Spillovers from the ECB's Non-standard Monetary Policy Measures on Southeastern Europe*

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This paper is the first to comprehensively assess the impact of the euro area's non-standard monetary policy measures on southeastern Europe. The outcomes of bilateral BVAR models suggest that the ECB's non-standard monetary policy measures have had pronounced price effects on all, and output effects on approximately half, of the countries in southeastern Europe. While I find evidence that exports have posed as relevant transmission channels in most cases, the role of the interbank market rate as a channel of shock transmission is less clear. Furthermore, the results suggest that exchange rates' responses have been relatively muted.

JEL Codes: C11, C32, E52, F42.

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 programs. Assessing potential spillovers from monetary policy measures of advanced economies has become important in a globalized world, and this incorporates not only potential

*I would like to thank the editor, two anonymous referees, Martin Feldkircher, Philipp Harms, Éva Katalin Polgár, Georgios Georgiadis, the members of the ESCB's International Relations Committee, and participants of the JGU Mainz Brown Bag Seminar and of an internal ECB seminar for helpful comments and suggestions. The views expressed in this paper are mine and do not necessarily reflect those of the ECB or of the ESCB. Author contact: isabella.moder@ecb.europa.eu.

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 Federal Reserve announced that it would gradually turn off its bond-buying program, 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 policymakers in order to design optimum policy responses, both to spillovers from the introduction of such measures and 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 European Union (EU) accession. More specifically, this paper deals with the countries of southeastern Europe (SEE) that can be regarded as transition countries with respect to their economic development stage.[1] 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 bank subsidiaries headquartered in the euro area and (correspondingly) a high degree of euroization[2] 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) floating exchange rates (Albania, Romania, and Serbia), to stabilized arrangements with the euro as a reference currency (Croatia and North Macedonia), to euro-based

[1]This is in contrast to Baltic and central European countries, where convergence towards the "old" EU member states progressed further than in SEE countries.

[2]Either through high unofficial asset and liability euroization 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.

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 members (Bulgaria, Croatia, and 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.[3] 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, exports, short-term interest rate, and (if applicable) exchange rate 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 in a positive and pronounced way. Furthermore, spillovers seem to be mostly transmitted via exports, while in only a few cases the interbank interest rate (used as a proxy for the financial channel) exhibits a clear response to the shock. Additionally, the results suggest that in countries operating under a flexible exchange rate regime, exchange rates did not react strongly to the non-standard monetary shock, which is in line with the 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

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

transmission channels are discussed both from a cross-country perspective and for each country individually in section 4. Section 5 documents robustness tests undertaken in order to cement the results. Section 6 concludes.

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 United States) to emerging economies (eight countries in Latin America), followed by other papers modeling spillovers from U.S. 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, and Benkovskis et al. 2011). On SEE countries, the literature on 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, Morales-Zumaquero, and Ègert 2010; Minea and Rault 2011; Feldkircher 2015; Petrevski et al. 2015; Hájek and Horváth 2016; and Potjagailo 2017, using near-VAR, VAR, GVAR, SVAR, and FAVAR models). Moreover, to the best of my knowledge, four SEE countries[4] have not yet been covered in the spillover literature at all.

The introduction of non-standard measures in October 2008 and the subsequent expansion and ongoing usage of several different unconventional instruments brought a new angle into the academic and policy discussion of euro-area monetary policy spillovers to countries outside the euro area.[5] However, given that the global experience with non-standard monetary policy is restricted (with a

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

[5]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, Dossche, and Peersman (2017); Burriel and Galesi (2018).

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 indexes, CDS spreads, or exchange rates); see, for example, Fratzscher, Lo Duca, and Straub (2016) for spillovers of U.S., and Georgiadis and Gräb (2015) as well as Falagiarda, McQuade, and Tirpák (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 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 programs 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, Claeys, and Vašíček (2016) investigate spillovers on six EU non-euro-area countries, among them three in CEE (Czech Republic, Hungary, and Poland). They conclude that the spillovers of unconventional shocks are transmitted differently than those of 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 and low-frequency macroeconomic data. They find that output effects of unconventional monetary policy measures were insignificant for

CEE countries (Czech Republic, Hungary, and Poland) and slightly negative for SEE countries (Bulgaria and 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). Contrary to Bluwstein and Canova (2016) and Babecká Kucharčuková, Claeys, and Vašíček (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, following the argument that flexible exchange rates are better suited to buffer real external shocks (based on Meade 1951 and 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 high external imbalances tend to amplify spillovers from U.S. 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.

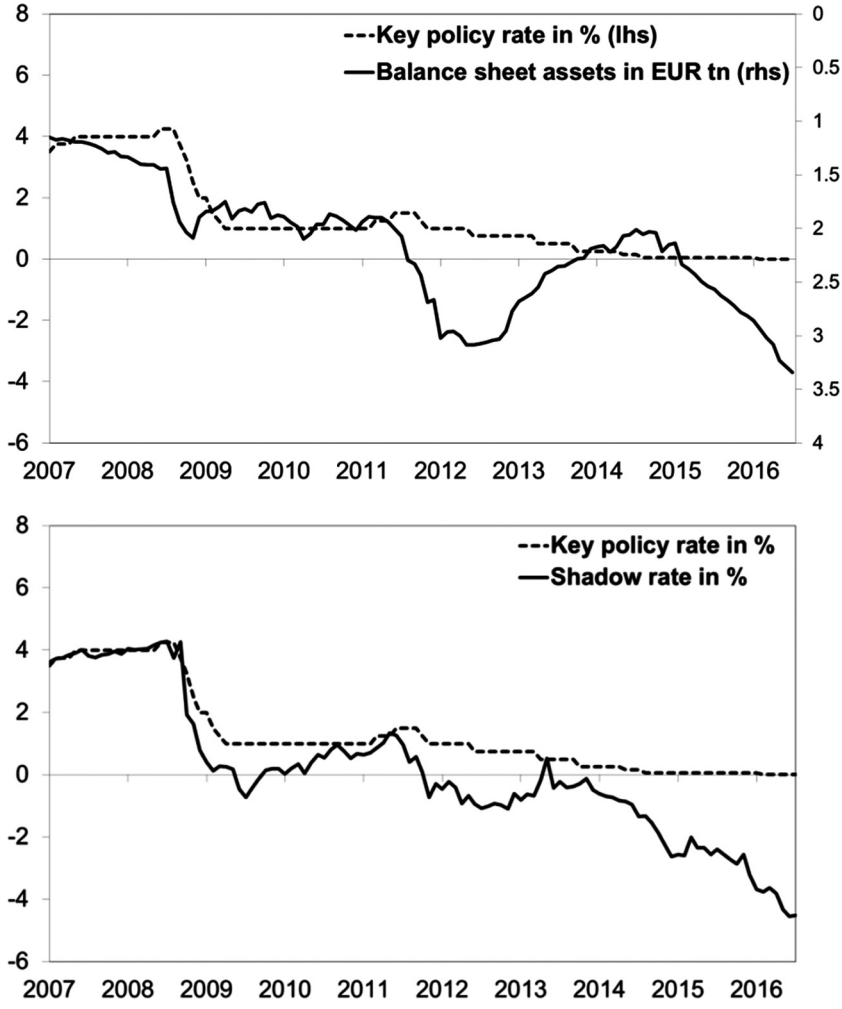
3. Methodology

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 behavior that does not necessarily transmit into the real economy. Second, the event-study approach requires developed financial markets to investigate the behavior 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 with 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, Hofmann, and Peersman 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

Figure 1. Indicators of Non-standard Monetary Policy Measures



Sources: ECB, Wu and Xia (2016).

October 2008, and thereafter fluctuated with the introduction and phase-out of the different programs. 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, Dossche, and Peersman 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, Dossche, and Peersman (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 programs. Compared with 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' behavior.

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:

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

where $y_1(t)$ represents a vector of macroeconomic variables of the SEE country, $y_2(t)$ represents a vector of macroeconomic variables of the euro area, and the vectors c_{11}, c_{21} are 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 modeling 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 variables:

$$y_1 = \begin{pmatrix} y_t^{SEE} & p_t^{SEE} \end{pmatrix}',$$

where y_t^{SEE} denotes output and p_t^{SEE} denotes prices of the respective SEE country. At a second stage, in order to investigate potential transmission channels, the vector y_1 includes either exports,[6] x_t^{SEE}, the interbank market rate of the respective SEE country, i_t^{SEE}, or the exchange rate of the local currency vis-à-vis the euro, e_t, for countries that are operating under a flexible exchange rate regime. The vector y_2 represents the euro area and includes six variables:

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

where y_t^{EA} and p_t^{EA} again denote output and prices, respectively, but this time for the euro area, and $assets_t^{EA}$ represents Eurosystem balance sheet assets as the main measure for non-standard monetary policy (as discussed in subsection 3.1). Moreover, following Gambacorta, Hofmann, and Peersman (2014), Boeckx, Dossche, and Peersman (2017), and Burriel and Galesi (2018), I include the

[6]In order to account for indirect spillovers, exports to the world (instead of only to the euro area) are used.

CISS indicator (composite indicator of systemic stress) developed by Holló, Kremer, and Lo Duca (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 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 better suited for shorter data sets compared with frequentist methods. 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 (Bayesian estimation, analysis, and regression) toolbox developed by Dieppe, Legrand, and van Roye (2016). 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 behavior 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, Legrand, and van Roye (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 Bayesian information criterion (BIC) suggests a lag length of 1; however, testing for autoregressive behavior of the residuals suggests that a model specification of four 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, Rubio-Ramirez, and Waggoner (2014) (see Dieppe, Legrand, and van Roye 2016). The non-standard

Table 1. Sign and Zero Restrictions for the Shock Identification of the Baseline Model

$assets_t^{EA}$	$CISS_t$	$spread_t^{EA}$	MRO_t	y_t^{EA}	p_t^{EA}	y_t^{SEE}	p_t^{SEE}
+ 0–1	– 0–1	– 0–1	0	0	0	0	0

Note: 0 indicates that the immediate response is restricted, while + (–) indicates that only a positive (negative) reaction is permitted in the respective period.

monetary policy shock is the only identified shock in the model (see table 1). 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's output and price level. An expansionary non-standard monetary policy shock increases the Eurosystem balance sheet assets on impact and in the first month following the shock, while the CISS indicator as well as the spread between 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, Dossche, and Peersman (2017) and Burriel and Galesi (2018). 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 EONIA increase (see Boeckx, Dossche, and Peersman 2017). Vice versa, a balance sheet expansion that is caused by an ECB monetary policy measure should not increase but *decrease* both financial stress and the demand for liquidity, which is exactly the assumption taken in the shock identification. 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. Similarly, zero restrictions are placed on output and price responses of the SEE country, in order to disentangle the potential spillover from domestic real economy disturbances.[7] The

[7]For the same reason, a zero restriction is put on exports in the subsequent estimations on potential transmission channels.

Table 2. Acceptance Rates of Structural Matrices (in %)

Albania	13.93
Bosnia and Herzegovina	12.21
Bulgaria	13.71
Croatia	11.95
North Macedonia	13.40
Montenegro	12.24
Romania	11.96
Serbia	13.12

non-standard monetary policy shock is the only shock identified. The acceptance rates of the structural matrices from the baseline models are depicted in table 2.

3.4 Data

The time span of the baseline model covers the period between January 2008 and December 2017. As a measure of output I use GDP, interpolated by the Chow-Lin method with industrial production to obtain data with monthly frequency.[8] The price level is measured as the consumer price inflation (harmonized consumer price inflation in the case of EU countries) index. As indicator for a potential financial channel I use short-term interest rates, since time series on asset prices or longer-term interest rates are not available for all countries. More specifically, I include monthly 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 of two-thirds of retail deposit rates and one-third of retail lending

[8]The exception is Montenegro, where GDP is not available for the whole time span and therefore industrial production is used as a measure for output.

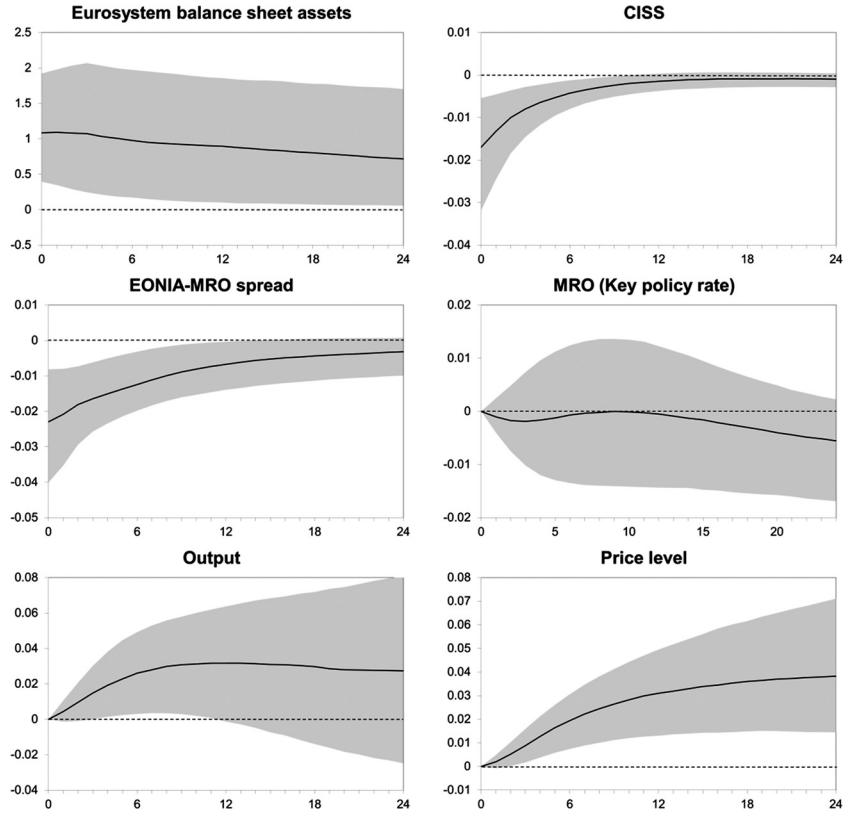
rates, both in the corporate sector. All exchange rates are expressed in average local currency vis-à-vis the euro, so an increase in the exchange rate depicts depreciation and vice versa. Data on exports, which are derived from the International Monetary Fund's (IMF's) Direction of Trade Statistics and converted into euros, are limited to merchandise exports, which means that service exports are not captured in the model. All variables enter the model in monthly frequency and in levels. Moreover, all variables are seasonally adjusted by the U.S. Census Bureau's X-13 seasonal adjustment procedure 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 Eurosystem 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. It can be observed that the one-standard-deviation (1.1 percent increase) balance sheet shock is very persistent, as it remains almost unchanged for two years. Both the accompanying decline of the CISS indicator and the decrease of the EONIA-MRO spread are less persistent but do not fade out completely until the end of the two-year horizon. The response of the MRO (key policy rate) to the non-standard monetary policy shock is ambiguous. Turning to the macroeconomic effects, the impulse responses suggest that output rises gradually, with a peak increase of 0.03 percent after eleven months. The price-level increase reaches 0.04 percent after two years and, in line with economic theory, the response seems to be relatively persistent.

Figure 2. Euro Area: Response to a Balance Sheet Shock

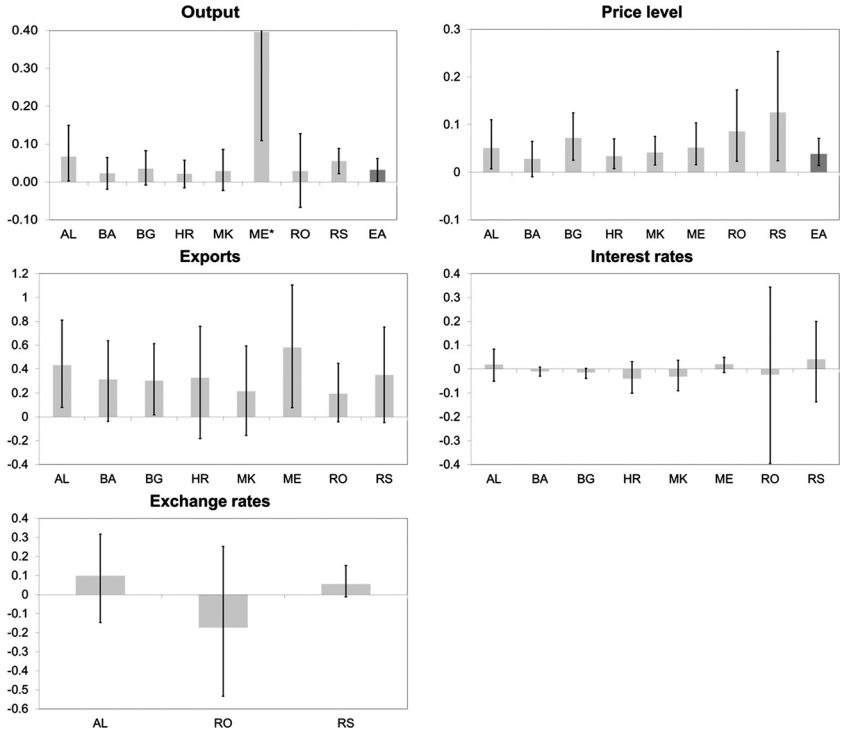


Notes: The figure shows the response of variables to an expansionary one-standard-deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, and the y-axis reports monthly growth rates in percent for all variables except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

4.2 Spillovers to SEE Countries and Their Transmission Channels

Turning to the SEE countries, the results suggest that spillovers from a euro-area expansionary non-standard monetary policy shock are positive (see figure 3, upper-left panel). In the three countries that exhibit the highest magnitude in their shock response

Figure 3. Comparison of Responses to a Non-standard Monetary Policy Shock



Note: The figure shows the peak response to an expansionary balance sheet shock within the first twenty-four months in percent.
*For Montenegro, output refers to industrial production instead of GDP. The results are derived from the baseline model (output and price level) as well as separate models including exports, interest rates, and exchange rates.

(Montenegro,[9] Albania, and Serbia), it is credible within the 68 percent interval. Moreover, in half of the countries the response of output seems to be stronger than in the euro area.

Price-level responses are positive in all countries and lie (with one exception) within the 68 percent credibility interval (see figure 3, upper-right panel). It can be observed that the peak response is by

[9]It should be noted that for Montenegro, the response of industrial production instead of GDP is depicted, which explains the magnitude.

far the strongest for Serbia (at 0.13 percent), followed by Romania and Bulgaria. The relatively strong price responses, which are in most 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.

In order to shed light on potential transmission channels, I estimate spillovers on exports and interbank interest rates in separate models, where the vector $y_2(t)$ for the identification of the euro-area shock remains unchanged but the vector $y_1(t)$ contains either exports or short-term interest rates. For exports, the peak response is depicted in the center-left panel of figure 3. The impact of a non-standard monetary policy shock on SEE exports is positive in all countries, suggesting that exports are indeed an important channel of shock transmission, and it is credible within a 68 percent interval in three countries. The largest magnitude of the shock response can be observed for Montenegro, Albania, and Serbia, which corresponds to the relative magnitude of their output reaction and thus suggests that exports are indeed a relevant transmission channel.

Turning to short-term interest rates, the peak responses across countries are heterogeneous in sign and magnitude, and surrounded by large uncertainty bands. One reason for the weak model output might be the relatively illiquid interbank money markets in SEE countries. Thus this result should not necessarily be taken as proof that financial channels do not transmit non-standard monetary policy shocks from the euro area to SEE countries, as changes in the interbank market rate do not capture foreign direct or portfolio inflows.

Comparing the peak responses across countries, the results suggest that the inflation-targeting countries which operate under a managed or flexible exchange regime were equally affected by spillovers as countries that have pegged their currency to the euro. This result is not surprising when the model output on exchange rate responses is taken into account (figure 3, lower-left panel), where the peak responses in Albania and Serbia suggest an exchange rate depreciation (rather than an appreciation, which would be expected by economic theory) and in Romania the peak appreciation is surrounded by a large uncertainty band. This is in line with the very stable exchange rates observed for Albania and Romania in the sample period. Moreover, between January 2008 and December 2017 the

Table 3. Forecast Error Variance

	Output	Price Level
Euro Area	1.24	4.94
Albania	3.98	3.10
Bosnia and Herzegovina	0.67	1.21
Bulgaria	1.45	4.23
Croatia	0.73	1.66
North Macedonia	1.04	2.68
Montenegro	1.29	3.78
Romania	0.83	4.27
Serbia	2.45	3.04

Note: Percentage of the variance of the respective variables explained by a non-standard monetary policy shock after twenty-four months.

central banks of Albania, Romania, and Serbia eased their monetary policy stance by decreasing their interest rates by a total of 500, 625, and 650 basis points, respectively, which might have counteracted appreciation pressures on the exchange rate. The finding that in SEE flexible exchange rates did not respond strongly to non-standard monetary policy shocks during the period under review 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).

4.3 The Importance of Euro-Area Non-standard Monetary Policy Shocks for SEE Countries

Besides analyzing the peak effect from non-standard monetary policy shocks on certain macroeconomic variables in SEE, it is also important to assess how much of the variance of output and prices can be explained by non-standard monetary policy shocks. Table 3 presents the percentage of the forecast error variance of output and price explained by a non-standard monetary policy shock. For the euro area itself, non-standard monetary policy shocks account for

1.24 percent of the fluctuations of GDP and 4.94 percent of the fluctuations of the price level after two years. In a similar vein, for most SEE countries the degree of variance explained by euro-area non-standard monetary policy shocks is higher for prices than for output. Comparing the forecast error variance of output among SEE countries, Albania, Serbia, and Bulgaria are the countries most exposed to euro-area non-standard monetary policy shocks, and in half of the countries the movements in output are larger than the output variability in the euro area, which is in line with the analysis from impulse response functions. With regard to the price level, the highest variability among SEE countries can be observed in Romania, Bulgaria, and Montenegro, which is again mostly in line with the previous analysis. However, the explanatory power of the non-standard monetary policy shock in price levels is lower in SEE countries than in the euro area.

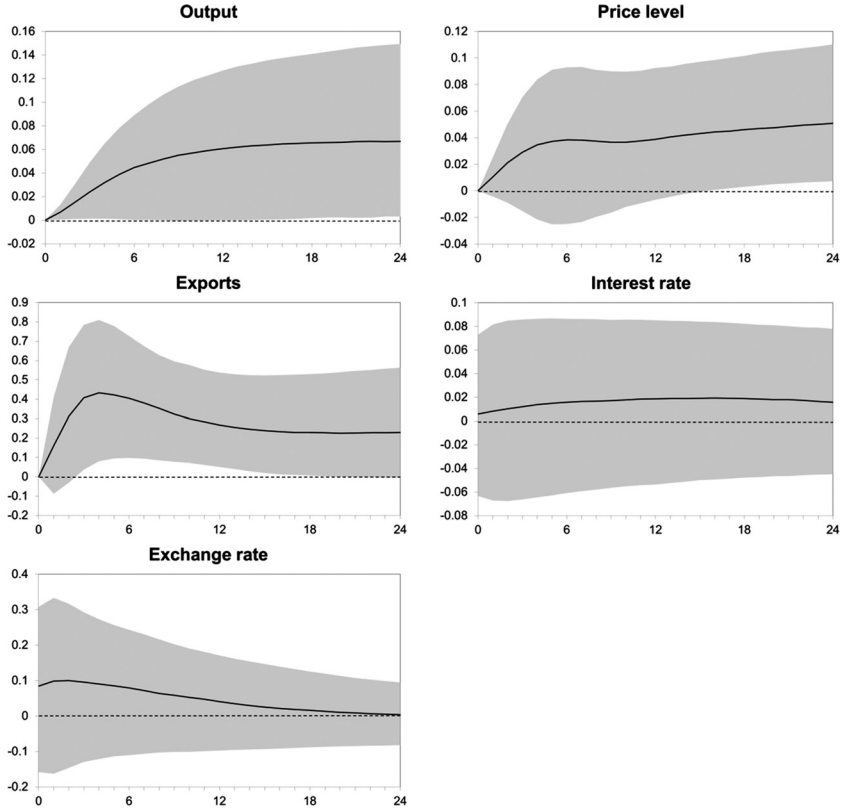
4.4 Results for Individual SEE Countries

The response of the Albanian economy to a non-standard monetary policy shock is shown in figure 4. An expansionary euro-area balance sheet shock raises output by 0.07 percent and prices by 0.05 percent after two years. Albania's exports rise as a response to the balance sheet shock, peaking at 0.43 percent after five months, suggesting that exports are an important transmission channel to explain the relatively strong spillover to the Albanian economy. The response of the interbank interest rate on the other hand seems to be muted. Also, the exchange rate of the lek vis-à-vis the euro does not exhibit an unambiguous response to the shock, which is in line with the fact that it has fluctuated only slightly against the euro in the sample period.[10]

In the case of Bosnia and Herzegovina, the economic response to a non-standard euro-area monetary policy shock is depicted in figure 5. Output shows initially a slightly negative response which turns positive after seven months, but the uncertainty band surrounding the response is relatively high. Notwithstanding the mixed output response, the price level increases gradually, with a peak

[10]Between 2008 and 2017 the average monthly fluctuation against the euro amounted to 0.5 percent.

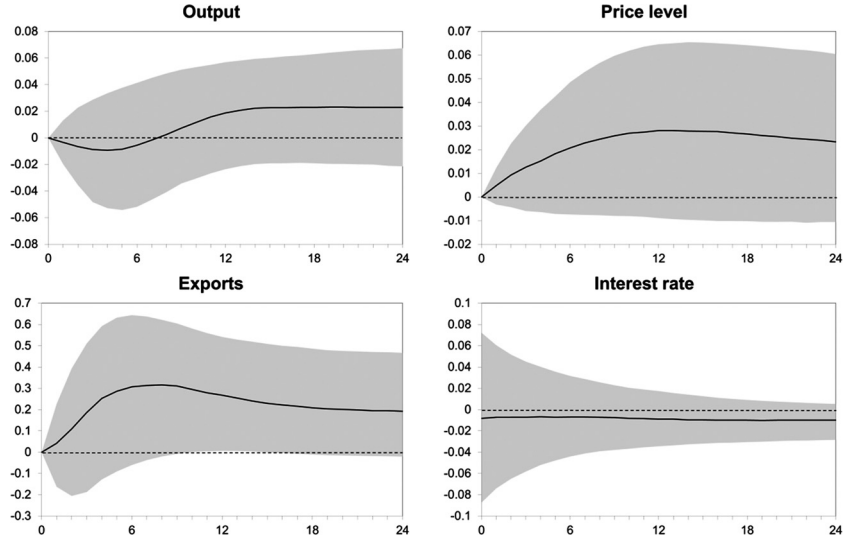
Figure 4. Albania: Response to a Balance Sheet Shock



Notes: The figure shows the 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, and the y-axis reports monthly growth rates in percent for all variables except for interest rates, which depict changes in percentage points. The results are derived from the baseline model (output and price level) as well as separate models including exports, the interest rate, and the exchange rate.

increase of 0.03 percent after twelve months. Exports react in a pronounced manner, with a peak response of 0.32 percent after nine months. The uncertainty band of the interest rate response (which in Bosnia and Herzegovina's case is a composite retail rate) is relatively wide in the short term but becomes more significant in the medium term, with a decrease of 0.01 percentage points.

Figure 5. Bosnia and Herzegovina: Response to a Balance Sheet Shock

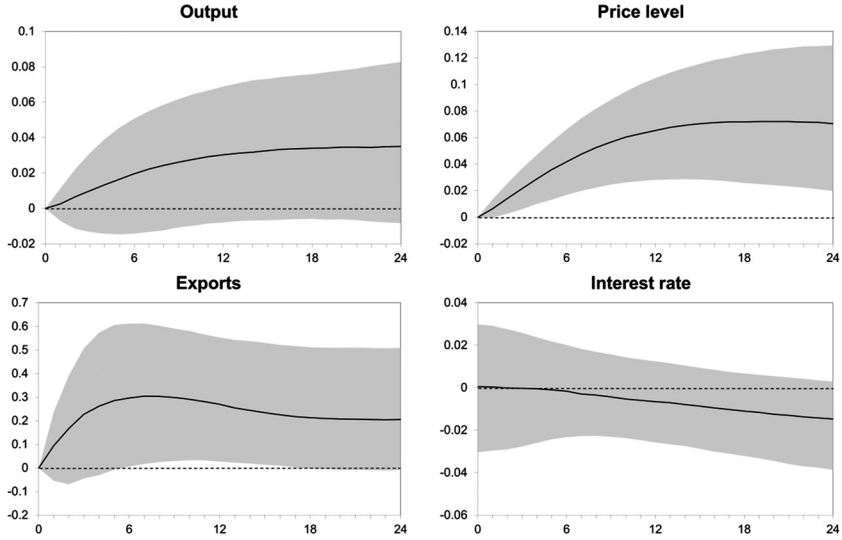


Notes: The figure shows the response of variables to an expansionary one-standard-deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, and the y-axis reports monthly growth rates in percent for all variables except for the interest rate, which depicts changes in percentage points. The results are derived from the baseline model (output and price level) as well as separate models including exports and the interest rate.

For Bulgaria (see figure 6), the output response is positive, with an increase of 0.04 percent after two years. The price level exhibits a pronounced increase, reaching the peak of 0.07 percent after nineteen months. The export channel seems to be relevant also in the case of Bulgaria, as exports rise, with a peak of 0.30 percent after eight months. The interbank interest rate does not react in the short run, but in the medium term it exhibits a decrease of 0.01 percentage point at the end of the two-year horizon. The marked reaction of output and prices in Bulgaria are in line with the results of Hájek and Horváth (2016) for spillovers of positive short-term interest rate shocks.

In the case of Croatia (see figure 7), the response of output is positive and peaks at 0.02 percent after twelve months, although it

Figure 6. Bulgaria: Response to a Balance Sheet Shock

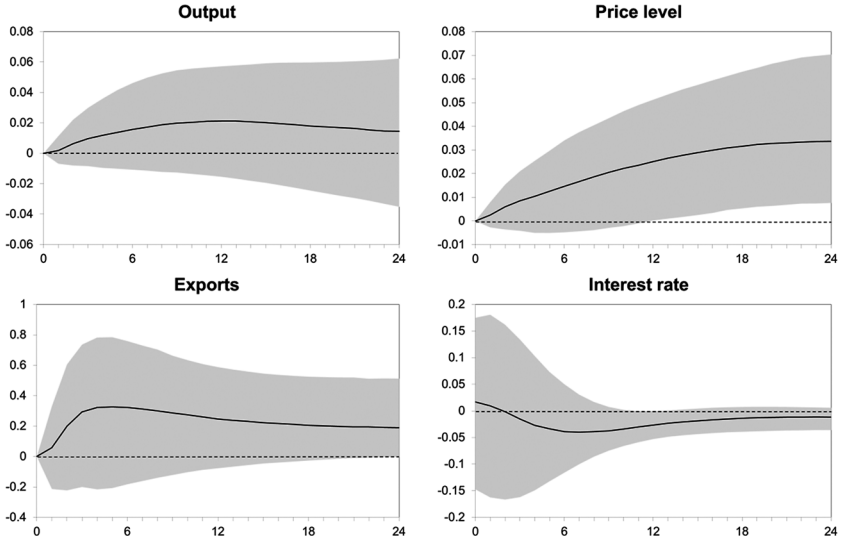


Notes: The figure shows the response of variables to an expansionary one-standard-deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, and the y-axis reports monthly growth rates in percent for all variables except for the interest rate, which depicts changes in percentage points. The results are derived from the baseline model (output and price level) as well as separate models including exports and the interest rate.

is surrounded by some uncertainty. The response of the price level is more significant and exhibits an increase of 0.03 percent at the end of the two-year horizon. Both the output and the price response are in line with what Hájek and Horváth (2016) find for policy spillovers of positive short-term interest rate shocks.[11] Furthermore, the export response peaks at 0.33 percent after six months, while the interbank market rate decreases, with a trough of 0.04 percentage point after eight months. The results suggest that both exports and financial channels might be relevant in transmitting shocks from non-standard monetary policy measures in the euro area to Croatia.

[11]Conversely, Petrevski et al. (2015) find that the same shock *increases* Croatia's price level.

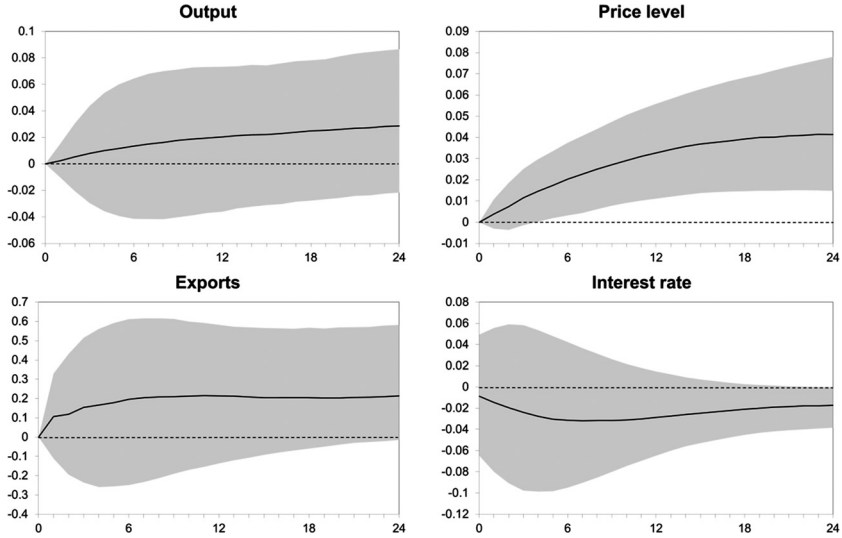
Figure 7. Croatia: Response to a Balance Sheet Shock



Notes: The figure shows the 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, and the y-axis reports monthly growth rates in percent for all variables except for the interest rate, which depicts changes in percentage points. The results are derived from the baseline model (output and price level) as well as separate models including exports and the interest rate.

The response of the economy of North Macedonia is depicted in figure 8. 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 positive, with a peak of 0.04 percent after twenty-three months. Exports peak—although not strictly significantly—at 0.22 percent after twelve months. The interbank market rate decreases by a maximum of 0.03 percentage point after eight months, with the response being relatively persistent and becoming more significant towards the end of the horizon, suggesting that financial spillovers could play a role at least in the medium term. The results for the interest rate response are in line with Petrevski et al. (2015) for a positive short-term interest rate shock; however, they find a different response of the price level.

Figure 8. North Macedonia: Response to a Balance Sheet Shock

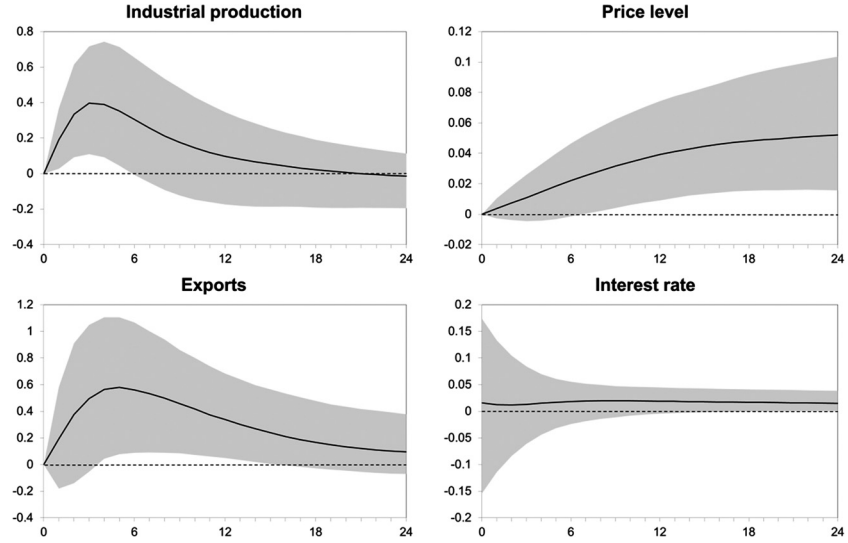


Notes: The figure shows the response of variables to an expansionary one-standard-deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, and the y-axis reports monthly growth rates in percent for all variables except for the interest rate, which depicts changes in percentage points. The results are derived from the baseline model (output and price level) as well as separate models including exports and the interest rate.

For Montenegro, an exogenous expansion of the Eurosystem's balance sheet translates into a pronounced rise of industrial production by 0.40 percent after three months (see figure 9). The price level also increases by 0.05 percent at the end of the two-year horizon. Montenegro's exports seem to rise by 0.58 percent after six months, suggesting that an increase in exports might explain the rise in industrial production and prices. The uncertainty of the interest rate response, which is in the case of Montenegro a composite of three- and six-month T-bill rates, is very high in the short term, while in the medium term the increase in interest rates becomes more significant.

Spillovers to Romanian output from the non-standard monetary policy shock are not very pronounced (compare figure 10). This

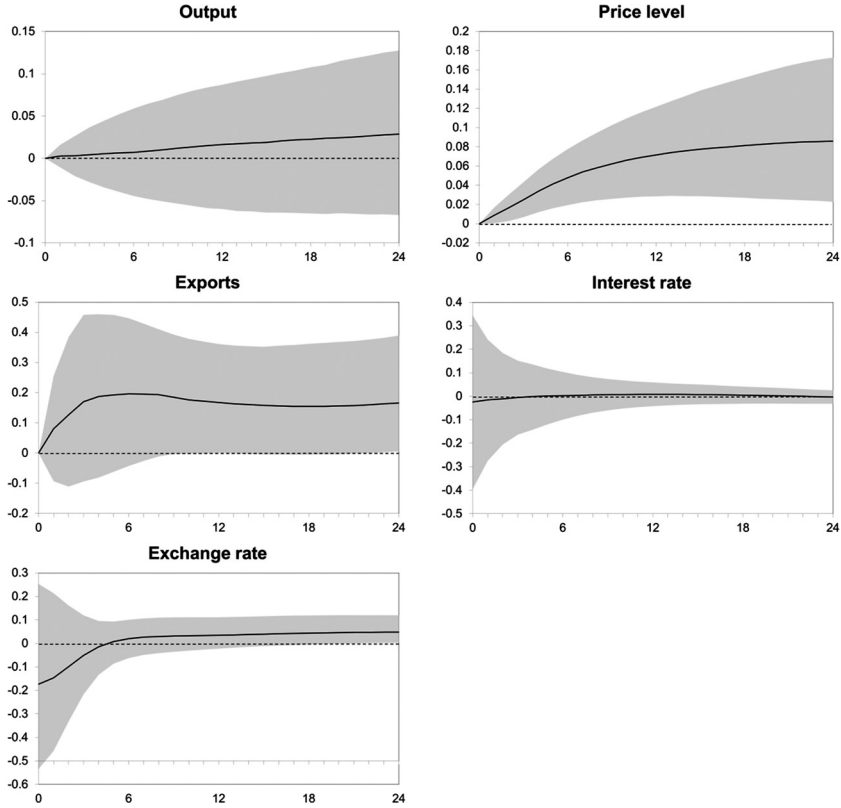
Figure 9. Montenegro: Response to a Balance Sheet Shock



Notes: The figure shows the 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, and the y-axis reports monthly growth rates in percent for all variables except for the interest rate, which depicts changes in percentage points. The results are derived from the baseline model (output and price level) as well as separate models including exports and the interest rate.

result is different from the findings of Hájek and Horváth (2016) and Bluwstein and Canova (2016), who conclude that a contractionary euro-area short-term interest rate 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 and relatively strong, with an increase of 0.09 percent after two years. Exports are peaking at 0.20 percent after a period of seven months. On the contrary, the response of the short-term interest rate is muted, suggesting that the euro-area shock does not affect the interbank market rate in Romania. Initially the exchange rate seems to appreciate, which is however subject to high uncertainty, which turns into a more pronounced and persistent depreciation after five months. The blurred response

Figure 10. Romania: Response to a Balance Sheet Shock

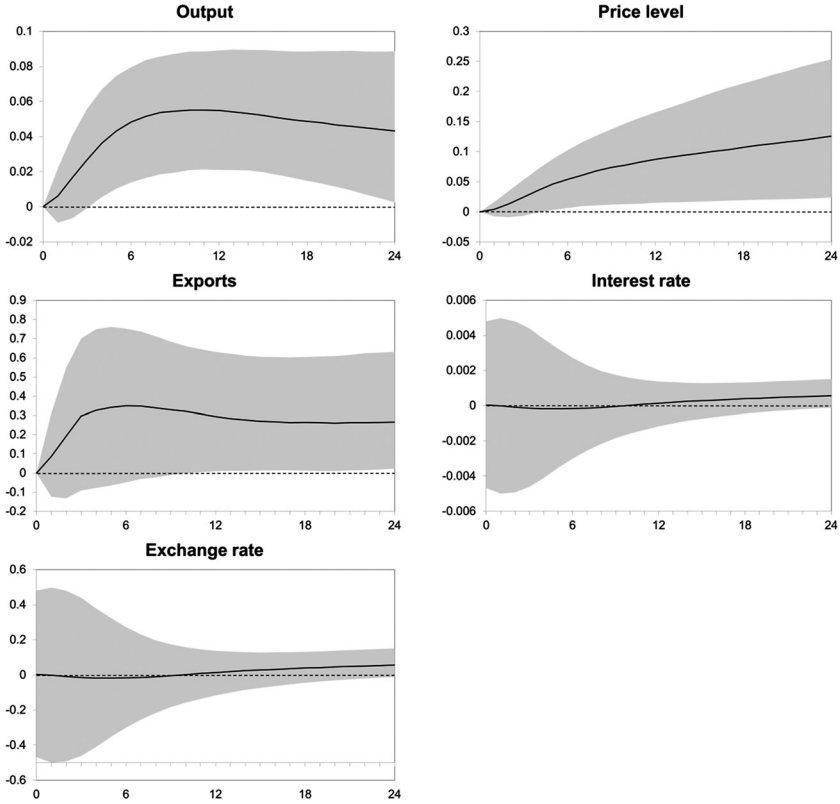


Notes: The figure shows the response of variables to an expansionary one-standard-deviation Eurosystem balance sheet shock. The shaded regions report pointwise 68 percent credibility intervals. The x-axis reports months, and the y-axis reports monthly growth rates in percent for all variables except for interest rates, which depict changes in percentage points. The results are derived from the baseline model (output and price level) as well as separate models including exports, the interest rate, and exchange rate.

is in line with the relative exchange rate stability of the lei vis-à-vis the euro since mid-2012.[12] The muted exchange rate response confirms the outcome of the event study by Falagiarda, McQuade, and

[12]From mid-2012 to end-2017 the average monthly fluctuation against the euro amounted to 0.5 percent, as compared with 1.0 percent from 2008 up to mid-2012.

Figure 11. Serbia: Response to a Balance Sheet Shock



Notes: The figure shows the 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, and the y-axis reports monthly growth rates in percent for all variables except for interest rates, which depict changes in percentage points. The results are derived from the baseline model (output and price level) as well as separate models including exports, the interest rate, and exchange rate.

Tirpák (2015), while they also find a pronounced reaction of the short-term money market rate which is different from the results obtained here.

Serbia's output (see figure 11) increases, with a peak of 0.06 percent after eleven months, which is one of the strongest output responses compared with the other countries in the region. Also,

Table 4. Sign and Zero Restrictions for the Shock Identification of the Shadow Rate Model

$shadow_t^{EA}$	$CISS_t$	$spread_t^{EA}$	MRO_t	y_t^{EA}	p_t^{EA}	y_t^{SEE}	p_t^{SEE}
– 0–1	– 0–1	– 0–1	0	0	0	0	0

Note: 0 indicates that the immediate response is restricted, while + (–) indicates that only a positive (negative) reaction is permitted in the respective period.

the price response is very pronounced, with a peak increase of 0.13 percent at the end of the two-year horizon, 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). Serbia's exports seem to react positively to the shock, with a peak response of 0.35 percent after seven months. On the contrary, neither the interbank interest rate nor the exchange rate seems to be affected significantly by the shock.[13]

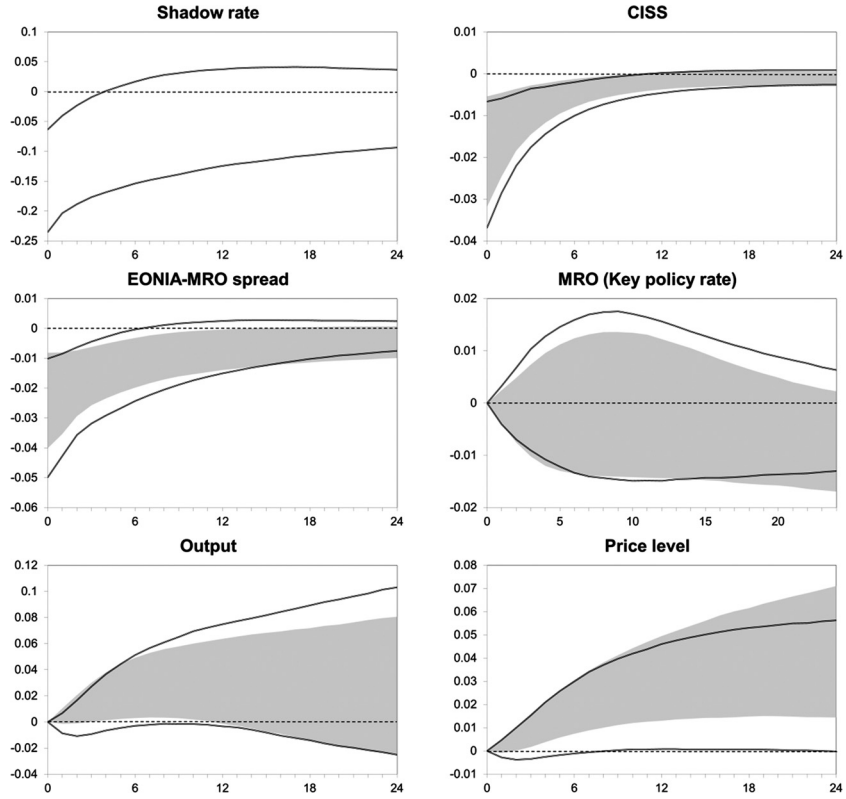
5. Robustness Testing

To test whether the results hold for different model specifications or variable choices, I perform the following 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 *decreases*, which means that the sign restriction for the shadow rate is turned into negative (see table 4).

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

[13]This is despite the fact that, compared with 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 0.9 percent.

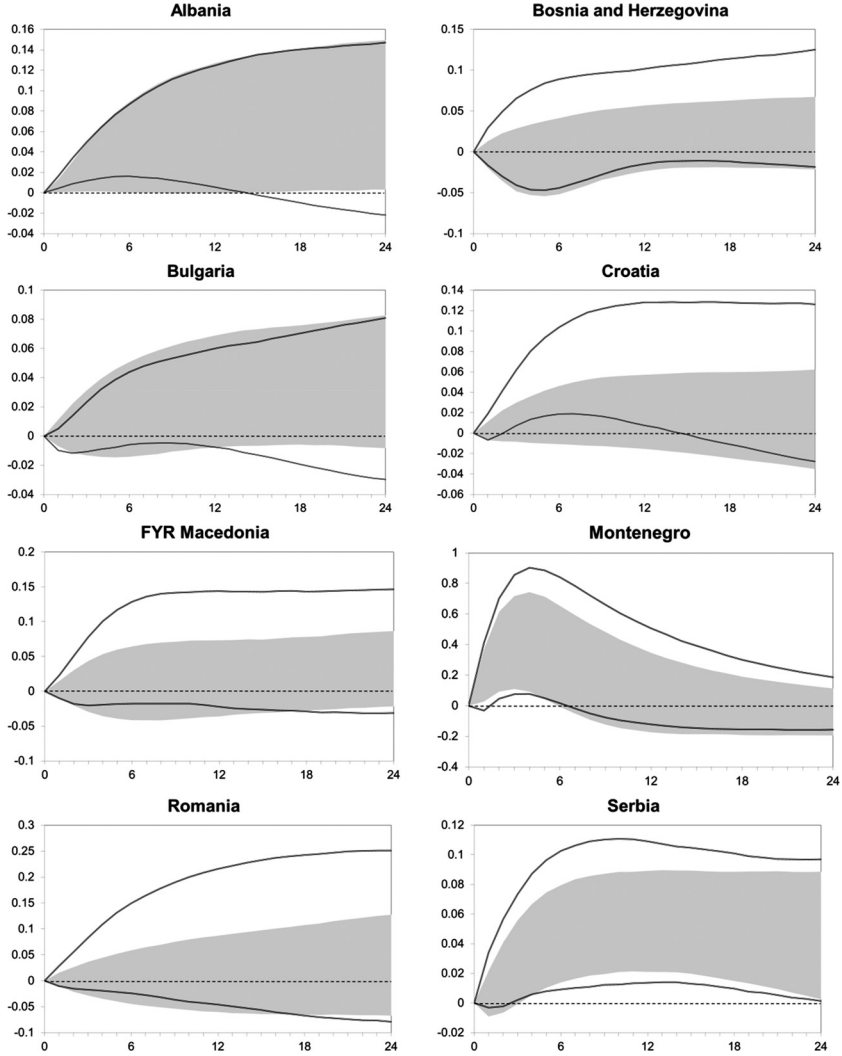
Figure 12. Euro Area: Response to a Shadow Rate Shock



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.

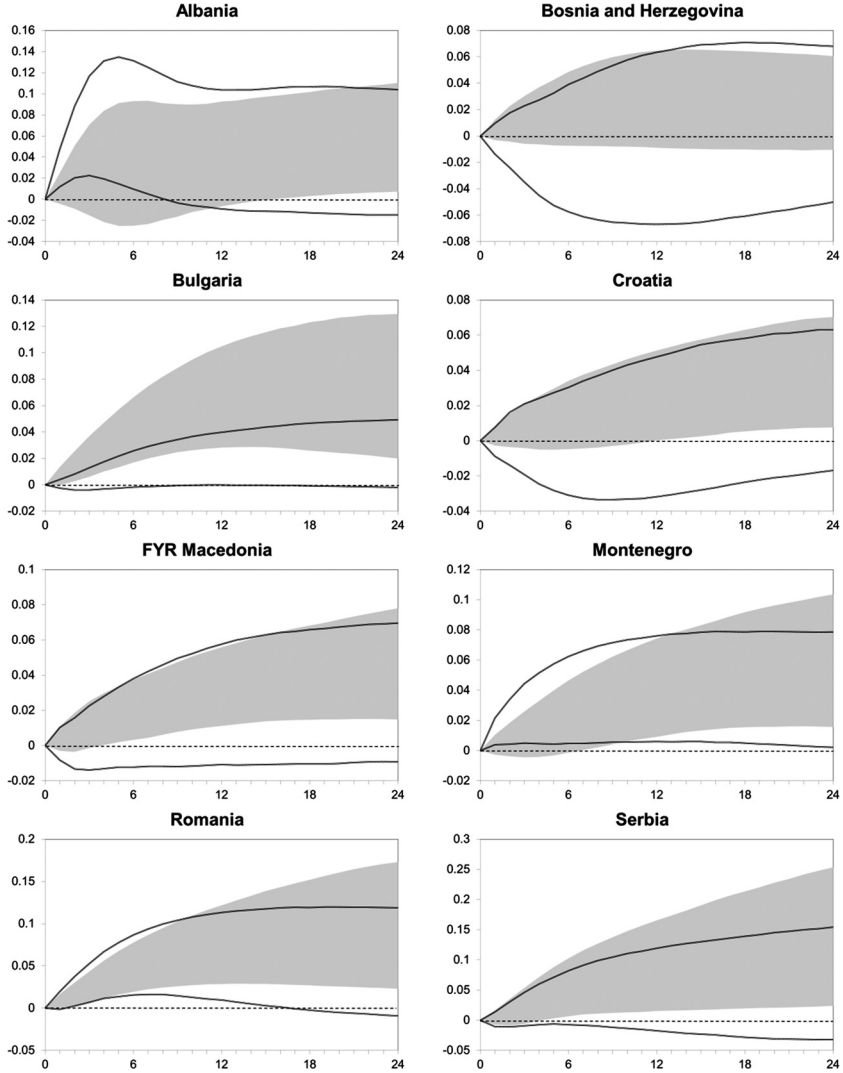
with a balance sheet shock (see figure 2), the shadow rate shock is less persistent. Regardless of the different time horizon, the responses of the financial variables (CISS, EONIA-MRO spread, and MRO) are very similar. The effects on output and prices are also in line with the baseline model, although the median price-level response is lower and 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

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.

baseline model. In some cases, the price-level response is less pronounced than in the baseline model, which can be explained by the more muted response of euro-area prices (see figure 12). Moreover, I reestimate 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 from composite spillovers of all programs. Again, the results are qualitatively robust.

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 southeastern Europe (SEE). By employing bilateral structural BVAR models, I am 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 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 with the euro-area response of the price level, the inflationary effect on SEE is larger in most SEE countries. With regard to the output response, the shock has an expansionary effect in approximately half of the countries, which is in some cases also more pronounced than the euro-area output response. These results are confirmed by robustness checks.

Regarding possible transmission channels, I find that spillovers seem to be mostly transmitted via the export channel. On the contrary, the interest rate channel exhibits a pronounced response only in a few countries, which might be driven by the relative illiquid interbank market in the SEE countries. 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.

The current work could be extended in 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 United States) 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.

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