Disparities of Exchange Rates in CEE Countries

Evžen Kočenda

CERGE-EI, Prague, Czech Republic,
W. Davidson Institute at the University of Michigan Business School,
CEPR, London

Abstract:

This paper analyzes disparities among nominal and real exchange rate movements across the Central and Eastern European (CEE) countries from 1991 to 1996. The method of analyzing such processes is to examine whether the differentials of exchange rate changes converge or diverge over time. Currently nine countries in Central and Eastern Europe 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.

Abstrakt:

Tento článek analyzuje rozdíly ve vývoji nominálních a reálných měnových kurzů v zemích střední a východní Evropy (CEE) v letech 1991 až 1996. Analýza zkoumá zda diferenciály změn měnových kursů v průběhu doby konvergují či divergují. Devět zemí střední a východní Evropy již formálně požádalo o plné členství v Evropské Unii. Výsledky analýzy ukazují na konvergenci v obecné rovině, ale její stupeň není zdaleka jednoznačný. Z hlediska reálného měnového kursu článek označuje nejvhodnější kandidáty na členství v Evropské Unii.

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Correspondence to: Evžen Kočenda, Center for Economic Research and Graduate Education (CERGE), Charles University, P.O.Box 882, Politických vězňů 7, 111 21 Prague, Czech Republic, tel. (420-2) 24005175, fax (420-2) 24227143, e-mail: evzen.kocenda@cerge.cuni.cz

1. Introduction

This paper analyzes exchange rate movements across the Central and Eastern European (CEE) countries from 1991 through the end of 1996 by employing econometric tools supported by economic theory on exchange rate convergence. Investigating the exchange rate convergence should enhance our knowledge of how transition economies function 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, the exchange rate and the exchange rate regime play an important role in economic development.

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 preannounced 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. Table 1 summarizes the types of exchange rate regimes that the countries involved in this analysis have adopted since their economic transition.

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

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

survey of the monetary practice in the Czech Republic, Poland, and Hungary with cross references to other transition countries. Currently nine 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 provides extensive material for the discussion of this question.

This paper aims to address the question of whether the transition countries have been able to manage the exchange rates of their national currencies within the framework of their exchange rate regimes, eventually leading to a certain degree of convergence. 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 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 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. What is more important, however, is how the entire cross-section behaves and, therefore, a rigorous convergence test will be conducted on groups of time series.

This study will be targeted primarily at the evolution of exchange rates in the countries of the original CEFTA Group (the Czech Republic, Slovakia, Poland, Hungary, and Slovenia), but will also encompass the other countries which have applied or are likely to apply for accession to the European Union. The transition process in Central and Eastern Europe provides a unique opportunity to carry out a quantitative analysis of exchange rate convergence. The results are supportive of 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).

The paper is organized in the following manner. Section 2 describes the data and conceptual approach. Section 3 describes the econometric methodology used in testing the convergence of exchange rate differentials. Section 4 presents empirical findings. A brief conclusion follows.

2. 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 1996. The monthly exchange rates of respective national currencies were obtained from the Bank for International Settlements, Basel, and the International Monetary Fund's International Financial Statistics. The monthly consumer price indices were obtained from the latter source. The bulletins of the national banks of each country in question were consulted as well.

The data are not stationary but are integrated of degree one. The analysis is therefore performed on the changes in exchange rates between two consecutive business days. For the purpose of further analysis the countries were pooled in several logically differentiated groups. There are 72 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 broadest group defines Central and Eastern Europe (CEE) for the purposes of this paper and includes the Czech Republic, Slovakia, Hungary, Poland, Slovenia, Romania, Bulgaria, Albania, Estonia, Latvia, and Lithuania. The Visegrad Four group is comprised of the Czech Republic, Slovakia, Hungary, and Poland.[2] By adding Slovenia to the Visegrad Four we created a group of "Original CEFTA" countries. For the sake of institutional consistency we also constructed a "Current CEFTA" group by adding Romania to the Original CEFTA group. Further, we constructed two other groups of countries: the Balkan Group (Romania, Bulgaria, and Albania) and the Baltic Group (Estonia, Latvia, and Lithuania). Pooling countries in certain groups is meant to show not only the consistency, but also the sensitivity of our results.

[2] Visegrad Four was established primarily as a political arrangement, unlike the CEFTA which aims almost entirely at economic targets. Thus, the names of groups are meant to be merely convenient labels rather than a rigorous taxonomy.

Figures 1 and 2 comprehensively document the evolution of nominal exchange rates in all the countries studied. The exchange rates are plotted in levels. The exchange rate of the Czech Crown is the only one that looks, at first glance, like a random walk among the rates in the Visegrad Four. The nominal exchange rates of Poland and Hungary apparently depreciated over time. The Slovak Crown was devalued by 10% in July 1993, but remained more or less stable during the period studied. The nominal exchange rates of Slovenia and the Balkan Group also depreciated to a greater or lesser extent over the researched period. The Baltic Group offers the most varied 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

$$Q_t = \left(E_t \cdot CPI_t *\right) / CPI_t \tag{1}$$

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 Visegrad Four continuously appreciated in real terms over time, but the extent of appreciation varied. The Baltic Group uniformly experienced a massive real appreciation during 1992. This movement, over next two years, transformed into an almost stable real exchange rate. The Balkan Group together with Slovenia offer the most varied picture of currencies which appreciated and depreciated in real terms over time.

A detailed description of the method used 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.

3. Convergence of Exchange Rates: Methodology

The following econometric methodology utilizes a combination of cross-sections of individual time-series. 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.[3] 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

$$EX_t = \left(E_t / E_{t-1}\right) - 1 \tag{2}$$

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

$$QX_t = \left(Q_t / Q_{t-1}\right) - 1 \tag{3}$$

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:

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

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

[3] Ben-David (1996) performed an analysis of real per-capita income growth on numerous countries. Kočenda and Papell (1997) recently applied this methodology to study inflation convergence in the European Union.

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:

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

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 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. 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.[4] Since the analysis is performed on panel data of exchange rate changes, there will be no intercept by

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

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

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

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 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.[5] 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.

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

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 and monthly data in his data sets, the critical values were higher than those reported in Levin and Lin (1992).[6]

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.

4. Empirical Findings

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. The results of the test performed on exchange rate differentials expressed in US Dollars and Deutsche Marks show that the absolute values of coefficient ϕ are very similar, but not

[6] A similar result was found in Kočenda and Papell (1997).

completely identical. However, the coefficients ϕ are both positive and negative and this fact divides results into two distinctive groups.[7]

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.

Thus, the most pronounced convergence effect can be found in the case of the Balkan Group. However, coefficient ϕ has a negative sign which means an oscillatory convergence. The differences among exchange rate differentials continuously diminish, but in an oscillatory way that is far from being smooth. The rest of the groups converge in a regular fashion with the Baltic and the Current CEFTA Groups being the fastest ones. The Original CEFTA group lags slightly behind and the Visegrad Four converge at the slowest pace.

The results of the convergence test on differentials of real exchange rates are presented in Tables 5 and 6 and offer a dramatically different picture. The most pronounced feature of these results is that, in contrast to what occurred in the nominal part of analysis, the Visegrad Four is now the group that converges at the fastest pace. The evolution of real exchange rates in the countries belonging to this group can be regarded as the most uniform.

Another striking feature concerns the values of convergence coefficients ϕ in general. These coefficients show a substantially increased rate of convergence among all groups. On the other hand, three groups, both CEFTA groups as well as the Balkan Group, converge in the oscillatory manner. In the case of the Balkan Group, this result is the same as in the nominal part of the analysis. Oscillatory convergence in the case of both CEFTA groups is even more interesting due to the great difference in values of coefficient ϕ. When Romania was added to form the Current CEFTA group, the convergence coefficient ϕ increased rather substantially. Hence, the pace of convergence decreased.

In a certain way, the oscillatory convergence should be regarded as a proxy for non-market exchange rate. Exchange rates in some transition economies are official rates for

[7] The Technical Appendix elaborates on this feature.

currencies that are not fully convertible yet and thus are not really free market exchange rates. If a parallel (or black) exchange rate were used, the oscillatory effect might disappear. 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. Differences in convergence may be also due to the country investment ranking in the past. For example, at one time Bulgaria enjoyed a better ranking than Romania. However, the latter country had already reached the bottom of its economic fall and currently attracts more foreign investors because of its potentially larger growth. To analyze the hypotheses outlined above is a task for further research.

5. 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).

The Visegrad Four is the group that in real terms converges at the fastest pace. The evolution of the real exchange rates in the countries in this group can be regarded as the most uniform and solid. From the real exchange rate standpoint these countries should, despite the economic and political problems associated with the transition process, be regarded as the first candidates to join the European Union.

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

Technical Appendix

Numerous methods that exploit time-series in modern macroeconomics and financial economics are based on the theory of difference equations. Time series econometrics generally involves estimation of difference equations that contain a stochastic component. It is in the very tradition of the use of time-series econometrics to forecast the time path of a variable. Since the predictable component of the time-series can be extrapolated into the future, uncovering the dynamics of time-series will logically improve such forecasts. Uncovering the dynamic path helps to model the process more precisely and the estimates provide a more accurate and reliable representation of reality. Stochastic difference equations arise naturally from dynamic economics.

If we model the process that reflects the dynamic movement in a time-series as an autoregressive process of n-th order then we make natural use of the difference equations theory in its very best spirit. The first order equation has to be solved first. To obtain the solution of the difference equation for the purpose of the further analysis we use the iterative technique. To illustrate this, we use the first-order difference equation:

$$y_t = a_0 + a_1 y_{t-1} + \varepsilon_t \qquad (1)$$

where ε_t is a pure random disturbance in t. Given the value of y_0, it follows that y_1 will be given by

$$y_1 = a_0 + a_1 y_0 + \varepsilon_1$$

In the same way, y_2 must be

$$\begin{aligned} y_2 &= a_0 + a_1 y_1 + \varepsilon_2 \\ &= a_0 + a_1(a_0 + a_1 y_0 + \varepsilon_1) + \varepsilon_2 \\ &= a_0 + a_0 a_1 + (a_1)^2 y_0 + a_1\varepsilon_1 + \varepsilon_2 \end{aligned}$$

When we continue the process in order to find y_3, we obtain

$$\begin{aligned} y_3 &= a_0 + a_1 y_2 + \varepsilon_3 \\ &= a_0\left[1 + a_1 + (a_1)^2\right] + (a_1)^3 y_0 + a_1^2\varepsilon_1 + a_1\varepsilon_2 + \varepsilon_3 \end{aligned}$$

It can be easily verified that for all $t > 0$, repeated iteration yields

$$y_t = a_0 \sum_{i=0}^{t-1} a_1^i + a_1^t y_0 + \sum_{i=0}^{t-1} a_1^i \varepsilon_{t-1} \qquad (2)$$

Equation (2) is a solution to (1) since it expresses y_t as a function of t, the forcing process $x_t = \sum (a_1)^i \varepsilon_{t-i}$, and the known value of y_0. A backward process allows to show that iteration from y_t back to y_0 yields exactly the formula given by (2). Since $y_t = a_0 + a_1 y_{t-1} + \varepsilon_t$, it follows that

$$y_t = a_0 + a_1(a_0 + a_1 y_{t-2} + \varepsilon_{t-1}) + \varepsilon_t$$
$$= a_0(1 + a_1) + a_1 \varepsilon_{t-1} + \varepsilon_t + a_1^2(a_0 + a_1 y_{t-3} + \varepsilon_{t-2})$$

Continuing the iteration back to period 0 yields Equation (2).

For the technique that we develop to test for convergence it is necessarry to state certain preliminaries. If we remove a stochastic component ε_t from (1) then we obtain so called homogenous portion of (1) which is:

$$y_t = a_1 y_{t-1} \qquad (3)$$

The solution to this homogenous equation is called the homogenous solution. Obviously, the trivial solution $y_t = y_{t-1} = K = 0$ satisfies (3). However, this solution is not unique. By setting a_0 and all the values of $\{\varepsilon_t\}$ equal to zero, (2) becomes $y_t = a_1^t y_0$. Hence, $y_t = a_1^t y_0$ must be a solution to (3). However, even this solution does not constitute the full set of solutions. It is easy to verify that the expression a_1^t multiplied by any arbitrary constant A satisfies (3). Simply substitute $y_t = A(a_1)^t$ and $y_{t-1} = A(a_1)^{t-1}$ into (3) to obtain

$$A(a_1)^t = a_1 A(a_1)^{t-1}$$

Since $(a_1)^t = a_1(a_1)^{t-1}$, it follows that $y_t = A(a_1)^t$ solves (3). Using this result we can classify the properties of the homogenous solution as follows:

1. If $|a_1| < 1$, the expression $(a_1)^t$ converges to zero as t approaches infinity. Convergence, in this case, is direct if $0 < a_1 < 1$ and oscillatory if $-1 < a_1 < 0$.
2. If $|a_1| > 1$, the homogenous solution is not stable. If $a_1 > 1$, the homogenous solution approaches infinity as t increases. If $a_1 < -1$, the homogenous solution oscillates explosively.

3. If $a_1 = 1$, any arbitrary constant A satisfies the homogenous equation $y_t = y_{t-1}$. If $a_1 = -1$, the system is *meta-stable*: $(a_1)^t = 1$ for even values of *t* and -1 for odd values of t.

From the previous outline it follows that a parameter a_1 is a useful indicator of convergence.

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Table 1
Exchange Rate Regimes

Country	**Regime**
Czech Republic	Fixed (basket) since January 1991 to May 1997 Float from May 1997
Slovakia	Fixed (basket) since January 1991
Hungary	Adjustable peg (basket) since before 1989 Preannounced crawling band since March 1995
Poland	Fixed (basket) 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
Romania	Managed float from August 1992
Albania	Managed float from July 1992
Estonia	Currency board
Latvia	Managed float from July 1992
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**
All	11	Czech Republic, Slovakia, Hungary, Poland, Slovenia, Bulgaria, Romania, Albania, Estonia, Latvia, Lithuania
Visegrad Four	4	Czech Republic, Slovakia, Hungary, Poland
Original CEFTA	5	Czech Republic, Slovakia, Hungary, Poland, Slovenia
Current CEFTA	6	Czech Republic, Slovakia, Hungary, Poland, Slovenia, Romania
Balkan Group	3	Bulgaria, Romania, Albania
Baltic Group	3	Estonia, Latvia, Lithuania

No. denotes number of countries in a particular group.

Table 3
USD Dollar Nominal Exchange Rates
Period 1991:1 - 1996:12

Group	**No.**	**ϕ**	**t-stat(ϕ)**	**k**	**Critical Values**		
					1%	**5%**	**10%**
All	11	0.2274[a]	-7.29	6	-3.19	-2.41	-1.93
Visegrad Four	4	0.7275[a]	-3.41	6	-2.81	-2.07	-1.69
Original CEFTA	5	0.5260[a]	-4.77	5	-3.34	-2.28	-1.80
Current CEFTA	6	0.4121[a]	-4.50	6	-2.98	-2.22	-1.80
Balkan Group	3	-0.3047[a]	-4.64	7	-3.77	-2.40	-1.93
Baltic Group	3	0.4858[a]	-4.11	5	-2.80	-2.05	-1.66

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 4
Deutsche Mark Nominal Exchange Rates
Period 1991:1 - 1996:12

Group	**No.**	**ϕ**	**t-stat(ϕ)**	**k**	**Critical Values**		
					1%	**5%**	**10%**
All	11	0.2154[a]	-7.34	6	-3.20	-2.41	-1.95
Visegrad Four	4	0.7304[a]	-3.39	6	-2.94	-2.19	-1.75
Original CEFTA	5	0.5214[a]	-4.81	5	-3.37	-2.29	-1.80
Current CEFTA	6	0.3905[a]	-4.60	6	-2.98	-2.22	-1.80
Balkan Group	3	-0.3015[a]	-4.62	7	-3.81	-2.42	-1.95
Baltic Group	3	0.4846[a]	-4.16	5	-2.79	-2.06	-1.66

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 5
USD Dollar Real Exchange Rates
Period 1991:1 - 1996:12

Group	No.	ϕ	t-stat(ϕ)	k	Critical Values		
					1%	5%	10%
All	11	0.1692[a]	-7.63	7	-3.06	-2.20	-1.77
Visegrad Four	4	0.0255[a]	-6.09	7	-2.74	-2.07	-1.70
Original CEFTA	5	-0.0235[a]	-9.96	4	-2.76	-2.05	-1.68
Current CEFTA	6	-0.3379[a]	-7.03	6	-2.95	-2.20	-1.77
Balkan Group	3	-0.0568[a]	-4.51	6	-4.46	-2.39	-1.90
Baltic Group	3	0.2206[a]	-5.04	6	-2.87	-2.07	-1.65

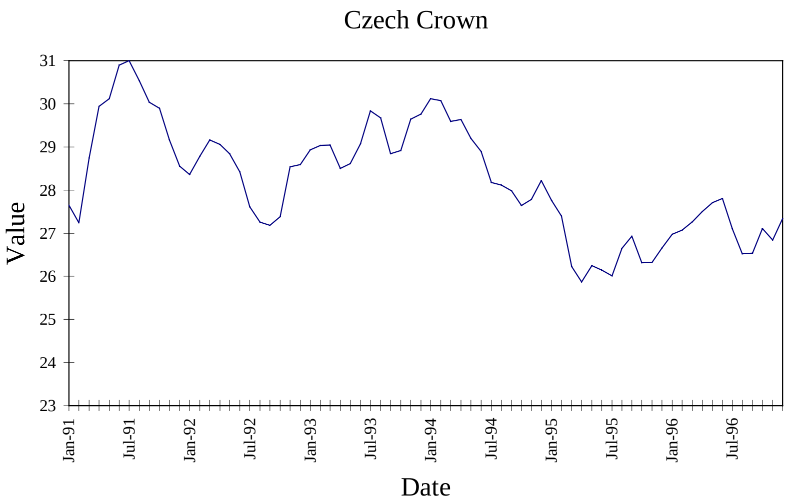
No. means number of countries in a particular group, k denotes number of lags.
a and b denote significance at 1% and 5% levels, respectively

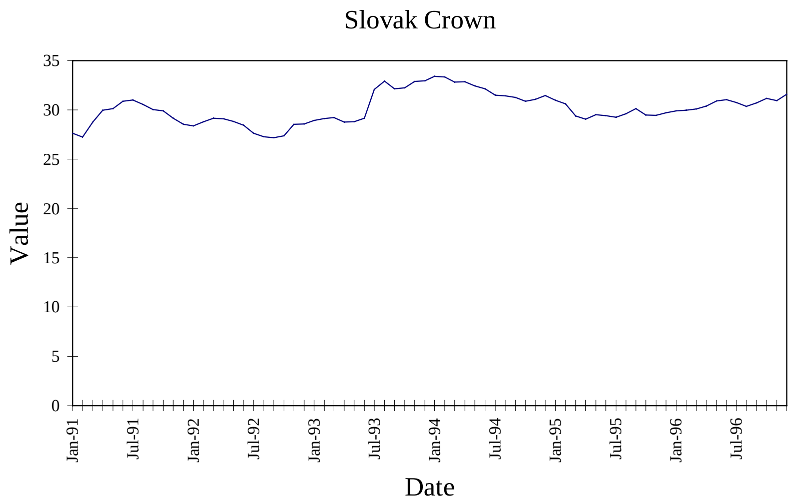
Table 6
Deutsche Mark Real Exchange Rates
Period 1991:1 - 1996:12

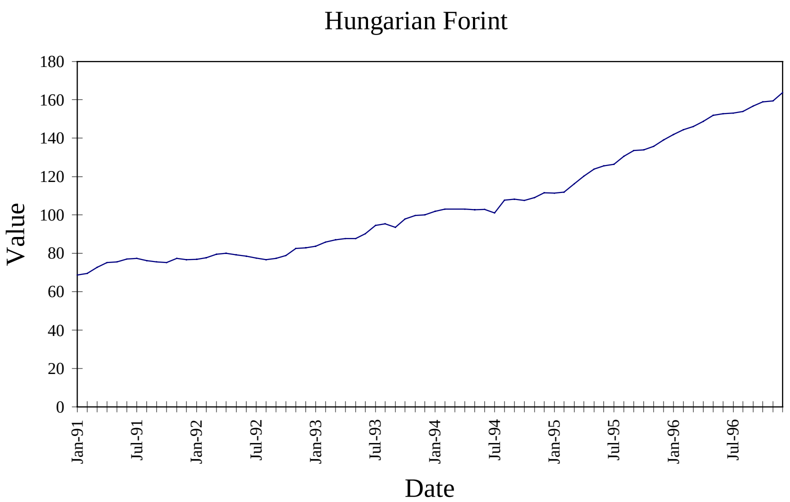
Group	No.	ϕ	t-stat(ϕ)	k	Critical Values		
					1%	5%	10%
All	11	0.1536[a]	-7.72	7	-3.06	-2.18	-1.77
Visegrad Four	4	0.0294[a]	-6.07	7	-2.87	-2.11	-1.73
Original CEFTA	5	-0.0322[a]	-10.06	4	-2.83	-2.11	-1.72
Current CEFTA	6	-0.3313[a]	-7.04	6	-2.95	-2.02	-1.77
Balkan Group	3	-0.0637[a]	-4.55	6	-4.47	-2.43	-1.91
Baltic Group	3	0.2051[a]	-5.12	6	-2.86	-2.06	-1.64

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

Figure 1.1
US Dollar Nominal Exchange Rates







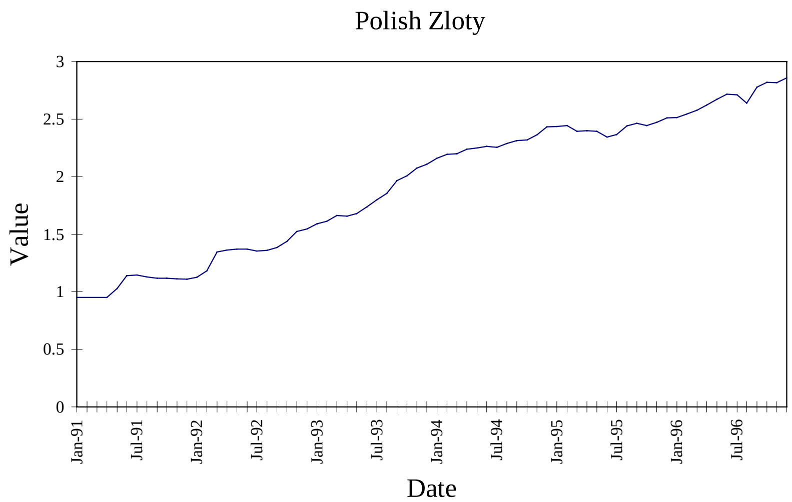


Figure 1.2
US Dollar Nominal Exchange Rates

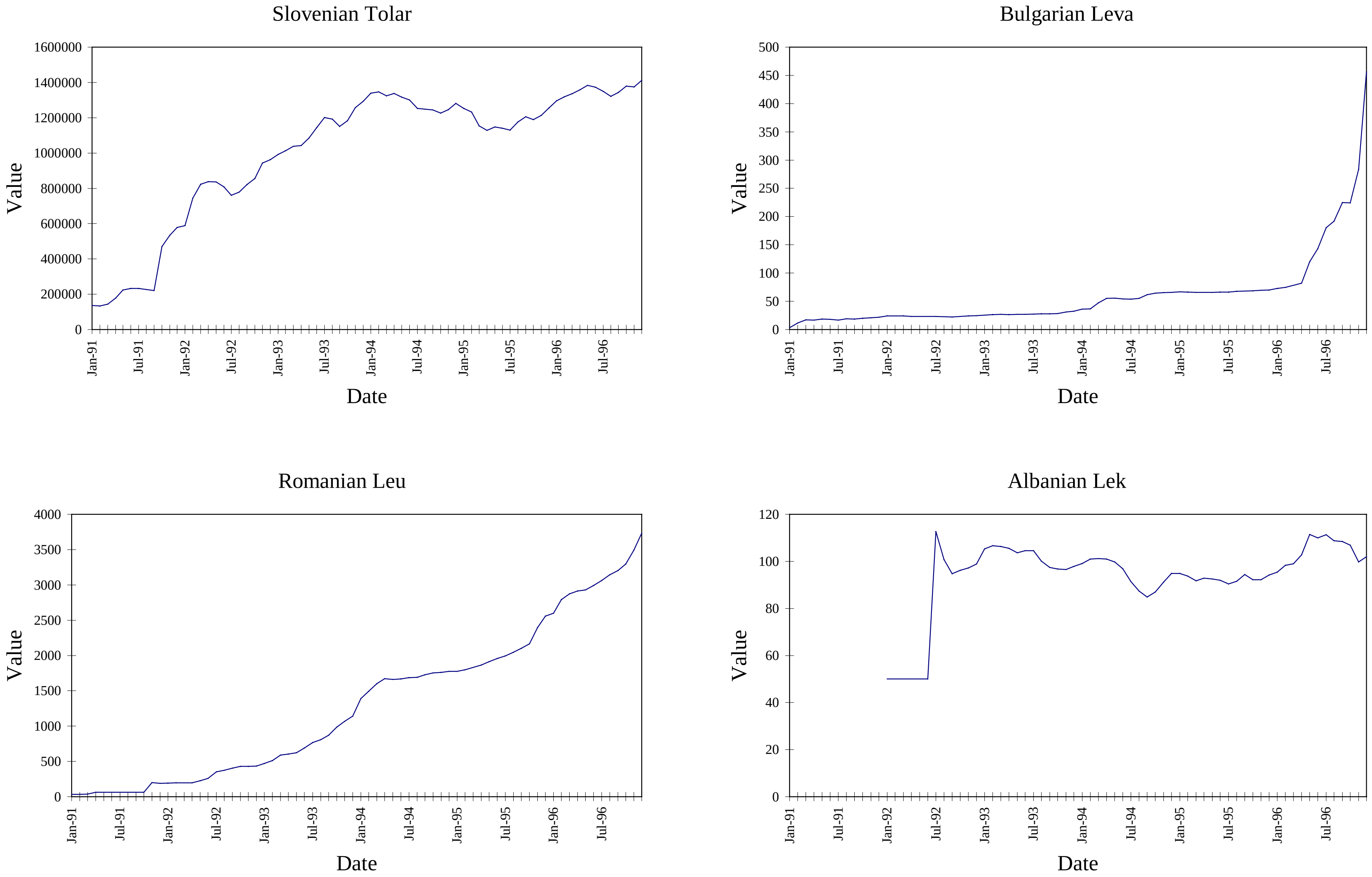
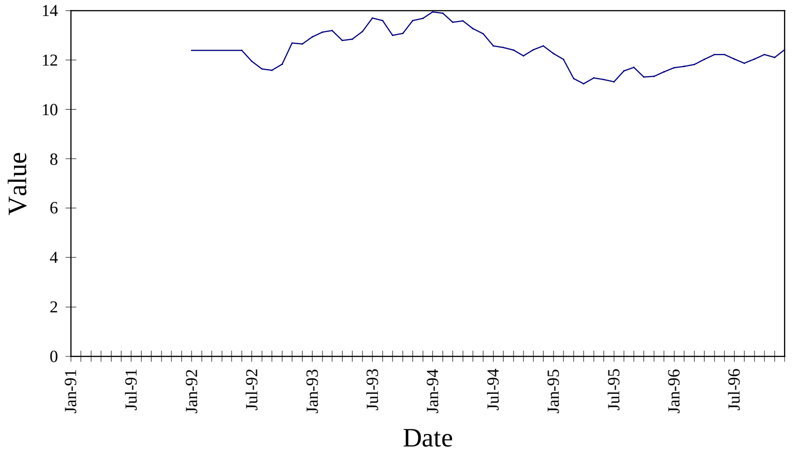
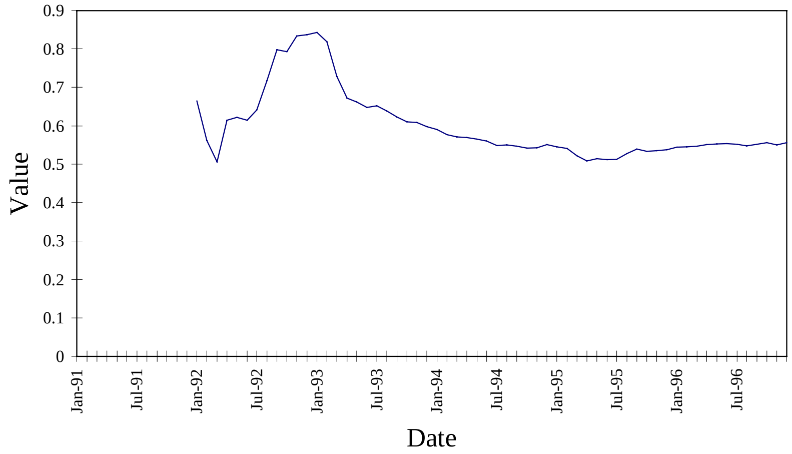


Figure 1.3
US Dollar Nominal Exchange Rates

Estonian Kroon



Latvian Lats



Lithuanian Litas

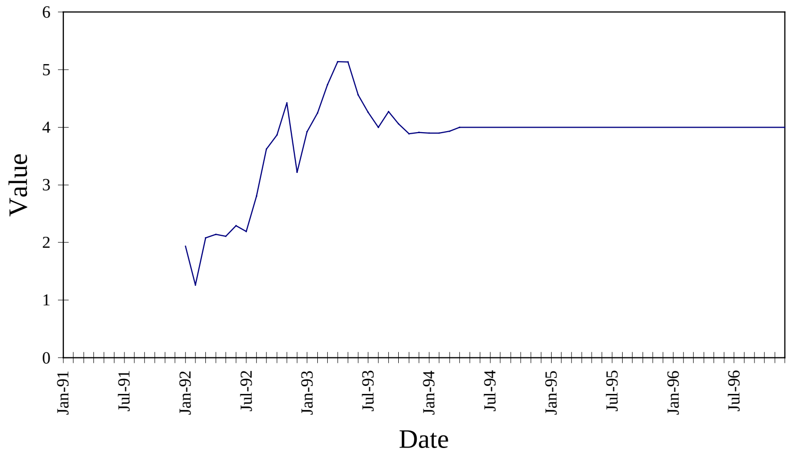


Figure 2.1
Deutsche Mark Nominal Exchange Rates

Figure 2.2
Deutsche Mark Nominal Exchange Rates

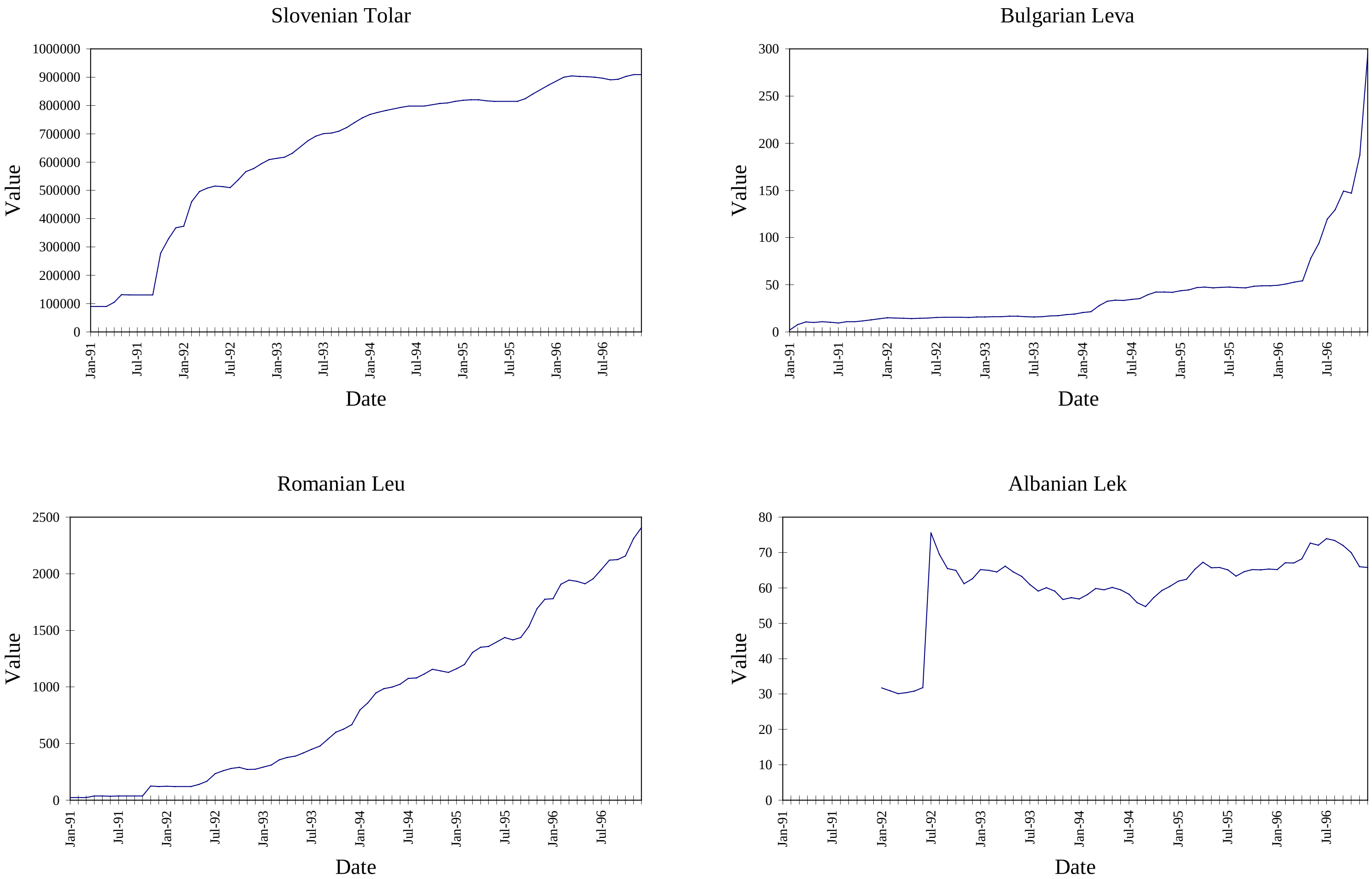
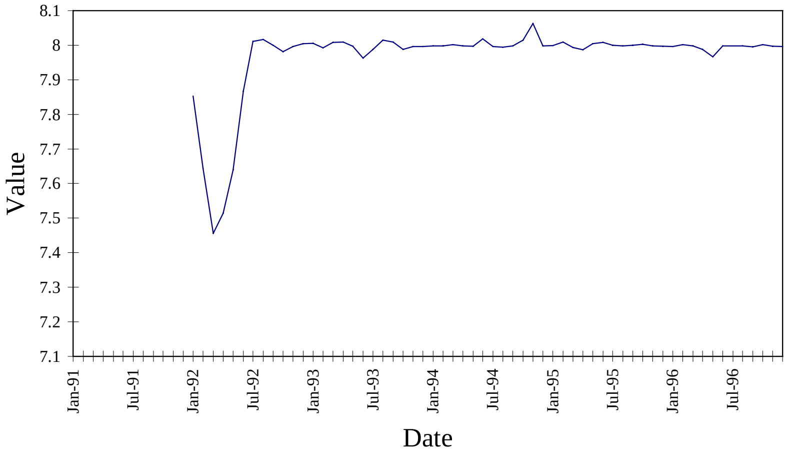


Figure 2.3
Deutsche Mark Nominal Exchange Rates

Estonian Kroon



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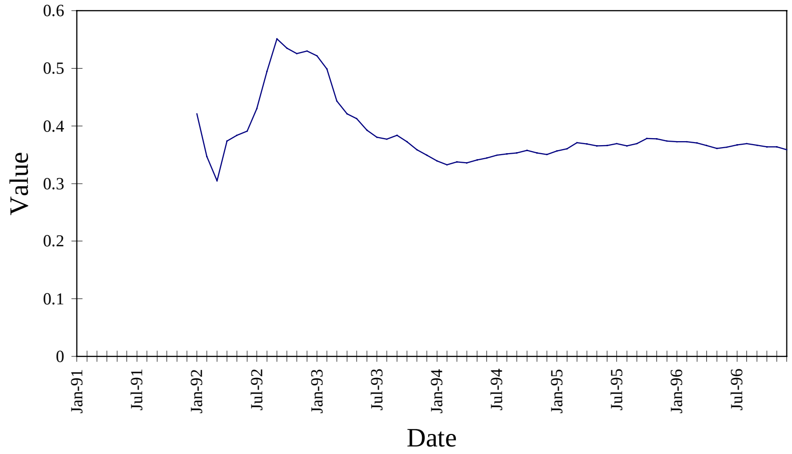

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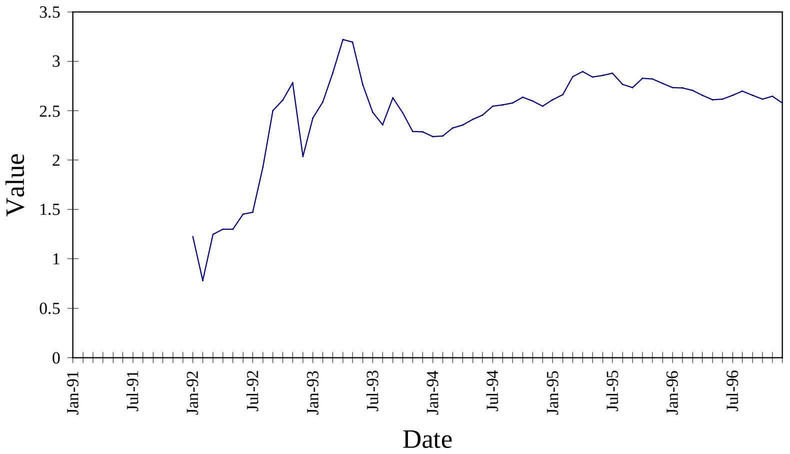


Figure 3.1
US Dollar Real Exchange Rates

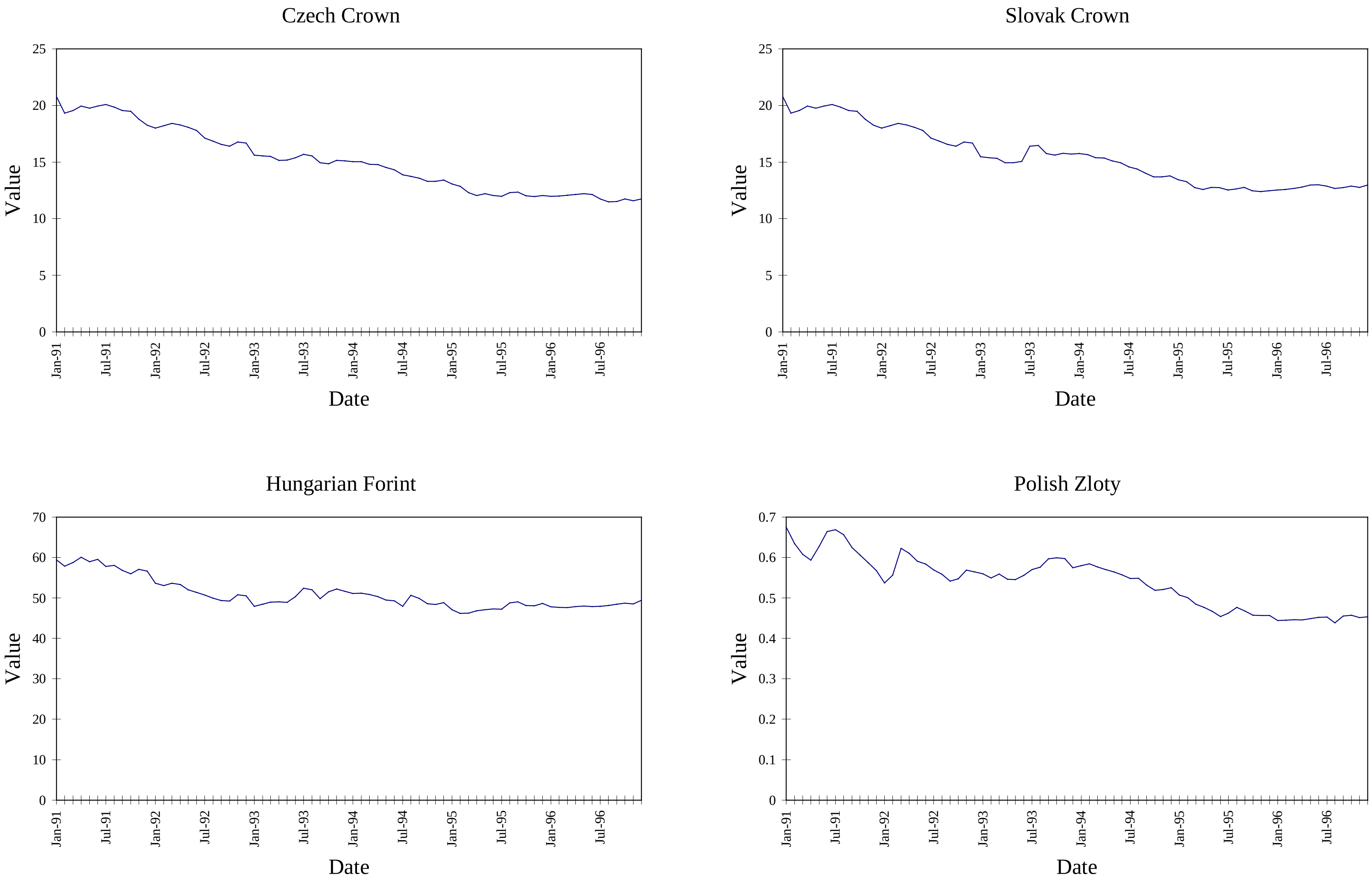


Figure 3.2
US Dollar Real Exchange Rates

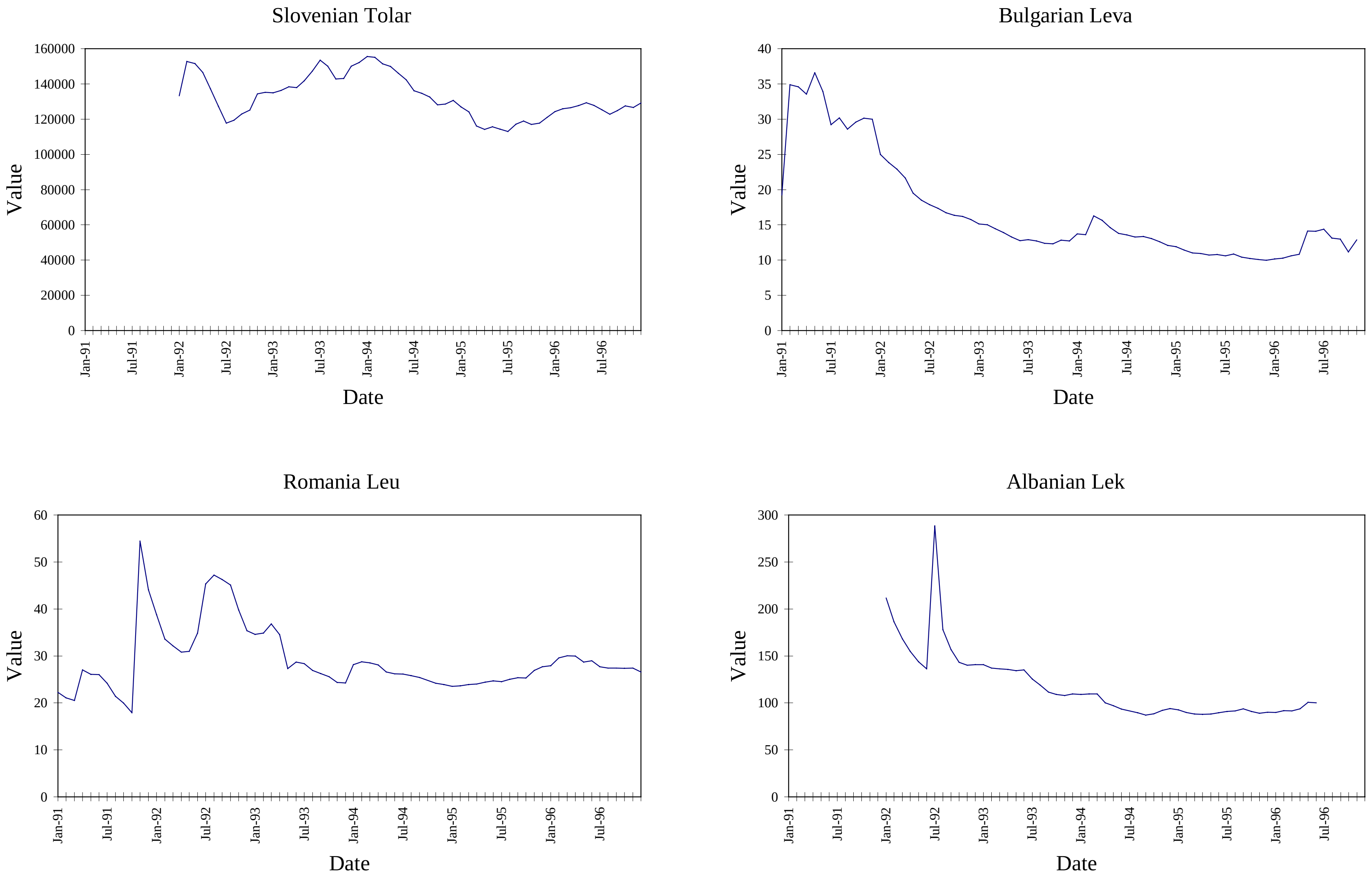
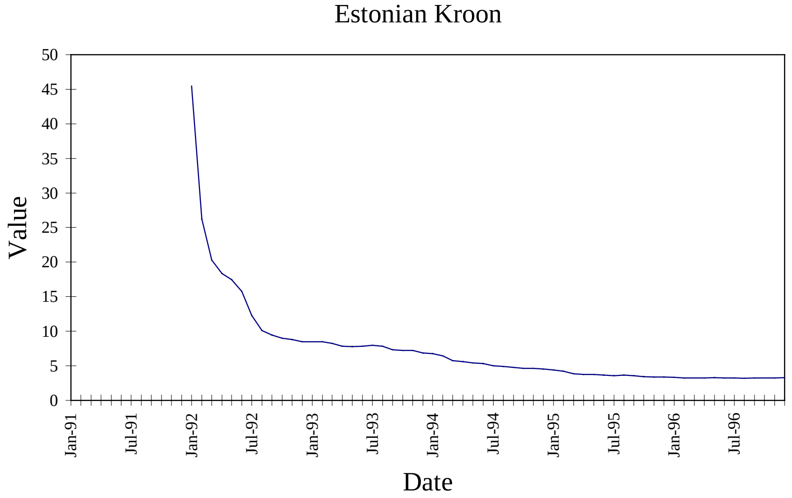
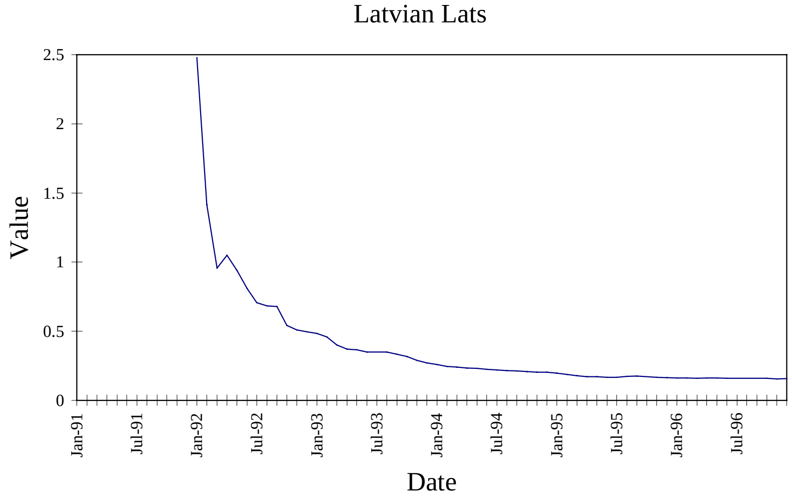


Figure 3.3
US Dollar Real Exchange Rates





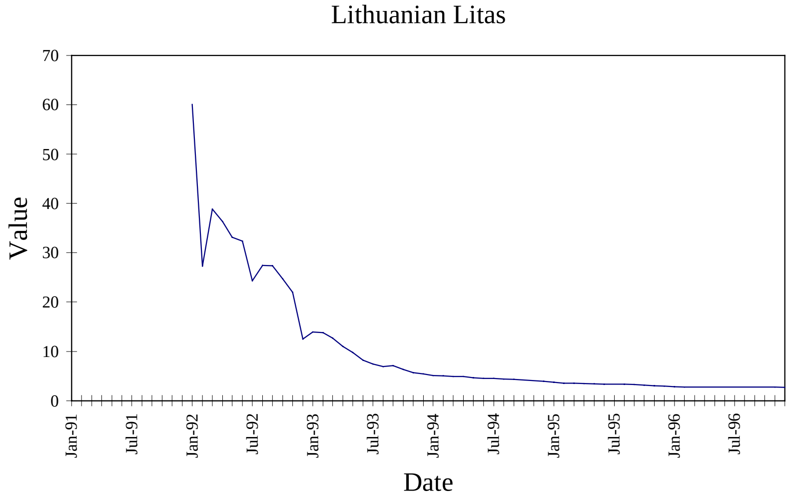
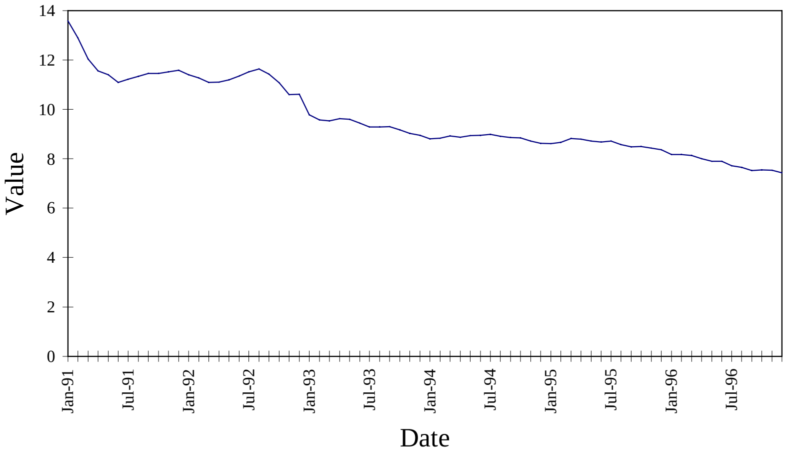
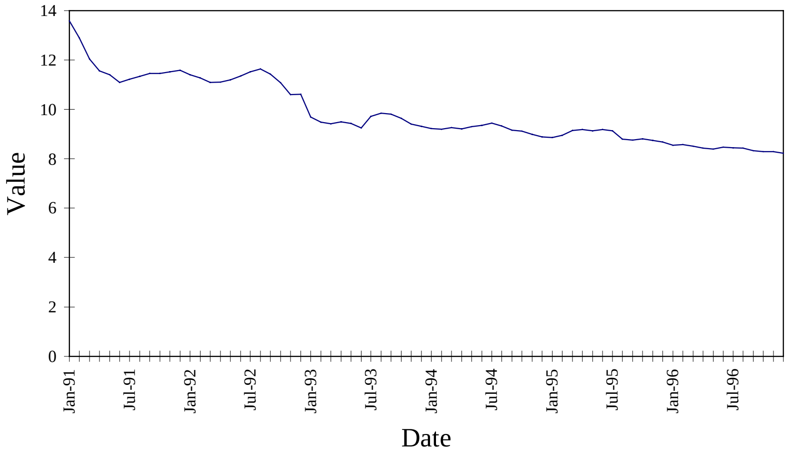


Figure 4.1
Deutsche Mark Real Exchange Rates

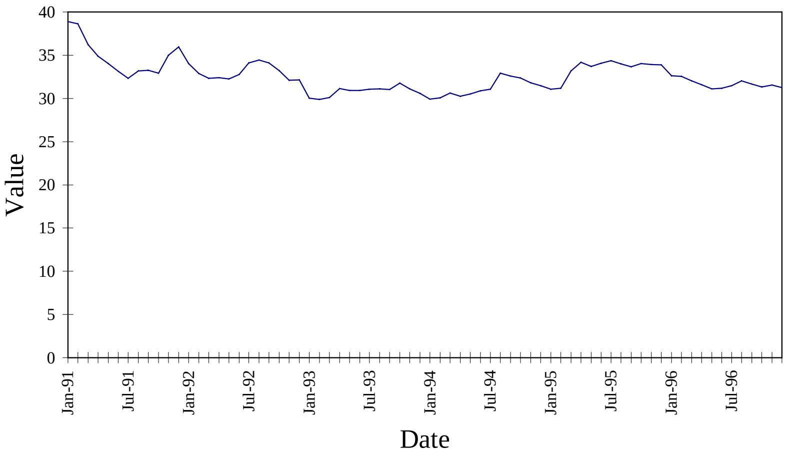
Czech Crown



Slovak Crown



Hungarian Forint



Polish Zloty

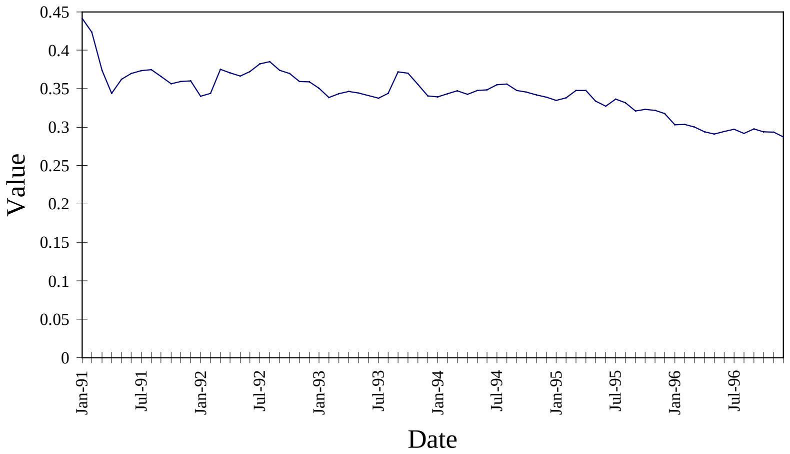


Figure 4.2
Deutsche Mark Real Exchange Rates

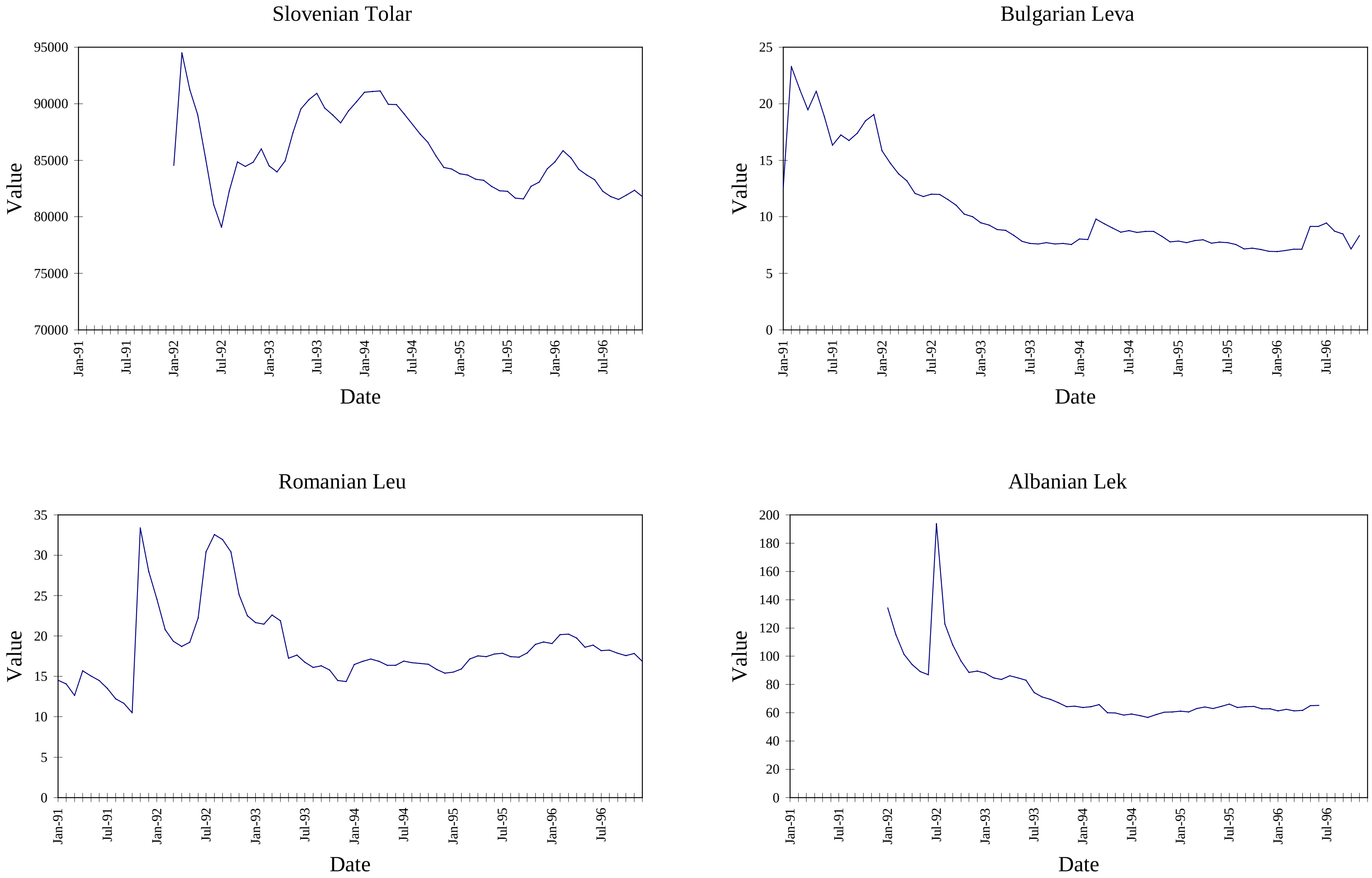
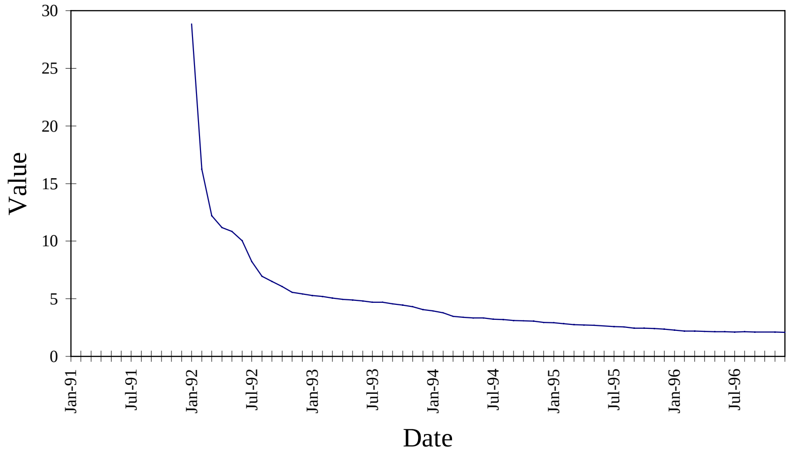
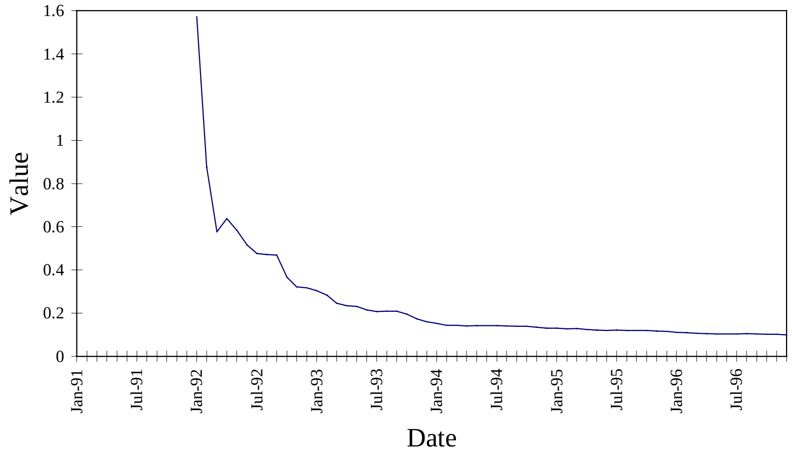


Figure 4.3
Deutsche Mark Real Exchange Rates

Estonian Kroon



Latvian Lats



Lithuanian Litas