Exchange rate regime and sensitivity to economic and financial shocks in Central European countries

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Abstract

The paper compares five Central European countries, i.e. Bulgaria, Hungary, Poland, Slovakia and Slovenia, through the lens of the reactions of their economies to economic and financial shocks. These countries are small open economies at a similar level of economic development and at the same time they have adopted different exchange rate regimes. This makes it possible to investigate whether the reactions of an economy to real and nominal shocks are indeed in line with the degree of exchange rate flexibility. The stochastic macroeconomic model of a small open economy is used to derive the long-term zero and sign restrictions. These are used to identify supply, demand, financial and monetary shocks within the Bayesian structural vector autoregression models with common serial correlations. For each economy a separate BSVAR model is estimated on quarterly data spanning from 1998 to 2013 for relative GDP, interest rate differential, real exchange rate and relative price level. Our findings lend some support to the hypothesis that the flexible exchange rate acts as a shock absorber: under the floating rate it is the exchange rate that reacts to real shocks rather than output, whereas under the fixed rate output responses are stronger. Moreover, the burden of adjustment to financial shocks in Hungary and Poland rests on the nominal exchange rate and on the relative price level and the real interest rate differential in Bulgaria and Slovakia.

Keywords: *open economy macroeconomics; real exchange rate; exchange rate regime; Bayesian structural VAR; common serial correlation*

JEL Classification: F41, C11

1. Introduction

The well-known finding of Mundell (1963) and Fleming (1962) is that the exchange rate regime matters for the effectiveness of macroeconomic policy. Though their models were deterministic, the stochastic implications are quite easy to derive: if it is nominal shocks that are the main source of disturbance, an economy is better off under the fixed exchange rate regime and if real shocks dominate – the floating exchange rate is superior (see Ghosh et al. 2002, p. 23). This finding has been called the 'Mundell-Fleming's dictum' by Lahiri et al. (2008).

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Central European economies can be used as a testing ground for this dictum because of two reasons. First, they have adopted different exchange rate regimes: from currency board in Bulgaria to free floating in Poland. Second, they are not too different economies: they are small open economies, are at a similar level of development and share similar economic history.

The research objective is to examine whether the exchange rate regime matters for the sensitivity of Central European economies to economic and financial shocks. The literature has not yet reached a consensus on that issue. There are two competing hypotheses on a role of the floating exchange rate: One is that it acts as a shock absorber and another that it contributes to shock propagation (or even that it is a source of shocks). The issue is usually investigated with the forecast error variance decomposition under VAR methodology. Thus, Kuijs and Borghijs (2004) and Shevchuk (2014) found that nominal shocks are the main driver of the exchange rate whereas Stążka-Gawrysiak (2009) and Dąbrowski and Wróblewska (2014) found that real shocks are more important.

Our contribution in this paper is that we adopt a strategy that consists of two complementary steps. First, the relative importance of real vs. nominal shocks is assessed for each economy. If real shocks drive both output and exchange rate, the floating exchange rate *can* be a shock absorber. If nominal shocks are behind output and exchange rate fluctuations then it is more *likely* that flexible exchange rate is a shock propagator. Second, the responsiveness of output to shocks is examined in order to confirm or to reject that the flexible exchange rate is indeed a shock absorber/propagator.

The paper is structured as follows. Section 2 covers the underlying theoretical model, empirical methodology and data. Empirical results are reported in Section 3 and the last section concludes.

2. Model

As a theoretical framework we use the model of a small open economy developed by Obstfeld et al. (1985) and extended by Clarida and Galí (1994) and Dąbrowski (2012) (see also Agénor and Montiel 2008, p. 302 ff). The model includes three equilibrium conditions for the goods market, money market and the foreign exchange market. Prices are sticky so shocks are not absorbed instantaneously and the short-run equilibrium can deviate from the long-run equilibrium. The model is stochastic and allows for supply, demand, financial and monetary shocks (for a more detailed description of the model see Dąbrowski and Wróblewska (2015).

The long-run solution of the model is used to derive zero and sign restrictions on the reactions of four main macroeconomic variables, i.e. relative output, real interest rate differential, real exchange rate and the relative price level, to structural shocks. Restrictions obtained and employed in the empirical analysis are summarised in Table 1.

Variable\shock	**supply**	**demand**	**financial**	**monetary**
Relative output	+	0	0	0
Real interest rate differential	–	+	+	0
Real exchange rate	–	+	–	0
Relative price level	–	+	+	+

Table 1. Long-run identifying restrictions.

3. Methodology and data

The basic model employed in the empirical analysis is a stable Bayesian *n*-dimensional VAR(k) model with three seasonal dummies, a constant and non-stochastic starting points:

$$y_t = \Gamma_1 y_{t-1} + \Gamma_2 y_{t-2} + \ldots + \Gamma_k y_{t-k} + \Phi D_t + \varepsilon_t, \quad \varepsilon_t \sim iiN(0,\Sigma), \quad t = 1,2,...,T \ . \tag{1}$$

The Normal-Wishart prior structure is imposed on the model parameters, with normal distribution for Γs centered around zero and the prior expectation of the covariance matrix Σ is $0.01 I_4$.

Additionally, in the set of the analysed models there are also structures with the reduced rank restrictions imposed on the Γs parameters:

$$y_t = \gamma\delta_1 y_{t-1} + \gamma\delta_2 y_{t-2} + \ldots + \gamma\delta_k y_{t-k} + \Phi D_t + \varepsilon_t, \quad \varepsilon_t \sim iiN(0,\Sigma), \quad t = 1,2,...,T \tag{2}$$

where $\gamma_{n\times(n-s)}$ is a matrix of full column rank. As pointed out by Engle and Kozicki (1993) in the VAR framework such restriction is equivalent to common serial correlations among the analysed processes, *s* denotes the number of these common features. Such a Bayesian VAR-CC model has been already analysed by Dąbrowski and Wróblewska (2015).

Summing up, for each considered country we have to compare 20 specifications, which may differ in the number of lags ($k \in \{5,6,\ldots,9\}$) and the number of common features ($s \in \{0,1,2,3\}$). We assume equal prior probability for each of them.

The below presented results are obtained by taking the advantage of the Bayesian Model Averaging technique within the set of models with the highest posterior probability (i.e. higher than the assumed 0.05 prior probability). To impose over mentioned sign and zero restrictions, resulting from the economic model, the algorithm proposed by Arias et al. (2014) is employed.

Quarterly data for real GDP, three-month money market interest rate, nominal exchange rate (defined as a price of domestic currency in terms of the euro), harmonised index of consumer prices for the period 1998q1-2013q4 are uploaded from the Eurostat database. They are used to obtain relative real output, real interest rate differential, real exchange rate and relative price level. For all variables the reference country is the euro area, so e.g. the relative output is the (log-) difference between real GDP in a given country and real GDP in the euro area.

4. Empirical results

Before moving on to the results from the structural VAR models countries included in our analysis are ordered according to the degree of flexibility of the exchange rate regime adopted. The *de facto* classifications provided by the IMF in the *Annual Reports on Exchange Arrangements and Exchange Restrictions* are used in Table 2. Bulgaria with a hard peg and Poland with a free floating are at the two extremes of the exchange rate regime spectrum. Slovenia and Slovakia limited the flexibility of the exchange rate and then adopted the euro in the late 2000s. Changes in Hungary were in the opposite direction, i.e. towards the floating exchange rate.

The first step was to examine the relative importance of real vs. nominal shocks. Using the forecast error variance decompositions we have found that output variability was driven to a larger extent by demand, financial and monetary shocks in Bulgaria than in other four countries at all forecasting horizons (see Table 3 for a one quarter forecasting horizon; results for other horizons are available upon request). When the contribution of real versus nominal shocks is compared then the contrast between these countries is not so stark. More striking is the observation that only in Hungary supply shocks accounted for almost all output variability. At 20 quarter forecasting horizon (not reported), the difference, however, is again between Bulgaria and other countries.

Bulgaria	**Slovenia**	**Slovakia**	**Hungary**	**Poland**
Currency board (July 1, 1997)	Managed floating [a)] Crawling band (Feb 1, 2002) Pegged band [b)]	Managed floating [a)] Pegged band [b)]	Crawling band Pegged band [b)] (Oct 1, 2001) Free floating	Crawling band Free floating (Apr 12, 2000)

(June 27, 2004)	(Nov 25, 2005)	(Feb 26, 2008)
Currency union	Currency union	Floating
(Jan 1, 2007)	(Jan 1, 2009)	(Mar 1, 2009)

Notes: date of the introduction in brackets; if there is no date, the regime was adopted before 2000; formal categories in *ARERER*: a) ‘Managed floating with no predetermined path for the exchange rate’; b) ‘Pegged exchange rate within horizontal bands’.

Table 2. Exchange rate flexibility of Central European currencies, 2000-2015.

Source: based on the IMF *Annual Reports on Exchange Arrangements and Exchange Restrictions* (various issues).

Country	**Proportions of forecast error variance, *h* periods ahead, accounted for by**			
	supply shocks	**demand shocks**	**financial shocks**	**monetary shocks**
Relative output				
Bulgaria	50.51	25.90	9.72	13.86
Hungary	97.76	0.63	0.51	1.09
Poland	79.48	5.90	4.95	9.67
Slovenia	75.98	11.14	5.41	7.47
Slovakia	86.67	2.99	2.99	7.35
Real exchange rate				
Bulgaria	15.30	43.75	36.93	4.03
Hungary	3.46	48.67	33.60	14.27
Poland	11.08	40.55	44.34	4.03
Slovenia	9.66	45.76	42.46	2.12
Slovakia	7.52	56.78	34.37	1.32

Table 3. Posterior expected value of forecast error variance decomposition of the real exchange rate and relative output (forecast horizon is one quarter).

Contribution of real shocks to the real exchange rate variability is more than 50% in all countries. In Hungary, supply shocks are less and monetary shocks are more important than in the other countries. Intuition based on the fact that the Polish zloty is the most flexible currency is indeed confirmed – the contribution of financial shocks in Poland is indeed the highest, but, interestingly, it is not too different in the other countries. Moreover, it disappears at longer forecasting horizons – it is about 40% at 20 quarter horizon in all countries.

Overall, it seems that real shocks are important drivers behind both output and real exchange rate variability in all countries. Even though the contribution of nominal shocks to the variance of real exchange rate is far from nil it is quite similar across all the countries, especially at longer forecasting horizons. Thus, our interpretation is that a flexible exchange rate could *potentially* be a shock absorber.

In order to settle whether the flexible exchange rate *actually* is a shock absorber we move on to the second step and examine the impulse response functions of the relative output. In Fig. 1 the output reactions to all shocks in Poland are compared to those in Bulgaria. Three observations can be made. First, reactions to demand shocks are stronger in Bulgaria whereas response to supply shocks is quite similar, at least at the short-term horizon. Second, reactions to nominal shocks are not too different although financial shocks seem to be more problematic in Bulgaria. Third, one has to admit that the degree of uncertainty is large – confidence intervals (range between the 16th and 84th quantiles of the posterior distribution) are wide, especially for Bulgaria, and overlap.

Comparisons between Poland and two other peggers look fairly similar, although in Slovakia it is a response to the supply shock and not to demand shock which is stronger than in Poland (all response impulse functions referred to in the text are available upon request). Two floaters react alike to demand shocks but in Hungary output responses to both nominal shocks are weaker in the short-term horizon and to supply shocks in the longer-term horizon.

Hungary and Slovenia are compared in Fig. 2. What is clear is that output reactions to demand, monetary and (in the longer run) to supply shocks are muted in Hungary in comparison to those in Slovenia. Overall, it seems that the exchange rate flexibility in Hungary and Poland insulated, at least to a certain extent, the output against real shocks.

It is also interesting to examine impulse response functions of other variables in the model (again figures are not reported but available upon request). Two regularities can be observed. First, in line with the theory and intuition real exchange rate responses to all shocks – with the possible exception for monetary shocks – are stronger under floating rate, i.e. in Poland and Hungary, than under the peg. This is in line with the theory: if the floating exchange rate is to be an effective mechanism of shock absorption it has to adjust in response to external disturbances and thanks to this the reactions of output are tempered (Fig. 1 and 2).

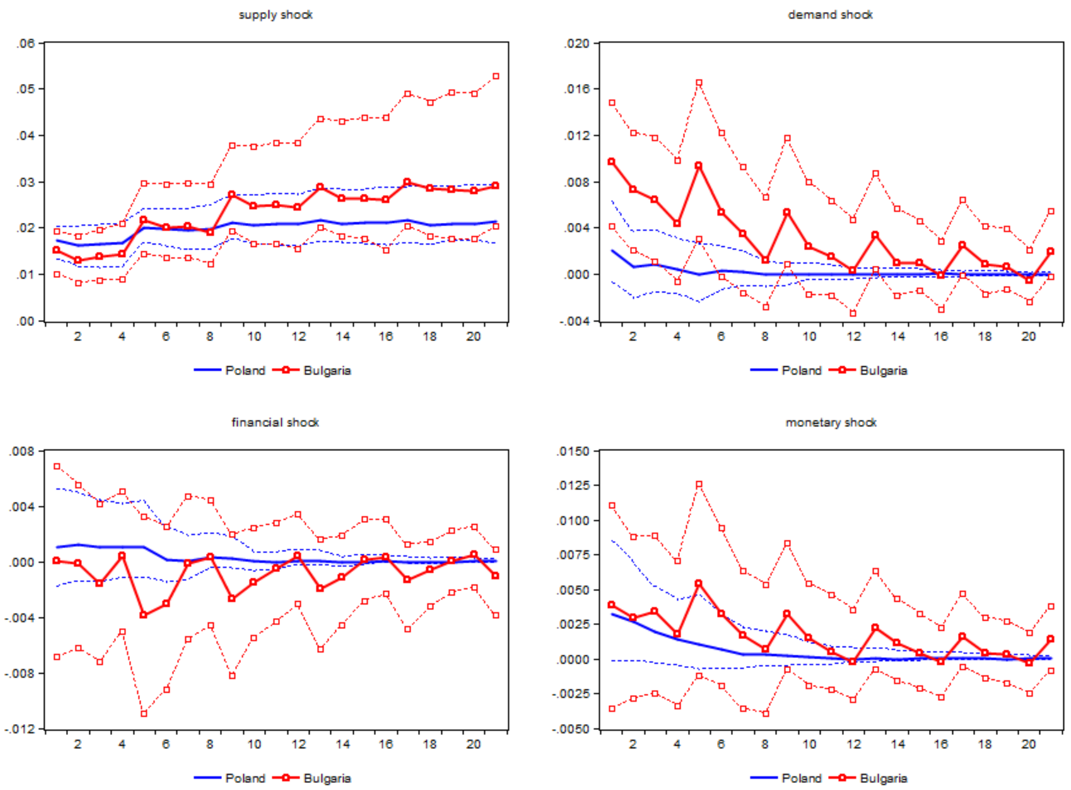

Fig. 1. Impulse response functions of the relative output in Bulgaria and Poland.

Second, countries with fixed exchange rates react differently than those under floating exchange rates not only to real shocks but also to nominal and especially financial shocks (reactions to monetary shocks were pretty much similar across countries). What we have observed is that the relative price level responds more strongly to these shocks in Bulgaria and Slovakia than in Hungary and Poland. If this observation is taken together with the previous one, it is possible to infer that the burden of adjustment to financial shocks rests on the nominal exchange rate in the two latter countries and on the relative prices in the former two ones. Additionally, stronger reactions of the real interest rate differential to financial shocks have been identified in the group of peggers (perhaps with the exception of Slovenia). Again this is in line with the theory: if an economy is hit by a financial shock and the exchange rate cannot change then – under no barriers to capital flows – the interest rate has to adjust (macroeconomic trilemma).

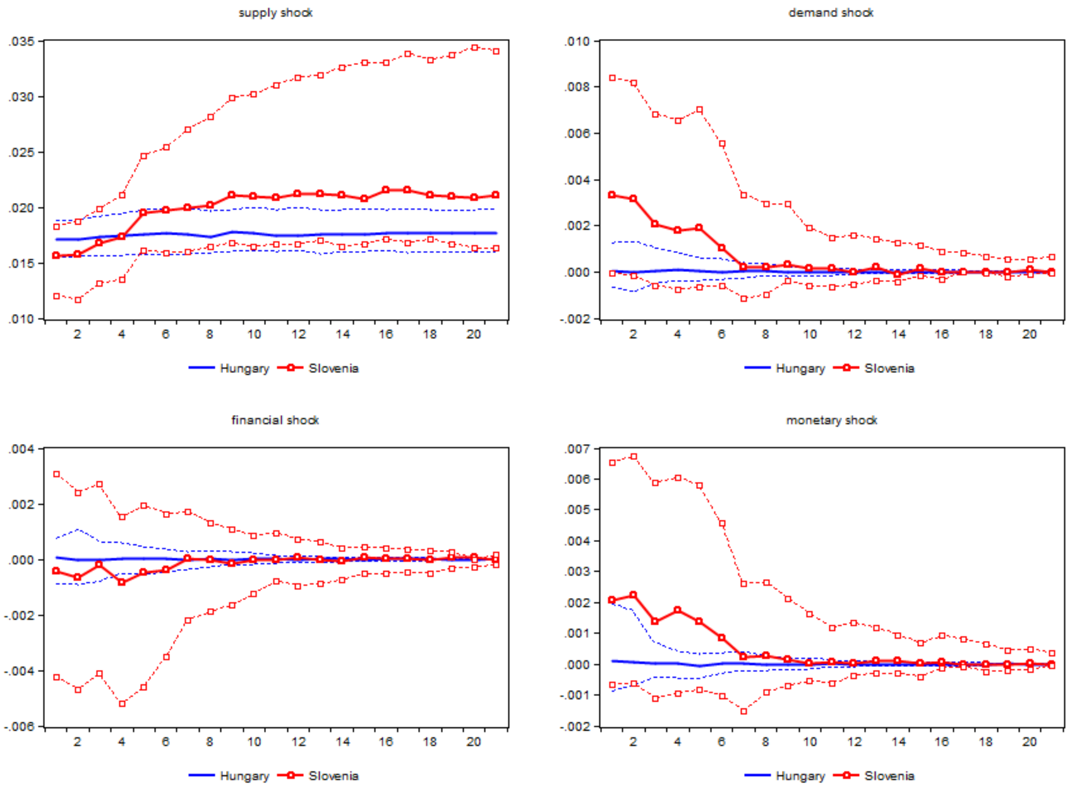

Fig. 2. Impulse response functions of the relative output in Hungary and Slovenia.

Conclusion

Our objective was to test whether the exchange rate regime matters for the sensitivity of an economy to economic and financial shocks in five Central European countries. The strategy was divided into two complementary steps. A forecast error variance decomposition was used to assess the relative importance of real and nominal shocks and then we carried out a comparative analysis of impulse response functions. Findings can be summarized in three points. First, supply and demand shocks are an important driver of output and real exchange rate variability in all countries. Moreover, although financial shocks cannot be neglected as a source of real exchange rate fluctuations, there is no convincing empirical evidence that their contribution is greater in Hungary and Poland, i.e. ‘floaters’.

Second, comparing impulse response functions across countries we found some evidence that the real shocks trigger quantitative adjustment, i.e. output reaction, that is stronger under the fixed exchange rate regime than under the floating rate. In the latter case it is the real exchange rate that responds to shocks and in fact its reactions to all shocks (with possible exception of monetary shocks) turned out to be stronger than in the former case.

Third, it was inferred from the empirical results that the burden of adjustment to financial shocks in Hungary and Poland rests on the nominal exchange rate and on the relative price level and the real interest rate differential in Bulgaria and Slovakia. This finding and the previous one are in line with the shock-absorbing property of the flexible exchange rate.

Though our final conclusion should not be treated as the last word, as it is not based on a conclusive evidence, we can see more arguments in favour of hypothesis that flexible exchange rate regime decreases the sensitivity of a real economy to economic and financial shocks than in favour of competing hypothesis that the exchange rate is a shock-propagating mechanism.

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