SOURCES OF REAL EXCHANGE RATE FLUCTUATIONS IN CENTRAL AND EASTERN EUROPE – TEMPORARY OR PERMANENT?

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Abstract

This paper investigates, using the SVAR model of Clarida and Gali (1994), the sources of real exchange rate fluctuations in eight Central and East European new EU member states. Theoretically, one should expect the real exchange rates of Exchange Rate Mechanism II participants to be primarily driven by temporary shocks and those of ERM II "outs" by permanent shocks. Our results reveal an opposite pattern. We conclude that the sources of real exchange rate movements – and the usefulness of nominal exchange rates as shock absorbing instruments – were not the decisive factor behind these countries' decisions concerning the ERM II participation.

JEL Code: F31, C32.

Keywords: exchange rate fluctuations, Central and Eastern Europe, ERM II, SVAR.

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1 Introduction

This paper investigates empirically the sources of real exchange rate fluctuations in eight Central and East European (CEE) new European Union (EU) member states: the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. At the time this paper was written five of these countries had already joined the Exchange Rate Mechanism II (ERM II), fixing their parities against the euro in the run-up to the Economic and Monetary Union (EMU) membership. All ten countries that became members of the EU on 1st May 2004 are obliged to adopt the euro as soon as they have fulfilled the Maastricht criteria; none has the formal right, exercised by Denmark and the United Kingdom, to opt out from the EMU arrangements. The timing of the euro adoption, however, depends largely on these countries' economic policy decisions, in particular the decision to join the ERM II. One possibility of delaying the EMU membership would simply be failing to fulfil the exchange rate stability criterion, just as Sweden has done.

Interestingly enough, the countries not (yet) participating in the ERM II are the largest CEE economies: the Czech Republic, Hungary and Poland, the latter also being the least open one. The fact that only the smaller and more open CEE countries have already joined the mechanism complies with the widely accepted proposition that nominal exchange rate flexibility does more harm than good to small open economies, particularly with regard to macroeconomic stability (see McKinnon, 1963). Consequently, small open economies should find fixed exchange rates in general and the accession to a monetary union in particular more advantageous than larger and less open ones.[1]

Fixing the nominal exchange rate has vital consequences for the ability of the real exchange rate to absorb real asymmetric, i.e. country specific shocks. In the short run, given sluggish price adjustment, the nominal exchange rate is the decisive factor driving the real exchange rate. Consequently, fixing the former directly translates into reduced flexibility of the latter. It has become a stylised fact of the international monetary economics that real rates tend to be significantly more volatile under floating than under fixed nominal rates. The essential point is to what extent real exchange rate fluctuations mirror the real economy and to what extent they result from innovations springing up from the financial markets.

The exchange rate economics provides, broadly speaking, two different explanations as to the sources of real exchange rate fluctuations (when prices are sluggish, in the short run both apply to nominal rates, too). The first approach, which is referred to as the disequilibrium view, presumes that the largest part of exchange rate volatility can be attributed to financial market disturbances, or nominal disturbances. The second approach, termed the real economy view or the equilibrium view, posits that real rates move so as to accommodate shocks to real macroeconomic variables, helping to bring about the necessary adjustment.

[1] One should not forget, though, that even the largest of all CEE countries account for very small fractions of the aggregate EU GDP. Obviously, the above considerations concern the size of these countries relative to each other.

Directly linked to this issue is the question of the usefulness of flexible nominal exchange rates as shock absorbing instruments. The disequilibrium view postulates that the nominal exchange rate is a propagator of shocks that spring up from the financial markets, in particular from the foreign exchange markets, whereas the real economy view treats the nominal rate as an absorber of real shocks. Thus, according to the former approach, fixing the parity would shield the real economy from nominal shocks and thus prove beneficial with regard to macroeconomic stability. According to the latter approach, in contrast, a country would find it relatively costly (in terms of stability of real macroeconomic aggregates) to give up nominal exchange rate flexibility, provided that prices are sluggish. As discussed in Section 2 of this paper, both views are plausible and both are supported by empirical evidence. Hence, the question as to which of them is the "correct" one for a given economy essentially boils down to an empirical one.

We therefore investigate empirically the sources driving real exchange rate fluctuations in the CEE economies and try to answer the question whether these countries' decisions to join or not to join the ERM II reflect the above considerations. As the (irrevocable) fixing of the nominal exchange rate should be more appealing for those CEE countries whose real rates fluctuate mainly in response to nominal shocks, we expect the real rates in those countries that already participate in the ERM II to comply with the disequilibrium view described above. In contrast, the economies that have yet to join the ERM II are expected to reflect the real economy approach. Intuitively, a country whose exchange rate plays the role of a shock absorbing instrument would be less inclined to give this instrument up than a country whose exchange rate acts as a shock propagator.

At this point, two qualifications are in order. Firstly, some of the CEE countries, notably the Baltic states, which have maintained currency boards since the beginning of the 1990s, had given up nominal exchange rate flexibility long before they joined the ERM II (see Table 1 in Section 4). Nevertheless, although a currency board does impart giving up monetary policy independence, the exchange rate cannot be treated as irrevocably fixed, as e.g. the recent Argentina crisis demonstrated. Therefore, we stress that only joining a fully-fledged monetary union like the EMU amounts to an (almost) irrevocable fixing of the nominal exchange rate.[2] Secondly and more importantly, the decision to join or not to join the ERM II and later the euro zone is ultimately a political one, although it should be primarily based, at least in theory, on economic costs and benefits considerations. The three largest of the new EU member states obviously lack the political will to adopt the euro and fail to bring their budget deficits down to the level stipulated by the Treaty of Maastricht; these are the two reasons for their failure to follow in the footsteps of the five smaller CEE countries. Still, we believe that it is insightful to empirically analyse the question whether these countries' decisions concerning the ERM II participation have sound economic foundations as far as the usefulness of their nominal exchange rates as shock absorbing instruments is concerned.

[2] Fully-fledged currency unions can break up too, as the examples of the former Soviet Union, Czechoslovakia and Yugoslavia show.

The analysis is based upon a structural vector autoregression (SVAR) model developed by Clarida and Gali (1994), which employs a long-run identification scheme pioneered by Blanchard and Quah (1989). A VAR system consisting of three variables – the rate of change in the real output, in the real exchange rate and in the price level – is estimated to draw inference on the three types of structural disturbances that constitute the driving forces of the variation in these variables. We would have liked to be able to interpret these disturbances as real aggregate supply, real aggregate demand and nominal shocks, respectively. However, the subsequent analysis showed that such interpretation was economically implausible so that the above names should be thought of as simplifying labels only. One should bear in mind that shocks identified within a SVAR framework are actually defined by their impact on the variables in the VAR. Specifically, "real supply" shocks in our model are defined as those which can exert long-run influence over all system variables, "real demand" shocks as those which can permanently affect prices or the real exchange rate but not the real income, and "nominal" shocks as those which can only affect the price level in the long run. Importantly, the interpretation problems that we encountered do not invalidate the analysis because its aim was essentially to answer the question whether it is primarily permanent or temporary (rather than supply, demand or nominal) disturbances that have driven the real exchange rates of the CEE economies.

To shed light on that question, we compute the forecast error variance decomposition (FEVD) based on the identification scheme just described. The results of this exercise are striking in that they suggest exactly the opposite of what we expected. In the short run, a substantial amount of the variance of the rate of change in the respective real exchange rate against the euro is due to "nominal" (i.e. temporary) shocks in those CEE countries that have not yet joined the ERM II. In countries that are ERM II participants – with the exception of Latvia, although this result is specification sensitive – "real demand" (i.e. permanent) shocks are the main force driving real exchange rate changes. That is to say, the former group of economies seems to comply with the disequilibrium view and the latter with the real economy view of exchange rate fluctuations. This finding might be primarily due to the different exchange rate regimes of the countries analysed. However, comparing ERM II vs. non-ERM II countries that were on the same or similar exchange rate regimes throughout the period under scrutiny again reveals the same pattern. We conclude that, provided that the model employed is the proper one for our analysis and correctly specified, the sources of real exchange rate fluctuations were not the decisive factor behind the CEE countries' decisions concerning the ERM II participation and the later adoption of the euro.

The remainder of this paper is structured as follows. The next section discusses the theoretical and empirical literature on the sources of real exchange rate fluctuations in developed and in transition economies. Then, the econometric methodology used to identify the sources of real exchange rate fluctuations in the CEE countries is presented in Section 3. Section 4 provides an overview of exchange rate regimes in the CEE economies on their way to the EMU, presents the data and discusses the empirical findings. Section 5 concludes.

2 Sources of real exchange rate fluctuations

Since the collapse of the Bretton Woods system of fixed nominal exchange rates in the early 1970s, the volatility of real exchange rates has increased dramatically. In this recent floating period, real exchange rate fluctuations have gone almost step-in-step with nominal exchange rate changes and have consequently shown the same high level of persistence[3]; the correlation between the two is near unity. These empirical regularities, which were extensively analysed in an influential paper by Mussa (1986), among others, have become stylised facts of the exchange rate economics. Quite naturally, the question has arisen as to the sources of the higher real rate volatility under floating than under fixed nominal rates, and specifically, as to whether it is the nominal exchange rate changes that drive real rate fluctuations or whether the causality chain is the reverse. Two contrasting views have been put forward on that question.

On the one hand, Mussa (1986) points out that the substantial and systematic differences in the pattern of real exchange rate fluctuations contradict the hypothesis of nominal exchange rate regime neutrality. Rather, they are consistent with theories that contrast the "asset price" behaviour of nominal exchange rates under floating with the relatively sluggish adjustment of national price levels under both floating and fixed rates. These theories, on their part, are in line with what can be observed from data:

"Given the volatility of real exchange rates under floating exchange rate regimes, ratios of national price levels exhibit too-little volatility under fixed exchange rate regimes. Given the stability of real exchange rates under fixed exchange rate regimes, ratios of national price levels exhibit too-little volatility under floating exchange rate regimes. Specifically, ratios of national price levels under floating exchange rate regimes do not move enough to offset the volatility of nominal exchange rates under floating exchange rate regimes and thereby preserve the stability of real exchange rates observed under fixed exchange rate regimes. … the conclusion must be that ratios of national price levels show too little volatility, under one exchange rate regime or the other, relative to that implied by the hypothesis of nominal exchange regime neutrality." [Mussa (1986, p. 200)]

In other words, Mussa advocates the so so-called "disequilibrium view" of exchange rate fluctuations, originally due to Mundell (1962), Fleming (1962) and Dornbusch (1976), stressing that it is the high volatility of nominal rates that drives the real exchange rates. In contrast, Stockman (1983) shows that the significant differences between the real exchange rate behaviour under fixed and flexible nominal rates can be explained without postulating the sluggishness of national price levels adjustment. Specifically, Stockman develops an equilibrium model of exchange rates that incorporates the nominal regime neutrality, but only under certain assumptions. Although his empirical findings confirm the statistically significant impact of the nominal regime on the real exchange rate volatility, he argues that this does not establish the direction of causality: the higher volatility of real rates under floating might simply reflect the fact that countries whose real exchange rates are subject to greater real disturbances are more likely to

[3] This effect was termed the purchasing power parity puzzle by Rogoff (1996) and Obstfeld and Rogoff (2000).

float their currencies (incidentally, this possibility was also acknowledged by Mussa). This is the so-called "real economy view".

Stockman (1988) further develops his equilibrium model of exchange rates, putting forward another argument in favour of the real economy view. The argument goes as follows. Real shocks alter real exchange rates as well as nominal exchange rates (under floating) or the level of international reserves (under pegged nominal rates). Obviously, disturbances that would lead to a real – and nominal, if prices are sticky – depreciation when the nominal rate is floating entail reserve losses under fixed rates. Faced with reserve losses that, if large enough, could create a balance of payments crisis and a forced devaluation, countries that choose a pegged exchange rate system are more inclined to impose trade restrictions, such as tariffs and quotas, or capital controls. Stockman argues that agents' expectations of such policies tend to stabilize real exchange rate fluctuations. This effect alone, without the assumption of sluggish price level adjustment relative to the "asset price" behaviour of nominal exchange rates, can account for the differences between the patterns of real rate behaviour under alternative nominal regimes.

As MacDonald (1998) notes, an important difference between the two views described above is the question of causality: whether it runs from nominal to real exchange rates, as postulated by the disequilibrium view, or the reverse, as the real economy view seems to posit. Closely connected with this issue is the question of the usefulness of a flexible nominal exchange rate as a shock absorbing instrument. The disequilibrium approach posits that the largest part of real exchange rate volatility under floating can be attributed to financial market shocks, or nominal shocks. The flexible nominal rate is therefore a propagator of shocks that spring up from financial markets, particularly from foreign exchange markets. Consequently, fixing the parity would shield the real economy from such disturbances and thus prove beneficial with regard to macroeconomic stability. In contrast, the equilibrium approach presumes that real exchange rates fluctuations tend to accommodate shocks to real macroeconomic variables like output or employment. In other words, real (and, if prices are sticky, also nominal) exchange rates change so as to bring about rapid adjustment of relative prices in the face of real disturbances that call for such adjustment, acting as an equilibrating force when asymmetric, i.e. country specific real shocks occur. Accordingly, a country would find it relatively costly in terms of macroeconomic stability to give up nominal exchange rate flexibility, again provided that prices are sluggish.

In this paper, we do not take an a priori stand on the question which of the two approaches is the "right" one. On the one hand, we do implicitly assume, in line with Mussa (1986), that nominal rigidities account for a large part of the high real rates volatility under floating. On the other hand, we do not exclude the possibility that countries which experience larger real disturbances tend to adopt flexible rather than pegged nominal exchange rates, as Stockman (1983) argues. As the rationale behind each of these approaches seems plausible to us, the question as to which of them is "correct" for a given economy essentially boils down to an empirical one.

The rapid development of methods of econometric analysis on the one hand and econometric software on the other since the end of the 1980s has brought about vast empirical literature on the sources of real exchange rate fluctuations. MacDonald (1998) distinguishes four alternative empirical approaches that seek to shed light on this question. The first involves an examination of the relationship between real exchange rates and real interest differentials, which should be present in the data if the propositions of the disequilibrium view hold. The second is to decompose the real exchange rate changes into permanent and transitory components, usually by means of the decomposition method pioneered by Beveridge and Nelson (1981). The third approach, drawing upon the Balassa-Samuelson theorem, consists in decomposing real exchange rate fluctuations into parts due to changes in internal and external relative prices, i.e. movements in the relative price of traded to non-traded goods within countries and in the relative price of traded goods across countries. Finally, the fourth approach involves estimating a VAR model with (the change in) the real exchange rate as one of the endogenous variables and, using the long-run identification scheme developed by Blanchard and Quah (1989), decomposing real exchange rate movements into parts due to different structural shock types.

In this paper we employ that last approach to investigate the sources of real exchange rate fluctuations in the CEE countries. The method itself and the criticisms it evokes are discussed in Section 3. In the remainder of this section we provide a brief overview over the empirical literature that adopts this approach as well as the empirical findings for developed and for transition countries. For a detailed presentation of the first three groups of methods, along with the results obtained using them, see MacDonald (1998). The general upshot is that both views described above are supported by empirical evidence, depending on the method used and the exact specification of the model.

Lastrapes (1992) was among the first to analyse the sources of exchange rate fluctuations using the Blanchard and Quah (1989) approach. The variables in his bivariate VAR model are the rates of change in the real and in the nominal exchange rate. Lastrapes identifies two types of structural disturbances, of which one has no long-run impact on the real exchange rate level but can affect the level of the nominal rate, and one can influence the levels of both variables in the long run; he interprets the former as a nominal shock and the latter as a real shock. Lastrapes analyses six countries: the United States (US), Germany, the United Kingdom (UK), Japan, Italy, and Canada over the period 1973 to 1989, using monthly data. His results indicate that for all countries under scrutiny and at all frequencies, real shocks account for the major part of both real and nominal exchange rate fluctuations, which is consistent with the real economy view.

Another seminal piece of work in this strand of literature is due to Clarida and Gali (1994), whose framework we employ in this paper. The authors develop a three-equation stochastic two-country, rational expectations open macro model that exhibits the Mundell-Fleming-Dornbusch properties in the short run when prices are sluggish to adjust. Based on the model, Clarida and Gali specify a trivariate VAR with the rate of change in the real output, in the real exchange rate and in the price level as endogenous variables. The three structural disturbance types that are identified are interpreted as real aggregate supply shocks (those which can influence the level of all three variables in the long run), real aggregate demand shocks (those which have no long-run impact on the real output level) and nominal shocks (those which only affect the price level in the long run). The analysis, based on quarterly data, covers four countries: Japan, Germany, the UK, and Canada (and implicitly the US, since all variables are measured relative to that country) over the floating period 1973 to 1992. The results suggest that in the former two countries nominal disturbances explain a substantial amount of the variance in the real exchange rate against the dollar, whereas in the latter two the real rate fluctuations are mainly driven by real demand shocks; real supply shocks play virtually no role in any of the countries under study. Hence, Japan and Germany seem to comply with the disequilibrium view of real exchange rate fluctuations, while the UK and Canada conform to the real economy view. Our explanation of these results is that the former two economies possibly exhibit a higher degree of nominal rigidities than the latter two, so that the real exchange rate reacts strongly to any nominal disturbances (see also Section 5).

The models of Lastrapes (1992) and Clarida and Gali (1994) set a benchmark for researchers seeking to explain real exchange rate movements. Chadha and Prasad (1997) carry out the same analysis as in the latter study for the slightly later period 1975 to 1996, applying the trivariate VAR described above to quarterly data for Japan. Their findings confirm those of Clarida and Gali, with the important difference that the contribution of real supply shocks to real exchange rate fluctuations is larger and statistically significant at all forecast horizons. Funke (2000) estimates the same model for the UK vs. the Euroland, using quarterly data from 1980 to 1997. He shows that most of the variation in the sterling's real exchange rate against the ECU is caused by real demand innovations.

The simpler two-dimensional model of Lastrapes (1992) has usually been adopted in studies of emerging rather than developed economies. One of important exceptions is the paper of Enders and Lee (1997), who apply this model to Canada, Germany and Japan relative to the US, using monthly data for the floating period 1973 to 1992. Their results are consistent with that of Lastrapes: real shocks account for the major part of both real and nominal exchange rate fluctuations. Chowdhury (2004) explores the sources of movements in real exchange rates against the US dollar in Chile, Colombia, Malaysia, Singapore, South Korea, and Uruguay, applying the model of Lastrapes to monthly data from 1980 to 1996. His conclusion, rather unusual for transition countries (see below), is that real shocks clearly dominate nominal shocks in all countries under scrutiny. Soto (2003) estimates a VAR with the rate of change in the real exchange rate of the Chilean peso against a basket of currencies and the interest rate differential between Chile and the international capital market (as proxied by LIBOR) on the basis of monthly data from 1990 to 1999. The results show that in the longer run, real shocks account for the greater part of the real rate volatility; however, nominal shocks play an important role in the short run.

Several authors extend the VAR dimension and thus the menu of structural disturbances identifiable within this framework.[4] Weber (1997) specifies a five-dimensional VAR with the labour input, the real output, the real exchange rate, the real money supply, and the price level and

[4] One can only identify as many independent shock types as there are variables in the VAR.

identifies five disturbance types: labour supply, productivity, aggregate demand, money demand, and money supply shocks. Applying the model to monthly data for the US vs. Germany, the US vs. Japan and Germany vs. Japan, spanning the period 1971 to 1994, Weber finds that the major part of the short-term volatility in the real exchange rates is attributable to demand shocks and a much smaller proportion to monetary shocks, while supply-side shocks play virtually no role. Rogers (1999) also estimates a VAR with five endogenous variables (the rate of change in the real government spending, in the real income, in the real exchange rate, in the money multiplier, and in the real monetary base) and five innovation types (fiscal, supply, demand or preference, money multiplier, and monetary base disturbances), using over 100 years of annual data (1889-1992) for the US and the UK. In addition to the baseline model he tries several alternative specifications, embodying different assumptions about the effects of the various shock types. The results suggest that nominal disturbances, i.e. those to the money supply or the money multiplier, account for nearly 50 percent of the variation in the real exchange rate over short horizons; in the alternative models the contribution of these shocks amounts to at least 20 percent.

A kind of stylised fact to emerge from this strand of literature is that real exchange rates of developed (low-inflation) countries are mainly driven by real or permanent shocks, whereas the movements in the real rates of emerging (high-inflation) economies are predominantly attributable to nominal or temporary shocks. The above-discussed results of Rogers (1999), who argues that most studies understate the role of nominal shocks for real exchange rate fluctuations in industrial countries, are a notable exception. Importantly, Rogers stresses that the results of SVAR modelling are sensitive to specification, an issue to which we will return at the end of this paper.

The sensitivity to specification can also be observed in studies of CEE economies. Dibooglu and Kutan (2000) were among the first to apply the structural VAR approach to study the sources of real exchange rate fluctuations in these countries. The authors specify a bivariate VAR with the rate of change in the real exchange rate and in the price level as endogenous variables, and identify two structural innovation types, one nominal (with no long-run impact on the real exchange rate) and one real. Using monthly data from 1990 to 1999 for Hungary and Poland, the authors find that real exchange rate movements are driven mainly by real disturbances in the former country and predominantly by nominal shocks in the latter country. Borghijs and Kuijs (2004) focus on five CEE economies: the Czech Republic, Hungary, Poland, Slovakia, and Slovenia. Using monthly data covering the floating period in these countries (from 1993 or later to 2003), they estimate bivariate VAR models with the rate of change in the nominal exchange rate and in the real output as endogenous variables, and trivariate ones similar to that of Clarida and Gali (1994), with the difference that nominal exchange rates are used instead of prices. They find that the real exchange rates of all these countries are driven mainly by nominal shocks and conclude that the flexible nominal exchange rates have been propagators of such shocks rather than stabilisation instruments.

In a larger study, Kontolemis and Ross (2005) analyse nine of the ten new EU member states (Malta is not included in the sample) over the period 1986 or later to 2003. They try several specifications: a bivariate VAR like that of Lastrapes (1992), a trivariate VAR like that of Borghijs and Kuijs (2004), and a four-dimensional model with the same variables as in the trivariate one and interest rates or, alternatively, credit to the private sector. In contrast to Borghijs and Kuijs, the results of Kontolemis and Ross indicate that real exchange rate fluctuations are predominantly due to real demand shocks, although the role of nominal shocks and in particular credit shocks is also significant over short horizons; in contrast, interest rate shocks have virtually no effect on real exchange rates. As can be seen from the above examples, results vary widely across studies, depending on the exact model specification and data used. Therefore, one has to be cautious when interpreting the findings of any specific model, especially when the conclusions are to be drawn upon when formulating policy recommendations.

3 Econometric methodology

Let

$X_t = [\Delta y_t \ \ \Delta q_t \ \ \Delta p_t]'$,

where Δ denotes the difference operator, $y_t = \left(y_t^{\text{home}} - y_t^{\text{EMU}}\right)$ is the difference between the real income in the home country and the real income in the EMU, $q_t = (e_t - p_t)$ is the real exchange rate of the domestic currency against the euro, e_t is the nominal exchange rate (the price of euro in units of domestic currency), and $p_t = \left(p_t^{\text{home}} - p_t^{\text{EMU}}\right)$ is the difference between the domestic price level and the price level in the EMU. All variables are in logarithms so that their differences can be interpreted as the rate of change in the underlying variable. y_t, q_t and p_t are assumed to be integrated of order 1 (so that the variables in X_t are stationary) and not cointegrated (because they follow different stochastic trends in the long run).

We use real income and price differentials against the respective euro zone aggregates as our system variables because our focus is on shocks that are asymmetric with regard to the EMU. An alternative specification would involve including absolute values of these variables in the system (i.e. $y_t = \log \mathrm{Y}_t^{\text{home}}$ and $p_t = \log \mathrm{P}_t^{\text{home}}$) and estimating a separate VAR for the euro zone, which would allow us to identify any shocks and not just the asymmetric ones. Computing simple correlation coefficients between the shock series in a given CEE country and the euro area would then be a way of judging the symmetry of the disturbances.[5]

Suppose that the true model can be represented by the following infinite vector moving average (VMA) process[6]:

[5] Artis and Ehrmann (2000) argue that specifying the variables in relative terms implies the assumption that shock transmission mechanisms in the analysed countries are identical as in the reference country. Admittedly, this assumption is not necessarily correct when applied to the CEE economies against the euro area.

[6] Equation (1) can also include deterministic components such as a constant, seasonal and other dummies, a deterministic trend, or other strictly exogenous variables. Our models do include such variables (see Table 5) but they are suppressed here for brevity.

$$X_t = A_0\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + ... = \sum_{i=0}^{\infty} A_i\varepsilon_{t-i} = \sum_{i=0}^{\infty} A_i L^i \varepsilon_t , \tag{1}$$

where $A_i = \begin{bmatrix} a_{11i} & a_{12i} & a_{13i} \\ a_{21i} & a_{22i} & a_{23i} \\ a_{31i} & a_{32i} & a_{33i} \end{bmatrix}$ ($i = 0, 1, 2, ...$), L is the lag operator, and $\varepsilon_t = [\varepsilon_{1t} \;\; \varepsilon_{2t} \;\; \varepsilon_{3t}]'$ is a vector of identically normally distributed, serially uncorrelated and mutually orthogonal white noise disturbances[7]:

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

It is therefore assumed that the system variables are driven by past and present realizations of the underlying disturbances, so-called structural or primitive shocks. Note that the elements of A_i are impulse response coefficients, e.g. the series a_{12i} ($i = 0, 1, ...$) describes the dynamic response of the first variable in the system, Δy_t, to one-unit shocks of the second type, ε_{2t-i}. To recover the impulse response functions (IRF) as well as identify the past primitive shocks, one has to estimate and invert the following vector autoregression (VAR) representation of the process:

$$X_t = B_1 X_{t-1} + B_2 X_{t-2} + ... + B_p X_{t-p} + e_t = \sum_{i=1}^{p} B_i L^i X_t + e_t = B(L) X_t + e_t , \tag{3}$$

$$X_t = (\mathrm{I} - B(L))^{-1} e_t = (\mathrm{I} + B(L) + B(L)^2 + ...) e_t = e_t + C_1 e_{t-1} + C_2 e_{t-2} + ... , \tag{4}$$

where $B_i = \begin{bmatrix} b_{11i} & b_{12i} & b_{13i} \\ b_{21i} & b_{22i} & b_{23i} \\ b_{31i} & b_{32i} & b_{33i} \end{bmatrix}$ ($i = 1, ..., p$), $C_i = \begin{bmatrix} c_{11i} & c_{12i} & c_{13i} \\ c_{21i} & c_{22i} & c_{23i} \\ c_{31i} & c_{32i} & c_{33i} \end{bmatrix}$ ($i = 1, 2, ...$), $B(L) = \sum_{i=1}^{p} B_i L^i$ is an invertible lag polynomial[8] and $e_t = [e_{1t} \;\; e_{2t} \;\; e_{3t}]'$ is a vector of normally distributed shocks that are serially uncorrelated but can be contemporaneously correlated with each other:

$$E(e_t) = 0 , \qquad E(e_t e_t') = \Sigma_e = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{13} \\ \sigma_{12} & \sigma_2^2 & \sigma_{23} \\ \sigma_{13} & \sigma_{23} & \sigma_3^2 \end{bmatrix} , \qquad E(e_s e_t') = [0] \quad \forall s \neq t . \tag{5}$$

Comparing equation (1) with equation (4) reveals that

$$e_t = A_0 \varepsilon_t \tag{6}$$

and therefore

$$\Sigma_e = A_0 \Sigma_\varepsilon A_0^{-1} = A_0 A_0^{-1} . \tag{7}$$

As A_0 is a 3×3 matrix, we need nine parameters to convert the residuals from the estimated equation (3) into the original shocks that drive the behaviour of the endogenous variables. Of these nine, six are given by the elements of $\hat{\Sigma}_e$ (three estimated variances and three estimated covariances of the VAR residuals). For the system to be just-identified, the missing three parameters have to be obtained by making further assumptions about the structural shocks.

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[7] The assumption that each of the disturbances has a unit variance is nothing but a convenient normalisation.
[8] The polynomial is invertible if the VAR is stationary.

Presume that the three structural shock types are aggregate supply (AS), aggregate demand (AD) and purely nominal or financial (LM) innovations and that they can be identified through their impact on the system variables. Specifically, let $\varepsilon_t^s \equiv \varepsilon_{1t}$ be a supply shock, $\varepsilon_t^d \equiv \varepsilon_{2t}$ a demand shock and $\varepsilon_t^n \equiv \varepsilon_{3t}$ a nominal shock.[9] Assume further that AD shocks do not affect the level of the real income in the long run, whereas LM shocks have no long-run impact on either the real income level or the real exchange rate. These restrictions are general enough to incorporate a number of economic models of exchange rate determination, including the sticky-price monetary model of Dornbusch (1976), which we have in mind (see also the discussion below). As the variables in X_t are in differences and not in levels, this means that the cumulated impact of the shocks on the differences is nil in the long-run:

$$\sum_{i=0}^{\infty} \frac{\partial(\Delta y_t)}{\partial(L^i \varepsilon_t^d)} = 0 \quad \text{and} \quad \sum_{i=0}^{\infty} \frac{\partial(\Delta y_t)}{\partial(L^i \varepsilon_t^n)} = 0 \quad \text{and} \quad \sum_{i=0}^{\infty} \frac{\partial(\Delta q_t)}{\partial(L^i \varepsilon_t^n)} = 0 . \tag{8}$$

Technically, making these assumptions amounts to imposing the following three restrictions on the sum of the matrices A_i in equation (1):

$$\sum_{i=0}^{\infty} A_i = \sum_{i=0}^{\infty} \begin{bmatrix} a_{11\,i} & a_{12\,i} & a_{13\,i} \\ a_{21\,i} & a_{22\,i} & a_{23\,i} \\ a_{31\,i} & a_{32\,i} & a_{33\,i} \end{bmatrix} = \begin{bmatrix} \bullet & 0 & 0 \\ \bullet & \bullet & 0 \\ \bullet & \bullet & \bullet \end{bmatrix} . \tag{9}$$

The system is now just-identified, which allows us to identify the past structural shocks (strictly speaking, their estimated values) and compute the IRF and the FEVD. The results for each of the eight CEE countries are presented and discussed in Section 4.

The long-run identification scheme described above was developed by Blanchard and Quah (1989), originally as a technique for decomposing real output into its permanent and transitory components in a bivariate framework with the rate of change in the real output and the rate of unemployment as endogenous variables. Following a modification by Bayoumi (1992), replacing the unemployment rate with the rate of change in the price level, the scheme has been used in a large number of papers analysing the prospects of the European monetary integration, and later the EMU enlargement, in the light of the optimum currency area theory.[10] As discussed in Section 2, Lastrapes (1992) was among the first to apply the scheme to nominal and real exchange rates, aiming at identifying the sources of real and nominal exchange rate fluctuations. Lastrapes' bivariate framework was later expanded to a trivariate one by Clarida and Gali (1994), whose model is the one described above. More-dimensional models, like those of Rogers (1999) or Weber (1997), followed suit. However, the problem with such models is, firstly, that the number of coefficients to be estimated depends on the square of the number of variables in the VAR so the time series must be sufficiently long to allow estimation. Secondly, the number of identification restrictions to be imposed on the system is also a square function of the VAR dimension: in a model with n endogenous variables $(n^2 - n)/2$ restrictions are needed for its just-

[9] The order in which the three shock types appear in the system is arbitrary and affects the results in no way.

[10] See, e.g., Bayoumi and Eichengreen (1992a,b) or Babetski (2003).

identification. Obviously, the more such constraints are imposed, the more they amount to "incredible identification restrictions" used in structural econometric modelling, which were criticised in a seminal paper by Sims (1980).

An important advantage of the identification scheme á la Blanchard and Quah (1989) is the fact that no contemporaneous restrictions are imposed on the system. Therefore, the short-run dynamics of the endogenous variables in response to the various innovation types are allowed to be fully determined by the data. Nevertheless, the scheme has been subject to a number of criticisms. Lippi and Reichlin (1993) point out that it is based on the assumption that the VMA representation is fundamental and argue that non-fundamental representations can lead to very different results. As Blanchard and Quah (1993) argue, though, this is a general problem of dynamic econometric modelling: the assumption of fundamental error terms is implicitly made in most empirical studies using time series analysis methods. A more severe criticism, due to Faust and Leeper (1997), is that using long-run identification restrictions may be inappropriate in finite order VAR (and finite data samples). The problem is aggravated by the relatively short time span over which usable data are available for the transition economies under scrutiny. Using monthly instead of quarterly data, which we do, is one solution to the problem[11]; employing a different identification scheme would be another.

A related point reflects the general objection to VAR models that any inference from such models relies upon the identification restrictions applied, and the latter can be criticised on the grounds of economic theory. Firstly, the procedure at hand allows one to identify at most as many structural shock types as there are variables in the system. The assumption that there are only three types of primitive disturbances is certainly an important limitation of our model. If there were more than three shock types, each with different impact on the endogenous variables, using the restrictions described above would lead to the identification of some linear combinations of the original shocks; this would mean that the identified shocks are not necessarily orthogonal.[12] Worse still, it might be that a shock identified in the VAR is a commingling of two or more innovation types that have opposite effects on one or more system variables, a point also due to Faust and Leeper (1997). If the reaction of the endogenous variables to a certain shock type poses serious interpretation problems (as is the case in our model, see next section), such commingling of shocks is probably the case.

Secondly, long-run neutrality assumptions have also been subject to severe criticism. Buiter (1995, p. 35) dismisses the restriction that demand shocks have no long-run impact on the level of real income as "laughable" and points out that e.g. fiscal shocks can affect saving and capital formation and therefore the potential output. Moreover, many authors stress that nominal shocks can have long-run impact both on the real output and on the relative price of the foreign and domestic goods, e.g. through hysteresis effects. In particular, Farrant and Peersman (2005)

[11] Still, using monthly data cannot solve the problem of our sample covering at most two business cycles, which can hardly amount to a "long run". This is a general problem when modelling economies in transition.
[12] For a discussion of the orthogonality assumption itself see, e.g., Gottschalk (2001) and the references therein.

use sign restrictions instead of long-run neutrality restrictions, which can be thought of as a single solution of a whole distribution of possible responses that are consistent with the more general sign constraints. They show that a number of IRF obtained by traditional zero restrictions are located in the tails of the distributions of all possible IRF. Hence, the inference drawn from models using such restrictions can be misleading.

Our response to that latter bunch of criticism is the simple reminder that the shocks identified in VAR models in general and in our model in particular are not some objectively identifiable disturbances. Ideally, the shocks that we seek to identify should be "structural", i.e. unanticipated (coming by surprise), unique (directly hitting just one macroeconomic aggregate each) and invariant to changes in the information set. One can hardly argue that this is the case as far as disturbances identifiable within the VAR framework are concerned. In particular, the quality of shocks being invariant to changes in the information set, which implies that an estimated shock should not change when e.g. the dimension of the VAR model is increased, is almost never given.[13] The reason is that "true" or "structural" shocks – defined as stochastic changes to the system variables – are unobservable; one can only try to retrieve them from data with the help of certain assumptions.

The question remains whether the assumptions used in this paper are plausible. Admittedly, not all nominal shocks are neutral in the long run and not all demand shocks have only temporary effects on the real income level. Nevertheless, the majority of all nominal shock types one can think of are neutral and the majority of disturbances to real demand do not affect real income level in the long run. We therefore argue, in line with Blanchard and Quah (1989) and Lastrapes (1992), that our identification restrictions are "approximately correct". Moreover, we believe that they are actually correct once we bear in mind that the above criticism is only a matter of definition: shocks that can be tracked down by a VAR model are in fact <u>defined</u> by the identification restrictions. Instead of calling e.g. ε_{2t} a demand shock, one can refer to it as "a shock that has no long-run impact on the real output level but can permanently influence the real exchange rate and the price level", which is a rather long name. One can therefore consider the notions "supply", "demand" and "nominal" shocks as short names for the three innovation types identified in our model. With these qualifications in mind, we can return to the shock interpretation question at the end of next section.

4 Empirical results

Table 1 provides an overview of the exchange rate regimes in the CEE economies on their way to the EMU. As can be seen from the table, these countries have been quite heterogeneous as regards their exchange rate arrangements during the last 15 years or so. Of eight exchange rate arrangements distinguished by the International Monetary Fund (2005), six have prevailed in the

[13] See Juselius (2006), Chapter 13.2 for a discussion.

CEE economies, ranging from a currency board (Estonia, Latvia and Lithuania) to pure floating (Poland). During the 1990s the CEE countries generally moved from fixed to more flexible exchange rates (with the exception of the Baltic states, which maintained currency boards throughout the whole period) and, when pegging, from the US dollar or a currency basket to the German mark and later the euro as reference currency.

Table 1: Exchange rate regimes in the CEE countries

Country	Date	Exchange rate regime [a]	Target currency or currency basket	Fluctuation band	Dummy variables [b]
Czech Republic	3.05.1993	Target zone	DEM (65%), USD (35%)	± 0.5%	
	28.02.1996	Target zone	DEM (65%), USD (35%)	± 7.5%	cz1
	26.05.1997	Managed float	Reference currency: DEM		cz2
	1.01.1999	Managed float	Reference currency: EUR		cz3
Estonia	06.1992	Currency board	DEM	0%	
	1.01.1999	Currency board	EUR	0%	est1
	28.06.2004	Currency board / ERM II	EUR	± 15%	est_erm
Hungary	22.12.1994	Crawling bands	ECU (70%), USD (30%)	± 2.25%	
	1.01.1997	Crawling bands	DEM (70%), USD (30%)	± 2.25%	hu1
	1.01.1999	Crawling bands	EUR (70%), USD (30%)	± 2.25%	hu2
	1.01.2000	Crawling bands	EUR	± 2.25%	hu3
	4.05.2001	Crawling bands	EUR	± 15%	hu4
	1.10.2001	Target zone	EUR	± 15%	hu5
Latvia	02.1994	Currency board	SDR	± 1%	
	1.01.2005	Currency board	EUR	± 1%	lv1
	2.05.2005	Currency board / ERM II	EUR	± 1%	lv_erm
Lithuania	10.1992	Free float			
	01.04.1994	Currency board	USD	0%	
	02.02.2002	Currency board	EUR	0%	lt1
	28.06.2004	Currency board / ERM II	EUR	0%	lt_erm
Poland	10.1991	Crawling peg	USD (45%), DEM (35%), GBP (10%), FF (5%), CHF (5%)	0%	
	02.1995	Crawling bands	USD (45%), DEM (35%), GBP (10%), FF (5%), CHF (5%)	± 2%	pl1
	16.05.1995	Crawling bands	USD (45%), DEM (35%), GBP (10%), FF (5%), CHF (5%)	± 7%	pl2
	26.02.1998	Crawling bands	USD (45%), DEM (35%), GBP (10%), FF (5%), CHF (5%)	± 10%	pl3
	28.10.1998	Crawling bands	USD (45%), DEM (35%), GBP (10%), FF (5%), CHF (5%)	± 12.5%	pl4
	1.01.1999	Crawling bands	EUR (55%), USD (45%)	± 12.5%	pl5
	25.03.1999	Crawling bands	EUR (55%), USD (45%)	± 15%	pl6
	12.04.2000	Free float			pl7
Slovakia	14.07.1994	Target zone	DEM (60%), USD (40%)	± 7%	
	1.01.1996	Target zone	DEM (60%), USD (40%)	± 3%	sl1
	31.07.1996	Target zone	DEM (60%), USD (40%)	± 5%	sl2
	1.01.1997	Target zone	DEM (60%), USD (40%)	± 7%	sl3
	2.10.1998	Managed float			sl4
	1.01.1999	Managed float	Reference currency: EUR		sl5
	25.11.2005	Target zone / ERM II		± 15%	sl_erm
Slovenia	01.1992	Managed float			
	28.06.2004	Target zone / ERM II		± 15%	si_erm

[a] Defined as in International Monetary Fund (2005)
[b] Dummy variables with the value 1 since the month of the respective regime change and 0 otherwise

Source: Czech National Bank, Bank of Estonia, Magyar Nemzeti Bank, Bank of Latvia, Bank of Lithuania, National Bank of Poland, National Bank of Slovakia, Bank of Slovenia, and Babetski (2003)

Tables 2 and 3 present the data used in our model. As the countries under scrutiny were all centrally planned economies until the end of 1980s and the transition process towards a market economy lasted several years, the time span over which usable data are available is rather short. Quite arbitrarily, we decided that data are not usable until 1993 or so, as this was the time when the most dramatic structural changes occurred. This leaves us with a simple size of at most twelve years, which renders using quarterly data impossible; we therefore use monthly data. The sample size varies from country to country due to time series availability. It would have been optimal to use an identical time span for each CEE economy but facing the choice between better comparability of data and longer samples, we chose the latter.

Table 2: Sample size

Country	Sample	Number of observations
Czech Republic	1995:M1 – 2005:M12	132
Estonia	1995:M1 – 2005:M12	132
Hungary	1995:M1 – 2005:M10	130
Latvia	1996:M1 – 2005:M12	120
Lithuania	1998:M1 – 2005:M12	96
Poland	1996:M1 – 2005:M12	120
Slovakia	1998:M1 – 2005:M12	96
Slovenia	1995:M1 – 2005:M12	132

Our proxy for the real income is the volume index of industrial production and for the price level the Harmonized Index of Consumer Prices (HICP), which is reported for the countries in question beginning in 1995 (in 1996 for Poland and Latvia); this fact, along with the above considerations, set the beginning of our sample. As indicated in Section 3, both variables are measured as differentials relative to the respective euro area aggregates. The real exchange rates are computed from monthly average nominal exchange rates against the euro, whereby the deflator used is the Producer Price Index (PPI). For the period prior to the introduction of the euro, exchange rates against a "synthetic euro" are computed as a GDP weighted average of the euro legacy currencies. All variables used in our model are indexes based in 1999:M1 and are not seasonally adjusted.

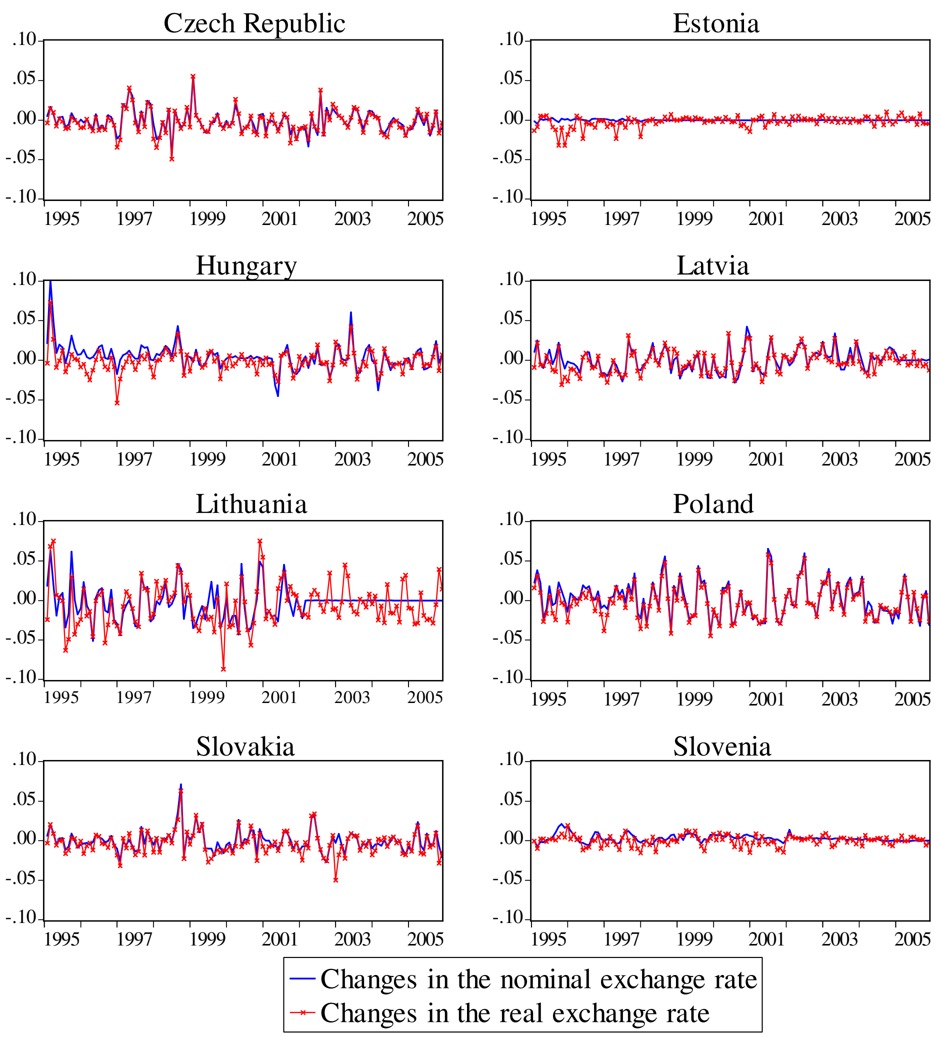
Table 3: Endogenous variables in vector autoregressions

Variables in VAR	Definition	Source
$\Delta y_t = \Delta\left(y_t^{\text{home}} - y_t^{\text{EMU}}\right)$	y_t^{j} – industrial production [a] in country j; log of the volume index (1999:M1=100); not seasonally adjusted	National governments (CEE countries); Eurostat (euro area)
$\Delta q_t = \Delta(e_t - p_t)$ $= \Delta\left(e_t - p_t^{\text{home}} + p_t^{\text{EMU}}\right)$	e_t – nominal exchange rate against the euro (price of euro in units of domestic currency); log of an index (1999:M1=100); p_t^{j} – Producer Price Index in country j; log of the price index (1999:M1=100); not seasonally adjusted	e_t – CEE countries' national central banks (until 1998:M12); ECB (since 1999:M1); p_t^{j} – IMF International Financial Statistics (CEE countries); Eurostat (euro area)
$\Delta p_t = \Delta\left(p_t^{\text{home}} - p_t^{\text{EMU}}\right)$	p_t^{j} – Harmonized Index of Consumer Prices in country j; log of the price index (1999:M1=100); not seasonally adjusted	Eurostat

[a] Of manufactured goods only for Latvia and Lithuania

Prior to model specification we look at the pattern of nominal and real exchange rate fluctuations. Figure 1 depicts month-on-month changes in the nominal and real rates. For better comparability across countries the exchange rates are logarithms of indexes (this time with the base 1995:M1) so that their differences can be interpreted as the rate of change in the underlying exchange rate. Note also that the vertical axis has the same scaling in all graphs. As can be seen from the figure, the real exchange rate fluctuations observed in the CEE economies follow the pattern described in Section 2: the real rate changes go almost step-in-step with nominal rate changes and are visibly less volatile under pegged than under floating nominal rates.

Figure 1: Nominal and real exchange rate fluctuations in CEE countries [a]



[a] The data are the same as in Table 5 below.

This finding is confirmed when looking at descriptive statistics (see Table 4). Firstly, the standard deviation of the real exchange rate is almost equal to that of the nominal exchange rate in all cases except for Estonia. Secondly, the simple correlation coefficients are all significant at the 1 percent level, have positive signs and are very high (between 0.5 and 0.96, again except for Estonia with the value of 0.23). Thirdly, not only nominal and real exchange rate levels (these have a unit root, see below), but also their rates of change show a relatively high degree of persistence, as measured by the first order autocorrelation coefficient (with the exception of Estonia for the nominal rate and the Czech Republic for both rates). We put the differential findings for Estonia down to its nominal exchange rate regime: as the only country in the sample, it maintained a hard peg against the German mark and later the euro throughout the whole period under study.

Table 4: The rates of change in the nominal and real exchange rates – descriptive statistics [a]

Country	Mean		Standard deviation		First order autocorrelation coefficient [b]		Simple correlation coefficient [b]
	Δe_t	Δq_t	Δe_t	Δq_t	Δe_t	Δq_t	$(\Delta e_t, \Delta q_t)$
Czech Republic	-0.0016	-0.0029	0.0138	0.0146	0.1268	0.1382	0.9592 ***
Estonia	0.0000	-0.0021	0.0008	0.0070	0.1339	0.3180 ***	0.2293 ***
Hungary	0.0046	-0.0012	0.0164	0.0141	0.4146 ***	0.2585 ***	0.8147 ***
Latvia	0.0001	-0.0021	0.0139	0.0140	0.3600 ***	0.2743 ***	0.8707 ***
Lithuania	-0.0026	-0.0051	0.0201	0.0271	0.2330 ***	0.2972 ***	0.7080 ***
Poland	0.0017	-0.0019	0.0220	0.0206	0.3312 ***	0.3163 ***	0.9652 ***
Slovakia	-0.0003	-0.0033	0.0130	0.0146	0.2605 ***	0.1964 **	0.8858 ***
Slovenia	0.0031	0.0002	0.0047	0.0064	0.7247 ***	0.2444 ***	0.4997 ***

[a] For definitions of the variables see Table 3 above. The sample covers the time span 1995:M1 – 20005:M12. The underlying indexes have been re-based so that their value in 1995:M1 is log (100).
[b] * = significant at the 10 percent level, ** = at the 5 percent level, *** = at the 1 percent level

Before specifying a VAR for each country, we test all variables for the order of integration and, where applicable, for cointegration.[14] The results of the Augmented Dickey-Fuller test applied to levels and differences of the variables indicate that all levels have a unit root and all differences are stationary, so that all (level) variables are integrated of order 1. Johansen cointegration tests generally show no cointegrating relationships, although some of the results are borderline and / or sensitive to specification. All in all, we conclude that the formal requirements for the application of the Blanchard and Quah (1989) identification scheme are satisfied.

When deciding upon the maximum lag length to use in the VAR, p, we look at the Akaike, Schwarz and Hannan-Quinn information criteria as well as the liquidity ratio test (AIC, SC, HQ, and LR, respectively) and test the regression residuals for serial correlation. The AIC, HQ and LR point to twelve lags in most cases, whereas the SC usually suggests one or two lags. Because with such a short lag structure the residuals are serially correlated while with twelve lags they are not, and because we think that one or two lags cannot capture the dynamics of the system correctly, we set p at twelve in all models with the exception of those for Poland and Slovenia, where ten lags seem more appropriate. We also include a constant in each VAR and experiment with a number of dummy variables representing exchange rate regime changes as well as a linear trend term. A dummy or trend is included if it is significant according to the t-test in at least one equation; for details see Table 5. Furthermore, we tried using seasonal dummies but they were generally insignificant so we eventually left them out. All VAR are stable, i.e. all their roots lie within the unit circle, although several roots are near unity in absolute value.

[14] The results of these tests are not reported here to save space. Like any other results, they are available upon request from the author.

Table 5: Exogenous variables in vector autoregressions

Country	Exogenous variables [a]	Country	Exogenous variables [a]
Czech Republic	c, t, cz2, cz3 = euro	Lithuania	c, t, euro
Estonia	c, est1 = euro	Poland	c, t, pl6
Hungary	c, t, hu2 = euro, hu3, hu4	Slovakia	c, t, euro
Latvia	c, lt1, lt_erm	Slovenia	c, t

[a] c is a constant, t is a linear time trend, euro is a dummy variable with the value 1 since 1999:M1 (start of the EMU) and 0 otherwise, and other variables are dummies defined in Table 1 above.

As a first step in our analysis we look at the IRF, depicting the impact of the various shock types on the endogenous variables, in order to verify the robustness of the identification scheme employed; the results are shown in Figure 2. Note that each IRF depicts the accumulated response of the differenced variable to a given shock, which is equivalent to the response of the respective level variable. A salient feature of all IRF is the high degree of shock persistence; the effects of even transitory shocks die out slowly over time. This is a direct consequence of the large absolute value of the VAR roots. Interestingly, and contrary to our expectations, the initial overshooting of the real exchange rate in response to real shocks can only be observed in Lithuania, Poland and, to a lesser degree, Slovenia. This effect is virtually nonexistent in the remaining five economies.

The responses of all variables to a (one standard deviation positive) nominal shock relative to the euro area are consistent with those predicted by the economic theory: the relative real output rises and the real exchange rate depreciates in the short run, whereas the relative price level rises in the short and the long run. In most cases, the same applies to the impact of a relative real aggregate supply innovation on the real variables: the relative real income rises and, in Hungary and Poland, the real exchange rate depreciates, whereas it appreciates in the remaining six countries; this perverse supply-side effect was also observed for the UK and Canada by Clarida and Gali (1994) and for the euro area in several subsequent studies (see MacDonald, 1998). The drop in relative prices following a relative supply shock, which can be observed in four economies, is utterly inconsistent with economic theory, though. Moreover, the IRF for what we initially called a relative real aggregate demand disturbance pose more serious interpretation problems. Firstly, in four countries the relative real income initially falls after being hit by a shock of this type; secondly, in all cases the real exchange rate depreciates; finally, in all economies except for Lithuania the relative price level falls in response to this kind of shock. All these effects are contrary to what we would expect. Thus, we cannot interpret this structural shock type as a relative real aggregate demand shock but rather, more generally, as a shock that has no long-run impact on the real output level but can permanently affect the other two variables. Similar remarks apply to what we called a relative real supply shock due to its effect on prices: it can only be interpreted as an innovation that influences all three variables in the long run.

We see two possible explanations of these perverse effects. Firstly, our choice of the proxy for income, i.e. industrial production, does not reflect the growing importance of services in the production and consumption basket. Choosing other aggregates, e.g. retail sales, exports etc., or intrapolating GDP series into monthly data might yield different results. Secondly, the system variables might be actually driven by more than just three types of structural disturbances. If this is the case, what we identify by our trivariate VAR are comminglings of the original shocks. A remedy for that would be to include more variables and more shock types in our model. Due to the relatively short time series available this is not a feasible solution, though. In the remainder of this paper we will continue to use the notions "relative real demand shocks" and "relative real supply shocks" for brevity, bearing in mind that these are only simplifying labels.

Figure 2: Impulse response functions (responses to one standard deviation shocks)

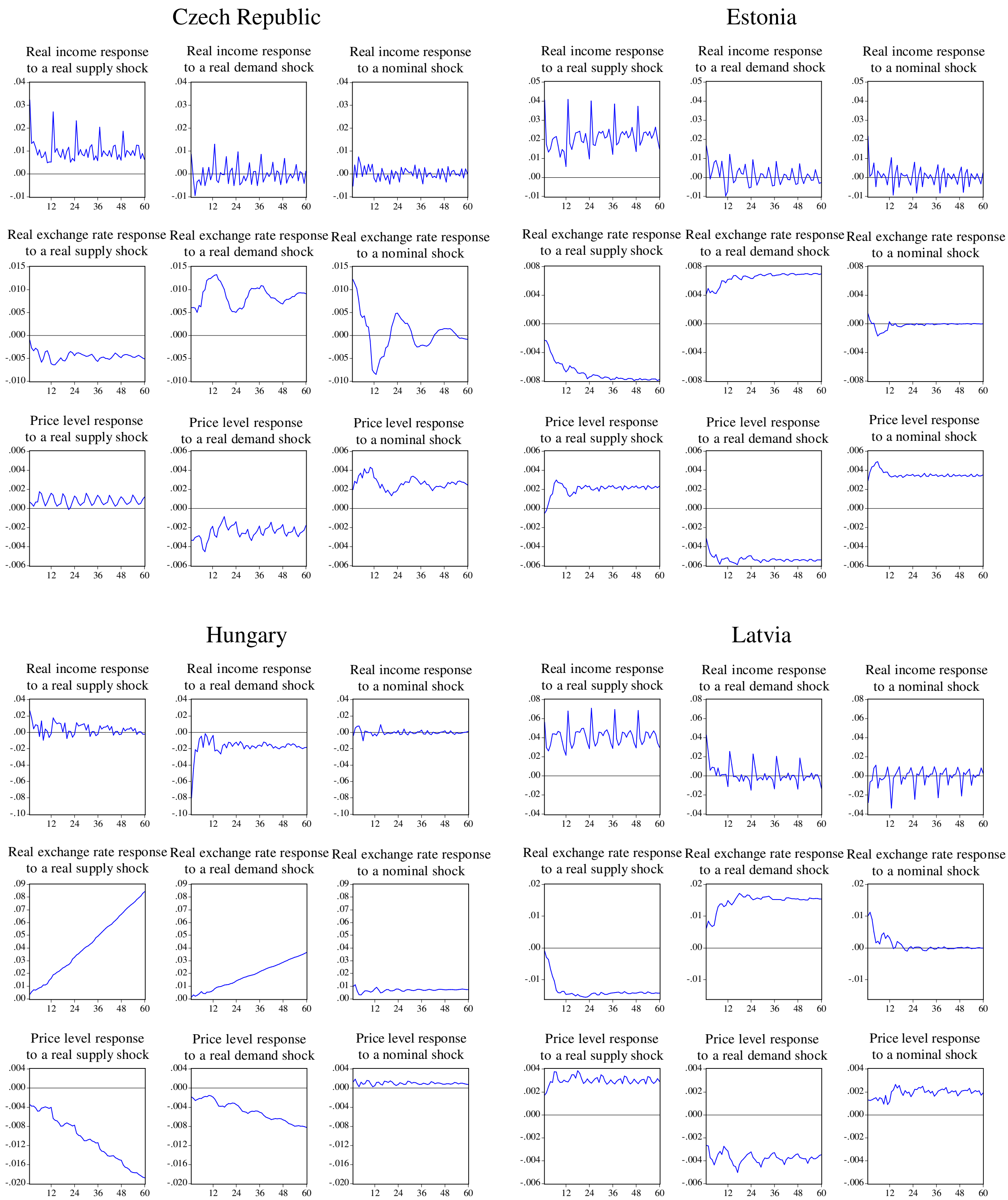
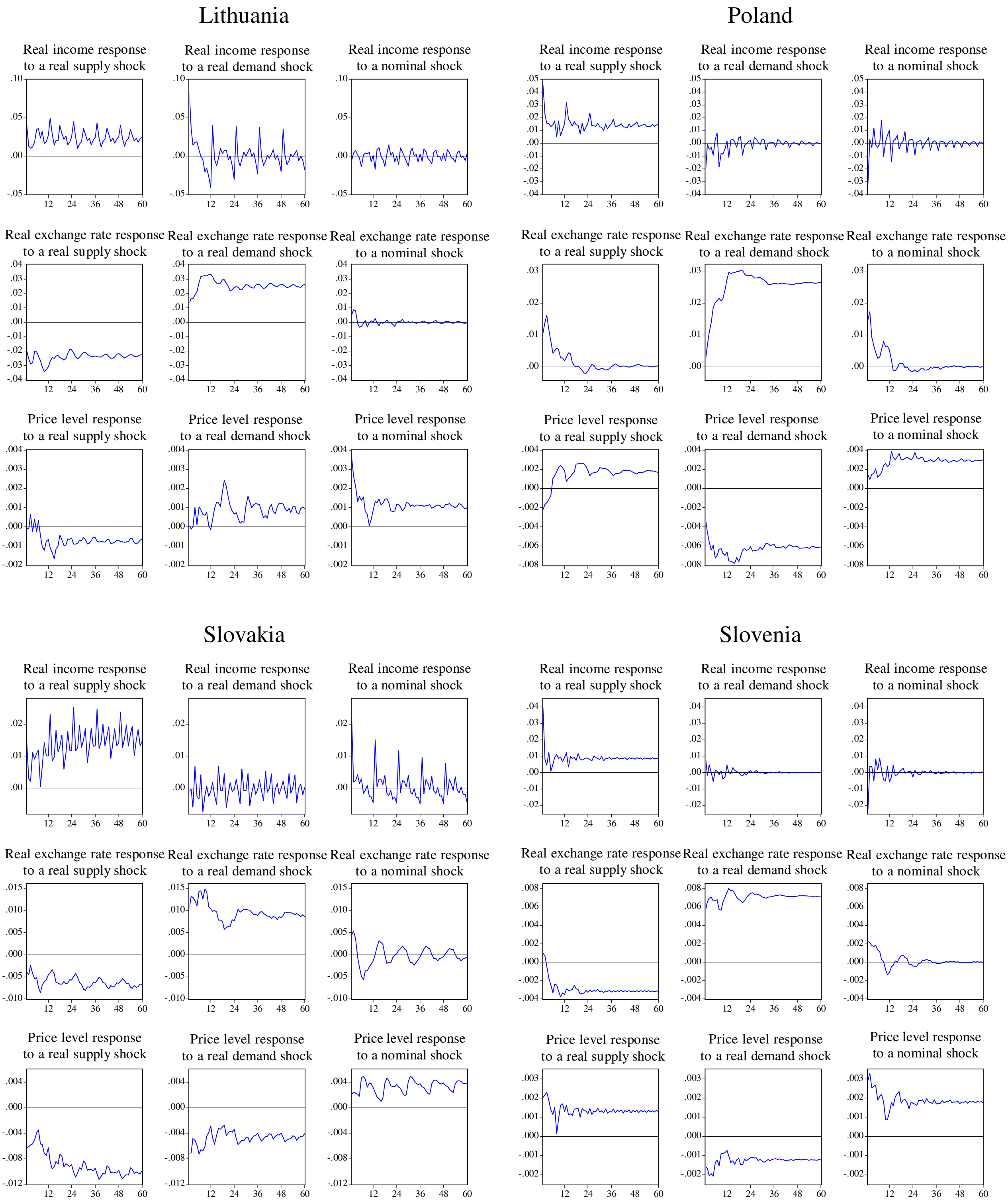


Figure 2 continued:



It is important to stress that the above-described interpretation problems are in fact not relevant to our research question. Our primary aim is to distinguish between permanent and temporary shocks to the real exchange rate and to assess the relative contribution of each shock type to real rate volatility. Certainly, it would be desirable that the identified permanent shocks be interpretable as relative supply or relative demand disturbances. Although this is not the case, the research question of this paper – whether real exchange rate fluctuations in the CEE economies are driven primarily by permanent shocks (real economy view) or by temporary ones (disequilibrium view) – can still be analysed within our framework.

To shed light on the question of the sources of real exchange rate fluctuations in the CEE countries, in a second step of our analysis we calculate the FEVD. The results, presented in Table 6, are striking in that they suggest exactly the opposite of what we expected. In the short run (during the first two years after the shock) between 52 and 88 percent of the forecast error variance (FEV) of the rate of change in the respective real exchange rate against the euro is due to relative nominal shocks in the Czech Republic, Hungary, Latvia, and Poland. In contrast, these shocks account for 4 to 29 percent of the FEV in Estonia, Lithuania, Slovakia, and Slovenia. In the former group of countries relative real demand disturbances account for 1 to 29 percent of the FEV, whereas in the latter group of economies their contribution to the FEV varies between 56 and 84 percent – again with an important exception, namely Lithuania, where they account for only 22 to 29 percent of the variance. Lithuania is the only CEE economy where relative real supply shocks play the dominant role in the short run: their contribution to the FEV of the rate of change in the real exchange rate amounts to 55 to 68 percent in the first 24 months after the shock. In all other countries the contribution of relative supply shocks to the fluctuations of the real exchange rate amounts to between 0.5 and 34 percent. Incidentally, the small aggregate supply component of real exchange rate fluctuations "has become something of a stylised fact in the literature on the economics of real exchange rates" (MacDonald 1998, p. 38). Bearing in mind that the countries under scrutiny are transition economies engaged in a catching-up process with the EMU, we find the relatively small contribution of relative supply shocks to real exchange rate volatility particularly interesting.

To summarize, a substantial amount of the FEV of the change in the real exchange rate is due to nominal shocks in those CEE countries that have not yet joined the ERM II, whereas the fluctuations in the real exchange rate in countries that already participate in the ERM II are mainly due to relative real demand shocks; Latvia constitutes an exception in that its FEVD follow the pattern of the former group of countries. Therefore, the ERM II "outs" seem to comply with the disequilibrium view and the ERM II participants with the real economy view of exchange rate determination.

These results might be primarily due to the different nominal exchange rate regimes of the countries analysed. As shown above, the real exchange rates fluctuate almost step-in-step with the nominal rates. We might therefore expect that the FEVD of real exchange rate changes simply reflect the different nominal exchange rate regimes. This effect can be observed when contrasting the FEVD for Latvia and those for Estonia. Both countries maintained a currency board during the whole sample period but the former adopted the SDR as its anchor currency until the end of 2004, while the latter was anchored to the German mark and later the euro from the very beginning. Consequently, Latvia was almost a floater against the euro during most of the sample.[15] Perhaps

[15] "Almost" because the euro is one of the components of the SDR.

not surprisingly, its real exchange rate is mainly driven by nominal shocks, just like that of another floater, Poland. In contrast, the FEVD for Estonia reveal a predominant role for real demand shocks.

Table 6: Forecast error variance decomposition of the rate of change in the real exchange rate

Forecast horizon	Czech Republic			Estonia			Hungary			Latvia		
(months)	ε^s	ε^d	ε^n	ε^s	ε^d	ε^n	ε^s	ε^d	ε^n	ε^s	ε^d	ε^n
1	0.54	19.65	79.81	21.58	70.13	8.29	10.65	1.89	87.45	0.57	26.79	72.64
2	2.11	19.26	78.63	20.41	68.63	10.96	13.04	3.76	83.20	3.06	28.33	68.61
3	2.29	19.11	78.60	21.11	67.44	11.45	12.59	3.51	83.90	3.29	27.82	68.90
4	2.38	18.94	78.68	23.36	65.54	11.10	11.98	3.66	84.36	7.54	24.47	67.99
5	2.28	18.72	79.00	23.16	62.37	14.47	12.33	4.53	83.14	9.52	22.43	68.05
6	3.07	18.56	78.36	23.85	60.53	15.62	12.34	5.80	81.86	9.77	26.79	63.43
7	3.71	22.13	74.15	23.96	60.42	15.63	12.23	6.77	81.01	12.99	27.14	59.87
8	3.84	21.73	74.44	23.87	60.55	15.59	13.52	6.67	79.80	12.74	26.43	60.84
9	4.80	22.80	72.40	23.34	61.48	15.18	13.43	7.25	79.32	12.71	26.36	60.93
10	4.63	21.98	73.39	23.30	61.38	15.32	13.96	7.19	78.85	12.62	26.22	61.16
11	4.36	18.94	76.70	24.38	60.54	15.08	16.97	6.99	76.04	12.57	26.17	61.27
12	5.43	18.74	75.83	23.55	57.98	18.47	17.69	7.22	75.08	12.75	26.67	60.58
13	5.44	18.75	75.81	23.62	57.50	18.88	20.75	7.93	71.32	12.63	26.60	60.77
14	5.39	18.58	76.04	24.26	57.01	18.73	20.56	8.19	71.25	12.42	26.31	61.27
15	5.40	18.70	75.90	24.27	57.04	18.70	20.46	7.98	71.56	12.39	26.44	61.18
16	5.46	18.72	75.82	24.18	56.83	18.99	20.71	7.97	71.32	12.25	26.46	61.29
17	5.53	18.88	75.59	24.29	56.77	18.95	21.06	8.01	70.93	12.25	26.68	61.07
18	5.55	18.91	75.53	24.68	56.51	18.81	21.65	8.13	70.23	12.29	26.80	60.91
19	5.49	19.78	74.73	24.67	56.50	18.83	21.82	8.12	70.07	12.31	26.76	60.93
20	5.53	19.78	74.69	24.47	56.78	18.75	22.28	8.05	69.67	12.27	26.78	60.96
21	5.75	19.85	74.41	24.47	56.78	18.75	22.40	8.15	69.45	12.27	26.77	60.96
22	5.75	19.82	74.43	24.55	56.72	18.73	23.22	8.13	68.65	12.21	26.79	60.99
23	5.73	19.68	74.60	25.22	56.23	18.55	25.37	8.09	66.54	12.20	26.77	61.03
24	5.82	19.66	74.52	25.33	56.15	18.52	25.85	8.37	65.78	12.22	26.85	60.93

Forecast horizon	Lithuania			Poland			Slovakia			Slovenia		
(months)	ε^s	ε^d	ε^n	ε^s	ε^d	ε^n	ε^s	ε^d	ε^n	ε^s	ε^d	ε^n
1	67.18	28.12	4.70	33.67	0.82	65.51	11.34	73.36	15.31	2.73	83.24	14.03
2	65.94	27.89	6.18	32.73	7.91	59.36	10.66	74.84	14.50	2.95	83.43	13.62
3	66.49	27.36	6.15	27.83	9.76	62.42	13.02	71.27	15.71	5.96	80.68	13.37
4	59.01	25.06	15.93	29.67	10.94	59.39	13.28	63.05	23.67	9.54	77.59	12.87
5	61.21	23.51	15.28	29.98	14.34	55.68	13.53	60.97	25.50	10.87	76.46	12.67
6	58.42	26.96	14.62	31.37	14.27	54.36	12.56	61.56	25.87	12.23	74.77	13.01
7	57.40	27.94	14.66	31.43	14.29	54.28	14.57	59.97	25.47	14.00	73.18	12.81
8	57.71	27.48	14.81	31.16	14.21	54.64	14.67	58.95	26.38	13.46	72.67	13.86
9	57.23	26.38	16.39	30.81	14.15	55.05	15.61	59.00	25.39	14.26	71.91	13.84
10	57.14	25.84	17.02	31.44	14.04	54.52	15.69	58.75	25.56	14.52	70.64	14.84
11	57.05	25.84	17.11	31.08	15.04	53.89	14.96	60.67	24.37	14.62	70.04	15.34
12	57.22	25.70	17.08	30.53	16.49	52.98	15.36	60.24	24.39	14.55	70.09	15.36
13	57.30	25.40	17.30	29.91	16.82	53.26	15.27	59.72	25.02	14.97	69.10	15.92
14	56.67	25.60	17.73	29.60	16.51	53.89	15.26	58.93	25.80	14.98	69.08	15.94
15	56.32	25.67	18.01	29.61	16.51	53.88	15.45	58.26	26.29	14.92	68.77	16.31
16	56.11	25.45	18.43	30.31	16.32	53.37	16.42	57.97	25.60	14.90	68.78	16.32
17	56.07	25.44	18.48	30.37	16.25	53.37	16.42	57.94	25.65	15.11	68.44	16.45
18	55.82	25.76	18.42	30.39	16.25	53.36	16.06	56.63	27.31	15.28	68.18	16.53
19	55.75	25.70	18.55	30.39	16.26	53.35	15.66	56.39	27.95	15.29	68.16	16.54
20	55.30	26.04	18.66	30.35	16.22	53.43	15.75	56.33	27.92	15.61	67.81	16.59
21	55.11	26.33	18.55	30.33	16.42	53.24	15.83	56.28	27.89	15.59	67.82	16.59
22	55.09	26.62	18.28	30.37	16.41	53.22	15.75	55.98	28.26	15.45	67.39	17.16
23	55.23	26.44	18.33	30.36	16.41	53.23	15.80	56.14	28.06	15.54	67.35	17.11
24	54.68	26.42	18.90	30.40	16.40	53.20	15.79	56.12	28.09	15.58	67.30	17.12

The next step in our analysis is thus confronting the results for non-ERM II vs. ERM II economies that were on the same or very similar exchange rate regimes during most of the period under scrutiny. A direct comparison is possible only for the Czech Republic (an ERM II "out") on the one hand and Slovakia and Slovenia (ERM II participants) on the other, as the exchange rate arrangements of these countries were almost identical over the past ten years. The contribution of relative nominal shocks to the FEV of the real exchange rate changes over the first 24 months after the shock amounts to between 72 and 80 percent in the Czech Republic, between 14 and 29 percent in Slovakia and between 13 and 18 percent in Slovenia. In contrast, relative real demand disturbances account for 18 to 23 percent of the FEV in the Czech Republic, 56 to 75 percent in Slovakia and 67 to 84 percent in Slovenia. Thus, the same pattern as the one described above is again revealed.

To check the robustness of our findings, we also estimated VAR models based on a different definition of the real exchange rate, using the HICP as deflator instead of the PPI. This alternative specification leaves the results by and large unchanged. Only seven of the total of 72 IRF, which are not reported here to save space, have a different shape than in the baseline model. The FEVD are qualitatively similar, with an important exception: the real rate changes in Latvia are primarily due to real demand shocks, i.e. Latvia ceases to be an outlier among the ERM II participants.[16] Very similar results are obtained when the models are estimated for the shorter time period starting in 1999:M1, after the launch of the euro: again, Latvia is not an outlier. These findings confirm our baseline results concerning the sources of real exchange rate fluctuations in the CEE countries.

5 Conclusions

In this paper we investigated empirically the sources of real exchange rate fluctuations in eight CEE economies and tried to find out whether these countries' decisions to join the ERM II are consistent with our theoretical considerations. We expected that countries whose real exchange rate changes were predominantly due to nominal disturbances (i.e. countries reflecting the disequilibrium view of exchange rates) should be more keen on the ERM II participation and the subsequent irrevocable fixing of the nominal exchange rate against the euro than those whose real rates were mainly driven by real shocks (i.e. those reflecting the real economy view).

Surprisingly, our results reveal an opposite pattern: the real exchange rate fluctuations in the ERM II participants – with the exception of Latvia, although this finding is specification sensitive – conform to the equilibrium view and that of the ERM II "outs" are in line with the disequilibrium approach. Neither accounting for differences in nominal exchange rate

[16] Two further differences are the following: firstly, the role of supply disturbances becomes more pronounced; indeed, the contribution of these innovations to real exchange rate fluctuations dominates that of demand shocks in some countries. Secondly, a larger part of real exchange rate volatility in Slovakia becomes attributable to nominal innovations. These results do not alter the general outcome of the alternative model, though.

arrangements nor trying a different model specification alters this outcome. Admittedly, what we initially called relative real demand shocks cannot be plausibly interpreted in this way; the same applies to relative real supply shocks due to their perverse effect on the relative price level. We believe that these interpretation problems are due to the low dimension of our VAR. If there are more than three structural shock types, then what we identify is a commingling of the underlying shocks. The best solution – expanding our VAR – is not feasible due to the short time series available for the transition countries under study. As argued above, though, the interpretation problems are in fact irrelevant to our research question, which amounts to disentangling permanent from temporary disturbances to real exchange rates, rather than identifying supply, demand and nominal shocks. Another possible explanation is that industrial production might be a poor proxy for the aggregate income, even though the economies under study are transition economies with still underdeveloped service sectors.

Nevertheless, even if we can solely speak of shocks that exert long-run influence on all system variables instead of real supply shocks, and of shocks that can affect the real exchange rate and prices but not the real income level in the long run instead of real demand shocks, the conclusion remains unaltered. The real rates in the ERM II participants are driven primarily by permanent shocks and thus behave in line with the real economy view, whereas the real rate fluctuations in the ERM II "outs" (and perhaps Latvia) are mainly attributable to temporary disturbances and hence conform to the disequilibrium view. As noted in Section 2, a great importance of nominal shocks in explaining real exchange rate movements may be seen as a result of a high degree of nominal inertia. Our interpretation of these findings is therefore that the latter group of countries might be characterised by substantial nominal rigidities. We conclude that, insofar as the model employed is the proper one for our analysis and correctly specified, the sources of real exchange rate fluctuations were not the decisive factor behind the CEE countries' decisions concerning the ERM II participation and the later adoption of the euro.

The question arises whether the countries staying out of the ERM II should join it as quickly as possible and, on the other hand, whether its participants should reconsider floating their exchange rates. Our answer to both questions is a clear no. We strongly believe that it is only sensible for the three largest new EU member states to enter the ERM II once they have met (or at least are very certain to meet within two years) all the other Maastricht criteria, especially the criterion of a sustainable government financial position. Otherwise adopting a soft peg may result in a speculative attack and a forced devaluation, which would do more harm to macroeconomic stability than nominal exchange rate flexibility could ever do. As regards the five smaller member countries, in our view the benefits of the euro adoption, which consist in microeconomic efficiency gains that enhance economic growth, exceed the potential stabilization costs. Therefore, we believe that these countries will be better-off within the EMU than they would be with their own independent currencies floating against the euro.

References

Artis, Michael and Michael Ehrmann (2000): The Exchange Rate: A Shock-Absorber or a Source of Shocks? A Study of Four Open Economies, European University Institute Working Paper No. 2000/38

Babetski, Jan (2003): EU Enlargement and Endogeneity of OCA Criteria: Evidence from the CEECs, University of Paris, mimeo

Bayoumi, Tamim (1992): The Effect of the ERM on Participating Economies, International Monetary Fund Staff Papers, Vol. 39, No. 2, pp. 330-56

Bayoumi, Tamim and Barry Eichengreen (1992a): Shocking Aspects of European Monetary Unification, National Bureau of Economic Research Working Paper No. 3949

Bayoumi, Tamim and Barry Eichengreen (1992b): Is There a Conflict Between EC Enlargement and European Monetary Unification?, National Bureau of Economic Research Working Paper No. 3950

Beveridge, Stephen and Charles R. Nelson (1981): A New Approach to Decomposition of Economic Time Series into Permanent and Transitory Components with Particular Attention to Measurement of the "Business Cycle", Journal of Monetary Economics, Vol. 7, No. 2, pp. 151-74

Blanchard, Olivier Jean and Danny Quah (1989): The Dynamic Effects of Aggregate Demand and Supply Disturbances, The American Economic Review, Vol. 79, No. 4, pp. 655-73

Blanchard, Olivier Jean and Danny Quah (1993): The Dynamic Effects of Aggregate Demand and Supply Disturbances: Reply, The American Economic Review, Vol. 83, No. 3, pp. 653-8

Borghijs, Alain and Louis Kuijs (2004): Exchange Rates in Central Europe: A Blessing or a Curse?, International Monetary Fund Working Paper No. 04/2

Buiter, Willem H. (1995): Macroeconomic Policy during a Transition to Monetary Union, Centre for Economic Performance Discussion Paper No. 261

Chadha, Bankim and Eswar Prasad (1997): Real Exchange Rate Fluctuations and the Business Cycle: Evidence from Japan, International Monetary Fund Staff Papers, Vol. 44, No. 3, pp. 328-55

Chowdhury, Ibrahim S. (2004): Sources of Exchange Rate Fluctuations: Empirical Evidence from Six Emerging Market Countries, Applied Financial Economics, Vol. 14, No. 10, pp. 697–705

Clarida, Richard and Jordi Gali (1994): Sources of Real Exchange Rate Fluctuations: How Important Are Nominal Shocks?, National Bureau of Economic Research Working Paper No. 4658

Dibooglu, Selahattin and Ali M. Kutan (2000): Sources of Real Exchange Rate Fluctuations in Transition Economies: The Case of Poland and Hungary, Zentrum für Europäische Integrationsforschung Working Paper No. B 14

Dornbusch, Rudiger (1976): Expectations and Exchange Rate Dynamics, The Journal of Political Economy, Vol. 84, No. 6, pp. 1161-76

Enders, Walter and Bong-Soo Lee (1997): Accounting for Real and Nominal Exchange Rate Movements in the post-Bretton Woods Period, Journal of International Money & Finance, Vol. 16, No. 2, pp. 233-54

Farrant, Katie and Gert Peersman (2005): Is the Exchange Rate a Shock Absorber or a Source of Shocks? New Empirical Evidence, Universiteit Gent, Faculteit Economie en Bedrijfskunde Working Paper No. 2005/285

Faust, Jon and Eric M. Leeper (1997): When Do Long-Run Identifying Restrictions Give Reliable Results?, Journal of Business & Economic Statistics, Vol. 15, No. 3, pp. 345-53

Fleming, J. Marcus (1962): Domestic Financial Policies under Fixed and Floating Exchange Rates, International Monetary Fund Staff Papers, Vol. 9, No. 3, pp. 369-79

Funke, Michael (2000): Macroeconomic Shocks in Euroland vs. the UK: Supply, Demand, or Nominal?, mimeo

Gottschalk, Jan (2001): An Introduction into the SVAR Methodology: Identification, Interpretation and Limitations of SVAR Models, Kiel Working Paper No. 1072

International Monetary Fund (2005): Classification of Exchange Rate Arrangements and Monetary Policy Frameworks, http://www.imf.org/external/np/mfd/er/2004/eng/1204.htm

Juselius, Katarina (2006): The Cointegrated VAR Model: Methodology and Applications, forthcoming from Oxford University Press

Kontolemis, Zenon G. and Kevin Ross (2005): Exchange Rate Fluctuations in the New Member States of the European Union, Economics Working Paper Archive No. 0504015

Lastrapes, William D. (1992): Sources of Fluctuations in Real and Nominal Exchange Rates, Review of Economics & Statistics, Vol. 74, No. 3, pp. 530-9

Lippi, Marco and Lucrezia Reichlin (1993): The Dynamic Effects of Aggregate Demand and Supply Disturbances: Comment, The American Economic Review, Vol. 83, No. 3, pp. 644-52

MacDonald, Ronald (1998): What Do We Really Know About Real Exchange Rates?, Oesterreichische Nationalbank Working Paper No. 28

McKinnon, Ronald I. (1963): Optimum Currency Areas, The American Economic Review, Vol. 53, No. 4, pp. 717-25

Mundell, Robert A. (1962): The Appropriate Use of Monetary and Fiscal Policy for Internal and External Stability, International Monetary Fund Staff Papers, Vol. 9, No. 1, pp. 70-9

Mussa, Michael (1986): Nominal Exchange Rate Regimes and the Behavior of Real Exchange Rates: Evidence and Implications, Carnegie-Rochester Conference Series on Public Policy, Vol. 25, No. 0, pp. 117-213

Obstfeld, Maurice and Kenneth Rogoff (2000): The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?, National Bureau of Economic Research Macroeconomics Annual, Vol. 15, No. 1, pp. 339-90

Rogers, John H. (1999): Monetary Shocks and Real Exchange Rates, Journal of International Economics, Vol. 49, No. 2, pp. 269-88

Rogoff, Kenneth (1996): The Purchasing Power Parity Puzzle, Journal of Economic Literature, Vol. 34, No. 2, pp. 647-68

Sims, Christopher A. (1980): Macroeconomics and Reality, Econometrica, Vol. 48, No. 1, pp. 1-48

Soto, Claudio (2003): The Effects of Real and Nominal Shocks on the Chilean Exchange Rate during the 1990s, Central Bank of Chile Working Paper No. 220

Stockman, Alan C. (1983): Real Exchange Rates under Alternative Nominal Exchange-Rate Systems, Journal of International Money and Finance, Vol. 2, No. 2, pp. 147-66

Stockman, Alan C. (1988): Real Exchange-Rate Variability under Pegged and Floating Nominal Exchange-Rate Systems: An Equilibrium Theory, Carnegie-Rochester Conference Series on Public Policy, Vol. 29, No. 0, pp. 259-94

Weber, Axel A. (1997): Sources of Purchasing Power Disparities between the G3 Economies, University of Bonn Discussion Paper No. B-419

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