Exchange Rate Fluctuations in the New Member States of the European Union

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and

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Abstract

This paper assesses the role of exchange rates in moderating the impact of economic disturbances in the new member states of the European Union, and finds some evidence in favour of this proposition. Exchange rates are mostly driven by real (demand) shocks, whilst output by real supply shocks. Nominal shocks, which have no long-run impact on output, are nevertheless important in explaining exchange rate fluctuations implying that less exchange rate flexibility may indeed be warranted in the run-up to the adoption of the euro. We find that while interest rate shocks generally do not explain exchange rate fluctuations, credit shocks matter in certain cases and seem to have considerable impact on exchange rate developments (e.g., for Poland). The analysis also shows that based on the average responses of exchange rates to different shocks, the adoption of narrow bands inside ERM II may be risky.

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Executive Summary

This paper assesses the role of real and nominal shocks in exchange rate fluctuations in (nine of) the ten new member states of the European Union. To our knowledge, this is the first attempt to analyze in a uniform fashion exchange rate fluctuations in the new member states. The methodology used allows us to differentiate between real and nominal shocks, and to assess their impact on real and nominal exchange rates: unlike real shocks, nominal shocks are assumed to have no long-run impact on real exchange rates or output (see Clarida and Gali, 1994). The analysis is taken one step further in order to throw some light on the precise source of nominal shocks with the inclusion of interest rate and credit information. This extension allow us to examine whether monetary policy or credit shocks are significant and have any bearing on exchange rate developments.

The results suggest that exchange rates are mostly driven by real (demand) shocks, whilst output by real supply shocks. Nominal shocks are also important, however, explaining a significant share of the variance of the exchange rate. We therefore examine to what extent interest rate policy contributes in a significant way to exchange rate fluctuations, but find little evidence in favor of that proposition. Credit shocks seem to be important in explaining the variance of exchange rates (e.g., in Poland, Latvia, Slovakia and the Czech Republic), and in some cases the variance of output (e.g., Cyprus, Poland, and Estonia).

The dominance of real shocks is noteworthy and, to the extent that it is symptomatic of "more to come" as real convergence advances, it could have implications for countries' decision to enter ERM II and adopt the euro soon after: in the face of real shocks exchange rates act as shock absorbers, and hence help smooth output fluctuations. Interestingly, real demand shocks seem to explain a relatively small part of the variance of exchange rates in the case of two early ERM II participants, namely Estonia and Lithuania. Among the other countries Hungary, the Czech Republic and Slovenia seem to be influenced significantly by real demand shocks, a finding which suggests that an early move to join ERM II could, ceteris paribus, be more problematic in the short to medium term.

The importance of nominal shocks is a reminder of the risks facing these countries in the run-up to euro adoption. Joining ERM II sooner could significantly limit policy induced shocks (e.g., monetary or fiscal policy) and through expectation effects, minimize speculative and contagion effects. The analysis does not reveal a significant impact from (relative) interest rates, but finds some evidence that credit developments are important in the determination of exchange rates. Although interest rates may converge fast, developments in credit markets may continue to diverge for the foreseeable future. The policy implication of the latter is two-fold. First, policy makers should avoid resorting to controls in the banking system that could adversely affect exchange rate volatility. Secondly, to the extent that fiscal policy contributes to higher domestic demand, a tighter fiscal stance would affect the overall demand for credit and thereby limit the impact on exchange rate volatility.

I. Introduction

On May 1st 2004, ten countries joined the European Union (EU), of which three—Estonia, Lithuania, and Slovenia—have already entered ERM II, with a view to fulfilling the Maastricht criteria by 2006 and adopting the euro as early as 2007. The remaining new member states have also indicated their intention to join ERM II soon, sparking a debate for the optimal timing of entry. The role of exchange rates, and of exchange rate regimes, in buffering exogenous shocks is key in this debate. Countries may choose early entry in ERM II so as to shield their economies from a variety of asymmetric shocks and speculative attacks, which tend be exacerbated by sizeable exchange rate movements (see Kontolemis, 2003, for example). Conversely, in cases where more exchange rate flexibility is deemed appropriate—perhaps due to more need for real convergence, or where progress in consolidating public finances is slower—a shorter stay inside ERM II may be the preferred strategy.

Recent academic research has examined the degree to which exchange rates provide a cushion against shocks in the face of asymmetric shocks.[2] Borghijs and Kuijs (2004), Pelkman, Gros, and Ferrer (2000), and Gros and Thygesen (1998) have concluded that flexible exchange rates in transition countries are poor buffers against external shocks. Other studies have argued in favour of floating exchange rates particularly in the face of temporary shocks (Vinhas de Souza and Ledrut, 2002, for example). On the other hand, Buiter and Grafe (2002), Coricelli (2002), Begg, et al (2003), and Schadler, et al (2004) have stressed that volatile capital flows and trend real appreciation pressures can lead to currency crises, necessitating a shorter stay inside ERM II.

A number of important questions arise concerning the role of exchange rates in moderating the impact of economic disturbances. Are exchange rate shock absorbers, or shock

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[2] Frenkel and Nickel (2002) and Fidrmuc and Korhonen (2002) have shown that while a degree of correlation between accession and euro area shocks exists, the majority of supply and demand shocks facing accession countries appear to be asymmetric in nature.

propagators? Do policies, either monetary or fiscal, influence exchange rate movements and what role do nominal or financial shocks play in exchange rate determination? Alternatively, to what extent do real demand factors, stemming from trade liberalisation and market opening, affect exchange rates? Answers to these questions boil down to what types of shocks explain the variance of exchange rates, and whether these shocks affect output, and prices. A related, and equally important, issue is whether the proposed ERM II fluctuation bands are sufficiently wide to accommodate exchange rate fluctuations triggered by exogenous real, or nominal, shocks.

Early attempts at understanding real exchange rate movements in transition countries centred on decomposing real exchange rate changes into those due to real (or permanent), and nominal (or temporary) shocks. As noted by Kutan and Dibooglu (2000), decompositions of this type were particularly useful in determining the effectiveness of monetary and fiscal policy in transition economies: a significantly large temporary component in the real exchange rate may indicate a high degree of nominal price inertia, suggesting that nominal exchange rate changes can influence the real exchange rate, and hence competitiveness. Kutan and Dibooglu's results suggested that in the case of Poland, for example, where nominal shocks explained over ¾ of the real exchange rate's forecast error variance at short horizons and continued to play an important role after some three years, monetary and exchange rate policies could have been effectively used to manage competitiveness.[3]

Mundell (1964), Obstfeld (2002) and others have shown that the ability of exchange rates to absorb shocks depends on the type of shocks that buffet the economy. For example, real asymmetric shocks, which require adjustments in relative prices to avoid output losses or inflation, can be accomplished by flexible exchange rates even in the context of price rigidity. Thus an unexpected increase in demand would cause a nominal exchange rate

[3] In sharp contrast, results from these relatively simple models estimated for industrial countries (Lastrapes, 1992, and Enders and Lee, 1997, for example), indicated that real factors play by far the dominant role in determining real (and nominal) exchange rate variability, suggesting competitiveness can only be improved by focusing on enhancements in productivity and efficiency.

appreciation, reducing demand pressures through normal expenditure switching channels, and in effect absorbing the shock. On the other hand, negative nominal shocks, such as those originating from a money market imbalance, would result in an interest rate spike and a exchange rate appreciation, which only serve to exacerbate the negative impact on output. In this case, flexible rates would only serve to propagate the shock.

The shock absorption capacity of exchange rates, however, depends on the pricing regime that governs market decisions.[4] In the sticky price world described above, flexible exchange rates achieve desirable relative price changes—and create expenditure switching—if nominal prices are set in producers' currencies. In effect, price changes are fully passed through to consumers and result in a minimization of the variance of output in the presence of a real shock. By contrast, if prices are set in local currencies and there is pricing-to-market, exchange rate changes have little or no effect on final consumer goods prices. In this context, exchange rates will not be able to act as a shock absorber when real shocks hit the economy. The current empirical evidence on pass through effects tends to support the view that exchange rate changes do move relative prices (see Obstfeld, 2002, for example).

This paper attempts to address these questions for the nine new member states of the EU (Malta is excluded for data availability reasons). The empirical methodology employed is based on the structural vector autoregressive (SVAR) model pioneered by Blanchard and Quah (1989), and applied in an open macro framework by Clarida and Gali (1994). This allows for the consideration of a wider range of exogenous shocks that closely fit traditional IS-LM structural exchange rate models. For example, use of three endogenous variables—relative output, real effective exchange rates, and nominal exchange rates—allows the identification of three exogenous structural shocks: real aggregate supply shocks which include labor market and productivity developments; real goods market shocks,

[4] See Engel (2002) and Devereux and Engle (1998) for descriptions of theoretical New Open Economy Macroeconomics models which have examined the international pricing of goods, and the role of exchange rates in international adjustment. Much of this literature has focused on the welfare effects of fixed versus floating exchange regimes.

encompassing exogenous changes to real relative domestic absorption; and nominal shocks, reflecting shifts in both relative money supplies and money demands.[5] Based on this model it is possible to examine the factors behind movements in real exchange rates, while an examination of the sources of variance of relative output can be used to answer the shock absorber-propagation question. The above discussion indicates that when fluctuations in exchange rates are mostly driven by real shocks, particularly supply shocks, the more likely the exchange rate will be a good absorber. By the same token, a more frequent occurrence of nominal shocks would imply little need for a flexible exchange rate lever. Indeed, flexible rates in the face a predominance of nominal asymmetric shocks would only act as propagator of shocks.

The empirical analysis is taken one step further with an examination of the precise source of nominal shocks via the inclusion of relative interest rates and relative credit. To the extent that nominal exchange rate fluctuations are explained by changes in interest rates one should expect such source of divergences to gradually dissipate once countries join ERM II. However, credit shocks—which are uncorrelated with monetary policy shocks and are related to the process of real convergence—can be more problematic if these are found to influence exchange rates. Private sector credit has soared in the majority of these countries, and—given the level of income relative to the euro area—it will continue to rise, albeit at a slower pace in some countries where leverage ratios have increased significantly.

II. EMPIRICAL RESULTS

Standard open economy models recognize two distinct types of shocks, with different impacts on real and nominal exchange rates. Real shocks, which can come from supply or demand sources, can affect both real and nominal exchange rates. Nominal shocks, perhaps

[5] Variants of this model have been empirically applied to bilateral rates in the U.S. by Clarida and Gali (1994), to Japan by Chadha and Prasad (1997), and to the U.K. by Astley and Garratt (2000).

emanating from fiscal or monetary sources, for example, can only affect real variables in the short-run but should not have an impact on real variables in the long-run. In this regard, permanent innovations in supply and demand will result in permanent changes in real and nominal exchange rates. Thus, a permanent change in say, the money supply, can have a permanent effect on the nominal exchange rate, but only a temporary effect on the real rate. This notion is the basis of the econometric analysis in this paper; a detailed description of the econometric methodology used is presented in Appendix A.

Innovation accounting results, particularly forecast error covariance decompositions and impulse response functions, are used to interpret and assess the importance of different (one standard deviation) shocks. Forecast error variance decompositions indicate how much of the (k-step-ahead) forecast error variance can be attributed to each innovation, enabling one to ascertain whether each innovation explains an important part of the variable in question. Impulse response functions map out the dynamic response of individual variables to particular shocks, and as noted above, are helpful in verifying the response of each variable to a given shock. In addition, historical decompositions compare the behavior of the actual endogenous series to the simulated series that are driven by the accumulated shocks which allows a determination of the relative importance of each of these shocks over historical episodes.

All data series are defined relative to the euro area. Hence effective exchange rates are defined only vis-à-vis the euro area, and are not the conventional effective exchange rate series which are based on all trading partners for each country. Similarly, relative output is defined in a similar fashion for consistency. Appendix B presents preliminary data analysis and details concerning the data used for each country. In what follows, only results based on a common-to-all-countries sample are presented, spanning 1994 to present.[6] The models are specified according to the Akaike Information Criterion (AIC), in first differences.

[6] More results, including for longer sample periods, can be found at www.kontolemis.com/pages/5/index.htm.

Clearly, the degree of flexibility, both in exchange rates and prices, will affect the resulting innovation dynamics seen in any empirical study. The empirical analysis in this paper does not make any specific adjustments for differences in exchange rate regime primarily because the objective is to view the propagation or buffering properties of exchange rates regardless of the exchange rate regime in effect. In addition, recent work on exchange rate regime classification indicates that many countries apply exchange rate polices that are quite different from their stated policies.[7]

The empirical analysis begins with the 2-variable model which includes the real and nominal effective exchange rates. Within this framework we focus on the extent to which: (i) nominal shocks explain a significant part of the variance of the real exchange rate; and (ii) similarly whether real shocks actually explain a large share of the nominal exchange rate variability. The results summarised in Figure 1 (top chart) indicate only a limited impact of nominal shocks on real exchange rate variability. With the exception of Estonia and Lithuania, nominal shocks appear to explain only a small share of real exchange rate variability. The large temporary component in the real exchange rate in Estonia and Lithuania is due to the existence of currency board as any nominal shock translates into a change in the real exchange rate. The same chart reveals a relatively a large contribution of nominal shocks in explaining the variance of the nominal effective exchange rates across countries. Hungary and the Czech Republic, and to a lesser extent Slovenia, are exceptions: a high degree of forecast error variance attributed to real shocks, could imply a passive exchange rate policy with realignments tied to real shocks which, if correct, could be construed as evidence of the nominal exchange rate acting as an absorber of real shocks to the economy. The impulse response analysis shows that with the exception of Hungary, the movements in real exchange rates in response to real shocks seem to have been somewhat larger, albeit not always

[7] Rogoff, et.al. (2003) document the differences between de jure and de facto exchange rate regimes for a large set of countries, and provide a new natural classification based upon statistical evidence.

statistically different from, changes in nominal exchange rates.[8] In the case of Estonia the nominal exchange rate remained unchanged following a real shock, consistent with the existence of a credible currency board system; for Lithuania the observed change in the nominal exchange rate, at least initially, is difficult to interpret but it is probably explained by the re-pegging of the currency board from the dollar to the euro in 2002.

Overall, nominal shocks do not generally play a major role in explaining real exchange rate variability, while real shocks seem to matter when it comes to explaining the variance of nominal exchange rates: specifically, the relative importance of real shocks in explaining the variance of real and nominal exchange rates is, respectively, 80 percent and 50 percent across countries. The influence of nominal shocks on the nominal exchange rate is not however insignificant, explaining about one-half of the variance of the nominal exchange rate.

An expanded model includes relative output, the real effective exchange rate and nominal effective exchange rate all defined vis-à-vis the euro area. In this setup three shocks are identified through restrictions (see Clarida and Gali, 1994, for example); the details are included in the Appendix. A real demand (IS) shock and nominal (LM) shocks are restricted to be temporary in nature, while aggregate supply (AS) shocks are allowed to have permanent effects on output. Similarly, only AS and IS shocks can have a permanent impact on the real effective exchange rate while nominal (LM) can have a permanent (i.e., long-run) impact only on nominal exchange rates.

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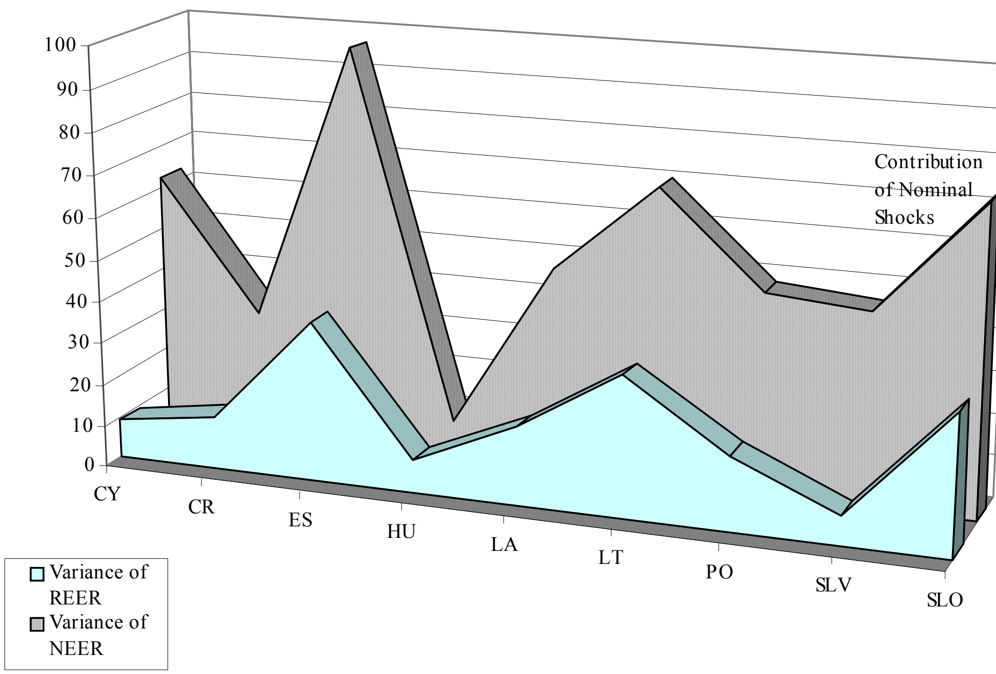
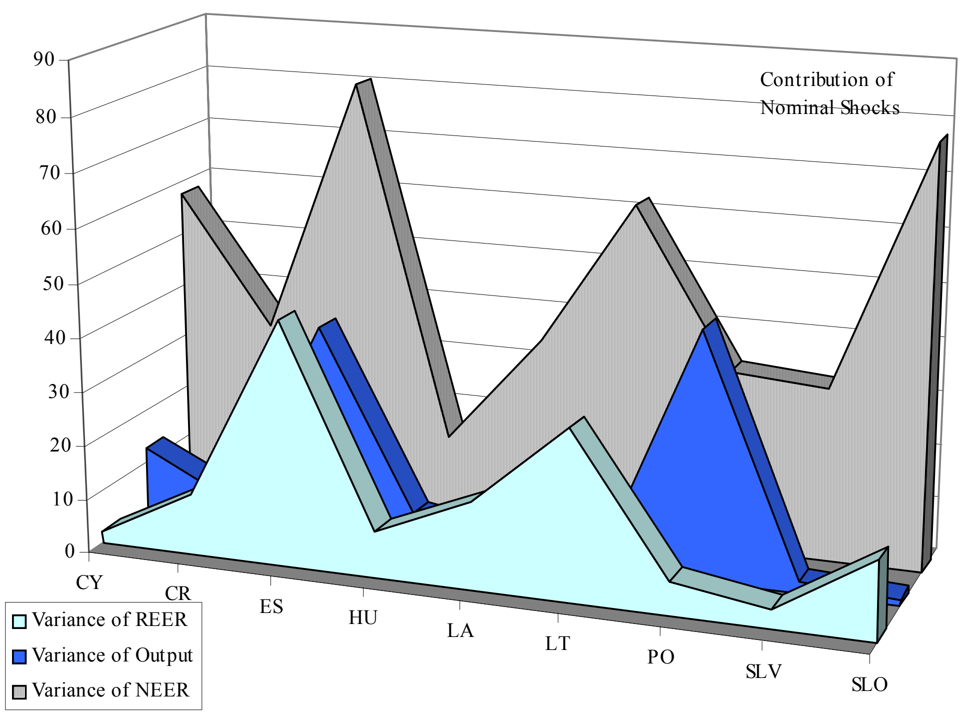
[8] An appendix which includes detailed impulse response analysis can be found at http://www.kontolemis.com/pages/5/index.htm.

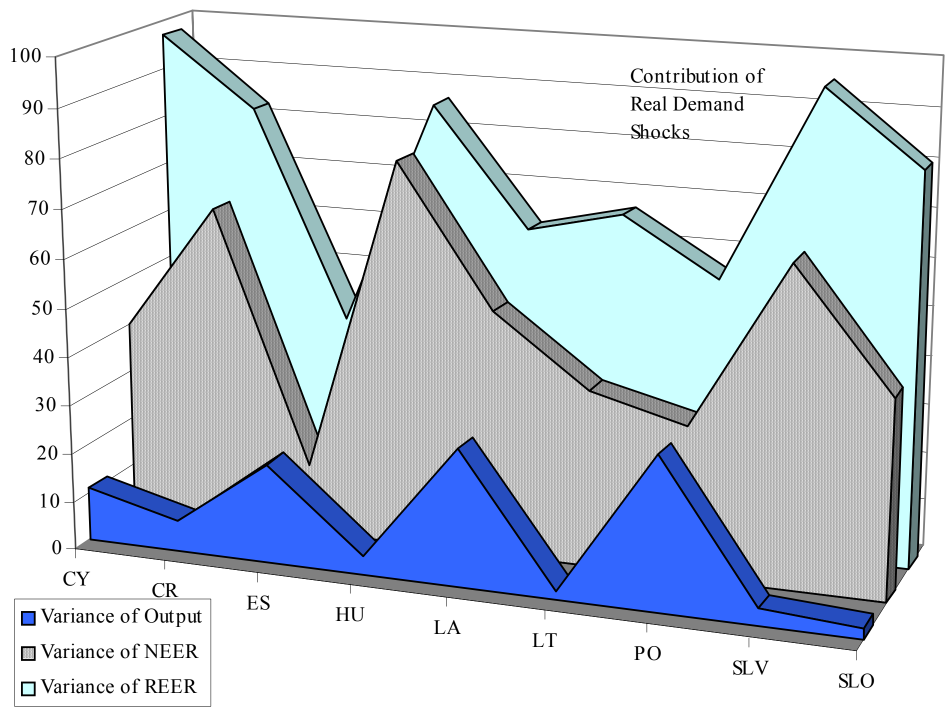
Figure 1. Contribution of Nominal Shocks

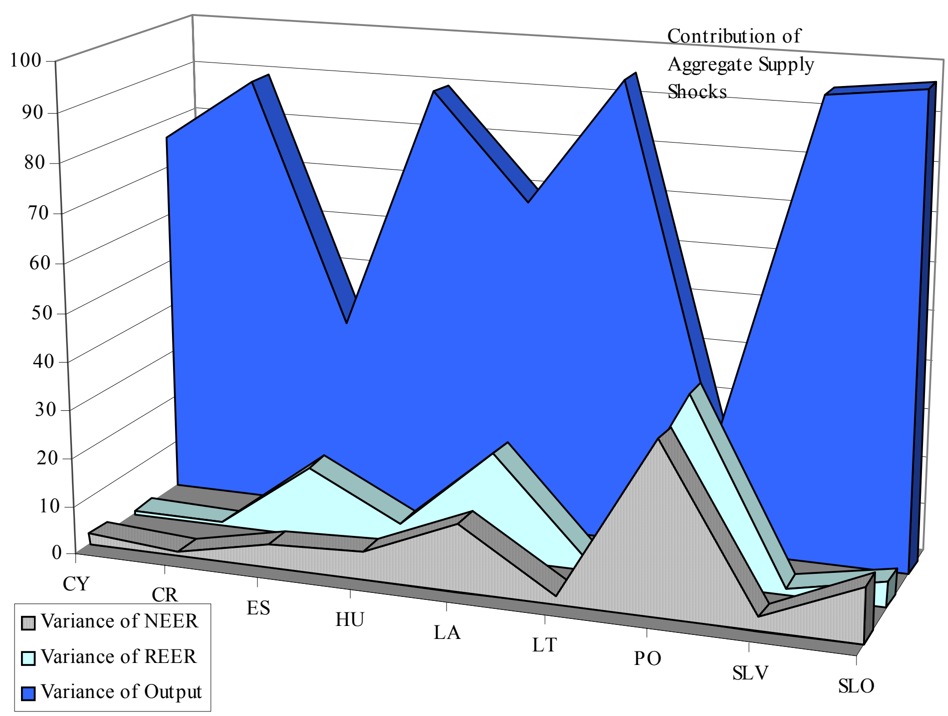




Source: Staff Estimates

Figure 2. Contribution of Real Shocks





Source: Staff Estimates

Figure 1 (lower chart) shows the proportion of forecast error variance which is explained by nominal (LM) shocks obtained using a forecast error variance decomposition, while Figure 2 shows similar decomposition for real (IS and AS) shocks. As noted before, real demand (IS) shocks still explain most of the variance of the real exchange rates, while a mixture of real demand and nominal disturbances drive nominal exchange rate dynamics. In contrast, the variability of output is explained almost entirely by aggregate supply shocks. Nevertheless, some differences across countries exist. For example, supply shocks, but also nominal shocks, are found to be rather important in explaining the unconditional variance of the real and nominal exchange rates in Poland. Nominal shocks seem to be also important in explaining the variance of the real exchange rate in Estonian and Lithuania. Overall, aggregate supply shocks are the main determinant of relative output forecast errors while real demand shocks have a large impact on exchange rate developments.

The results from the historical decomposition for the nominal and real effective exchange rates, for the period 2000-2002 are shown in Figure 3; note that the effective exchange rate is defined relative to euro area only.[9] They confirm that real demand shocks account for fluctuations in the real exchange rate during this period. Poland, Slovenia, and to a lesser extent Estonia and Latvia are notable exceptions. In the case of Poland nominal shocks seem to explain the rapid appreciation of the real exchange rate (against the synthetic euro) in 2000 while supply shocks account for the subsequent depreciation in 2001. In the case of Slovenia, real demand shocks do not explain the trend appreciation of the real exchange rate since 2001. In Estonia nominal shocks explain developments in mid- and late-2001. These historical decompositions further confirm that a combination of real demand and nominal shocks seem to be the driving force behind recent nominal exchange rate movements. One notable exception is Hungary where although real demand shocks seem to explain sudden

[9] Fluctuations in relative output were overwhelmingly caused by their own innovations and are omitted in the figure.

changes in the exchange rate, neither nominal nor real disturbances can account adequately for the significant appreciation of the currency since the beginning of 2001.[10]

Implications for ERM II Membership

In the communication on exchange rate issues relating to (the then) acceding countries, the ECB indicated the exact width of the band inside the ERM II will be determined by mutual agreement among all parties in the mechanism.[11] Fluctuation bands narrower than the normal one (of ±15 percent) may be set at the request of the interested country; for example, Denmark, currently an ERM II participant—albeit well-advanced in the convergence process—has retained a narrow (±2.5 percent) band for the Danish krone.

The results from the impulse response functions, which trace out the reaction of each of the variables in the model to corresponding real and nominal shocks, can be used to assess the feasibility of adhering to ERM II. For example, impulse response functions of nominal effective exchange rates to different shocks can provide a good approximation of the movement in nominal rates in the face of exogenous shocks.[12]

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[10] An appendix which includes detailed impulse response analysis can be found at http://www.kontolemis.com/pages/5/index.htm.

[11] See "Policy Position of the Governing Council of the European Central Bank on Exchange Rate Issues Relating to the Acceding Countries" December 18, 2003, (www.ecb.int).

[12] Notice that such an assessment is limited since it cannot determine an individual country's susceptibility to shocks, or the responsiveness of exchange rates to multiple shocks.

Figure 3: Historical Decompositions for Real and Nominal Effective Exchange Rates

Figure 4. Response of Nominal Exchnage Rate to Alternative Shocks
(percent change to 2-standard deviation shocks)

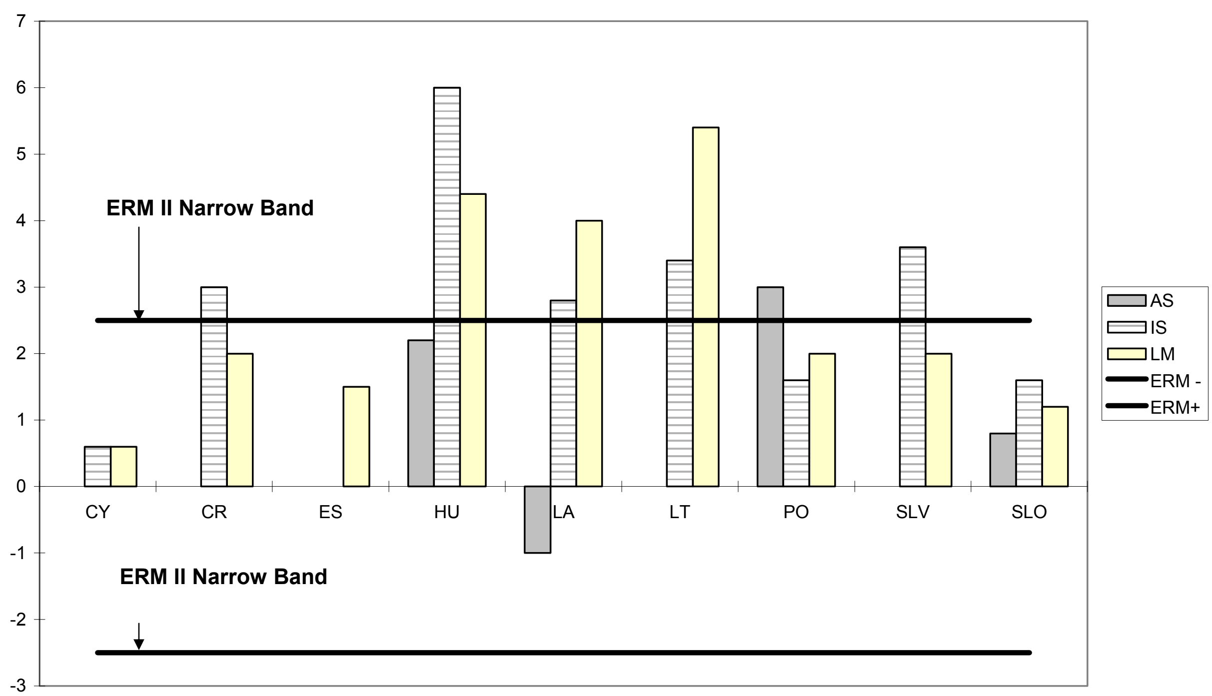

Figure 4 shows the impact on the level of the nominal effective exchange rate of a 2-standard deviation real and nominal shock. At least under the assumption of one-off shocks, the results suggest that all countries should be able to cope easily with the wider bands of ERM II. In contrast, introducing narrow exchange rate bands appears to be inappropriate in most cases with the exception of Cyprus, Estonia and Slovenia. Hungary, and the Slovak and Czech Republics appear most likely to experience wider exchange rate swings in the face of real demand and nominal shocks.[13]

Another Look at Identifying Nominal Shocks: Interest Rates and Credit

Theoretically, nominal shocks may arise from a number of sources, including monetary policy changes, other financial shocks, as well as adjustments in fiscal policy. Identification of nominal shocks in the earlier section was accomplished by using information from real and nominal exchange rates, and relative output, and making a number assumptions about the long-run impact of these type of shocks on output and the real exchange rate. Given the importance of nominal shocks in the determination of nominal exchange rates, for example, it is important to take another look at the identification of nominal money shocks. Other variables, for example, relative interest rates, or private sector credit, may provide more insight into the role of nominal shocks.

Indeed, with the exception of the Czech Republic and Slovakia, credit to the private sector soared in most countries, relative to the euro area, and these credit trends are more likely to continue, albeit in a more sustainable fashion, in the medium to long run.[14] In theory if credit

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[13] The results for the Baltics, particularly for Latvia and Lithuania are difficult to interpret given the problem of identifying accurately shocks in view of the re-pegging of the litas to the euro, for the case of Lithuania, and the link to the SDR for Latvia. In the case of Lithuania it is even more complicated given that the country was pegged to the German DM, while the euro effective exchange rate used in this study takes into account of exchange rate fluctuations vis-à-vis all other euro-area countries, and hence of bilateral exchange rate changes between Germany and the other countries.

[14] The negative growth of credit in the Czech and Slovak Republics reflects, in part, efforts to clean up bad loans in the banking system.

developments were driven primarily by monetary policy actions, interest rate differentials could provide sufficient information for assessing the extent to which monetary shocks influence output and exchange rate developments. Nonetheless, credit shocks are frequently uncorrelated with monetary policy shocks and therefore deserve a more thorough examination.

Hence, we proceed by adding in our specifications relative interest rates and credit in an attempt to isolate the sources of nominal shocks. The relative interest rate is defined as the difference between each individual country's average money market rate and the average money market rate from the euro area, while relative private credit is based on IFS data on private sector claims for the nine countries in the sample, and loans to the private sector for the euro area (as compiled by the ECB).

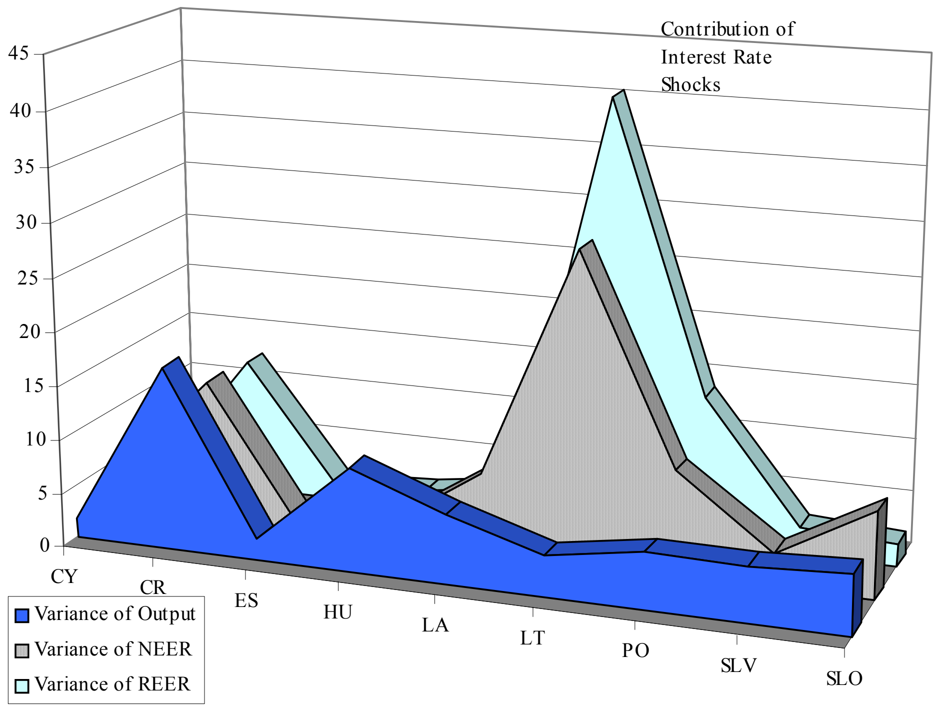
Figure 5 summarizes the main results obtained using the model which includes the relative interest rate variable. For the most part these results appear to be in line with those obtained with the 3-variable model.[15] The chart shows that the contribution of interest rate shocks seems to be rather small—with the exception of Lithuania, where interest rate shocks explain a significant part of the forecast error variance of the real and nominal effective exchange rates and which is difficult to explain given the currency board regime in that country.[16,17]

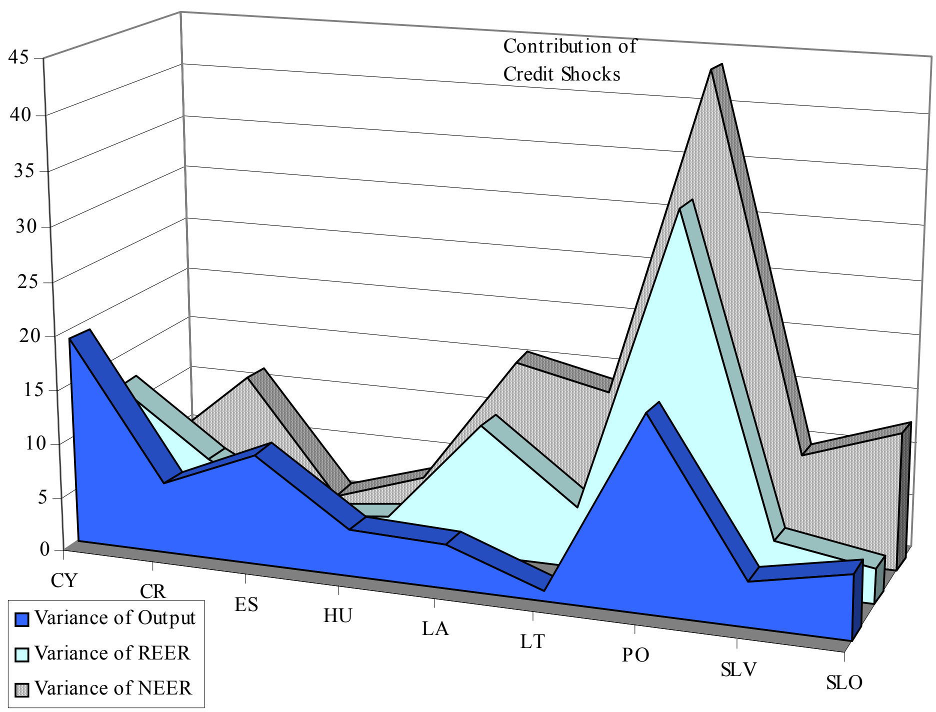
[15] However, the inclusion of the relative interest rate significantly moderates the role of supply shocks in exchange rate determination for the case of Poland, which was the main outlier in the previous analysis.

[16] Interestingly, the results from the impulse response analysis (presented in the Appendix) show that shocks to the relative interest rate appear, with the exception of Slovenia, to have no significant impact on the nominal exchange rate in any country.

[17] The addition of the interest rate variable raises significantly the contribution of nominal (LM) shocks in explaining nominal and real exchange rate fluctuations in the case of Hungary. This is interesting since it suggests that although interest rates do not appear to be explaining exchange rate fluctuations, other nominal shocks are very important. Indeed, interest rate changes over the last few years have not had a meaningful impact on the exchange rate, although the authorities have been maintaining a quasi-fixed exchange rate vis-à-vis the euro. In contrast, wages in the public, but also in the private, sectors have soared since 2000, and have led to a major deterioration in the external competitiveness during a period of record (relative to the past-decade) low interest rates.

Figure 5. Contribution of Interest Rate and Credit Shocks





Source: Staff Estimates

Figure 5 presents the results (lower chart) based on the model which includes relative credit. Credit shocks seem to be important in explaining the variance of exchange rates (e.g., in Poland, Latvia, Slovakia and the Czech Republic), and in some cases the variance of output (e.g., Cyprus, Poland, and Estonia). Interestingly, the addition of relative credit lowers the contribution of real demand and nominal shocks in explaining nominal exchange rate variability in Estonia, thus implying full pass through of nominal shocks alone, which is consistent with the currency board arrangement.

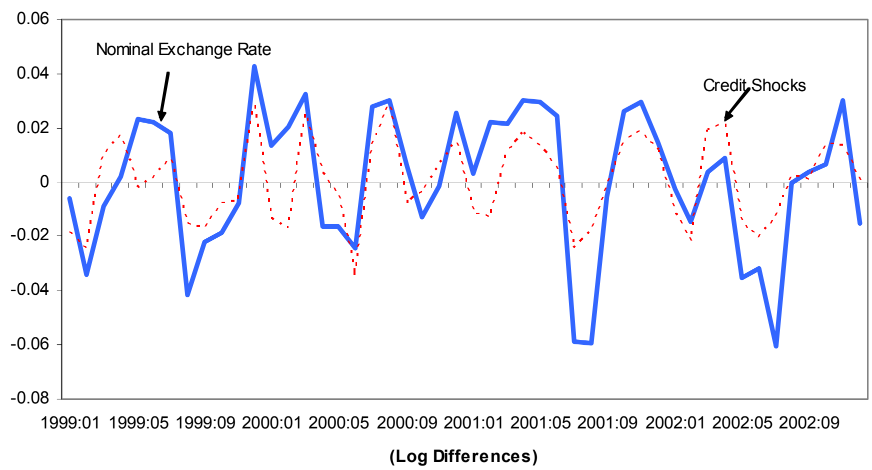
In Poland credit shocks seem to play an important role in determining real and nominal exchange rate movements. The case of Poland is interesting, since previous results from historical decomposition indicated that nominal shocks explain the rapid appreciation of the real exchange rate in 2000. After growing rapidly for several years credit growth slowed down steadily through 2002, at the same time as foreign-currency borrowing soared. During the period 1999-2001, for example, the share of foreign currency lending to households out of total bank lending tripled, and doubled as a share of GDP, to some 2½ percent.[18] Capital account liberalisation, together with measures taken by the Central Bank to control credit expansion, were the principal factors behind these trends which, in turn, led to a significant appreciation of the exchange rate as individuals and firms borrowed abroad and purchased zloties to finance their activities in Poland.

Figure 6 shows the contribution of credit shocks to changes in the nominal effective exchange rate during 1999-2002 obtained through the historical shock decomposing of the model. It confirms that credit developments were a major factor behind exchange rate developments in Poland. For the case of Slovenia and the Czech Republic credit played a limited role, although IS shocks appear to drive changes in the nominal effective exchange rate. In fact results from the impulse response analysis (Figure 7) show that positive relative

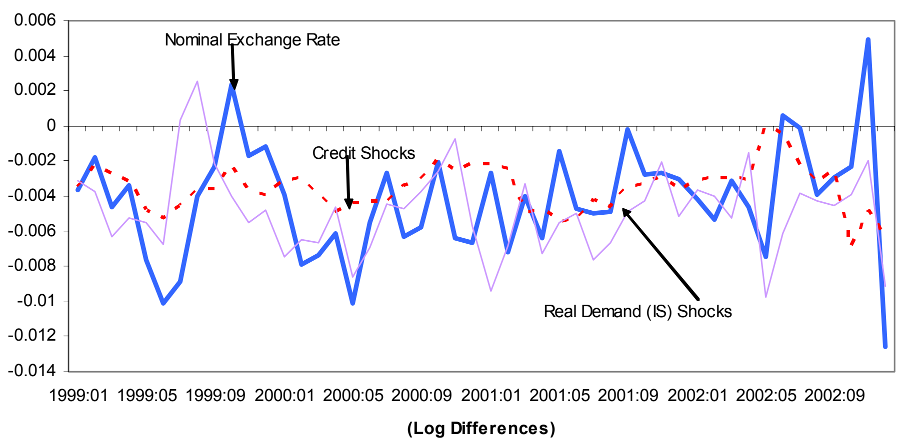
[18] See IMF (2002) and OECD (2002) for a discussion.

Figure 6: Contributions of Credit Shocks

Poland: Changes in the NEER, and contribution from (Relative) Credit Shocks



Slovenia: Changes in the NEER, and contribution from (Relative) Credit Shocks



Czech Republic: Changes in the NEER, and contribution from (Relative) Credit Shocks

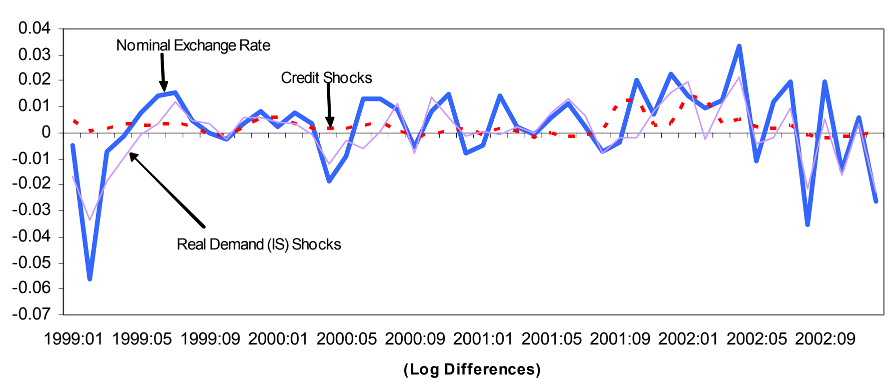
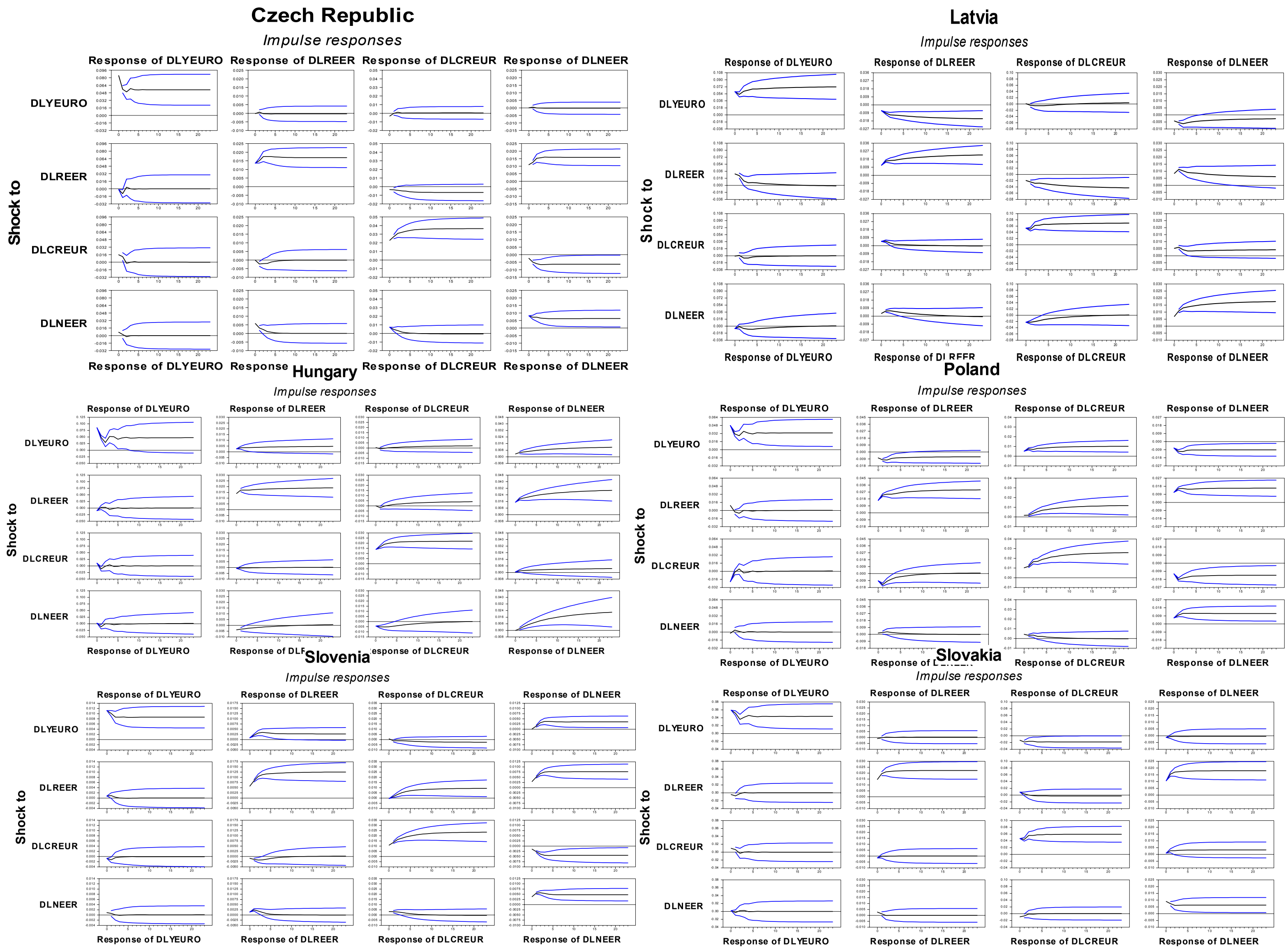


Figure 7. Impulse Respose Functions: Model with Relative Credit



credit shocks lead to a depreciation of the nominal effective exchange rate in the range of ½ to 1¾ percent; specifically, about a 1.8 percent depreciation for the case of Poland.

III. Conclusions

The empirical analysis shows that real demand shocks explain most of the variance of real exchange rate fluctuations. Fluctuations in nominal exchange rates appear to be primarily driven by real demand shocks, and nominal shocks, but not by real aggregate supply shocks. In contrast, movements in relative output appear to be predominately determined by aggregate supply shocks while there is little evidence that exchange rate shocks, either nominal or real, cause fluctuations in relative output. Hence, while real and nominal shocks seem to have an influence on exchange rate, exchange rate fluctuations, per se, do not appear to hinder growth in any significant way.

The dominance of real shocks is noteworthy and, to the extent that it is symptomatic of "more to come" as real convergence advances, it could have implications for countries' decision to enter ERM II and adopt the euro soon after. In the face of real shocks exchange rates act as shock absorbers, and hence help smooth output fluctuations. Interestingly, real demand shocks seem to explain a relatively small part of the variance of exchange rates in the case of two early ERM II participants, namely Estonia and Lithuania. Among the other countries Hungary, the Czech Republic and Slovenia seem to be influenced significantly by real demand shocks. An early move to join ERM II could, ceteris paribus, be more problematic for these countries in the short to medium term. However, the relative importance of real demand shocks—which may be associated with the liberalization of these economies and opening up to trade, and which are likely to dissipate in the future—implys that gradually less exchange rate flexibility may be needed. In contrast, real supply shock—linked to productivity and labour supply changes which are expected to dominate in the medium term—do not influence significantly exchange rate dynamics. The size of the observed shocks also reveals that the majority of countries, except Cyprus, Estonia, and Slovenia, can only cope with participation in a more flexible ERM II arrangement, with wide fluctuation bands vis-à-vis the euro.

Based on this evidence the case in favour of more exchange rate flexibility is not unambiguous. In particular, the importance of nominal shocks in a number of countries is a reminder that exchange rate flexibility can be destabilising. In addition, the lack of output response to exchange rate movements in the majority of countries may be consistent with the "pricing-to-market" hypothesis which , if true, strengthens further the case in favour of ERM-II membership.

In order to examine more thoroughly the precise source of nominal shocks we took the analysis one step further by examining whether these originated from interest rate changes, or credit developments. To the extent that nominal exchange rate fluctuations are explained by changes in interest rates one should expect such source of divergences to gradually dissipate once countries join the ERM II. However, credit shocks—which can be uncorrelated with monetary policy shocks and are linked to the process of real convergence, and consumption smoothing by the private sector—can be more problematic.

We find that changes in interest rates do not propagate nominal or real exchange rate movements. Nonetheless, credit shocks explain a significant share of the variance of the nominal exchange rate most notably in Poland, and less so in other countries. Positive credit shocks tend to lead to a depreciation of the exchange rate: a 1-standard deviation positive shock to credit results in a depreciation of the nominal effective exchange rate in the range of -½–1¾ percent. The finding for Poland merits attention given that it probably reflects events from 1999-2001, when measures taken to control credit led to a stall in credit expansion and to a dramatic increase in foreign borrowing, which was in turn accompanied by an appreciation of the exchange rate.

These suggest measures introduced to curb credit growth might affect the exchange rate, and should therefore be undertaken with caution; interestingly, credit shocks were found to have very little impact on exchange rate dynamics in those countries which have experienced rapid credit expansion over the past decade. Thus, credit developments, which are likely to continue influencing financial sector trends in these countries, do not have strong influence on exchange rate dynamics unless they lead to dramatic policy measures that typically compel market participants to circumvent controls, and resort to alternative borrowing practises.

Our attempt to pin down the source of nominal shocks, either stemming from monetary policy or credit market developments, was partly successful. To some extent, the results indirectly highlight the significance of fiscal policy and its role in propagating nominal shocks. In this regard participation in ERM II and subsequently euro adoption, which will limit the incidence of fiscal and hence the importance of nominal shocks, may prove less problematic.

The importance of nominal shocks is a reminder of the risks facing these countries in the run-up to euro adoption. Joining ERM II sooner could limit minimize significantly policy induced shocks (e.g., monetary or fiscal policy) and could further, through expectation effects, limit speculative and contagion effects. The analysis does not reveal a significant impact from (relative) interest rates, but finds some evidence that credit developments are important in the determination of exchange rates. Although interest rates may converge fast, developments in credit markets may continue to diverge for the foreseeable future. The policy implication of the latter is two-fold. First, policy makers should avoid resorting to controls in the banking system that could adversely affect exchange rate volatility. Secondly, to the extent that fiscal policy contributes to higher domestic demand, a tighter fiscal stance would affect the overall demand for credit and thereby limit the impact on exchange rate volatility.

APPENDIX A: Structural VAR methodology

Structural VARs are simultaneous equation systems that allow the dynamic impact of exogenous shocks on endogenous variables to be identified through the imposition of restrictions. There are a number of SVAR models that can be used to identify innovations. Here we use the Blanchard-Quah (BQ) structural VAR methodology which bases the identification restrictions on the long-run effect of the exogenous shocks on the endogenous variables. Given the consensus on these long-run restrictions, the BQ SVAR methodology can fit a number of theoretical models. Also, given the lack of consensus in the literature on the behavior of short-run dynamics in SVAR models, these dynamics are left completely unconstrained.

Consider the moving average representation of a vector of variables x_t, and structural shocks ε_t:

$$\Delta x_t = A_0 \varepsilon_t + A_1 \varepsilon_{t-1} + \ldots = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i} \qquad (1)$$

where the A_i matrices represent the impulse response functions of the shocks to the elements of x, while the ε vector contains real and nominal shocks. To identify the shocks the restriction on the matrix of long-run moving average coefficients, is imposed such that $C(1)$ is lower triangular:

$$\sum_{i=0}^{\infty} a_{11i} = 0 \qquad (2).$$

Under these conditions the structural VAR model can be estimated in its reduced form version by ordinary least squares. In typical VAR format, this means that each element of x_t

is regressed on lagged values of all the elements of x, with the estimated coefficients represented by B. That is:

$$x_t \quad = \quad B_1 x_{t-1} \quad + \quad B_2 x_{t-2} \quad + \ldots + B_n x_{t-n} \quad + \quad e_t \tag{3}$$

where e_t represents residuals from the estimation of the reduced form VAR. Next, the following algebraic manipulation is used to find the matrix of long-run moving average coefficients:

$$x_t \quad = \quad (I - B(L))^{-1} e_t \quad = \quad (I + B(L) + B(L)^2 + \ldots +)\, e_t \tag{4}$$

$$x_t \quad = \quad e_t + D_1 e_{t-1} + D_2 e_{t-2} + D_3 e_{t-3} + \ldots \tag{5}$$

Notice that the identification allows us to obtain the structural shocks since $e_t = C\varepsilon_t$. This methodology is appealing since it enables us to pin down the long-run, or steady-state, solution of the model—based on economic theory—while imposing no structure over the short-run dynamics of variable.

Identification of Shocks to Exchange Rates

Standard open economy models recognize two distinct types of shocks, with different impacts on real and nominal exchange rates. Real shocks, which can come from supply or demand sources, can affect both real and nominal exchange rates. Nominal shocks, perhaps emanating from fiscal or monetary sources, for example, can only affect real variables in the short-run but should not have an impact on real variables in the long-run. In this regard, permanent innovations in supply and demand will result in permanent changes in real and nominal exchange rates. Thus, a permanent change in say, the money supply, can have a permanent effect on the nominal exchange rate, but only a temporary effect on the real rate.

Following Kutan and Dibooglu (1998) let x_t contain the logged change in real and nominal exchange rates, hence:

$$\begin{bmatrix} \Delta q_t \\ \Delta s_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} \varepsilon_{qt} \\ \varepsilon_{st} \end{bmatrix} \tag{6}$$

where

$$Var(\varepsilon_t) = \Sigma \tag{7}$$

The fundamental shocks ε_{qt} and ε_{st} are assumed to be orthogonal and therefore, the variance-covariance matrix Σ is diagonal. The BQ framework contains the restriction that real shocks have permanent effects on the level of output while nominal shocks have only temporary effects—implying that the cumulative effect of nominal shocks on the change in output must be zero. Both shocks have permanent effects on the level of nominal rates.

Given the two variable real and nominal effective exchange rates (also denoted by REER, and NEER, respectively) case under consideration, four restrictions are required to define the four elements of C. Two of these restrictions are simple normalizations, which define the variance of the shocks ε_{qt} and ε_{st}. A third restriction comes from assuming that the real and nominal shocks are orthogonal. The final restriction regarding the temporary nature of nominal shocks, uniquely defines the C matrix and implies equation (4) in the structural model. For the reduced form VAR, this means:

$$= \sum_{i=0}^{\infty} \begin{bmatrix} d_{11i} & d_{12i} \\ d_{21i} & d_{22i} \end{bmatrix} \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix} = \begin{bmatrix} .. & 0 \\ .. & .. \end{bmatrix} \tag{8}$$

Intuitively these shocks are, respectively, innovations to the real and nominal exchange rate that are not explained by the dynamics of relative prices and the nominal exchange rate. The identification scheme also allows us to assume that nominal shocks do not have a long-lasting impact on the real effective exchange rate.

An alternative specification—based on the work by Clarida and Gali (1994)—allows the identification of real shocks to be broken up into aggregate supply and demand components, in addition to the nominal shock. The increased complexity of this model also moves the BQ SVAR model closer to more traditional structural exchange rate models, e.g. Obstfeld (1985) stochastic two-country version of the Dornbusch (1976) overshooting model. The model is specified as:

$$\begin{bmatrix} \Delta y_t \\ \Delta q_t \\ \Delta s_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} & a_{13i} \\ a_{21i} & a_{22i} & a_{23i} \\ a_{31i} & a_{32i} & a_{33i} \end{bmatrix} \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{qt} \\ \varepsilon_{st} \end{bmatrix} \tag{9}$$

where the relative vis-à-vis the euro area output variable y_t is added in the model, and in the place of relative price level used by Clarida and Gali (1994), we use the nominal effective exchange rate s_t; the two models should be equivalent, but including the nominal exchange rate allows us to infer directly the impact of the shocks on this variable. The three shocks are again identified through restrictions on the long-run impact matrix. For example, the real exchange rate (IS) and nominal exchange rate (LM) shocks to relative output are restricted to be temporary in nature, while only the aggregate supply (AS) shocks are allowed to have permanent effects. Regarding real effective exchange rates, only AS and IS shocks are allowed to have a permanent impact. Shocks to nominal rates are left completely unrestricted, i.e., all disturbances can have a permanent (i.e., long-run) impact on nominal exchange rates. Given the ordering of relative output, and real and nominal effective exchange rates in the SVAR, a restriction on a long-run multiplier effectively imposes a restriction on the elements of the factor matrix. Thus the (1,2), (1,3), and (2,3) elements of C matrix are set to zero. The lower triangular structure of the factor matrix implies that the structural shocks can be interpreted as underlying supply, demand and nominal shocks, respectively.

Like Clarida and Gali, impulse response dynamics in response to the three structural shocks are examined in order to assess the extent to which identified shocks generate dynamics that are in line with the Mundell-Fleming-Dornbusch model.[19] For example, a relative aggregate supply shock that boosts domestic output relative to foreign output should result in a fall in domestic prices and depreciation in the real exchange rate. While the movement in the nominal exchange rate is uncertain, given the high correlation between nominal and real exchange rates, it is expected that the nominal exchange rate would help to facilitate the real exchange rate response, i.e., the nominal rate would depreciate in response to an aggregate supply shock.

A positive nominal shock which increases domestic money supply or reduces money demand should result in a decrease in domestic relative to foreign interest rates and depreciation in the nominal exchange rate.[20] Of course, the simulative monetary outcome should result in an increase in domestic prices, and a rise in domestic output and a real depreciation if prices are sticky. Finally, a positive demand shock should in the short-run, result in a nominal, and due to sticky prices, real appreciation of the exchange rate as relative output increases. However, as prices increase in the long-run, relative output should return to its old level. If the shock is permanent, the appreciation in the real rate is permanent as well.

Introducing relative interest rates and private sector credit

Consider the 3-variable model including the interest rate differential (R):

[19] In the two variable model, the strong positive correlation among nominal and real effective exchange rates, would indicate the impulse response functions would behave similarly, except of course, for the long-run restriction on nominal shocks to real rates.

[20] Astley and Garratt (1998) note, however, that only real demand shocks have unambiguous effects on nominal exchange rates. The effects of nominal and real shocks are more indeterminate since they have opposite effects on real exchange rates and relative prices.

$$\begin{bmatrix} \Delta y_t \\ \Delta q_t \\ \Delta R_t \\ \Delta s_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} & a_{13i} & a_{14i} \\ a_{21i} & a_{22i} & a_{23i} & a_{24i} \\ a_{31i} & a_{32i} & a_{33i} & a_{34i} \\ a_{41i} & a_{42i} & a_{43i} & a_{44i} \end{bmatrix} \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{qt} \\ \varepsilon_{Rt} \\ \varepsilon_{st} \end{bmatrix} \quad (10)$$

where it is assumed that the nominal exchange has no long-run impact on relative output, the real exchange rate, or the relative interest rate. Alternatively, equation (11) provides

$$\begin{bmatrix} \Delta y_t \\ \Delta q_t \\ \Delta s_t \\ \Delta R_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} & a_{13i} & a_{14i} \\ a_{21i} & a_{22i} & a_{23i} & a_{24i} \\ a_{31i} & a_{32i} & a_{33i} & a_{34i} \\ a_{41i} & a_{42i} & a_{43i} & a_{44i} \end{bmatrix} \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{qt} \\ \varepsilon_{st} \\ \varepsilon_{Rt} \end{bmatrix} \quad (11)$$

a specification which instead implies no long-run impact on the nominal effective exchange rate from changes in the relative interest rate.[21]

It could be argued that in a flexible exchange rate environment, interest rate shocks should have an impact on the exchange rate, particularly in smaller open economies, and hence the first formulation (equation 10) would correspond to these groups of countries with flexible exchange rates during a considerable part of the period. On the other hand, in countries with fixed exchange rates the second formulation (equation 11) might be more relevant, since relative interest rates respond to shocks in the nominal effective exchange rate.

To examine the extent to which credit shocks have influenced exchange rate developments we substitute the interest rate differential with relative credit vis-à-vis the

[21] The addition of relative interest rates also means there are now two real and two nominal shocks identified in the model.

euro area. The credit variable is ranked third in the VAR, before the exchange rate, allowing it have a long-run effect on the nominal effective exchange rate.

APPENDIX B: PRELIMINARY DATA ANALYSIS

Monthly observations on the nominal effective exchange rate and the CPI index for each transition country on a trade-weighted basis relative to their euro area partners have been taken from the International Monetary Fund's INS database. The real exchange rate for each country is defined as the nominal exchange rate divided by the relative price index, all relative to the euro area. A relative output series, defined as the level of industrial production in each accession country minus a trade-weighted average of industrial production in the euro area, was also constructed from IFS database. Table A1 reports the exact dates of the sample periods used in the 2- and 3-variable models.

Table A1. Monthly Data Sample Periods

	Start	End
Cyprus	1988:1	2003:1
Czech Republic	1992:1	2003:2
Estonia	1994:1	2003:2
Hungary	1986:1	2003:2
Lativa	1992:12	2003:1
Lithuania	1993:1	2003:2
Poland	1985:6	2002:12
Slovakia	1990:1	2002:10
Slovenia	1992:1	2003:2

Preliminary data analysis, not presented in detail here but available from the authors upon request, was undertaken on all four variables. Augmented Dickey-Fuller and Philips-Perron tests on the logged data have indicated that stationarity can be rejected for the relative output series y_t, nominal s_t and real exchange rate q_t series and relative price series p_t, however, these tests confirm stationarity of the series in first differenced form. In addition, the Johansen maximum likelihood test for cointegration indicated that the null hypothesis of cointegrating relationships among the two exchange rate series and for the variables in the 3-variable model can be rejected at the 5 or 10 percent level. Thus, the three variables considered are all found to be difference stationary and there is no evidence of cointegration among them. Therefore, we include the logged first differences of real and nominal effective exchange rates in the 2-variable SVAR model, and add the relative output in the 3-variable model. Finally, the results of Granger causality tests on exchange rates, relative output and price series indicated that no clear causal relationships that would require a formal reduced form approach to estimating these relationships. This leads one to believe that the structural decomposition approach applied here is the correct way to proceed. The assumption of nonstationary real exchange rates in transition countries seems reasonable due to evidence of strong real wage and productivity catch up over time (Balassa-Samuelson effects). Thus it is expected that equilibrium real exchange rates should have a permanent stochastic component during the transition process.[22]

Table A2 Exchange Rate Regimes of New E.U. Members

Cyprus	Peg to euro, +/- 15% bands
Czech Republic	Free float
Estonia	Currency board to euro (since 1992)
Hungary	Peg to euro, +/- 15% bands
Lativa	Peg to SDR, with 30% euro weight
Lithuania 1/	Currency board to euro (since 1994)
Poland	Free float
Slovakia	Managed float
Slovenia	Managed float

1/ Repegged from U.S. dollar to euro in February 2002.

Finally, it is important to point out that a variety of exchange rate regimes were in place in the individual countries over the sample set. As the accompanying Table A2 indicates, only two countries currently have fully floating exchange rate regimes, while two others have some degree of a managed floating system. The remaining five countries have various types of hard pegged regimes, with two—Lithuania and Estonia—actually having the ultimate hard peg in the form of currency boards. In the case of Lithuania the litas, which was linked to the dollar through the currency board arrangement since 1994, was re-pegged to the euro as of February 2002; which creates a non-trivial problem of interpreting the results given that all other variables are defined vis-à-vis the euro area, e.g., the effective exchange rates and relative output. Similarly, results for Latvia, which maintains a peg vis-à-vis the SDR, should also be interpreted with some caution given the definition of the other variances relative to the euro area.

[22] See Kutan and Dibooglu (2000) for a discussion.

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