The role of exchange rate dynamics in Bulgaria and Romania in the process of economic transition

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Abstract. Our contribution focuses on the role of the exchange rate changes in Bulgaria and Romania during the transition process toward a market economy. We are interested in the degree of exchange rate pass-through to the domestic inflation in these countries. Both of the countries suffered from a high level of inflation and tried to fix their exchange rates in some of the periods. But they were forced to abandon it consequently and it was often followed by sharp depreciation. The goal of our contribution is to evaluate shock absorbing role of the exchange rate changes. We try to verify a traditional hypothesis that exchange rate adjustments are able to accommodate the shocks hitting the economy and to dampen their influence on the other macroeconomic variables. On the other hand, exogenous shocks in the foreign countries may affect exchange rate and lead to additional volatility of the main economic indicators in the domestic economy. This shock generating role of the exchange rate will be evaluated as well. We will use structural vector autoregression models identified by Cholesky decomposition.

Keywords: Bulgaria, Rumania, exchange rate pass-through, structural vector autoregression, Cholesky decomposition.

JEL Classification: C22, F31
AMS Classification: 91B84

1   Introduction

The ex-centrally planned countries decided to follow different exchange rate strategies during their transformation process. Our goal is to detect the impact of the exchange development on inflation in Bulgaria and Romania in the period between the beginning of 1992 and the end of 2008. The first date was selected due to availability of data and the second due to the start of the financial crisis that would affect the overall results. We generally pick up the threads of our previous work (Němec and Žídek [8]) where we analysed the impact of exchange rate regime on inflation among the Central European countries.

We suppose that the different exchange rate strategies had different impacts on inflation development. Foremost we expect that currency board (applied in Bulgaria after 1997) should stabilize it. The same should be true about managed floating that has been used in Romania after 1997. And we expect that the impact of the floating regime will be ambiguous because there are usually periods of both appreciation and depreciation. We split the overall analysed period into sub periods according to the applied exchange rate regime. And we use the country specific Structural Vector Autoregression models (SVAR models) to estimate structural shocks. Using SVAR simulation procedures we are able to decompose the development of inflation into contributions of the specific structural shocks. This method allows us to evaluate the impact of the historical exchange rate shocks on inflation. Our approach differs from many other authors (see e.g. Mirdala [6], [7]) due to the fact that they evaluate the exchange rate pass-through to domestic prices using the forecast error variance decomposition. We are thus able to observe the real historical consequences of the exchange rate changes from the beginning of the 1990s. Although the SVAR approach assumes possible interdependencies among all of the modelled endogenous variables, we will focus on one sided causality from nominal exchange rates changes to price level changes. Our results suggest that the nominal effective exchange rate changes in Bulgaria and Romania determine inflation development in an important way.

2   Exchange rates in the transformation process

In this section we describe different development of exchange rates in Bulgaria and Romania. First of all, we mention theoretical exchange rate systems. The two countries used different exchange rate regimes during the

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transformation. In the first period, rather chaotic systems were applied in both of the countries. The central banks did not have the situation under control and attempted to fix/control exchange rates with consequent huge devaluations. These periods were interposed by periods of floating. The exchange rate strategies were determined by high inflation that was characteristic for both of the countries. The second exchange rate regime/period was currency board that has been used in Bulgaria since 1997. It became an anchor of the whole system when the economy stabilized after hyperinflation. The third applied exchange rate regime was managed floating that was used in Romania after 1997. The central bank applied de facto a system with bandwidth.

What was the specific development of the exchange rate regimes? We will consider only the main changes in the development. Bulgaria started the transformation process with an attempt at shock therapy (without restrictive policy). However, contrary to other countries that applied this strategy, the country was not able to fix its exchange rate due to insufficient foreign reserves. But the exchange rate was unified, devalued and the Leva became internally convertible at the beginning of 1991 (Dimitrov [3]). Consequently, the country experienced several episodes of high inflation and deep depreciation. The central bank tried several times to defend the currency by applying its currency reserves but with limited success. For example, in March 1994 the central bank gave up its attempts at stabilising the exchange rate and the Leva depreciated by 50% against the Dollar (Bristow [2]). After relatively calm 1995 the bank again tried to keep the exchange rate at an unrealistic level. And the Leva again collapsed in March 1996. At that time the whole economy was in total disarray because Videnov government tried to reapply some elements of the central planning – for example control of prices. At the same the government had highly ambitious spending plans but was not able to finance them from its incomes and the budget ended with an enormous deficit that was covered by monetization. The obvious consequences were hyperinflation, dollarization and evasion of the Leva. The exchange rate depreciated by 90% against the Dollar in 1996 and this slump continued in the first quarter of 1997 when the Leva dropped from 487 to 1588 per dollar. The government, together with the economy, collapsed in spring of that year. The new government (after the elections) applied a stabilization policy. It incorporated currency board against the German Mark (later on the Euro) in the mid-1997. It was backed 100% by the foreign exchange reserves.
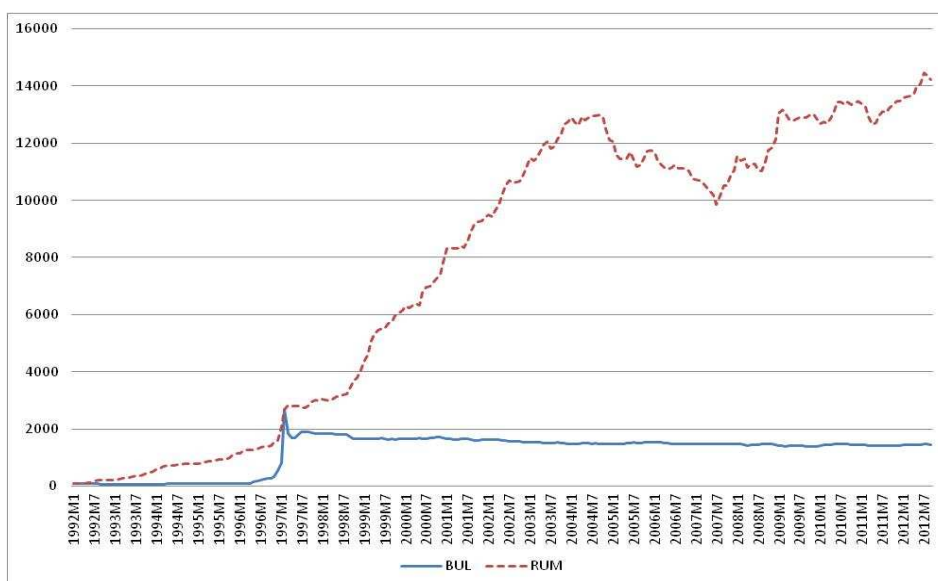

Figure 1 Development of the nominal exchange rates (index, 1992M1 = 100, indirect quote)

The development of Romanian exchange rate policy was no less dramatic and the description is more complicated because opinions among authors vary. The currency was devaluated and unified (the tourist and business exchange rates) in February 1990. There were further devaluations in the following years and the Leu became again operating in the system of multiple exchange rates (Fidrmuc et al. [4]). The situation changed in 1997 when exchange rates were unified and the central bank started to apply managed floating. Fidrmuc et al. [4] write that the system was de facto crawling band with +/- 5% bandwidth. The Leu became convertible for transactions on the current account in 1998 (Popescu [9]). After 2004, the National Bank of Romania relaxed exchange rate policy by decreasing the size and frequency of interventions on the currency market. At the end of the year it further increased the exchange rate flexibility (Penkova-Pearson [10]). These steps were preparatory for a fundamental change in monetary policy because the central bank introduced inflation targeting system in 2005. However it has kept managed float at the same time.

The trend in Romania till 2004 was towards a lasting nominal depreciation. Then the exchange rate relatively stabilized and in some periods appreciated. In Bulgaria the exchange rate was relatively stable (in comparison to

Romania) till the period of hyperinflation that started in 1996. The exchange rate became steady with currency board system after 1997. We can see the development of the nominal exchange rates in Figure 1.[3]

3   Data and methodology

The main goal of our paper is to estimate and quantify the impact of exchange rate changes on domestic inflation. To study the possible factors standing behind the domestic price level changes in the economy we use the methodology proposed by Ito and Sato [5] or Audzei and Brázdík [1]. In order to examine the sources of inflation in the transition period, we will use a structural VAR model of a small economy. This approach allows us to reveal the important interaction between the exchange rate and domestic macroeconomic variables.

Our analysis starts with an estimation of a reduced form VAR model. Based on these estimates we will transform the reduced form residuals into the structural shocks using Cholesky decomposition. That means, we are imposing only the short-term restrictions. As Audzei and Brázdík [1] pointed out, another possibility is to implement sign restrictions where shocks are identified imposing restriction on the signs of the impulse response function to the structural shocks. This approach may solve many puzzles occurring due to alternative estimation procedures. But, regarding our main focus on the transition period of the Romania and Bulgaria, we are aware that traditional sign assumptions about the impulse response functions might be not valid in this case. Cholesky decomposition seems to be the most appropriate and straightforward solution due to the fact that we will use the monthly data and the causal ordering of the variables may thus reflect the instantaneous interdependencies among the variables very well.

Our methodology will be as follows. Identified structural shocks are incorporated into simulation exercises that will decompose the actual trajectories of our observed variables into the particular shock components. The resulting historical shock decomposition reveals the main factors influencing the development of inflation in the transition period. Moreover, we try to quantify the absolute and relative importance of these factors.

Our basic VAR model is set up using the vector x_t of five endogenous variables[4], $x_t = (\Delta OIL_t, gap_t, \Delta m_t, \Delta NEER_t, \Delta p_t)$, where ΔOIL_t denotes changes in the natural log of oil prices, gap_t is the output gap, Δm_t stands for changes in the natural log of money supply, $\Delta NEER_t$ is the growth rate of nominal effective exchange rate and Δp_t is the difference of the natural log of the consumer price index.

The data set used for estimation is from January 1992 to December 2008. The data source is International Financial Statistics (IFS) provided by the International Monetary Fund. The observed variables are as follows:
- IPM: Index of industrial production, 2005=100 (for Romania only);
- TMG: Value of imports, US Dollars (for Bulgaria only);
- CPI: Consumer prices index, all items, 2005=100;
- M1: Monetary aggregate M1, national currency (for Romania only);
- IR: Money market rate, percent per annum (Bulgaria only);
- OIL: Crude oil prices (Brent – Europe), dollars per barrel;
- NEER: Nominal effective exchange rate (index), base year 2005 = 100, direct quote (increase means appreciation).

All variables (except NEER) were seasonally adjusted using the X12-ARIMA procedure. After seasonal adjustment, the variables were transformed using logarithmic transformation. Unit root tests proved the existence of unit roots in all variables. Except IPM and TMG, the variables were expressed in growth rates terms (i.e. logarithmic differences) or changes (interest rate variable). Variables IPM and TMG were filtered using Hodrick-Prescott filter with the smoothing constant $\lambda = 14400$ (this is the standard value for monthly data). This procedure resulted in the corresponding gap_t variable. We prefer to use the gaps as proxy variables for the business cycle. These transformations led to stationary variables. As a monetary policy variable (money supply), the base money (M1) is used for Romania and money market rate (IR) for Bulgaria. As price index variable, we used CPI in our final model. All the variables were selected in accordance with the arguments presented by Ito and Sato [5] and are very similar to those used by Mirdala [7] and Němec and Žídek [8].These variables express economic linkage between inflation and internal and external macroeconomic factors. Oil price inflation represents possible external supply shocks, demand shock effects are included in the output or import gaps, and money supply or changes of the interest rate one the money market allows us to capture the effects of monetary

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[3] The data source is International Financial Statistics (IFS) provided by the International Monetary Fund. The observed variables are nominal effective exchange rate (index).
[4] We have checked many other specifications and ordering but the main results presented in this paper remained relatively stable.

policy on domestic inflation. We used the import gap for Bulgaria due to the fact, that the index of industrial production was not available till the year 2000. The dynamics of both output gaps is very similar and the import gap may thus serves as proxy variable very well. Similar arguments hold in case of using the interest rates in Bulgaria as a proxy for monetary variable (M1 statistics was available since 1994 only).

Identified structural shocks are based on the Cholesky decomposition of the variance-covariance matrix Ω of the reduced-form innovations. The link between the reduced-form residuals (u_t) and the structural shocks (ε_t) can be written as $u_t = S\varepsilon_t$ where $u_t = \left(u_t^{oil}, u_t^{gap}, u_t^{m}, u_t^{neer}, u_t^{cpi}\right)$, $\varepsilon_t = \left(\varepsilon_t^{oil}, \varepsilon_t^{gap}, \varepsilon_t^{m}, \varepsilon_t^{neer}, \varepsilon_t^{cpi}\right)$ and S is the lower-triangular matrix derived given the covariance matrix Ω. The Cholesky decomposition of Ω implies $\Omega = PP'$ with a lower triangular matrix P. Since $\Omega = E(u_t u_t') = SE(\varepsilon_t \varepsilon_t')S' = SS'$, where structural disturbances ε_t are considered to be orthonormal, the matrix S is equal to P. The structural model defined by the equation (2) is identified due to the fact that the lower-triangular matrix S imposes enough zero restrictions $(k(k-1)/2)$, where k denotes the number of endogenous variables. The lower-triangular matrix S implies that some structural shocks have no instantaneous effects on the chosen endogenous variables. The ordering is thus important and is based on the economic intuition. For example, we assume that changes in oil prices are influenced only by the oil price (supply) shock ε_t^{oil} itself in the first period. As another example, we assume that changes in the output gap may be influenced by the oil price shock immediately, but the changes in monetary policy, exchange rate or inflation have no effect in the same period. These assumptions seem to be intuitive with regards to the monthly data frequency.

4   Estimation results

The lag order of the VAR model was selected using the Akaike information criterion (AIC). In particular, the lag order of 6 periods was selected for Bulgaria and the lag order of 8 periods for Romania. The constant term was included in our model specification. That might be justified by the fact, that there was a significant (i.e. non-zero) growth in the monthly CPI.
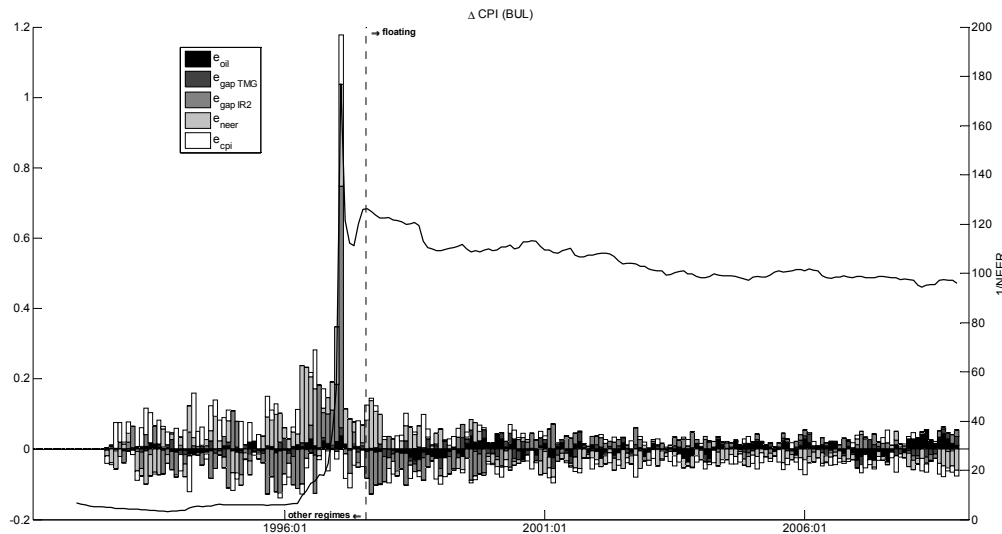

Figure 2 Historical shock decomposition – inflation (Bulgaria)

Figure 2 and Figure 3 show the historical shocks decomposition of monthly CPI inflation and the development of the NEER (indirect quotation where increase means depreciation) for the Romania and Bulgaria respectively. The corresponding structural shocks contributions were computed using the identified SVAR model. The subplots in Figure 2 and Figure 3 contain a mark of the period of change (vertical line) of the exchange rate regimes. These time intervals are used in Table 2 to determine the relative importance of all shocks to the variance in inflation during the examined period. In particular, the start of managed floating exchange rate period was stated in both countries as 1997M6. The previous periods are considered as the regime of various exchange rate combinations including the fixed exchange regime. We can notice (see Figure 2 and Figure 3) that in several periods exchange rate plays an important role in the explanation of inflation. An interesting period is for example the January of 1997 in both countries. The strong devaluations were causing inflation.
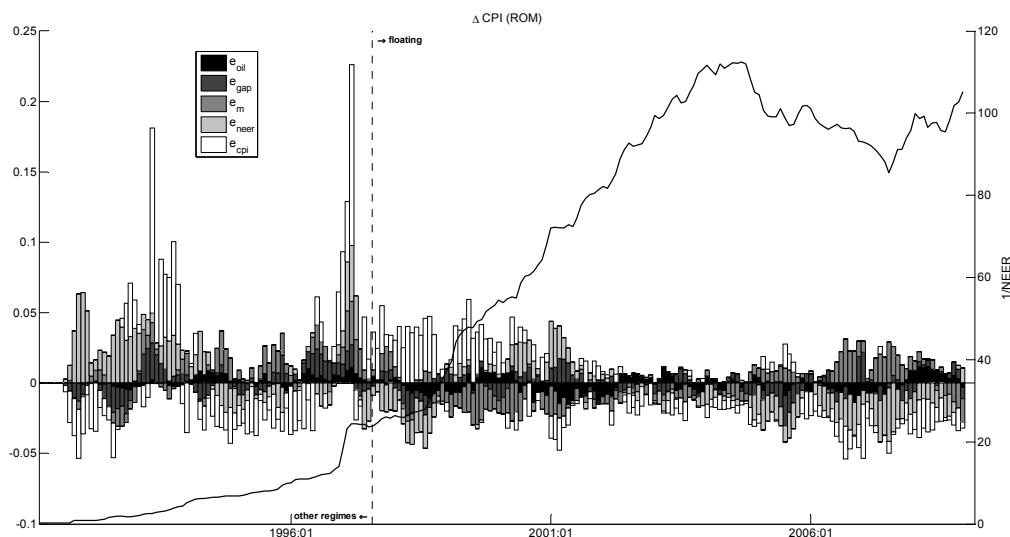
Figure 3 Historical shock decomposition – inflation (Romania)

Forecast error variance decomposition of inflation for both countries is presented in Table 1. The exchange rates are important inflation variables for both countries. Surprisingly, the impact of exchange rate shocks are very similar. The only difference lies in the role of monetary policy. Monetary factors in Bulgaria constitute more than 50% of the realized variability in the inflation. In case of Romania, the half of the inflation variability cannot be explained solely by the structural shocks under consideration.

	ε^{oil}	ε^{gap}	ε^{m}	ε^{neer}	ε^{cpi}
ROM	0.0292	0.0609	0.1012	0.2836	0.5251
BUL	0.0496	0.0159	0.5090	0.2841	0.1414

Table 1 Forecast error variance decomposition of inflation

The evaluation of the relative importance of structural shocks may be found in Table 2. The presented numbers are outputs of the regressions where dependent variable is the standardized inflation and the explaining variables are standardized structural shocks (see Němec and Žídek [8] for further details). There is no violation of classical linear regression assumptions due to the fact, that the explanatory variables are true driving forces for all endogenous variables in our SVAR models. This regression procedure is thus a useful tool for deriving the relative importance of mutually independent structural shock variables. All the computations were carried out for the periods of mixed exchange rate regimes, floating exchange rate and the period of both regimes.

	"1990s"		"2000s"		"1990s" and "2000s"	
	ROM	**BUL**	**ROM**	**BUL**	**ROM**	**BUL**
	Mixed	**Mixed**	**Float**	**Float**	**All regimes**	
Period	1992-1997	1993-1997	1997 - 2008		1993 - 2008	
ε^{oil}	0.04%	2.73%	4.56%	3.09%	2.01%	3.38%
ε^{gap}	5.95%	1.80%	7.42%	2.29%	3.97%	1.67%
ε^{m}	1.16%	57.26%	5.26%	55.22%	4.49%	47.77%
ε^{neer}	41.05%	27.08%	24.89%	26.09%	45.37%	31.60%
ε^{cpi}	45.29%	10.37%	57.79%	13.33%	35.34%	14.72%

Table 2 Explained historical variability of inflation

For the analysis of the results we divided our period as mentioned above. For easier recognition we roughly divided the period to the 1990s and the 2000s in Table 2. We have computed contribution of the nominal effective exchange rates to the year-on-year inflation in our countries. These computations are presented in Table 3. The periods are similar to those from Table 2. The column "Model" contains estimated intercept in the ΔCPI (i.e. inflation) equation of the SVAR model. This estimate corresponds to a part of the inflation which is not explained by the variability of the endogenous variables and may be thus considered as the overall trend in price

level development. We can see the inflationary impacts of the NEER changes in the 1990s and the mostly deflationary tendencies caused by the NEER changes in the 2000s.

| | "1990s" | | "2000s" | | "1990s and 2000s" | | Model |
	ε^{neer}	ΔCPI	ε^{neer}	ΔCPI	ε^{neer}	ΔCPI	ΔCPI
ROM	4.15%	98.48%	-6.58%	21.40%	-3.68%	39.40%	31.16%
BUL	73.64%	127.63%	-14.62%	6.71%	5.65%	33.94%	26.77%

Table 3 Contribution of NEER changes to the average year to year CPI inflation

The goal of our contribution is to evaluate shock absorbing role of the exchange rate changes. Table 3 shows that in case of Bulgaria, exchange rate shocks contributed very strongly to the inflation pressures in the first half of 1990s. The exchange rate changes contributed to the average year on year CPI inflation of 127% by increasing the price level by 74% in this period. On the other hand, the high average year on year CPI inflation of 99% was not determined by the exchange rate movements. The average contribution of 4% was thus negligible compared to the average 100% price level changes. After adoption of managed floating, both countries experienced negative impact of exchange rate changes on domestic inflation. That was crucial for the mild price level development in Bulgaria.

5   Conclusion

In our contribution, we have analysed the relationship between exchange rates and inflation in Bulgaria and Romania. These countries applied different exchange rate strategies during the transformation process. We have found out that change in exchange rates played an important role in the first half of 1990s. We can conclude that the exchange rate adjustments were not able to accommodate the shocks hitting both economies and to dampen their influence on the inflation in the first half of the 1990s. Exogenous shocks affected exchange rate and led to additional volatility of the main economic indicators in the domestic economy. After 1997, both countries changed their exchange rate regimes (to the managed floating and currency board). As a result, the exchange rate adjustments accommodated the shocks affected the CPI inflation in this period.

Acknowledgements

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