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Preface

The vulnerability against financial crises of EU candidate countries and other Central and East European countries is on the agenda of the Institute for Economic Research Halle. Research concentrates on the developing of effective early warning indicators and includes a strong orientation on quantitative methods.

This volume presents selected methods for the analyse of financial fragility. The finding complete the signals approach, which is used by the IWH for routine checks of the risk potential of EU candidate an other countries of the region. The four studies presented here were written by the scientific staff of the IWH and by guest researchers. Their objective is to deepen insights into selected problems of financial fragility by using alternative methods.

The subject of the first paper is the problem of the equilibrium exchange rate. *David Kemme* and *Saktinil Roy* present an 'eclectic' model, the equilibrium exchange rate being the function of a vector of various macroeconomic fundamentals.

The following two studies deal with the measurement of financial fragility by using a probit model. *Matthias Deschryvere's* analysis is based on a multivariate probit model whereas *Axel Brüggemann* and *Thomas Linne* use a panel probit model. Both approaches have their merits. *Brüggemann's and Linne's* model includes countries which have not previously experienced a financial crisis thereby utilising valuable information on how a crisis can be avoided. *Deschryvere's* approach concentrates solely on crisis countries. The advantage of this country sample is that the results are closer oriented towards the origins of a crisis, but at the detriment that some determinants get a stronger impact than in the panel approach.

The last study, by *Jens Hölscher* and *Matriusz Jarmuzek*, presents a fundamental approach to the equilibrium exchange rate, using optimal trade and current account estimations.

Halle (Saale), April 2003

Hubert Gabrisch
Head of Division Central and Eastern Europe

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I. Introduction

Currency and banking crises during the 1990s in Mexico, Asia and Russia have had disastrous consequences for economic development. Estimates of economic losses range from 4 to 15 per cent of GDP in Mexico (1994/5), Indonesia, Thailand, Korea, Malaysia (1997/8), and Russia (1998/9). Argentina currently faces a similar currency and financial system crisis, the losses of which have not yet been tallied.[1] Several European transition economies have faced similar crises.[2] The Czech Republic experienced a banking crisis in 1996 resulting in the closure of Kreditni Banka, the forced administration of Agrobanka and then the closure of six smaller banks, and a balance of payments crisis in 1997 which led to the abandonment of the fixed exchange rate system leaving the koruna to float. Bulgaria experienced a banking crisis in 1996 that eliminated nearly half of all banks and a balance of payments crisis in 1997, leading to the introduction of the currency board. Hungary experienced a banking crisis in 1993 with bad debts increasing to 18 percent of all loans and a balance of payments crisis in 1994, which led to the introduction of a severe austerity program. Romania experienced a banking crisis in

1 We use balance of payments crisis and currency crisis interchangeably and banking crisis and financial system crisis interchangeably as well even though there are numerous caveats and nuances that make every crisis unique. In the literature the exact criteria employed to define a crisis varies widely.

2 The countries mentioned in this paragraph have faced both balance of payments (or currency) crises and banking or financial system crises. Note that the definition of a crisis and the exact dating and sequencing of many of these crises may be debated. E. g., a balance of payments crisis is typically associated with a devaluation. However, the necessary size of a devaluation that constitutes a crisis is unclear. Similarly, a banking crisis is usually identified with a run on a bank and peaks when the financial authorities offer financial assistance or recapitalization to the banking system. The magnitude and form of assistance varies significantly as policies to resolve crises vary across countries. If the initial response is effective perhaps only a single bank is closed and the event is not a system crisis. If the initial response is ineffective or events are of a larger magnitude, affecting several banks, the system is threatened and a crisis ensues. *Tang, Zoli and Klytchnikova* (2000) provide a detailed taxonomy of banking crises for twelve transition economies for the 1990-1998 period in which crisis refers to ‘extreme financial distress,’ i. e., a large share of non-performing loans, to an actual bank run. They note that the costs of such crises range from 0.1% to 42% of GDP. See also *Frydl* (1999).

1996 with bad debts reaching 57% of lending by the end of 1997 and a balance of payments crisis in 1997 that depreciated the lei by 20% in one week. And, the Russian financial and balance of payments crisis in 1998, which caused the abandonment of the fixed exchange rate system and decreased GDP by about 15%, nearly caused a collapse in the entire global financial system. Other countries, such as Slovakia, Poland and Slovenia have managed relatively well, avoiding these 'twin crises' even during the 1998 Russian crisis when potential spillover effects were quite large.[3]

The desire to join the European Union and the European Monetary System is nearly universal among the transition economy political leadership and populations as a whole. The criteria for membership, however, require convergence of economic performance, such as unemployment and inflation rates, and congruence of macroeconomic policies for attaining these outcomes.[4] Balance of payments and financial system crises raise serious doubts among EU member states as to the readiness of the transition economies, even for the leading candidates.[5] Further, if a candidate country successfully accedes to the European Union, monetary union then requires fixing the exchange rate and later abandoning the domestic currency.[6] The rate at which the currency is pegged is critical. If the domestic currency is overvalued as in the Ostmark – Deutschemark case, domestic industry will not be competitive and be forced into bankruptcy. Similarly if the domestic currency is undervalued then domestic firms producing exportable goods and services will enjoy a competitive advantage to the detriment of other domestic firms and EU member country firms. Thus, it is critical to know whether the real exchange rate, floating or fixed, is approximating the long run equilibrium rate for two reasons: 1) balance of payments or currency crises are less likely, and 2) assuming EU accession and macroeconomic policy congruence, at the time of monetary unification an exchange rate approximating the equilibrium must be ascertained, the currency values fixed and the

3 Poland, like most other Central European countries did face a banking crisis in 1991 and banks were recapitalized in 1993 at a cost estimated to be 2-6% of GDP.

4 Note here the focus is on the economic criteria, focusing on macroeconomic performance issues, and not the political criteria (stable democratic institutions, rule of law, observance of human rights, and respect for and protection of minorities) and obligations of membership (legal and regulatory systems compatible with the *acquis communautaire*, and demonstrated capacity to implement the new laws and regulations).

5 The annual strategy report of the European Commission issued in November 2001 indicates that ten of thirteen candidates may be ready for accession by 2004. These ten are Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. Bulgaria, Romania and Turkey are not considered ready yet. Many observers consider 2004 rather optimistic.

6 For some monetary union may be considered premature, but this chapter of negotiations has been closed for ten of the candidates. Some aspects of the debate are being forced by unilateral actions on the part of certain transition economies. For example, Bulgaria adopted a currency board employing the Deutsche Mark as the base currency with little discussion with the Bundesbank and some policy makers and economic advisers in Poland are discussing unilateral Euroization. Monetary union requires much more stringent economic performance congruence than most EU accession issues.

domestic currency abandoned. In short the exchange rate is the single most important price in an open economy because it affects the price of every traded or tradable good or service, and indirectly the value of every resource that flows into the production of those goods and services.[7] Both policy makers and market participants have a keen interest in the determinants of the equilibrium exchange rate and deviations from it. Further, because of the contagion effects of such crises, United States, Japanese and West European monetary authorities are also concerned since the negative impact upon the global financial system can be ameliorated only with concerted action of Western monetary authorities, as in the 1998 Russian financial crisis.

This paper examines the determinants of the real exchange rate and measures the deviation between the current exchange rate and the long run equilibrium for two transition economies, one relatively stable, Poland, and one crisis prone, Russia. The results indicate that generally well-behaved models with robust and statistically significant coefficient estimates may be estimated for both Poland and Russia. The measures of misalignment indicate periods of under and overvaluation. For Poland the measure s move with changes in monetary policy objectives of the national bank of Poland and for the most recent period provides evidence of potential overvaluation in the recent period that may dampen export growth. Within sample forecasts for Poland are quite good, reflecting the general stability in foreign exchange and financial markets and steadily declining inflation during the sample period. For Russia the measure of misalignment clearly reflects the August 1998 crisis, but significant changes in misalignment do not appear to precede the crisis. Within sample forecasts parallel actual values, but forecast errors are higher than those for Poland. Forecast errors for out-of-sample forecasts with known macro-fundamentals are even higher. Both out-of-sample forecasts for Russia, with known exogenous variables and with naïve forecasts of the exogenous variables, are unable to forecast the 1998 currency and banking crisis. The next two sections of this paper provide a brief survey of exchange rate modeling. Section II presents a brief overview of the notion of an equilibrium exchange rate; Section III presents the econometric methodology employed in this paper to estimate the exchange rate. Empirical results are then presented in section IV and Section V concludes with a summary of the implications.

II. Determinants of the equilibrium real exchange rate and measuring misalignment

There is a wealth of both theoretical and empirical literature on the determinants of exchange rates and balance of payments or currency crises. Levich (1985) provides a de-

7 Even further, if domestic markets are competitive the exchange rate then affects the prices of substitutes for tradable goods and services.

tailed survey of the literature on exchange rate determination, from early purchasing power parity models to portfolio balance models, while Rogoff (1996) focuses on the purchasing power parity approach, and MacDonald and Marsh (1999) review empirical modeling techniques. Clark and MacDonald (1998) discuss and compare methodological issues in the two most prevalent approaches to modeling equilibrium exchange rates in both developing and industrial economies: the fundamental equilibrium exchange rate and the behavioral equilibrium exchange rate. In modeling exchange rate or balance of payments crises, *per se*, Agenor, et al. (1992) provide a review of so called first generation models, in which crises are caused by macroeconomic policy inconsistencies. Eichengreen, et al. (1996) review second-generation models. These models, inspired by the first generation models, focus on the same macroeconomic fundamentals (e. g., inflation differentials, income growth differentials) as in the earlier models, but consider the macroeconomic fundamentals themselves, not just the exchange rate or trade flows, as being sensitive to changes in expectations about the future. Third generation models developed by Krugman (1999) and Aghion, Bachetta and Banerjee (2000, 2001) focus on monetary policy recommendations in a currency crisis.

Only recently, as sufficient data have become available, has attention turned to the same problems for the transition economies. Kemme and Teng (2000) provides a brief review of this literature and examines the determinants of the equilibrium real exchange rate using both purchasing power parity measures and estimates of the real exchange rate as a function of macroeconomic fundamentals in a non-crisis environment for Poland. The results indicate that while there was some degree of misalignment (as defined by the relative difference between the real exchange rate and the estimated long run equilibrium), the misalignment varied over time. Further, it was not as much as some commentators claimed in the early 1990s, and the movement from a fixed, to a managed peg, to a floating exchange rate, reduced both the magnitude and the volatility of the misalignment.[8] While Poland's policy makers have been criticized on a number of fronts they have avoided balance of payments crises and after an early recapitalization of the banking system avoided financial crises as well. Therefore, a closer examination of the Polish case may prove to be a useful comparison for the other crisis prone transition economies. This is considered further in the next section along with a discussion of the methodology employed.

A second strand of research focuses not on estimating the equilibrium exchange rate, but on examining economic variables that may predict an exchange crisis, the 'early warning indicators' or 'signals' approach. These models may be stochastic (typically a probit or logit model), estimating the probability of a large exchange rate change, or

8 Note that misalignment may arise even with a freely floating exchange rate because of differing speeds of adjustment of the prices of money, other assets and goods, as in the *Dornbusch* (1976) model of exchange rate overshooting.

non-stochastic, simply examining changes in variables determined to be leading indicators of currency or banking crises. For example, some variable may be found to be significantly different from its typical value (say, two standard deviations from its mean) just prior to a currency crisis. This variable would be a leading indicator. Kaminsky and Reinhart (1996) developed this approach[9] and Brüggeman and Linne (1999, 2002) apply it to several Central and Eastern European economies. In each case researchers and policy makers are trying to determine the extent to which the prevailing exchange rate differs from the equilibrium rate, or the degree of 'misalignment,' because significant misalignment is associated with currency crises, and, in some cases depending upon the composition of the liabilities of the banking system, bank crises as well.

Regardless of the specific approach in modeling exchange rate determination, to measure misalignment the equilibrium exchange rate must be ascertained. The methodology employed in this paper focuses on the macroeconomic fundamentals that determine the exchange rate, as initially employed in Kemme and Teng (2000). There, rather than assuming a particular year or set of observations to be the long run equilibrium values, the sustainable fundamentals were defined to be the mean values for the period under consideration. This of course remains an empirical question and below we suggest using a trimmed mean of the fundamentals for the long run sustainable values to be used as the benchmark.[10]

III. Measuring exchange rate misalignment and predicting currency crises

Exchange rate misalignment may be considered the difference between the prevailing nominal exchange rate and the long run equilibrium exchange rate. Determining the long run equilibrium exchange rate is a problem economists have examined for nearly a century. The first notions of purchasing power parity exchange rates were developed as early as the 16th century. The basic ideas were developed more fully by Ricardo, Mill and Marshall. The purchasing power paradigm was formalized and forcefully advanced in the post World War I period by Cassel (1921). The basic idea is that a representative bundle of goods should cost the same the world over (or the 'law of one price' or perfect commodity arbitrage holds) and therefore for any two countries the 'purchasing power parity exchange rate' (PPP) between the two currencies is that rate which ensures

9 See *Kaminsky, Lizindo and Reinhart* (1997) for additional details.

10 Many researchers determine that the overall economic performance in a particular year may be deemed a sustainable level of economic performance and is selected as the benchmark for comparison. This choice is often difficult to justify.

the bundle of goods has the same price regardless of currency, i.e. the real purchasing power of currencies is constant over time.[11] This is an intuitively appealing, very powerful notion that makes sense both in terms of logic and economic theory. However, as a practical matter prevailing exchange rates are rarely observed to be PPP exchange rates due to, *inter alia*, differences in representative commodity bundles, transportation costs, tariffs and other barriers to trade, imperfect or incomplete markets and imperfect information. Nonetheless, calculating PPP exchange rates, attempting to correct for those factors that move prevailing rates away from PPP rates, is still employed as a means of forecasting exchange rates and measuring misalignment primarily because no other method works better.[12] As a result many studies begin with PPP estimates as a benchmark for comparison of new techniques or methodologies. However, a major problem is that once PPP exchange rates are calculated they are rarely equal to prevailing nominal or real rates. So, at what point in time should they be considered an equilibrium rate? To answer this other factors must be brought to bear on the analysis.

The long run equilibrium real exchange rate is defined as the rate that, for sustainable values of other real variables such as trade, taxes, capital flows and technology, results in the simultaneous attainment of internal and external equilibrium.[13]

Therefore, knowledge of macroeconomic fundamentals is incorporated into the process of estimating long run equilibrium exchange rates in a variety of ways. While estimating PPP exchange rates typically focuses on trade flows and goods markets, the monetary approach to estimating exchange rates emphasizes the fact that the exchange rate may be considered the relative price of two monies (the domestic money and foreign money). Therefore, changes in the relative magnitudes of foreign and domestic monetary aggregates or inflation differentials, or interest rate differentials are likely to be important determinants of the exchange rate.[14] These models may estimate the exchange rate as part of a larger model using a simultaneous equation estimation technique or employ single equation estimation techniques assuming the exchange rate equation is the reduced form solution of an unspecified simultaneous equation system.[15]

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11 This simple notion is quickly complicated, as we consider relative vs. absolute PPP and further empirical issues. There are numerous survey articles that address these issues, including *Rogoff* (1996).

12 See *MacDonald and Marsh* (1999), chapter 3.

13 For internal equilibrium the non-tradable goods market clears in the current period and is expected to be in equilibrium in the future, whereas for external equilibrium the current account balances (current and future) are compatible with long-run sustainable capital flows.

14 The monetary model has been extended to include other financial assets, the 'portfolio balance' approach, as determinants of the exchange rate. These are very similar in their nature. Usually financial assets are also included in the hybrid exchange rate models that are more comprehensive in nature. See *Neely and Sarno* (2002) for a review of how well monetary models forecast exchange rates.

15 See *Baffes, Elbadawi and O'Connell* (1999, pp. 418-425) for a discussion of the single equation approach.

Finally, the eclectic models typically specify the long run equilibrium exchange rate e_t^{eq} (in logarithms) as a function of a vector of macroeconomic fundamentals:

$$e_t^{eq} = \beta' F_t^p \qquad (1)$$

where F_t^p is the vector of fundamentals and may include any or all of the above variables from the monetary model, variables intended to capture Balassa-Samuelson effects and variables capturing unique transition economy characteristics, and β' is a vector of parameters to be estimated. To calculate the equilibrium exchange rate the model is first estimated in an error correction format:

$$\Delta e_t = \alpha(e_{t-1} - \beta' F_{t-1}) + \sum_{j=1}^{n} \mu_j e_{t-j} + \sum_{j=0}^{n} \Sigma\gamma_j' \Delta F_{t-j} + \omega_t \qquad (2)$$

Here changes in the log of the exchange rate are a function of the difference between the last period exchange rate and the predicted long run value of $\beta' F_{t-1}$, plus short term period to period adjustments to both the previous period exchange rate and the current and previous periods' vector of macro fundamentals, n periods in the past. α, β', μ_j, and γ_j' are parameters to be estimated and ω_t is an error term. The equilibrium exchange rate is then the predicted value from this equation based on a given vector of macroeconomic fundamentals, F_t^p, assumed to be sustainable long run equilibrium values. Then, given the equilibrium exchange rate the misalignment may be calculated as:

$$m_t = e_t^{eq} - e_t \qquad (3)$$

Once the misalignments are calculated we have determined whether the currency is overvalued or undervalued and may make statements about the appropriateness of prevailing monetary and fiscal policies and exchange rate regimes.

IV. Empirical results

Kemme and Teng (2000) estimate equation (2) and calculate misalignments for Poland during the 1991-1999 period using four different measures of the real exchange rate.[16] Here we focus on one measure of the real exchange rate, the nominal rate deflated by the CPI. All data are monthly and are provided by the Economic Research Institute – Halle. We adopt the single equation approach assuming that from a structural model there exists an identifiable reduced form equation as in equation (2). The question of interest then is simply whether or not there is a combination of exogenous variables, a

16 The nominal exchange rate was deflated by the CPI, PPI, an index of wage costs and an index of profitability to obtain a real exchange rate.

change in which would indicate a potential exchange rate crisis.[17] Prior to estimating equation (2) we test for the existence of a cointegrating equation for the logarithm of the exchange rate and the relevant exogenous variables common to most exchange rate models in the literature, the logarithm of currency reserves, the logarithm of capital flight, interest rate differentials, the percentage change in the current account balance and the percentage change in the ratio of the fiscal deficit to industrial output for both Poland and Russia.[18] The results of the trace test for the existence of a cointegrating equation are reported in the Appendix. For Poland the test indicates the existence of four cointegrating equations at the 5% level of significance and at least one at the 1% level of significance for the sample period July 1993 to December 2001, as reported in Table A.1. For Russia there is less evidence of the existence of a cointegrating equation for the entire sample period, January 1995 to December 2001. As indicated in Table A.2 the trace test indicates the existence of one cointegrating vector at the 5% level of significance and none at the 1% level of significance. Similar tests for these variables with and without a deterministic trend and with a quadratic trend, each specification restricted (with a constant term) and unrestricted, yield no evidence of a cointegrating vector for this sample period for Russia. The financial crisis of August 1998 is a clear structural break in the data. For the pre-crisis sample period January 1995 to August 1998, however, the trace test indicates the existence of 4 cointegrating vectors at the 5% level of significance and one at the 1% level of significance.

Given the existence of a cointegrating equation we then estimate equation (2) for the Polish Zloty – US-Dollar exchange rate and the Russian Ruble-US-Dollar exchange rate. Three initial specifications (labeled 1a, 1b, and 1c) were considered for Poland and estimation results are presented in Table 1 along with the final specification (1d). The first column lists the relevant variables with the expected sign of the coefficient in parentheses below the variable name. The first specification, 1a, emphasizes international monetary flows specifying the logarithm of the real exchange rate, LNPLRER, as a function of that variable lagged one period, the logarithm of currency reserves, LOGPLCR, the logarithm of capital fight, LOGPLCF, and the domestic – international interest rate differential, PLIDIF. We expect the coefficient of the logarithm of the

17 If we were interested we could then determine the structural model: i. e., estimate the other reduced form equations with identifying restrictions and solve for the structural coefficients. Here we are interested only in whether any reduced form equation for the exchange rate exists and whether it can be used to forecast exchange rate changes. Thus, the first task is to test for the existence of a cointegrating equation. If one exists we estimate ad hoc specifications examining statistical significance of coefficient estimates, goodness of fit and forecasting properties.

18 Note, we first test for the existence of a unit root for each variable using the Augmented Dickey-Fuller test. All variables are nonstationary except PCPLAX. Although the individual variables may be nonstationary the endogenous variable, the log of the real exchange rate in this case, may be regressed against the others without concern for spurious correlation, if the variables are cointegrated. Thus, we use the Johansen test for cointegration to address this issue.

lagged exchange rate, LNPLRER, to be positive and the coefficient of the logarithm of currency reserves, LOGPLCR, to be negative since an increase in reserves will decrease their price, increasing the value of the domestic currency, therefore decreasing the Zloty-US-Dollar exchange rate. The capital flight variable, LOGPLCF, is a measure of bank deposits of domestic residents held abroad. An immediate increase in capital flight will increase the demand for foreign exchange, reducing the value of the Zloty and increasing the Zloty-US-Dollar exchange rate. However, these deposits may be repatriated and if there is confidence in the domestic economy the expectation of greater repatriation of foreign currency held abroad by domestic residents may bid up the price of the Zloty and thus decrease the Zloty-US-Dollar exchange rate. The expected sign of the coefficient then is ambiguous. Finally, if the differential between the world and domestic interest rate widens financial capital flows abroad increase the demand for foreign exchange and depreciate the Zloty, increasing the Zloty-US-Dollar exchange rate. Thus, we expect the sign of PLIDIF to be positive.[19]

The second and third specifications include real variables. Specification 1b includes the percentage change in the current account balance, PCPLCAX, and specification 1c additionally includes the percentage change in the ratio of the fiscal deficit to industrial output, PCPLHXIOUT. We expect the sign of PCPLCAX to be negative since an increase in the current account balance decreases the demand for foreign exchange and increases the demand for domestic currency, thus decreasing the Zloty-US-Dollar exchange rate. The sign of PCPLHXIOUT is indeterminate. For any given level of output an increase in the fiscal deficit would reduce the relative demand for tradables, imports, because it is assumed most government expenditures are on domestically produced goods and services. The decrease in the demand for imports reduces the demand for foreign exchange and decreases the Zloty-US-Dollar exchange rate. However, the effect of financing the deficit matters. If there is an increase in the money supply and an increase in domestic inflation with no change in domestic interest rates the value of the domestic currency falls, increasing the Zloty-US-Dollar exchange rate. If financing the deficit requires the issuance of bonds and domestic interest rates rise there will be an increase in foreign demand for Zloty and the Zloty-US-Dollar exchange rate will fall, reinforcing the trade balance effects. (This effect may also be captured by the interest rate differential variable). The sign of the coefficient, representing the net effect of the trade balance effect and the financing effects, depends upon the relative magnitudes of these.

For each coefficient estimate p-values are reported in parentheses below the coefficient estimate. The Chow break point test for each of the policy regime changes indicates that although the exchange rate management policies changed, the data structure did not.

19 This holds assuming inflation differentials are unchanged. For Poland this is reasonable, and in fact the inflation differential is narrowing as domestic inflation falls. For Russia, domestic inflation was large and variable complicating the signing of the coefficients, as discussed below.

Three of the coefficients of the variables in specification 1a, emphasizing the monetary flows, are statistically significant, one has the incorrect sign (but is not statistically significant) and the specification suffers from serial correlation, based upon the Breusch-Godfrey test for serial correlation. (The Durbin-Watson statistic is inconclusive for specifications 1a, 1b, and 1c).[20] In specification 1b currency reserves and the interest rate differential are insignificant and in 1c those variables as well as the capital flight variable are insignificant. For both specifications the White test for heteroscedasticity indicates that we must reject the null hypothesis of homoscedasticity. The Breusch-Godfrey test for serial correlation also indicates that we must reject the null hypothesis of no first order autocorrelation. The ARCH test, however, indicates that the structure of the serial correlation and heteroscedasticity is not a simple ARCH process for any of the three specifications.

Given the likely presence of serial correlation and heteroscedastticity, various moving average and autoregressive schemes were tested for specifications emphasizing both monetary and real goods variables and the results converged to specification 1d in Table 1. The best specification is a complex AR(1)-MA (2) process. The coefficients of all variables have the correct sign and are statistically significant and the equation has been corrected for heteroscedasticity and serial correlation. (The Durbin-Watson statistic and the Breusch-Godfrey statistic indicate that we cannot reject the null hypothesis of no autocorrelation. And the White test for heteroscedasticity indicates we cannot reject the null hypothesis of homoscedastisity.) For this specification the actual values of the log of the real exchange rate, the within sample fitted values and the residuals are graphed in Figure 1. This specification is also used to calculate the exchange rate misalignment and graphed in Figure 2. Even though the period of analysis has been extended and the model is slightly different, the pattern of misalignment is similar to that reported earlier in Kemme and Teng (2000). Monetary policy of the National Bank of Poland (NBP) was somewhat erratic through the 1990's.[21] Initially monetary policy focused on maintaining a fixed exchange rate nominal anchor. This was abandoned in 1991with the introduction of a crawling peg in 1991 a further devaluation in 1992 and again in 1993. The crawling peg was maintained until 1995 when a float within a gliding band was introduced. As movement toward a float occurred the NBP began targeting other monetary policy variables. In 1996 it focused on controlling short term interest rates, then domestic credit growth. The plot of misalignment in Figure 2 reflects many of these changes. For example, in 1997 the real exchange rate was undervalued and the NBP shifted monetary policy to targeting the growth rate of the monetary base. The real ex-

20 Also note that the simple Durbin-Watson statistic is biased when there are lagged endogenous variables in the equation.

21 See *Orlowski* (1999), *Orlowski* (2000) pp. 150-151, *Kemme and Teng* (2000) pp. 173-174 and various issues of the NBP Annual Report for further details.

change rate then became overvalued through 1998. The real exchange rate became undervalued and the NBP changed policy to direct inflation targeting and the real exchange rate became overvalued shortly thereafter through 2001.

Table 1:
Parameter Estimates of Real Exchange Rate Model, Poland (1994:02 2001:12)
- Coefficient Estimates (p-value) -

Variable	Specification 1a	Specification 1b	Specification 1c	Specification 1d
C	1.01873	1.081498	1.023590	1.134999
	(0.0009)	(0.0004)	(0.0019)	(0.0)
LNPLRER(-1)	0.881482	0.872393	0.877678	0.849351
(+)	(0.0)	(0.0)	(0.0)	(0.0)
LOG(PLCR)	0.001920	-0.000387	-0.007404	
(-)	(0.8942)	(0.9784)	(0.6973)	
LOG(PLCF)	-0.051436	-0.05	-0.039693	-0.045929
(+/-)	(0.0077)	(0.0072)	(0.1288)	(0.0004)
PLIDIF	0.001272	0.001401	0.001789	0.001678
(+)	(0.1552)	(0.1140)	(0.1134)	(0.0)
PCPLCAX		0.000956	0.000944	0.000989
(+)		(0.0605)	(0.0625)	(0.0290)
PCPLHXIOUT			0.000195	
(+/-)			(0.4808)	
AR(1)				0.710820
				(0.0)
MA(1)				-0.516208
				(0.0)
MA(2)				-0.448674
				(0.0001)
Diagnostic Statistics				
R^2	0.909707	0.913192	0.924294	0.929145
Adj. R^2	0.905738	0.908369	0.918395	0.923444
Root Mean Sqd. Error	0.020483	0.020084	0.019698	0.017704
Durbin Watson	1.433368	1.460371	1.543632	1.940995
F-statistic	229.2075	189.3538	156.6819	162.9799
Prob(F-statistic)	0.0	0.0	0.0	0.0
Breusch-Godfrey statistic(lag)[a]	23.71107(12)	36.65266(23)	8.5662(2)	0.0(1)
Probability(B-G)	0.022261	0.035341	0.013799	1.0
White Statistic[b]	16.61638	30.91764	37.35498	8.220779
Probability(White)	0.277198	0.056287	0.088630	0.877510
ARCH Statistic (lag = 1)[c]	0.090292	0.000149	0.162243	0.460502
Probability(ARCH)	0.763806	0.990271	0.687100	0.497390

[a] H_0: absence of serial correlation. – [b] H_0: absence of heteroscedasticity. – [c] H_0: ARCH is not applicable.

Figure 1:
Poland, Actual and Fitted Real Exchange ‘Rates and Residuals, Specification 1d

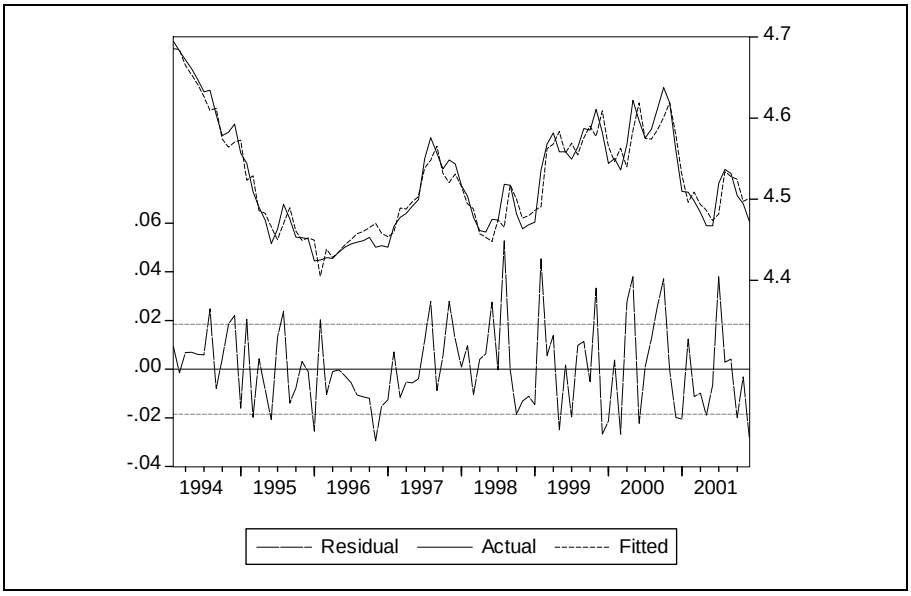
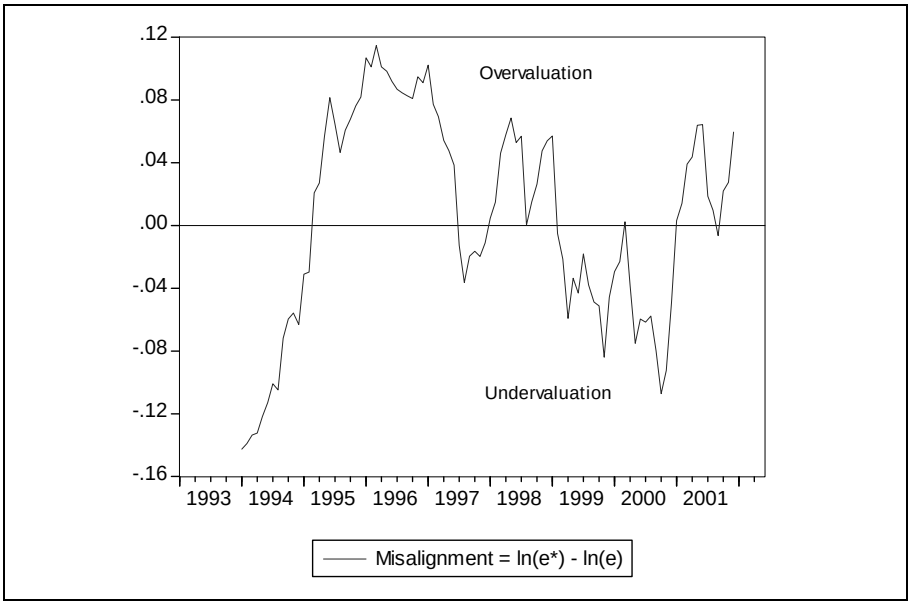


Figure 2:
Poland, PLZ/USD Real Exchange Rate Misalignment, Specification 1d



For Russia a similar set of specifications was estimated for the period January 1995 to December 2001 and the results are reported in Table 2. In addition to the variables used in the models for Poland we included a measure of foreign debt, LOG(RUFD). An increase in foreign debt implies that the domestic supply of foreign exchange is increasing and the Ruble-US-Dollar exchange rate would fall, assuming that the expectations about the ability to repay the debt are favorable. Therefore, the expected sign would be negative. If the expectations about the ability to repay foreign debt are not favorable there would be a flight from Rubles to the US-Dollar, increasing the demand for the US-Dollar and increasing the Ruble US-Dollar exchange rate. If these negative expectations dominate the expected sign for LOG(RUFD) then would be negative.

In each of the specifications, 1a, 1b, and 1c, of Table 2, the Chow break point test indicates a clear structural change at the time of the August 1998 currency and banking crisis. Also for these specifications, the Durbin Watson statistic is inconclusive, but the Breusch-Godfrey statistic indicates there is autocorrelation. The White statistic indicates homoscedasticity. As in the case for Poland, the ARCH test indicates that the structure of the serial correlation and heteroscedasticity is not a simple ARCH process for any of the specifications. Therefore, various autoregressive and moving average formulations are considered. Both the specifications emphasizing monetary flows and the specifications including real goods variables converge to specification 1d, an AR(1) process. All of the variables have the correct sign and are statistically significant at the 10% level or less.

To examine the effects of the financial crisis more closely we first estimated autoregressive, moving average models for only the pre-crisis period, January 1995 to August 1998 as reported in specification 1e, and a simple dummy variable model, with results reported in Table 3. In specification 1e the coefficient estimates are statistically significant at the 5% level or less, but interestingly the signs for LOG(RUDF) and RUDIF change. The estimation results for the entire period yield a negative sign for the foreign debt variable. This would indicate normal expectations about the ability to repay the debt and an increase in foreign debt, making more US-Dollars available, would decrease the Ruble-US-Dollar exchange rate. However, the estimation results for the pre-crisis period alone yield a positive coefficient. This may indicate that expectations concerning the ability to repay the debt were very doubtful and there was potential flight from the Ruble generating incipient pressures to devalue the Ruble. Similarly, the coefficient of the interest rate differential is negative for the pre-crisis period only. The same logic concerning expectations about the incipient pressures against the Ruble may explain the change in sign of this variable as well. Normally, if domestic interest rates increase there would be an increase in the demand for Rubles and the Ruble-US-Dollar exchange rate would fall. However, if there are strong expectations about the potential of devaluation then further increases in domestic interest rates may actually trigger a flight from the Ruble and the Ruble–US-Dollar exchange rate will rise. Thus, the expected sign of the coefficient may

Table 2:
Parameter Estimates of Real Exchange Rate Model, Russia
- Coefficient Estimates (p-value) -

Variable	Specification 1a	Specification 1b	Specification 1c	Specification 1d	Specification 1e
	(1995:01-2001:12)	(1995:01-2001:12)	(1995:01-2001:12)	(1995:01-2001:12)	(1995:01-1998:08)
C	1.473514	1.729717	2.244106	0.692097	-0.481626
	(.3405)	(0.2770)	(0.1973)	(0.0310)	(.4310)
LNRURER(-1)	0 928133	0.920433	0.897226	0.945002	0.678260
(+)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
LOG(RUFD)	-0.053257	-0.068838	-0.070589		0.132906
(-/+)	(.5377)	(.4394)	(.4643)		(0.0017)
LOG(RUCR)	-0.063285	-0.063050	-0.115216	-0.044557	-0.029332
(-)	(0.0847)	(0.0832)	(0.0198)	(0.0790)	(0.0213)
LOG(RUCF)	0.005276	0.013012	0.011301		0.065044
(+/-)	(0.9342)	(0.8461)	(0.8821)		(0.0026)
RUIDIF	0.001047	0.001051	0.001325	0.00088	-0.000700
(+)	(0.0350)	(0.0405)	(0.0236)	(0.0607)	(0.0196)
PCRUCAX		0.002115	0.002273		
(-)		(0.5914)	(0.5916)		
PCRUHXIOUT			0.003846		
(+/-)			(0.3428)		
AR(1)				0.290827	
				(0.0140)	
AR(2)					
AR(3)					0.045636
					(0.7799)
MA(1)					0.782482
					(0.0)
MA(2)					-0.797274
					(0.0)
MA(3)					-0.915066
					(0.0)
Diagnostic Statistics					
R^2	0.963966	0.964179	0.963748	0.966528	0.992904
Adj. R^2	0.961656	0.961352	0.959720	0.964811	0.990843
Root Mean Sqd. Error	0.052323	0.052230	0.055015	0.0504899	0.009134
Durbin Watson	1.410101	1.407540	1.498586	1.966429	1.902502
F-statistic	417.3262	340.9481	239.2598	563.0721	481.9332
Prob(F-statistic)	0.0	0.0	0.0	0.0	0.0
Breusch-Godfrey Statistic (lag)[a]	8.520676(1)	8.797821(1)	5.332940(1)	0.220124(1)	0.534810(1)
Probability(B-G)	0.003511	0.003016	0.020926	0.638946	0.464592
White Statistic[b]	35.23788	38.04696	38.90463	10.07088	28.18516
Probability(White)	0.018873	0.077123	0.298242	0.344778	0.105088
ARCH Statistic (lag=1)[c]	0.009842	0.013592	0.000805	0.006008	0.105901
Probability(ARCH)	0.920975	0.907190	0.977362	0.938216	0.744860

[a] H_0: absence of serial correlation. – [b] H_0: absence of heteroscedasticity. – [c] H_0: ARCH is not applicable.

Table 3:
Parameter Estimates of Real Exchange Rate Model, Russia
- Coefficient Estimates (p-value) -

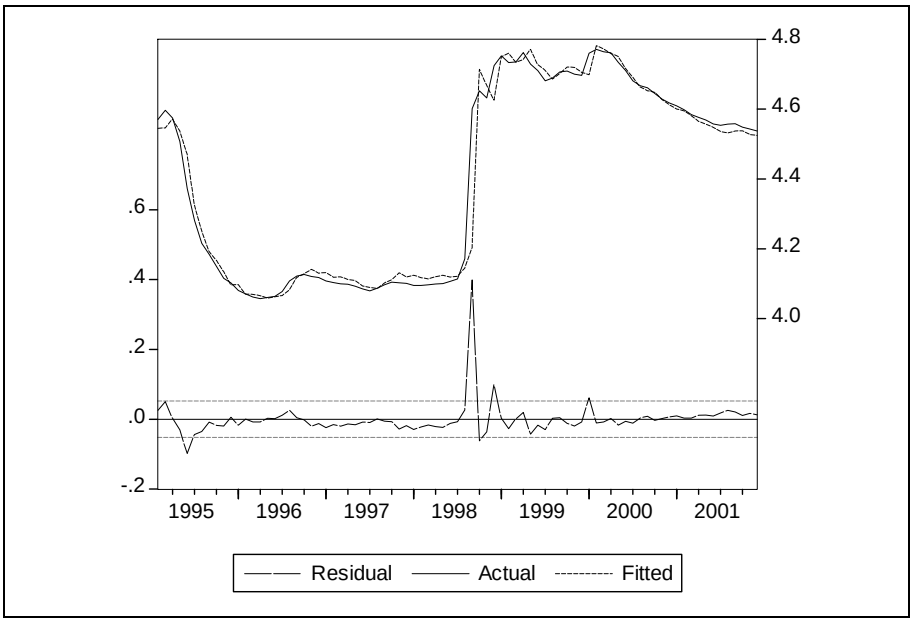
Variable	Specification 2a	Specification 2b	Specification 2c	Specification 2d [EGARCH(4, 9)]
	(1995:01-2001:12)	(1995:01-2001:12)	(1995:01-2001:12)	(1995:01-2001:12)
C	-1.775839	-1.965193	-2.305112	-1.695677
	(0.0414)	(0.0300)	(0.0218)	(0.0002)
DUM	0.327393	0.331024	0.344727	0.274294
	(0.0)	(0.0)	(0.0)	(0.0)
LNRURER(-1)	0.512280	0.509789	0.487194	0.594024
(+)	(0.0)	(0.0)	(0.0)	(0.0)
LOG(RUFD)	0.242566	0.254396	0.260045	0.227751
(-/+)	(0.0)	(0.0)	(0.0)	(0.0)
LOG(RUCR)	-0.120547	-0.117207	-0.116895	-0.100677
(-)	(0.0)	(0.0)	(0.0)	(0.0)
LOG(RUCF)	0.235608	0.239462	0.277458	0.190303
(+/-)	(0.0)	(0.0)	(0.0)	(0.0)
RUIDIF	-0.002611	-0.002686	-0.003008	-0.001943
(+)	(0.0)	(0.0)	(0.0)	(0.0)
PCRUCAX		-0.001864	-0.001926	
(-)		(0.3828)	(0.3970)	
PCRUHXIOUT			0.002422	
(+/-)			(0.2610)	
AR(1)				
AR(2)				0.148078
				(0.0329)
MA(1)				0.595496
				(0.0)
MA(2)				-0.177882
				(0.0057)
Diagnostic Statistics				
R^2	0.989775	0.989841	0.989984	0.990295
Adj. R^2	0.988978	0.988893	0.988691	0.985442
Root Mean Sqd. Error	0.27804	0.027815	0.028918	0.027288
Durbin Watson	1.217607	1.229696	1.283872	2.362050
F-statistic	1242.228	1043.917	765.9982	204.0785
Prob(F-statistic)	0.0	0.0	0.0	0.0
Breusch-Godfrey statistic(lag) [a]	18.1717(6)	18.61913(6)	13.46491	
Probability(B-G[b])	0.006189	0.004858	0.009214	
White Statistic[b]	74.15964	73.12320	66.53810	
Probability(White)	0.000002	0.000111	0.012157	
ARCH statistic(lag)[c]	6.986234(1)	8.038033(2)	9.074473(2)	0.064904(1)
Probability(ARCH)	0.030406	0.017971	0.010703	0.798907

[a] H_0: absence of serial correlation. – [b] H_0: absence of heteroscedasticity. – [c] H_0: ARCH is not applicable.

be negative if this effect dominates. Further, if lowering domestic interest rates, widening the interest rate differential, increases domestic inflation vis-à-vis world inflation, the real exchange rate will fall. This being the case the expected sign would be negative.

The second set of regressions on the entire sample period, but including a binary variable for observations for August 1998 and later, are reported in Table 3.[22] For specifications 2a, 2b and 2c reported in Table 3 the introduction of the dummy variable also introduces heteroscedasticity into the model. Again, as in the specifications without the binary variable, the ARCH test indicates that the structure of the serial correlation and heteroscedasticity is not a simple ARCH process for any of the specifications. Therefore, various autoregressive and moving average formulations were considered and the results converged to 2d, a more complex AR(1)-MA(1) process, which corrects for both heteroscedasticity and autocorrelation.

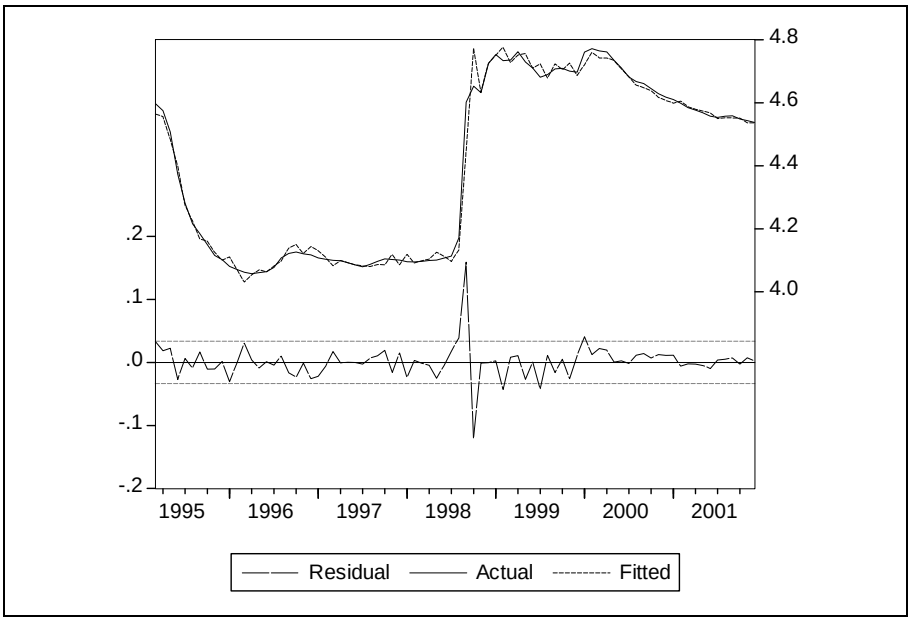
Figure 3:
Russia. Actual and Fitted Real Exchange Rates and Residuals, Specification 1d
- Out of Sample Forecast for 1998:09 to 2001:12 -



22 Several models interacting the binary variable with the other exogenous variables were estimated, but the interaction terms were generally not significant and the overall goodness of fit was less than the models reported in Table 3.

For specifications 1d and 2d of Table 2 and 3 the actual exchange rate, fitted value and residuals are graphed in Figures 3 and 4. In addition, the real exchange rate misalignment, from equation (3), is calculated assuming that the vector of permanent macroeconomic fundamentals in equation (1) is the trimmed mean of each of the exogenous variables included in the relevant empirical specification.[23] The misalignments are graphed in Figures 5 and 6 respectively. The pattern of overvaluation and under valuation is the same for both models. The Ruble was significantly over valued prior to the crisis. How long the overvalued currency could be maintained is unclear, but certainly incipient pressures for devaluing the currency were building. By August 1998 the currency value could not be maintained and policies to manage the crisis resulted in a dramatic decline in the value of the Ruble and then it slowly appreciated in value.[24]

Figure 4:
Russia, Actual and Fitted Real Exchange Rates and Residuals, Specification 2d



23 We calculate the mean and standard deviation for each variable. Each observation for which any variable had a value beyond one standard deviation from the mean was discarded. The mean of each variable based upon the remaining observations is then the vector of permanent macro-fundamentals, F^p.

24 For detailed discussion of the crisis see *Abalkin and Whalley* (1999), *Chapman and Mulino* (2000), *Desai* (2000), *Granville* (2000), *Kemme* (2002), and *Popov* (2000a), (2000b).

Figure 5:
Russia, Real Exchange Rate Misalignment, Specification 1d

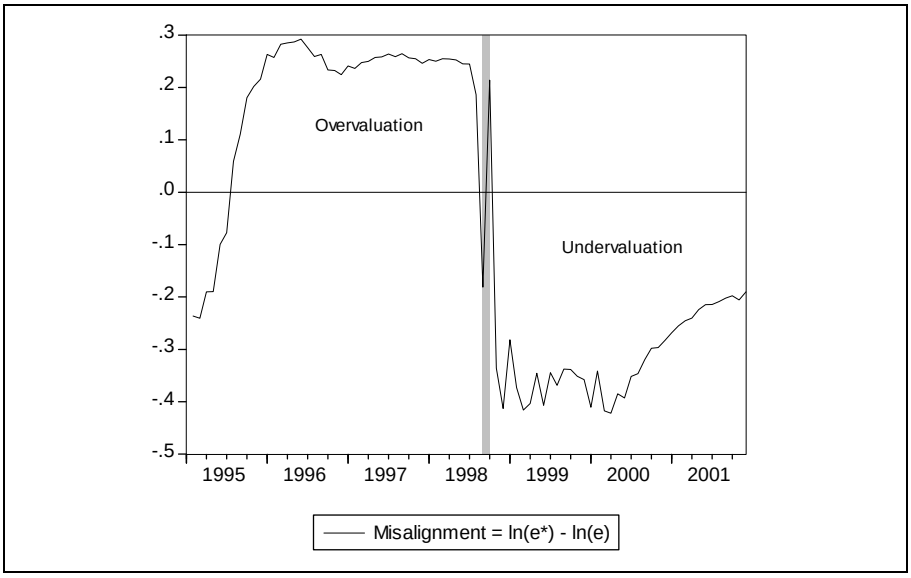
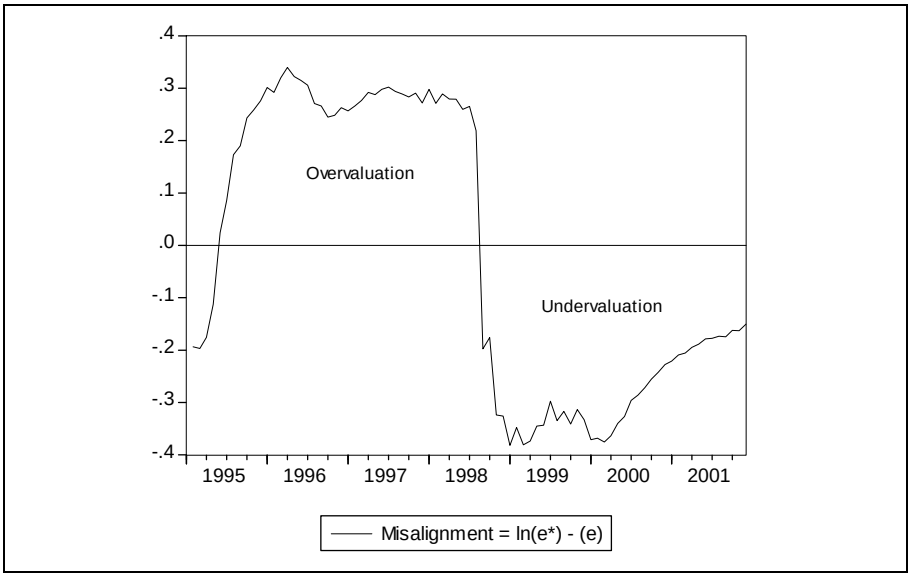
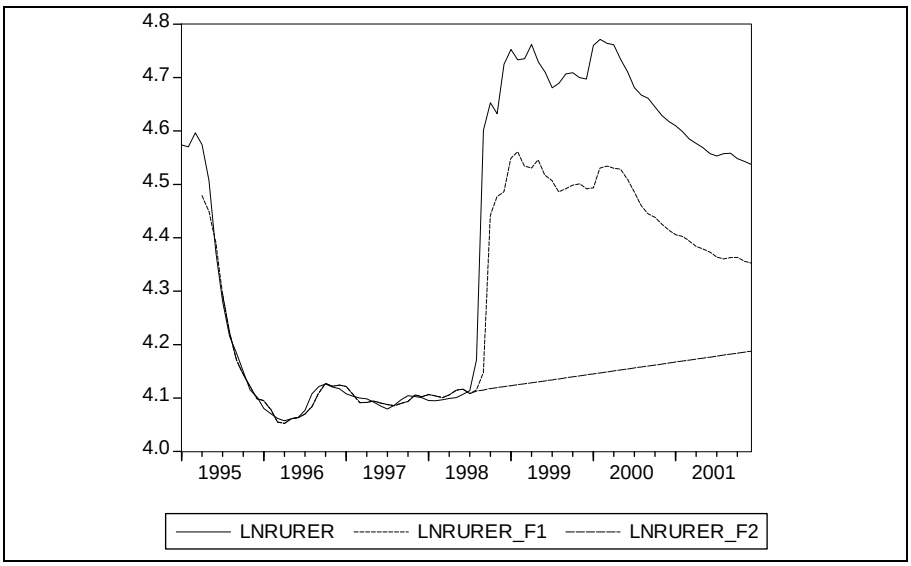


Figure 6:
Russia, Real Exchange Rate Misalgnment, Specification 2d



Now suppose we ask whether or not the models can forecast the 1998 exchange rate crisis. First, two out of sample forecasts are made using the actual data for the explanatory variables for the post-August 1998 period using specification le, the model estimated on only the pre-crisis data, with known exogenous variables for the post-crisis period. This is graphed in Figure 7 as LNRURERF1, along with the actual values of the logarithm of the real exchange rate. These forecasts track the crisis fairly well. However, given that the actual post-crisis values of the exogenous variables are not known, a second forecast is made employing a naïve forecast of the exogenous variables – a simple extrapolation based upon the two year average rate of growth for each of the variables – rather than the actual, but then unknown values. The forecast errors are reported in Tables 4a-4c. For the within sample forecast errors for both Poland and Russia we see that all measures decline as we improve the specification, in Table 4a and 4b. For Russia, the forecast errors are lower for specifications 2a-2d, including the dummy variable breaking the sample into pre- and post-crisis periods, than specifications 1a-1d that do not control for the data break. The lowest within sample forecast errors are for specification 1e, estimated on the precrisis data only. However, using that model to forecast out-of-sample yields significantly higher forecast errors. This forecast, LNRURERF2 is also graphed in Figure 7, and misses the crisis completely. While the models fit the data quite well, none can identify the crisis or forecast for the post-crisis period.

Figure 7:
Russia, Actual and Fitted Real Exchange Rates, Specification 1e
(Out of Sample Forecasts for 1998:09 to 2001:12)



Note: LNRURER_F1 is based upon known exogenous variables. LNRURER_F2 is based upon a naïve forecast of exogenous variables.

Table 4a:
Poland, Within Sample Forecast Errors

	Specification 1a	Specification 1b	Specification 1c	Specification 1d
Root Mean Squared Error	0.020483	0.020084	0.019604	0.017704
Mean Absolute Error	0.015740	0.015458	0.015175	0.013993
Mean Absolute percent Error	0.347145	0.340961	0.334252	0.308921

Table 4b:
Russia, Within Sample Forecast Errors

	Specification 1a	Specification 1b	Specification 1c	Specification 1d	Specification 1e (1995:04-1998:08)
Root Mean Squared Error	0.052195	0.052230	0.045527	0.050489	0.009134
Mean Absolute Error	0.024618	0.024696	0.026614	0.022270	0.006885
Mean Absolute percent Error	0.553088	0.555504	0.614391	0.499896	0.166503

	Specification 2a	Specification 2b	Specification 2c	Specification 2d
Root Mean Squared Error	0.027804	0.027815	0.028918	0.027288
Mean Absolute Error	0.019593	0.019516	0.020459	0.015264
Mean Absolute percent Error	0.443498	0.441430	0.465891	0.343798

Table 4c:
Russia, Out-of-Sample Forecast Errors

	Specification 1e, with known exogenous variables (in sample: 1995:04 – 1998:08) (out of sample: 1998:08 – 2001:12)
Root Mean Squared Error	0.150824
Mean Absolute Error	0.109300
Mean Absolute percent Error	2.3574

Table 4d:
Russia, Out-of-Sample Forecast Errors

	Specification 1e, with naive forecast of exogenous variables (in sample: 1995:04 – 1998:08) (out of sample: 1998:08 – 2001:12)
Root Mean Squared Error	0.368781
Mean Absolute Error	0.265026
Mean Absolute percent Error	5.6842

V. Conclusions

Modeling the exchange rate is a problem of great interest and importance to policy makers. The models estimated in this paper track exchange rate movements quite well for Poland and Russia. Further, in periods of relative stability the measures of misalignment depicted in Figures 5 and 6 may provide guidance to policy makers. For Poland, although there have been exchange rate regime changes, progress toward a floating regime was steady and predictable. Macroeconomic policy, generally deflationary, has also been supportive of exchange rate stability generating relatively small measures of misalignment. In the case of Russia the misalignment measures indicated incipient pressures to devalue prior to August 1998, but alone could not identify when the crisis would occur. Thus, they do not serve as a good forecaster of the crisis, *per se*. With respect to forecasting, the final specifications of the models for both Poland and Russia provide excellent within-sample forecasts. However, out of sample forecasts are problematic. For Russia, the August 1998 crisis was not anticipated at all by the forecasts. Further refinement of the model, e. g., including other more volatile variables, such as measures of foreign portfolio investment, may improve the out of sample forecasting. In addition to including other appropriate variables in the model two other research tasks are worth pursuing. First, given the calculated misalignments what are the sources of the deviation from the long run equilibrium? That is, what macro variables are causing the misalignment and what policies are appropriate to restore equilibrium? And second, for Russia, given the poor performance in out of sample forecasting using the single equation model with naïve forecasts of the exogenous variables would more sophisticated forecasts of exogenous variables be appropriate? That is, a simultaneous equation approach may yield better forecasting results, if data availability provides sufficient degrees of freedom.

References

Abalkin, A. and J. Whalley (1999): The Problem of Capital Flight from Russia. The World Economy, 22: 421-444.

Agenor, Pierre-Richard; Jagdeep S. Bhandari and Robert Flood (1992): Speculative Attacks and Models of Balance of Payments Crises. IMF Staff Papers, 39,2: 357-394.

Aghion, Philippe; Phillippe Bacchetta and Abhijit Banerjee (2000): A Simple Model of Monetary Policy and Currency Crises. European Economic Review, 44,4-6: 728-738.

Aghion, Philippe; Phillippe Bacchetta and Abhijit Banerjee (2001): Currency Crises and Monetary Policy in an Economy with Credit Constraints. European Economic Review, 45,7: 1121-1150.

Arvai, Zofia and Janos Vincze (2000): Models of Financial Crises and the Transition Economy Experience: Financial Crises in Transition Countries: Recent Lessons and Problems yet to Solve, pp. 7-43. Conference Proceedings, Halle Institute for Economic Research. Halle.

Brüggemann, Axel and Thomas Linne (1999): How Good are Leading Indicators for Currency and Banking Crises in Central and Eastern Europe? An Empirical Test. Discussion Papers No. 95, Halle Institute for Economic Research. Halle.

Brüggemann, Axel and Thomas Linne (2002): What were the Driving Factors Behind the Financial Crises in the Central and Eastern European Transition Countries? Results from a Rare Event Logit Analysis. Paper presented at the 71st Annual Conference of the Southern Economic Association. New Orleans, LA 24-27, 2002.

Buchs, Thierry D. (1999): Financial Crisis in the Russian Federation: Are the Russians Learning to Tango? Economics of Transition 7,3: 687-715.

Burnside, A. Craig; Martin Eichenbaum and Sergio Rebelo (2001): On the Fiscal Implications of Twin Crises. Discussion Paper 2918 Centre for Economic Policy Research. London, UK.

Calvo, Guillermo A. and Enriqueu Mendoza (1996): Mexico's Balance of Payments Crisis: A Chronicle of a Death Foretold. Journal of International Economics, 41: 235-283.

Chapman, Shiela A. and Marcella Mulino (2000): Explaining Russia's Currency and Financial Crises. Working paper #59 April 2000.

Chiodo, Abbigail J. and Michael T. Owayang (2002): A Case Study of a Currency Crisis: The Russian Default of 1998. Federal Reserve Bank of St. Louis Review, 84,6: 7-18.

Clark, Peter B. and Ronald MacDonald (1998): Exchange Rates and Economic Fundamentals: A Methodological Comparison of BEERs and FEERs. IMF Working Paper WP/98/67, May 1998. IMF Washington, DC.

Cole, Harold L. and Timothy J. Kehoe (1996): A Self-fulfilling Model of Mexico's 1994-1995 Debt Crisis. Journal of International Economics, 41: 309-330.

Coricelli, Fabrizio and Bostjan Jazbec (2001): Real Exchange Rate Dynamics in Transition Economies. CEPR Discussion Paper No. 2869. Centre for Economic Policy Research. London, UK.

De Broeck, Mark and Torsten Slok (2001): Interpreting Real Exchange Rate Movements in Transition Economies. IMF Working Paper WP/01/56, May 2001 IMF Washington, DC.

Desai, Padma (2000): Why did the Ruble Collapse in August 1998? American Economic Review 90,2: 48-52.

Devereux, Michael B. and Philip R. Lane (2001): Exchange Rates and Monetary Policy in Emerging Market Economies. CEPR Discussion Paper No. 2874 Centre for Economic Policy Research. London, UK.

Dooley, Michael (1996): The Tobin Tax: Good Theory, Weak Evidence, Questionable Policy, in ul Haq, M. I. Kaul and I Grunberg (eds.), The Tobin Tax: Coping with Financial Volatility. Oxford University Press, New York, pp. 83-108.

Dooley, Michael (2000): A Model of Crises in Emerging Markets. The Economic Journal, 110: 256-272.

Flood, Robert P. and Nancy P. Marion (2000): Self-fulfilling risk predictions: an Application to Speculative Attacks. Journal of International Economics 50: 245-268.

Forbes, Kristin J. (2001): Are Trade Linkages Important Determinants of Country Vulnerability to Crises? NBER Working Paper 8194. National Bureau of Economic Research. Cambridge, MA.

Fratzscher, Marcel (2000): What Causes Currency Crises: Sunspots, Contagion or Fundamentals? Financial Crises in Transition Countries: Recent Lessons and Problems yet to Solve. Conference Proceedings. Halle Institute for Economic Research. Halle, pp. 44-76.

Fratzscher, Marcel (1998): Why are Currency Crises Contagious? A Comparison of the Latin American Crisis of 1994-1995 and the Asian Crisis of 1997-1998. Weltwirtschaftliches Archiv. 134,4: 664-691.

Gandolfo, G. et al. (1990): Exchange Rate Determination: Single Equation or Economy Wide Models. Journal of Money Banking and Finance, 14,5: 993-1021.

Gorton, Gary and Andrew Winton (1998): Banking in Transition Economies: Does Efficiency Require Instability? Journal of Money, Credit and Banking 30,3: 622-650.

Granville, Brigitte (2000): Moral Hazard and Burden-sharing: The 1998 Russian Debacle as a Turning Point, in: Granville, Brigitte (Ed.), Essays on the World Economy

and its Financial System. The Royal Institute of International Affairs. London, UK, pp. 196-217.

Jeanne, Olivier (1997): Are Currency Crises Self-fulfilling? A Test. Journal of International Economics, 43: 263-286.

Kaminksy, Graciela and Carmen Reinhart (1998): Financial Crises in Asia and Latin America: Then and Now. American Economic Review, 88: 444-448.

Kaminksy, Graciela and Carmen Reinhart (1999): The Twin Crises: The Causes of Banking and Balance of Payments Problems. American Economic Review, 89,3: 473-500.

Kaminksy, Graciela; Carmen Reinhart; *Saul Lizondo and Carmen Reinhart* (1977): Leading Indicators of Currency Crises. IMF Working Paper No. 79. IMF, Washington, DC.

Kemme, David M. (2002): Russian Financial Transition: The Development of Institutions and Markets for Growth, in Russia's Uncertain Economic Future. Compendium of Papers submitted to the Joint Economic Committee of the U.S. Congress of the United States. USGPO, Washington, DC., 2001, pp. 183-212.

Kemme, David M. and Wenyuan Teng (2000): Determinants of the Real Exchange Rate, Misalignment and Implications for Growth in Poland. Economic Systems, 24,2: 171-205.

Krugman, Paul (1979): A Model of Balance of Payments Crises. Journal of Money Credit and Banking, 11: 311-325.

Krugman, Paul (1999): Balance Sheets, the Transfer Problem, and Financial Crises. International Tax and Public Finance, 6,4: 459-472.

Neely, Christopher J. and Luciano Sarno (2002): How well do Monetary Fundamentals Forecast Exchange Rates? Federal Reserve Bank of St. Louis Review, 84,5: 51-74.

Nuti, Domenico Mario (2000): The Polish Zloty, 1990-1999: Success and Underperformance. American Economic Review, 90,2: 53-58.

Obstfeld, Maurice (1986): Rational and Self-Fulfilling Balance of Payments Crises. American Economic Review, 76: 72-81.

Orlowski, Lucjan (2001): From Direct Inflation Targeting to the Euro-peg. A Model of Monetary Convergence for Transition Economies. Economic Systems 25,3: 223-251.

Orlowski, Lucjan (2000): Monetary Policy Regimes and Real Exchange Rates in Central Europes Transition Economies. Economic Systems 24,2: 145-166.

Popov, Vladimir (2000a): Exchange Rate Policy after the Currency Crisis: Walking the Tightrope. Memo No. 174, Program on New Approaches to Russian Security,

Policy Memo Series. http://www.fas.harvard.edu/~ponars/POLICY%20MEMOS/Popov174.html.

Popov, Vladimir (2000b): The Currency Crisis in Russia in a Wider Context. C.D. Howe Institute Commentary, No. 138, March 2000 (http://www.cdhowe.org/eng/-PUB/frame.html.

Rich, G. (1990): Exchange-rate Management under Floating Exchange Rates. Journal of Banking and Finance, 14,5: 993-1021.

Sachs, Jeffery D.; *Aaron Tornell and Andres Velasco* (1996): Financial Crises in Emerging Markets: The Lessons from 1995. Brookings Papers on Economic Activity :147-198.

Sarno, Lucio and Mark P. Taylor (2001): Purchasing Power Parity and the Real Exchange Rate. Discussion Paper No. 2913. Centre for Economic Policy Research. London, UK.

Stein, J. L. (1990): The Real Exchange Rate. Journal of Banking and Finance, 14,5: 993-1021.

Appendix

Table A.1
Poland: Unrestricted Cointegration Rank Test
Sample(adjusted): 1993:07 2001:12; Included observations: 102 after adjusting endpoints
Trend assumption: Linear deterministic trend
Series: LNPLRER LNPLCR LNPLCF PCPLCAX
Lags interval (in first differences): 1 to 4

Hypothesized		Trace	5 percent	1 percent
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Critical Value
None	0.250951	63.92176	47.21	54.46
At most 1	0.164925	34.44880	29.68	35.65
At most 2	0.097737	19.44140	15.41	20.04
At most 3	0.026271	6.044967	3.76	6.65

Trace test indicates 4 cointegrating equation(s) at the 5% level. – Trace test indicates 1 cointegrating equation at the 1% level.

Table A.2
Russia: Unrestricted Cointegration Rank Test
Sample: 1995:01 2001:12; Included observations: 84
Trend assumption: Linear deterministic trend
Series: LNRUCF LNRUCR LNRUFD LNRURER
Lags interval (in first differences): 1 to 4

Hypothesized		Trace	5 percent	1 percent
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Critical Value
None	0.246560	49.79609	47.21	54.46
At most 1	0.164925	26.01516	29.68	35.65
At most 2	0.097737	10.87555	15.41	20.04
At most 3	0.026271	2.236266	3.76	6.65

Trace test indicates 1 cointegrating eqation(s) at the 5% level. – Trace test indicates no cointegration at the 1% level.

Table A.3
Russia: Unrestricted Cointegration Rank Test
Sample: 1995:01 1998:08; Included observations: 44
Trend assumption: Linear deterministic trend
Series: LNRUCF LNRUCR LNRUFD LNRURER
Lags interval (in first differences): 1 to 4

Hypothesized		Trace	5 percent	1 percent
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Critical Value
None	0.552744	70.50256	47.21	54.46
At most 1	0.321615	35.09913	29.68	35.65
At most 2	0.276277	18.02537	15.41	20.04
At most 3	0.082700	3.798103	3.76	6.65

Trace test indicates 4 cointegrating equation(s) at the 5% level. – Trace test indicates 1 cointegrating equation at the 1% level.

What was driving the financial crises in the Central and Eastern European transition countries? Results from a probit analysis

Axel Brüggemann and Thomas Linne

I. Introduction

The increased frequency of severe financial crises – i. e. the more or less contemporaneous occurrence of both a currency and a banking crisis – in the last years has lead to an intensified research effort into the underlying factors and causes driving the build-up of economic distress and subsequently the outbreak of a financial crises. Much of the research has centered on the emerging economies in Asia and Latin America. Important work in this area was done by the IMF, who developed a probit approach to assess the vulnerability of different countries to financial crises. This paper builds upon this work and attempts to fil the gap on the origins of crises in the emerging markets in Central and Eastern Europe. Our focus is to highlight the causes of financial crises in several of the Central and Eastern European candidate countries to the EU as well as in Turkey and Russia, two important countries of the region who have lived through severe crises recently. To this end we use the results obtained by the IMF as a baseline and examine whether currency crises in Central and Eastern Europe were caused by the same factors as identified in the IMF Model for the crises in Asia and Latin America. Our results show us, that not all of the variables that were of importance in these crises, were also significant when applied to our country sample. Thus in a second step we analyze which variables did drive the crises in Central and Eastern Europe. In order to extract the maximum of information from the tested variables, the analysis comprises both crises countries and countries which have not experienced a financial crisis so far. In accordance with the literature we find that an overvalued exchange rate is an important determinant of a financial crisis, especially if this accompanied by a current account deficit. No evidence was found for the hypothesis that elections have an influence on the timing of a crises or that financial crises are anticipated by credit ratings awarded to the different countries.

The rest of the paper is structured as follows. The next section provides a brief surveys on previous studies on the origins of currency crises. In section four we describe the tested variables of our model. Section five outlines the estimation method and the data. The empirical results are presented in section six. The final section draws some conclu-

sions and outlines a few policy options for the transition countries in the wake of accession to the European Union.

II. Survey of the literature

Numerous currency crises in the second half of 1990s in various parts of the world have stimulated the economic research into the origins of these crises. The mostly found definition of a currency crisis in the literature is a very substantial depreciation of the nominal exchange rate. The economic theory on the causes of currency crises can be devided into three generations of models – named according to the chronological development of the theory.

In the first-generation models (Krugman 1979) the currency crisis is a consequence of economic policies which have become inconsistent with the fixed exchange rate. Driving force in this type of model is an expansionary monetary policy which often roots in a monetisation of fiscal deficits. With an unchanged money demand this will result in inflationary pressure. The real appreciation leads to a current account deficit and diminishing reserves. Ultimately, the abanonding of the peg is inevitable.

The second-generation models originate in the work of Flood and Garber (1984) and Obstfeld (1986). Central to these models is the element of self-fullfilling expectations and the existence of multiple equilibria. A currency can be subject to speculative attacks even if the macroeconomic fundmentals appear to be sound. In case of a speculative attack a country raises the interest rate to defend the fixed exchange rate. But the ensuing costs, for instance, in terms of higher unemployment, may outweigh the advantages of maintaining the fixed exchange rate. In this instance, it is optimal for the country to abandon the peg although it wishes to maintain it.

Third-generation models emphasise the interaction between a banking crisis and a currency crisis (Kaminsky and Reinhart 1996; Kaminsky 1998). The key variables responsible for the interaction are excessive short term debt and domestic credit by banks which reflect the overlending and overborrowing behaviour of banks (McKinnon and Pill 1997). This is often accompanied by a currency and maturity mismatch. The causal relationship between a banking and a currency crisis can run both ways but in practise a banking crisis is more often preceded by a currency crisis than the other way round. Large open foreign exchange position of the banks make them vulnerable to currency depreciations. If the depreciation is large enough the bank's liabilities can easily exceed the assets and force the bank into bankruptcy.

On the empirical level of research on currency crises two different strands of research have emerged: The first strand goes back Kaminsky and Reinhart (1996). Its basic idea

is to find some sort of anomolous behaviour in the time series of various macroeconomic variables prior to the outbreak of a crisis. By defining a threshold for each variable it is possible to distinguish between a normal and a signaling behaviour of a variable. The number of signals are summarised in a composite indicator and the level of the indicator then determines the level of vulnerability of a country for a crisis. Examples of this type of model include Kaminsky, Lizondo and Reinhart (1998) and Goldstein, Kaminsky and Reinhart (2000).

The second strand of research tries to capture the causes of crises in terms of probability by using a logit or probit type of model. One of the first studies was done by Eichengreen, Rose and Wyplosz (1996) who use data from 1959 through 1993 for industrial countries to characterize common causes of many currency crises. The analysis by Frankel and Rose (1996) was motivated by the Mexico crisis in 1994. They examine a panel of 105 developing countries from 1971 through 1992. While Radelet and Sachs (1998) do a cross-country analysis of 20 countries for the year 1995 to examine how strongly these countries were affected by the Mexico crisis. The probit type model plays an important role in country risk analysis of the IMF. The model goes under the name DCSD model (*Developing Country Studies Division Model*). The model is extensively described in Berg et al. (1999) and Berg and Patillo (1999a, b, c). The model is targeted towards the forecasting of speculative attacks. The crisis definition is derived from the Exchange Market Pressure Index (EMP), which is a weighted sum of changes in reserves, changes in interest rates, and changes of the nominal exchange rate. Our model resembles that of Berg and Patillo (1999b).

Common to both strands of empirical research is the finding that falling foreign exchange reserves and an appreciation of the real exchange rate precipate most financial crises and are therefore good indicators for upcoming speculative attacks.

III. Exchange rate policy

At the beginning of the transformation process several transformation introduced a fixed or predetermined exchange rate system (see Figure 1). The exchange rate anchor provided an effective device for guiding a disinflation programme and for establishing macroeconomic stability. However, inflationary persistence in the presence of a fixed – or predetermined – nominal exchange rate has resulted in a real exchange rate appreciation in several countries which was not matched equally by productivity gains. Consequently, the real appreciation has resulted in a decline in exports' competitiveness and in ongoing current account deficits (Table 1).

During the period 1996 through 2000 all countries in our sample except Russia have experienced an appreciation of the real exchange rate against the Euro (see Figure 2).

The appreciation was the strongest with more than 30% for Latvia, Romania and Turkey. Since September 1998 the Russian Rouble appreciated by almost 25%. The Hungarian Forint experienced the lowest appreciation – in appreciated by only 13% over the observation period due to the crawling peg exchange rate regime.

At the same time, the Czech Republic (December 1995), Hungary (May 1996), Poland (July 1996), and the Slovak Republic (October 2000) have already become members of the OECD. With the membership the countries had to open their capital accounts by accepting the *OECD Codes of Liberalisation of Capital Movements and Current Invisible Operations.* Although the opening of the capital account is generally beneficial for the countries as it enables a better allocation of capital, it exposed them also to the risk of a sudden and massive reversal of capital flows.

IV. Estimation methodology and data

We use a panel regression model of the main determinants of financial crises using monthly data for nine Central and East European transition countries and Turkey. The estimated model is of the following form:

$$Pr(\text{crisis}_{it}) = Pr(y_{it} = 1 \mid x_t, \beta_t) = F(x_t, \beta_t)$$

where x_t is a set of explanatory variables and β_t is a vector of parameters to be estimated. The observed variable y_{it} behaves according to $y_{it} = 1$ if a crisis occurs and $y_{it} = 0$ otherwise. The criterion for a crisis to be met is that the nominal exchange rate depreciated by at least 20% within five trading days.[25] In such a case the corresponging month was declared a crisis month.

The country sample is devided equally between crisis and non-crisis countries. The sample period runs from January 1996 through December 2000. During this period we identified five episodes of financial crises, namely: in Bulgaria in January 1997, in the Czech Republic in May 1997, in Romania in February 1999, in Russia in August 1998, and in Turkey in November 2000. The non-crisis countries are: Estland, Hungary, Latvia, Poland, and the Slovak Republic. The latter countries were included in the sample as the behaviour of the analysed varaibles in non-crisis countries yields further meaningful information. The exclusive analysis of crisis countries would on the other hand

25 Another commonly used indicator in the literature to determine the timing of a crisis is the Emerging Market Pressure Index (EMP) developed by *Eichengreen, Rose and Wyplosz* (1996). The EMP index takes a weighted sum of changes in the currency reserves, the interest rates, and the nominal exchange rate. As soon as the EMP index deviates by a certain measure from its mean, a crisis is called. All crises we are considering in this paper pass the EMP test.

only give a distorted view of the variable behaviour which needs to be balanced by the inclusion of non-crisis countries.

In order to achieve comparability with the previous studies on this topic our definition of the variables follows the those adopted in Berg and Patillo (1999a, 1999b). We differ in one important aspect though; unlike Berg and Patillo we define the real exchange rate of the local currencies against the Euro rather than the US-Dollar. This follows from the geographical proximity of the Central and East European countries to the European Union, means that the Euro as a means of payment in trade is much more important than the US-Dollar for these countries.

Since data for GDP and the Current Account balance are only available on a quarterly basis, the monthly data are generated by linear interpolation. All variables enter in percentile form, that is the original data are converted into percentiles of the distribution of that variable for that country over the sample period.[26]

To sum up, our analysis of the determinants of currency crises in the CEE countries is done in two steps. The baseline for our analysis is the model the IMF uses to assess the vulnerability of economies to financial crises. The basic idea is to see whether the driving factors for crises in Central and Eastern Europe are different from those identified by the IMF for the crises in Asia and Latin America in the past twenty years. In a second step, we construct an alternative probit model. Initially, we start out with a large number of possible determinants of financial crises, which are described in the next section. Subsequently, we reduce the number of variables using a general-to-specific methodology whereby all variables that prove to be statistically insignificant are dropped from the model.

V. Explanatory variables

The tested variables comprise a wide range of macroeconomic and financial variables. The choice of tested variables is based on considerations of the theoretical and empirical literature on currency and banking crises. We generally did not employ proxy varaibles to model certain aspects that could also be of relevance, e. g. to account for structural distortions in the banking sectors, which is given due to state ownership in the banking sector as well as lax supervision and weak regulation. We also did not attempt to capture contagion effects. Although contagion was important following the Russian crisis in August 1998, we believe that all crises in Central and Eastern Europe were essen-

26 For the advantages of this transformation see *Berg and Patillo* (1999b).

tially home made and were triggered mostly by domestic events and developments. The list of explanatory variables is as follows:

Ratio of the Balance of the Current Account to GDP – Although emerging market economies can be expected to experience some persistent productivity growth and terms-of-trade improvements because of the Balassa-Samuelson-effect it may not be sufficient to finance a rising current account deficit for a longer period of time. Ultimately, the current account deficit may become to be judged unsustainable by the market participants (Corsetti, Pesenti and Roubini 1998).

Growth rate of Currency Reserves – Diminishing currency reserves limit a country's ability to defend its currency, which makes a devaluation of the currency or the abandoning of the peg in case of a speculative attack more likely. Conversely, the higher a country's international liquidity, the better the cushion to defend a speculative attack against the currency (Feldstein 1999).

Growth rate of GDP – Currency crises are often preceded by a recession. In general, an economy is more vulnerable to a crisis when economic growth slows down (Hardy and Pazarbasioglu 1998).

Growth rate of Exports – Reduced exports inhibit a country's ability to earn foreign exchange to finance an existing current account deficit. Thus, falling exports add to the crisis potential. Additionally, it is an indicator for decreasing competitiveness and possible problems of domestic enterprises (Radelet and Sachs 1998).

Overvaluation of the Real Exchange Rate – Usually, a currency crisis is closely linked to an overvalued real exchange rate. A persistently overvalued currency has adverse effects on exports, growth prospects, and ultimately, a country's ability to service its debt. The variable is defined as the negative deviation of the real exchange rate from the long term linear trend (Kaminsky, Lizondo and Reinhart 1998).

Ratio of the Budget Deficit to GDP – This indicator corresponds to the classic Krugman-type explanation for a currency crisis. A large budget deficit is a typical source of a country's vulnerability for a crisis and signals an unsustainable economic policy. A steady rise of the budget deficit can be expected before the eruption of a crisis as the higher deficit will impair the government's willingness to service its debt (Krugman 1979).

Ratio of the Bank Deposits to GDP – When a banking crisis is looming, domestic residents, who are usually better informed than foreigner, slowly loose faith in the stability of the banking sector and begin to withdraw their savings. Therefore, a drop in bank deposits can be expected before a crisis (Demirgüc-Kunt and Detragiache 1999).

Growth Rate of Domestic Credit – In the time leading up to a crisis a rapid credit expansion can usually be observed. The main reason for this stylised fact lies in lending booms that typically follow financial deregulation and the dismantling of capital controls. This may create balance sheet problems for the banks in form of non-performing loans (Mishkin 1997).

Ratio of Short-term Foreign Debt to Currency Reserves – Following financial liberalisation, massive inflows of foreign capital can create macroeconomic imbalances that ultimately prove unsustainable. The opening of the capital account creates certain incentives for domestic banks which are characterised as an 'over-borrowing syndrome', whereby the riskiness of borrowing from abroad to finance the current account deficit is systematically underestimated by the banks (McKinnon and Pill 1997).

Exchange Rate Regime – A rigid exchange rate rystem increases the risk of a strong real appreciation of the currency because of the inflation differential towards the anchor currency countries. For the analysis the prevailing exchange rate systems are devided into three categories: fixed, semi-flexibel, and flexible exchange rate systems (see Figure 1) and assigned numbers from 1 to 3 respectively (Chang and Velasco 1998).

Credit Rating – Sovereign credit ratings play an important role in determining the terms and conditions with which a country can borrow on the international capital markets. In this sense sovereign credit ratings are often interpreted as an indicator capturing the likelihood of a country's default. Data for the sovereign credit ratings are taken from Standard & Poors (2001) (see Table 2).

Presidential/Parliamentary Elections – Quite often the timing of a crisis is closely linked to the event of a Presidential or Parliamentary election. With a nationwide election coming up, the incumbant government has strong incentives to surpress the outbreak of a crisis as it would reduce their chances of getting re-elected (Dornbusch 2001). A necessary corrective devaluation will be postponed. In the end, the crisis happens shortly after the election, not before. In order to take this phenomenon into account a *1* is assigned for the twelve months following an election, otherwise it is *Zero* (see Table 3).

VI. Empirical results

The results of the estimation are presented in Table 4. The signs of the coefficients of the IMF model coincide with what we generally expect from economic theory although the coefficients of currency reserves to GDP ratio and short term foreign debt are not statistically significant. Higher current account deficit, lower export growth, lower currency reserves, and higher short term foreign debt raise the odds of a crisis. Overall, the

fit of the IMF model to the emerging markets in Central and Eastern Europe is not as good as claimed by the IMF for the countries in Asia and Latin America.

In our model the coefficients of all variables are statistically significant and have the expected signs. In contrast to the IMF model, the ratio of fiscal deficit to GDP does play a role prior to speculative attackes while short term foreign debt is less important. The ratio of fiscal deficit to GDP is negatively and robustly associated with the risk of a currency crisis. Therefore, countries in Central and Eastern Europe with a larger deficit face a higher risk of crisis. Common to both models is that an overvalued real exchange rate is most strongly associated with a financial crisis. The positive sign of the coefficient of the interaction term between the current account balance and the real exchange rate shows that if a current account deficit is accompanied by an overvalued exchange rate, then the probability of a crisis is increased. This is also in line with the findings of Corsetti, Pesenti and Roubini (1998) for some Asian and Latin American countries.

Concerning the variables which were not incorporated into the final model two results stand out: First, we fail to find evidence for the hypothesis that sovereign ratings anticipate banking and currency crises. This result is consistent with the findings of Goldstein, Kaminsky and Reinhart (2000) for the Asian crises in Summer 1997. And second, Dornbusch's hypothesis (Dornbusch 2001) that parliamentary election play an important role in the timing of a crisis has to be rejected for the Central and East European countries.

VII. Conclusions

In this paper we tested a wide range of variables, which have previously been found significant for the outbreak of crises in Asian and Latin American countries. The aim was to see whether they also prove to be influential in causing financial crises in Central and Eastern Europe. Overall, our results support the strong empirical evidence in the literature that explains financial crises by focusing on the behaviour of a small number of macroeconomic variables. However, the important role played by short-term foreign debt taken up by commercial banks in the build up of the crisis potential seems to have been special to the Asian countries. Except for this factor, the other determinants of a crises in the CEE countries are similar to the driving factors for crises in Asian and Latin America. In this respect, the CEE transition are already akin to other emerging markets in various parts of the world. Ironically, this seems also to be part of the catching up process. Fiscal deficits appear to play an important role in triggering speculative attacks. This provides empirical support for the first generation models in the currency crisis literature. Whereas empirical evidence for the *overborrowing syndrome* of banks could not be found.

The recommendations for economic policy based on our empirical findings are twofold:

1. Watch out for the fiscal deficit. If fiscal surpluses are out reach, for instance, because of the public expenditures to finance investments required to fullfil EU-obligations prior to EU-accession, it is all the more important to maintain an adequate deficit level. A relatively high fiscal deficit could easily tilt the market sentiment against the domestic currency.

2. The exchange rate policy is the key to avoid a financial crisis. Against the background of persistent current account deficits in the Central and East European transformation countries and the importance of overvalued exchange rates as a driving force in the build up of crisis potential, the EU-accession countries are well advised to make their exchange rate systems more flexible. This would avoid an excessively high real appreciation of the real exchange rate. At the same time it would maintain the competitiveness of domestic enterprises on international markets and the export earnings would enable the central bank to keep an adequate level of foreign exchange reserves. However, introducing more flexibility into the exchange rate system of the Central and Eastern European countries and maintaining it for a sufficiently long time seems to be a daunting task as the new EU member states have to peg eventually the exchange rate irrevocably to the Euro. Therefore, it is all the more important that the EU-accession candidates pick the right exchange rate when entering the exchange rate mechanism of the European Monetary Union (ERM-II) and begin to reduce their current account deficits like Hungary and Poland have done so since 1999.

References

Berg, Andrew; Eduardo Borensztein; Gian Maria Milesi-Ferretti and Catherine Patillo (1999): Anticipating Balance of Payments Crises: The Role of Early Warning Systems. IMF Occassional Paper No. 186. Washington, DC.

Berg, Andrew and Catherine Pattillo (1999a): Are Currency Crises Predictable? A Test. IMF Staff Papers, Vol. 46(2), pp. 107-138.

Berg, Andrew and Catherine Pattillo (1999b): Predicting Currency Crises: The indicators approach and an alternative. Journal of International Money and Finance, vol. 18(4), pp. 561-586.

Berg, Andrew and Catherine Pattillo (1999c): What caused the Asian Crises: An Early Warning Approach. Economic Notes, Vol. 28(3), pp. 285-334.

Chang, Roberto and Andrés Velasco (1998): Financial Fragility and the Exchange Rate Regime. NBER Working Paper No. W6469. Cambridge, MA.

Corsetti, Giancarlo; Paolo Pesenti and Nouriel Roubini (1998): What Caused the Asian Currency and Financial Crisis? Part I: A Macroeconomic Overview. NBER Working Paper No. 6833. Cambridge, MA.

Demirgüc-Kunt, Asli and Enrica Detragiache (1999): Monitoring Banking Sector Fragility – A Multivariate Logit Approach. IMF Working Paper No. 147. Washington, DC.

Dornbusch, Rudiger (2001): A Primer on Emerging Market Crises. Cambridge, MA: MIT, mimeo, http://web.mit.edu/rudi/www/media/PDFs/crisesprimer.pdf.

Eichengreen, Barry; Andrew K. Rose and Charles Wyplosz (1996): Contagious Currency Crises: first tests. Scandinavian Journal of Economics, Vol. 98(4), pp. 463-484.

Feldstein, Martin (1999): Self-Protection for Emerging Market Economies. NBER Working Paper No. 6907. Cambridge, MA.

Flood, Robert P. and Peter M. Garber (1984): Collapsing Exchange-Rate Regimes: Some Linear Examples. Journal of International Economics, Vol. 17(1), pp. 1-13.

Frankel, Jeffrey A. and Andrew K. Rose (1996): Currency Crashes in Emerging Markets: An Empirical Treatment. Board of Governors of the Federal Reserve System. International Finance Discussion Paper No. 534. Washington, DC.

Goldstein, Morris; Graciela L. Kaminsky and Carmen M. Reinhart (2000): Assessing Financial Vulnerability: An Early Warning System for Emerging Markets. Institute for International Economics. Washington, DC.

Hardy, Daniel C. and Ceyla Pazarbasioglu (1998): Leading Indicators of Banking crises: Was Asia different? IMF Working Paper 98/91. Washington, DC.

Kaminsky, Graciela L. (1998): Currency and Banking Crises: The Early Warnings of Distress. Board of Governors of the Federal Reserve System. International Finance Discussion Paper No. 629. Washington, DC.

Kaminsky, Graciela L. and Carmen L. Reinhart (1996): The Twin Crises: The Causes of Banking and Balance-of-Payments Problems. Board of Governors of the Federal Reserve System. International Finance Discussion Paper No. 544. Washington, DC.

Kaminsky, Graciela L.; Saul Lizondo and Carmen M. Reinhart (1998): Leading Indicators of Currency Crisis. IMF Staff Papers, vol. 45(1), pp. 1-48.

Krugman, Paul (1979): A Model of Balance-of-Payments Crises. Journal of Money, Credit and Banking, vol. 11(3), pp. 311-325.

MacKinnon, Ronald I. and Huw Pill (1997): Credible Economic Liberalizations and Overborrowing. American Economic Review, Papers and Proceedings, Vol. 87(2), pp. 189-193.

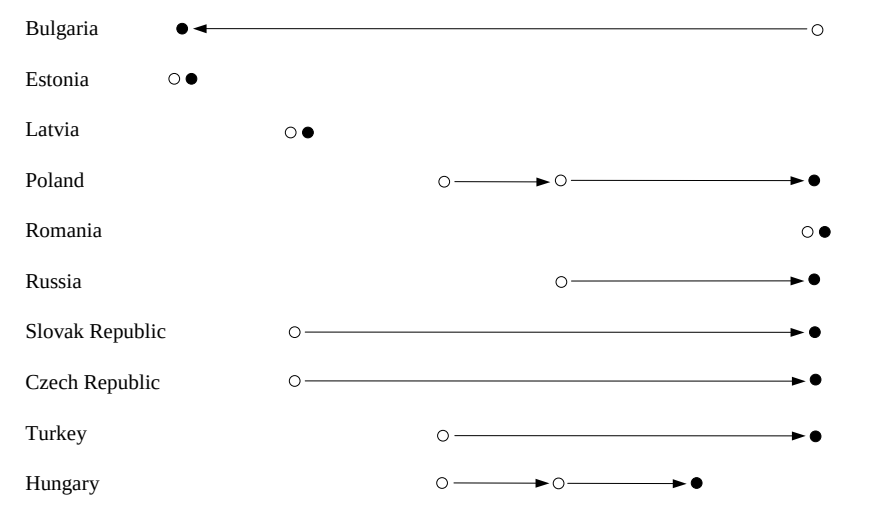
Mishkin, Frederic S. (1997): The Causes and Propagation of Financial Instability: Lessons for Policymakers, in: Federal Reserve Bank of Kansas-City (ed.), Maintaining financial stability in a global economy, pp. 55-96

Obstfeld, Maurice (1986): Rational and Self-Fulfilling Balance-of-Payments Crises. American Economic Review, Vol. 76(1), pp. 72-81.

Radelet, Steven C. and Jeffrey D. Sachs (1998): The East Asian Financial Crisis: Diagnosis, Remedies, Prospects. Brookings Papers on Economic Activity, Vol. 28(1), pp. 1-74.

Appendix

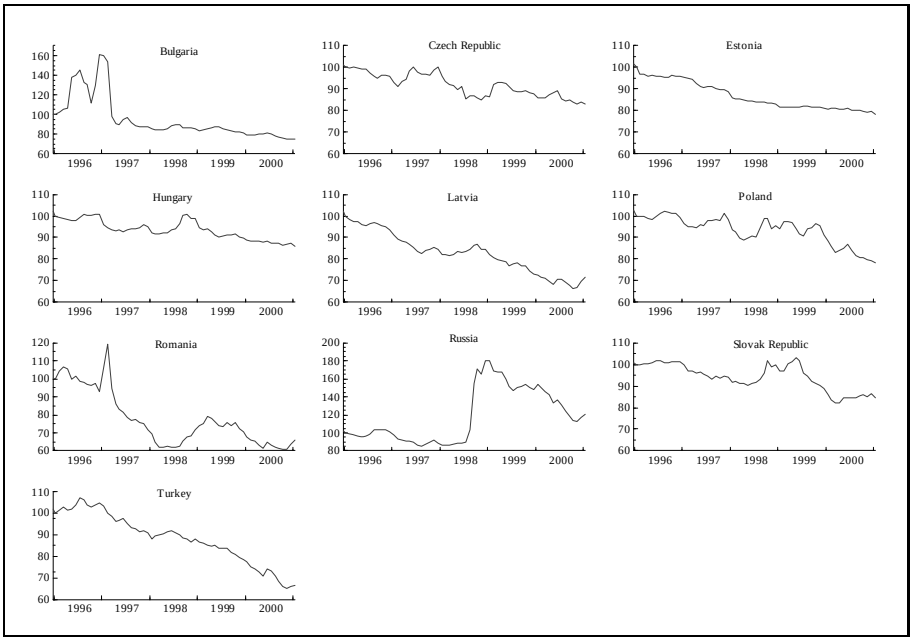
Figure 1:
Overview of Exchange Rate Systems in Selected Countries in Central and Eastern Europe



Note: ○ Exchange Rate System prior to the last change.
● Exchange Rate System in October 2001.

Sources: Central Bank Reports; EBRD Transition Report, variour issues.

Figure 2:
Monthly Real Exchange Rates vs the Euro
- January 1996 = 100 -



Note: The real exchange rate is calculated using consumer prices. An upward movement of the real exchange rate represents a depreciation and accordingly, a downward movement represents an appreciation.

Source: WIIW-Database and own calculations.

Table 1:
Ratio of Current Account Balance to GDP
- in percent -

	1996	1997	1998	1999	2000
Bulgaria	0.2	4.2	-3.1	-5.5	-5.8
Czech Republic	-7.6	-6.3	-1.9	-2.9	-4.5
Estonia	-9.1	-12.0	-9.2	-4.8	-6.4
Hungary	-3.7	-2.1	-4.8	-4.3	-3.3
Latvia	-5.5	-6.2	-11.1	-9.7	-6.9
Poland	-1.0	-3.0	-4.3	-7.5	-6.3
Romania	-7.3	-6.1	-7.9	-3.7	-3.7
Russia	2.8	0.7	0.4	12.9	18.5
Slovak Republic	-11.2	-7.0	-10.1	-5.0	-3.7
Turkey	-1.4	-1.4	1.0	-0.7	-4.8

Source: WIIW-Database; for Turkey, Central Bank of the Republic of Turkey, http://www.tcmb.gov.tr.

Table 2:
Overview of Sovereign Credit Ratings of Selected Central and Eastern European Countries

Country	Date	Foreign Currency Rating Long Term/ Outlook
Bulgaria	May 10, 2000	B+/Positive
	Nov. 23, 1998	B/Positive
Czech Republic	Nov. 5, 1998	A-/Stable
	Nov. 7, 1995	A/Stable
Estonia	Dec. 21, 2000	BBB+/Positive
	Dec. 11, 1997	BBB+/Stable
Hungary	Dec. 19, 2000	A-/Stable
	Feb. 2, 2000	BBB+/Positive
	Dec. 11, 1998	BBB/Positive
	Jan. 22, 1998	BBB-/Positive
	Oct. 28, 1996	BBB-/Stable
	Jan. 31, 1996	BB+/Stable
Latvia	Jan. 16, 1997	BBB/Stable
Poland	May 15, 2000	BBB+/Stable
	June 10, 1999	BBB/Positive
	June 3, 1997	BBB-/Positive
	April 10, 1996	BBB-/Stable
Romania	Aug 4, 2000	B-/Stable
	Oct. 19, 1998	B-/Negative
	May 20, 1998	B+/Stable
	Jan. 23, 1998	BB-/CW-Neg
	March 6, 1996	BB-/Stable
Russia	Dec. 8, 2000	B-/Stable
	July 27, 2000	B-/Stable
	Feb. 15, 2000	CCC+/Positive
	May 7, 1999	CCC/Stable
	Sept. 16, 1998	CCC-/Negative
	Aug. 17, 1998	CCC/Negative
	Aug. 13, 1998	B-/Negative
	June 9, 1998	B+/Stable
	May 27, 1998	BB-/CW-Neg.
	Dec. 19, 1997	BB-/Negative
	Oct. 4, 1996	BB-/Stable
Slovak Republic	Nov. 9, 2000	BB+/Positive
	Nov. 12, 1999	BB+/Stable
	Sept. 17, 1998	BB+/Negative
	April 7, 1998	BBB-/Negative
	April 11, 1996	BBB-/Stable
Turkey	December 5, 2000	B+/Stable
	April 25, 2000	B+/Positive
	Dec. 10, 1999	B/Positive
	Jan. 21, 1999	B/Stable
	Aug. 10, 1998	B/Positive
	Dec. 13, 1996	B/Stable
	July 17, 1996	B+

Source: Standard & Poors, Sovereign Ratings History Since 1975, http://www.standardandpoors.com/europe/francais/Fr_action-notes/LISTE_Sovereign_Since_1975.html.

Table 3:
Overview of Nationwide Elections in Selected Central and Eastern European Countries

Country	Parliamentary Elections	Presidential Elections
Bulgaria	Apr. 19, 1997	Oct. 27/Nov. 3, 1996
Czech Republic	May 31/June 1, 1996	
	June 19/20, 1998	
	Nov. 13/14, 1998	
Estonia	Mar. 7, 1999	
Hungary	May 10/24, 1998	May 10/24, 1998
Latvia	Oct. 3, 1998	
Poland	Sep. 21, 1997	Oct. 8, 2000
Romania	Nov. 3, 1996	
	Nov. 26, 2000	
Russia	Dec. 19, 1999	June 16/July 3, 1996
		Mar. 3, 2000
Slovak Republic	Sep. 25/26, 1998	May 15/29, 1999
		Nov. 11, 2000 (Referendum)
Turkey	Apr. 18, 1999	

Source: International Foundation for Election Systems (IFES); http://www.ifes.org/eguide/elecguide.htm; Political Studies Association (PSA); http://www.psa.ac.uk/www/election.htm.

Table 5:
Panel Estimation of the Probit Model

Independent Variable	IMF Model (i) Coefficient (z-statistics)	Final Model (ii) Coefficient (z-statistics)
Current Account / GDP	-0.00946	-0.03391
	(-2.825)	(-4.966)
Currency Reserves / GDP	-0.00669	-0.00587
	(-1.419)	(-2.316)
Overvaluation of Real Exchange Rate	-0.02659	-0.05798
	(-6.289)	(-6.605)
Growth of Exports	-0.01295	-0.01536
	(-3.134)	(-3.228)
Growth of short-term Foreign Debt	0.00564	-0.01512
	(1.349)	(-3.837)
Budget Deficit / GDP		
Current Account × REXR		0.00063
		(4.269)
Number of Observations:	597	597

Determinants of financial crises: an application of a probit model on the EU candidate countries

Matthias Deschryvere

I. Introduction

Several of the EU (EMU)-candidate countries have had recent experiences with financial crises.[27] Although the crisis literature has grown immensely since the Asian crises of the previous decade, there has been a lack in diversified crisis research that focused on the Central- and East-European countries. This paper wants to make a complementary contribution to the empirical research of the financial vulnerability of those candidate countries.

In the count-down period towards the EU (EMU)-accession it is important to keep on evaluating the financial and macro-economic stability of the EU-candidates in order to prevent financial distress. In this paper we will try to trace those essential determinants of financial crises that should be followed closely by policy makers by asking three specific questions: (1) How can we empirically detect the determinants of financial crises, and are there different methods for that? (2) What are the determinants of financial crises in the candidate countries and do they differ of those in existing analyses? (3) Which variables should be evaluated very carefully, and what are the policy implications of our results?

II. How can we empirically detect the determinants of financial crises?

In the literature we can find several quantitative methods to analyse the importance of different potential determinants of financial crises. Methods that have been used to ana-

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27 This article is based on the results of my thesis research 'Determinants of financial crises: an application on the EU candidate countries (Central- and East-European Countries)'. The empirical part of this thesis was carried out at the Halle Institute for Economic Research (IWH) in the summer of 2002. The author is grateful to Dr. Toker Doganoglu, Thomas Linne, Dr. Hubert Gabrisch and to Prof. Dr. Rudi Vander Vennet for usefull comments. Matthias Deschryvere took his degree in Economics at the University of Ghent, Belgium. At the moment he is a Ph.D. candidate in quantitative economics at the University of Kiel, Germany. Please address editorial correspondence to: Matthias Deschryvere, Department of Economics, University of Kiel, Wilhelm-Seelig-Platz 1, 24098 Kiel, Germany. E-Mail: Deschryvere@bwl.uni-kiel.de.

lyse determinants of financial crises run from parametric and non-parametric tests over event studies, the signals approach, logit and probit analysis, cross-country regression to VAR analysis. We will briefly describe the application of two important methods, the signals approach and the probit (or logit) analysis.

The signals approach of Kaminsky et al. (1998) has been applied to the EU candidate countries by Brüggemann and Linne (2001) and is an example of a non-parametric method. It has to be stressed that this method has mainly a uni-variate character. Kaminsky (1998) elaborated this method by constructing a composite indicator which consisted of a combination of different signal variables that are weighted by the inverse of the so-called Noise-to-Signal ratio. In a next step, Brüggemann and Linne applied this elaborated method on the candidate countries. Although this composite indicator is multivariate, the correlation between the different variables is not taken into account. A logical next step is to apply a second methodology which is multivariate and which takes into account the correlation between the independent variables.

One group of empirical studies that does take into account the correlation between independent variables use pooled panel data and discrete choice techniques. Thereby economic and financial data are used to explain discrete crisis events in a group of countries. Eichengreen et al. (1995) use a probit-model with quarterly data from 1959 till 1993 for industrialized countries. A crisis is called if the so-called *Emerging Market Pressure* index (EMP), which is a weighted sum of (i) the relative change of the bilateral exchange rate against the US-Dollar, (ii) the change in reserves, and (iii) the change in interest rates, increases by more than 25%. Frankel and Rose (1996) use a probit-model with annual data from 1971 till 1992 for developing countries. A crisis is called if the depreciation of the bilateral exchange rate against the US-Dollar is greater than 25% in a given period and at least 10% greater than the depreciation of the year before.

An important advantage of the logit- and probit-approach is that this type of models treats the significance of all variables at once. This makes it easy to control for the explanatory power of new variables. Another advantage is that the results of such models can easily be interpreted as the probability of a crisis. A disadvantage is that the contribution of a certain variable is more difficult to identify because the result depends on the variables used.

Like Berg and Pattillo (1999), who apply a probit-model on the same crisis definition as Kaminsky et al. (1998), we want to estimate a probit-model on the base of the data and crisis definition used by Brüggemann and Linne (2001).

III. What are the determinants of financial crises in the candidate countries?

3.1 The model and data

We estimate the probability of a financial crisis based on monthly data. We use a multivariate probit model that uses important determinants of financial crises. The estimated model is of the form:

$$prob(crisis) = P(y = 1|x\beta) = G(x\beta) \equiv p(x) \qquad (1)$$

We assume $0<G(x\beta)<1$, thus the values for p(x) are in the unit interval. To guarantee this, normally the function *G* is a cumulative distribution function. The early warning phase is 18 months. The observations in the turbulent periods are not dropped from the sample. The independent variable gets the value 1 in the early warning phase and 0 in all other cases.

In the analysis a simple crisis definition is used that concentrates on currency crises. We define a crisis as a nominal exchange rate depreciation of at least 20% within 5 trading days. In this case the corresponding month is defined as a crisis month (turbulent period).

The country sample is composed of the following countries: Bulgaria, Czech Republic, Romania, Russia, and Turkey. The sample period runs from January 1996 to December 2001. Based on our crisis definition we could identify five financial crises during this period, namely: in Bulgaria in January 1997, in Czech Republic in May 1997, in Romania in February 1999, in Russia in August 1998, and in Turkey in November 2000. We stress that the analysis differs here from the existing ones which use a larger number of countries and crisis periods in their sample. To minimize this disadvantage, we included the – for us relevant – two extra crisis countries Russia and Turkey.

We use the dataset of Brüggemann and Linne.[28] With this dataset, we can make a comparison with previous studies while their definition of variables is based on the one of Berg and Patillo (1999). An important difference is that the real exchange rate is not defined with respect to the US-Dollar but rather against the Euro. This follows from the geographical proximity of the Central and East European countries to the European Union. For the Central and Eastern European countries the Euro is more important as a means of payment in trade than the US-Dollar.

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28 *Halle Institute for Economic Research* (IWH)-database.

To obtain monthly data on the current account balance and the GDP the quarterly data were linearly interpolated. A simple linear interpolation can be seen inferior in comparison with a Kalman filter but has often been used in empirical crisis research (Berg and Patillo 1999). The current account balance / GDP variable uses a ratio of the moving average of the current account balance (over 4 periods) on a moving average (over 4 periods) of the GDP.

Like Brüggemann and Linne (2002b) we make our analysis of determinants of financial crises in the EU candidate countries in two steps.

The base of our analysis is a probit-model which the IMF uses to assess a country's vulnerability to a financial crisis. This model plays an important role in the country risk analysis of the IMF and is called the *Developing Country Studies Model* (DCSM). The model is extensively described in Berg et al. (1999). The model was constructed to predict speculative attacks. The crisis definition is based on the on the *Exchange Market Pressure Index* (EMP index).

Our model uses a different crisis definition than the original IMF model. Because the same independent variables are used in our model we refer to the IMF model as the *basic model*. This way we can test if the determinants of the crises in the candidate countries differ from those that were identified by the IMF for the crises in Asia and Latin America in the last two decades.

In a second step we construct an alternative probit-model. Initially, we start out with a large number of possible determinants of financial crises, which are listed in the next section. Subsequently, we reduce the number of variables using a general-to-specific methodology (see Hendry 1995) whereby all variables that prove to have the wrong sign are dropped from the model. After this we only keep the statistically significant (10% level) variables in the model. During the selection of relevant independent variables we also test for the correlation between the different variables. Finally we get our final model with robust independent variables that have the right sign and are statistically significant. We use a general-to-specific methodology because it enables us to (i) test a group of different potentially important variables and (ii) to get a final model which is economically and statistically robust.

3.2 Explanatory Variables

The variables that we test are chosen from a wide range of macroeconomic and financial variables. The choice of these variables is based on the theoretical and empirical

crisis literature and on the data availability.[29] There were no proxy variables used that could show relevant structural changes in the banking sector. In addition, we do not use variables that take into account possible contagion effects. Following is a list of relevant independent variables that have been tested:

- Current account balance as a percentage of GDP.
- International reserves as a percentage of GDP.
- Growth of real GDP.
- Growth of export.
- Overvaluation of the real exchange rate. This variable is defined as a negative deviation of the real exchange rate of its long-term linear trend.
- Budget balance as a percentage of GDP.
- Bank deposits as percentage of GDP.
- Domestic credit as a percentage of GDP.
- Growth of the short-term foreign debt.
- Foreign short-term debt as a percentage of international reserves.
- A variable that captures the event of presidential or parliamentary elections. In some cases the timing of a crisis is closely connected with the event of presidential or parliamentary elections. With upcoming national elections, the government has strong incentives to postpone the eruption of a crisis as to secure re-election. A necessary devaluation will than be postponed. Finally, the crisis will occur after the election and not before. The 12 months after the election this dummy is assigned a 1 and in all other cases a zero. In appendix 1 we give a summary of all national elections in ten candidate countries and Russia and Turkey.
- A variable that captures credit ratings. Sovereign credit ratings are important to set the conditions at which a country can borrow on the international capital markets. In this sense they are often interpreted as an indicator that measures the probability of the default of a country. The data for the sovereign credit ratings are taken from Standard & Poor's (2001). In appendix 2 we give an overview of the sovereign credit ratings for ten EU-candidate countries and Russia and Turkey.

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29 For a description of importance and the relevance of the explanatory variables we also refer to *Brüggemann and Linne* (2002b).

- Growth of the ratio of M2 to M0.
- An interaction term between the current account balance and the budget balance. The use of this variable is based on the fact that if a deficit on the current account balance goes together with a budget deficit, the probability of a crisis increases. We also tested another interaction term between the current account balance and the real exchange rate. A combination of a deficit on the current account balance and an overvalued real exchange rate increases the probability of a crisis (Corsetti et al., 1998).

3.3 Empirical Results

Table 1 shows the results of the probit-regression, estimated for the period January 1996 to December 2001. How to interpret the coefficients β_j ? If β_j is continuous and the function G ($0<G(x\beta)<1$) is a cumulative distribution function, then:

$$\frac{\partial P(y=1|x)}{\partial x_j} = \frac{\partial p(x)}{\partial x_j} = g(x\beta)\beta_j, \qquad where\ g(z) \equiv \frac{dG}{dz}(z)$$

Therefore, the partial effect of x_j on p(x) depends on x through g ($x\beta$). Thus the partial effect depends on other exogeneous variables which also influence the probability (in the OLS case , $\frac{\partial y}{\partial x_j} = \beta_j$ thus the partial effect does not depend on the other exogenous variables). Knowing the sign of β_j is enough to determine whether the exogeneous variable has a positive or a negative effect on the probability, in the continuous case g($x\beta$) is positive in any case, thus β_j determines the sign. But to find the magnitude of the effect, we have to estimate the last expressions. And for this we have to estimate values for the x_j, because we must compute $g(x\hat{\beta})$ at interesting values of x. But what is interesting? Often the sample averages of the x_j's are plugged in to get $g(\bar{x}\hat{\beta})$. This factor can than be used to adjust each of the $\hat{\beta}_j$ to obtain the effect of a one-unit increase in x_j. These effects are called marginal effects. Only these effects can be interpreted as known from the OLS model (Christensen, 2002, p. 8 f). In the left column we show the results for the variables of the basic-model while the right column lists the results of our final model.

The coefficients of the variables of the basic model are all significant. The signs of the coefficients of the basic model are in line with the general *a priori* expectations based on economic theory. A higher current account deficit (as a percentage of GDP), lower export growth, lower currency reserves (as a percentage of GDP), and a higher growth of the short-term foreign debt are contributing to a higher probability of a crisis. In general, the results of our basic model for the EU candidate countries are in line with the results of the IMF model for the Asiatic and Latin American countries.

In our final model we included all the statistically significant variables that also had the *a priori* expected sign. In contrast to the IMF-model, in our model the budget balance (as a percentage of GDP) was important in the onset of a speculative attack. The budget balance (as a percentage of GDP) has a negative sign and has the largest statistical impact on the conditional probability of a crisis. Therefore, the candidate countries with a higher budget deficit are running a higher risk of experiencing a crisis. Also the ratio of domestic credit to GDP is statistically significant and has the right sign. Both models underline the importance of an overvalued real exchange rate.

Concerning the variables that were not included in the final model we can make some interesting notations. Primarily, we do not find empirical evidence for the hypothesis that banking crises and currency crises are preceded by a downgrading of sovereign credit ratings. This finding is in line with the results of Goldstein et al. (2000) for the Asian crisis in the summer of 1997. Secondly, the hypothesis of Dornbusch (Dornbusch 2001) that parliamentary elections play an important role in the timing of a crisis has to be rejected for the candidate countries.

Table 1:
Probit-estimations of the probability of a financial crisis

	Basic model (1)		Final model (2)	
Independent variabele	Coefficient	z-statistics	Coefficient	z-statistics
Constant	-0.578	-2.45**	-2.236	-6.12***
Current account balance / GDP	-0.017	-3.24**	-0.023	-3.99***
International reserves / GDP	-0.034	-2.72**	-0.104	-5.29***
Real exchange rate (deviation from trend)[a]	-0.039	-4.91***	-0.089	-6.71***
Change in exports	-0.055	-4.98***	-0.053	-4.01***
Change in short term foreign debt	0.020	5.38***	0.009	1.83*
Budget balance / GDP			-0.132	-3.98***
Domestic credit / GDP			0.055	6.21***
Number of Observations	355		354	
Log-Likelihood	-125.68		-86.19	
Pseudo-R2	0.34		0.54	

[a] A negative deviation of the trend of the real exchange rate is an overvaluation, a positive deviation of the trend is an under-valuation. One, two, three stars refer to a significance level of respectively 10, 5 and 1 percent.

The interaction term of the current account balance and the budget balance had the wrong sign. The other interaction term between the current account balance (as a per-

centage of GDP) and the real exchange rate had the right sign but was not significant at the 10% level.

We conclude that for the candidate-countries, the probability of crisis rises when:

(1) the overvaluation of the real exchange rate is increasing,

(2) the international reserves as a percentage of the GDP are dwindling,

(3) the budget deficit as a percentage of the GDP is rising,

(4) the exports are falling,

(5) the deficit on the current account balance as a percentage of the GDP is rising,

(6) the domestic credit as a percentage of the GDP is growing,

(7) the short term foreign debt is rising.

The first five of those variables are consistent with the first generation-models of currency crises. This models stress the growing inconsistencies between the internal and external economic policy objectives. These inconsistencies lead ultimately to an abandoning of the fixed exchange rate system.

High values of the sixth variable can be due to a weak regulation of the financial sector. The seventh variable underlines the risk for capital reversals.[30] We stress that the significance of short-term foreign debt and domestic credit – two variables that play a role in the third generation crisis-models – is in line with the importance of the over-borrowing and over-lending syndrome of banks during the Asian crises.

3.4 Some tests of the prognostic quality of the model

The probit-model can also be evaluated. Both the basic model and the final model delivered significant likelihood ratio values. This supports the explanatory power of both the individual variables and the set of independent variables of the model.

Two tests are implemented to evaluate the model in terms of forecasting accuracy. They evaluate the average closeness of the predicted probabilities and the observed realizations, as measured by a zero-one dummy variable. Suppose we have N probability forecasts $[P_t]_{t=1}^{T}$, where P_t is the probability of crisis in the interval $[t, t+h]$ conditional on

30 Other variables that capture this risk are the ratios of short term foreign debt to international reserves and M2 to international reserves.

information provided by the model in period *t*. Similarly let $[R_t]_{t=1}^{T}$ be the corresponding time series of realizations; R_t equals one if the crisis occurs between *t* and *t+h* and equals zero otherwise. The *Quadratic Probability Score* test (QPS) is given by

$$QPS = \frac{1}{N}\sum_{t=1}^{N} 2(P_t - R_t)^2 \qquad (2)$$

The QPS ranges from 0 to 2, with a score of 0 corresponding to perfect accuracy. The second scoring rule is the *log probability score* test (LPS) given by

$$LPS^k = -1/T\sum_{t=1}^{T}\left[(1-R_t)\ln(1-P_t^k) + R_t \ln(P_t^k)\right] \qquad (3)$$

The LPS ranges from *0* to infinity with a score of *0* corresponding to the perfect accuracy. The LPS depends exclusively on the probability forecast of the event that actually occurred, assigning as a score the log of the assessed probability. The loss function associated with the LPS differs from that corresponding to the QPS as large mistakes are penalized more heavily under the LPS.

Table 2:
Goodness of fit statistics: Quadratic Probability Score Test (QPS) and the Log Probability score Test (LPS)

	Basic model	Final model
Quadratic Probability Score Test (QPS)	0.227	0.149
Log Probability Score Test (LPS)	0.354	0.243

In table 2 we listed the QPS and LPS values for the basic model and the final model. All values are close to 0 and show the strong predictive power of the basic model and the final model.

3.5 Do our results differ from previous analyses?

Before concluding with some policy implications, we want to compare our results with other studies on the determinants of currency crises. First, we compare our results with existing results from the signals approach and second, with results from logit- and probit analyses.

Our results are in line with those of the signals approach study of Brüggemann and Linne (2001, 2002a). Striking is the importance of the budget deficit in both analyses, although the analysis of Brüggemann and Linne does find bank deposits to be statistically significant, in contradiction to our analysis and that of Kaminsky et al. (1998). Our

results are further in line with those of Kaminsky concerning the importance of the real exchange rate, the exports, the international reserves and the domestic credit as a percentage of GDP. In contrast to our analysis Kaminsky found also the output, the real interest rate and the M2 to M0 ratio to be significant. Most of the results of Goldstein et al. (2000) for currency crises are in line with those of Kaminsky et al. (1999a). We stress the importance of the budget deficit in both studies and our analysis.

Both our basic and the final model for the EU candidate countries support the probit-analysis results of the IMF for Latin-American and Asian counties (Berg and Pattillo 1999). Our analysis however does find the budget deficit to be significant. Although both the IMF-model and our model find the short term foreign debt to be significant whereas the study by Brüggemann and Linne (2002b) could not find statistical support for the inclusion of this variable.[31]

IV. Conclusions: some policy implications

We tested a broad range of variables that were of importance for the onset of financial crises in Asian and Latin American countries. The results of our probit-model for several crisis countries (Bulgaria, Czech Republic, Romania, Russia and Turkey) stress the importance of five determinants of financial crises: the overvaluation of the real exchange rate, the export, the current account balance, the international reserves, and the short term foreign debt. The importance of these determinants has also been supported by studies for Asian and Latin American countries. We also stress the importance of two extra determinants that were used in our final model: the budget balance and domestic credit.

In our sample, budget deficits play an important role during the onset of a speculative attack. This delivers empirical support for the first generation-models in the currency literature and for the importance of fundamentals with the onset of a financial crisis in the candidate countries. Next to that we conclude that the significance of the short-term foreign debt and the domestic credit – two variables that play a role in the third generation crisis-models – is in line with the importance of the over-borrowing and over-lending syndrome of banks during the Asian crises.

31 The probit-analysis of *Brüggemann and Linne* (2002b) differs in important aspects from ours: they use a panel of 10 Central- and East-European transition countries with both crisis countries and non-crisis countries. Their sample runs from January 1996 to December 2000, their crisis definition is based on the EMP index, they convert the original data into percentile form.

Our empirical results enable us to conclude that economic policy in the candidate countries should concentrate on three crucial points: (i) the control and regulation of banks, like the limitation of short-term foreign debt, (ii) to limit the budget deficit. A relative high deficit can cause an attack on the domestic currency, (iii) the exchange rate system is the key to avoid a financial crisis. For the candidate countries it is advised to make their exchange rate systems more flexible because of the persistent current account deficits and the importance of an overvalued exchange rate. This would avoid an excessively high real appreciation of the exchange rate. However, more flexibility in the exchange rate systems seems not to be in line with the fact that new EU members are expected to peg eventually their exchange rate to the Euro. Therefore, the choice of a right exchange rate system when entering ERM II and the reduction of the current account deficits are of crucial importance for the EU-candidate countries.

References

Berg, Andrew; Eduardo Borensztein; Maria Gian Milesi-Ferretti and Catherin Pattillo, (1999): Anticipating Balance of Payments Crises: The Role of Early Warning Systems IMF Occassional Papers. International Monetary Fund, No. 186.

Berg, Andrew and Catherin Pattillo (1999): What causes the Asian Crises: an EWS Approach. Economic Notes, 28:3, pp. 285-334.

Brüggemann, Axel and Thomas Linne (2001): Weiterentwicklung und Anwendung eines Frühwarnindikatorensystems zur Betrachtung und Bewertung von Finanzkrisen in EU-Beitrittskandidatenländern und ausgewählten Staaten Mittel- und Osteuropas. Institut für Wirtschaftsforschung Halle, IWH-Sonderheft 4/2001, 70 p.

Brüggemann, Axel and Thomas Linne (2002a): Are the Central and Eastern European Transition Countries still Vulnerable to a Financial Crisis? Results from the Signals Approach. Halle Institute for Economic Research, Discussion papers, No. 157, March 2002, pp. 1-24.

Brüggemann, Axel and Thomas Linne (2002b): What was driving the Financial Crises in the Central and Eastern European Transition Countries? Results from a Probit Analysis. Halle Institute for Economic Research, in mimeo, pp. 1-12.

Corsetti, Giancarlo; Paolo Pesenti and Nouriel Roubini (1998): What Caused the Asian Currency and Financial Crisis? Part I: A Macroeconomic Overview. NBER Working Paper Series. National Bureau of Economic Research, Nr. 6833, December 1998, pp. 1-49.

Dornbusch, Rudiger (2001): A Primer on Emerging Market Crises. Cambridge, MA: MIT, mimeo. URL: <http://web.mit.edu/rudi/www/media/PDFs/crisesprimer.pdf>. (20/07/2002).

Eichengreen, Barry; Andrew K. Rose and Charles Wyplosz (1995): Exchange Market Mayhem: The Antecedents and Aftermath of Speculative Attacks. Economic Policy, Nr. 21, October 1995, pp. 249-312.

Eichengreen, Barry; Andrew K. Rose, and Charles Wyplosz (1996): Contagious Currency Crises. NBER Working Paper Series. National Bureau of Economic Research, Nr. 5681, July 1996. Cambridge, Massachusetts, pp. 1-48.

Eichengreen, Barry and Ricardo Hausmann (1999): Exchange Rates and Financial Fragility. New challenges for Monetary Policy. A symposium sponsored by the Federal Reserve Bank of Kansas City,Wyoming, 26-28 August, pp. 329-368.

Flood, Robert P. and Nancy P. Marion (1998): Perspectives on the Recent Currency Crisis Literature. IMF Working Paper. International Monetary Fund, Nr. 98/130, September 1998, pp. 1-37.

Frankel, Jeffrey A. and Andrew K. Rose (1996): Currency Crashes in Emerging Markets: An Empirical Treatment. Journal of International Economics, Nr. 41, pp. 351-366.

Goldstein, Morris; Graciela L. Kaminsky and Carmen M. Reinhart (2000): Assessing Financial Vulnerability. Institute for International Economics, Washington, DC., June 2000, 134 p.

Halle Institute for Economic Research (IWH), database.

Hendry, D. F. (1995): Dynamic Econometrics. Oxford University Press, Oxford.

International Foundation for Election Systems (IFES). URL: <http://www.ifes.org/eguide/elecguide.htm>. (21/07/2002).

International Monetary Fund (IMF) (1998a): Financial Crisis: Characteristics and Indicators of Vulnerability. World Economic Outlook, May 1998, pp. 74-97.

Johnston, Jack and John Dinardo (1997): Econometric Methods, fourth edition. Mcgraw-Hill, pp. 412-452.

Kaminsky, Graciela; Saul Lizondo and Carmen M. Reinhart (1998a): Leading Indicators of Currency Crises. IMF Staff Papers. International Monetary Fund, Nr. 45/1, March 1998, pp. 1-48.

Kaminsky, Graciela and Carmen M. Reinhart (1998b): Financial Crises in Asia and Latin America: Then and Now. The American Economic Review, No. 88/2, May 1998, pp. 444-448.

Kaminsky, Graciela and Carmen M. Reinhart (1999): The Twin Crisis: The Causes of Banking and Balance-of-Payments Problems. The American Economic Review, June 1999, pp. 473-500.

Krugman, Paul (1979): A Model of Balance of Payment Crisis. Journal of Money, Credit and Banking, Nr. 8, August 1979, pp. 311-325.

Linne, Thomas (1999b): Contagion Effects of Central and East European Currency Crises. Halle Institute for Economic Research. Discussion papers, No. 96, April 1999, pp. 5-20.

Obstfeld, Maurice (1994): The Logic of Currency Crises Cahiers Economiques et Monétaires, Nr. 43, pp. 189-213.

Political Studies Association (PSA) URL: <http://www.psa.ac.uk/www/election.htm>. (21/02/2002).

Sachs, Jeffrey; Aaron Tornell and Andrés Velasco (1996): Financial Crises in Emerging Markets: The Lessons from 1995. NBER Working Paper Series. National Bureau of Economic Research, Nr. 5576, May 1996, pp. 1-51.

Schnatz, Bernd (2000): Speculative Attacks in Emerging Markets: the Role of Macroeconomic Fundamentals. Intereconomics, March/April 2000, pp. 81-89.

Standard & Poors, Sovereign Ratings History Since (1975): URL:<http://www.standardandpoors.com/europe/francais/Fr_action-notes/LISTE_Sovereign_Since_1975.html> (21/07/2002).

Appendix 1

Survey of national elections in 10 EU candidate countries, Russia and Turkey in the period 1992-2002

Country	Parliamentary elections	Presidential elections
Bulgaria	18 December, 1994 19 April, 1997 18 June, 2001	12-19 January, 1992 27 October / 3 November, 1996 11-18 November, 2001
Estonia	20 September, 1992 5 March, 1995 7 March, 1999	
Hungary	8-29 May, 1994 10-24 May, 1998 7-21 April, 2002	10-24 May, 1998
Latvia	5-6 June, 1993 30 September / 1 October, 1995 3 October, 1998 5 October, 2002	
Lithuania	25 October, 1992 20 October / 10 November, 1996 8 October, 2000	21 December, 1997 4 -10 January, 1998
Poland	19 September, 1993 21 September, 1997 23 October, 2001	5-19 November, 1995 8 October, 2000
Romania	27 September, 1992 3 November, 1996 26 November, 2000	27 September / 11 October, 1992 3-17 November, 1996 26 November / 10 December, 2000
Russia	12 December, 1993 17 December, 1995 19 December, 1999	16 June / 3 July, 1996 26 March, 2000
Slovak Republic	5-6 June, 1992 30 September / 1 October, 1994 30 September / 1 October, 1998 20-21 September, 2002	15-29 May 1999 11 November, 2000 (referendum)
Slovenia	15 October, 2000	23 November, 1997 10 November, 2002
Czech Republic	31 May / 1 June, 1996 15-23 November, 1996 19-20 June, 1998 13-21 November, 1998 14-15 June, 2002	
Turkey	18 April, 1999 3 November 2002	

Source: International Foundation for Election Systems (IFES); Political Studies Association (PSA).

Appendix 2

Survey of Sovereign Credit Ratings of 10 EU candidate countries, Russia and Turkey

Country	Date	Foreign Currency Rating Long Term Outlook
Bulgaria	31 July, 2002 7 November, 2001 10 May, 2000 23 November, 1998	BB-/Stable BB-/Stable B+/Positive B/Positive
Estonia	31 July, 2002 20 November, 2001 21 December, 2000 11 December, 1997	A-/Stable A-/Stable BBB+/Positive BBB+/Stable
Hungary	31 July, 2002 19 December, 2000 2 February, 2000 11 December, 1998 22 January, 1998 27 July, 1997 28 October, 1996 31 January, 1996 6 February, 1995 15 April, 1994 20 April, 1992	A-/Stable A-/Stable BBB+/Positive BBB/Positive BBB-/Positive BBB-/Stable BBB-/Stable BB+/ Stable BB+/Negative BB+/ Stable BB+/Positive
Latvia	31 July, 2002 9 August, 2001 16 January, 1997	BBB/Positive BBB/Positive BBB/Stable
Lithuania	31 July, 2002 22 April, 2002 9 June, 1997	BBB/Stable BBB/Stable BBB-/Stable
Poland	31 July, 2002 22 August, 2001 12 April, 2001 15 May, 2000 10 June, 1999 3 June, 1997 10 April, 1996 1 June, 1995	BBB+/Stable BBB+/Stable BBB+/Positive BBB+/Stable BBB+/Stable BBB/Positive BBB-/Stable BB/Positive
Romania	31 July, 2002 19 April, 2002 7 June, 2001 5 March, 2001 4 August, 2000 1 April, 1999 19 October, 1998 20 May, 1998 23 January, 1998 30 April, 1997 6 March, 1996	B+/Positive B+/Positive B/Positive B-/Positive B-/Stable B-/Negative B-/Negative B+/Stable BB-/CW-Negative BB-/Stable BB-/Stable

Country	Date	Foreign Currency Rating Long Term Outlook
Russia	31 July, 2002	BB-/Stable
	22 February, 2002	B+/Positive
	19 December, 2001	B+/Stable
	4 October, 2001	B/Positive
	27 June, 2001	B/Stable
	8 December, 2000	B-/Stable
	27 July, 2000	SD/Not Meaningful
	15 February, 2000	SD/Not Meaningful
	7 May, 1999	SD/Not Meaningful
	27 January, 1999	SD/ Not Meaningful
	16 September, 1998	CCC-/Negative
	17 August, 1998	CCC/Negative
	13 August, 1998	B-/Negative
	9 June, 1998	B+/Stable
	27 May, 1998	BB-/CW-Negative
	19 December, 1997	BB-/Negative
	4 October, 1996	BB-/Stable
Slovak Republic	31 July, 2002	BBB-/Positive
	30 October, 2001	BBB-/Positive
	9 November, 2000	BB+/Positive
	12 November, 1999	BB+/Stable
	17 September, 1998	BB+/Negative
	7 April, 1998	BBB-/Negative
	24 June, 1997	BBB-/Stable
	11 April, 1996	BBB-/Stable
	5 April, 1995	BB+/Stable
	15 February, 1994	BB-/Stable
Slovenia	31 July, 2002	A/Stable
	15 January, 1998	A/Stable
	8 May, 1996	A/Stable
Czech Republic	5 November, 1998	A-/Stable
	30 June, 1998	A/Stable
	7 November, 1995	A/Stable
	18 July, 1994	BBB+/Positive
	28 July, 1993	BBB/Positive
Turkey	31 July, 2002	B-/Negative
	26 June, 2002	B-/Stable
	29 January, 2002	B-/Positive
	30 November, 2001	B-/Stable
	11 July, 2001	B-/Negative
	27 April, 2001	B-/Stable
	16 April, 2001	B-/CW-Negative
	23 February, 2001	B-/CW-Negative
	21 February, 2001	B+/CW-Negative
	5 December, 2000	B+/Stable
	25 April, 2000	B+/Positive
	10 December, 1999	B/Positive
	21 January, 1999	B/Stable
	10 August, 1998	B/Positive
	13 December, 1996	B/Stable

Source: Standard & Poor's, Sovereign Ratings History since 1975.

An FEER approach on over- or undervalued Euroland entry

Jens Hölscher and Mariusz Jarmuzek

I. Introduction

This study aims to identify exchange rate strategies for European Union (EU) accession countries in view of the optimal conversion rate upon entering the Exchange Rate Mechanism II (ERM-II) type arrangement prescribed by the EU.[32] For the purpose of this study the ERM-II type arrangement is taken as granted although there are many crucial reservations about its feasibility.[33] Here the focus is on which exchange rate regime pursued by each country of enlargement will lead to what type of conversion rate. It is assumed that the then factual exchange rate will serve as orientation rate for the entry rate to be adopted. Even if the entry rate might be negotiable to a certain extent, negotiations will take the market rate as a point of reference. A final devaluation, which seems to be desirable from many accession countries' point of view (see Bratkowski/ Rostowski 2001) in order to promote competitiveness, is by this assumption not subject to this study and postponed towards the political sphere.

Before this study can proceed further, it is necessary to clarify, what is meant by an over- or undervalued exchange rate. The underlying problem is that exchange rate models work quite well in the long run (from 10 years onwards), but have very little to say about short run movements. As this study tackles a short or medium run problem, if ERM-II entry is assumed to happen within the next decade, a more pragmatic approach is needed. Here the exchange rate is taken as an asset price and its level depends on expectations of future policy, productivity and risk. An undervalued exchange rate would be defined by revaluation expectations and an exchange rate would be overvalued, if future devaluations were to be expected. This definition is an obvious tautology, but one needs to bear in mind that it bears the advantage to leave the question for the actual

32 Parts of this study were written during the author's research stay at the Halle Institute for Economic Research. Stimulating discussions with staff, in particular Hubert Gabrisch, Axel Brüggemann, Bogdan Gorokhovskij, Thomas Linne and Johannes Stephan as well as financial support are gratefully acknowledged. Correspondence: j.holscher@brighton.ac.uk.

33 The original ERM-II system worked under the conditions of halfway symmetric economies with one dominant player in Frankfurt, whereas now a number of relative small economies are entering an economic mega-bloc. The original regulations on interventions are seen in particular need of inflation adjustment and revision.

equilibrium exchange rate open. In view of the short term nature of this study such a procedure is superior to other methodologies, which incur superfluous questions about PPP, internal versus external balances and alike in order to estimate the (long run!) future equilibrium exchange rate. In the terminology of approaches to estimating equilibrium exchange rates here the method of Fundamental Equilibrium Exchange Rates is chosen (see Driver/Westaway 2001). The implication in terms of economic policy is that there exists a degree of choice for the countries in question as to what extend their Euroland entry rate will be over- or undervalued.

As next step this study moves is evaluating the current situation with regards of exchange rate regime and exchange rate stability. Here the current account is taken as fundamental determinant of foreign capital flows. The same question is addressed by estimating the fundamental equilibrium exchange rates (FEERs). The fourth section discusses possible choices of exchange rate strategies under the given EU restrictions. Four entry strategies are classified and their policy implications are evaluated. Finally the study concludes.

II. The Pre-ERM-II scenario

The legislation for ERM-II entry is equal for each accession country and can be summarised by the following components (see in detail Deutsche Bundesbank 1998):

Box 1:
ERM-II components

- Precondition for participation in Euroland (and thereby for EU membership)
- Fixed parity to the Euro (floating within a band up to +/- 15%)
- Unlimited marginal interventions ‘pre-paid’ by national central bank concerned and financed by the ECB
- Intra-marginal interventions can be financed by the ECB to a limited extent
- Confidential assessment of central parity

It is noteworthy that even a currency board arrangement is possible in agreement with the ECB within ERM-II, what leaves only a free-float exchange rate arrangement and unilateral Euroisation as exchange rates arrangements directly violating the system.

Given this ‘one size for all’ approach of the EU it seems to be surprising that the entry strategies among the accession countries are differing widely from currency boards to free float and even a serious consideration of unilateral Euroisation (Bratkowski/ Rostowski). The following sub-sections interpret the current strategies in respect of exchange rate stability and potential over- or undervalued ERM-II entry in particular. Before proceeding to that stage two observations shall be made.

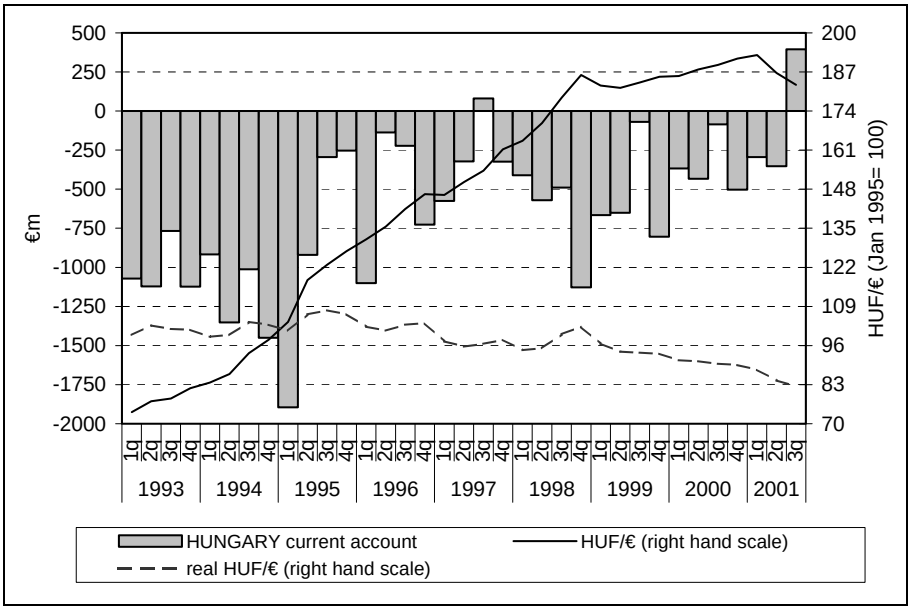
The graphs show the fluctuations of nominal and real exchange rates of selected EU accession countries quarter on quarter. The real exchange rate is defined as the nominal exchange multiplied with the harmonized price index of the EU divided by the consumer price index of the relevant transition country. It can be seen that the exchange rate fluctuations are high and do not follow a clear trend. Also, apart from some outliers, correlation seems to be high, leading to the suspicion that these emerging markets were subject to similar shocks, albeit to different extents. The nominal and real exchange rates are indexed in January 1995 by 100. This does not mean that the exchange rate at this particular date is seen as some kind of equilibrium exchange rate, but it does allow observing the direction of the movement of the exchange rates. The pictures show a clear and strong revaluation of the real exchange rate and the devaluation of the nominal exchange rate vis-à-vis the Euro in all countries. This is interrupted in some points of time in some countries. A more detailed analysis will proceed country by country.

2.1 Hungary: The success story

Among the accession countries Hungary stands as an example of a success story, because in this case the nominal devaluation of the exchange rate went along with an only moderate revaluation of the real exchange rate and a reduction of the current account deficits.

In the graph above the real and the nominal exchange rate of the Forint are indexed equal to hundred in January 1995. The difference of both rates is the difference of the cumulative inflation rate between the Euro (and its predecessors) and the inflation rate of the Forint. Before 1995 this interpretation has to be reversed. From 1998 onwards the difference between nominal and real rate develops in an almost parallel direction, which reflects the success of stabilisation policy in Hungary since then. The nominal depreciation of the Forint was pursued by a pre announced crawling rate until the crawl was abolished in October 2001. Since then the Hungarian Forint is fixed to the Euro at Ft 276.1 per € 1 and allowed to fluctuate within in a horizontal band of +/-15%. This anticipation of the ERM-II arrangement has recently lead to a revaluation of the Forint, which is seen as harmless, as it was accompanied by an export surplus. Clearly the exchange rate is determined by capital movements and asset market expectations. The general observation is that the connection between real exchange rate as a measure for competitiveness and the current account performance is more loose than economic textbooks suggest.

Figure 1:
Hungary`s current account and the Forint exchange rate



Source: Own calculations based on WIIW database.

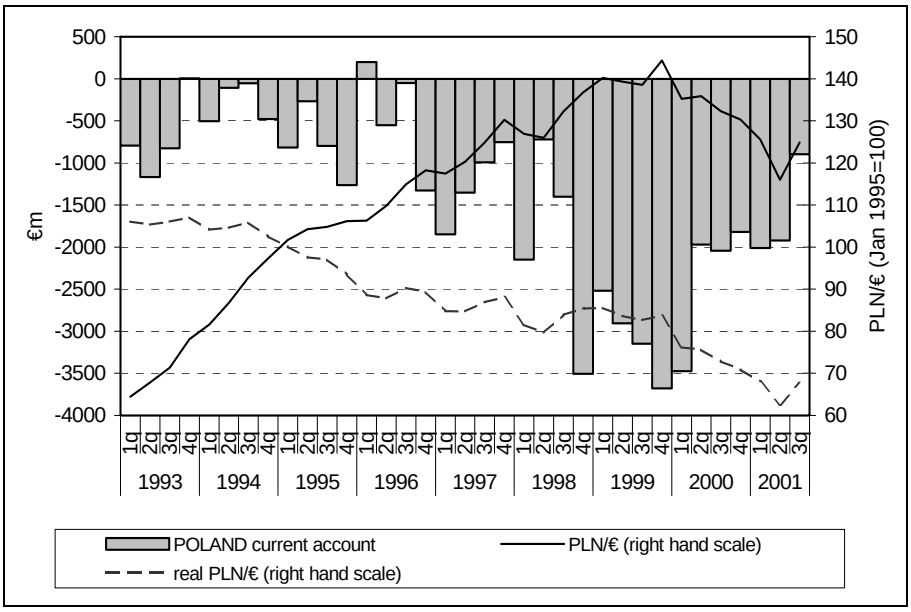
2.2 Poland: On edge

Although the parallel development of the real and nominal exchange rate can be observed here, too, in Poland the situation is different in comparison to Hungary in many respects. First of all the revaluation of the Polish Zloty is far stronger both in real as well as nominal terms. Secondly the exchange rate regime is classified as independently floating against all currencies since April 2000. Before this the Zloty fluctuated within a crawling band of +/-15% around a central parity, which was pegged against a basket of two currencies, comprising the Euro (55%) and the Dollar (45%). This regime change lead to an even stronger revaluation of the real exchange rate, which was this time in line with a substantial revaluation of the nominal Zloty rate, too. Recent developments have corrected this only in a modest fashion.

Current account deficits declined to pre-1998/99 levels, but are still running at high scales. The high levels of 1998/99 were caused by special effects such as a domestic consumption boom. The reduction was achieved at the expense of domestic growth, which was axed by the interest rate increases of the central bank. Under these circumstances and the need to return to pegged exchange rates upon entering ERM-II, the

Zloty appears to be vulnerable to possible speculative attacks or as Brüggemann/Linne (2002) put it there is 'trouble brewing in Poland'.

Figure 2:
Poland`s current account and the Zloty exchange rate



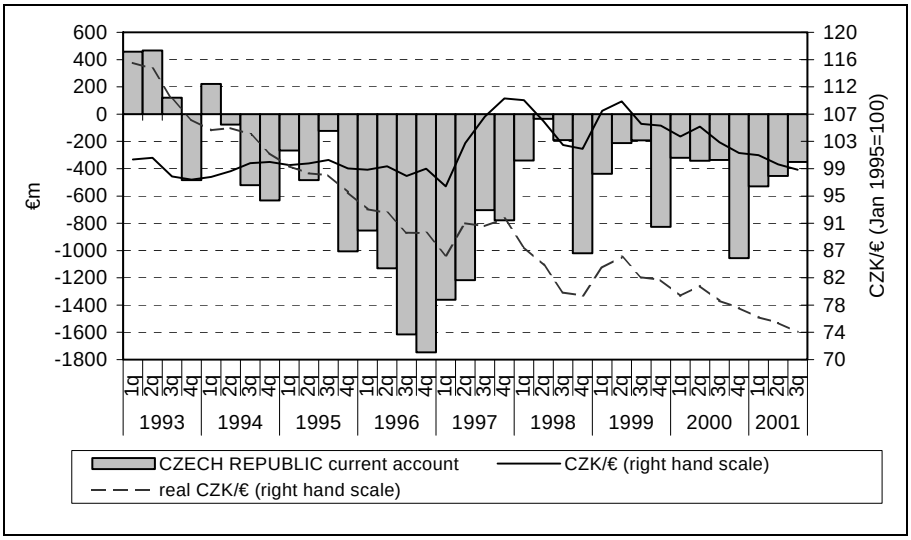
Source: Own calculations based on WIIW database.

2.3 Czech Republic: Critical

The exchange rate regime of the Czech Republic is an arrangement of managed floating with no pre-announced path for the exchange rate. The Czech Republic became victim of a speculative attack in 1997, which resulted in a hefty devaluation of the Czech Koruna. This crisis was preceded by a widening gap between real and nominal exchange rates as well as rising current account deficits. Since that crisis the currency revalued steadily, but the current account deficit remained stable. This performance is interpreted as being critical, because there seems to be no connection between the current account and the exchange rate, which might be caused by other overriding structural problems such as privatisation. The situation became even more worrying since the Czech National Bank intervened on the foreign exchange market with modest success in order to bring the exchange rate down. This is a change of policy in the sense that Czech regime was classified as a managed float allowing central bank interventions only to

'smooth large intra-day volatility swings of the Euro/Koruna rate' (IMF 2001, p. 279). Once again the Czech Republic looks being vulnerable to a possible speculative attack.

Figure 3:
The Czech Republic`s current account and the Koruna exchange rate



Source: Own calculations based on WIIW database.

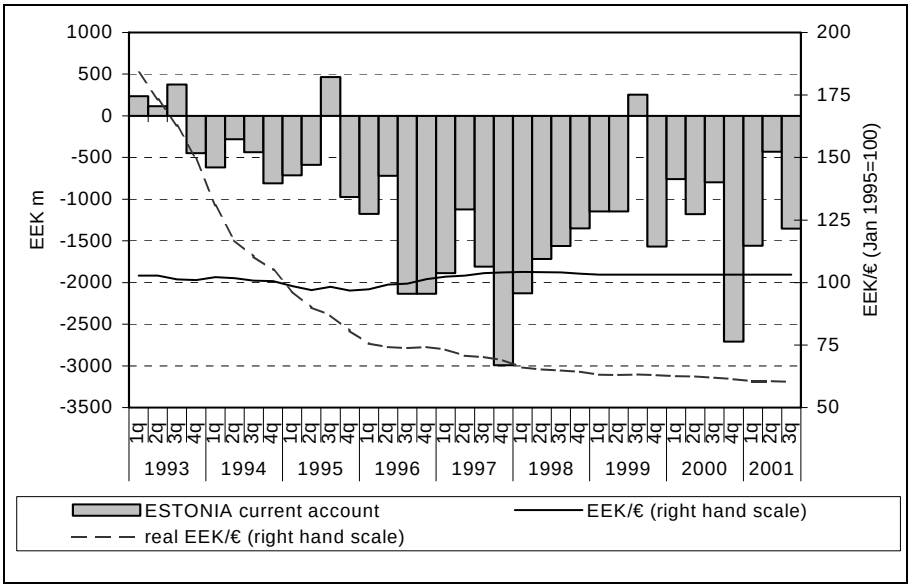
2.4 Currency boards: Safe option

Among the accession countries there are at the moment three clear currency board arrangements. These are in Bulgaria, Estonia and Lithuania. Latvia has a conventional peg arrangement and fixed its currency, the Latvian Lat against the SDR. In general it can be stated that these arrangements remained stable and helped to stabilise the current accounts in these small open economies.

Estonia pegged its Estonian Kroon against the Deutsche Mark in 1992 and later the ECU and Euro. Since the introduction of the Euro the nominal exchange rate is represented by a straight line. Marginal changes before that date reflect revaluations of the Deutsche Mark within the European Exchange Rate Mechanism. The revaluation of the real exchange rate of the Kroon is caused by high inflation rates in particular in the early phase of transition. Recent years have shown that even the rate of inflation could be successfully reduced under the currency board arrangement in Estonia. The Estonian central bank provides commercial bank with the possibility of buying or selling foreign exchange to adjust their Kroon liquidity, but all transactions are initiated by commercial

bank. A forward exchange market fro the Kroon exists on a low scale level. Hristov (2001) estimates that the real exchange rate of the Kroon is undervalued by 15%.

Figure 4:
Estonia`s current account and the Kroon exchange rate

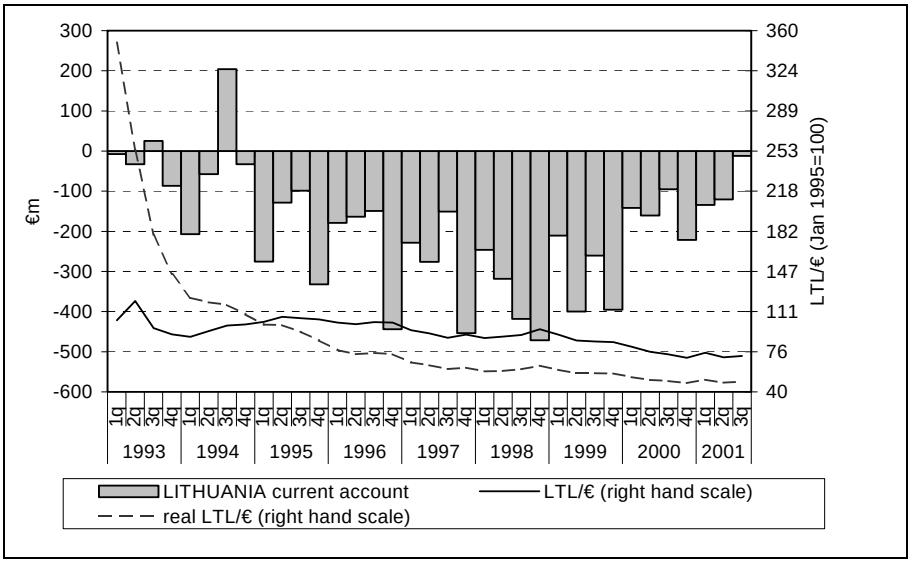


Source: Own calculations based on WIIW database.

Lithuania pegged its currency, the Litas, against the Dollar in 1994, when the currency board was established. Since February 2002 the Litas is pegged against the Euro. The graph above is not displaying a straight line, because it mirrors the devaluation of the Euro against the Dollar. In the wake of the Russian crisis the current account increased, but the currency board as such survived and deficits were reduced thereafter partly through trade reorientation towards the European Union. Lithuania provides a further example for a successful reduction of inflation under a currency board regime.

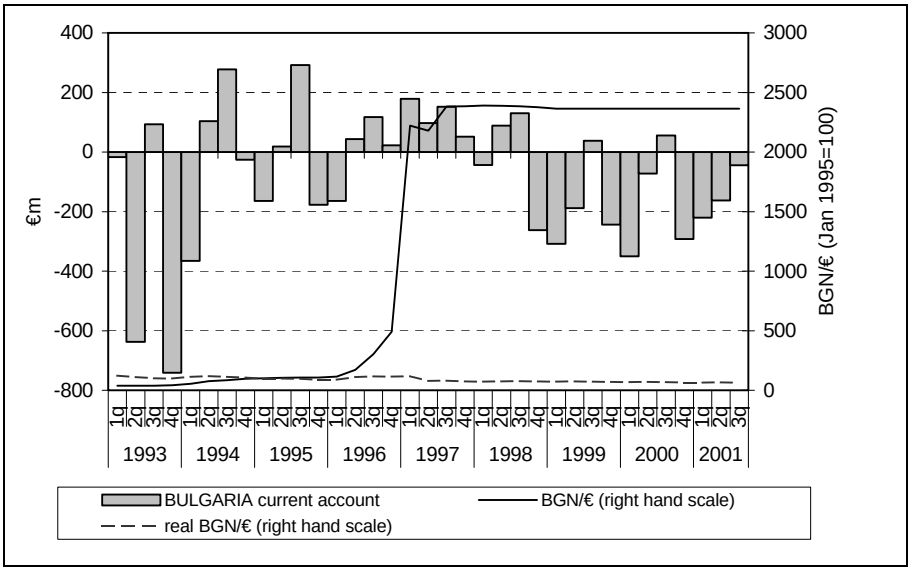
Bulgaria is the third accession country with a currency board arrangement. The Bulgarian Lev was pegged against the Deutsche Mark in 1997 and the Euro thereafter. The Lev had become a victim of a speculative attack and the currency board was established as a reaction to that crisis under control of the IMF. Since then the exchange rate is stable as are inflation rate and current account. The Bulgarian case is an example for successful mastering a crisis by the introduction of a currency board, whereas the other countries stood for successful crisis prevention. In contrast to the other countries under review here, Bulgaria is still maintaining rigid capital controls.

Figure: 5
Lithuania`s current account and the Litas exchange rate



Source: Own calculations based on WIIW database.

Figure 6:
Bulgaria`s current account and the Lev exchange rate



Source: Own calculations based on WIIW database.

III. The optimal entry exchange rate: An estimation

In order to validate the above stated message from an econometric point of view, we estimate the equlibrium exchange rate of the accession countries with the aim to identify, whether the exchange rate has a track record of over- or undervaluation. For this purpose we use the concept of Fundamental Equilibrium Exchange Rates (FEERs), which assumes that a balance in the economy has two dimensions. The first one is the internal balance defined as the output consistent with both full employment and a low inflation rate. The second dimension is the external balance characterised by sustainable desired net flow of resources between countries when they are in internal balance (Clark and MacDonald, 1998). This approach abstracts from short-run cyclical conditions and temporary factors, as it relies on economic fundamentals, which are assumed to persist over the medium term. These conditions should be envisaged to ensure a sustainable balance in the economy. However, one should note that this method is rather a normative one (Williamson, 1994), as the equilibrium exchange rate is based on the desirable economic conditions. The balance between the demand and supply implies that there is no output gap and that savings and investments are sustainable (Driver and Wren-Lewis, 2001). It does not, however, mean that full stock flow equilibrium is achieved.

3.1 Estimating FEERs

There are basically two approaches to calculating FEERs. The first approach employs a complete macroeconomic model to calculate the level of the FEER or to examine how sensitive to some shocks the model is. There are two types of models we can use to estimate FEER. First, a single country model (Wren-Lewis et al. 1994; Church 1992) with exogenous assumptions with respect to the world, second, a multicountry model (Bayoumi et al. 1994) which ensures the balance in the whole world. The main advantage of this method is consistency with other macroeconomic variables.

The second approach is a partial equilibrium model. This method is very common and often used in the studies on the FEERs (Barrel and Wren-Lewis, 1989). We decided to follow an approach adopted by Driver and Wren-Lewis (1998), therefore steady state relationships are estimated. This solution allows us to avoid problems related to short-term dynamics. The approach can be divided into two stages. The first stage is an estimation of the trend current account, which should be different from actually recorded statistics. We commence from replacement of the actual value of exports and imports with the values our models predict. The reason behind the distinction between actual and predicted values can be associated with the occurrence of shocks. We assume that these shocks are temporary, which enables us to omit them in our medium term estimations. Subsequently, we employ the elasticities derived from the trade equations to find out what exports and imports would have been if there was no output gap being a con-

firmation of internal balance existence in the economy. In other words, it informs us what the medium-term current account would be if the real exchange rate remained unchanged. One should, however, note that the real exchange rate should alter to enable the balance of payments to be squared. Therefore, the trend current account matches medium-term flows. Thus, the second stage refers to the calculation of the real exchange rate that ensures a medium-term equilibrium current account consistent with desired structural medium-term flows.

3.2 The model of aggregate trade

Although there are some reservations in the literature (Driver and Wren-Lewis, 1998) trade equations based on a widely used demand curve approach are modelled (i. e. Goldstein and Kahn, 1985). In standard models, export and import are dependent on the real effective exchange rate as a measure of competitiveness and foreign and domestic demand, respectively. The definition of export and import includes both merchandise trade and trade in services.

The estimation of trade equations has serious empirical and theoretical inadequacies stemming from conceptual inconsistencies of the model and the specific considerations of the Accession countries analysis. First, this approach attempts to examine the relationship between nominal variables (export and import at nominal prices expressed in US-Dollars) and real variables (real effective exchange rate and real GDP). Second, we apply the simplifying assumptions with respect to the real effective exchange rate based on the euro-Zloty exchange rate and foreign demand measured by GDP in the EU only. The former renders some inadequacies in so defined competitiveness measure, as the euro zone is the only trade partner for accession countries. There are some discrepancies between the real exchange rate constructed based on euro-Zloty exchange rate and based on a basket comprising more currencies. The latter allows us not to estimate potential output for other countries and weight foreign demands with trade shares (Rawdanowicz, 2002). Third, the omission of nonprice competitiveness factors also distorts obtained results (Driver and Wren-Lewis, 1998).

Accession countries have experienced many shifts in exchange rate regimes since the beginning of transition period. This substantially affects the results of trade elasticities estimations, which, in turn, influence on obtained the real exchange rate. Parameters of the price elasticities have significant impact on the FEER estimations, as their value determines how much the real exchange rate has to alter to bring economy into internal and external balance. The higher price elasticity is the smaller changes in real exchange rate to correct disequilibrium are required (Hristov, 2002).

The estimation techniques we apply are Johansen procedure and error correction mechanism (ECM). In almost all cases obtained results are not entirely robust. The main prob-

problem is wrong signs in the parameters of competitiveness in export equations as well in some import equations. The reason behind this can be attributable to both the Russian crisis, which distorted the relationships and the lag structure of the response of export to the real exchange rate (Rawdanowicz, 2002). Due to the above-mentioned obstacles we have decided to calibrate the parameters of trade elasticities. We derived the parameters from studies conducted by Driver and Wren-Lewis (1998) for other countries.

3.3 The model of the trend current account

The FEER concept is compatible to with exogenously determined values for internal balance, therefore potential output so as to equate output gaps to zero should be modelled. According to the literature there are three methodologies for the estimation of potential output and output gap (see Giorno et al., 1995). Both the first and the second approach rely on mechanical times series smoothing. This can be done either through the Hodrick-Prescott filter or through the time trend method. However, both methods are neither based on inter-relationships in the economy nor information about the structure of the economy. The third method stems from a Cobb-Douglas production function depending on equilibrium unemployment and capital stock. This approach does relate to structural relationships in the economy, however, it has one drawback regarding availability of the data on capital stock and potential employment for accession countries. Given the lack of the data and we have decided to use the HP filter.

Once we have received estimates of trend output estimated trade equations are used to calculate the values of export and import at which there is no output gap at home and abroad. Having calculated in this manner the trend current account is consistent with internal balance in the economy.

3.4 Structural flows

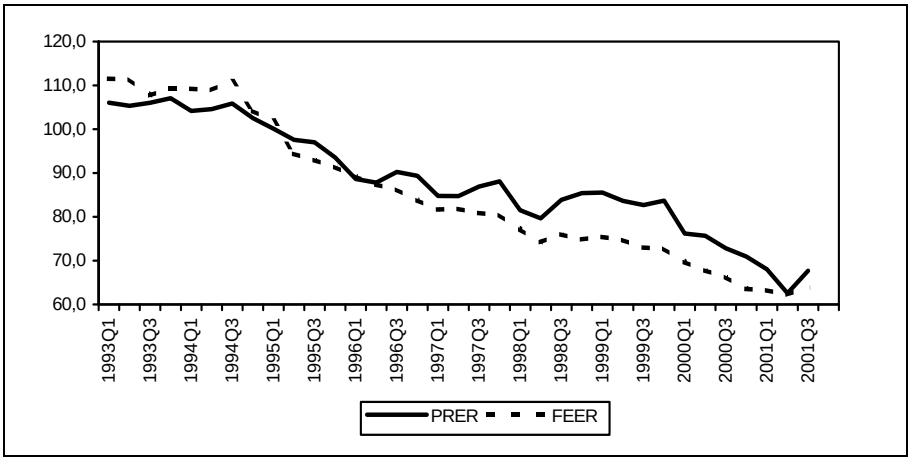
The third stage is to calculate the sustainable level of the current account that one has to estimate as the level of the current account that corresponds to external balance. There are two approaches of estimating it. The first is based on the method by Williamson and Mahar (1998) who assume structural capital flows, which are not speculative as a constant proportion of GDP. The second method is developed by Masson (1998) and implemented by Faruqee and Debelle (1998). The concept is linked to the identity which states that the difference between savings and investments provides an explanation what might be the sustainable level of the current account in the medium term if the economy were in internal balance. The above methods seem to be difficult to apply in the accession countries case, as these statistics are short and not reliable. Thus, we have used an expert estimation based on available information. Once we have had the trend current account compatible with internal balance of the economy as well as sustainable current

account, then we can solve the model to obtain the real exchange rate that matches these two estimates.

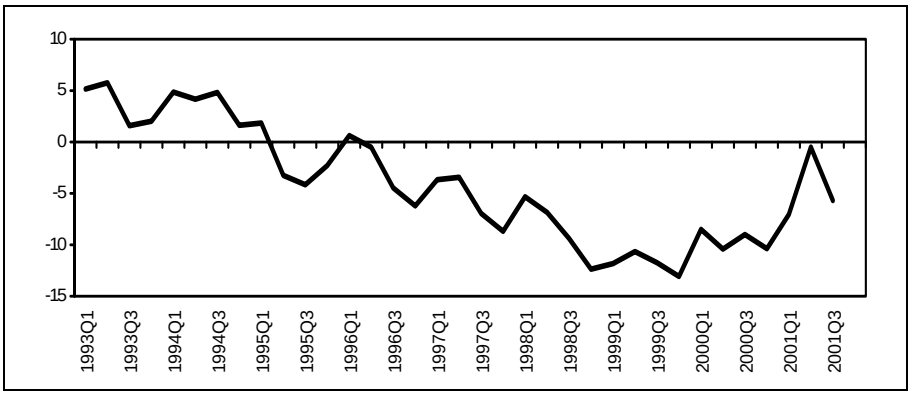
3.5 The results

The empirical findings do not reject the judgmental analysis of the the previous sections. This can be illustrated by the case of Poland, which is chosen for its importance due to its size as well for its analytical interest due to being characterised above as being „on edge' (see the appendix for a full set of estimations for each country).

Figure 7:
The overvaluation of the Polish Zloty



Note: January 1995 = 100.



Misalignment: (FEER - RER) * 100 / RER.

The first graph above compares the Polish real exchange rate (PREER) with the estimated fundamental exchange rate (FEER) for Poland it can be seen that only after the dramatic devaluation of 1992 the Zloty is below its FEER, i. e. undervalued. From 1995 onwards the real Zloty rate is above its FEER value only interrupted by the second quarter in 2001, where it is in equilibrium due to a reduction of the trade deficit. The econometric analysis displays a long history of overvaluation of the Polish Zloty. The second graph displays the degree of this overvaluation as the per cent difference between FEER and PEER. It can be seen that the Zloty is still within the ERM-II band of 15% below or over the agreed parity, which in our case could be assumed to be the FEER. It does however move narrowly along this margin. With respect to economic policy it needs to be stress, that our econometric model does not capture portfolio choice on the market for foreign exchange. Obviously an exchange rate movement towards the lower margin could trigger a speculative attack.

For the other countries the picture is less clear (see appendix). This is either because there are stronger fluctuations or as in the case of Bulgaria and the Czech Republic, or the 1997 crisis impact is very strong. Only Hungary appears to provide some sort of contrast picture to the Polish case, as here some degree of undervaluation seems to be sustainable. The Forint in 2001 seems to be undervalued by almost 10 percent in 2001. Recent development however cast some doubt on whether or not this might be sustainable.

IV. Strategic choice under EU restrictions (= Maastricht straight jacket)

If assumed that the ERM-II conditions are given and not negotiable the question of how to enter the system can be limited to whether or not the countries under review should continue their current strategy. Also a change of this strategy in order to avoid an overvalued entry into ERM-II and thereby risk becoming a victim of a speculative attack needs to be considered.

From a political economic point of view an overvalued exchange rate can have the benefits of relative cheaper imports. This could lead to a feel-good-factor among the population as far as consumer goods are concerned and it can accelerate technological change as far as capital goods are concerned. At the same time export goods from transition countries become relative more expensive, again for consumer goods (here agriculture and tourism are particularly important) as well as capital goods (here high tech such as software is particularly important). Ceteris paribus the current account balance would run more and more into deficit under these conditions incurring a higher amount of foreign debt. This would not be a matter of too much concern, if imports of capital

goods would lead to higher productivity rates in the transition countries. This logic is flawed on two grounds: First of all in practice the distinction between consumer goods and capital goods is less clear.[34] Secondly, rising productivity in transition economies would lead to further revaluations of the exchange rate and thereby perpetuate the constellation.[35] For the ERM-II accession problem in question this strategy is not an option unless one argues in favour of delayed entry, as Begg et al. (2001) do, in order to wait until real convergence has reached a level feasible with long run 'equilibrium' exchange rates. In general an overvalued entry exchange rate incurs the risk of being not able to maintain the exchange rate within the ERM band.

A further point for consideration in view of exchange rate policy concerns the role of capital controls. As all the countries under review here have agreed to full capital account liberalisation as necessity according to the Maastricht Treaty (chapter 4) apart from some exemptions regarding transition periods for buying land, there seems little room for manoeuvre in this respect. This does however not explicitly exclude one or the other form of taxation of short-term capital inflow, which appears to be feasible with current law (see Spahn 2002). Whether or not such a step would be viable depends on whether or not this is regarded as being in 'common interest' with the EU. So far the French move to pass some Tobin-tax like law is not enforced, because of reservations of EU partners. This might change in view of vulnerability of transition countries against financial and currency crises and in the common interest of stability. The same thought applies to certain Maastricht criteria (in particular inflation), which might be waived for the sake of common interest. These reflections are not considered for an assessment of options of choice for the new EU entrants, but they would make an overvalued entry possible and perhaps sustainable. For the reasons outlined above this would nonetheless neither be desirable, nor does this study intend to enter the sphere of political speculation.

The strategic choice under the assumption that the current restriction is in force is presented in Box 2. Here the entry strategy is related to the available monetary policy and its policy variable. The first row sketches the 'safe option' of a currency board. This entry strategy in its pure form implies that there is no room for domestic monetary policy. The hard peg shields the economy against a speculative attack from abroad, which is supported by the fact that financial and capital markets of the countries in question do not have the depth (i. e. quantity of securities in circulation) necessary for the absorption of huge short term capital imports. This does however not mean that these markets are protected against bank runs, which might spill over into currency crises. Such a

34 The author's anecdotal evidence points to ski-lifts in Zakopane imported from Austria.

35 This 'Ballassa-Samuaelsen-effect' features prominently in the transition literature despite the fact that it is a long run (based on PPP for tradable goods) empirical approach.

strategy is pursued by the Baltic States and Bulgaria and there is no reason to change that strategy, which imports external stability.

Box 2:
Entry strategy and policy options

	Monetary policy	Policy variable	country
Ucurrency board	Exchange rate targeting (hard peg)	none	Lithuania Estonia Bulgaria
Peg + managed float	Income targeting	i, P, e	Hungary
Managed float	Inflation targeting	i	Czech Republic
Delayed entry (free float)	direct inflation targeting	i	Poland

The second strategy is a soft peg of the currency against the Euro, which would mean an exchange rate strategy of a managed float after the time of crawling pegs with or without band seems to be over. Potentially a managed float strategy can include the latter arrangements. In general managed float is defined by active central bank interventions in the market of foreign exchange. The target would be income creation, i. e. GDP growth, and the policy variables would include the rate of interest (i), the price level (P) and the exchange rate (e). As this is a peg, the exchange rate is limited in being instrumental for income generation.[36] The aim for transition countries would be to keep the change rate slightly undervalued in order to support the competitiveness of exports and through this channel domestic income generation. Under this primary goal one can think of some levy for interest rate setting and inflation acceptance. On the other hand the inclusion of the exchange rate strategy of undervaluation might require a degree of stability, which might not be in accordance with income creation. Devaluations in order to achieve a more competitive exchange rate is counterproductive, because they would decrease the level of income relative to abroad and they might be also counterproductive with regards to the exchange rate strategy of undervaluation as such. Revaluation expectations would be destroyed and expectations of further devaluations might be nurtured. Under this entry regime the use of interventions for the sterilisation of short-term inflows of foreign capital is a central instrument of monetary policy. At the moment only Hungary can be attributed to such a strategy.

The third entry strategy of a managed float with an inflation target is pursued by the Czech Republic. This strategy is sometimes called ‘dirty float’, because an inflation tar-

36 This is the difference between transition countries and the US, where the FED can pursue a policy of income targeting without considering the exchange rate of the US Dollar.

get is announced and pursued in principle, but at the same time the Central Bank maintains a set of exceptions allowing for deviation from this policy rule. For the purpose of this study the escape clause regarding interventions in the market for foreign exchange is most important.[37] It means that the exchange rate is in practice part of the target. It remains to be seen, whether the Czech Republic switches to the Hungarian strategy or even to a currency board arrangement after the proclaimed free float strategy seems to become non-credible.

The only pure free-floating exchange rate is currently pursued by Poland. The rationale of this strategy is to prove the stability of the exchange rate even under the condition of not having this variable as a target. Also it potentially gives more freedom to the central bank, because all powers can be concentrated on inflation control. There are two obvious concerns related to this strategy: First of all there seems to be much more research needed about how far an efficient transmission channel through interest rate policy and quantitative monetary policy can be assumed for emerging market economies. It could well be that the exchange rate channel is the most effective way for ensuring macroeconomic stability. Secondly this strategy in the run up to European Monetary Union (EMU) is by definition only an interim strategy, as this is the only strategy clearly violating the ERM-II arrangement apart from unilateral Euroisation. The question is simply: how to return to the peg and even further how to return to the peg without hefty overvaluation? The answer to this question is very simple: Wait and see! Real convergence and structural changes might catch up to an extent, where one could trust that after a period of exchange rate stability PPP with EU level is achieved. The problem with this answer is, that such an approach normally operates with a time horizon of 10 years or longer. Only in the long run PPP equilibria can be sufficiently confirmed in theory and by empirical research so far (compare Driver/Westaway for a comprehensive overview). Whether Poland or other transition countries have that much time seems doubtful. It seems to be more likely that Poland will enter ERM-II with an overvalued currency, which would also lead to delay of catching up with Western income levels or it might even become victim of a speculative attack, as the high Zloty rate is not credible for the asset market.

V. Conclusions

This study looked at entry strategies of accession countries into Euroland. A variety of strategies is currently pursued and these strategies werea reviewed against the background of stylised facts and an estimated equilibrium exchange rate (FEER). Both back-

37 CNB, 4.4.02: ‘The Czech National Bank is today intervening on the foreign exchange market with the aim of weakening the Czech Koruna’s exchange rate.’

backgrounds came to the conclusion that the Zloty is overvalued and the Forint is now in tendency undervalued. The econometric FEER analysis is less clear, as the role of the trade deficit is less suggestive as compared to stylised facts. However, the policy implications seem to suggest that, given the advantages of an undervaluation strategy, the optimal entry strategy seems to be a policy of managed float combined with a soft exchange rate peg. Only Hungary pursues such a strategy. Given the tough implications of such an entry strategy this way might not be feasible for all the new EU members.

Two alternatives were discussed above: Currency board arrangements have proved to be credible in Bulgaria, Estonia and Lithuania. Small open economies under financial repression do apparently fare well with such a regime, which is in principle in accordance with the ERM-II requirements. Benefits, which could potentially be gained from switching to a managed float (such as sovereignty in monetary policy) have to be counterweighted against possible costs in terms of destroying the stability record of the recent past and thereby irritate exchange rate expectations of asset markets. The safe option is to maintain the currency board arrangements until the arrival in Euroland.

The second alternative is a free float entry strategy, which has been critically considered. Ultimately this strategy will delay and threaten the integration process. Poland and the Czech Republic are seen on the edge of the sustainability of this strategy or even in a critical state.

Finally a widespread reservation against an undervaluation strategy shall be addressed: The fear of competitive devaluations as experienced in the 1930s.[38] This fear is misleading in two respects. First of all this study had a small number of small economies under review. These economies have a clear goal, namely to join the mega-bloc economy Euroland. Secondly the entry strategy is limited in time as far as the entry date is determined, which looks like a foreseeable medium-term period of time. All this study intended to elaborate, was to identify the best possible start conditions for the new EU members.

38 The option of devaluations has been ruled out above anyway. This is the reason why the proposed strategy here is labelled as ‘stability oriented undervaluation’.

References

Barrel, Ray and Simon Wren-Lewis (1989): Fundamental Equilibrium Exchange Rate for the G7. CEPR Discussion Paper No. 323. Centre for Economic Policy Research. London.

Bayoumi, Tamim et al. (1994): The Robustness of Equilibrium Exchange Rate Calculations to Alternative Assumptions and Methodologies, in: Williamson, John (eds.), Estimating Equilibrium Exchange Rates. Institute for International Economics. Washington.

Begg, David et al. (2001): Sustainable Regimes of Capital Movements in Accession Countries. CEPR, http://www.bundesbank.de/.

Bofinger, Peter and Timo Wollmershäuser (2002): EU Accession Countries: What Path to successful EMU Membership, in: Adalbert Winkler (eds.), Banking and Monetary Policy in Eastern Europe. Palgrave.

Bratkowski, Andrzej and Jacek Rostowski (2001): Why Unilateral Euroization Makes Sense for (some) Applicant Countries – a response, with particular reference to Poland, mimeo.

Brüggemann, Axel and Thomas Linne (2002): Are the Central and Eastern European Transition Countries still vulnerable to a Financial Crisis? Results from the Signals Approach, Halle Institute for Economic Research. Discussion Papers No. 157.

Church, Keith (1992): Properties of the Fundamental Equilibrium Exchange Rates in Models of the UK Economy. National Institute Economic Review, No. 141.

Clark, Peter and Ronald MacDonald (1998): Exchange Rates and Economic Fundamentals: A Methodological Comparison of BEERs and FEERs. IMF Working Paper 98/67. International Monetary Fund. Washington.

Deutsche Bundesbank (1998): Monthly Reports, 10/1998.

Driver, Rebecca and Peter Westaway (2001): Concepts of Equilibrium Real Exchange Rates. Bank of England, mimeo.

Faruqee, Hamid and Guy Debelle (1998): Saving-Investment Balances in Industrialised Countries: An empirical Investigation, in: Isard, Peter and Hamid Faruqee (eds.), Exchange Rate Assessment: Extensions to the Macroeconomic Balance Approach. IMF Occasional Paper No. 167.

Giorno, C. et al. (1995): Potential Output, Output Gaps and Structural Budget Balances. OECD Economic Studies N24.

Goldstein, M. and M. Kahn (1985): Income and Price Effects in Foreign Trade, in: Jones R. Kenen P. (eds.), Handbook of International Economics, Volume 2. Elsevier Science Publishers B.V.

Hristov, Kalin (2002): FEER and Currency Boards: Evidence from 90's. Bank of England, mimeo.

International Monetary Fund (2001): Annual Report on Exchange Arrangements and Exchange Restrictions. Bank of England. Washington, mimeo.

Masson, Paul (1998): A Globally Consistent Conceptual Framework, in: Isard, Peter and Hamid Faruqee (eds.), Exchange Rate Assessment: Extensions to the Macroeconomic Balance Approach. IMF Occasional Paper No. 167.

Orlowski, Lucjan (2000): A Dynamic Approach to Inflation Targeting in Transition Economies, www.zei.de.

Rawdanowicz, Łukasz (2002): Poland's Entry to EMU. ING Barings Conference, mimeo.

Spahn, Peter (2002): On the Feasibility of a Tax on Foreign Exchange Transactions. Report to the Federal Ministry for Economic Co-operation and Development of Germany. University of Frankfurt, Frankfurt/Main.

Williamson, John and Molly Mahar (1998): Current Account Targets, in: Wren-Lewis, Simon and Rebecca Driver (eds.), Real Exchange Rates for the Year 2000, Policy Analyses in International Economics 54. Institute for International Economics. Washington.

Williamson, John (*ed.)* (1994): Estimating Equilibrium Exchange Rates. Institute for International Economics. Washington.

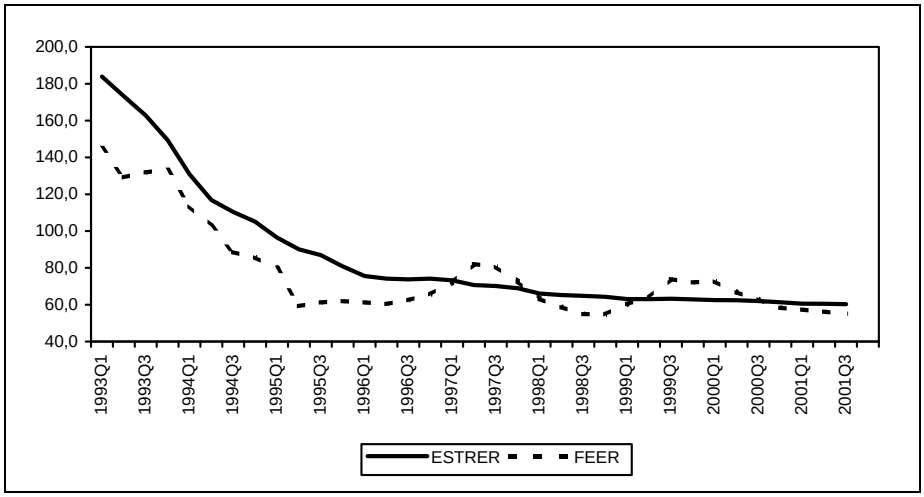
Wren-Lewis, Simon and Rebecca Driver (1998): Real Exchange Rates for the Year 2000, Policy Analyses in International Economics 54. Institute for International Economics. Washington.

Wren-Lewis, Simon et al. (1991): Evaluating the UK's Choice of Entry Rate into the ERM. The Manchester School, Vol. LIX Supplement.

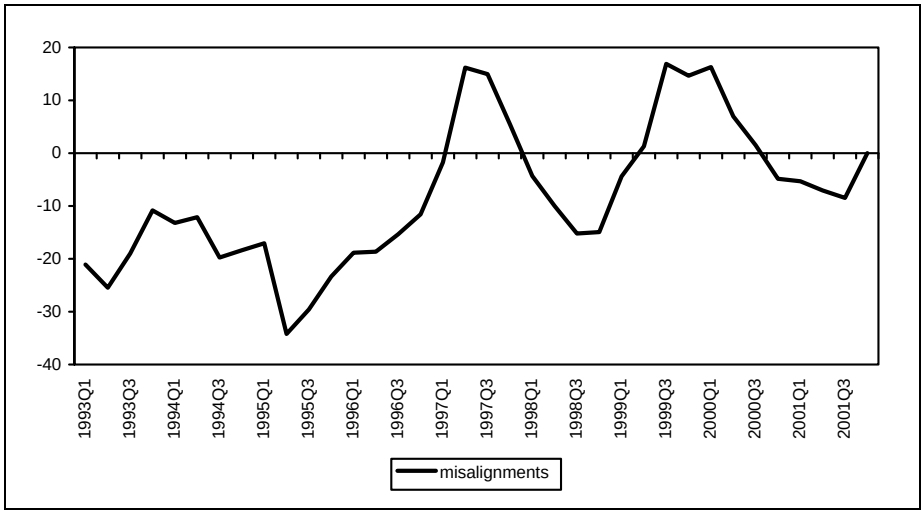
Appendix

Fundamental equilibrium exchange rates (FEERs) and misalignments

1. Estonia

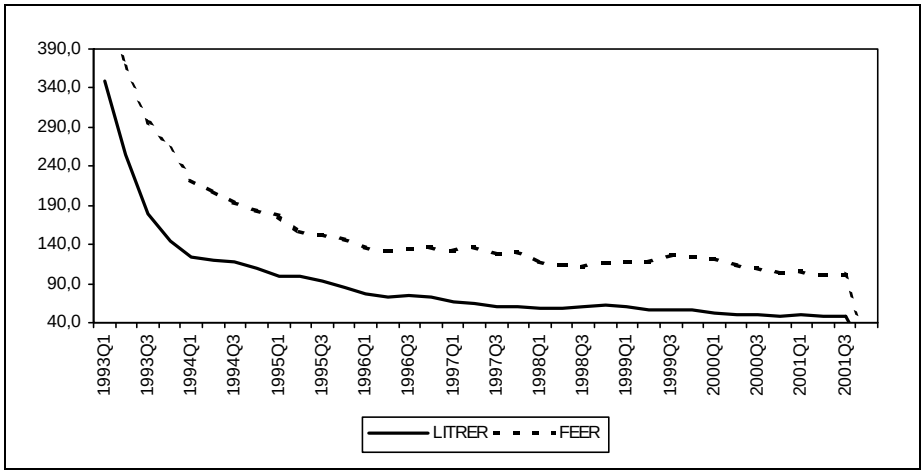


Note: January 1995 = 100.



Misalignment: (FEER - RER) * 100 / RER.

2. Lithuania



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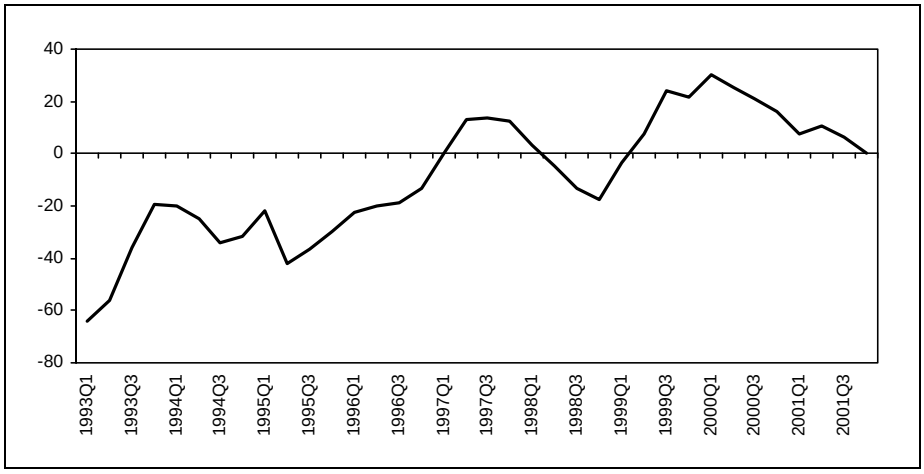
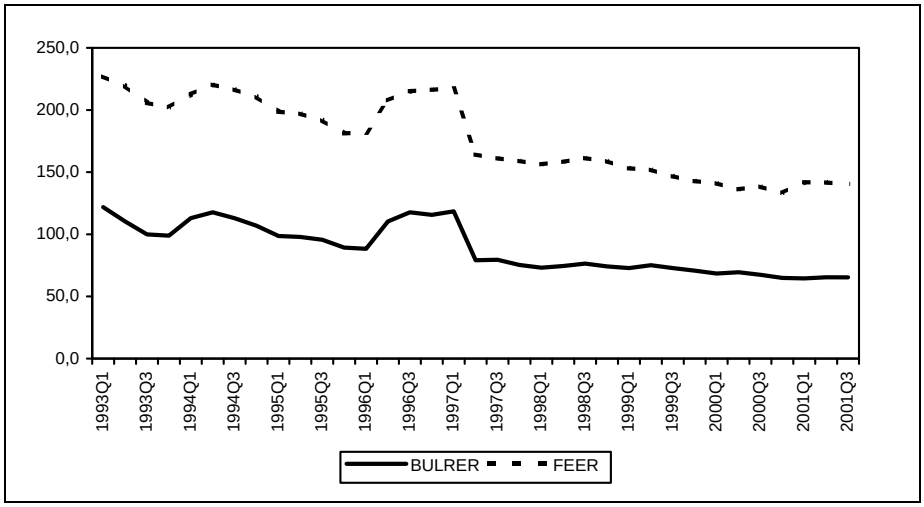


Misalignment: (FEER - RER) * 100 / RER.

3. Bulgaria



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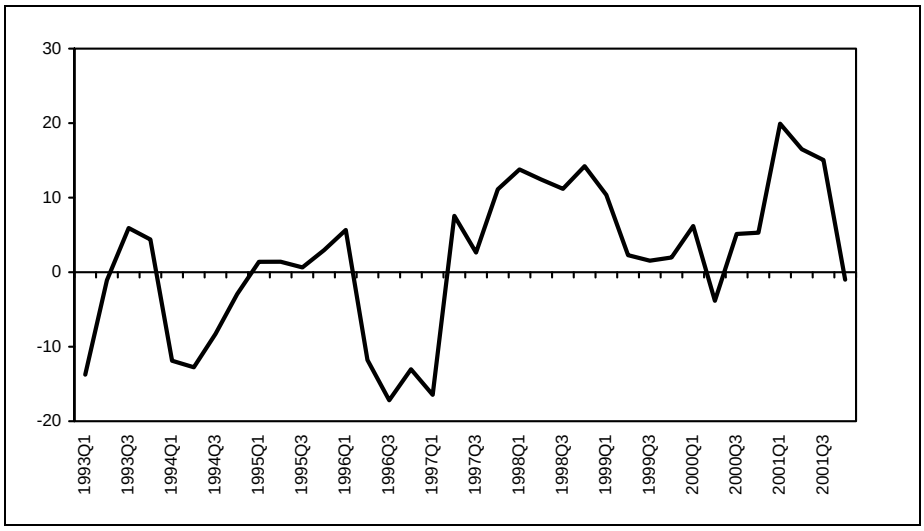
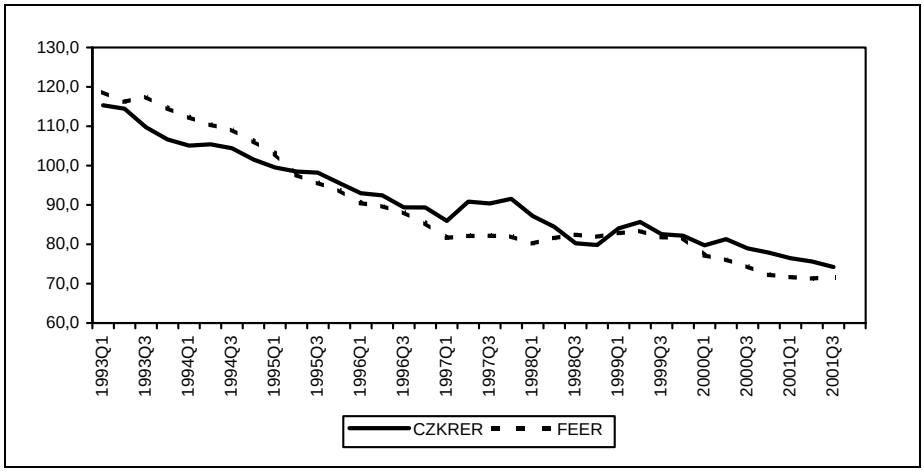
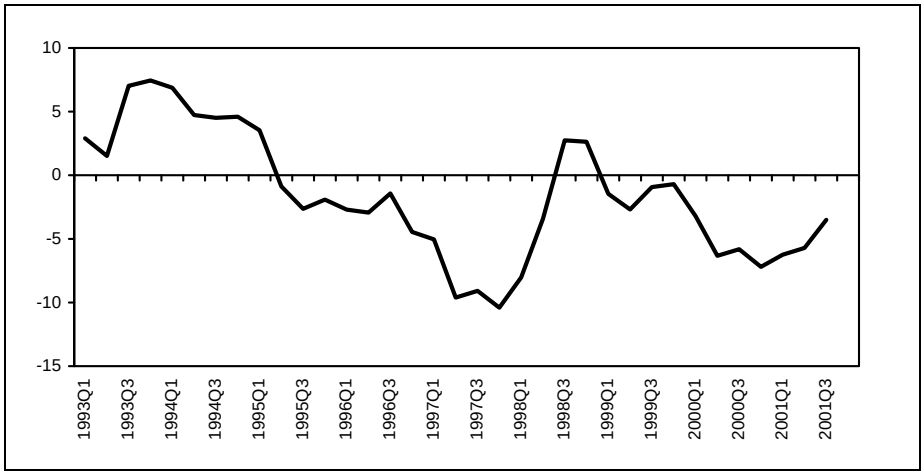


Misalignment: (FEER - RER) * 100 / RER.

4. Czech Republic

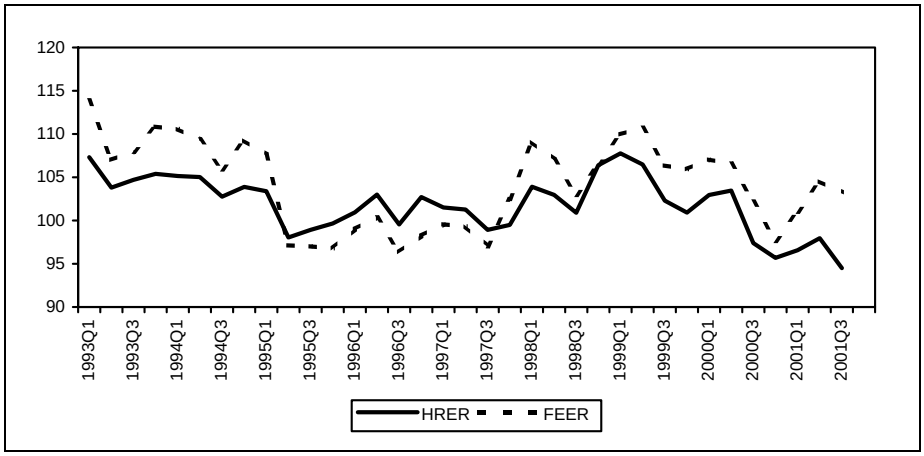


Note: January 1995 = 100.



Misalignment: (FEER - RER) * 100 / RER.

5. Hungary



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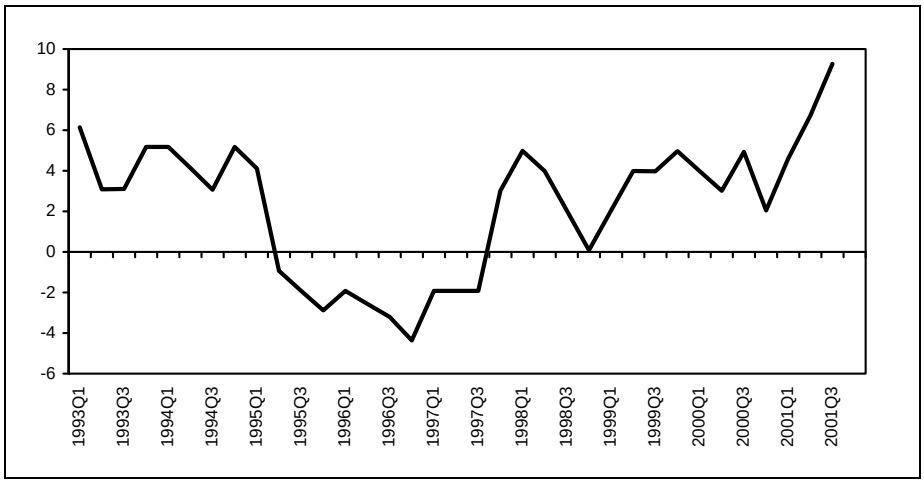

Misalignment: (FEER - RER) * 100 / RER.

Major studies by the IWH on financial crises

Are the Central and Eastern European Transition Countries still vulnerable to a Financial Crisis? Results from the Signals Approach. *Axel Brüggemann and Thomas Linne*. Bank of Finland Institute for Economies in Transition (BOFIT) Discussion Paper No. 5, 2002.

Die Bestimmung des Risikopotenzials von Finanzkrisen anhand eines Frühindikatorensystems. *Axel Brüggemann and Thomas Linne*. Nomos, Baden-Baden 2002.

Weiterentwicklung und Anwendung eines Frühwarnindikatorensystem zur Betrachtung und Bewertung von Finanzkrisen in EU-Beitrittskandidatenländern und ausgewählten Staaten Mittel und Osteuropas. *Axel Brüggemann and Thomas Linne.* IWH-Sonderheft 4/2001. Halle.

Financial crises in transition countries. Conference proceedings. With contributions by *Zsofia Àrvai; János Vincze; Marcel Fratzsche; Roland Beck; Lúcia Vinhas de Souza; Àdám Szeidl; Marek Jaarocinski and Jozef Maluch*. IWH-Sonderheft 6/2000. Halle.

Währungskrisen in Mittel- und Osteuropa. *Axel Brüggemann; Hubert Gabrisch; Martina Kämpfe; Thomas Linne; Lucjan Orlowski and Johannes Stephan.* Nomos, Baden-Baden 2000.