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Measuring the Effects of Oil Price and Euro-area Shocks on CEECs Business Cycles

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Abstract

This paper aims to assess the effects of external macroeconomic shocks on business cycles of Central and Eastern European Countries, not yet Euro-area members. Using quarterly data from 1999 to 2015 and the structural near-VAR methodology, we focus on the effects of Euro-area monetary policy and global oil price shocks on prices and output of the analyzed countries. Results show that business cycle fluctuations are mainly explained by domestic shocks in the short run, while monetary policy and oil price shocks play an increasing role in the medium run. Adding domestic fiscal shocks the overall picture does not change significantly, since fiscal policy turns out to be a minor driver of business cycle fluctuations in CEECs.

Keywords: CEECs; Business Cycle Fluctuations; Euro Area; Common Shocks; near-Structural VARs;
JEL Classification: C32, E32, Q43;

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1 Introduction

In recent years, the Euro Area enlargement has been one of the most debated issues among scholars and within European institutions. Indeed, all the Central and Eastern European Countries (CEECs)[1], except Albania, have become members of the European Union during the last two decades. Moreover, some of these countries have already joined the Euro Area, others have shown a strong interest in entering.[2] In order to join the Euro Area, potential entrants must fulfill a number of Convergence Criteria or "Maastricht Criteria" set out in Article 140(1) of the Treaty on the Functioning of the European Union. The Convergence Criteria have been designed in order to ensure that new Euro-area members are able to absorb macroeconomic shocks without using domestic monetary policy and exchange rate instruments.

However, this ability will strongly depend on their economic integration and alignment with the Euro-area business cycle. For, if business cycles are not synchronized and are mainly driven by local shocks, the costs of losing the independence of monetary policy increase, the process of implementation of common monetary policy will be costly, and a country might run into competitiveness problems (cf. The Monetary Policy of ECB, Technical Report, Third edition ECB (2011)). Therefore, it becomes important to investigate the degree of integration between the Euro-area business cycle and those of countries that are interested in joining the Euro Area.

This paper investigates the effects of macroeconomic shocks, at the Euro-area and international level, on prices and output of some Central and Eastern European Countries that have already joined the European Union but not the Euro Area. More precisely we will consider Bulgaria, the Czech Republic, Poland, Romania and Croatia. Nevertheless, we also include Lithuania in the analysis, given its recent entry in the Euro Area. We are interested in studying if country specific business cycle fluctuations are mainly affected by exogenous and external, Euro-area and oil price, shocks or by domestic shocks. In regard to external shocks, we focus on monetary policy and oil price shocks by virtue of the important role played by the common monetary policy in the Euro Area and given the large turmoil in the oil market experienced in recent years.

We use the structural near-VAR model and consider a sample period that goes from 1999:Q1 to 2015:Q4. The structural disturbances are recovered by imposing a recursive ordering of the variables (see e.g. Cavallo and Ribba (2015)). One of the advantages of the near-VAR model is that each member country is subject to the same set of exogenous shocks plus specific country shocks. This model implies the assumption that each analyzed country is a small open economy

[1] Central and Eastern European Countries (CEECs) is a terminology proposed by the Organisation for Economic Co-operation and Development (OECD). CEECs includes Albania, Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, the Slovak Republic, Slovenia, and the three Baltic States: Estonia, Latvia and Lithuania.

[2] The Slovak Republic, Slovenia, Estonia, Latvia and Lithuania have already joined the Euro Area; Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania are not yet Euro-area members.

characterized by notable interaction with the Euro Area and for which there exists unidirectional macroeconomic causation running from Euro-area variables and oil prices to national variables. The CEECs' dimension generally supports this assumption. However, this hypothesis could be more questionable for Poland. Thus, we tackle this issue by undertaking a robustness analysis and estimating an alternative VAR model with full interaction among variables and where the structural shocks are recovered by imposing sign restrictions.

In the last part of the paper we enlarge the model in order to account also for the role played by fiscal domestic shocks and to characterize their relative importance for CEECs. Indeed, fiscal policy shocks may be other potentially important drivers of business cycles and hence the results obtained on the role of external shocks may be overstated. Thus we add in the near-VAR specification national government spending and government revenues. These fiscal variables are included in the block of endogenous variables for each country VAR model.

Some researches have investigated the effects of Euro-area and international shocks on CEECs. Part of these studies focus on the effect of Euro-area monetary shocks (see, e.g. Georgiadis (2015) and Jiménez-Rodríguez et al. (2010)). Instead, a few recent papers try to identify both Euro-area monetary policy shock and oil price shocks by using a GVAR appproach (see e.g. Hájek and Horváth (2016)).

Instead, important papers studying the dynamic effects of oil shocks on the US economy and OECD countries, include *inter alios* Kilian (2009) and Blanchard and Gali (2007).

It is worth stressing that by choosing the period from the start of the European Monetary Union (EMU), we identify the Euro-area monetary policy shock unambiguously, within a single monetary policy regime.

Our results show that Central and Eastern European economies are significantly influenced by both Euro-area monetary policy and oil price shocks. Moreover, we find that for the majority of countries considered in our investigation, business cycle fluctuations are mainly explained by domestic shocks in the short run, while the common, external shocks are notable drivers from the medium to the long run. Results also show that contractionary monetary policy shocks cause recessionary effects in all investigated countries, though with some delay with respect to the Euro Area. Finally, an increase in oil prices causes a positive effect on prices and a contraction on output in all the countries, except for Lithuania which instead shows a positive response for output.

The strand of the literature applying the structural VAR methodology to study the effects of fiscal shocks on aggregate output was initiated by Blanchard and Perotti (2002) and then followed by many other studies. Nevertheless, only recently have the effects of domestic fiscal shocks begun to be studied for CEECs (see e.g. Borys et al. (2014)). Our main finding is that fiscal shocks are not among the main drivers of business cycle fluctuation in CEECs. Further, the

effects of spending shocks seem to be more consistent with the traditional Keynesian interpretation, while results concerning the revenue shocks are less clear and more difficult to interpret.

The rest of the paper is organized as follows. In section 2 we discuss (part of) the related literature. In section 3 we present some descriptive statistics, in particular concerning the comovements between national variables and external, Euro-area and global variables. Section 4 presents the methodology based on near-VARs and the identification strategy. In sections 5 and 6 we present the results using respectively, the impulse response functions and variance decomposition. In section 7 we propose an alternative identification strategy based on sign restrictions as a robustness check for Poland. In section 8 we show some results on the role of domestic fiscal shocks. Section 9 concludes.

2 Literature Review

In a recent investigation concerning the synchronization of business cycles between CEECs and the Euro Area, Di Giorgio (2016) concludes that there are important differences between the recession regime, in which the synchronization is high, and the normal and high growth regimes, where the business cycle synchronization is lower. The authors utilizes Markow switching models and considers the sample period 1993 - 2014.

Georgiadis (2015) studies 61 different economies[3] over the sample period 1999 – 2009 and finds that spillovers from Euro-area monetary policy to Central and Eastern European countries are of remarkable size.

In a very recent article Potjagailo (2017) uses a FAVAR model and include a wide group of countries in his investigation[4]. The main result for CEECs is that, on average, while the responses of output exhibit the expected signs, the responses of prices are more difficult to reconcile with theoretical models.

In regard of the literature concerning the effects of oil price shocks on non-Euro Area countries, some studies converge to the conclusion that CEECs are more sensitive compared to the Euro Area (see, e.g. (Dybczak et al. (2008)).

In recent years the literature on oil shocks has widely debated over the theme of possible oil price endogeneity, i.e. on the idea that fluctuations in oil prices do not always (and not only) depend on exogenous events related to supply disruption, but are instead frequently ascribable to global demand factors. In other words a reverse causality mechanism, running from global de-

[3]Among these economies, there are also the countries in which we are interested: Bulgaria, the Czech Republic, Poland, Lithuania, Romania, Croatia.

[4]Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia, Romania, Denmark, Sweden and the UK, Austria, Belgium, Finland, France, Germany, Greece, Italy, Ireland, Netherlands, Portugal, Spain.

mand shocks to oil prices, may be at work. This position has been forcefully taken, for instance, by Kilian (2009). In his article Kilian also builds an interesting indicator of global demand pressures, the Index of Global Real Economic Activity.[5] Moreover, the paper investigates the effects of oil shocks on US macroeconomic variables, CPI inflation and GDP growth.

Another empirical contribution that tackles potential endogeneity problems is provided by Baumeister and Peersman (2013).

In line with a demand side interpretation of the fluctuations of oil prices, Barsky and Kilian (2001) have challenged the traditional, supply side, interpretation of the stagflation of the 1970s (cf. Blinder (1979)) maintaining that an expansionary monetary policy mainly explain the rising inflation which affected that decade.

However, other prominent researchers do not seem to give excessive importance to the endogeneity issue. For example, Blanchard and Gali (2007) identify the oil supply shock by assuming that unexpected variations in the nominal price of oil are exogenous relative to the contemporaneous values of the remaining macroeconomic variables included in their VAR model.[6] Despite possible and legitimate critiques of this identification restriction, they are confident that they are correctly recovering oil shocks, since *"What matters, however, to any given country is not the level of global oil production, but the price at which firms and households can purchase oil, which in turn depends also on world demand for oil. Thus, if the price of oil rises as a result of, say, higher Chinese demand, this is just like an exogenous oil supply shock for the remaining countries."* (Blanchard and Gali (2007)).

Another important contribution on the interpretation of oil shocks comes from Hamilton (1983)[7].

In a recent paper Hájek and Horváth (2016) have jointly investigated the effects of both Euro-area monetary policy and oil price shocks on a group of Central and Eastern European economies. The authors, by using a GVAR and monthly data from 2000 to 2014, characterize the responses of output and prices and find that Euro-area monetary policy shocks have a similar, strong effect on output in all countries, while some heterogeneity is shown in the price responses.

[5]The Index aims to measure the component of global, real economic activity underlying the demand for industrial commodities. (see Kilian (2009)

[6]CPI inflation, GDP deflator inflation, wage inflation and log changes in GDP and employment.

[7]See also Hamilton (2003).

3 Methodology and Identification Strategy

In this paper, by using quarterly data from 1999:Q1 to 2015:Q4[8], we estimate a near-VAR in order to model dynamic interactions among oil price, Euro-area aggregate variables and CEECs variables.

While in the classical VAR model, introduced by Sims (1980), all the estimated variables are endogenous and treated as functions of lagged values of all the endogenous variables, in the near-VAR approach proposed by Cushman and Zha (1997) two blocks are separated: an exogenous block, whose variables can affect the other variables of the model, and a second block of endogenous variables which do not enter the equations of the first block. Thus, in a near-VAR, not all the equations include the same regressors.

Using a near-VAR system, Ordinary Least Squared (OLS) gives consistent estimates. However, some potential gain comes from Seemingly Unrelated Regressions (SUR) (cf. Zellner (1962)) estimator, reason why we will use SUR rather than OLS.

Near-VAR has some advantages. The most powerful is that, although we estimate for each country a separate system which allows the joint dynamics among Euro-area aggregate variables, oil and the national variables to be modeled, the set of exogenous shocks is identical for all countries. In other words, this near-VAR specification ensures a property of invariance for the set of aggregate Euro-area and oil shocks affecting the national variables.

The near-VAR reduced-form representation is given by:

$$\begin{pmatrix} oil_t \\ p_t \\ y_t \\ i_t - i_t^* \\ \epsilon_t \\ p_{i,t} \\ y_{i,t} \end{pmatrix} = \begin{pmatrix} A_{11}(L) & A_{12}(L) & A_{13}(L) & A_{14}(L) & A_{15}(L) & 0 & 0 \\ A_{21}(L) & A_{22}(L) & A_{23}(L) & A_{24}(L) & A_{25}(L) & 0 & 0 \\ A_{31}(L) & A_{32}(L) & A_{33}(L) & A_{34}(L) & A_{35}(L) & 0 & 0 \\ A_{41}(L) & A_{42}(L) & A_{43}(L) & A_{44}(L) & A_{45}(L) & 0 & 0 \\ A_{51}(L) & A_{52}(L) & A_{53}(L) & A_{54}(L) & A_{55}(L) & 0 & 0 \\ A_{61}(L) & A_{62}(L) & A_{63}(L) & A_{64}(L) & A_{65}(L) & A_{66}(L) & A_{67}(L) \\ A_{71}(L) & A_{72}(L) & A_{73}(L) & A_{74}(L) & A_{75}(L) & A_{76}(L) & A_{77}(L) \end{pmatrix} \begin{pmatrix} oil_{t-1} \\ p_{t-1} \\ y_{t-1} \\ i_{t-1} - i_{t-1}^* \\ \epsilon_{t-1} \\ p_{i,t-1} \\ y_{i,t-1} \end{pmatrix} + \begin{pmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \\ e_{5t} \\ e_{6t} \\ e_{7t} \end{pmatrix} \quad (1)$$

and in a more compact way by:

$$X_t = A(L)X_{t-1} + e_t \quad (2)$$

where X_t is a $7x1$ vector of macroeconomic variables; e_t is the $7x1$ vector of error terms, such that $E(e_t) = 0$ and $E(e_t e_t') = \Sigma_e$; X_{t-1} is the $7x1$ vector of lagged macro variables at $t-1$; A(L) is the $7x7$ matrix polynomial in the lag operator L.

[8]Except for Lithuania for which we use a sample period from 1999:Q1 to 2014:Q4.

In the first exogenous block, we introduce the following variables: real Brent crude oil price expressed as euro per barrel at time t, oil_t; the Euro-area HICP index at time t, p_t; the real gross domestic product in the Euro Area at time t, y_t; the differential between the European overnight interest rate (Eonia), i_t, and the US federal funds rate, at time t, i_t^* ; the nominal exchange rate at time t, ϵ_t, defined as US dollars per currency unit. Euro Area is seen as an open economy that has important interactions with the US economy, the reason why we take into account potential influences from the US Federal Funds rate and exchange rate (see e.g. Scotti (2011)).

The second endogenous block instead includes the domestic macroeconomic variables for CEECs: HICP index for each country i at time t, p_{it}; the real gross domestic product, expressed in national currency, in each country i at time t, y_{it}. In this second block, national countries are treated as small open economies that interact with the Euro Area, i.e. there is unidirectional, macroeconomic causation (in the Granger sense) running from the Euro Area to national economies.

In order to account for global factors on the demand side, capable of influencing oil prices, we include in the near-VAR specification the Index of Global Real Economic Activity developed by Kilian (2009), which is taken as a proxy for the global business cycle. This variable is included as an exogenous one, in this way we can control for an important demand factor without enlarging the dimension of the estimated VAR. The model specification also includes a constant.

Since we are also interested in potential long-term effects of shocks on macro variables, we do not apply any transformation eventually needed to obtain stationary series, nor we undertake an investigation aiming to test the potential existence of cointegration relations among variables, given the (relatively) small number of observations available.

In order to easily calculate and show the shock effects on variables in percentage, oil price, prices and output both for the Euro Area and CEECs are log-transformed and then multiplied by 100. Interest rates differential are instead computed in basis points. As for lag length selection, Schwartz and the Akaike criteria suggest two different options, respectively 1 and 2-3 lags, depending of the country. We follow the Schwartz criterion and estimate the model applying 1 lag, a choice consistent with the small data sample utilized.

We are interested in the structural shocks driving the system and we recover them in the following way. Firstly, we obtain the reduced-form moving average representation of the near-VAR system:

$$X_t = C(L)e_t \tag{3}$$

where $C(0) = I$

Secondly, the structural disturbances are obtained by imposing a contemporaneous recursive structure to the estimated near-VAR model:

$$X_t = B(L)\eta_t \tag{4}$$

in which $B(L) = C(L)B$, and $\eta_t = B^{-1}e_t$. B is the matrix of contemporaneous coefficients that measure the impact of structural shocks on variables. More precisely, B is the Cholesky factor of Σ_e, i.e. the unique lower triangular matrix such that $BB' = \Sigma_e$.
To sum up, in order to have exact identification of the structural shocks, we apply the Cholesky decomposition which incorporates a recursive structure and, in particular, imposes a contemporaneous triangular structure to the model.
The macroeconomic assumptions underlying these identifying restrictions may be related to: (a) nominal rigidities affecting the economies; (b) delays in the effects of monetary policy on the macroeconomic variables.

As for the exogenous block, the oil price shock has an impact on all the variables in the model and in the spirit of Blanchard and Gali (2007) it is exogenous relatively to the contemporaneous values of the remaining macroeconomic variables included in the near-VAR. Therefore the price of oil does not contemporaneously respond to other shocks. Regarding Euro-area variables, the demand shock exerts a delayed effect on prices, while the monetary policy shock does not influence either prices or aggregate output within the quarter. Finally, the exchange rate does not exert a contemporaneous effect on the variables included in the exogenous block of the model.
As far as the national block is concerned, the imposed causal structure implies that a local aggregate demand shock does not exert a contemporaneous effect on local prices. However, an exercise of robustness of both the identification strategy and the assumption of open small economy for Poland is in the next section, in which shocks are recovered by sign restrictions.
In order to get the impulse response functions with the confidence bands we utilize an iterative Markov chain Monte Carlo (MCMC) algorithm and in particular the Gibbs sampling, Bayesian technique useful to disentangle situation in which is not possible make a draw from a random normal.

4 The responses of variables to structural shocks

In this section we present the responses of variables to structural shocks. Median responses are shown with error bands, and in the spirit of Sims and Zha (1999) we consider the 16th and the 84th percentiles.

Figure 1 shows the responses of domestic prices and output to an oil price shock. An increase

in oil prices leads to an initial increment in domestic prices for all countries and for a quite similar size. This effect is not persistent in Lithuania and Bulgaria which returns to pre-shock values after 10 quarters. Instead, regarding to the Czech Republic the effects of the oil shock vanishes (in the sense that they become statistically non-significant) after around 4 years. Croatia and Romania show a very persistent effect associated with oil prices, while Poland, in spite of an initial positive effect, starting from the 10th quarter is characterized by a negative response to the oil shock.

Output responses show a contraction for almost all countries which disappears after 20 quarters, except for Lithuania which is the only country to exhibit a permanent and positive effect of oil price shocks on output.

Insert Figure 1 about here

Table 3 shows that a 10% increase of oil prices causes a positive and maximum effect in Romanian prices of 0.57%, followed by all the other countries that are in the range 0.16% - 0.39%, and a negative and maximum effect on Croatian output of -0.95%, followed by all the other countries that show an effect close to -0.6%. Comparing the results obtained for the responses of Euro Area and CEECs to an oil price shock, almost all countries, except Poland, show a maximum effect on prices which is higher than the Euro Area. Regarding the output response, also in this case CEECs show an higher effect compared to the Euro Area.

Insert Table 3 about here

Figure 2 collects the responses of prices and output to the monetary policy shock for the analyzed countries. Generally, a contraction in output and prices appears for almost all countries even if substantial differences exist in timing and size of the responses. Instead, Lithuania and Romania show positive initial effects. However, in all the countries the effect becomes negative, at the latest after 4 quarters, and also persistent but not for Lithuania which returns to pre-shock values after 10 quarters. An increase in the interest rate differential causes an initial positive reaction in domestic prices that quickly become negative for almost all countries at the latest after 5 quarters, except for Poland, which shows a late negative effect only after 22 quarters, and for Romania, which exhibits a positive response which is significant for around two years. Moreover, while the monetary policy shock has a very persistent effect on prices in Bulgaria, Lithuania and Poland, in all the other countries the effect is temporary and vanishes after 2-3 years.

Insert Figure 2 about here

As shown in table 4, an increase of 100 basis points in the interest rate differential causes a negative maximum effect on Croatian output of -3.23%, followed by the Czech Republic -2.65%, Bulgaria -2.66%, Romania -2.25%, Poland -1.92% and ultimately Lithuania -1.81%. In addition, the maximum effect on prices is negative for almost all countries, except Romania. In fact, an increase of 100 basis points in the interest rate differential causes a negative, maximum effect on Lithuanian prices of -2.63%, then followed by Poland -1.42%, while all the others are in the range from -0.41% to -0.56%. The effects on prices are generally weaker than the ones on output, except for Lithuania. Comparing national results with the Euro-area ones, both show a contraction in prices and output to a monetary policy, however the effect on national countries appears later than the Euro-area. Moreover, CEECs are more sensitive to the Euro Area monetary policy shocks, in fact they have a bigger impact on domestic variables rather than Euro-area one: i.e. the negative, maximum effect on Euro Area is -0.37% and -1.45%, respectively, for prices and output, while all the analyzed countries show a greater contraction.

Insert Table 4 about here

To sum up, monetary policy shocks cause recessionary effects on Central and Eastern European economies, though with some delay with respect to the Euro Area. These effects are persistent in the output responses for all the countries, except Lithuania, while the effects on prices are persistent only for Bulgaria, Lithuania and Poland. The Polish output reacts less than all other CEECs, which is in line with the conclusion of previous literature, for investigations not covering the more recent periods (cf. Jiménez-Rodríguez et al. (2010)). Moreover, all the countries, but except for Lithuania, show a much stronger reaction in output than prices.

Instead, concerning oil shocks, all countries show a positive temporary effect on prices and a negative effect on output. The exception is again represented by Lithuania, which exhibits a persistent positive sign in the response of output.

5 Sources of Fluctuations in CEECs

By using the structural representation (4), it is possible to build the error in forecasting X_t for each horizon k:

$$X_{t+s} - E_t X_{t+s} = B_0 \eta_{t+s} + B_1 \eta_{t+s-1} + B_2 \eta_{t+s-2} + ... + B_{s-1} \eta_{t+1} \tag{5}$$

From equation (5) and given the orthonormality of the structural disturbances, the variance of the forecasting error is:

$$Var(X_{t+s} - E_t X_{t+s}) = B_0 B_0' + B_1 B_1' + B_2 B_2' + ... + B_{s-1} B_{s-1}' \tag{6}$$

From equation (6), it is possible to decompose the total variance of the forecast error, for each variable, which is referable to the variance of each structural shock. In this section we will use equation (6) to investigate if the pre-eminent source of macroeconomic variability in Central and Eastern European economies comes from the set of common, area-wide and oil shocks or, alternatively, from local specific shocks. Clearly, identifying the sources of macroeconomic fluctuations is of paramount importance in order to assess the degree of integration of the national business cycles in the Euro Area one.
Tables 1 and 2 in Tables illustrate the output variance decomposition for the investigated countries. National output variability in the very short run (from one to four periods) is mainly explained by local structural shocks, for all countries but especially for Bulgaria, Croatia, Poland and Romania, where at the fourth horizon the dominant source of variability is still given by local exogenous shocks. The picture is different for Lithuania and the Czech Republic where, from the fourth period onward, local macroeconomic shocks play a significant minor role with respect to external shocks.

Oil price shocks have a limited role at shorter horizons but their role steadily increases, starting from the eighth period. Indeed from the medium to the long run, oil shocks are a notable source of business cycle fluctuations in all CEECs included in the present investigation.

However it is important to stress that in the medium run, after 16 quarters, Euro-area and oil shocks explain more than 70% of national output variability in all the countries.

As for the variance decomposition of prices (not reported to save space), the results substantially confirm the previous analysis: there is a group of countries, including Bulgaria and Poland characterized by an important role played by national shocks. Instead, the role of external shocks in driving price fluctuations, at various horizons, is dominant in the Czech Republic, Lithuania and Romania. Thus, only in the case of Romania can we draw two different conclusions on the relative importance of shocks looking at output or, alternatively, at prices.

6 Sign restrictions as an alternative identification strategy

In this section we present a sensitivity analysis for the case of Poland using a VAR model with full interaction among Euro-area and national variables and by adopting an alternative identification scheme based on sign restrictions.

The near-VAR methodology presented in the previous sections has some advantages and, in particular, the invariance of the set of exogenous shocks affecting the national economies. However, a potential weakness of this approach consists in treating all the CEECs economies as small open economies. This is a quite well motivated assumption and fits well for almost all

countries, but is questionable for Poland.[9]

So in order to check the robustness of our assumption, we undertake a sensitivity analysis and estimate a VAR model including the variables of the exogenous block in system (1) jointly with prices and output for the Polish economy. We proceed as follows. First, we estimate a traditional, reduced-form VAR model, i.e. in this case the estimation of the equations of oil price and Euro-area variables include Polish variables. Then we proceed to identification of a positive oil price shock and of a contractionary monetary policy shock by imposing sign restrictions.[10]

First, we estimate the following reduced form for a VAR model of order 1:

$$X_t = A_1 X_{t-1} + e_t \tag{7}$$

where the vector X_t includes the five endogenous variables related to the (previous) exogenous block, specifically oil prices, prices, output, the differential between the Eonia rate and the US federal funds rate, and the exchange rate, and the two Polish variables, i.e. prices and output.

The covariance matrix of the vector of residuals, e, is given by Σ_e. In the second step, the matrix Σ_e is randomly drawn from the posterior distribution of the matrix of the VAR coefficients.

Let us note that there exists the following relation between the error terms, e_t, and the exogenous macroeconomic shocks: ϵ_t, is given by $e_t = F\epsilon_t$. Given FF' = Σ_e, by imposing sign restrictions on the responses of some variables to selected shocks, we aim to identify an impulse vector f, such that $f = F\alpha$, where $\|\alpha\| = 1$. Where the sign restrictions imposed are, ideally, consistent with some macroeconomic model. The restrictions are "weak", both in the sense that they do not impose an excessive strait jacket on data and since they do not allow a selection of a unique set of dynamic responses of variables to the identified structural shocks. Nevertheless, in order to circumvent this last problem, we introduce a penalty function in the spirit of Uhlig (2005).

In particular, to identify the contractionary monetary policy shock, we impose a negative response of Euro-area prices for 2 quarters to an unexpected increase in the differential between the Eonia rate and the federal funds rate. Instead, the responses of the Euro-area output, oil price, exchange rate are left free. Moreover, we do not impose restrictions on the responses of Polish variables. In addition, to identify the oil price shock we impose an even less strong restriction: we impose a positive sign only for the oil price for 2 quarters. Instead, the responses of all the other variables included in the VAR model are left free.

Figure 4 shows that a positive oil price shock causes a contraction in GDP as well as an

[9]CEECs economies have different dimensions. Poland for example holds on average 2.6% of the European Union's GDP, while Bulgaria only 0.27%.

[10]In particular we use a Penalty-Function Approach, which is one of two Bayesian methods used by Uhlig (2005) to impose sign restrictions.

increase in prices for both Euro Area and Poland. Results for the Euro Area are very similar in the dynamic of response profile and signs to those obtained by using the near-VAR, while for Poland, using sign restriction approaches, responses are smaller in magnitude compared to the ones of near-VAR, especially for the dynamics of output.

Insert Figure 3 about here

Insert Figure 4 about here

Quite encouraging results also come from the forecast-error variance analysis (not reported), since the variability of prices and output ascribable to both the oil shock and the contractionary monetary policy shock are similar to the ones obtained by using the near-VAR model approach.

To sum up, the two alternative approaches show no great differences in the behavioral responses to the identified shocks, and we are thus led to conclude that the results obtained by using the near-VAR specification with a recursive structure are pretty robust.

7 Fiscal Policy Shocks

In the previous sections we have seen how Euro Area, oil and national shocks, affect the business cycle of CEECs. In this section, we introduce fiscal policy shocks. This extension aims to improve the identification of structural national shocks and to investigate if the introduction of fiscal policy shocks lead to notable changes in the results concerning national economies.

In particular, an important question we want to investigate is: Do fiscal shocks play a significant role in the stabilization of CEECs business cycle fluctuations?

Starting from (Blanchard and Perotti (2002), the effects of domestic fiscal shocks have mainly been studied for developed countries[11].

More recently, studies on the effects of fiscal shocks have been extended to emerging countries, including CEECs (e.g. Afonso et al. (2006) and Borys et al. (2014)).

It is worth noting that the empirical literature does not reach a consensus about the effects of fiscal policy, and much less on the underlying reasons. In particular, scholars debate widely about the reasons for Non-Keynesian effects of fiscal policy on some national economies.

The Keynesian interpretation of the role of fiscal policy in stabilizing business cycle fluctuations is well known: expansionary fiscal policy stimulates the economy and thus helps recovery in recessionary contexts. However, Non-Keynesian views argue that fiscal consolidations are sometimes correlated with rapid output growth in the short-term, particularly if implemented by cutting government spending rather than by increasing taxes (see e.g. Alesina and Perotti

[11] Interesting recent studies include, among others, Leeper et al. (2015), Ilzetzki et al. (2013).

(1995) and Alesina et al. (2002)). According to this view, fiscal consolidations can be expansionary because reduction of deficit based on reduced spending may give households and firms more confidence of a lasting change in regime so that they can anticipate lower future tax burdens.

The empirical literature on fiscal policy effects for CEECs (as well as for developed countries) shows heterogeneity in results which are thus not consistent with a single framework or model. Moreover, small magnitude and small effects are ascribable overall to fiscal shocks in CEECs.

In a recent paper Borys et al. (2014) they show that private consumption and households' confidence do not respond to fiscal policy shocks. Moreover, expenditure-based fiscal consolidations increase investments, export and reduce wages, supporting the idea that fiscal consolidation of such composition enhances the competitiveness and profitability of domestic enterprises.

In this section in order to answer our research questions, we use the near-VAR already presented in section 3, adding government spending and government revenues into the block of endogenous variables for each country VAR model.

Government spending is constructed as the sum of government consumption and government investment, whereas revenues are obtained by subtracting transfers and interest expenses from the total revenue stream (see Blanchard and Perotti (2002)).[12] The main idea of the definition of these two variables is that that public spending on goods and services impacts aggregate demand directly, while transfers and taxes change the amount of disposable income, and therefore the savings-investment decisions of households.

Nevertheless, since the fiscal policies are announced in advance and discussed in the Parliamentary process, economic agents might foresee the fiscal shocks. The potential presence of fiscal foresight implies some difficulties in the identification of the structural fiscal shocks, since the associated VAR representation might suffer from non-fundamentalness.

Although, in order to control for fiscal foresight the strategy of identifying the shock directly from the news narrative can help in this regard (see Ramey (2011)), time-series of fiscal announcements are not available for our countries. Useful alternative measures in helping to recover the true sequence of structural shocks are leading indicators like stock prices and business confidence indexes (Forni and Gambetti (2014)), which is why we insert in each country VAR economic sentiment indicators and composite indexes of the domestic stock markets.

Fiscal data come from Quarterly Non-Financial Accounts for General Government of Eurostat's Government Finance Statistics.[13] The composite indexes of the domestic stock markets were retrieved from Datastream[14], while business confidence indexes are the economic senti-

[12] As defined in the Government Finance Statistics, Transfers are the sum of subsidies, other current expenditure and social benefits other than social transfers in kind, and social transfers in kind, purchased market production, payable.

[13] Data are seasonally adjusted by the original source, using moving average technique. We use the GDP deflator to express the variables in real terms.

[14] They are adjusted for seasonality using the moving average technique.

ment indicator provided by the European Commission - Directorate general for economic and financial affairs (DG ECFIN).[15]

Fiscal variables are expressed as a percentage of GDP, which is convenient for the purpose of comparing fiscal shocks across different countries, while exogenous variables are inserted in level. All the other variables are expressed as in the previous near-VAR estimation (see section 3).

The identification strategy for the exogenous block does not change and thus the recursive structure is confirmed in the analysis conducted in this section.

Instead, as far the domestic block is concerned, we impose a new recursive ordering: spendings, revenues, prices and output. The fiscal shocks are identified by assuming that the government does not react within the same quarter to macroeconomic changes. This identification strategy for the fiscal shocks has beeen recently adopted by Monacelli et al. (2010) and Dallari and Ribba (2015).

The remaining restriction in the domestic block involves a zero contemporaneous response of the price level to local aggregate demand shock.

The sample covers the EMU period, 1999:Q1 - 2015:Q4, though owing to data availability constraints there are some small differences among countries[16].

The results obtained using the forecast-error variance decomposition (FEVD) (not reported) show that the contribution of fiscal shocks to the national business cycle is quite low. Nevertheless, the response of the national variables to the fiscal shocks seems to be slightly more pronounced in Bulgaria. This result could be reasonably explained by considering that Bulgaria has a Currency Board regime, and it is consistent with the conclusions reached by Ilzetzki et al. (2013) who show that the size of the fiscal multiplier is larger in economies operating under fixed exchange rate regimes.

All countries reach the maximum percentage ascribable to fiscal shocks at 4 period horizons and after there is a steadily decrease.

Figure 5 collects the response of prices and GDP to a government spending shock. All the countries, except Lithuania show an increase in GDP after a positive spending shock. However, Polish response is not statistically significant at all horizons.

Bulgaria and Romania show a negative reaction on impact, but in the subsequent periods the responses become positive and statistically significant. The positive effect disappears after 5 quarters in Bulgaria, while in Romania the effects of the fiscal shocks vanish not earlier than 30 quarters. The Czech Republic shows a positive and significant impact which is absorbed after 25 quarters.

[15] It is available already adjusted for seasonality.

[16] Data starts in 2001:Q1 for Bulgaria, in 2000:Q1 in Lithuania, in Poland 2002:Q1 and in 1999:Q1 in Romania and Czech Republic. We exclude Croatia owing to the short sample available.

The impact on prices of spending shock is smaller compared to the impact on GDP and for almost all countries is not statistically significant. In particular Bulgaria and the Czech Republic show a negative effect to the impact, which within a quarter becomes positive even though not statistically significant for Bulgaria. Poland shows a positive and significant response on price only to the impact, while Lithuania shows a positive and persistent effect. Romania exhibits a slightly negative effect on price which is significant only to the impact.

To sum up, we find responses to spending shocks which are (almost) in line with the predictions of standard Keynesian models for Bulgaria, the Czech Republic and Romania. On the contrary, the evidence for Lithuania shows that an expansionary fiscal shock has a contractionary effect on output. In the case of Poland, the responses of both prices and output are not statistically-significant at any horizon.

The effect on price and GDP of revenue shocks is more muted compared to expenditure shocks and appears more heterogeneous among the countries.[17]

However, on the whole, the response of variables to revenue shocks in CEECs seem more in line with Non-Keynesian interpretations of the role of fiscal policy. In the light of the results obtained, an exception is represented by Poland.

Insert Figure 5 about here

8 Conclusions

In this paper, by using structural VAR techniques, we have focused the investigation on the so-called "cyclical alignment" (cf. Analysis of the Czech Republic's Current Economic Alignment to the Euro Area 2016. Czech National Bank Technical Report, CNB (2016)) of a group of Central and Eastern European economies with the Euro Area.

The novelty of this paper was to apply the near-VAR methodology to jointly study the effects of monetary policy, oil price and fiscal shocks on small open economies (CEECs) interacting with a large economy (Euro Area).

In order to accomplish this task, we have first identified a set of common macroeconomic shocks at the Euro-area and international level and studied their effects on national output and prices. Second, we have also identified domestic fiscal shocks, expenditure and revenue shocks, in order to study their relative importance as drivers of national business cycles.

The results obtained in this research show that Lithuania and the Czech Republic exhibit a good degree of integration with the Euro-area business cycle, since output and price fluctuations

[17] The impulse response functions for GDP and prices to revenue shocks are not reported here.

are mainly explained by area-wide and global oil shocks. In other words, in these two countries, local macroeconomic shocks play a notable role only at very short-run horizons.

Another important finding of this research is that Euro-area contractionary monetary policy shocks cause recessionary effects in all the investigated countries, while an increase oil price increase leads to a positive effect on prices and a contraction of output, except for Lithuania. It is worth stressing that Lithuania's picture could be a consequence of the important role of oil within the country, also considering that a big European refinery is located in Lithuania.

As far as fiscal shocks are concerned, they turned out to be minor drivers of business cycle fluctuations in almost all the investigated countries. Instead the response of national variables to government spending shocks seems to be more pronounced in Bulgaria. This is not surprising in the light of the Currency Board regime adopted by this country over the sample period. Indeed the literature on fiscal shocks has pointed out that fixed exchange rate regimes are often associated with bigger fiscal multipliers (e.g. Ilzetzki et al. (2013)).

Of course, the "cyclical alignment" is just one important factor, among others, for assessing the suitability of a given country to join a currency area. Potential structural disalignments (not investigated here) or, no less important, political considerations might induce caution on a further, rapid enlargement of the Euro Area.

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Tables

Table 1: Variance Decomposition of GDP for Bulgaria and Croatia and Czech Republic

	Horizon	Oil Shock	Euro Area Monetary Shock	National Shock		
				Supply	Demand	All
	(1)	(2)	(3)	(4)	(5)	(6)
Bulgaria	1	3.9	5.7	35	45	80
		(1.0, 8.7)	(2.3,10.2)	(28.5,41.5)	(38.8,51.3)	
	4	6	9.5	26.4	33.9	60.3
		(2.6,10.7)	(6.2,13.7)	(21.4,32.0)	(29.4,38.5)	
	8	10.2	22	20.3	24.3	44.6
		(4.5,18.8)	(16.2,28.6)	(15.7,25.5)	(19.7,29.1)	
	16	18.7	37.2	12.4	13.7	26.1
		(7.1,35.9)	(27.9,46.3)	(7.3,18.3)	(8.1,19.3)	
	40	25.8	40.3	7.4	7.4	14.8
		(10.1,55.0)	(26.7,52.3)	(1.5,14.7)	(1.4,14.2)	
Croatia	1	0.7	0.9	6.8	86	92.8
		(0.1, 2.8)	(0.1, 4.0)	(3.1,11.5)	(79.5,91.2)	
	4	2	4.3	6.5	73	79.5
		(0.5, 5.8)	(1.7, 9.4)	(2.8,11.9)	(63.1,81.6)	
	8	9	18.4	4.8	49.7	54.5
		(2.9,19.2)	(10.7,27.2)	(2.1,10.0)	(37.3,62.9)	
	16	27.5	32.2	2.5	24	26.5
		(12.7,43.5)	(22.2,42.7)	(1.0, 5.9)	(13.4,38.0)	
	40	37.5	32.5	1.4	13.7	15.1
		(16.8,59.6)	(21.1,44.5)	(0.2, 4.2)	(2.9,29.7)	
Czech Republic	1	0.6	6.1	3.2	63.8	67
		(0.1, 2.4)	(1.9,12.5)	(1.1, 6.3)	(56.7,71.1)	
	4	10.1	38.2	0.9	18.1	19
		(4.9,17.3)	(31.8,44.9)	(0.4, 1.8)	(14.6,22.0)	
	8	22	52.8	0.3	5.9	6.2
		(12.2,33.3)	(43.1,62.9)	(0.1, 0.7)	(4.3, 7.7)	
	16	31.9	54.3	0.1	2.2	2.3
		(16.4,48.4)	(39.1,68.3)	(0.0, 0.3)	(1.2, 3.5)	
	40	33.5	51.5	0.1	1.2	1.3
		(18.3,56.9)	(31.2,65.9)	(0.0, 0.2)	(0.2, 2.5)	

Notes. For each country, the total variance of the forecast error for GDP is computed and then decomposed in the part attributable to each structural shock. The table presents for each country the fraction of GDP variability, at various horizons, ascribable to oil prices shock in column (2), monetary shock in column (3) and all national shocks in column (6). In addiction, all national shocks can be distinguished in supply and demand shocks respectively in column (4) and (5). Error bands are shown in parenthesis.

Table 2: Variance Decomposition of GDP for Lithuania, Poland and Romania

	Horizon	Oil Shock	Euro Area Monetary Shock	National Shock		
				Supply	Demand	All
	(1)	(2)	(3)	(4)	(5)	(6)
Lithuania	1	5.6	12.2	2.7	56.2	58.9
		(1.9,10.9)	(7.0,18.5)	(0.6, 6.6)	(49.0,63.9)	
	4	13.0	7.9	6.8	36.4	43.2
		(5.8,22.5)	(5.2,11.5)	(3.7,11.0)	(30.7,42.4)	
	8	11.5	16.4	10.4	21.6	32.0
		(4.8,23.5)	(8.4,26.2)	(6.7,14.9)	(17.8,25.7)	
	16	14.5	14.1	14.2	14.8	29.0
		(6.1,32.2)	(7.9,26.3)	(9.5,19.6)	(10.6,19.0)	
	40	41.0	18.7	9.8	6.5	16.3
		(21.3,59.3)	(11.9,29.2)	(3.7,16.7)	(2.0,12.4)	
Poland	1	1	0.4	2.4	91.2	93.6
		(0.1, 3.7)	(0.0, 1.8)	(0.5, 5.8)	(86.2,95.1)	
	4	12.9	5.4	1.6	73.7	75.3
		(5.1,23.1)	(2.6, 9.5)	(0.3, 4.5)	(64.0,82.4)	
	8	27.7	12.8	1.1	50.2	51.3
		(11.5,44.3)	(6.4,20.7)	(0.3, 3.5)	(37.9,63.2)	
	16	36.9	22.4	0.7	27.8	28.5
		(12.6,59.9)	(9.5,37.2)	(0.2, 2.2)	(16.2,41.8)	
	40	40.4	31.8	0.3	12.7	13
		(14.9,67.9)	(11.4,51.3)	(0.0, 1.2)	(3.5,24.5)	
Romania	1	0.5	10.5	10.1	55.5	65.6
		(0.0, 2.2)	(5.6,16.8)	(6.3,14.7)	(48.6,62.6)	
	4	5	7.1	7.4	48.8	56.2
		(1.5,11.1)	(4.9,10.1)	(4.4,11.3)	(40.4,57.5)	
	8	18.2	21.1	4	30.4	34.4
		(8.2,29.6)	(14.3,28.4)	(2.2, 6.8)	(21.4,42.7)	
	16	32.2	34	1.8	14.2	16
		(17.4,47.8)	(22.8,45.3)	(0.9, 3.5)	(7.6,25.2)	
	40	34.6	36.9	1	8	9
		(19.4,57.1)	(23.3,49.7)	(0.2, 2.5)	(1.8,18.1)	

Notes. For each country, the total variance of the forecast error for GDP is computed and then decomposed in the part attributable to each structural shock. The table presents for each country the fraction of GDP variability, at various horizons, ascribable to oil prices shock in column (2), monetary shock in column (3) and all national shocks in column (6). In addiction, all national shocks can be distinguished in supply and demand shocks respectively in column (4) and (5). Error bands are shown in parenthesis.

Table 3: Estimated maximum effect of a oil price shock

Prices							
Country	EA	BG	HR	CZ	LT	PL	RO
Max.Effect	0.24	0.37	0.39	0.37	-0.45	0.16	0.57
Quarter	4	4	6	4	22	2	12
Output							
Country	EA	BG	HR	CZ	LT	PL	RO
Max.Effect	-0.33	-0.60	-0.95	-0.62	1.0	-0.63	-0.63
Quarter	12	12	15	12	26	30	13

Notes. The table reports the maximum responses of output and prices in each country to an oil price shock. The size is a 10% increase in oil prices. For each country and value is shown the number of quarters required to reach the maximum effect.

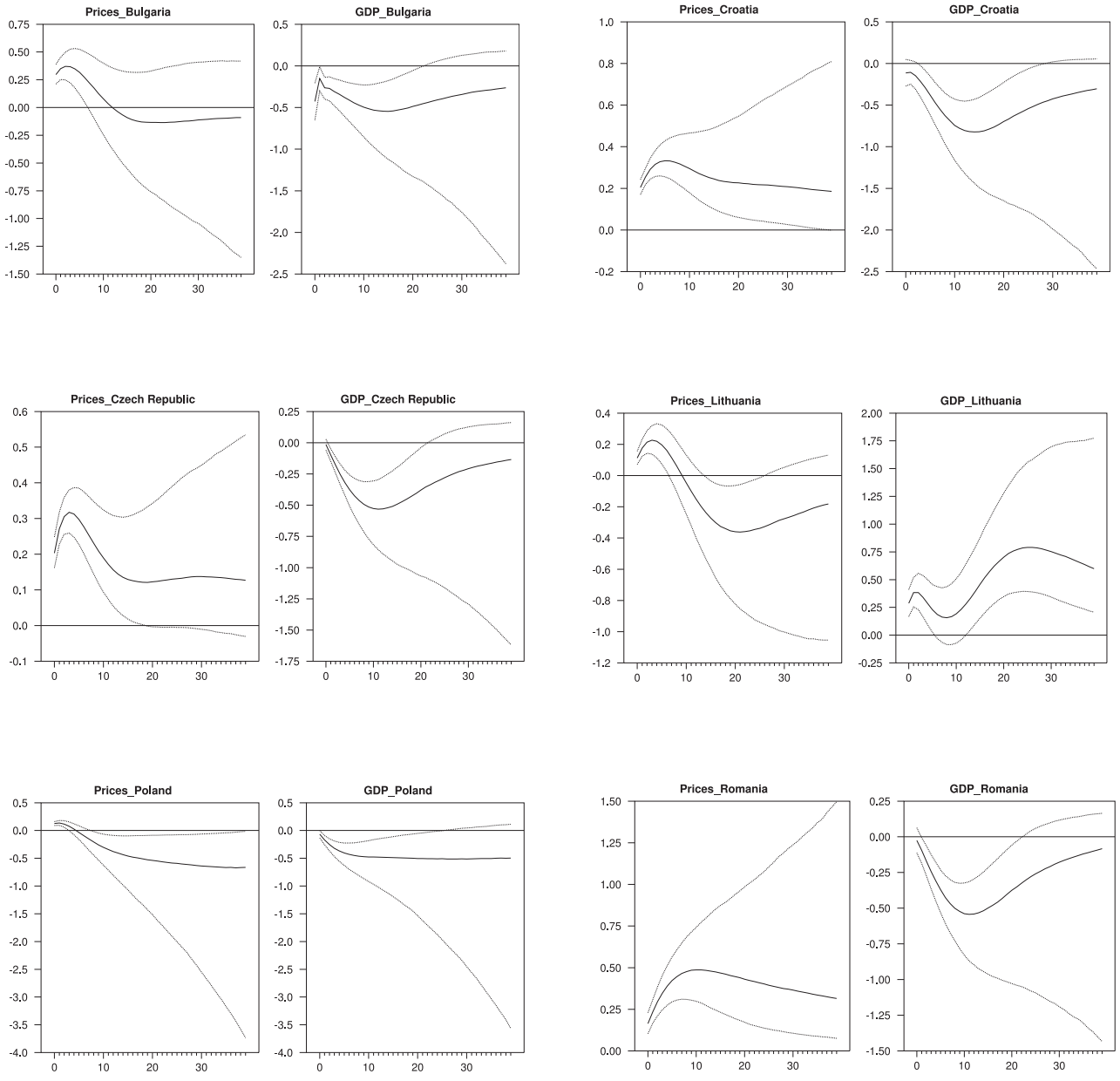
Table 4: Estimated maximum effect of a monetary policy shock

Prices							
Country	EA	BG	HR	CZ	LT	PL	RO
Max.Effect	-0.37	-0.54	-0.41	-0.56	-2.66	-1.42	0.73
Quarter	13	14	15	14	29	40	7
Output							
Country	EA	BG	HR	CZ	LT	PL	RO
Max.Effect	-1.45	-2.63	-3.23	-2.65	-1.81	-1.92	-2.25
Quarter	10	10	11	14	7	23	11

Notes. The table reports the maximum responses of output and prices in each country to a monetary policy shock. The size is a 100 basis points increase in the differential between Eonia and the US federal funds rate. For each country and value is shown the number of quarters required to reach the maximum effect.

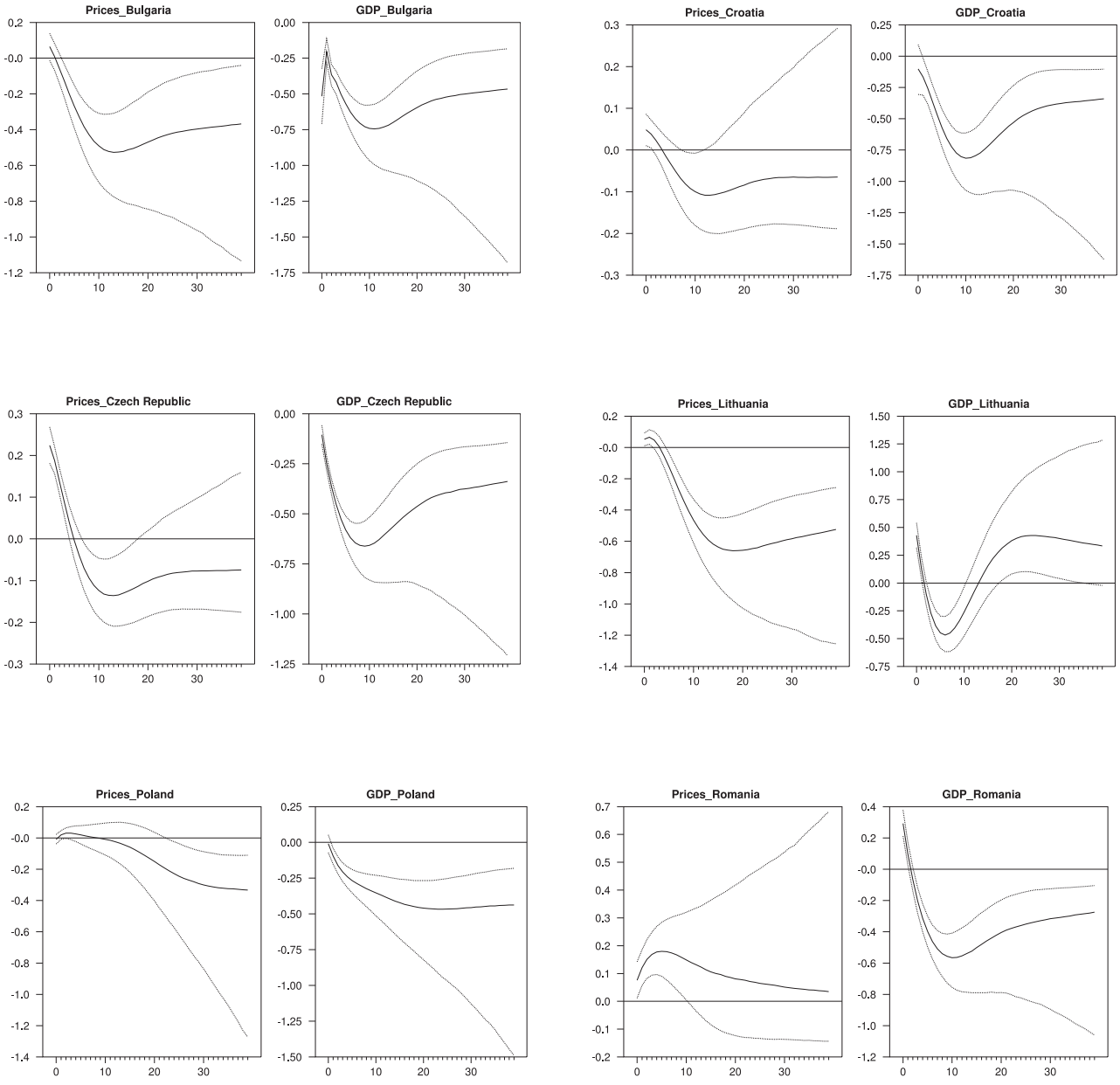
Figures

Figure 1: Responses of prices and GDP to a common, oil price shock for the national economies



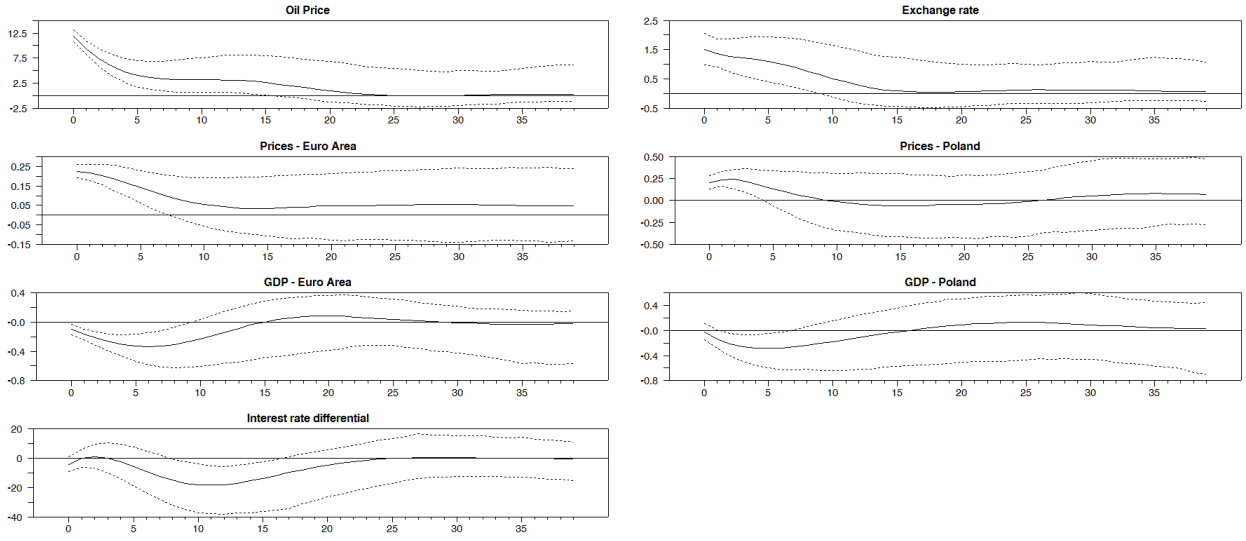
Notes. Responses of prices and GDP to a common, oil price shock for the national economies. Solid line: median estimate; dashed lines: 68 percent confidence interval.

Figure 2: Responses to a common, Euro-area monetary policy shock of prices and GDP for the national economies



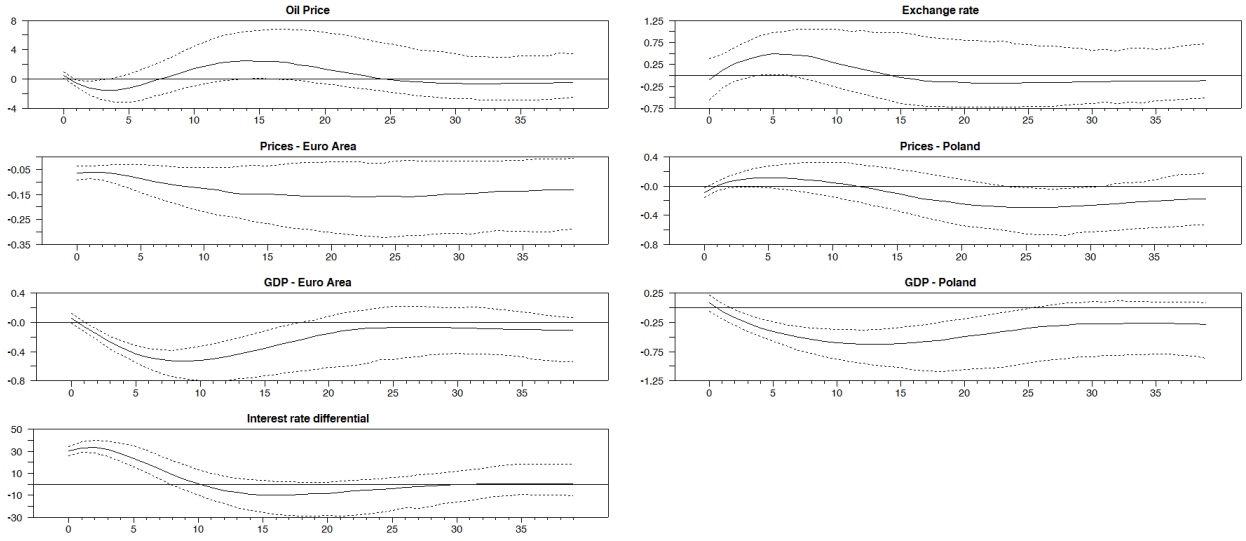
Notes. Solid line: median estimate; dashed lines: 68 percent confidence interval.

Figure 3: Responses of Euro-area and Polish variables to a positive oil shock identified by using sign restrictions



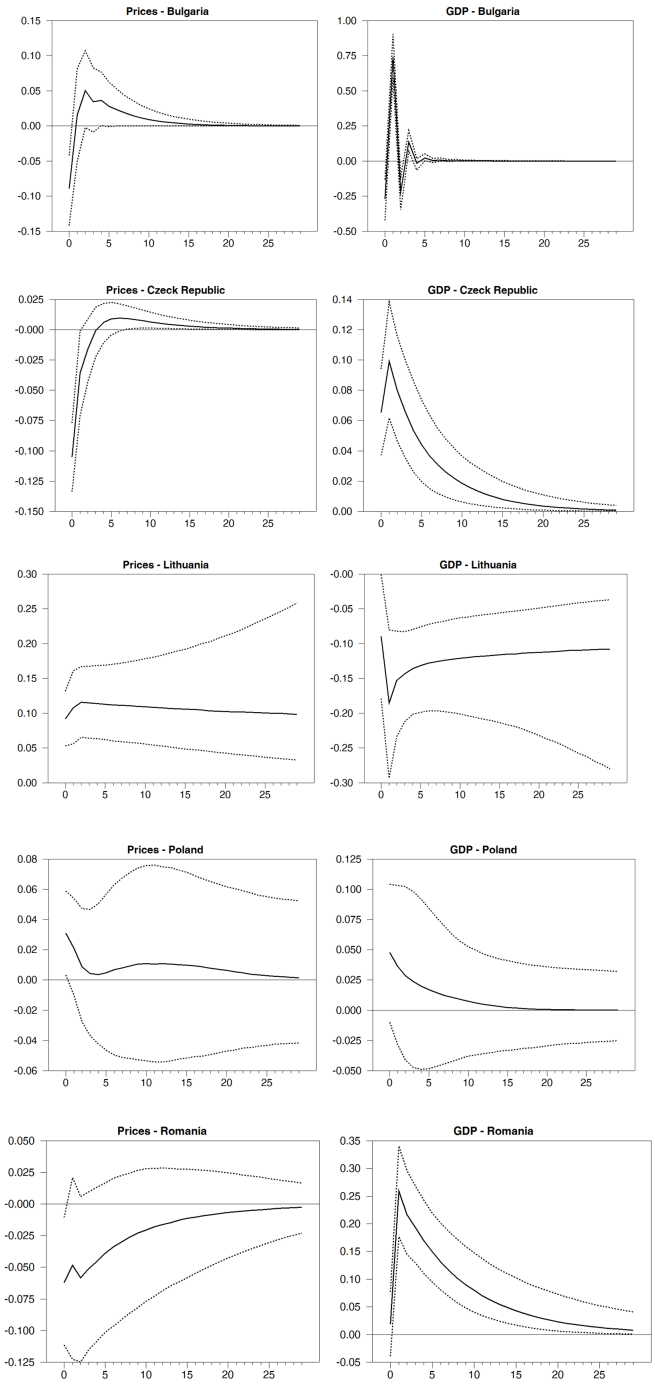
Notes. Solid line: median estimate; dashed lines: 68 percent confidence interval.

Figure 4: Responses of Euro-area and Polish variables to a contractionary Euro-area monetary policy shock identified by using sign restrictions



Notes. Solid line: median estimate; dashed lines: 68 percent confidence interval.

Figure 5: Impulse-response functions for the analyzed countries to a government spending shock: Prices and GDP responses



Notes. Solid line: median estimate; dashed lines: 68 percent confidence interval.

Data Appendix

- **Oil Brent Price**: Data are collected from the Energy Information Administration and retrieved from FRED, Federal Reserve Bank of St. Louis database, quarterly frequency with aggregation based on the average. Original data are measured in dollars per barrel. We express the oil Brent price in Euro by correcting for the US-Euro exchange rate. The global oil price that we include in the model is the real Brent oil price obtained by deflating the Brent oil price (in Euro) with the Euro-area GDP Deflator collected from Eurostat.

- **Prices**: Data for HICP index are collected from European Central Bank. In particular for Euro Area is already available the variable adjusted for seasonality, while for all Central Eastern European Countries the moving average technique is applied. The reference year is 2015 and the frequency is quarterly.

- **Output**: The real Gross Domestic Product, Chain linked volumes (2010) are collected from Eurostat. Data are quarterly, expressed in national currencies and seasonally adjusted. Due to availability constrain on seasonality, the Real GDP for Poland, Croatia and Bulgaria are obtained by deflating the nominal GDP with the GDP Deflator of each country (nominal GDP for the three countries and GDP Deflator for Bulgaria are collected from Eurostat, while GDP Deflator for Poland and Croatia are collected from Datastream). Then the real GDP for Poland, Croatia and Bulgaria are adjusted for seasonality using the moving average technique.

- **Interest rate differential**: The variable is the difference between the European overnight interest rate (Eonia) and the US Federal Funds rate. The former is collected from Eurostat. The latter is retrieved from FRED, Federal Reserve Bank of St. Louis. Data are quarterly.

- **Exchange rate**: Euro/ECU exchange rates collected from Eurostat. Data are quarterly and expressed as US dollars per currency unit.

- **Global Real Economic Activity Index**: The variable is developed in Kilian (2009); data are available at the website of Lutz Kilian: http://www-personal.umich.edu/ lkilian/paperlinks.html.

- **Government Spending**: This variable is the sum of government consumption and government investment. Once collected data from Eurostat, firstly they are seasonally adjusted and transformed in real term using GDP Deflator of each countries; secondly the variable government spending for each country is built. Data are quarterly.

- **Government Revenues**: The variable are obtained by subtracting transfers (Transfers are the sum of subsidies, other current expenditure and social benefits other than social transfers in kind and social transfers in kind purchased market production, payable) and interest expenses from the total revenue stream. Once collected data from Eurostat. First, data are seasonally adjusted and transformed in real term using GDP Deflator of each countries; secondly the variable government revenues is built. Quarterly Frequency.
- **Composite indexes of the domestic stock markets**: Data are collected from Datastream, except for Romania for which we use Bloomberg Database. Data are adjusted for seasonality. Quarterly Frequency.
- **Economic Sentiment Indicator**: Data come from the European Commission - Directorate general for economic and financial affairs (DG ECFIN). They are already adjusted for seasonality. The monthly values have been aggregated to quarters through simple average.

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