MONETARY SHOCKS AND REAL EXCHANGE RATE FLUCTUATIONS IN CEE COUNTRIES

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Abstract

The aim of this paper is to investigate the role of the exchange rate regime in absorbing macroeconomic shocks for a group of Central and East European countries (CEE). Whether the flexible exchange rate regime is beneficial for an economy depends on the capacity of the exchange rate to act as a shock absorber. An appropriate framework for assessing the role of the exchange rate is a structural vector autoregressive (SVAR) model. Impact of two types of macroeconomic shocks is estimated: nominal and real. The shocks are identified on the basis of Blanchard-Quah long run identification scheme which means that the restrictions are imposed on the long run responses while the short run dynamics is kept unrestricted. The importance of nominal and real shocks is assessed using the variance decomposition and the impulse response functions.

Key words: *SVAR, Blanchard-Quah decomposition, impulse response function, macroeconomic shocks*

1. INTRODUCTION

The economies of CEE countries share a common feature: a transition process towards market economies during which they introduced numerous structural and institutional reforms and confronted similar obstacles. These countries have different forms of fixed and floating exchange rate regimes. Table 1 presents an overview of the exchange rate regimes in the selected CEE economies.

Table 1: Exchange rate regimes in selected CEE countries (1999M1-2011M12).

Country	Label	Exchange Rate regimes	Introduction date
Croatia	CRO	Managed float	1.1.1999.
Hungary	HUN	Crawling bands Target zone	1.1.1999. 4.5.2001.
Czech Republic	CZE	Managed float	1.1.1999.
Romania	ROM	Managed float	1.1.1999.
Poland	POL	Crawling bands Free float	1.1.1999. 12.4.2000.

Analyzed countries include countries that are already EU members and countries in the negotiation process and accession countries. Considering that all of these countries have an obligation to meet the convergence criteria and adopt euro as their currency, it is worthwhile to evaluate what are advantages and disadvantages of giving up the exchange rate flexibility. The question is to what extent the real exchange rate fluctuations reflect the real economy and nominal disturbances. Lastrapes (1992) was among the first to investigate the sources of exchange rate fluctuations using the Blanchard and Quah (1989) approach. Results of the analysis for a set of advanced economies indicate that the real shocks account for major part of both real and nominal exchange rate fluctuations. Similar to Lastrapes (1992), a bivariate SVAR model was used in a number of studies for the CEE countries. Dibooglu and Kutan (2001) find that for the period from 1990 to 1999 the real shocks are the main source of the exchange rate fluctuations in Hungary while opposite holds for Poland. Borghijs and Kuijs (2004) study sources of fluctuations in the real exchange rate in the Czech Republic, Poland, Slovakia, Hungary and Slovenia from 1993 to 2003. The results indicate destabilizing role of flexible exchange rate regimes as the nominal shocks are the main source of real exchange rate fluctuations. Kontolemis and Ross (2005) analyze a set of CEE countries over the period from 1986 to 2003. While nominal shocks proved to be significant only in the short run, real shocks are a dominant source of fluctuations in the real exchange rate for all CEE economies. Morales-Zumaquero (2006) analyzes the sources of fluctuations in the real exchange rate for Czech Republic, Hungary, Poland, Slovenia and Romania for the period from 1991 to 2000. The author finds that the real shocks are the main source of fluctuations in the real exchange rate for the Czech Republic, Slovenia and Hungary while nominal shocks mostly explain movements in the real exchange rate for Poland and Romania. The author explains mixed results as a consequence of the different initial conditions that countries under consideration where in. Rodríguez-López and Torres (2006) examine the role of the exchange rate as a shock absorber in the

Czech Republic, Hungary and Poland from 1993 to 2004. The exchange rate seems to be a destabilizing factor in the Czech Republic and Hungary, while in Poland it acts as a shock absorber.

In addition to the previously mentioned studies, this paper provides new insight into the sources of fluctuations in the real exchange rate by using a richer data set and by adding results for Croatia. The rest of the paper is organized as follows. In the next section the Blanchard-Quah (1989) long run structural restriction technique is presented. Section 3 contains description of the data sets employed in the empirical analysis and the sources from which they are obtained. In section 4 the most important results of the empirical analysis are reported, including the forecasting error variance decomposition and the impulse response analysis. Finally, the last section concludes.

2. SVAR APPROACH

The starting point in the analysis of the real exchange rate fluctuations is a structural moving average model which can be written as[1]:

$$\Delta x_t = A_0\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + ... = A(L)\varepsilon_t , \tag{1}$$

where Δ denotes the difference operator, $x_t = [q_t, s_t]'$ is a vector of the relevant endogenous variables, $\varepsilon_t = [\varepsilon_{rt}, \varepsilon_{nt}]'$ is a vector of structural disturbances and $A(L) = A_0 + A_1 L + A_2 L^2 + ...$ is a matrix polynomial in the lag operator[2] L. By definition, structural shocks (ε_t) are serially uncorrelated and mutually orthogonal and $E[\varepsilon_t \varepsilon_t']$ is normalised to the identity matrix, *i.e.*

$$E[\varepsilon_t] = 0 ,\ E[\varepsilon_t \varepsilon_t'] = \Sigma_\varepsilon = I \text{ and } E[\varepsilon_s \varepsilon_t'] = [0], \quad \forall s \neq t . \tag{2}$$

The vector moving average (VMA) representation of the standard VAR model is given by

$$\Delta x_t = u_t + C_1 u_{t-1} + C_2 u_{t-2} + ... = C(L)u_t , \tag{3}$$

where $C(L) = I + C_1 L + C_2 L^2 + ...$, and $u_t = [u_{rt}, u_{nt}]'$ is a vector of reduced form disturbances that are serially uncorrelated but can be contemporaneously correlated with each other, *i.e.*

$$E(u_t) = 0 ,\ E[u_t u_t'] = \Omega \text{ and } E[u_s u_t] = [0], \quad \forall s \neq t . \tag{4}$$

Suppose that there exists a non singular matrix S such that $u_t = S\varepsilon_t$. Comparing equations (1) and (3) reveals that

$$u_t = A_0 \varepsilon_t , \tag{5}$$

with variance-covariance matrix of the reduced form disturbances

[1] Deterministic components are left out due to notation simplicity.
[2] The lag polynomials are assumed to have absolutely summable coefficients.

$$\Omega = E[u_t u_t'] = A_0 A'_0 . \tag{6}$$

As model (3) is underidentified, additional restrictions are needed to obtain estimates of A_0 (and thus structural shocks ε_t) from the estimated model (3). Since A_0 is a 2x2 matrix, we need four parameters to recover the structural residuals ε_t (original shocks that drive the behaviour of the endogenous variables) from the reduced form residuals u_t. Of four parameters, three are given by the elements of $\hat{\Omega}$ (two estimated variances and one estimated covariance of the VAR residuals). Therefore, one additional restriction is needed to exactly identify the system. Additional restriction is made by making further assumptions about the structural shocks. Constraint is imposed on the long run multipliers while the short run dynamics are left unconstrained. These two restrictions are as follows: Nominal shocks (ε_{nt}) are only a short run phenomenon and for that reason they are expected to have no long run impact on the real exchange rate, which is consistent with the long-run money neutrality. On the other hand, real shocks (ε_{rt}) are expected to influence the levels of both variables (real end nominal exchange rate) in the long run. Therefore, the structural shocks are defined according to their impact on the variables in the VAR and do not necessarily coincide with the true real and nominal shocks as they are defined by the economic theory. Nevertheless, the assumptions are consistent with most existing macroeconomic theories. Furthermore, the approach avoids using contemporaneous restrictions which are often considered to be controversial.

Letting $A(1) = A_0 + A_1 + A_2 + \ldots$, the long run representation of our structural moving average model (1) can be written as follows:

$$\begin{pmatrix} \Delta q_t \\ \Delta s_t \end{pmatrix} = \begin{pmatrix} A_{11}(1) & A_{12}(1) \\ A_{21}(1) & A_{22}(1) \end{pmatrix} \begin{pmatrix} \varepsilon_{rt} \\ \varepsilon_{nt} \end{pmatrix}, \tag{7}$$

where $A(1)$ is a matrix of the long-run effects of ε_t on Δx_t. $A_{ij}(1)$ are polynomials in the lag operator *L* such that the individual coefficients of $A_{ij}(1)$ are denoted by $a_{ij}(1)$. For example, the third coefficient of $A_{21}(1)$ is $a_{21}(3)$. (7) is a compact form of the bivariate moving average representation of the Δq_t and Δs_t, i.e.

$$\Delta q_t = \sum_{k=0}^{\infty} a_{11}(k)\varepsilon_{rt-k} + \sum_{k=0}^{\infty} a_{12}(k)\varepsilon_{nt-k}$$
$$\Delta s_t = \sum_{k=0}^{\infty} a_{21}(k)\varepsilon_{rt-k} + \sum_{k=0}^{\infty} a_{22}(k)\varepsilon_{nt-k}$$

where $a_{ij}(k)$ is the k-th coefficient in $A_{ij}(1)$.

The restriction that nominal shocks (ε_{nt}) do not influence the real exchange rate in the long run requires that the coefficients in $A_{12}(1)$ sum to zero, i.e.:

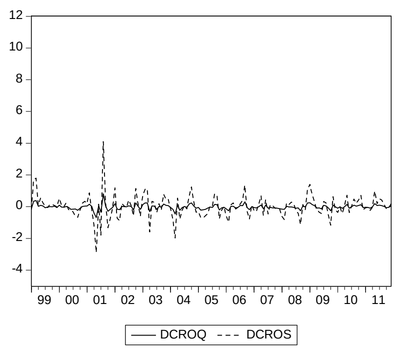
$$A_{12}(1) = 0 \tag{8}$$

which is equivalent that the long-term accumulated effects of the innovations are equal to zero, i.e. $\sum_{k=0}^{\infty} a_{12}(k) = 0$. This restriction makes the $A(1)$ matrix triangular and the system is exactly identified.

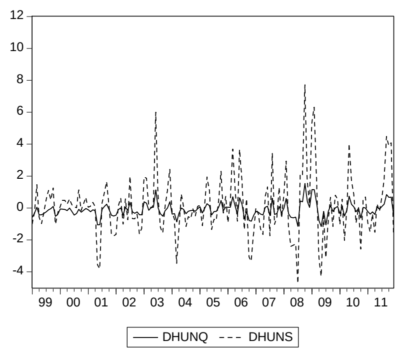
3. DATA

To assess the relative importance of real and nominal shocks, a two variable VAR model for Croatia, Romania, Hungary, Bulgaria and Czech Republic is estimated. The variables employed in the model are: the real exchange rate (q_t) and the nominal exchange rate (s_t) (the price of euro in units of domestic currency). All variables are in logarithms and multiplied by 100 so that their differences can be interpreted as the percentage change in the underlying variable. We use seasonally adjusted monthly data starting from January 1999 to December 2011, which gives a total of 156 observations.

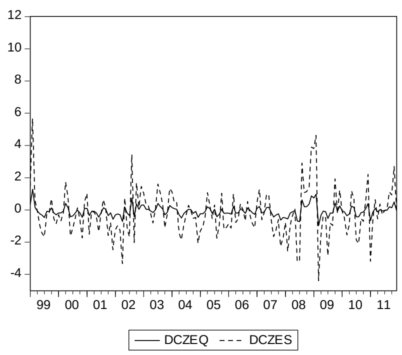
CROATIA:



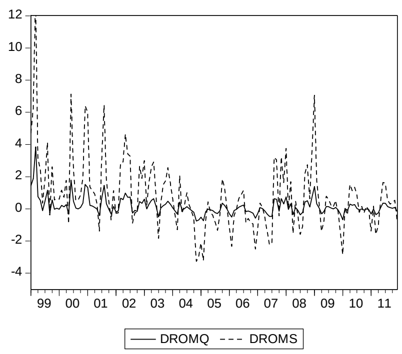
HUNGARY:



CZECH REPUBLIC:



ROMANIA:



POLAND:

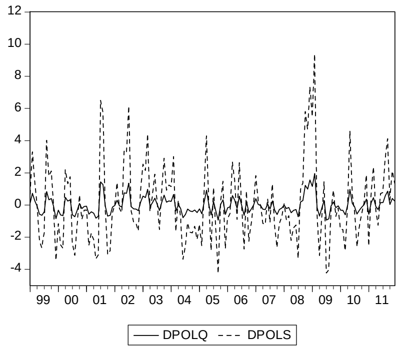


Figure 1:.Nominal and real exchange rate fluctuations in CEE countries.

Beginning of the observation period, January 1999, corresponds to the introduction of euro as a common currency and the beginning of the third stage of the implementation of the Economic and Monetary Union (EMU). The price level is measured by the Harmonized Index of Consumer Prices (HICP) and is used as a deflator in turning nominal exchange rate into real exchange rate. Data sets are obtained from EUROSTAT. The dynamics of the series in the period under study are presented in Figure 1. To obtain a better insight into the volatility of the real exchange rate (RER) and nominal exchange rate (NER) in studied countries the vertical axis has the same scaling in all graphs.

4. MAIN EMPIRICAL RESULTS

As a prerequisite of BQ decomposition, variables are assumed to be integrated of order one (so that the variables in x_t are stationary) and not cointegrated, because they follow different stochastic trends in the long run. Therefore, prior to empirical analysis, integration level of the series is tested. The results[3] of the ADF tests indicate that most of the variables are integrated of order one, i.e. $I(1)$. However, test results are ambiguous in some cases (Hungary) and it is not quite clear whether the variables are $I(0)$ or $I(1)$. Second prerequisite for the implementation of the Blanchard and Quah (1989) identification scheme is that the variables are not cointegrated. Generally, Johansen cointegration tests provide evidence that cointegration relationships between variables do not exist, although there are a few borderline cases[4]. The optimal lag length in the VARs, p, is selected according to the values of the information criteria (Akaike, Schwarz and Hannan-Quinn) as well as sequential modified LR test statistic (each test is conducted at 5% level), Final prediction error (FPE) and testing the regression residuals for serial correlation. VAR models include constant and dummy variables capturing regime

[3] The results of the underlying ADF tests are left out to preserve space, but are available upon request.
[4] Johansen cointegration test results are not reported, but are available upon request.

shifts visible in residuals of the model if they were significant according in at least one equation. All models are stable, i.e. all roots are within unit circle. On the basis of the estimated VAR models and two structural shocks identified as described in the second section, variance decomposition and impulse response analysis are carried out in order to measure the importance of real and nominal shocks in explaining the real exchange rate fluctuations. The results of the forecast error variance decomposition at various horizons (up to 24 months) are reported in Table 2.

Table 2: Variance decomposition of real and nominal exchange rates due to real shocks.

Months	1	4	8	12	24
Croatia					
RER	95.0	97.2	98.6	99.1	99.6
NER	79.2	75.7	75.6	75.6	75.6
Czech Republic					
RER	96.2	99.2	99.7	99.8	99.9
NER	86.3	86.6	86.6	86.6	86.6
Hungary					
RER	62.3	71.7	86.1	91.4	96.2
NER	38.3	35.5	35.5	35.5	35.5
Poland					
RER	79.0	89.7	93.1	95.1	97.4
NER	75.2	87.0	90.3	92.3	94.9
Romania					
RER	99.2	99.8	99.9	100.0	100.0
NER	98.8	98.2	98.1	98.1	98.1

Source: authors' calculation.

Variance decomposition assesses the relative importance of analysed shocks and decomposes real and nominal exchange rate movements into those caused by real and nominal shocks. Table 2 shows the proportion of the forecast error variance which can be attributed to the real shocks. The contribution of nominal shocks is, by construction, 100 minus the contribution of the real shock. The results imply that the real shocks account for the majority of the real exchange rate variability, both in the long-run (by construction) and in the short-run. Nominal shocks have a limited role in Croatia, Czech Republic and Romania where they account for up to 5% of real exchange rate variability at all reported horizons. On the other hand, nominal shocks explain an important part of real exchange rate fluctuations in Hungary (37.7%) and Poland (21%). Therefore, the importance of the nominal shocks does not depend on the exchange rate regime as Hungary is an example of a country with pegged rate, and Poland is an example of a country with a floating exchange rate regime.

Figures 2 and 3 display the impulse response functions (IRFs) for the levels of real and nominal exchange rates. Each graph shows the dynamic response of the exchange rate to a standard deviation impulse in either the real shock or the nominal shock over forecast horizons from 1 to 24 months with one standard error confidence interval which indicates the precision of the IRFs estimates. These bands are calculated around the point estimate, which is the mean of the drawn responses, as the square root of mean squared deviations in each direction over 10000 Monte Carlo draws. It is important to note that the bands are asymmetric.

On impact, real shock leads to an increase in both the real and the nominal exchange rate. In most countries the effect on the real exchange rate becomes permanent after four months. On the other hand, the adjustment of the real exchange rate to real shocks appears to be rather slow in Hungary and Poland. As indicated by the imposed identification restriction, the effect of a nominal shock on the real exchange rate is temporary and dies out within four months. However, in Hungary and Poland the effects of a nominal shock on the real exchange are more persistent and fade to zero after a year.

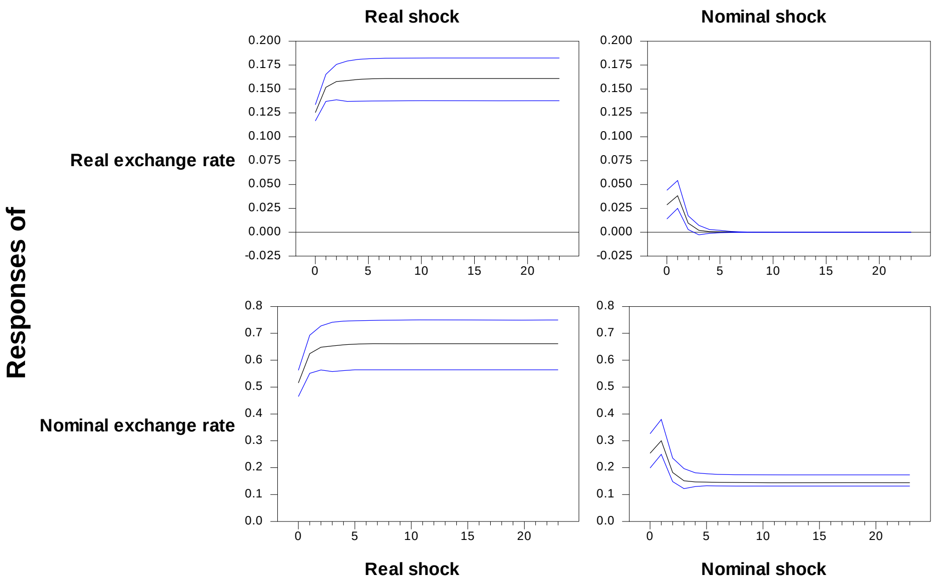


Figure 2:.Impulse response functions for Croatia.

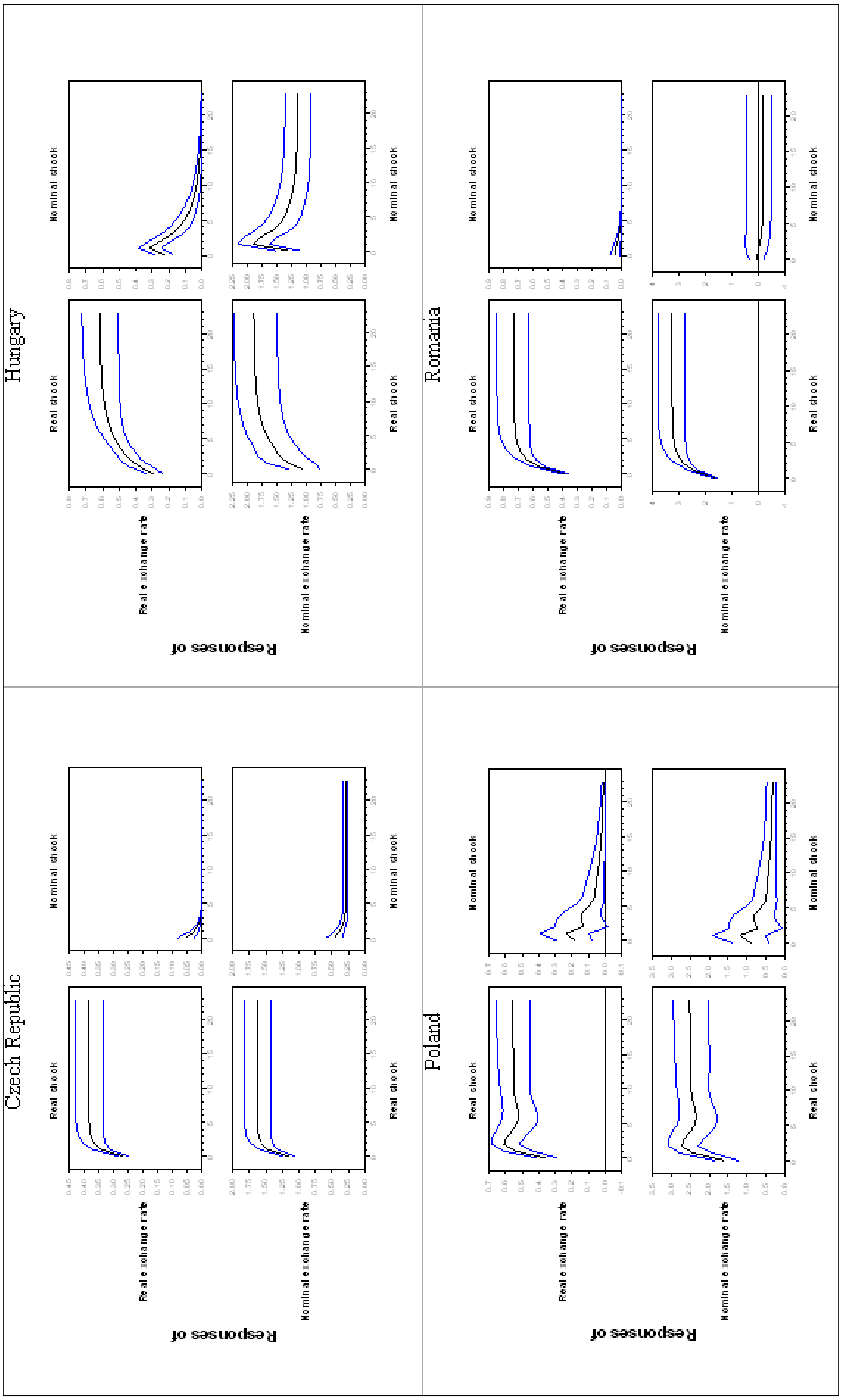


Figure 3:.Impulse response functions for selected CEE countries.

5. CONCLUSION

The paper investigates the role of the exchange rate regime in absorbing macroeconomic shocks for a group of Central and East European countries (CEE). The results of the empirical analysis indicate that the real shocks are the main determinant of real exchange rates in Croatia, Romania and Czech Republic. In other words, exchange rate acts as a shock absorber in these countries and abandoning flexible exchange rate as an instrument for absorbing shocks is not so favourable. Although weaker, evidence of a shock absorbing role also exist for Poland and Hungary where nominal shocks explain a larger proportion of real exchange rate fluctuations then in Croatia, Romania and Czech Republic.

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