi (2016).

effect on long-term government bond yields, while the exchange rate seems not to respond immediately to an ECB announcement. Ciarlone and Colabella (2016) test the effect of the ECB's asset purchase programmes on a panel of eleven countries in central, eastern and south-eastern Europe, including all countries covered in this paper. They find significant short-term spillover effects on financial variables as well as long-term spillovers on portfolio and cross-border banking flows.

Focusing on longer-lasting macroeconomic effects instead, the second strand of literature has been following the methods of the literature on 'conventional' monetary policy spillovers by using some kind of VAR model to assess spillovers on macroeconomic variables. The literature on non-standard monetary policy spillovers from the euro area to central and eastern Europe (CEE) is scarce, whereas it is non-existent for most countries in SEE. Babecká Kucharčuková et al. (2016) investigate spillovers on six EU non-euro area countries, among them three in CEE (Czech Republic, Hungary, Poland). They conclude that the spillovers of unconventional shocks are transmitted differently compared to conventional shocks, and while exchange rates respond quickly, the effect on inflation is ambiguous. Bluwstein and Canova (2016) use a Bayesian mixed-frequency VAR to incorporate both high-frequency financial as well as low-frequency macroeconomic data. They find that output effects of unconventional monetary policy measures were insignificant for CEE (Czech Republic, Hungary, Poland), and slightly negative for SEE (Bulgaria, Romania), and that the impact on inflation was slightly positive for both groups. With regard to the exchange rate channel, they conclude that it does not seem to shape the response of macroeconomic variables in the case of unconventional monetary policy shocks, as opposed to the case for conventional monetary policy. Halova and Horváth (2015) employ a PVAR model for eleven CEE and SEE countries (among them Bulgaria, Croatia and Romania). On the contrary to Bluwstein and Canova (2016) and Babecká Kucharčuková et al. (2016), their results suggest sizable spillovers and that a significant amount of output fluctuations in the CEE and SEE countries can be explained by the euro area's non-standard monetary policy measures. Ultimately, whether a country benefits from or is negatively affected by spillovers of a foreign monetary policy shock depends on whether its business cycle is in the same position as that of the 'core country' (Chen et al., 2015).

Another open issue that has been discussed in the spillover-literature is what shapes the response of an economy to a foreign monetary policy shock (both conventional and non-standard). The role of the exchange rate regime has featured prominently in the spillover discussion, fol-

lowing the argument that flexible exchange rates are better suited to buffer real external shocks (based on Meade, 1951; Friedman, 1953). Other potential determinants identified by the literature are the degrees of trade and financial openness (see e.g. Miniane and Rogers, 2007). More recently, Georgiadis (2016) systematically examines U.S. monetary policy spillovers and finds that the role of the exchange rate regime is non-linear, and that non-advanced economies operating under an inflexible exchange rate regime experience larger spillovers the more strongly they are integrated in global trade. Furthermore, the results suggest that trade integration amplifies spillovers to non-advanced economies if the share of manufactured goods in aggregate output is large and the country participates in global value chains. Crespo Cuaresma et al. (2016) additionally find that macroeconomic vulnerabilities such as a high external imbalances tend to amplify spillovers from US monetary policy shocks. For spillovers of euro area monetary policy, Potjagailo (2017) presents some evidence that spillovers on other EU countries' output are larger if the exchange rate regime is fixed.

3 Methodology

The methodology used in this paper follows the strand of literature that investigates the effects of non-standard monetary policy measures on the real economy by employing some specification of a VAR model. There are two reasons to choose this approach: First, although event studies could identify significant financial market spillovers for some European countries outside the euro area, this does not necessarily imply that the real economy is equally affected, since financial variables often exhibit overshooting behaviour that does not necessarily transmit into the real economy. Second, the event study approach requires developed financial markets to investigate the behaviour of high-frequency indicators. This is a major drawback in the case of emerging markets in general and SEE in particular, as these countries have very shallow financial markets in line with their small economic size and comparatively low GDP per capita levels.

3.1 Issues in dealing with non-standard monetary policy

Empirically assessing non-standard monetary policy measures brings a number of additional challenges compared to conventional monetary policy. First, as the key monetary policy rate does not incorporate non-standard measures, alternative indicators for the stance of non-standard monetary policy have to be found. Those used in the literature so far have been the term

spread between government bonds of different maturities (e.g. Chen et al., 2012), central bank balance sheet assets (e.g. Gambacorta et al., 2014), or shadow rates that are supposed to be directly comparable to key policy rates (Lombardi and Zhu, 2014; Krippner, 2015; Wu and Xia, 2016). In this paper I use Eurosystem balance sheet assets as the main measure of non-standard monetary policy. In the upper chart of figure 1, inverted Eurosystem balance sheet assets are plotted together with the key policy rate. It can be seen that the key policy rate was decreased in various steps to 1 percent in May 2009, from where it slowly and gradually moved towards the zero lower bound, which was reached in March 2016. In contrast, the Eurosystem balance sheet assets started to increase already with the switch of liquidity operations to a fixed rate tender with full allotment in October 2008, and thereafter fluctuated with the introduction and phase-out of the different programmes. In this paper I use additionally the shadow rate developed by Wu and Xia (2016) for robustness testing. It is calculated by assessing bond prices in a framework of a multifactor term structure model; and is directly comparable to the key policy rate as both interest rates are equal in conventional times (see the lower chart of figure 1). In contrast to balance sheet assets, this indicator also includes announcement effects of non-standard monetary policy measures whenever they affect bond yields.

Second, the way some of the ECB's non-standard monetary policy measures have been designed makes it necessary to find an empirical strategy that disentangles exogenous monetary policy shocks from endogenous or demand-driven monetary expansions. Since the change in the operational framework from standard tender-based allotment to fixed-rate full allotment in October 2008, monetary policy operations have been essentially endogenous or demand-driven, as banks have unlimited access to liquidity at the interest rate on the main refinancing operations (MRO) under the condition that they can provide enough collateral (Boeckx et al., 2017). Moreover, the (targeted) longer-term refinancing operations, which were increased in duration and size in October 2008, are also endogenous to a certain extent since the ECB only fixes the upper ceiling of these operations, whereas banks decide how much to draw upon that limit. This paper deals with endogeneity issues in several ways. First, I follow the approach proposed by Boeckx et al. (2017), who complement the Eurosystem's balance sheet assets as the main measure for non-standard monetary policy measures with certain assumptions on shock identification (see subsection 3.3). Moreover, I perform robustness checks by using only the position 'Securities held for monetary policy purposes' (A070100) of the Eurosystem's balance sheet, which incorporates all securities purchased under the various purchasing programmes. Compared to other positions

of the Eurosystem balance sheet, this is the most exogenous part since the size and frequency of bond purchases are ex-ante determined by the ECB and not shaped by banks' behaviour. However, with the start of the extended asset purchase programme (APP) in January 2015, combined monthly asset purchases of EUR 60 billion were pre-announced, meaning that they were in fact fully anticipated. Therefore, I also conduct robustness checks with a shorter sample.

3.2 Model

To model spillovers from the euro area's non-standard monetary policy to SEE countries, the following structural BVAR model with a monthly frequency is employed for each SEE country:

$$\sum_{s=0}^{p} \begin{bmatrix} A_{11}(s) & A_{12}(s) \\ A_{21}(s) & A_{22}(s) \end{bmatrix} \begin{bmatrix} y_1(t-s) \\ y_2(t-s) \end{bmatrix} + \begin{bmatrix} c_{11} \\ c_{21} \end{bmatrix} = \begin{bmatrix} \varepsilon_1(t) \\ \varepsilon_2(t) \end{bmatrix} \tag{1}$$

where $y_1(t)$ represents a vector of macroeconomic variables of the SEE country, $y_2(t)$ a vector of macroeconomic variables of the euro area, and the vectors c_{11}, c_{21} constants. The vectors $\varepsilon_1(t) \sim N(0, \Sigma_1)$ and $\varepsilon_2(t) \sim N(0, \Sigma_2)$ denote structural shocks of domestic and euro area origin, respectively.

For each s, $A_{21}(s) = 0$, implying that the variables of the SEE country are set to be exogenous to the variables of the euro area under the assumption that neither current nor past economic developments in the SEE countries influence developments in the euro area. This so-called 'block exogeneity' feature introduced by Cushman and Zha (1997) has been used frequently in the literature (see e.g. Canova, 2005; Maćkowiak, 2007; Benkovskis et al., 2011) and is well suited for modelling spillovers from large to small economies, as it helps to identify spillovers from the viewpoint of the small open economy and reduces the number of parameters to be estimated (Cushman and Zha, 1997).

The vector y_1 consists of the following seven variables:

$$y_1 = \begin{pmatrix} y_t^{SEE} & x_t^{SEE} & p_t^{SEE} & i_t^{SEE} & y_t^* & r_t^{SEE} & e_t \end{pmatrix}' \tag{2}$$

where y_t^{SEE} denotes output, x_t^{SEE} exports to the euro area, p_t^{SEE} prices and i_t^{SEE} the interbank market rate of the respective SEE country. y_t^* represents global developments and is constructed as the weighted average of the output of the five most important export partners for each

country[7]. It is included to control for indirect spillovers that would otherwise not be covered in a bilateral model set-up. The key policy rate r_t^{SEE} as well as the exchange rate of the local currency vis-à-vis the euro, e_t, are included only for countries that are operating under an inflation targeting regime[8]. Otherwise the vector y_1 consists of only five variables. The vector y_2 represents the euro area and includes six variables:

$$y_2 = \begin{pmatrix} y_t^{EA} & p_t^{EA} & assets_t^{EA} & CISS_t & spread_t^{EA} & MRO_t \end{pmatrix}' \tag{3}$$

where y_t^{EA} and p_t^{EA} again denote output and prices, respectively, but this time for the euro area and $assets_t^{EA}$ represent Eurosystem balance sheet assets as the main measure for non-standard monetary policy (as discussed in subsection 3.1). Moreover, following Gambacorta et al. (2014); Boeckx et al. (2017); Burriel and Galesi (2016), I include the CISS-indicator developed by Holló et al. (2012) ($CISS_t$), which serves two purposes: First, it controls for the impact of euro area financial stress and economic risk, which is important to capture in the model as it has had pronounced effects on euro area macroeconomic developments. Second, the inclusion of the CISS-indicator helps to disentangle exogenous balance sheet movements from endogenous ones and thus enables a proper identification of monetary policy shocks (see subsection 3.3). For the same purpose, I also include the spread between the EONIA and the MRO-rate (denoted $spread_t^{EA}$). To disentangle conventional from non-standard monetary policy shocks, the model incorporates additionally the MRO-rate (MRO_t).

The chosen estimation procedure is Bayesian, because it is very well suited for shorter data sets. I use an independent normal-Wishart prior and obtain the scale matrix S_0 from individual AR regressions. Estimations are carried out by employing the BEAR toolbox developed by Dieppe et al. (2016) in *MatLab*. The autoregressive coefficient of the prior is set to 1, since the variables enter the model in levels. This specification is possible in Bayesian models, where the prior can account for unit root behaviour by including an autoregresssive coefficient on the first own lag of each variable, and it has the advantage of avoiding the transformation bias that occurs when data enter transformed into first differences. The remaining hyperparameters that specify the prior are chosen following Dieppe et al. (2016). The posterior is derived by Gibbs sampling with a total number of 5,000 iterations and a burn-in sample of 1,000 iterations. The

[7] The respective countries are chosen according to their export share in the country's exports in 2015, which is also used for creating the weighted average.

[8] The two additional variables are therefore included in the bilateral models for Albania, Romania and Serbia.

Bayesian information criterion (BIC) suggests a lag length of 1; however, testing for autoregressive behaviour of the residuals suggests that a model specification of 4 lags is best to avoid residual autocorrelation. Therefore I define $p = 4$.

3.3 Identification

In order to generate impulse response functions, the identification of shocks is carried out via sign and zero restrictions, following the method proposed by Arias et al. (2014) (see Dieppe et al., 2016). The non-standard monetary policy shock is the only identified shock in the model and takes the following form:

$assets_t^{EA}$	$CISS_t$	$spread_t^{EA}$	MRO_t	y_t^{EA}	p_t^{EA}	i_t^{SEE}	e_t	r_t^{SEE}	y_t^{SEE}	x_t^{SEE}	p_t^{SEE}	y_t^*
+	−	−	0	0	0	·	·	0	0	0	0	0
1-1	0-1	0-1										

Note: 0 indicates that the immediate response is restricted, while + (−) indicate that only a positive (negative) reaction is permitted in the respective period (see third row). · denotes that no restriction is placed on the variable.

The first six variables define the non-standard monetary policy shock and its effects on the euro area, while the remaining variables apply to the respective SEE country and its trade partners. An expansionary non-standard monetary policy shock increases the Eurosystem balance sheet assets at least in the first month following the shock (I do not put a restriction on impact to allow for announcement effects which are followed by the policy action in the subsequent month), while both the CISS-indicator as well as the spread between the EONIA and the MRO decrease immediately (on impact) and in the first month after the shock. These identifying assumptions are taken to distinguish demand-driven from exogenous balance sheet shocks, following Boeckx et al. (2017) and Burriel and Galesi (2016). More specifically, in periods of financial stress or other shocks increased demand for liquidity expands the balance sheet, implying that the CISS-indicator as well as the EONIA increase (see Boeckx et al., 2017). Vice versa, a balance sheet expansion that is caused by an ECB monetary policy measure should not increase but *de*crease both financial stress and the demand for liquidity, which is assumed in the sign restrictions above. Finally, the zero restriction of the MRO rate ensures that the balance sheet increase is orthogonal to a conventional monetary policy shock. For the response of output and prices, I

follow the standard approach of defining conventional monetary policy shocks by imposing zero restrictions to disentangle it from other shocks.

Turning to the respective SEE country, I stay agnostic about potential spillovers on the domestic interest rate and exchange rate vis-à-vis the euro (if applicable). To distinguish a spillover from euro area monetary policy from a domestic monetary policy action[9] I impose a zero restriction on the domestic policy rate r_t^{SEE} for floaters, analogous to the zero restriction put on the MRO-rate. For the potential effect on exports, output, price level and trade partners' output I use zero restrictions to disentangle the spillover from domestic real economy disturbances. Through the choice of variables and structural identification, I can investigate the spillover on each country's output and price level, as well as the role of the financial and real transmission channels. The acceptance rates of the structural matrices are depicted in table 1.

3.4 Data

The time span of the baseline model covers the period between January 2008 and December 2015. As a measure of output I use GDP, interpolated by the Chow-Lin method with industrial production[10] to obtain data with monthly frequency. The price level is measured as the consumer price inflation (harmonised consumer price inflation in the case of EU countries) index expressed in 2010 levels. As indicator for a potential financial channel I use short-term interest rates, as asset prices or longer-term interest rates are not available. More specifically, I include monthly end-of-period values of three-month interbank market rates, with the exception of Bosnia and Herzegovina as well as Montenegro, which do not publish interbank market rates. In the case of Montenegro, an unweighted average of three-month and six-month government T-bill rates is used as a proxy for interbank market rates. For Bosnia and Herzegovina, no such short-term interest rate exists. Therefore, following the approach of Cerutti et al. (2010), I create a composite series that consists to two-thirds of retail deposit rates and to one-third of retail lending rates, both in the corporate sector. All exchange rates are expressed in average local currency vis-à-vis the euro, so an increase in the exchange rate depicts a depreciation and vice versa. Exports to the euro area are limited to merchandise exports, which means that service exports are not

[9] Between January 2008 and December 2015, SEE countries operating under an inflation targeting regime have substantially lowered their key policy rates: cumulatively rates were decreased by 450 bps in Albania, 575 bps in Romania and 550 bps in Serbia.

[10] With the exception of Montenegro, where GDP is not available for the whole time span and therefore industrial production is used for output.

captured in the model. Export data is derived from the IMF's direction of trade statistics and converted from dollars into euros. All variables enter the model in monthly frequency and in levels. Moreover, all variables are seasonally adjusted by the U.S. Census Bureaus X-13 seasonal adjustment procedure in *EViews* and are transformed into their natural logs (with the exception of financial variables). The data sources are national central banks, national statistical offices, Eurostat, the ECB, the IMF's direction of trade statistics and Bloomberg.

4 Results

4.1 The effect of a non-standard monetary policy shock on the euro area economy

I start by looking at the transmission of an expansionary balance sheet shock within the euro area. The impulse response functions of the euro area are displayed in figure 2, where the continuous line depicts the median posterior response and the shaded area represents 68 percent of the credibility interval. Because the variables enter the model in natural logs, the y-axis reports percentage changes, except for financial variables which are depicted in percentage point changes. The one standard deviation (0.7 percent increase) balance sheet shock seems to be very persistent, as it does not fade out completely even after two years. The accompanying decline of the CISS indicator lasts for approximately 15 months, and the decrease of the EONIA-MRO spread has a half life of approximately four months. Turning to the macroeconomic effects, the impulse responses suggest that output rises gradually with a peak increase of 0.02 percent after eight months, and a complete fade-out after 21 months. The price level increase reaches the peak of 0.02 percent after 13 months and, in line with economic theory, the response seems to be relatively persistent.

4.2 Results for individual SEE countries

The response of the Albanian economy to a non-standard monetary policy shock is shown in figure 3. An expansionary euro area balance sheet shock does not significantly affect the Albanian output, while the price level responds with an increase of 0.02 percent after twelve months. The exchange rate of the lek vis-à-vis the euro does not show a pronounced response to the shock, which is in line with the fact that it has fluctuated only slightly against the euro in the sample

period[11]. The transmission of a euro area balance sheet shock on the Albanian interbank interest rate is uncertain in the short term, while in the medium term the interest rate rises in line with the increase of the policy rate. Albania's exports rise as a response to the balance sheet shock, while the significant output response of Albania's trade partners suggests that spillovers might also be indirectly transmitted.

In the case of Bosnia and Herzegovina, the economic response to a non-standard euro area monetary policy shock is depicted in figure 4. It is puzzling, as output seems to contract following the shock with a trough of 0.01 percent that fades out after two years. However, it should be noted that this response might by blurred by some structural breaks in the underlying data, related to severe floods in 2014 and the termination of the IMF-programme in 2015. Notwithstanding the negative output response, the price level increases gradually with a peak increase of 0.02 percent after twelve months, which seems to be relatively persistent. The interest rate – which in Bosnia and Herzegovina's case is a composite retail rate – does not seem to respond significantly to the shock. Exports, on the other hand, react relatively strongly with a peak increase of 0.3 percent after five months, as does the output of Bosnia and Herzegovina's trade partners.

For Bulgaria (see figure 5), the output response is positive (not strictly significant, but the mass of posteriors lies above zero), with a peak after eleven months. The price level also increases as a response to the shock, reaching the peak of 0.3 percent after 13 months. Regarding potential transmission channels, it seems that the monetary policy shock is not transmitted via the Bulgarian interbank market rate, since its posterior mass is relatively widespread. Also, the export channel does not seem to play a role in transmitting non-standard monetary policy shocks to Bulgaria, as both exports as well as trade partners' output do not exhibit a significant response to the shock. However, one should keep in mind that exports denote only merchandise exports here, while service exports are not taken into account. The pronounced reaction of output and prices in Bulgaria are in line with the results of Hájek and Horváth (2016) for conventional monetary policy spillovers.

In the case of Croatia (see figure 6), the response of output is positive and peaks at 0.05 percent after eight months, which makes it one of the strongest output responses in the region (see subsection 4.3). The response of the price level is also positive and significant with a peak at 0.03 percent after 24 months. Both the output as well as the price responses are in line with what

[11] Between 2008 and 2015 the average monthly fluctuation against the euro amounted to 0.5 percent.

Hájek and Horváth (2016) find for conventional monetary policy spillovers[12]. Croatia's interbank market rate exhibits an initial increase, although not at significant levels, which turns into a significant negative response after four months with a trough at 0.05 percentage points. This relatively pronounced response suggests that the financial channel plays a role in transmitting shocks from the euro area to Croatia. Conversely, exports respond negatively to the shock, despite the fact that the output of Croatia's trade partners increases. However, as service exports are not accounted for, the response of exports might be not entirely captured.

The response of the economy of the former Yugoslav Republic of Macedonia is depicted in figure 7. The results suggest that the euro area non-standard monetary policy shock does not trigger a significant output response, while the price level response is strongly positive with a peak of 0.05 percent after eight months. The increased euro area liquidity seems to be immediately transmitted to the interbank market rate, which decreases by a maximum of 0.05 percentage points after five months. Exports increase – although not strictly significantly – relatively strongly at 0.4 percent after eight months, and indirect trade links might also play a role as the positive output response of the country's trade partners suggests. The results for the interest rate response are in line with Petrevski et al. (2015) for a conventional euro area interest rate shock; however, they find a different response of the price level.

For Montenegro, an exogenous expansion of the Eurosystem's balance sheet translates into a pronounced rise of industrial production by 0.5 percent after four months. The price level also increases and peaks after eleven months. The euro area monetary policy shock does not seem to transmit into the short-term interest rate, which is in the case of Montenegro a composite of three- and six-month T-bill rates. Montenegro's exports seem to rise by 0.4 percent after five months, while its trade partners' output also increases as a response to the shock.

Spillovers to Romanian output from the non-standard monetary policy shock seem to be muted (compare figure 9). This result is different from the findings of Hájek and Horváth (2016) and Bluwstein and Canova (2016), who conclude that a contractionary conventional euro area monetary policy shock initially increases Romanian output (or that an expansionary non-standard monetary policy output decreases Romanian output, respectively). The response of prices, on the other hand, is positive with a peak increase of 0.04 percent after eleven months. The exchange rate does not significantly react to the euro area shock, which is in line with

[12]Conversely, Petrevski et al. (2015) find that a contractionary conventional euro area interest rate shock *in*creases Croatia's price level.

the relative exchange rate stability of the lei vis-à-vis the euro since mid-2012[13]. Similarly, the response of the interest rate is uncertain in the short run and turns significantly positive some months after the shock. The exchange rate response confirms the outcome of the event study by Falagiarda et al. (2015), while according to them the short-term money market rate is significantly affected, which is not reflected in the results. Exports seem to react negatively to the shock and the trade partners' output seems to be isolated from the euro area shock, which might explain the overall muted output response of the Romanian economy.

Serbia's output (see figure 10) increases with a peak of 0.05 percent after eight months, which is one of the strongest output responses compared to the other countries in the region. Equally, the price response is very pronounced with a peak increase of 0.07 percent after eight months, which *inter alia* can be explained by the strong contribution of euro area import prices to inflation pressures in the past (see e.g. International Monetary Fund, 2011). Both the interbank interest rate as well as the exchange rate[14] do not seem to be affected significantly by the shock, while Serbia's key policy rate rises in the medium term. Exports seem to react positively to the shock and the trade partners' output also rises in the medium term after an initial period of uncertainty.

4.3 Cross-country comparison and discussion

In this subsection a horizontal comparison of the countries' responses to a non-standard monetary policy shock is undertaken. Following the euro area shock, all countries exhibit a distinct price level response (see figure 11), where it can be observed that the peak response is by far the strongest for Serbia, followed by the former Yugoslav Republic of Macedonia, Romania and Bulgaria. The relatively strong price responses, which are for around half of the countries stronger than the euro area response itself, are in line with the high share of imports from the euro area that range from around one third to over 50 percent of all imports in SEE countries.

Output responses to a euro area expansionary non-standard monetary policy shock are positive for approximately half of the countries, where it can be observed that the output response is largest for Croatia, followed by Serbia and Bulgaria. Montenegro's output also responds positively, but is measured in industrial production, thus the effect on GDP is unknown. While the

[13]From mid-2012 to end-2015 the average monthly fluctuation against the euro amounted to 0.7 percent, as compared to 1.2 percent from 2008 up to mid-2012.

[14]Compared to Albania and Romania, Serbia's exchange rate fluctuated relatively strong vis-à-vis the euro in the sample period with an average monthly fluctuation of 1.1 percent.

output of the Albanian, former Yugoslav Republic of Macedonian and Romanian economies does not respond significantly to the shock, Bosnia and Herzegovina seems to be the only country that is negatively affected. Compared to the transmission of the balance sheet shock within the euro area, the spillovers are sizable and in the case of Croatia and Serbia even larger than in the euro area itself.

Comparing the peak responses across countries, the results suggest that the exchange rate regime does not play a significant role in shaping the size and magnitude of output and price spillovers, as countries with flexible exchange rates lie on opposite ends of the range. This result is not surprising, as for the three countries operating under a flexible exchange rate regime none of the domestic exchange rates shows a pronounced response to the euro area balance sheet shock in the model output, which is in line with the very stable exchange rates in the case of Albania and Romania in the sample period. Thus, in south-eastern Europe flexible exchange rates did not seem to act as shock absorbers during the time period covered. This finding is in line with Bluwstein and Canova (2016), who argue that the exchange rate channel is not important for unconventional monetary policy transmission (which is different from the conventional case).

Regarding potential transmission channels, the comparison suggests that the impact of a non-standard monetary policy shock on SEE exports to the euro area is the largest for the former Yugoslav Republic of Macedonia and Montenegro, followed by Bulgaria, Serbia and Albania. On the other hand, the real transmission channel does not seem to be considerable in Bulgaria, where no significant increase of exports can be observed, and in Croatia and Romania where exports react negatively to the balance sheet shock. Taking into account both the financial and the real transmission channels, it seems that for a majority of countries spillovers are transmitted via exports, while the interest rate channel plays a significant role only in two countries. This result reflects the significant bank cross-border deleveraging many SEE countries experienced after the crisis. In some countries (e.g. Albania, Romania), spillovers via both transmission channels might work in opposite directions and therefore lead to a non-significant output response. However, a word of caution is necessary here: both indicators, exports and interest rates, suffer from drawbacks due to data availability. Exports here denote only merchandise exports, since exports of services are not available, which might underestimate the export channel in countries with a high share of service exports, e.g. Croatia. In the case of financial flows, changes in the interbank market rate might not capture foreign direct or portfolio inflows, and therefore underestimate the role of the financial channel in transmitting shocks.

With regard to indirect spillovers, the composite output of trade partners responds especially strongly in the case of Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia and Albania, while the response seems to be smaller for Montenegro, Croatia and Serbia, and absent for Bulgaria and Romania. However, the approach taken can only give an idea of the possible role of indirect spillovers, as I do not test for spillovers of the trade partners' output on SEE countries.

5 Robustness testing

To test whether the results hold for different model specifications or variable choices, I perform a number of robustness checks. As discussed in subsection 3.1, besides balance sheet assets, shadow rates can also be used as an indicator for non-standard monetary policy measures. To see whether the results are robust to an expansionary shadow rate shock (where I use the shadow rate developed by Wu and Xia, 2016), I keep all other variables and the shock identification unchanged. The only difference is that an expansionary shock implies that the shadow rate *de*creases, which means that the sign restriction for the shadow rate is turned into negative. Moreover, the period for the restriction is changed to impact and the first month following the shock. This is based on the fact that the shadow rate incorporates also announcement effects, which is not the case for balance sheet assets, and thus is expected to immediately react to the shock.

$shadow_t^{EA}$	$CISS_t$	$spread_t^{EA}$	MRO_t	y_t^{EA}	p_t^{EA}	i_t^{SEE}	e_t	r_t^{SEE}	y_t^{SEE}	x_t^{SEE}	p_t^{SEE}	y_t^*
-	–	–	0	0	0	·	·	0	0	0	0	0
0-1	0-1	0-1										

Note: 0 indicates that the immediate response is restricted, while + (−) indicate that only a positive (negative) reaction is permitted in the respective period (see third row). · denotes that no restriction is placed on the variable.

The results of a one standard deviation shadow rate shock for the euro area are depicted in figure 12. The double lines represent the credibility interval of the shadow rate shock, while the shaded area indicates the credibility interval of the baseline model. Compared to a balance sheet shock (see figure 2), the shadow rate shock is more short-lived, as it fades out completely after approximately twelve months. Regardless of the different time horizon, the responses of

the financial variables (CISS, EONIA-MRO spread and MRO) are very similar. The effects on output and prices are also in line with the baseline model, although the credibility intervals are larger when using the shadow rate as an indicator for non-standard monetary policy measures. The spillovers to output and price levels of the SEE countries are depicted in figures 13 and 14. The outcome is qualitatively in line with the baseline model, with the notable exception of the price level response of Serbia, which turns negative if the shadow rate is taken as an indicator for non-standard monetary policy measures. Interestingly, an appreciation of the exchange rate can now be observed in the shadow rate model output[15], that might cause disinflationary pressures on the price level response. This result confirms the prior findings that the exchange rate regime only influences the shock response if the exchange rate also shows a distinct response.

Moreover, I re-estimate all models by using only the position 'Securities held for monetary policy purposes' (A070100) of the Eurosystem's balance sheet. As discussed in subsection 3.1, this balance sheet position reflects the most exogenous non-standard monetary policy measure and therefore serves as another robustness test for exogenous monetary policy shocks. Furthermore, I can also infer from the results whether spillovers of securities purchases are different to composite spillovers of all programmes. The results are robust with the exception of the Serbian price level response, which is similar to the previous robustness test. Finally, since the monthly balance sheet expansions have been pre-announced from the start of the APP, implying that they are anticipated, I additionally conduct a robustness check with a shorter sample until December 2014 (instead of December 2015). The results obtained from the shorter sample are in line with the baseline model.

6 Conclusion

This paper is the first one to comprehensively assess the economic impact of the euro area's non-standard monetary policy measures on the countries of south-eastern Europe (SEE). By employing bilateral structural BVAR models, I are able to identify macroeconomic spillovers as well as potential transmission channels for each country individually. Three questions are addressed in this paper: first, how have the ECB's non-standard monetary policy measures been affecting the SEE countries? Second, which channels are transmitting these shocks to SEE? Third, do different exchange rate regimes play a role in the SEE countries' responses to

[15]For brevity reasons the responses of all variables are not displayed here, but are available upon request from the author.

the shock?

The results show that the price level of all countries is positively affected by an expansionary non-standard monetary policy shock originating in the euro area, in line with the importance of euro area imports in total imports. Compared to the euro area response of the price level, the inflationary effect on SEE is larger for around half of the countries. With regard to the output response, the shock has an expansionary effect in approximately four out of eight countries, which is in some cases also more pronounced than the euro area output response. These results are confirmed by a number of robustness checks.

Regarding possible transmission channels, I find that spillovers seem to be mostly transmitted via the export channel, while only in two countries the interest rate channel plays a significant role, in line with the significant bank cross-border deleveraging many SEE countries experienced after the crisis. Nevertheless, financial flows in the form of foreign direct or portfolio investments, which are not captured in the model, still might play a role.

With respect to the exchange rate regime, I find no influence of it on the price level or output responses. This is in line with the absence of a distinct exchange rate response in the model output for the countries under a flexible regime, which can in turn be explained by the very stable exchange rate the respective currencies have exhibited vis-à-vis the euro in the past years. Therefore, it seems that flexible exchange rates did not act as buffers to mitigate spillovers.

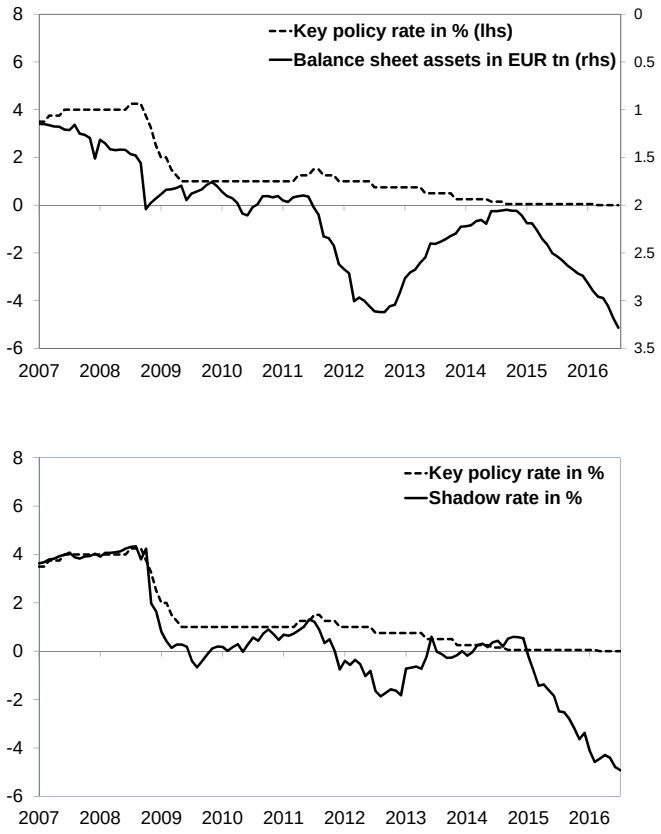
The current work could be extended into various directions. A comparison between the spillovers of euro area non-standard and euro area conventional monetary policy measures could indicate whether these measures have different international effects. Moreover, future research might include additional variables to shed more light on potential transmission channels; especially the role of financial transmission could be further explored and other channels not covered here could be added (e.g. confidence channel). Finally, a comparison with spillovers from non-standard monetary policy measures undertaken by the central banks of other large advanced economies (notably the US) would shed light on the relative importance of euro area non-standard monetary policy, and be helpful for policymakers to design optimal policy responses to advanced economies' monetary policy measures and their (potential) reversal.

Tables and Figures

Table 1: Acceptance rates of structural matrices

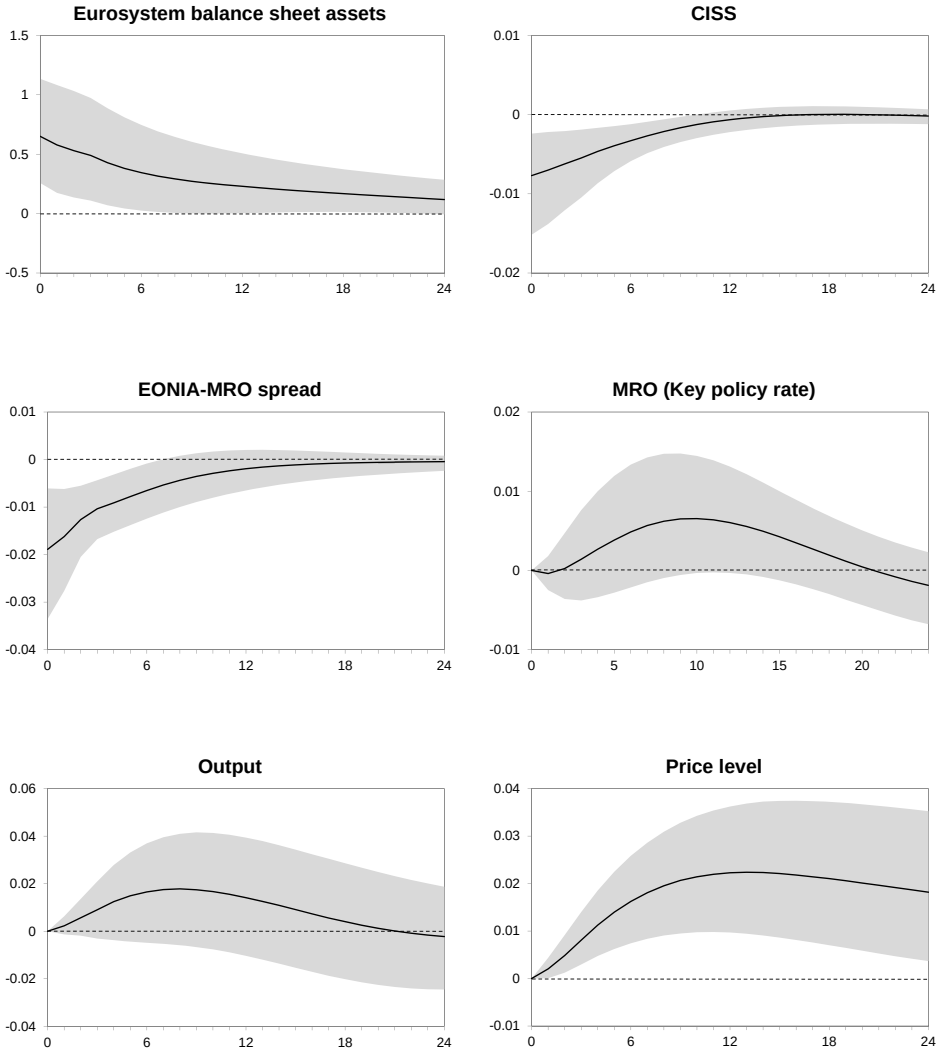
Albania	19.52%
Bosnia and Herzegovina	16.95%
Bulgaria	18.19%
Croatia	16.30%
Former Yugoslav Republic of Macedonia	19.58%
Montenegro	20.51%
Romania	15.43%
Serbia	19.51%

Figure 1: Indicators of non-standard monetary policy measures



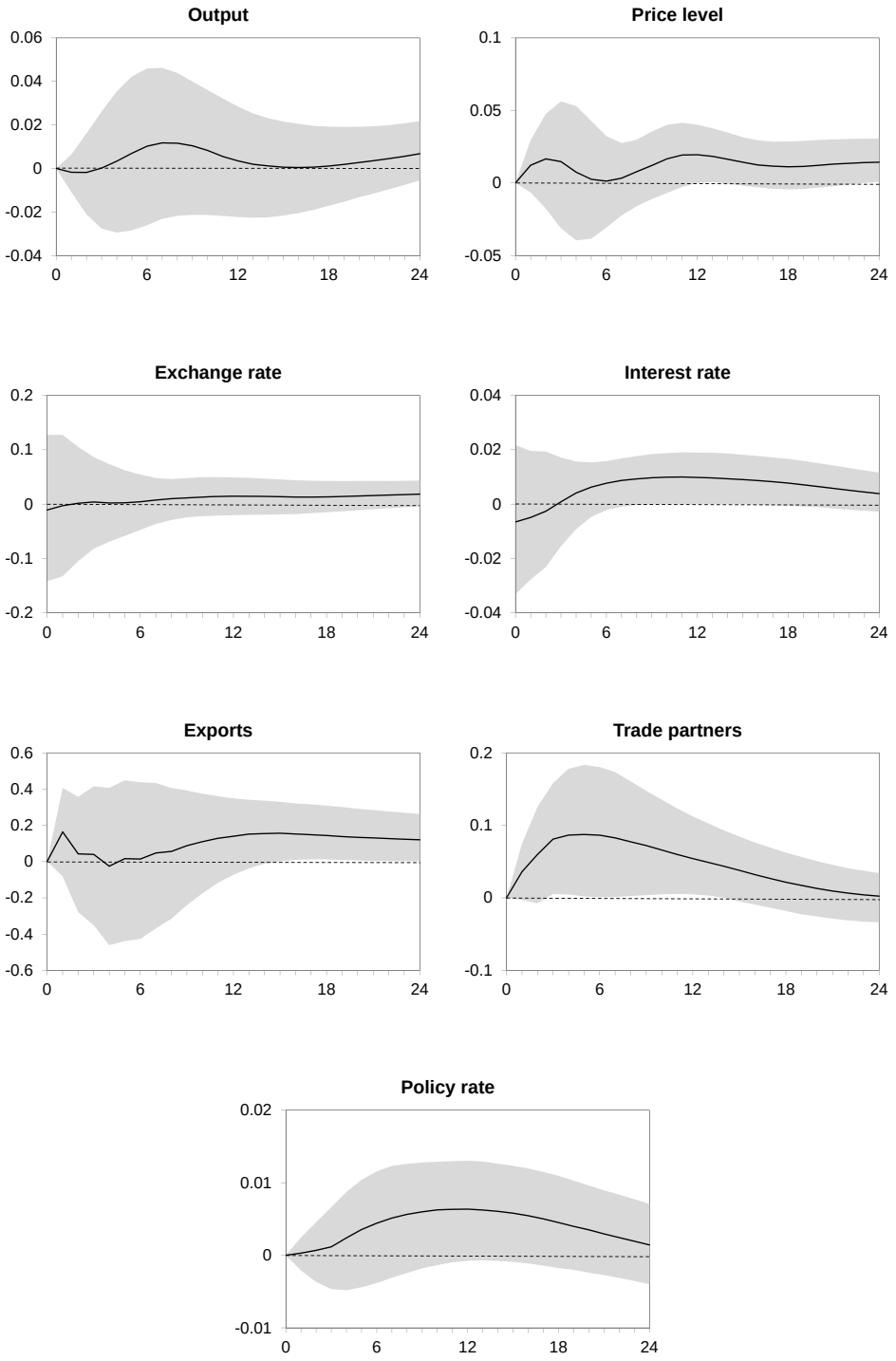
Sources: ECB, Wu and Xia (2016)

Figure 2: Euro area: Response to a balance sheet shock



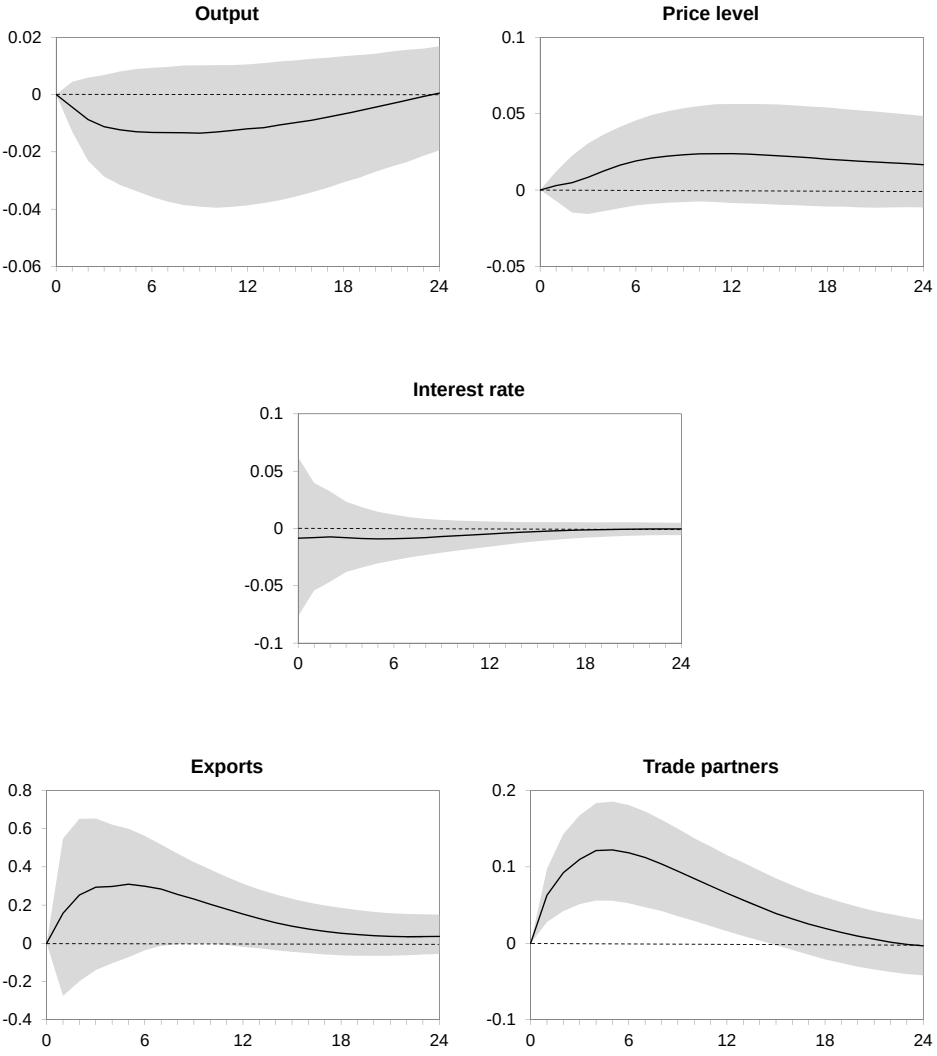
Note: Response of variables to an expansionary one standard deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, the y-axis monthly growth rates in percent for all variables except for financial variables, where percentage point changes are depicted.

Figure 3: Albania: Response to a balance sheet shock



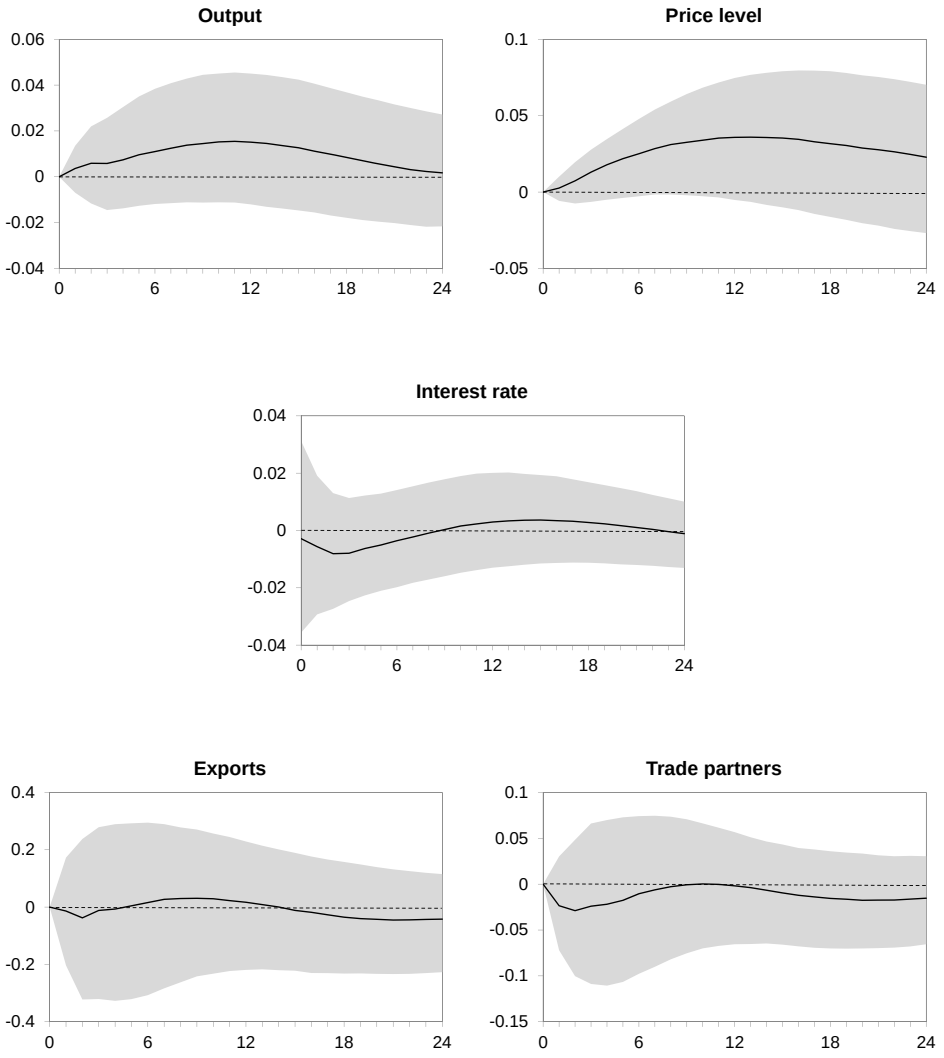
Note: Response of variables to an expansionary one standard deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, the y-axis monthly growth rates in percent for all variables except for interest rates, which depict changes in percentage points.

Figure 4: Bosnia and Herzegovina: Response to a balance sheet shock



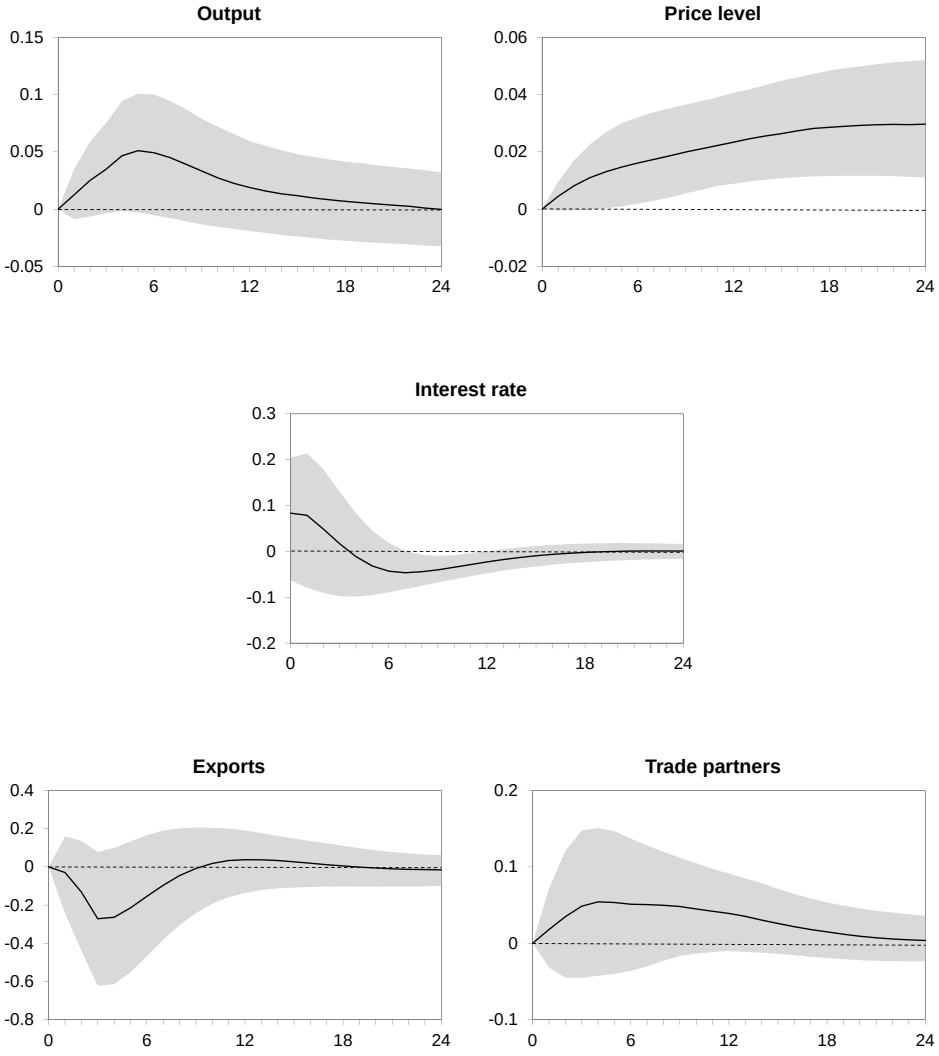
Note: Response of variables to an expansionary one standard deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, the y-axis monthly growth rates in percent for all variables except for the interest rate, which depicts changes in percentage points.

Figure 5: Bulgaria: Response to a balance sheet shock



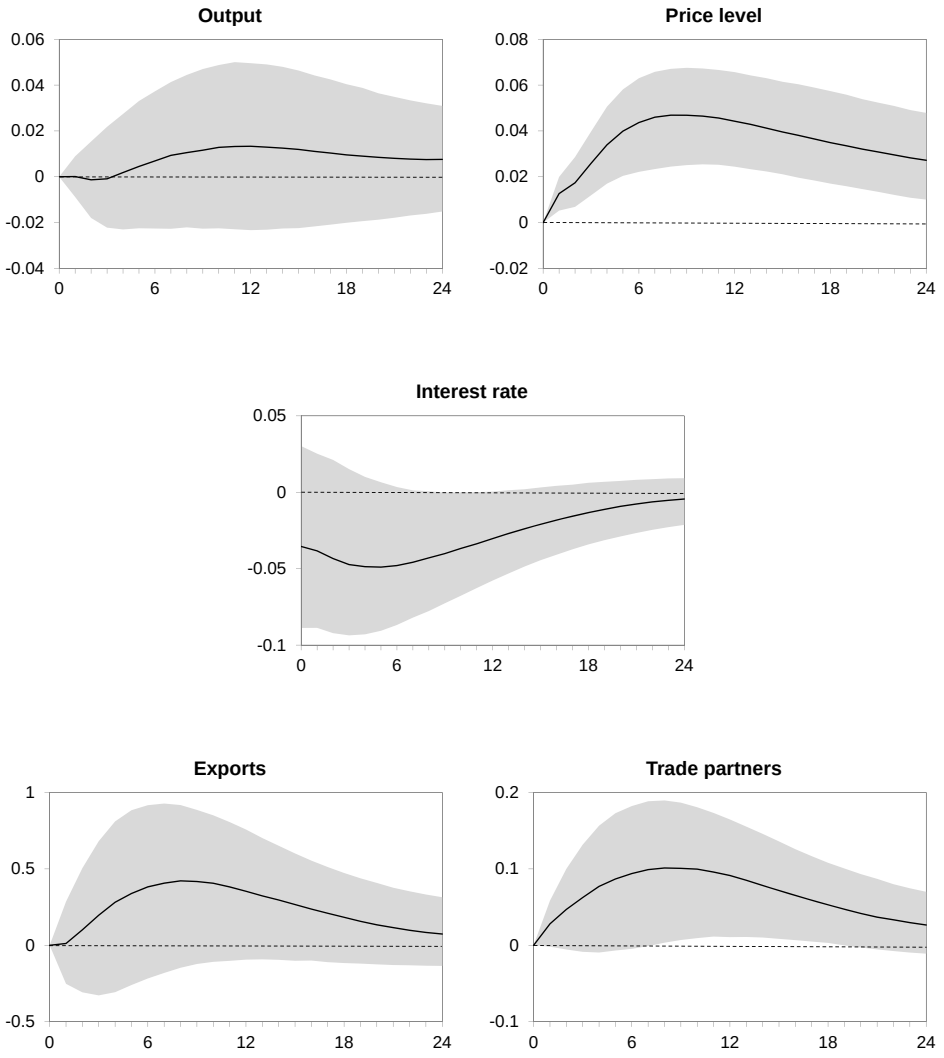
Note: Response of variables to an expansionary one standard deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, the y-axis monthly growth rates in percent for all variables except for the interest rate, which depicts changes in percentage points.

Figure 6: Croatia: Response to a balance sheet shock



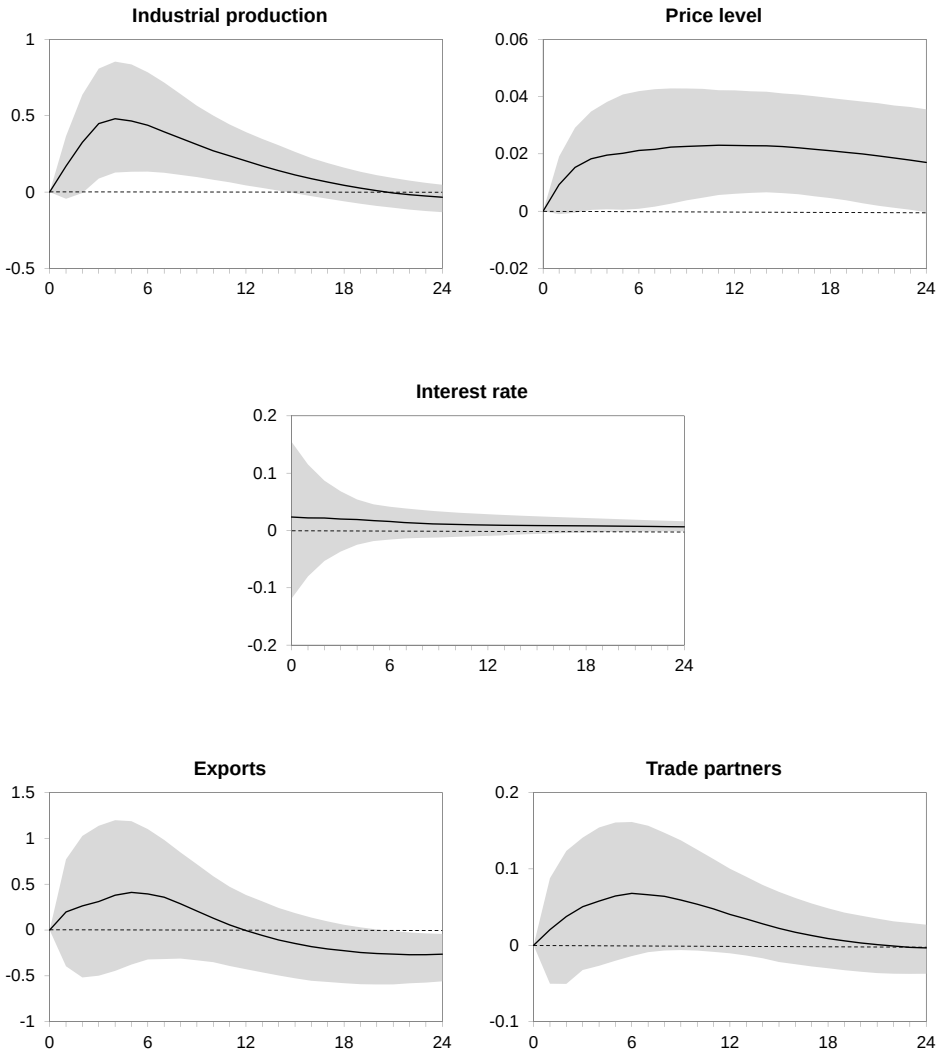
Note: Response of variables to an expansionary one standard deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, the y-axis monthly growth rates in percent for all variables except for the interest rate, which depicts changes in percentage points.

Figure 7: Former Yugoslav Republic of Macedonia: Response to a balance sheet shock



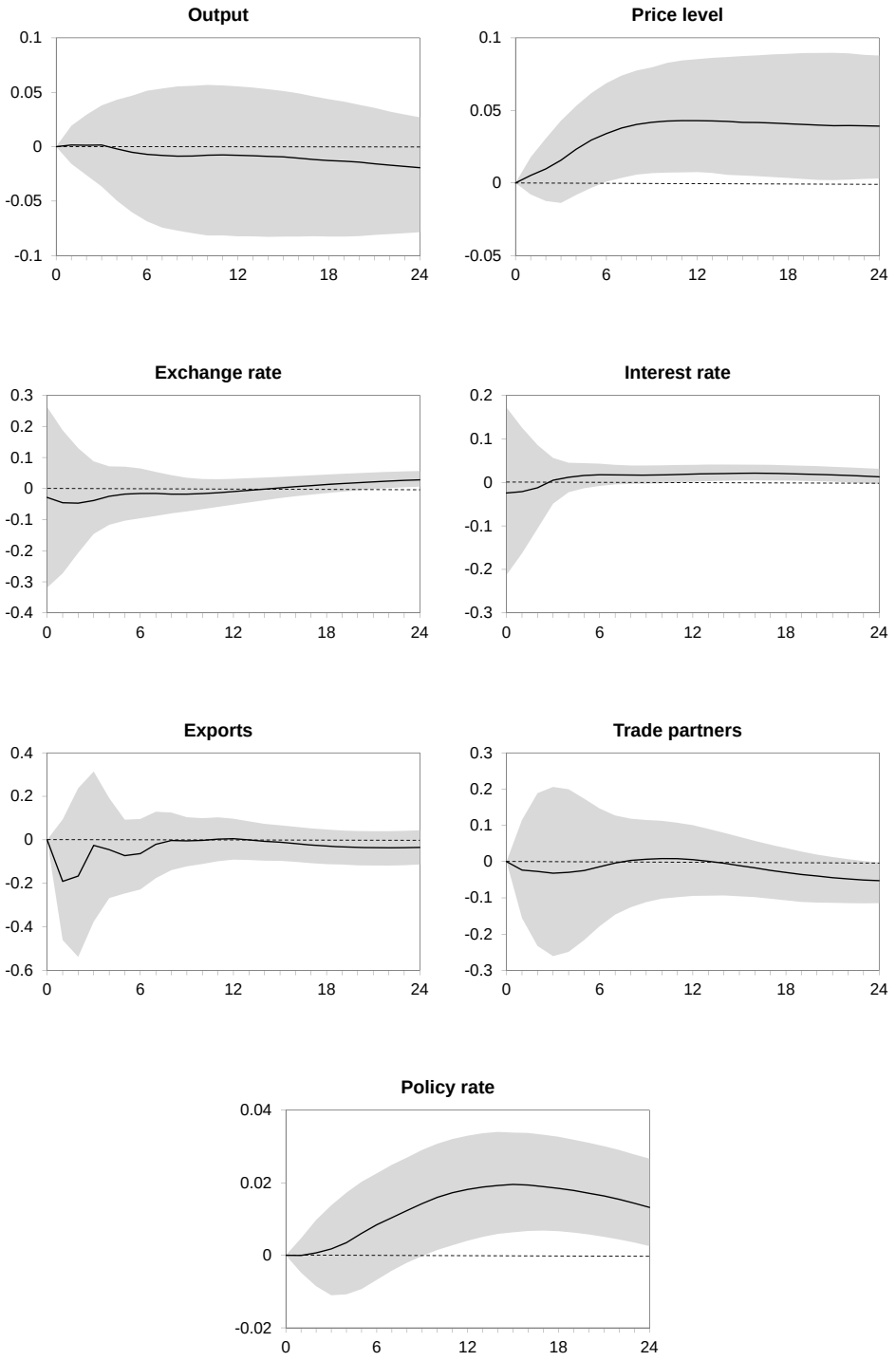
Note: Response of variables to an expansionary one standard deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, the y-axis monthly growth rates in percent for all variables except for the interest rate, which depicts changes in percentage points.

Figure 8: Montenegro: Response to balance sheet shock



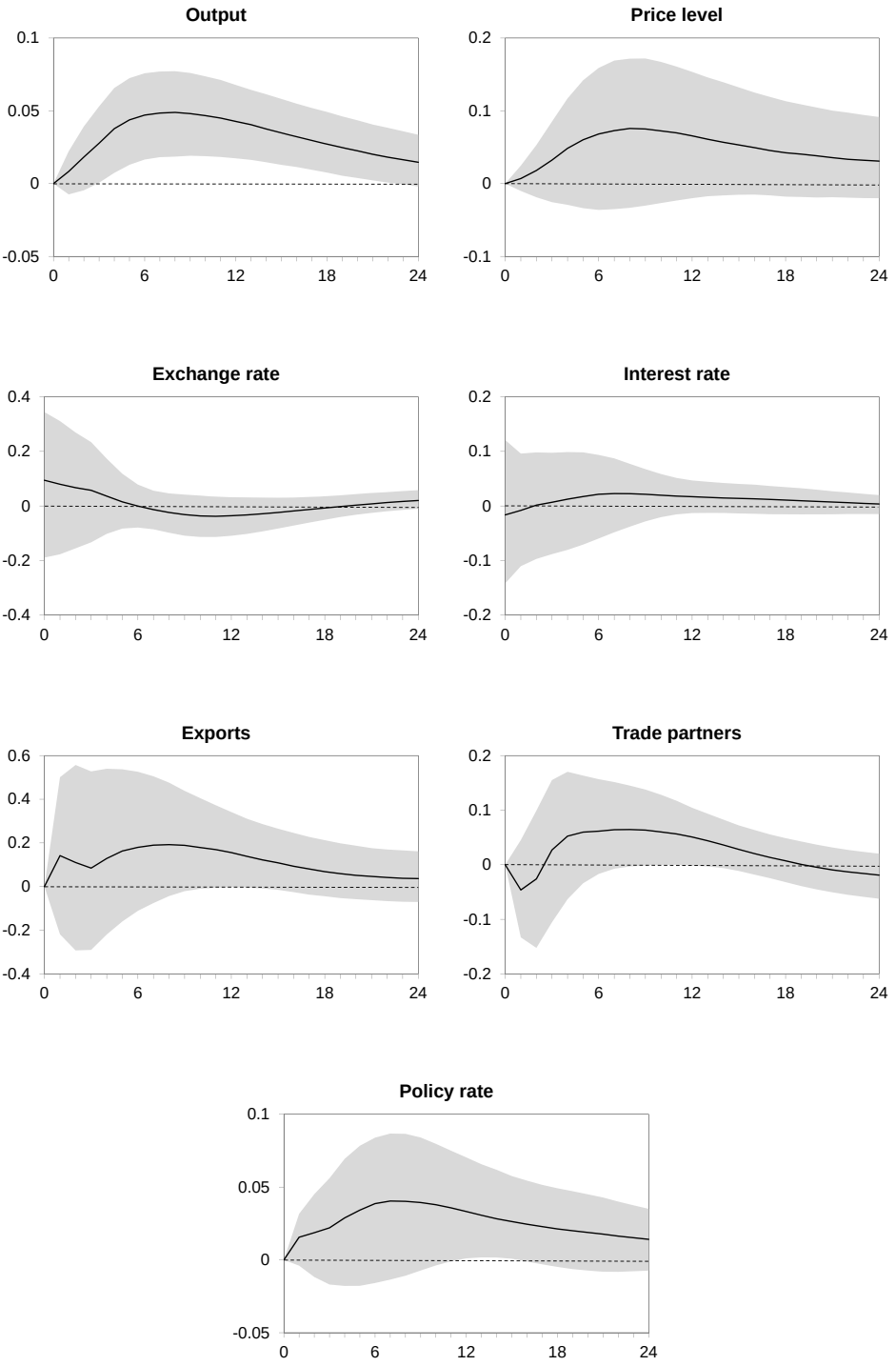
Note: Response of variables to an expansionary one standard deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, the y-axis monthly growth rates in percent for all variables except for the interest rate, which depicts changes in percentage points.

Figure 9: Romania: Response to a balance sheet shock



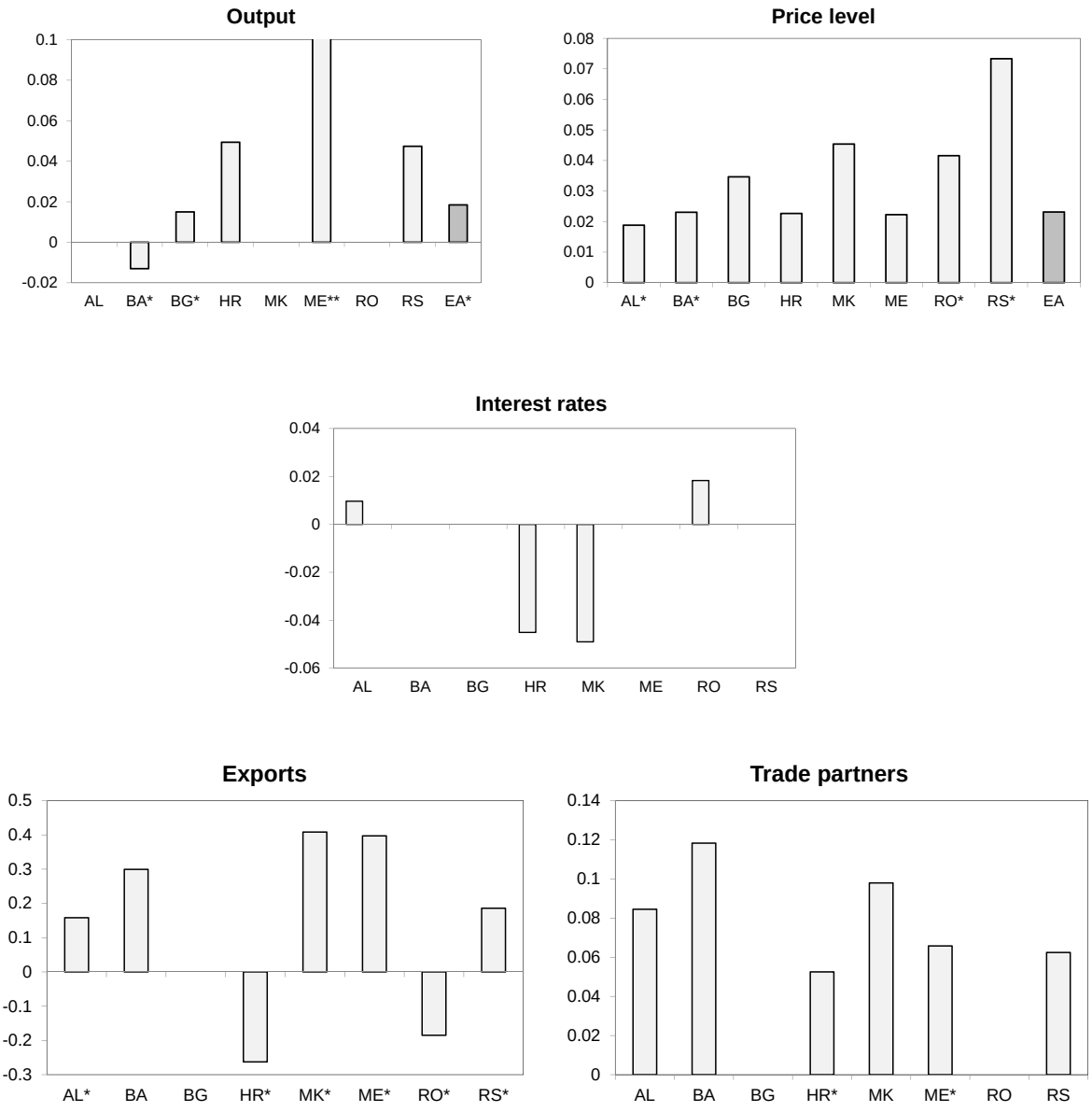
Note: Response of variables to an expansionary one standard deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, the y-axis monthly growth rates in percent for all variables except for interest rates, which depict changes in percentage points.

Figure 10: Serbia: Response to a balance sheet shock



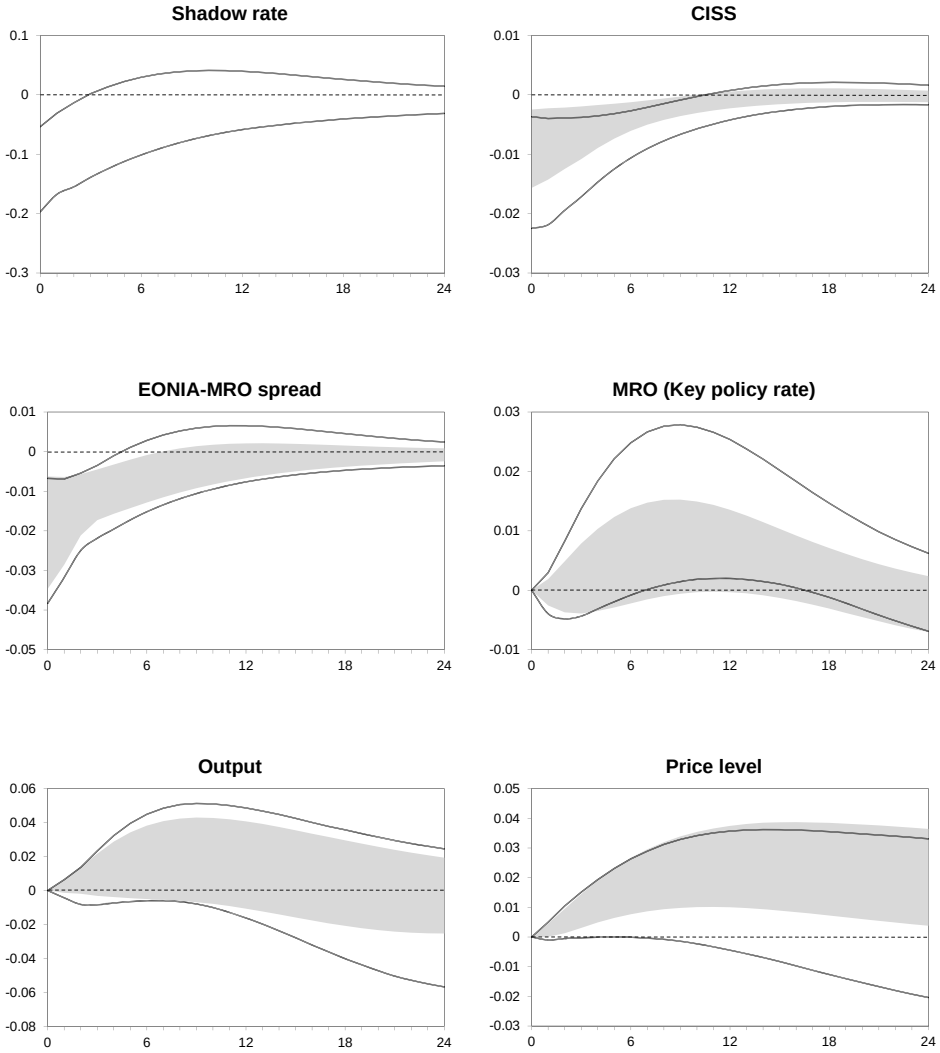
Note: Response of variables to an expansionary one standard deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, the y-axis monthly growth rates in percent for all variables except for interest rates, which depict changes in percentage points.

Figure 11: Comparison of responses to a non-standard monetary policy shock



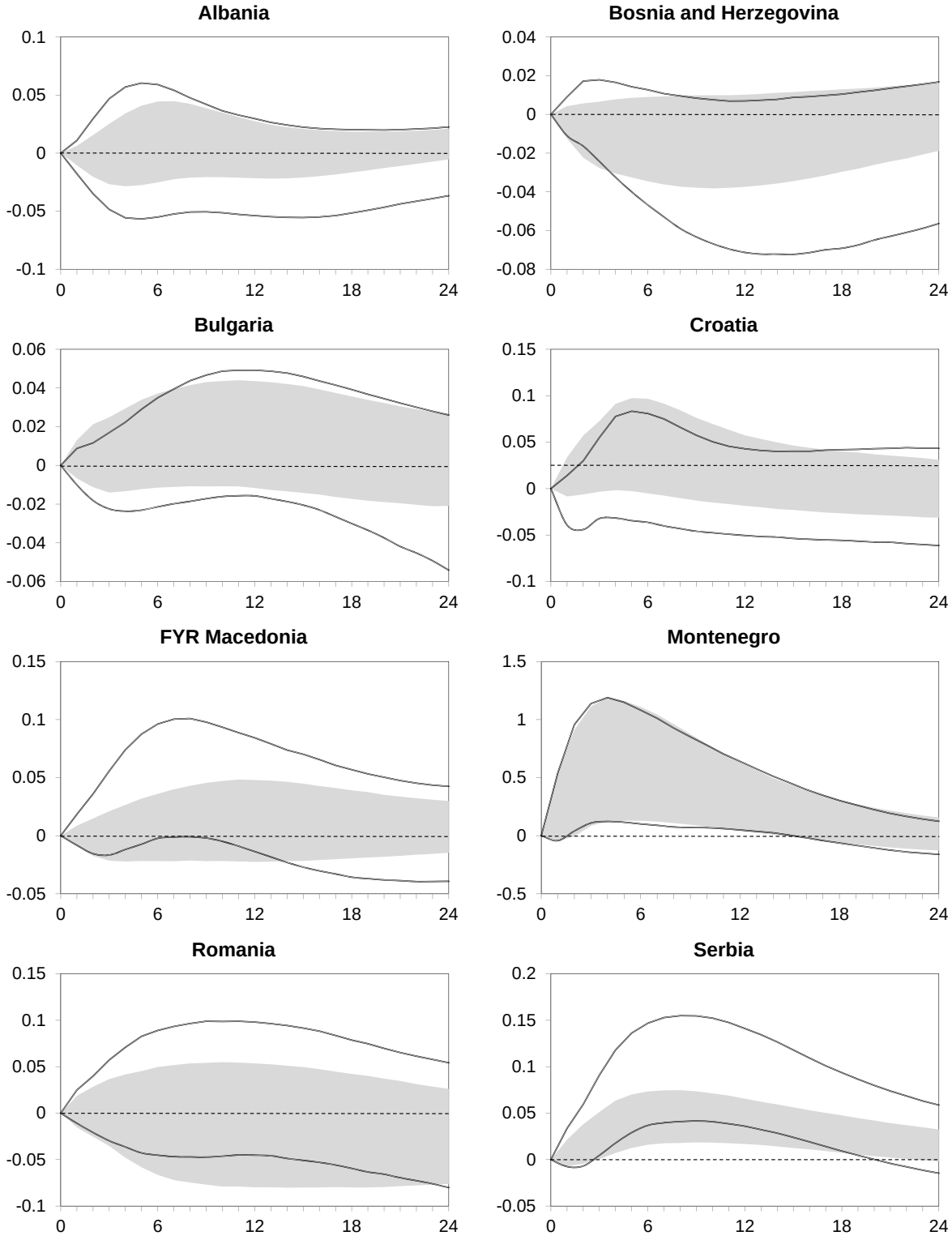
Note: Peak response to expansionary balance sheet shock within the first 12 months in percent. * denotes not strictly credible responses. ** For Montenegro the response of industrial production is depicted.

Figure 12: Euro area: Response to a shadow rate shock



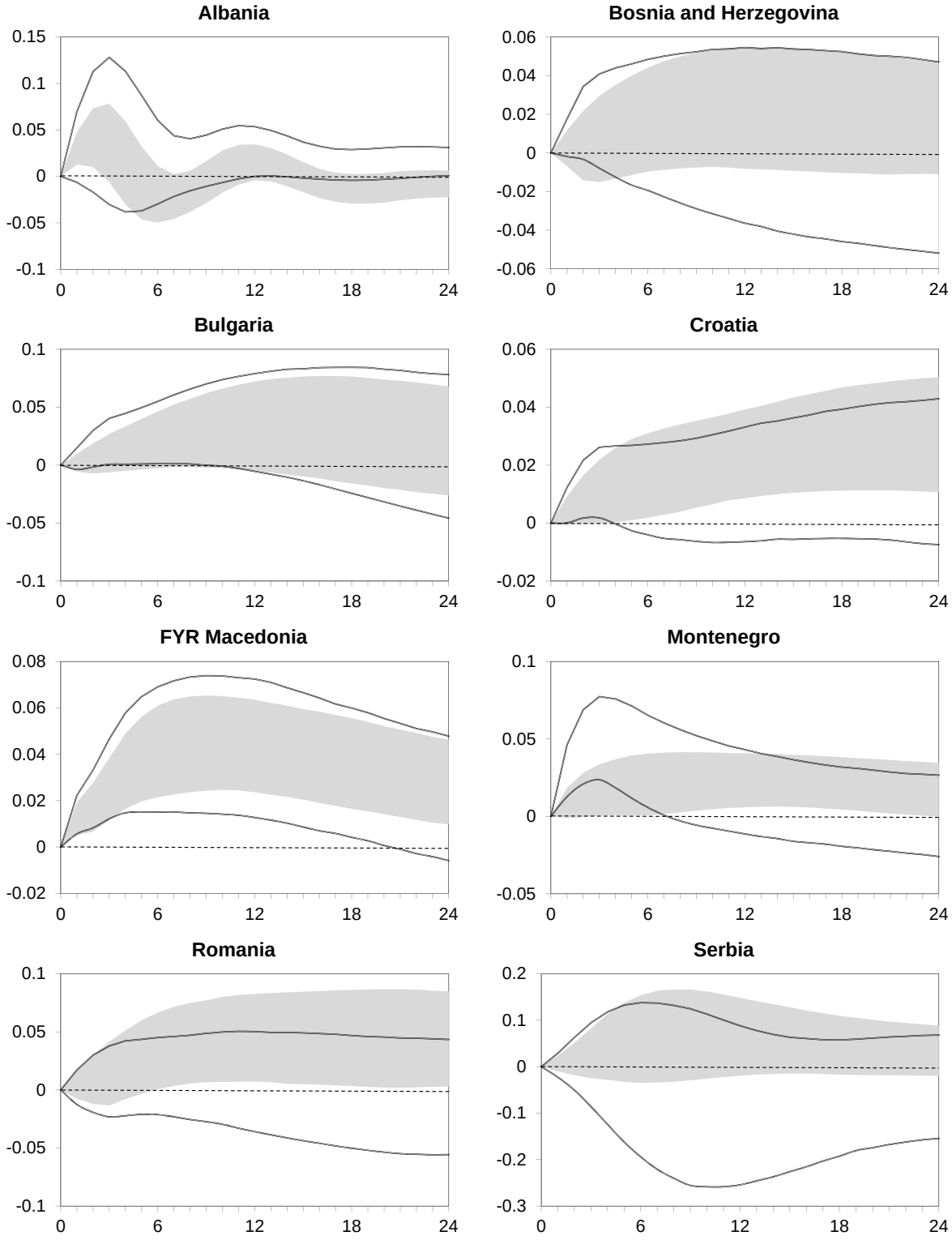
Note: The shaded area represents the 68 percent credibility interval of the benchmark model, while the double lines indicate the credibility interval of the response to an expansionary one standard deviation shadow rate shock.

Figure 13: Response to a shadow rate shock: effect on output



Note: The shaded area represents the 68 percent credibility interval of the benchmark model, while the double lines indicate the credibility interval of the response to an expansionary one standard deviation shadow rate shock. For Montenegro industrial production is taken as a measure for output.

Figure 14: Response to a shadow rate shock: effect on price level



Note: The shaded area represents the 68 percent credibility interval of the benchmark model, while the double lines indicate the credibility interval of the response to an expansionary one standard deviation shadow rate shock.

References

Arias, J. E., Rubio-Ramirez, J. F., and Waggoner, D. F. (2014). Inference based on SVAR identified with sign and zero restrictions: Theory and applications. CEPR Discussion Paper 9796, Centre for Economic Policy Research.

Babecká Kucharčuková, O., Claeys, P., and Vašíček, B. (2016). Spillover of the ECB's monetary policy outside the euro area: How different is conventional from unconventional policy? *Journal of Policy Modeling*, 38:199–225.

Benkovskis, K., Bessonovs, A., Feldkircher, M., and Wörz, 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*, 2011(3):8–36.

Bluwstein, K. and Canova, F. (2016). Beggar-thy-neighbor? The international effects of ECB unconventional monetary policy measures. *International Journal of Central Banking*, 12:69–120.

Boeckx, J., Dossche, M., and Peersman, G. (2017). Effectiveness and transmission of the ECBs balance sheet policies. *International Journal of Central Banking*, 13:297–333.

Burriel, P. and Galesi, A. (2016). Uncovering the heterogeneous effects of ECB unconventional monetary policies accross euro area countries. Working Paper 1631, Banco de Espanã.

Canova, F. (2005). The transmission of US shocks to Latin America. *Journal of Applied Econometrics*, 20:229–251.

Cerutti, E., Ilyina, A., Makarova, Y., and Schmieder, C. (2010). Bankers without borders? Implications of ring-fencing for European cross-border banks. IMF Working Paper WP/10/247, International Monetary Fund.

Chen, Q., Filardo, A., He, D., and Zhu, F. (2012). International spillovers of central bank balance sheet policies. In *Are central bank balance sheets in Asia too large?*, volume 66, pages 220–264. Bank for International Settlements.

Chen, Q., Filardo, A., He, D., and Zhu, F. (2015). Financial crisis, US unconventional monetary policy and international spillovers. BIS Working Paper 494, Bank for International Settlements.

Ciarlone, A. and Colabella, A. (2016). Spillovers of the ECB's non-standard monetary policy into CESEE economies. Occasional Paper 351, Banca d'Italia.

Crespo Cuaresma, J., Doppelhofer, G., Feldkircher, M., and Huber, F. (2016). US monetary policy in a globalized world, mimeo.

Cushman, D. O. and Zha, T. (1997). Identifying monetary policy in a small open economy under flexible exchange rates. *Journal of Money, Credit and Banking*, 39:433–448.

Dieppe, A., Legrand, R., and van Roye, B. (2016). The BEAR toolbox. ECB Working Paper 1934, European Central Bank.

European Central Bank (2016). The international role of the euro. Technical report, ECB.

Falagiarda, M., McQuade, P., and Tirpák, M. (2015). Spillovers from the ECB's non-standard monetary policies on non-euro area EU countries: evidence from an event-study analysis. ECB Working Paper 1869, European Central Bank.

Feldkircher, M. (2015). A global macro model for emerging europe. *Journal of Comparative Economics*, 43:706–726.

Fratzscher, M., Duca, M. L., and Straub, R. (2016). On the international spillovers of US quantitative easing. *The Economic Journal*.

Friedman, M. (1953). *Essays in Positive Economics*, chapter The case for flexible exchange rates. University of Chicago Press.

Gambacorta, L., Hofmann, B., and Peersman, G. (2014). The effectiveness of unconventional monetary policy at the zero lower bound: A cross-country analysis. *Journal of Money, Credit and Banking*, 46:615–642.

Georgiadis, G. (2016). Determinants of global spillovers from US monetary policy. *Journal of International Money and Finance*, 67:41–61.

Georgiadis, G. and Gräb, J. (2015). Global financial market impact of the announcement of the ECB's extended asset purchase programme. Working Paper 232, Federal Reserve Bank of Dallas Globalization and Monetary Policy Institute.

Hájek, J. and Horváth, R. (2016). The spillover effect of euro area on Central and Southeastern European economies: A global VAR approach. *Open Economies Review*, 27:359–385.

Halova, K. and Horváth, R. (2015). International spillovers of ECBs unconventional monetary policy: The effect on Central and Eastern Europe. IOS Working Paper 351, Institut für Ost- und Südosteuropaforschung.

Holló, D., Kremer, M., and Duca, M. L. (2012). CISS - a composite indicator of systemic stress in the financial system. ECB Working Paper 1426, European Central Bank.

International Monetary Fund (2011). Republic of Serbia: Seventh review and inflation consultation under the Stand-By Arrangement. IMF Country Report 11/95.

Jarociński, M. (2010). Responses to monetary policy shocks in the east and the west of Europe: a comparison. *Journal of Applied Econometrics*, 25:833–868.

Jiménez-Rodriguez, R., Morales-Zumaquero, A., and Ègert, B. (2010). The VARying effect of foreign shocks in Central and Eastern Europe. *Journal of Policy Modeling*, 32:461–477.

Krippner, L. (2015). A comment on Wu and Xia (2015), and the case for two-factor Shadow Short Rates. CAMA Working Paper 48/2015, Centre for Applied Macroeconomic Analysis.

Lombardi, M. and Zhu, F. (2014). A shadow policy rate to calibrate US monetary policy at the zero lower bound. BIS Working Paper 452, Bank for International Settlements.

Maćkowiak, B. (2006). How much of the macroeconomic variation in Eastern Europe is attributable to external shocks? *Comparative Economic Studies*, 48:523–544.

Maćkowiak, B. (2007). External shocks, U.S. monetary policy and macroeconomic fluctuations in emerging markets. *Journal of Monetary Economics*, 54:2512–2520.

Meade, J. (1951). *The Theory of International Economic Policy, Vol. 1: The Balance of Payments. Vol. 2: Trade and Welfare, with "Mathematical Supplements."*. Oxford University Press.

Minea, A. and Rault, C. (2011). External monetary shocks and monetary integration: Evidence from the bulgarian currency board. *Economic Modelling*, 28:2271–2281.

Miniane, J. and Rogers, J. H. (2007). Capital controls and the international transmission of U.S. money shocks. *Journal of Money, Credit and Banking*, 39:1003–1035.

Peersman, G. (2011). Macroeconomic effects of unconventional monetary policy in the euro area. ECB Working Paper 1397, European Central Bank.

Petrevski, G., Exterkate, P., Tevdovski, D., and Bogoev, J. (2015). The transmission of foreign shocks to South Eastern European economies: A Bayesian VAR approach. *Economic Systems*, (39):632–643.

Potjagailo, G. (2017). Spillover effects from euro area monetary policy across the EU: a factor-augmented VAR approach. *Journal of International Money and Finance*, 72:127–147.

Sahay, R., Arora, V., Arvanitis, T., Faruqee, H., N'Diaye, P., and Mancini-Griffoli, T. (2014). Emerging market volatility: Lessons from the taper tantrum. IMF Staff Discussion Note SDN/14/09, International Monetary Fund.

Wu, J. C. and Xia, F. D. (2016). Measuring the macroeconomic impact of monetary policy at the zero lower bound. *Journal of Money, Credit and Banking*, 48:253–291.

Acknowledgements

I would like to thank Martin Feldkircher, Philipp Harms, Éva Katalin Polgár, Georgios Georgiadis, the members of the ESCB's International Relations Committee, participants of the JGU Mainz Brown Bag Seminar and of an internal ECB seminar, and an anonymous referee for helpful comments and suggestions; and Li Savelin for data assistance. The views expressed in this paper are mine and do not necessarily reflect those of the ECB or of the ESCB.

Isabella Moder
European Central Bank, Frankfurt am Main, Germany; email: isabella.moder@ecb.europa.eu

Postal address	60640 Frankfurt am Main, Germany
Telephone	+49 69 1344 0
Website	www.ecb.europa.eu

ISSN	1725-2806 (pdf)	DOI	10.2866/830401 (pdf)
ISBN	978-92-899-2817-5 (pdf)	EU catalogue No	QB-AR-17-107-EN-N (pdf)