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Accession and Real Exchange Movements: A Comparison

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Abstract:

This paper analyzes disparities among nominal and real exchange rate movements across the Central and Eastern European (CEE) countries from 1991 to 1997. The method of analyzing such processes is to examine whether the differentials of exchange rate changes converge or diverge over time. Currently ten CEE countries have formally applied for full membership in the European Union. The results support convergence in general, but indicate a wide disparity in the degree of convergence. From the real exchange rate standpoint the paper identifies the best candidates to join the European Union in the first round of accession.

Keywords: exchange rates, convergence, transition, European Union

JEL Classification: C23, E65, F31

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1. Introduction

This paper analyzes exchange rate movements across the Central and Eastern European (CEE) countries from 1991 through the end of 1997 by employing econometric tools supported by economic theory on exchange rate convergence. Investigating exchange rate convergence should enhance our knowledge of how transition economies adjust from an academic point of view. It should also provide concrete evidence and enhanced policy tools, when addressing the issue of the accession of the CEE countries to the European Union.

Any country in transition must undergo a stage of macroeconomic stabilisation, which is inevitably accompanied by large shocks to macroeconomic fundamentals. The nature and magnitude of these disruptions affect the progress of economic development. Research into the success of the stabilisation programs in transition economies is especially important for policy makers. Owing to the relative openness and the close economic relations between transition economies in Central and Eastern Europe and between these countries and the EU, the exchange rate and the exchange rate regime play an important role in economic development.

A fundamental issue is how the exchange rates themselves evolved during the transition process. Koch (1997) reviews and analyzes monetary and exchange rate policy issues in selected European transition countries and provides a timely and thorough survey of the monetary practices in the Czech Republic, Poland, and Hungary with cross references to other transition countries. Currently ten countries in Central and Eastern Europe have formally applied for full membership in the European Union. The issue of accession is debated in the Transition Report (1997) of the EBRD which also provides extensive material for the discussion of this question.

This paper aims to address the question of whether the transition countries have achieved exchange rates' development eventually leading to a certain degree of convergence. The convergence of exchange rates will be analyzed by using the concept of the so-called σ-convergence outlined in the seminal paper by Barro and Sala-i-Martin (1991). Transposed from the original application to growth of output, σ-convergence in the current context implies that convergence of exchange rates should be reflected in a reduction of the exchange rate differentials across countries over time.

depreciated to a greater or lesser extent over the researched period. The Baltic countries offer interesting picture of evolution, as its countries were severing monetary ties with the former Soviet Union while gradually establishing different exchange rate regimes.

In order to see the real evolution of the national currencies we explore the real exchange rates as well. For the purpose of econometric analysis the real exchange rates (Q_t) of national currencies in relation to the US Dollar and the Deutsche Mark were constructed in the usual manner as

$$d_{i,t} = X_{i,t} - \overline{X_t} \qquad (1)$$

where Q_t is the defined real exchange rate, E_t is a nominal exchange rate, CPI_t is a domestic consumer price index (CPI), and CPI_t^* is a foreign CPI.

Figures 3 and 4 illustrate the evolution of currencies in real terms. The real exchange rates are plotted in levels. The currencies of the countries belonging to the Visegrad Four continuously appreciated in real terms over time, but the extent of appreciation varied. Koch (1997) claims that the empirical evidence indicates that the current level of the real effective exchange rates does not appear to be seriously out of line with the underlying fundamentals of the Czech Republic, Poland, and Hungary. The Baltic countries uniformly experienced a massive real appreciation during 1992. This movement, over next two years, transformed into an almost stable real exchange rate. The Balkan countries together with Slovenia offer the most varied picture of currencies which appreciated and depreciated in real terms over time. Koch (1997) argues that in general terms, in most of the CEE countries occurred a period when real appreciation has been stronger when measured in consumer rather than producer prices. The two most important factors that may explain such difference are phasing-out of consumer subsidies (affecting CPI) and an increased demand for services (affecting both CPI and PPI) combined with an initially small services sector.

At the beginning of the transition process most of the CEE countries devalued their national currencies. Halpern and Wyplosz (1995) suggest four main factors for the initially large undervaluation of transition currencies: (i) the existence of monetary overhang, (ii) pent-up demand for foreign assets, (iii) the lack of credibility on the part

The significance of the matter is related not only to the economic performance of each country but also to the expectations of the average citizen. Both aspects are crucial to the assessment of convergence with respect to the possible accession of the countries in question into the European Union. Therefore, studying whether and how the transition economies managed to reduce disparities among themselves seems to be a relevant issue to investigate. An innovative way of analysing this process is to examine whether the differentials of exchange rate changes converge or diverge over time.

The paper is organized as follows. Section 2 provides a motivation for the research. Section 3 describes the data and conceptual approach. Section 4 describes the econometric methodology used in testing the convergence of exchange rate differentials. Section 5 presents the empirical findings. A brief conclusion follows.

2. Motivation

Currently ten countries in Central and Eastern Europe have formally applied for full membership in the European Union. The transition process in Central and Eastern Europe provides a unique opportunity to carry out quantitative analysis of exchange rate convergence within distinctive groups of the CEE countries. This project addresses the question as to whether the transition countries have achieved exchange rate development that would eventually lead to convergence with the countries within the European Union. This study is targeted on the evolution of exchange rates in the countries that have applied for accession. The formation of groups of countries has to be related to the choice of exchange rate regime. Investigating to what an extent the exchange rate regime is partially susceptible to support convergence or to prevent it, can enhance our knowledge of the functioning of transition economies from an academic point of view and can also provide concrete evidence and enhanced policy tools, when addressing the issue of the European Union accession.

Figures 1 and 2 comprehensively document the evolution of nominal exchange rates in all the countries under consideration from 1991 to 1997. The Czech Crown remained quite stable and depreciated in connection with the financial crisis in summer of 1997. The nominal exchange rates of Poland and Hungary depreciated over time. The Slovak Crown was devalued by 10% in July 1993, but remained more or less stable during the period. The nominal exchange rates of Slovenia and other Balkan countries also

topic in transition economies, its choice resulted from economic and/or political forces dominating each country at a time.

Thus, from the long-term perspective an exchange rate regime (typical for a transition economy) does not play that important role because it is a transitive feature. However, from the short-term perspective it is an important issue. An optimal exchange regime is supposed to limit instability of the local currency without preventing economic growth at the same time. The reasons for numerous changes in exchange rate policies appear to have a common purpose that concerns inflation. The target is either to lower inflation directly or to stabilize inflationary expectations. The "tighter" exchange rate regimes, like fixed or pegged regimes, can be understood as vehicles to impose price discipline or to reduce inflation or inflationary expectations. From this point of view it is legitimate to ask whether inflation stabilization correlates with successful convergence.

In the future a crucial issue will be to harmonize exchange rate policies of the CEE countries with those prevailing in the European Union and especially with the forthcoming European Monetary Union. The EU countries participating in the European Monetary System (EMS) have already a record of their exchange rates convergence. Sarno (1997) found evidence of long-run convergence for both nominal and real exchange rates that was more frequent in cases of countries that adhered to the Exchange Rate Mechanism (ERM) than for the non-ERM countries. This suggests that the ERM of the EMS has been effective in reducing the tendency towards exchange rate misalignment, at least among its own members. The results therefore suggest that a significant increase in policy convergence has been achieved within the EMS.

In case of the CEE countries a relevant and related question arises. With so many varieties of exchange rate regimes does the degree of convergence depend on a particular exchange rate regime? Or in other words, is convergence faster in countries that favoured some kind of tight exchange regime opposite to a rather free one? The following analysis aims to provide answers to these questions.

3. Data and Definitions

The study uses data from the following eleven countries: the Czech Republic, Slovakia, Hungary, Poland, Slovenia, Romania, Bulgaria, Albania, Estonia, Latvia, and Lithuania. The time span of the data is from January 1991 to December 1997. The monthly

of the new authorities, and (iv) total uncertainty about the appropriate equilibrium exchange rate and, therefore, the tendency for risk-averse authorities to err on the side of undervaluation rather than overvaluation. The crucial reason for undervaluation seems to be more simple: the rates were undervalued in order to be long lasting and able to promote exports of local companies while discouraging mainly imports of consumer goods.

From the very beginning of the transition process in Central and Eastern European economies, exchange rate behaviour and associated exchange rate regimes were closely monitored. The choice of a particular exchange rate regime is one of the major policy decisions countries in transition had to make.[1] Exchange regimes and the evolution of nominal exchange rates relative to major currencies differ widely across these countries. The Czech Republic and Slovakia favoured the semi-fixed regime of a basket peg, while Hungary moved from an adjustable peg to a pre-announced crawling band in 1995, and Poland moved from a fixed basket peg to a crawling basket peg. Many other countries in the region favoured a managed float or currency board. Table 1 summarizes the types of exchange rate regimes that the countries involved in this analysis have adopted since their economic transition.

The choice of an exchange rate regime is an institutional decision of each country that often depends to various extent on the advice of an international institution (the IMF for example). Any form of non-free-float exchange regime (i.e. fixed, pegged, crawling-peg, managed float etc.) requires a certain degree of commitment from the monetary authorities. Such a commitment is a way of creating a consistent policy and establishing confidence in the policy actions of monetary authorities. For example the peg to a single currency may be the exchange regime with the greatest potential to gain credibility because it represent the simplest rule that is clear and understood by both the policy makers and the public.

Although the problem of exchange regime choice is of major concern for transition countries, the optimality of any such choice is subject to debate. The reason stems from two stylized facts: (i) no exchange regime has proven to be everlasting, and (ii) countries have tended to shift back and forth between exchange rate regimes. Despite the fact that the suitability of any adopted exchange rate regime remains an important

[1] For further discussion see Edison and Melvin (1990), Edwards (1993), Quirk (1994), Begg (1996), and Sachs (1996), among others.

averages of exchange rates of respective national currencies were obtained from the Bank for International Settlements, Basel, the International Monetary Fund's International Financial Statistics, and the EBRD. The monthly consumer price indices were obtained from the latter two sources. The bulletins of the national banks of each country in question were consulted as well.

The prevalent view in the literature is that floating exchange rates follow a random walk (see Mussa, 1984; Meese and Singelton, 1982; Taylor, 1995).[2] Such behaviour was not found in case of exchange rates of transition economies. This is apparently due to the nature of their exchange rate regimes and the fact that these economies are still undergoing huge structural shifts. The data (exchange rates) are not stationary but are integrated of degree one. The analysis is therefore performed on the changes in exchange rates between two consecutive periods. These changes are analogous to the first logarithmic differences. Such a method of how to achieve stationarity is preferred to that of detrending the data. By their nature the exchange rates contain polynomial trends of different degrees and thus a formerly described method is preferred to the latter one.

For the purpose of further analysis the countries were pooled in several logically differentiated groups. There are 84 observations per country and the dimension of each panel data structure changes accordingly. Table 2 shows all the countries that were included in our analysis and describes the composition of the various groups for which we tested the convergence hypothesis.

The institutional groups are defined with respect to eventual accession. Three groups were formed with respect to the analyses of progress in economic and political transition made by the EBRD about ten countries that have applied for the membership in the European Union. According to the European Commission five of the countries were identified as leading candidates in terms of the progress they have made so far. These are the Czech Republic, Hungary, Poland, Slovenia, and Estonia and form the First Round group. Removing Estonia makes a control group because this country maintained currency board exchange regime throughout the researched period.[3] The Second Round group was formed from Bulgaria, Latvia, Lithuania, Romania, and Slovakia.

[2] However, no strong statistical evidence has emerged to confirm or refute this view so far (see Brock, Hsieh, and LeBaron (1993), p. 130).

[3] Elimination of Estonia from the First Round group is purely institutional step in this analysis.

Other groups were formed on the basis of the exchange rate regime prevailing in each country for the time span of our analysis. There are two groups with a peg regime. One group, Peg A, contains Slovakia, Hungary, Poland, and Latvia. The other group, Peg B, includes also the Czech Republic. This country abandoned currency basket peg regime in May 1997 and therefore two peg groups were created. There is one group of countries that maintains fixed regime. The group is called Fix and contains Estonia and Lithuania. At last, we formed two groups of countries with float regimes. The Float A group contains Albania, Romania, Slovenia, and Bulgaria. The control Float B group in addition includes also the Czech Republic. Bulgaria is included in both groups because this country changed its regime from the managed float to a currency board only recently in July 1997. Pooling countries in certain groups is meant to show not only the consistency, but also the sensitivity of our results.

From the Figures 1 to 4 it can be detected that few currencies experienced structural breaks. The most notable examples are Albania and Bulgaria. These breaks were associated with a change in the exchange regime of respective currency that can be traced from the Table 1. However, such breaks occurred at the beginning of the range for which the data were available. The Vogelsang (1997) Sup Wald (or $SupF_t$) test for detecting structural break was used as a tool to investigate this issue on levels of exchange rates for individual countries. This test is non-restrictive and allows for unit roots, polynomial trends, and serial correlation. Vogelsang (1997) reports critical values for both 1 and 15 percent trimming that is required for asymptotic results being non-degenerate. Procedure that allowed for 1 percent trimming suggested that few breaks occurred but they were not considered to be important because of their occurrence at the very beginning of period under consideration. Thus, they played only a minor role from the point of further evolution of a particular currency. 15 percent trimming that enables greater power to detect breaks near the middle of the sample yielded statistically insignificant results. However, the point is that the convergence analysis was performed on changes in exchange rates between two consecutive periods (hence on stationary data). In this case testing for breaks yielded statistically insignificant results and therefore structural breaks in individual countries were not incorporated into the tests for convergence performed on panel data.

A detailed description of the method to test for convergence follows in the next section. That section concentrates on investigating logically structured groups of

countries to see how the differences in exchange rate differentials evolved over time, i.e. whether they increased or diminished.

4. Convergence of Exchange Rates: Methodology

The following econometric methodology, which was exploited in several published empirical analyses, utilizes a combination of cross-sections of individual time-series.[4] A panel data analysis of the convergence of exchange rate differentials is conducted in order to fully exploit the effect of cross-variances in a pooled time series of moderate length. Previous econometric research has demonstrated the specific advantages of utilizing panel data in studying a wide range of economic issues. As shown by Levin and Lin (1992), the statistical power of a unit root test for a relatively small panel may be an order of magnitude higher than the power of the test for a single time series.

The analysis is performed for two types of exchange rates (X_t) which are measured as a change in the respective exchange rate over two successive periods. The individual nominal change in the exchange rate between two consecutive business days is defined as

$$nX_t = (MI_t / MI_{t-1}) - 1 \qquad (2)$$

where E_t denotes the nominal exchange rate at time t. In a consistent manner we define the change in the real exchange rate as

$$rX_t = ((MI_t / CPI_t)/(MI_{t-1} / CPI_{t-1})) - 1 \qquad (3)$$

[4] Ben-David (1995, 1996) performed an analysis of real per-capita income growth on numerous countries. Koèenda and Papell (1997) recently applied this methodology to study inflation convergence in the European Union. Papell (1997) tested purchasing power parity for the real exchange rates of 20 developed countries.

where Q_t is a real exchange rate at a time t as defined earlier in equation (1).

We model the evolution of exchange rates (X_t) for a group of i individual countries with observations spanning over t time periods in the following way:

$$X_{i,t} = \alpha + \phi X_{i,t-1} + \varepsilon_{i,t} \quad (4)$$

The fact that the exchange rate is modelled as an autoregressive process is based on the common practice in the literature and does not represent any theory of how this variable is determined. It also constitutes a suitable form for the convergence test introduced later in this section.

The convergence measure adopted here is based on a relationship that describes the dynamics of exchange rate differentials in a panel setting. Formally, we can transcribe this as follows:

$$X_{i,t} - \overline{X_t} = \phi\left(X_{i,t-1} - \overline{X_{t-1}}\right) + \varepsilon_{i,t} \quad (5)$$

where $\overline{X_t} = \frac{1}{n}\sum_{i=1}^{n} X_{i,t}$. In the presence of pooling, the intercept α vanishes since, by construction, the exchange rate differentials have a zero mean over all the countries and time periods. How the countries are pooled into different groups was described in detail in the previous section.

The convergence issue is typically addressed using the concept of σ-convergence outlined by Barro and Sala-i-Martin (1991, 1995). Translated from the original application to growth of output, σ-convergence means that convergence of exchange

unit root is rejected in favour of the alternative of level stationarity if $(\phi - 1)$ is significantly different from zero or, implicitly, if ϕ is significantly different from one.

The number of lagged differences (k) is determined using the parametric method proposed by Campbell and Perron (1991) and Ng and Perron (1995). An upper bound of the number of lagged differences k_{max} is initially set at an appropriate level.[7] The regression is estimated and the significance of the coefficient γ_j is determined. If the coefficient is not found to be significant, then k is reduced by one and the equation (6) is reestimated. This procedure is repeated with a diminishing number of lagged differences until the coefficient is found to be significant. If no coefficient is found to be significant in conjunction with the respective k, then $k = 0$ and a standard form of the Dickey-Fuller test is used in the analysis. A ten- percent value of the asymptotic normal distribution (1.64) is used to assess the significance of the last lag. The advantage of this recursive t-statistic method over alternative procedures where k is either fixed or selected in order to minimize the Akaike Information Criterion is discussed in detail by Ng and Perron (1995).

Recent work has established that a sub-unity convergence coefficient ϕ is indeed a robust indication of convergence which is respectively true for divergence (when $\phi > 1$). Ben-David (1995) performed 10,000 simulations for each of three possible cases where data should portray the processes of convergence, divergence, and neutrality. His numerous simulations provide ample evidence of convergence or divergence when these features truly reflect the situation. When neutral data with no strong inclination in either direction are used, the convergence coefficient tends towards unity.

To evaluate the statistical significance of the convergence coefficient ϕ we cannot use the standard critical values which are used when such an analysis is conducted on panel data. The common critical values for panel unit root tests tabulated by Levin and Lin (1992) do not incorporate serial correlation in disturbances and are, therefore, incorrect for small samples of data. Using the Monte Carlo technique, Papell (1996) tabulated critical values taking serial correlation into account and found that, for both quarterly

[7] $k_{max} = 7$ since monthly data are used. We also wanted to incorporate up to half-year lags between monetary and real sides of economy.

rates should be reflected in a reduction in the exchange rate differentials across countries over time. Such a diminishing dispersion is typically measured by the sample variance of the respective time series. However, as Quah (1995) points out in his study on growth convergence empirics, "what matters, instead, is how the entire cross-section behaves". Therefore, we study the convergence of exchange rates using panel data that combine time series and cross-section data.

Convergence in this context requires that exchange rate differentials become smaller and smaller over time. For this to be true, ϕ must be less than one. On other hand, ϕ greater than one indicates a divergence of exchange rate differentials. A detailed introduction to this concept is supplied in the Technical Appendix. Further, one of sufficient conditions for convergence in our context is, that sample average of squared return differentials (i.e. sample dispersion) must decrease over time.[5]

The convergence coefficient ϕ for a particular group of countries can be obtained using the Dickey and Fuller (1979) test on equation (5). The augmented version of this test (ADF) is used in order to remove possible serial correlation from the data.[6] Since the analysis is performed on panel data of exchange rate changes, there will be no intercept by construction. Denoting the exchange rate differential as $d_{i,t} = X_{i,t} - \overline{X_t}$, and its difference as $\Delta d_{i,t} = d_{i,t} - d_{i,t-1}$, the equation for the ADF test is written as

$$\Delta d_{i,t} = (\phi - 1) d_{i,t-1} - \sum_{j=1}^{k} \gamma_j \Delta d_{i,t-j} + z_{i,t} \qquad (6)$$

where the subscript i = 1,...,k indexes the countries in a particular group. Equation (6) tests for a unit root in the panel of exchange rate differentials. The null hypothesis of a

[5] See seminal paper on convergence of output by Barro and Sala-i-Martin (1992).

[6] It was found that, in cases of both nominal and real exchange rates, the correlation sensitivity threshold was about 0.50. Employing the ridge regression of Hoerl and Kennard (1970) compensated for the encountered multicollinearity.

The results of convergence tests for all constructed groups of countries are presented in four tables. Tables 3 and 4 show results for the nominal exchange rate differentials as an introduction to the principal part of real exchange rates. The results of the test performed on exchange rate differentials expressed in US Dollars and Deutsche Marks show that the values of coefficient ϕ are very similar, but not completely identical. The coefficients are lower than and significantly different from one. Thus, the differences in the differentials of all groups clearly diminish over time. From the construction of the test it follows that, as the value of the statistically significant coefficient ϕ approaches unity in absolute value, the convergence effect decreases. Implicitly, as the value of the statistically significant coefficient ϕ approaches zero, the convergence effect becomes greater. Due to the fact that ($\phi<1$) *per se* does not necessarily imply convergence, the sample average of squared return differentials (i.e. sample dispersion) was computed as well. We did not reject hypothesis that sample dispersion was decreasing over time for all groups of countries listed in Table 2.

When we compare the two groups seeking accession, we can see that both of them show comparable speed of convergence. However, the Second Round group fares somehow better. Performance of the groups divided on the base of the exchange rate regime is shown in the second part of both tables. Countries with a float regime converge at the fastest pace, followed by those with a fixed regime. The countries favouring peg regime stand at the last place.

The primary results of the convergence test on differentials of real exchange rates are presented in Tables 5 and 6. The countries of the First Round converge at slower pace than those from the Second Round. However, when Estonia is removed from the First Round group, than this group surpasses the Second Round group. These results may be caused by two reasons. First one is an extent of economic integration of the CEE countries with the EU. Such an extent should be greater for the countries of the First Group. This effect mirroring the real side of the economy should be even more pronounced in the later years of transition. The second reason stems from the monetary side and reflects the beginning situation when exchange rates and inflations in particular countries started to evolve from very different conditions. Unfortunately, both two effects tend to cancel each other with respect to the speed of convergence.

and monthly data in his data sets, the critical values were higher than those reported in Levin and Lin (1992). A similar result was found in Koèenda and Papell (1997).

Because of these findings, the exact finite sample critical values for the resulting test statistics were computed using the Monte Carlo method in the following way. Autoregressive (AR) models were first fit to the first differences of each panel group of exchange rate differentials using the Schwarz (1978) criterion to choose the optimal AR models. These optimal estimated AR models were then considered to be the true data generating process for errors of each of the panel group of data. Finally, for each panel, pseudo samples of corresponding size were constructed employing the optimal AR models described earlier with iid $N(0,\sigma^2)$ innovations. The variance σ^2 is the estimated innovation variance of a particular optimal AR model. The resulting test statistic is the t-statistic on the coefficient $(1-\phi)$ in equation (6), with lag length k for each panel group chosen as described above.

This process was replicated 10,000 times and the critical values for the finite sample distributions were obtained from the sorted vector of such replicated statistics. The derived finite sample critical values are reported for significance levels of 1%, 5%, and 10% in the tables, along with the results of the ADF test conducted on different panel groups in the respective time periods.

5. Empirical Findings

Despite the fact that the convergence of real exchange rates is the purpose of this analysis, we report results of nominal convergence as well. The reason is to provide reader with an institutional overview as well as with the data. One reason why it is legitimate to analyse the nominal convergence is that in theory real exchange rate should behave the same way no matter whether the nominal rate is pegged or not because the price level should move as well. In practice, however, price level movements are much slower than nominal exchange rate movements and the convergence should be different as well. The second reason is that by fixing or pegging nominal exchange rate the authorities aim to lower inflation. By definition the fixed or pegged regimes should affect real exchange rate changes in a different manner than the floating regime.

in the CEE countries than that in Germany or the USA. This is connected with the process of decreasing disparities of the inflation rates among the CEE countries and Germany. Only after the inflation rates in transition economies come near to that of Germany, there will be more pronounced convergence of the nominal exchange rates.

There is certain portion of institutional noise that has to be taken into account when presenting results of our analysis. Changes in exchange regimes are the most important ones. In addition, at times exchange rates in some transition economies were official rates for currencies that were not fully convertible yet and thus were not really free market exchange rates. Non-negligible effects certainly also played wild Ponzi games in Albania and Bulgaria. Such pyramid schemes considerably disturbed the financial sector and, naturally, the exchange rates as well. To analyze the hypotheses outlined above is a task for further research.

6. Concluding Comments

The results support convergence in general. However, the findings seem to indicate that the answer to the question of convergence is far from obvious and may not be the same for all countries (or groups of countries).

When we compare two groups of countries seeking accession, we can see that both of them show comparable speed of convergence. When time span of the data is divided to two equal periods then the Second Round group converges during the earlier period of transition at the faster pace than the First Round group. The monetary effect representing the beginning conditions thus prevails since the degree of real integration was quite limited in that time. However, during the later period of transition the First Round group converges faster then the Second Round group. This is presumably due to the higher degree of real economic integration of the CEE countries with the EU that was achieved at the advanced stage of the transition period.

Performance of the groups divided on the base of the exchange rate regime significantly differs. Countries with a float regime converge at the fastest pace, followed by those with a fixed regime. The countries favouring peg regime are the slowest ones. The policy implication of these facts is that the countries with a float or fixed exchange rate regimes are cutting disparities among the exchange rates of their currencies faster than those with a peg regime.

In order to investigate the extent of both effects, the test was performed on First and Second Round groups again but this time the time span was divided to two periods of equal length of three and half years (1991:1 – 1993:6 and 1993:7 – 1997:12). The results are reported in Tables 7 and 8. For both currencies we can see that the Second Round group converges during the earlier period of transition at the faster pace than the First Round group. The monetary effect representing the beginning conditions thus prevails since the degree of real integration was quite limited in that time. However, during the later period of transition the First Round group converges faster then the Second Round group. This is presumably due to the higher degree of real economic integration of the CEE countries with the EU that was achieved at the advanced stage of the transition period.

Additional information about real convergence is contained in the second part of the Tables 5 and 6. When we compare countries according to their exchange rate regimes, then countries with the float regime show greater degree of convergence than those with fixed regimes. The groups of countries with peg regimes converge at the slowest pace. We conclude that the peg regime is the least effective regime to promote convergence in both nominal and real terms. On other hand, the float regime seems to be one that is most effective in this sense. Fixed regime lies between. The policy implication of these facts is that the countries with a float or fixed exchange rate regimes are cutting disparities among the exchange rates of their currencies faster than those with a peg regime.

Quite interesting conclusion stems from comparison of results that come from two different currencies in which exchange rates are expressed. The exchange rates in Deutsche Mark show higher degree of convergence than those expressed in US Dollars. The difference is not large but consistent across all the groups. This fact hints on the stabilizing effect of Deutsche Mark for the exchange rates of the CEE countries.

Convergence of nominal exchange rates is an indicator of increasing stability of the currencies. It is not an incidental event that majority of the CEE countries included Deutsche Mark in their exchange rate regimes in a form of direct peg or heavily weighted currency in a currency basket. This can be viewed from the perspective of eventual accession to EU and further joining the EMU. The policy implication is that convergence of exchange rates to some long-run equilibrium is likely to be faster in case of real exchange rates rather than nominal ones. The reason is a higher rate of inflation

Table 5
US Dollar Real Exchange Rates
Period 1991:1 - 1997:12

Group	No.	ϕ	t-stat(ϕ)	k	Critical Values		
					1%	5%	10%
Accession Rounds Groups							
First Round	5	0.5575[a]	-8.04	6	-2.74	-2.07	-1.70
First Round w/o Estonia	4	0.1959[a]	-10.80	4	-2.76	-2.05	-1.68
Second Round	5	0.2163[a]	-4.98	7	-2.95	-2.20	-1.77
Exchange Rate Regime Groups							
Peg (A)	4	0.6958[a]	-4.38	6	-2.91	-2.15	-1.71
Peg (B)	5	0.6806[a]	-5.13	6	-2.88	-2.10	-1.74
Fix	2	0.4440[b]	-4.11	4	-4.46	-2.39	-1.90
Float (A)	4	0.1028[a]	-4.82	7	-2.87	-2.07	-1.65
Float (B)	5	0.1758[a]	-7.22	6	-2.79	-2.05	-1.69

No. means number of countries in a particular group, k denotes number of lags.
a and b denote significance at 1% and 5% levels, respectively.

Table 6
Deutsche Mark Real Exchange Rates
Period 1991:1 - 1997:12

Group	No.	ϕ	t-stat(ϕ)	k	Critical Values		
					1%	5%	10%
Accession Rounds Groups							
First Round	5	0.5552[a]	-8.14	6	-2.86	-2.06	-1.64
First Round w/o Estonia	4	0.2008[a]	-10.88	4	-2.79	-2.05	-1.69
Second Round	5	0.2061[a]	-5.01	7	-2.90	-2.15	-1.70
Exchange Rate Regime Groups							
Peg (A)	4	0.6398[a]	-5.13	5	-2.87	-2.11	-1.73
Peg (B)	5	0.6239[a]	-5.96	5	-2.83	-2.11	-1.72
Fix	2	0.4395[b]	-4.10	4	-4.47	-2.43	-1.91
Float (A)	4	0.0978[a]	-4.86	7	-2.90	-2.15	-1.70
Float (B)	5	0.1807[a]	-7.28	6	-2.85	-2.09	-1.74

No. means number of countries in a particular group, k denotes number of lags.
a and b denote significance at 1% and 5% levels, respectively.

Table 3
US Dollar Nominal Exchange Rates
Period 1991:1 - 1997:12

Group	No.	ϕ	t-stat(ϕ)	k	Critical Values		
					1%	5%	10%
Accession Rounds Groups							
First Round	5	0.5152[a]	-5.16	5	-3.19	-2.41	-1.93
First Round w/o Estonia	4	0.5109[a]	-4.70	5	-2.81	-2.07	-1.69
Second Round	5	0.4188[a]	-5.35	6	-3.34	-2.28	-1.80
Exchange Rate Regime Groups							
Peg (A)	4	0.5216[a]	-6.71	5	-2.80	-2.05	-1.66
Peg (B)	5	0.5716[a]	-6.53	6	-2.98	-2.22	-1.80
Fix	2	0.4988[a]	-4.12	5	-3.77	-2.40	-1.93
Float (A)	4	0.2861[a]	-5.26	6	-2.98	-2.16	-1.74
Float (B)	5	0.3296[a]	-5.86	6	-3.40	-2.23	-1.82

No. means number of countries in a particular group, k denotes number of lags.
a denotes significance at 1% level.

Table 4
Deutsche Mark Nominal Exchange Rates
Period 1991:1 - 1997:12

Group	No.	ϕ	t-stat(ϕ)	k	Critical Values		
					1%	5%	10%
Accession Rounds Groups							
First Round	5	0.5107[a]	-5.20	5	-3.20	-2.41	-1.95
First Round w/o Estonia	4	0.5061[a]	-4.74	5	-2.94	-2.19	-1.75
Second Round	5	0.4122[a]	-5.37	6	-3.37	-2.29	-1.80
Exchange Rate Regime Groups							
Peg (A)	4	0.5234[a]	-6.71	5	-2.79	-2.06	-1.66
Peg (B)	5	0.5413[a]	-7.47	5	-2.88	-2.15	-1.70
Fix	2	0.4996[a]	-4.12	5	-3.81	-2.42	-1.95
Float (A)	4	0.2717[a]	-5.32	6	-2.84	-2.14	-1.72
Float (B)	5	0.3181[a]	-5.92	6	-3.33	-2.24	-1.82

No. means number of countries in a particular group, k denotes number of lags.
a denotes significance at 1% level.

Table 1
Exchange Rate Regimes

Country	Regime
Czech Republic	Fixed (basket peg) since January 1991 to May 1997 Float from May 1997
Slovakia	Fixed (basket peg) since January 1991
Hungary	Adjustable peg (basket peg) since before 1989 Pre-announced crawling band (peg) since March 1995
Poland	Fixed (basket peg) from January 1990 to October 1991 Pre-announced crawling peg from October 1991 to May 1995 Float within crawling band from May 1995 to January 1996 Pre-announced crawling peg from January 1996
Slovenia	Managed float from October 1991
Bulgaria	Managed float from February 1991 Currency board from July 1997
Romania	Managed float from August 1992
Albania	Managed float from July 1992
Estonia	Currency board from june 1992
Latvia	Managed float from July 1992 (in reality peg to SDR basket)
Lithuania	Float from October 1992 to April 1994 Currency board from April 1994

Table 2
Groups of Countries in Each Panel Data Set

Group	No.	Countries
Accession Rounds Groups		
First Round	5	Czech Republic, Hungary, Poland, Slovenia, Estonia
First Round w/o Estonia	4	Czech Republic, Hungary, Poland, Slovenia
Second Round	5	Bulgaria, Latvia, Lithuania, Romania, Slovakia
Exchange Rate Regime Groups		
Peg (A)	4	Slovakia, Hungary, Poland, Latvia
Peg (B)	5	Slovakia, Hungary, Poland, Latvia, Czech Republic
Fix	2	Estonia, Lithuania
Float (A)	4	Albania, Romania, Slovenia, Bulgaria
Float (B)	5	Albania, Romania, Slovenia, Bulgaria, Czech republic

No. denotes number of countries in a particular group.

Further, the exchange rates in Deutsche Mark show higher degree of convergence than those expressed in US Dollars. This fact hints on the stabilizing effect of Deutsche Mark for the exchange rates of the CEE countries.

This paper, for institutional reasons, does not analyze the situation in countries where the exchange rates, at a time, were not yet fully convertible, nor does it examine other financially related features common to transition economies. This is left as a task for further research.

Table 7
US Dollar Real Exchange Rates
Two Period Division

Group	No.	ϕ	t-stat(ϕ)	k	Critical Values		
					1%	5%	10%
Period 1991:1 – 1993:6							
First Round w/o Estonia	4	0.4145	-8.23[a]	4	-3.55	-2.46	-2.01
Second Round	5	0.2498	-2.98[b]	7	-3.22	-2.39	-1.94
Second Round w/o Lithuania	4	0.1680	-2.92[b]	7	-2.99	-2.21	-1.76
Period 1993:7 – 1997:12							
First Round w/o Estonia	4	0.1205	-6.08[a]	4	-3.04	-2.28	-1.89
Second Round	5	0.1616	-4.26[a]	6	-3.63	-2.52	-2.00
Second Round w/o Lithuania	4	0.2001	-4.29[a]	7	-3.45	-2.41	-1.91

No. means number of countries in a particular group, k denotes number of lags.
a and b denote significance at 1% and 5% levels, respectively.

Table 8
Deutsche Mark Real Exchange Rates
Two Period Division

Group	No.	ϕ	t-stat(ϕ)	k	Critical Values		
					1%	5%	10%
Period 1991:1 – 1993:6							
First Round w/o Estonia	4	0.4284	-8.34[a]	4	-3.50	-2.47	-2.01
Second Round	5	0.2346	-3.02[b]	7	-3.20	-2.37	-1.92
Second Round w/o Lithuania	4	0.1556	-2.95[b]	7	-2.99	-2.21	-1.77
Period 1993:7 – 1997:12							
First Round w/o Estonia	4	0.1253	-6.07[a]	4	-3.12	-2.32	-1.93
Second Round	5	0.1735	-4.24[a]	6	-3.62	-2.52	-2.00
Second Round w/o Lithuania	4	0.1816	-4.26[a]	7	-3.46	-2.40	-1.90

No. means number of countries in a particular group, k denotes number of lags.
a and b denote significance at 1% and 5% levels, respectively.