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# External Monetary Shocks to Central and Eastern European Countries

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Pierre Lesuisse

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## **Abstract**

Few countries are part of the European Union but on the verge of the Euro-zone. This study aims at identifying the amplitude of the direct ECB monetary policy impact, i.e. the so-called international monetary spillovers, in Central and Eastern European countries (CEECs). The use of a panel-VAR method allows to deal with the small time span and endogeneity. We found that CEECs tend to significantly converge in monetary terms to the ECB standards. The direct impact on real variables remains relatively weak but contrary to the literature, is significant and in line with expectations. A persistent negative adjustment of GDP gives a quick glimpse of a robust reaction against monetary shock when the focus is made on the post-economic crisis period. The exchange rate regime plays a small but significant role in terms of magnitude. This increased interdependence is the result of macroeconomic reforms implemented during the last 25 years.

## **Keywords**

Monetary integration, External shocks, Panel VAR.

## **JEL Codes**

C23, E52, F42.

## **Acknowledgment**

We are particularly grateful to Ekrame Boubtane and Jean-Louis Combes for their useful suggestions, as well as all the participants of the “Doctoriales du développement” (Orléans - 2016) for their comments. The usual disclaimers apply.

# 1 Introduction

Being part of the Euro-zone should not be a leitmotiv. Since 2008, the economic crisis has been hitting the Euro area. Nowadays, more than an economic crisis, it has been transformed into a prominent political issue. Six Central and Eastern European Countries (CEECs) are still on their way to join the Euro-zone. Thanks to the recent political and economic European imbroglio, it has become evident, for these countries that focusing on long run convergence and inclusive growth is the key determinant of a better performed integration. The Euro, as a currency, must be perceived as a step, part of the growth process. Policies should focus on solid and coherent macroeconomic structures. Since the first EU integration process, concerning CEECs in 2004, Cyprus, Estonia, Latvia, Lithuania, Malta, Slovenia and Slovakia already joined the EMU, the latter one being Lithuania in January 2015. The six remaining countries, on the verge of the Euro-area, are Bulgaria, Croatia, Czech Republic, Hungary, Poland and Romania. Two of them, Poland and Romania, the biggest, are particularly of interest as they both represent strong economic issues, demographic and migration challenges. Figuet and Nenovsky (2006) pointed out that Bulgaria and Romania were, at the beginning of the century, still strongly disconnected from the European cycles.

Many ways exist for the six New Member States (NMS) to integrate the EMU such that efficient political choices differ and are heterogeneous. Bulgaria and Croatia decided to stay close to the ECB development; both gave up totally or partially their monetary independence by adopting respectively a currency board and a crawling peg regime. Since 2001, Hungary opts for a crawling peg regime but with huge band (+/- 15%). Poland quickly joined Romania and Czech Republic, with an inflation targeting (IT) strategy. Inflation targeting, as a tool of monetary policy, is one of the main determinants allowing to maintain price stability, while giving a framework to the domestic demand, encouraging exports and controlling for credit boom. Referring to the trilemma literature from Mundell-Fleming, a country must choose two options between the three-following: free capital movement, fixed exchange rate and independent monetary policy. By choosing IT, i.e. independent monetary policy, Poland engaged in a flexible exchange rate regime as free capital movements is a *sine qua non* condition to join the EU. Moreover, Poland and Romania present both good results in maintaining their annual exchange rate volatility close to 1%. The last decade reveals that monetary policy autonomy leads to a better resilience in front of international macroeconomic imbalances. To conclude this economic perspective of the CEECs, over the last quarter-century, Poland and Romania have had a 6.4% per year average annual growth rate, while the Euro area poorly reached a 3.3% per year; this last point reveals the high economic potential of these countries.

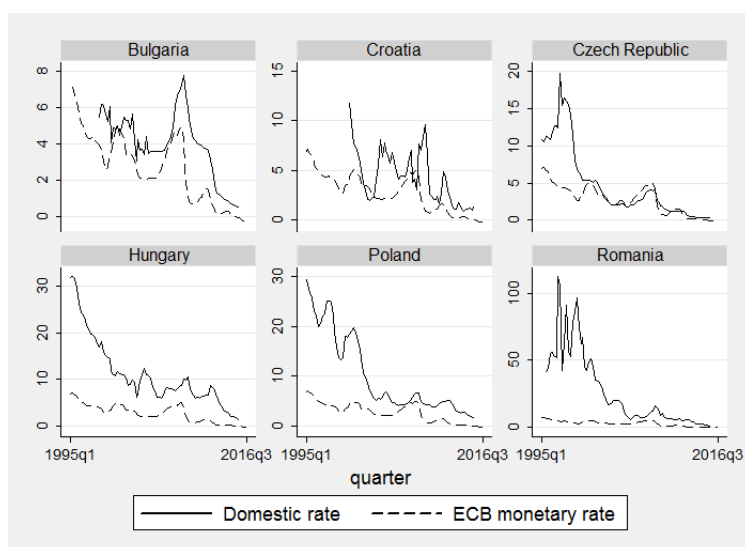
One may wonder if economic development, helped by structural reforms, has led

to a better integration. This refers to the common economic cycle, such that linear reactions to macroeconomic policies are expected. Integration is said to be successful once countries' heterogeneity does not hold problems to drive a single monetary policy. This is possible thanks to coherent domestic policy mix. The recent literature considers two different ways to disentangle the interdependencies that reflect policy shocks to the economy. The first one, often used by many institutions, as National Banks, consists on modeling the economy through a DSGE model (Gambacorta and Signoretti, 2014; Copaciu et al., 2015). The other useful method is to implement a vector autoregressive (VAR) model as it allows to consider endogeneity among the different variables. Thus, it is possible to analyze the so-called "international spillovers" i.e. the idea that the *ceteris paribus* condition does hold neither inside a country, nor at the international level. In this paper, a focus is made on direct international monetary spillovers from the European Central Bank (ECB) to countries which are not taking part of the European Monetary Union (EMU). Indeed the CEECs' monetary policies are hampered by euroisation, inducing weaker interest rate channel (Stojanovic and Stojanovic, 2016; Velickovski, 2013).

The recent monetary literature mainly focuses on monetary spillovers to the financial sector (Bruno and Shin, 2015; Takats and Vela, 2014). Moreover, it is common to find studies concerning international spillovers, usually dealing with the USA's influence on emerging market economies as Brazil (Barroso et al., 2016). Few studies have a look at international spillovers from the ECB to transition economies and the concerned studies mostly refer to one or two countries with a country by country perspective (Babeck Kucharukov et al., 2016). This last study focused on the monetary spillovers from the ECB to the three richest countries (Czech Republic, Hungary and Poland). Our paper provides more than an up-to-date analysis of the existing literature. First we made the focus only on the CEECs, given their common characteristics. We consider two groups of countries, those which already joined the EMU and those still on the verge. Second, we try to understand whether the six last CEECs out of the Euro-zone highlight a coherent behavior compared to their peers, which already joined the EMU and implement a comparison over time. Third, we provide a distinction given their exchange rate regime. This last approach deals with the loss of the monetary autonomy as a tool of an efficient convergence.

To do so, we propose, not to study each country, but a block of country through a panel; the domestic rate is found to react as expected, given an ECB monetary contraction. It slightly increases with delay. The impact on GDP is less pronounced. A small positive impact in the short run precede a more long lasting negative impact. No consistent impact is found on prices. EMU-members are found to be more integrated, in the previous period of their integration; non-EMU members

Figure 1: 3-month money market interest rates



still need time to integrate the Euro-zone in an efficient way. The specific choice of an “anchored” regime does not lead to stronger results but confirm an efficient sigma convergence. A specific focus at the end-of-period provides informations about new perspectives, that have been emerging since the political and economic European turmoil.

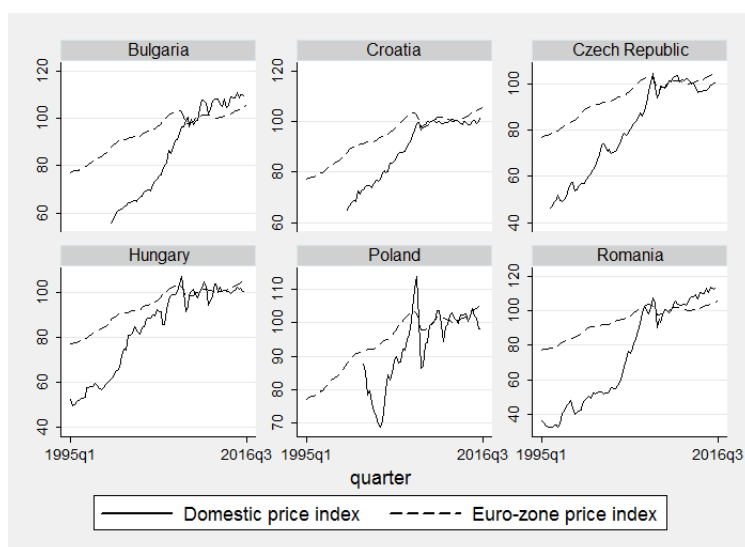
The section 2 of this paper gives some stylized facts. The section 3 proposes a review of the existing literature. The section 4 describes the econometrical approach and the data; the section 5 highlights the main results; then, the rest of the paper is divided in two sections; section 6 deals with the robustness and more advanced analysis and the section 7 concludes.

## 2 Stylized facts

Figure (1) highlights the strong convergence, between the ECB interest rate and the NMS money market rates. Such a convergence may be the result of prominent structural reforms, leading to an increase of trust and credibility. It also reflects the NMS ambition to join as quickly as possible the monetary union. The more efficient convergence concerns Czech Republic. This is not surprising as the IMF considers the country no more in transition but as developed.

The six challenging countries display good results, concerning their inflation rate. Indeed, one of the institutional key challenge following the liberalization during

Figure 2: Price index

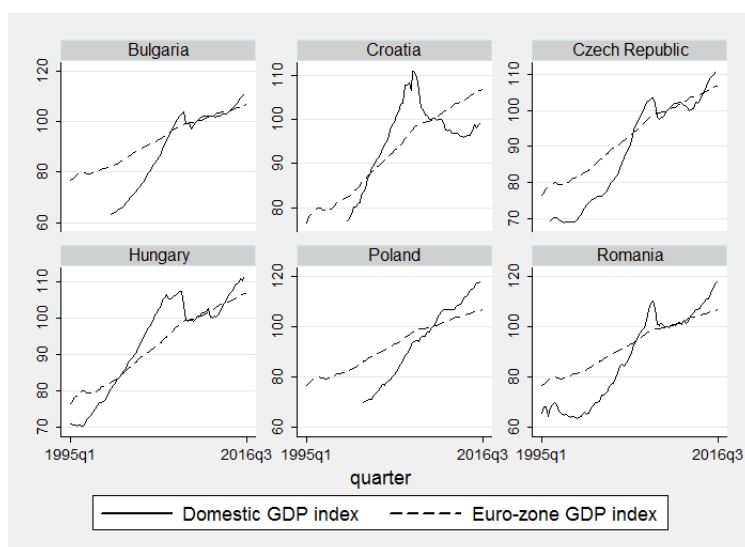


the nineties, was to fight the high volatility on prices, which was inducing too many uncertainty to enter coherent structural reforms. The figure (2) represents the evolution of the price index of each NMS in comparison to the Euro-zone price index. For most of the countries, we conclude of a price increase more in line with the Euro-area trend among the end of the period. Indeed, the trend is widely smoothed. Such good results reward the efficient policies, implemented during the last twenty-five years. However, we should bare in mind economics circumstances. Cheap imports from China, low food and oil prices are part of the improvement. Also, domestic reforms, such as changes in VAT rates, as the ones observed in Romania in 2013, 2015 and even more recently, in January 2016, must be considered. These changes helped a lot, in decreasing inflation and do not have to lead to spurious analysis.

The evolution of the GDP index, on figure (3), proves the efficient convergence over the period. The trends were higher in comparison with the Euro-zone index during the period before the crisis. This reflect the success of the transition process after the end of the communist period in Europe. On the overall, regarding the ten last years, the GDP index evolution is closer to the Euro-zone index. This is particularly true for Bulgaria, Czech Republic and Hungary. Thanks to this graph, Croatia appears to suffer more from the 2008 economic crisis; whereas Poland displays a linear trend. If the convergence, through European economic standards, has been successful, a better integration of the NMS is expected.



Figure 3: GDP index



### 3 Literature

Thanks to models, like those developed by Mundell (1961), Fleming (1962) and Dornbusch (1976), expansionary monetary policy, through a drop in the main interest rate, leads to an increase in output as it favors investment (the price of capital declines). The MFD approach considers a recession abroad after a domestic monetary expansion. However, Svensson and Wijnbergen (1987) thanks to a two-countries model, found more ambiguous results. The interdependence depends on elasticities introduced in the model. Based on a similar intuition and a two-countries sticky price intertemporal model, Clarida et al. (2002) highlighted the necessity, for small open economies, to integrate the monetary policy shocks of developed economies, in their Taylor rules; indeed those shocks directly affect their economic conditions. This “new keynesian model” is in line with the theories developed by Obstfeld and Rogoff (1996) [ch.10] and Walsh (2010) [ch.9]. Referring to Walsh (2010): “*The spillover effect of the output gap on inflation in the other country gives rise, in general, to gains from policy coordination*”. According to this, coordination leads to a welfare increase. This follows the idea that the output increase, in a given country, stimulates the domestic demand for foreign goods. Grilli and Roubini (1995) consider a VAR system for seven OECD countries and confirm the presence of international spillovers.

Kim (2001) studied the impact of a USA shock on different OECD countries. A VAR model, with real GDP, a GDP deflator, a price index and the Federal funds

rate, allows to understand endogenous phenomena. An expansionary monetary policy induces an economic boom elsewhere; the increase of exports and imports is possible through the world capital market channel.

Calvo et al. (1993) analysed the impact of a US monetary shock to Latin America countries. They found the macroeconomic volatility, to be impacted by the US shocks (e.g. a US monetary contraction induces an increase on inflation abroad). Makowiak (2007) goes further in concluding that when the “US sneeze, emerging countries catch a cold”. He implemented a VAR model, country by country, focusing on Latin America and Asian countries. If Kim (2001) was not able to find any conclusive results, Makowiak (2007) explains that emerging countries, contrary to OECD countries, are more vulnerable to external shocks, such that impacts are easier to quantify.

A recent study from Osorio and Vesperoni (2015) gives detail about the ECB policy impact on the financial sector, stronger in CEECs compared to other regions. According to Barbone and Zalduendo (1999), to successfully access to the EU, the NMS must implement, as quick as possible, structural reforms, to bridge the income gap. Brada and Kutun (2001) suggest to strengthen the financial sector, to obtain more coordination with the ECB policy. Anzuini and Levy (2007) analyzed the monetary policy in the NMS and found some similar co-movement in the different NMS; they implemented a VAR model country by country on Czech Republic, Hungary and Poland using measures of the industrial production, the consumer price, the interest rate, monetary aggregate and the exchange rate. Referring to Coricelli et al. (2006), some of the asymmetries between Eastern European countries and the Euro area, concern the monetary transmission mechanism. They drew an exhaustive description of the different channels and pass-through of the monetary policy. The monetary policy, in the NMS, does not follow the same channel compared to Euro-area countries; such conclusion induces questioning concerning an optimal single monetary policy. Focusing on the monetary spillovers, to CEECs, cannot be separated from the euroisation process. Indeed, a more or less high degree of euroisation is a symptom justifying a direct impact from ECB monetary rate to GDP or inflation in NMS countries. It is of huge interest, for transition economies, to find the right equilibrium between macroeconomic policies control and institutional credibility. One way is to stay close to another currency. To develop investment in a country, part of assets and loans are denominated in Euro. This provides a higher security and a stronger stability to attract investors. Unfortunately, it hampers drastically the transmission channel of the monetary policy. Euroisation process is mainly used in case of high and unmanageable inflation (Brown et al., 2015; Ize and Levy-Yeyati, 2005). Once institutional credibility is restored, the authorities try to get back their influence on monetary policy. During the last decade, Broda and Yeyati (2006) and Brown and Stix (2014) noted

some hysteresis mainly on the demand side and so difficulties for central banks to recover their power.

## 4 Econometrical approach

Despite a huge number of studies concerning international monetary spillovers, little has been done concerning the ECB ones on CEECs. Studying countries one by one has strong limitations due to small time horizon. Moreover, the recent economic crisis and more importantly, the political crisis of the euro-zone may have hindered some usual aspects of the monetary spillovers from the ECB to acceding countries. To bypass the usual time series limitation, a panel approach has been preferred. The VAR specification, i.e. a dynamic panel model, using a LSDV estimator, provides a powerful identification scheme to deal with both fixed effects issue and endogeneity.

The panel approach is widely used in empirical economic literature. Indeed, it allows a higher degree of freedom such that econometrical results appear to be more robust. To lead to robust and efficient results, the panel has to be as homogeneous as possible. Despite different observed behaviors in the CEECs, in terms of policy choices, we consider our panel to fulfill the homogeneity hypothesis. The concerned countries have a similar historical background, during the cold-war. The different implemented policies do not hamper the homogeneity of the panel. Indeed, each country is constrained by the Maastricht criteria. They have to respect some budgetary rules which do not allow huge discrepancies. This can be seen as a “common” budgetary framework. Moreover, the panel approach is more interesting, regarding the ECB decision process. The Euro-area is under a single monetary policy. This bar the ECB from implementing country specific decisions. Considering a group of countries allows us to disentangle whether the overall effect is consistent.

### 4.1 Econometric methodology

Up to now, the literature concerning monetary policy transmission and its spillovers is abundant. The commonly empirical approach is the use of a country by country VAR specification. This approach has been generalized by Sims (1980) and Engle and Granger (1987). Even though, those specifications are useful, it only provides statistical results; strong economic foundations help to justify the results (Stock and Watson, 2001). For Kim and Roubini (2000), VAR model alleviates the price puzzle sometimes found in the empirical international monetary spillovers literature (i.e. an increase of prices following a monetary contraction which is counter-intuitive according to the monetary policy theory).

The panel-VAR approach is particularly interesting as it overcomes usual econometric limitations. For Fabio Canova and Matteo Ciccarelli (2013), it captures static and dynamic interdependencies. It is undoubtedly a useful tool to give some good interpretation of macroeconomic impacts of the monetary policy without modeling the global economy. Moreover, as precised by Ganey et al. (2002), the panel estimation is more appropriate to solve the transmission channel of the monetary policy as it allows to control also for the necessary institutional and structural reforms.

As our panel exhibits a medium temporal dimension and a relatively small number of countries (6 to 12 countries), the panel with fixed effect specification (LSDV)<sup>1</sup> is the most appropriated (Bun and Kiviet, 2006) and found to be consistent (Nickell, 1997). The present model is a  $k$  variables panel VAR specification at order  $q$  with fixed effects:

$$Y_{it} = Y_{i(t-1)}\Gamma_1 + Y_{i(t-2)}\Gamma_2 + \dots + Y_{i(t-q)}\Gamma_{q-1} + \omega_i + \varepsilon_{it} \quad (1)$$

where

$$i \in \{1, 2, \dots, N\} \ \& \ t \in \{1, 2, \dots, T_i\}$$

In equation (1),  $Y_{it}$  is a  $(1 \times k)$  dimension vector containing all the dependent variables. The right side of the equation includes an individual fixed effects vector and a vector of idiosyncratic errors respectively denominated as  $\omega_i$  and  $\varepsilon_{it}$ . The different  $(k \times k)$  dimension  $\Gamma$  matrices represent the parameters of the model to be estimated. Given the usual econometric hypothesis, the error term is supposed to behave in the following way:  $E[\varepsilon_{it}] = 0$ ,  $E[\varepsilon_{it}\varepsilon'_{it}] = \sigma$ ,  $E[\varepsilon_{it}\varepsilon'_{ir}] = 0 \ \forall r < t$ . The equation (1) in its reduce form:

$$Y_{it} = \Gamma(L)Y_{it} + \omega_i + \varepsilon_{it} \quad (2)$$

where  $\Gamma(L)$  is a matrix polynomial of the lag operator; whereas the other elements remain unchanged. A crucial restriction is imposed in applying the VAR procedure under a panel database. The underlined structure is assumed to be the same for each cross-sectional unit. Fixed effects, introduced as  $\omega_i$  in the model, bypass this unrealistic assumption on parameters, thanks to the introduction of heterogeneity. Unfortunately, the problem is not entirely solved. The lags of the dependent variables induce regressors to be correlated with those fixed effects such that eliminating the fixed-effects through mean-differencing creates biased coefficients. The Helmert procedure as the one described by Love and Zicchino (2006) solves the inconsistency by using forward mean-differencing. Only the mean of future observations is used to transform the variables. In a formal way, variables

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<sup>1</sup>LSDV: Least Squares Dummy Variables

are transformed as follow:

$$\tilde{y}_{it}^p = \sqrt{\frac{T_i - t}{T_i - t + 1}} \left( y_{it}^p - \frac{1}{T_i - t} \sum_{r=t+1}^{T_i} y_{ir} \right) \quad (3)$$

As period differs for each country in the panel,  $T_i$  refers to the last available period for country “ $i$ ”. This procedure gives more weight to data close to the beginning of the period and no transformation is allowed on the last period as no future observation is available. The same transformation is applied on the error vector; indeed, given the assumptions of neither auto-correlation nor homoscedasticity, the procedure does not alter its characteristics. The following model is obtained:

$$\hat{Y}_{it} = \Gamma(L)\hat{Y}_{it} + \hat{\varepsilon}_{it} \quad (4)$$

This well-known procedure keeps the orthogonality between lagged regressors and the transformed variables; consistent lagged regressors are introduced as instruments. Instead of referring to the common use of Anderson and Hsiao (1982) and Arellano and Bover (1995) methods, estimating the model equation by equation, here the Holtz-Eakin et al. (1988) method is preferred; this last one is a system based approach. Indeed, it allows strong efficiency gains. To disentangle international spillovers, a first estimation with stationary variables is computed where the vector of endogenous variables is built as:

$$Y_{it} = (i_t^{ecb}, i_{it}^{dom}, \Delta y_{it}, \Delta p_{it}) \quad (5)$$

$y$  refers to the real GDP index,  $p$  is the GDP deflator as a proxy of prices,  $i^{dom}$  is the real 3-month domestic money market rate and eventually  $i^{ecb}$  is the 3-month maturity EUro Interbank Offered Rate. The key element in the use of VAR is the possibility to draw the impulse response function (IRF) and the variance decomposition of the error (FEVD). To do so, standard errors of the estimated coefficient are taken into account. The confidence interval set at 95% is computed thanks to 500 repetitions of the Monte Carlo simulation. To obtain the IRF, errors have to remain orthogonal; i.e. a diagonal variance-covariance matrix. The Cholesky decomposition solves such a constraint. Indeed, the use of a specific ordering assumes the variable, in the first position, not to be contemporaneously impacted by the other variables in the model. The ECB rate is the most exogenous variable as the NMS are not part of the ECB board. Then is introduced the domestic interest rate. Here is supposed that national banks consider in their Taylor rule the ECB monetary policy. Therefore, the ECB rate may influence contemporarily the domestic rate but conversely is not true. This idea refers directly to Clarida et al. (2002). Finally, are added GDP measure and prices to obtain the impact on the the real economy<sup>2</sup>.

<sup>2</sup>As no consensus exists concerning the causal ordering, we switched output and prices. No relevant changes are found such that we assume a good specification.

## 4.2 Data and preliminary investigation

To remain coherent with the existing literature and to draw comparison over time with previous studies, common used variables are introduced in this model. We use quarterly data<sup>3</sup> from 1995 to 2016 for twelve transition countries. Two groups of countries are studied. The first one considers Bulgaria, Croatia, Czech Republic, Hungary Poland and Romania. The second one, used as a benchmark, includes Cyprus, Estonia, Latvia, Lithuania, Malta and Slovenia. These countries were chosen as they were acceding countries not so far away. They were also part of the Soviet block or exhibit the same economic background<sup>4</sup>. Hence, the homogeneity hypothesis of the panel may not be hurt. All the variables are downloaded from the Eurostat database (Eurostat, 2016). Table (1) summarizes each country characteristics. We use the real GDP at market prices, seasonally and calendar adjusted as a measure of output. The index considers chain linked volumes and equal 100 in 2010. For more convenience, it is transformed in log-form. The impact on prices is captured through the GDP deflator as the implicit price for GDP (index 2010=100) also in log form. These choices refers to Christiano et al. (1994) Kim (2001) and Gavin and Kemme (2009).

The ECB rate is the 3-month Euribor<sup>5</sup> as in Minea and Rault (2011). According to the vast empirical literature (Ehrmann et al., 2001; Ganev et al., 2002; Assenmacher and Gerlach, 2008), the 3-month domestic interest rate is used to consider the national monetary policy.

Indeed, Reynard (2007) justifies this choice as rates paid on deposits are rigid and change only when there is a persistent change in the interest rate on the market. Moreover, the 3-month interest rate fits particularly well to the Taylor rule and reflects the credit market stance<sup>6</sup>. The table (2) sums up the different variables previously introduced.

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<sup>3</sup>To control for our results, the model has been implemented, using monthly data (with the Industrial Production Index and the HICP to consider respectively output and prices); results are in line with the quarterly specification.

<sup>4</sup>To draw an interesting comparison, we also wanted to study international monetary spillovers from the ECB to EU candidates. Unfortunately, lack of data do not allowed us to construct a robust and pertinent third group

<sup>5</sup>It has become a usual approach to include non-conventional measures of the monetary policy to interpret transmission channels; especially, when analyzing spillovers to the financial market as the policy rate is close to zero (Aysan et al., 2015; Takats and Vela, 2014). Non conventional tools are previously announced and strongly anticipated, such that consistent spillovers are hard to discern. A recent survey from Ammer et al. (2016) highlights that spillovers between conventional and non-conventional policies are nearly the same; they are not introduced in this analysis.

<sup>6</sup>Different maturities are used as robustness checks. Results highlight almost the same behavior, they are not presented.

Table 1: Countries characteristics

Country name	Data availability	Number of periods	EMU member	Exchange rate regime
Bulgaria	2000q1 - 2016q2	62	No	Currency board
Croatia	2000q2 - 2015q3	61	No	Soft peg
Cyprus	1999q1 - 2007q4	32	2008	Pegged*
Czech Republic	1996q2 - 2015q3	77	No	Managed - IT**
Estonia	1996q1 - 2010q4	56	2011	Pegged*
Hungary	1995q2 - 2015q3	81	No	Floating - IT
Latvia	1997q3 - 2013q4	61	2014	Pegged*
Lithuania	1999q1 - 2014q4	60	2015	Pegged*
Malta	2000q2 - 2008q1	28	2008	Pegged*
Poland	2002q2 - 2015q3	50	No	Free floating - IT
Romania	1995q3 - 2015q3	80	No	Floating - IT
Slovenia	1998q2 - 2006q4	35	2007	Pegged*

\* Corresponds to the exchange rate regime before the EMU accession.

\*\* IT refers to the Inflation Targeting strategy.

### 4.3 Econometrical issues

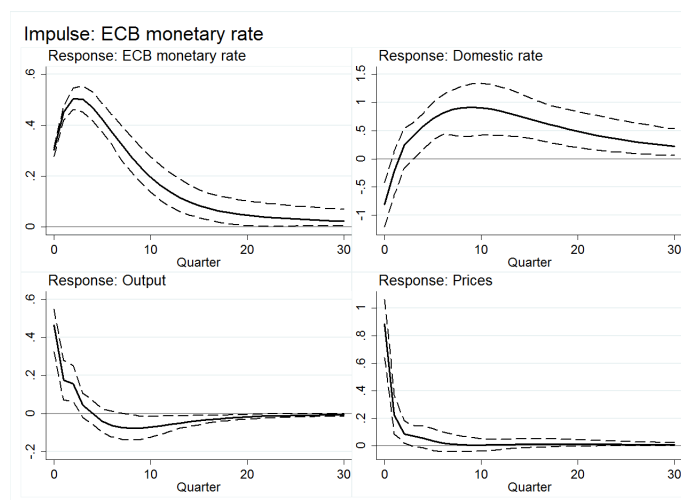
The VAR model needs to satisfy different first order conditions. Variables in the model must be integrated of the same order. To control for the order of integration, the Im-Pesaran-Shin (IPS) test has been implemented (Im et al., 2003). To get stationary variables, output and prices are transformed in first difference<sup>7</sup> whereas, both ECB rate and the domestic rate are kept in level.

Table 2: Variables Summary

Variable	Description	Level of integration
Output	Real GDP index	I(1)
Prices	Implicit price for GDP index	I(1)
ECB rate	Euribor - 3-month maturity	I(0)
Domestic rate	3-month money market interest rate	I(0)

<sup>7</sup>As both variables are in log-form, we obtain their growth rate which are stationary

Figure 4: Overall estimation



Note: The solid lines are the impulse response functions whereas, the dashed one represent the 95% confidence interval; Errors are generated with 500 repetitions of Monte Carlo.

## 5 Results

In this section, we present the results of the different models. Figures transcript the impulse response up to thirty periods, of the four endogenous variables after the simulation of a positive shock on the ECB rate. The positive impulse corresponds to a monetary policy contraction. According to the theory, such a contraction may induce a decrease in both output and prices. The lag order has been chosen according to the minimization of the Hannan-Quinn criteria. Indeed, following Ivanov and Kilian (2005), the HQ criteria fits better when dealing with monthly and quarterly data. Output and prices, in the model, correspond respectively to their growth rate. The first estimation considers the whole panel i.e. 12 countries on the overall period.

On figure (4), the domestic interest rate reacts significantly with some lags after the shock imposed on the ECB rate. The positive response, induced by the shock, remains significant over the all estimated projection. This first result corroborates some other empirical studies highlighting a significant, persistent and sufficiently wide effect to be taken into consideration (Calvo et al., 1993; Clarida et al., 2002; Gavin and Kemme, 2009). The domestic rate increase is in line with expectations; the non-immediate response refers to institutional delays. Domestic national banks interpret the ECB rate change as permanent and consistent with some lags. This cautious behavior partly explains the long lasting positive



Table 3: Variance decomposition

	$i^{ecb}$	$i^{dom}$	$y$	$p$
$i^{ecb}$	77.3	5.92	13.34	3.40
$i^{dom}$	11.08	74.6	2.08	12.23
$y$	13.02	0.51	86.28	0.18
$p$	11.87	32.28	4.48	51.36

Numbers are expressed in percentage of the total variance; Projection: 30 periods ahead; Columns explain lines.

responses. After thirty periods, the domestic rates fluctuations are explained by the output (2.08%), prices (12.23%) and the ECB rate (11.08%). The influence of the ECB rate confirms Clarida et al. (2002), national banks have to consider the external monetary shocks when implementing their Taylor Rules.

The GDP growth rate reacts positively in the short run. This counterintuitive positive impact on the GDP growth in case of a contractionary monetary policy is also found by Minea and Rault (2011) and can be interpreted as even more integrated economies in the EU. Agents anticipate a future increase in their domestic rates as their monetary policy goes close to the ECB one. This positive differential on interest rates favors the domestic one, inducing investment to increase and so the GDP. A rapid absorption follows the positive impact. Then, the GDP growth rate highlights a small but persistent negative trend during almost four years with a peak at -7.7 bp<sup>8</sup>. The negative sign confirms the IS-LM theory.

As IRFs do not provide information about the amplitude of the changes, we consider the forecast error variance decomposition (FEVD). It allows to identify how strongly a variable plays a role in the volatility of another one. Thus, 13.02% of the GDP-variance is explained by the ECB rate. This can be explained through two channels. The first one is the well-known euroisation phenomenon which plays a strong role in the CEECs. The second channel is explained by the negative reaction of the EMU output. An ECB monetary contraction induces a negative reaction in Euro-area member states and then negatively impacts GDP of transition economies. The slowdown in the euro-zone, induced by the monetary contraction, leads to a downturn in European imports. As countries like Poland are part of the European supply chain, such a decrease causes an export contraction for the NMS. To better understand this phenomenon, one may have a look at the share of NMS exports devoted to Euro area member states. Data, available on Eurostat,

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<sup>8</sup>bp: Basis Point

reveal that in 2015, exports from Hungary Poland and Romania to the Euro area represent respectively 55%, 45% and 55% of their total exports<sup>9</sup>. Given the huge share of European exports, domestic output reacts to a European downturn.

The impact on prices is more tricky to discern. First, a short-lived price puzzle is found. This reaction has been already found by Jarocinski (2010). The price puzzle quickly disappears. Different ways to deal with price puzzles are studied in the literature such as considering a different lag order or using another measure as a proxy for prices<sup>10</sup>. The absence of an overall reaction on prices is explained by an “aggressive” policy mix against inflation. Indeed, policies implemented to annihilate the high prices volatility, have smoothed the impact of external monetary shocks.

The different impacts demonstrate a good integration with the European economies and tend so, to contradict results found by Figuet and Nenovsky (2006) who concluded, that Bulgaria and Romania were still disconnected from the EMU.

## 6 Robustness

### 6.1 Sub-panel

The main goal of this study is to focus more precisely on EU countries at the verge of the euro zone. A specific attention is paid on the six concerned countries i.e. Bulgaria, Croatia, Czech Republic, Hungary, Poland and Romania. The purpose here is to identify whether the previous significant results, are more or less driven by the “best performers” (i.e. countries which actually joined the monetary union)<sup>11</sup>.

The GDP negative reaction disappears when the focus is made on the non-EMU members; whereas it remains on the second sub-group. This partly confirms the hypothesis that results are driven by the EMU member states. Moreover, domestic rates respond at a higher magnitude when dealing with non-EMU members. The

<sup>9</sup>ratio of:  $\frac{\text{exports devoted to euro zone}}{\text{total exports}}$ ; available on Eurostat (2016)

<sup>10</sup>We tried different numbers of lags which were not able to get rid of the puzzle. As in our case, this puzzle is almost not significant we will not consider it as an issue.

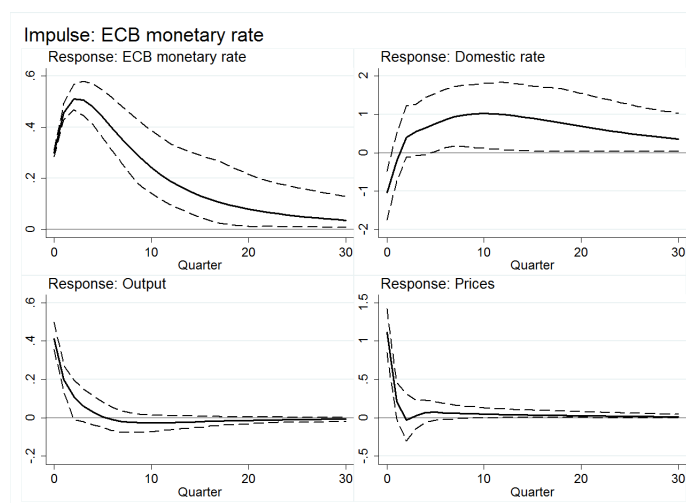
Instead of using the implicit GDP deflator as commonly used, it is possible to introduce the HICP; but as in transition economies administrated prices are still of interest, core inflation does not lead to the same definition upon all countries such that the HICP index responses are hard to discern.

<sup>11</sup>The panel is split into two groups:

Group 1: the non-EMU members (Bulgaria, Croatia, Czech Republic, Hungary, Poland and Romania).

Group 2: the EMU-members (Cyprus, Estonia, Latvia, Lithuania, Malta, Slovenia).

Figure 5: Non-EMU members

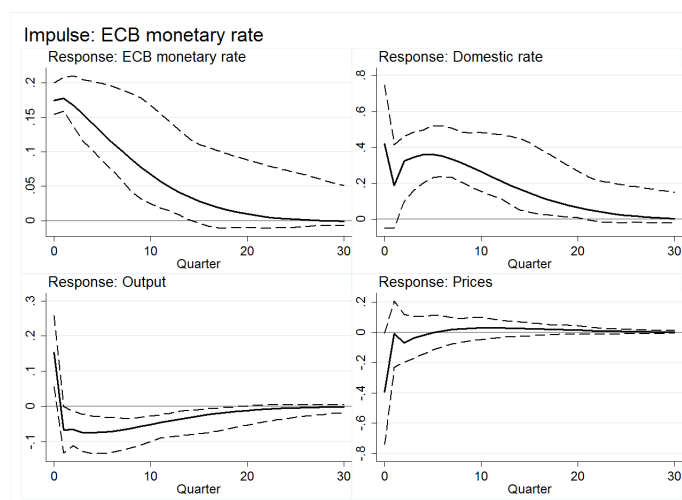


Note: The solid lines are the impulse response functions whereas, the dashed one represent the 95% confidence interval; Errors are generated with 500 repetitions of Monte Carlo.

positive impact is more short-lived and highlight huge confidence interval bands. Such results lead us to the conclusion that the current EMU-members were better integrated when they adopted the common currency. The transition process was quicker, more intense and successful. Until such results are not proven to the last CEECs, we expect their economies not to be fully ready to join the EMU.

Given the FEVD, concerning current EMU members, during their pre-acceding period (see table 4 in appendix A), the ECB rate does explain a larger part of the domestic rate fluctuations in comparison with countries still on the verge of the EMU (respectively 31.12% and 10.35%). On the contrary, prices and GDP are more sensitive in the non-EMU countries (respectively 13.71% against 11.52% for prices and 17.08% against 13.4% for GDP). This is the result of a higher vulnerability to external shocks in those countries. The most important difference concerns the domestic rate. Indeed, the explained variance is three times bigger for current EMU-members. During the pre-integration period, these countries react strongly to the ECB monetary policy. This last result gives more weight on the conclusion that non-EMU members still have to converge to Euro-area economies, in terms of monetary conditions, before adopting the common currency.

Figure 6: After the crisis



Note: The solid lines are the impulse response functions whereas, the dashed one represent the 95% confidence interval; Errors are generated with 500 repetitions of Monte Carlo.

## 6.2 Sub-period

In line with the previous estimation and to determine whether the six last NMS perform better at the end of the period, the model is implemented on the period after the 2008 economic crisis. Indeed, changes in the behavior of the variables could have appeared in the aftermath of the crisis. The Euro-area crisis has had strong negative impacts in European economies. If the NMS show signs of efficient integration, then one may wonder to find a negative impact on GDP following an ECB monetary contraction. Moreover, it is of interest to have a look at the period after 2009, as concerned countries almost ended with their huge structural reforms. The 1990s and 2000s decades reforms probably induced specific changes in macroeconomic variables that ended up on misinterpretation on VAR model in the period before the crisis.

According to the impulse-responses, the impact of the ECB rate shock is less prominent on the domestic rate and more short-lived, as after twenty periods it returns to its long-term tendency. The peak arrives after six periods but remains at lower magnitude compared to the initial projection; a quicker absorption is the sign of a stronger efficiency and a quicker responsiveness. Smaller confidence intervals consolidate the intuition.

The variance decomposition confirms the response function. 10.35% of the domestic rate variance, after thirty periods, was explained by the ECB rate on the whole period; on the aftermath of the crisis, 22.3% is explained. The domestic policies

are more independent, more robust and so more credible to implement a coherent monetary policy in line with their development.

The output reacts negatively and significantly to the shock after one lag. This new result positively corroborates the better integration hypothesis and may be analyzed as an encouraging statement. Despite the negative impact, the output variance is less explained by the ECB rate. The concerned countries are less sensitive to shocks from the euro-zone. This point confirms the efficient inclusive growth path. To sum up, on one hand, countries do react negatively, in the following of an ECB monetary contraction, as predicted by the theory. On another hand, the negative reaction has a smaller long-term consequence. The impact on prices remains relatively marginal. This point reveals a still strong control on inflation from the monetary authority, in line with the inflation targeting strategy. It also corroborates the current barrier for the ECB to impact real variables, within the EMU itself.

This last approach is a first step, to confirm the even more credible monetary policies in the NMS, for investors. Macroeconomic reforms and the policy mix are more coherent. The negative impact on GDP, following a monetary contraction, highlights a higher level of integration for NMS economies during the last decade. Obviously, only 24 periods under study, do not allow to make robust inference. What is found here should be viewed as a possible new tendency that must be kept in mind and more deeply analyzed during the integration process of NMS to the monetary union.

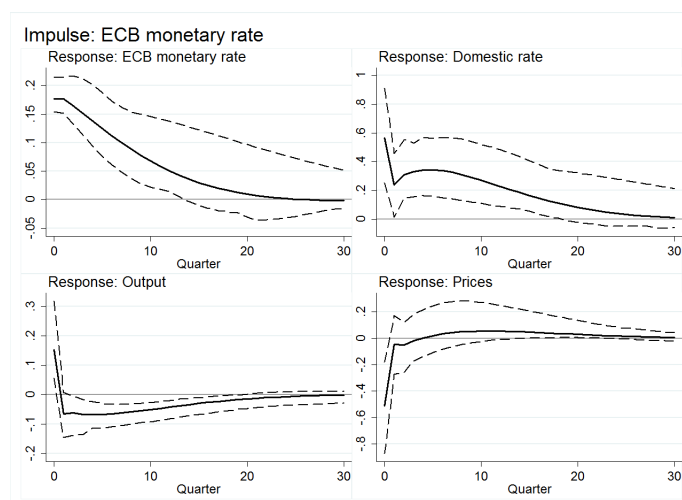
### 6.3 Exchange rate regime

Minea and Rault (2011) found a better transition process in Bulgaria, thanks to the currency board arrangement, compared to its peers. The two following estimations try to disentangle whether the exchange rate regime plays a role, on the international spillovers. To do so, a new variable is introduced to capture the exchange rate regime. For more convenience, it has been decided, to consider only two different regimes. On one hand, we have floating countries with Czech Republic, Hungary, Poland and Romania (figure 7). On another hand, we have more or less "anchored" countries (figure 9 appendix B).

The response functions, concerning the "anchored" countries, give results in line with the first estimation. The domestic rate adjusts with delay to the shock and GDP increases first before highlighting a negative reaction. The impact on the domestic rate is less pronounced in case of floating countries; 23.12% of the domestic rates' variance is explained by the ECB shock against 38.06% for "anchored" countries. This is explained by the loss of the monetary autonomy.

GDP reaction is also smaller in magnitude in the floating countries with a peak

Figure 7: Floating regime



Note: The solid lines are the impulse response functions whereas, the dashed one represent the 95% confidence interval; Errors are generated with 500 repetitions of Monte Carlo.

at -6.8 bp against -24 bp in the “anchored” countries. Thanks to this, floating economies are more resilient to external shocks; consolidated by the FEVD (14.93% of the GDP variance explained against 30.95% in the “anchored” countries). This conclusion has to be considered with caution. Indeed, Czech Republic, Hungary and Poland are the three richest countries of the last six NMS. Nevertheless, as mentioned previously, the exchange rate volatility, in these countries, was particularly small during the last years. This last point is relevant to consider a medium term projection to enter the ERM-II<sup>12</sup>.

Our results do not state a divergence in convergence, regarding exchange rate regime. Floating economies are found to be more resilient; we contradict results found by Minea and Rault (2011). But, considering the different initial economic backgrounds, we kept in mind that, Bulgaria and Croatia were the poorest countries, with the biggest institutional challenges.

## 7 Conclusion

This paper aims at highlighting the importance for emerging and transition open economies on Central and Eastern Europe, to integrate in their macroeconomic policies, the ECB monetary policy decisions. In the case of the single ECB monetary policy, a panel estimation with a VAR specification, gives rather better results.

<sup>12</sup>ERM: Exchange Rate Mechanism

Moreover, panel estimation is an efficient way to deal with short time span.

To do so we implemented different countries approach. On the overall panel, the domestic interest rate adjusts to the ECB one; this suggests strong monetary convergence and increased inter-dependencies. First, we compared EMU-members with non-EMU countries. The underlined goal was to disentangle whether the last six NMS, still on the verge of the EMU perform as well as countries which already joined the monetary union. The results confirm that the different economies are on the right way but not fully ready to join the EMU. Indeed, the shocks on GDP are quickly absorbed and then remain not significant.

Then, we looked at the end of the period, i.e. after 2009. The NMS are closer to the Euro area. Whereas prices do not react significantly, the impact on GDP is negative and long lasting which contradicts Figuet and Nenovsky (2006). The absence of effect on prices is due to the inflation targeting strategy, adopted by most of the countries under study.

Thanks to this, we eventually took into consideration the different exchange rate regimes. Czech Republic, Hungary, Poland and Romania are studied as "floating" economies; the magnitude of the spillovers are more pronounced in case of "anchored" countries. This is in line with the theory as their economies are more dependent on EMU fluctuations. The floating economies perform quite well given a small fluctuation of their exchange rate. Nevertheless, the loss of the monetary autonomy stems from macroeconomic issues. For instance, Bulgaria and Croatia wanted to get rid of high inflation and non-credible institutions.

The NMS strongly focused on their inflation rate over the last twenty-five years. Now that inflation is more or less under control, it is time for these countries to switch through real convergence. As mentioned during this paper, those results are converging to the idea that countries tend to homogenize their monetary policy. This is strengthening the converging process and stimulates a better further integration to the monetary union. Recent behaviors of the GDP highlight a stronger sensitivity to European shocks, which may be under concerns during the following years.

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# Appendices

## A Variance decomposition

Table 4: Variance decomposition

Non-EMU members					EMU members				
	$i^{ecb}$	$i^{dom}$	$y$	$p$		$i^{ecb}$	$i^{dom}$	$y$	$p$
$i^{ecb}$	80.06	6.47	11.93	1.52	$i^{ecb}$	76.9	8.28	14.06	0.71
$i^{dom}$	10.35	77.62	1.52	10.49	$i^{dom}$	31.12	52.3	10.04	6.5
$y$	17.8	0.97	80.15	1.08	$y$	13.4	6.03	79.98	0.58
$p$	13.71	29.53	2.69	54.05	$p$	11.51	53.27	8.25	26.95

After the crisis					Floating regime				
	$i^{ecb}$	$i^{dom}$	$y$	$p$		$i^{ecb}$	$i^{dom}$	$y$	$p$
$i^{ecb}$	85.04	5.58	6.47	2.9	$i^{ecb}$	84.7	6.01	7.51	1.75
$i^{dom}$	22.3	72.8	1.98	2.9	$i^{dom}$	23.12	73.48	13.16	2.07
$y$	15.46	5.92	77.9	0.63	$y$	14.93	5.04	79.45	0.56
$p$	3.63	87.55	0.94	7.86	$p$	5.6	88.69	0.42	5.24

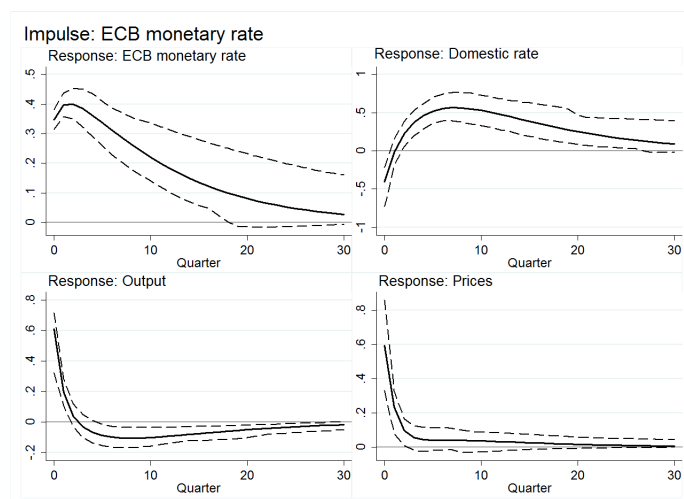
  

"Anchored" regime				
	$i^{ecb}$	$i^{dom}$	$y$	$p$
$i^{ecb}$	69.44	11.54	18.67	0.32
$i^{dom}$	38.06	42.58	14.15	5.2
$y$	30.95	10.50	57.38	1.15
$p$	14.72	55.70	10.96	18.59

Numbers are expressed in percentage of the total variance; Projection: 30 periods ahead  
Columns explain lines.

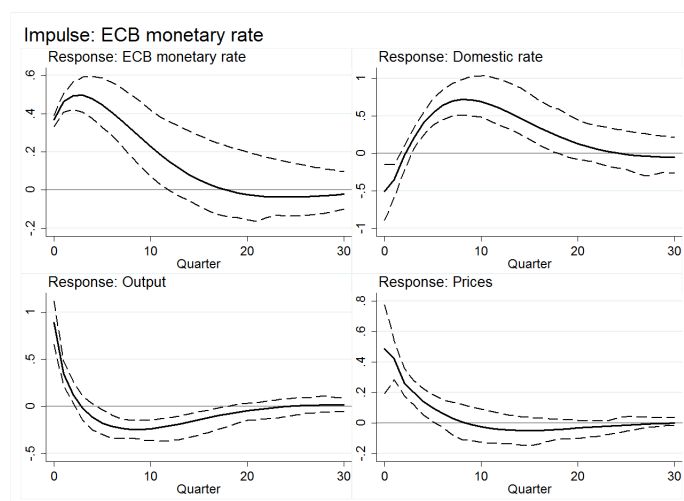
## B IRFs

Figure 8: EMU members



Note: The solid lines are the impulse response functions whereas, the dashed one represent the 95% confidence interval; Errors are generated with 500 repetitions of Monte Carlo.

Figure 9: “Anchored” economies



Note: The solid lines are the impulse response functions whereas, the dashed one represent the 95% confidence interval; Errors are generated with 500 repetitions of Monte Carlo.