ASSESSMENT OF THE EXCHANGE RATE VOLATILITY IN NEW EU MEMBER STATES AND ROMANIA[1]

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Abstract: This paper assesses exchange rate volatility is four new EU member countries (Czech Republic, Hungary, Poland, and Slovakia) and Romania. The study is motivated by the unavoidable participation of the new member states' currencies in the Exchange Rate Mechanism II and fulfillment of the exchange rate stability convergence criterion. The results suggest decline of volatility and indicate that the Slovak koruna entered into the mechanism at optimal time. On the other hand, the admissible fluctuation band seems to be still too narrow for the remaining new members states' currencies analyzed as well as the Romanian leu, thus they should remain out of ERM II for some time.

Key words: exchange rates, volatility, ERM II, new EU member states, Romania

The enlargement of the European Union (EU) in May 2004 and the prospective enlargement in 2007 establish a gradual further spreading of the euro to all new member states (NMS). However, according to the Maastricht Treaty, the euro implementation is conditioned on the fulfillment of several convergent criteria. One of them is focused on exchange rate stability (ERSC) and goes hand in hand with compulsory participation in the European Exchange Rate Mechanism II (ERM II) for at least two years prior to the assessment of the ERSC fulfillment. Moreover, no downward realignment of central parity of the national currency vis-à-vis euro (devaluation) is possible within the two-year evaluation period. Additionally, fulfillment of the ERSC requires the exchange rate to have been maintained within a fluctuation margin around the central parity "without severe tensions". Although the standard fluctuation band of ERM II is ± 15 %, according to the European Central Bank (ECB) and other European authorities, maintaining the exchange rate within the narrow margin of ± 2.25 % (ERSC band) will be demanded for successful fulfillment of the ERSC (CNB, 2003, p. 3). If the exchange rate breaks through the fluctuation limit, a distinction is to be made between a breach of the upper margin and a breach of the lower margin. Therefore, even an excessive appreciation of national currency is implicitly more admissible than depreciation.

The aim of this paper is to analyze the exchange rate volatility and assess the ability of currencies to fluctuate within the ERSC band. Consequently, using the results obtained, we can determine whether Slovakia, which currently participates in ERM II, has chosen the optimal time of entry or not (from an exchange rate volatility and

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development point of view). The results for the ERM II-non-participating NMS can serve as one of the indicators used for the best timing of ERM II entry.

The paper is structured as follows: Chapter one describes analytical tools and data used. Chapter two presents empirical results and the paper ends with some conclusions.

Data and Analytical Tools

The dataset used in the analysis consists of daily nominal bilateral exchange rates of four NMS national currencies (Czech koruna, Hungarian forint, Polish zloty, and Slovak koruna) and the Romanian leu against the euro. The exchange rate series covers the period from November 14, 1996 to December 31, 2005. All data were retrieved from the Pacific Exchange Rate Service.[2] Only data from business days are included in the dataset, and it should be noted that the Canadian civic holiday schedule applies. Exchange rates prior 1999 were calculated using exchange rates of NMS currencies against the German mark and the irrevocable conversion rate of the German mark to the euro.

In the literature, different approaches for measuring exchange rate volatility have been applied but there is not consensus on which measure is the most appropriate. Some papers use the standard deviation of the percentage change of the exchange rate or the standard deviation of the first differences of the logarithmic exchange rate. Others consider the average absolute difference between the previous period forward rate and the current spot rate to be the best indicator of the exchange rate volatility. Another possibility is to use the high-low variation defined as the percentage difference between the maximum and minimum spot rate over some certain period preceding the observation or as the difference between the highest and lowest daily return during the period observed. Recently, estimation of the exchange rate volatility seems to be increasingly adopting the use of generalized autoregressive conditional heteroscedasticity (GARCH) models. For more about the methods mentioned, including some critical assessment, see Dell Ariccia (1998).

In accordance with the previous discussion and due to lack of conformity on optimal measurement method, we experimented with several measures of exchange rate volatility. First, we applied a set of the moving sample standard deviations of the annualized daily returns of the nominal bilateral exchange rates. For all exchange rates, we estimated volatility calculating standard deviations of samples containing 30, 180, 360, and 720 daily annualized returns. In this case, the exchange rate volatility is defined as follows:

$$r_i = \frac{ER_i - ER_{i-1}}{ER_{i-1}} * 360 \qquad (1)$$

$$V_t = \sqrt{\frac{\sum_{i=1}^{m} \left(r_i - \bar{r}\right)^2}{m}} \qquad (2),$$

[2] This service is provided free of charge for academic purposes by Werner Antweiler (University of British Columbia, Sauder School of Business, Vancouver, Canada) and available online at: http://fx.sauder.ubc.ca/.

where r_i is the annualized daily return, $\bar{r}$ represents the average of annualized daily returns, V_t is the standard deviation denoting exchange rate volatility and m is the order of the moving average (number of r_i included in the calculation).

Second, we also used another time-varying measure of volatility constructed by the moving average standard deviation of the changes in the logarithmic exchange rate:

$$V_t = \sqrt{\frac{\sum_{i=1}^{m}\left(er_{t-i-1} - er_{t-i-2}\right)^2}{m}} \qquad (3),$$

where *er* is the log of the exchange rate and other variables are defined as before. As with the previous case, we applied four orders of the moving average (30, 180, 360, and 720 days).

Finally, we applied as a measure of the exchange rate volatility the high-low variation (extreme-value variance) which is defined by the following formula:

$$\sigma_{hl} = max\ (r_i) - min\ (r_i) \qquad (4),$$

where σ_{hl} is the high-low variation, *max* (r_i) and *min* (r_i) represent the maximum and minimum daily return in the respective period of time preceding the day of observation. The high-low variation is less sensitive to outliers than the standard variation.

Empirical Results

In the empirical analysis, we estimated volatility of exchange rates of NMS currencies against the euro. For this, we used exchange rates in direct quotation (number of NMS currency units for one unit of euro) and applied three alternative measures discussed above and defined by formulas (1) – (4). Even though the assumptions of the volatility measures are different from each other, the comparison of the three alternative methods reveals very strong correlations indicating that all versions adequately measure exchange rate volatility. The smallest correlation coefficient obtained (0.869) is between the moving average standard deviation of the changes in the logarithmic exchange rate and the high-low variation in Poland. The coefficients' values indicate almost perfect positive associations for all currencies and methods. Such results allow us to use only moving average standard deviations of the annualized daily returns of the nominal bilateral exchange rates for discussion on exchange rate volatility. See Figures 1 – 5 for graphs of the exchange rate volatility measures.

We calculated four moving average standard deviations covering different time intervals. We used one-month and six-month measures to estimate short-term and mid-term volatility and one-year and two-year indicators to analyze long-term volatility. One can point out that the exchange rate volatility development reflected the exchange rate regime applied in the countries as well as shifts in the exchange rate policy. Since all countries analyzed applied a more flexible regime, the volatility development patterns are very similar. All currencies experience a gradual decline of all four volatility measures and the differences among them almost disappear in the last three years. Moreover, there is one more common feature. At the end of 2005, volatility of all exchange rates analyzed reached or was close to the minimum level on record.

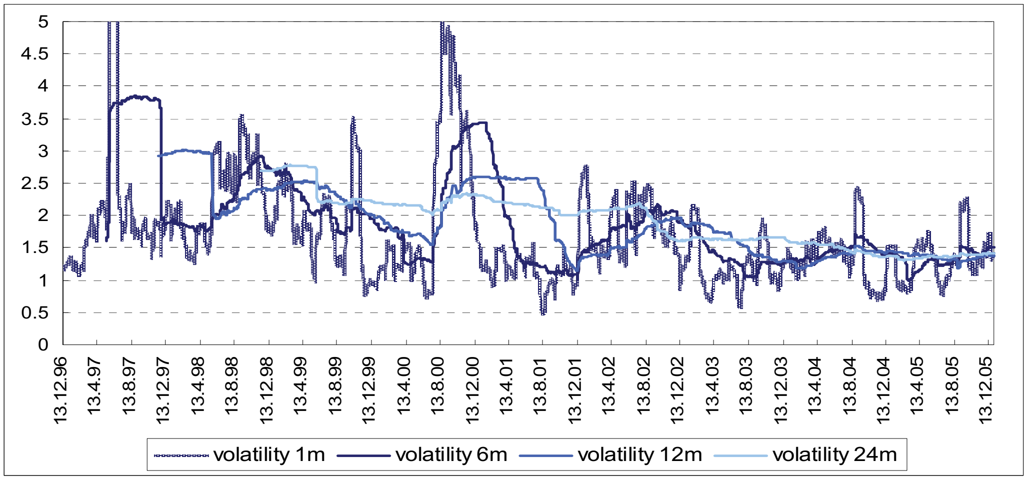

Figure no. 1 Volatility of the exchange rate CZK/EUR

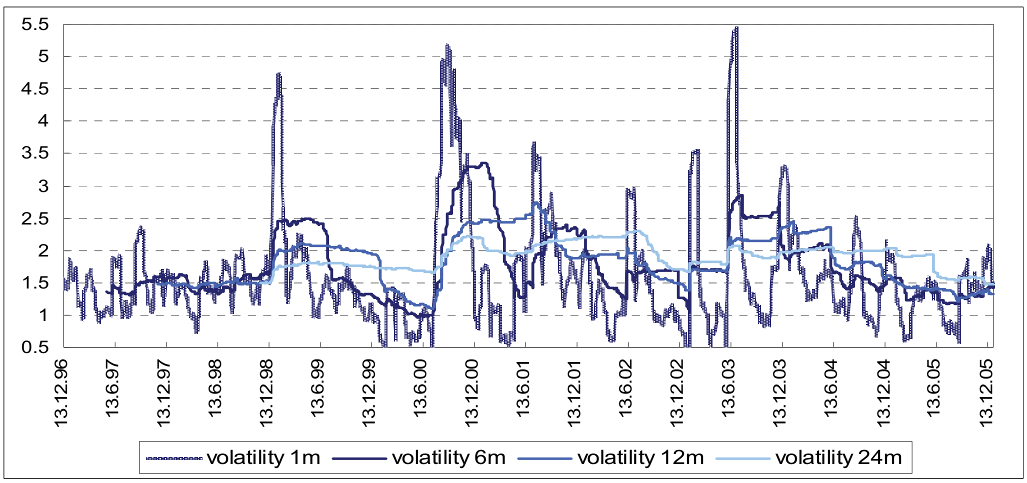

Figure no. 2 Volatility of the exchange rate HUF/EUR

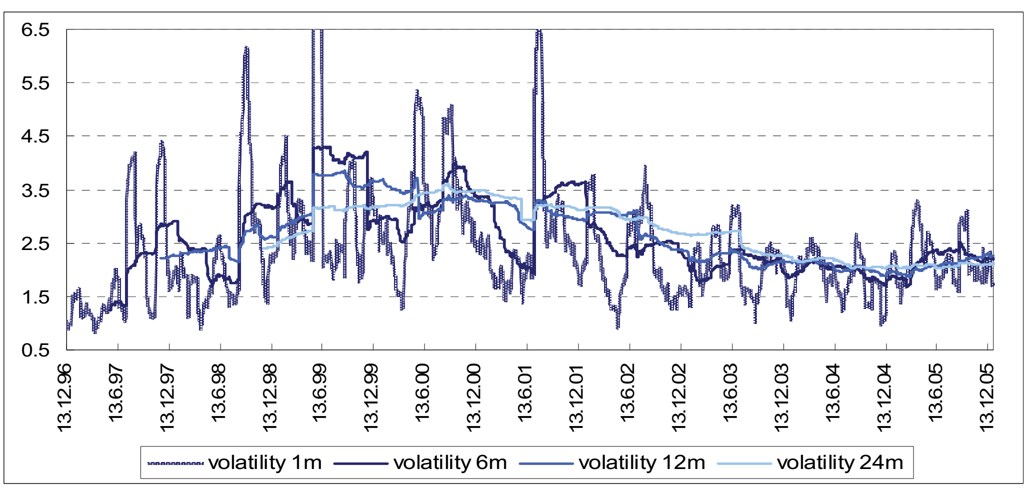

Figure no. 3 Volatility of the exchange rate PLN/EUR

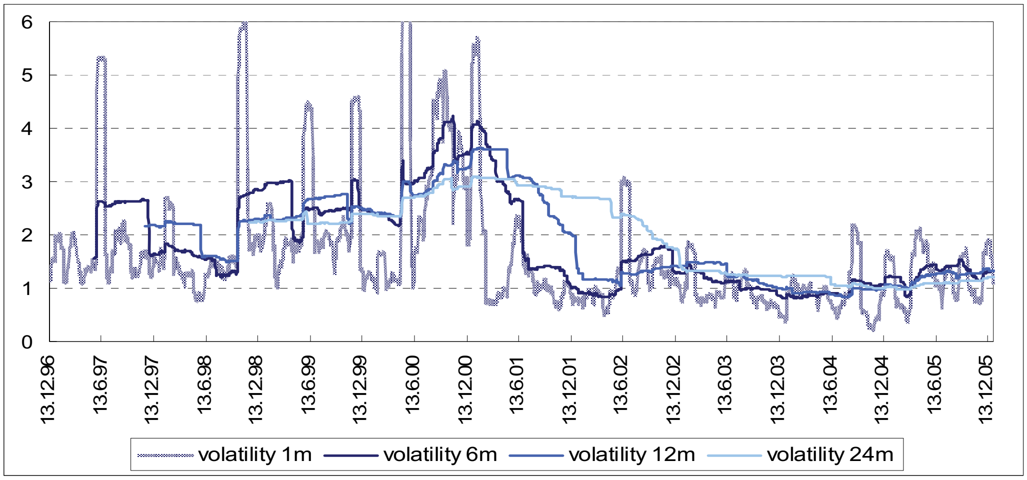

Figure no. 4 Volatility of the exchange rate SKK/EUR

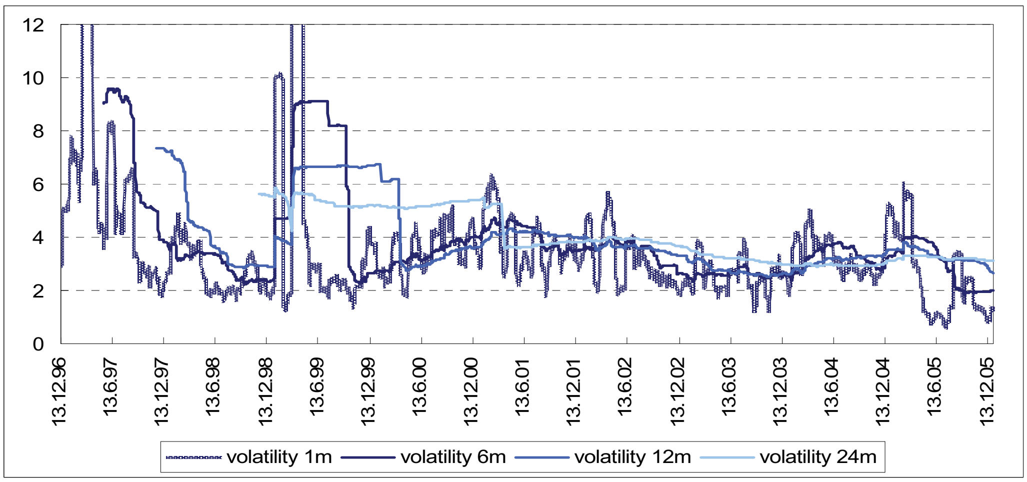

Figure no. 5 Volatility of the exchange rate RON/EUR

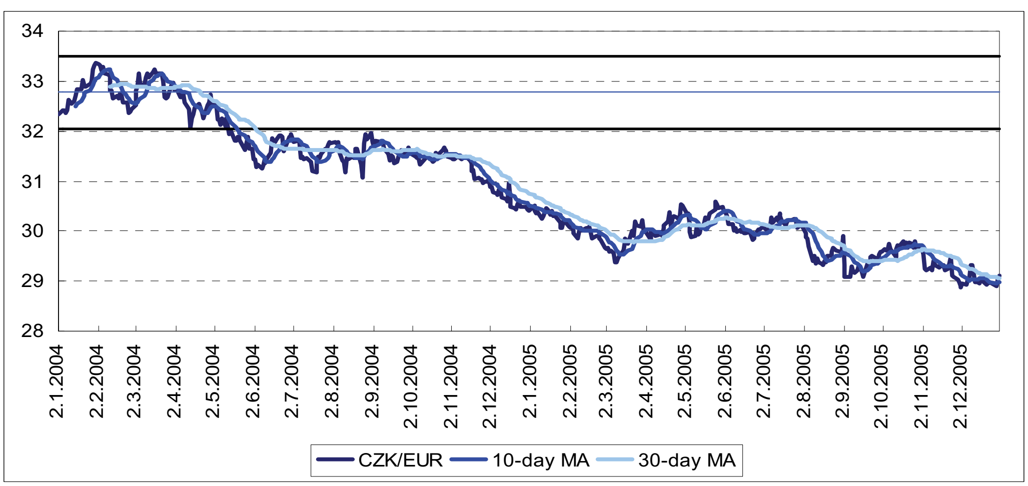

Figure no. 6 Simulation of the CZK participation in ERM II

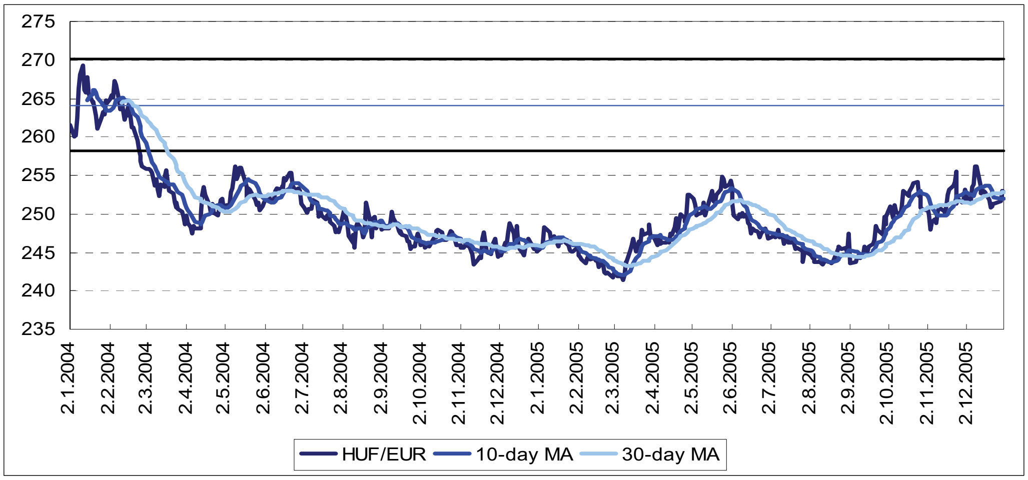

Figure no. 7 Simulation of the HUF participation in ERM II

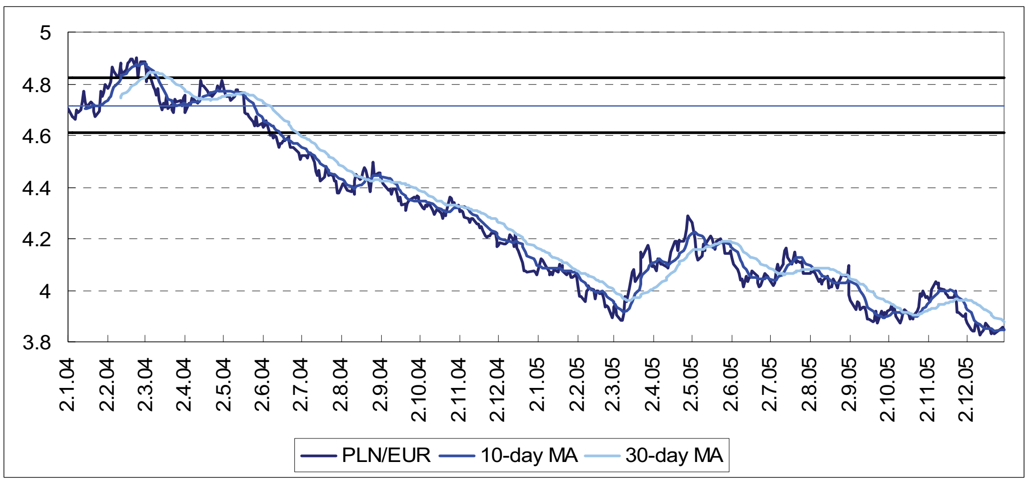

Figure no. 8 Simulation of the PLN participation in ERM II

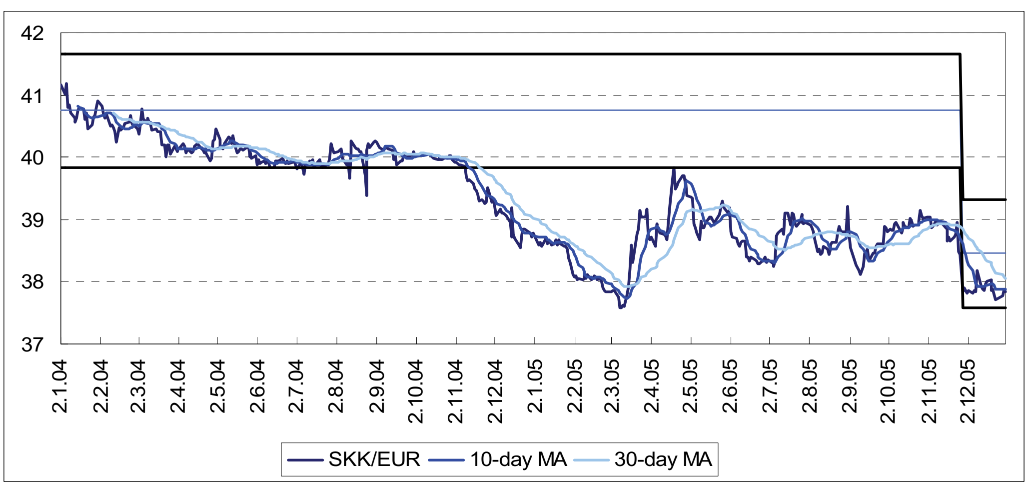

Figure no. 9 Simulation of the SKK participation in ERM II

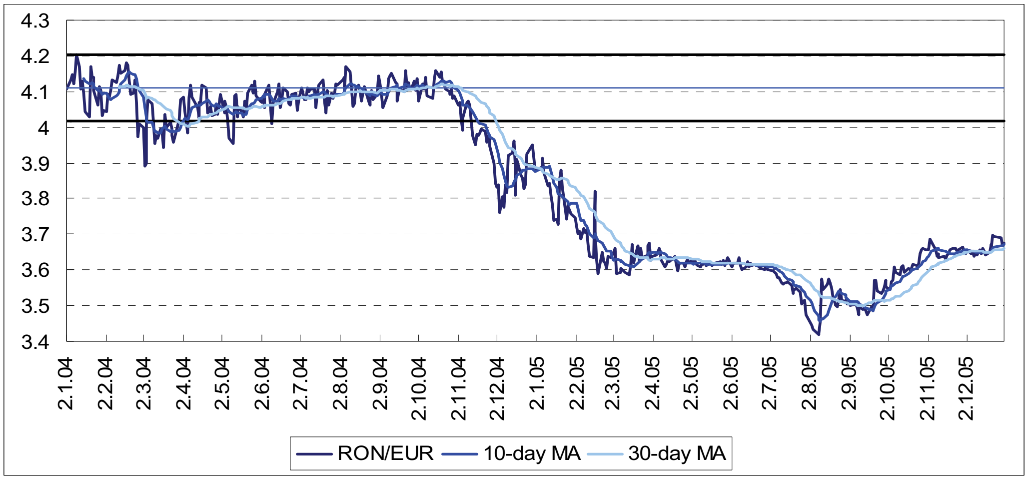

Figure no. 10 Simulation of the RON participation in ERM II

Using the volatility figures, we can also assess the time when any NMS enters into ERM II. According to the results obtained we can conclude that Slovakia was successful in its timing of ERM II entry, because the Slovak koruna entered into the mechanism in a period of very low and stable exchange rate volatility. In other words, Slovakia made this monetary integration step in a time when its exchange rate volatility was the lowest among all countries analyzed. This conclusion is important because Slovakia was the first NMS with floating exchange rate regime which started participation in ERM II. Thus, its decision to enter into ERM II was often referred to as very ambitious and maybe untimely.[3]

To put stress on the exchange rate volatility within the ERM II framework, an approach similar to the ECB methodology was applied.[4] This approach is based on the simulation of participation in ERM II with the average exchange rate from the first month observed as a substitute of the central parity. In this paper we used data from the last two years, which indicates that the January 2004 average exchange rate served as a benchmark.[5] Within this framework we identified the minimum and maximum exchange rates for each currency pair, derived upward and downward deviations respectively, and calculated the standard error. The same indicators were also estimated for the 10-day moving average. The 10-day moving average can enervate effects of any sporadic and short-lasting excessive deviation of the exchange rate. Thus, it provides a more polished picture about exchange rate volatility and more serious database for assessment of the ERSC fulfillment. The results are summarized in Table 1. The graphical illustration showing besides sport exchange rate and 10-day moving average also 30-day moving average is provided in Figures 6 – 10. The horizontal lines depict the ERSC band with the January 2004 average exchange rate as a central parity.

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[3] The decision of the Slovak government and central bank to adopt ERM II in November 2005 was considered as surprising because the previous statements of national authorities indicated the entry to ERM II in the middle of 2006.

[4] For practical application of the methodology mentioned see ECB (2004) as an example of a series of regular convergence reports published by ECB. The similar approach was also applied in Čech *et al.* (2005).

[5] This methodology is only illustrative and does not reflect any judgment as to the appropriate level of the central exchange rate.

Table no. 1 Volatility of exchange rates (01/01/2004 – 31/12/2005)

Exchange rate	Min	Max	Fluctuation band (%)	Standard error	Min 10-day MA	Max 10-day MA	Fluctuation band (%)
CZK/EUR	28.864	33.360	(11.9; -1.8)	1.2164	28.958	33.240	(11.6; -1.4)
HUF/EUR	241.41	269.30	(8.6; -1.9)	5.2404	242.02	266.16	(8.4; -0.8)
PLN/EUR	3.8248	4.9000	(18.9; -3.9)	0.3085	3.8434	4.8786	(18.5; -3.4)
SKK/EUR	37.571	41.184	(7.8; -1.1)	0.8578	37.736	40.829	(7.4; -0.2)
SKK/EUR (ERM II)	37.715	38.189	(1.9; 0.7)	0.1129	37.872	38.603	(1.5; 0.4)
RON/EUR	3.4196	4.2026	(16.8; -2.2)	0.2237	3.4554	4.1548	(16.0; -1.1)

Since Slovakia entered into ERM II during the period January 2004 – December 2005 we examined two scenarios for the Slovak koruna. Besides the two-year simulation with the January 2004 average exchange rate**,** we also calculated descriptive statistics of the authentic participation in ERM II. Logically, the time span of the second scenario is shorter than two years (only one month). Comparing the results of both scenarios, there is strong evidence of lower exchange rate volatility in ERM II characterized by a narrower fluctuation band. Regarding SKK, no exchange rate movement to the depreciation zone occurred from the beginning of ERM II participation, and, thus, the lower margins of their bands are positive.

Nevertheless, even the wider band portraying the SKK/EUR two-year simulation is not as wide as those of the four remaining currencies. During the simulation period, the appreciation margin of the ERSC band was exceeded in the case of exchange rates CZK/EUR, HUF/EUR, PLN/EUR, and RON/EUR. The extent of the margin breach were 9.67, 6.36, 16.65, and 14.58 percentage points respectively above the allowed limit 2.25 % from the central rate. No matter which exchange rate or scenario considered one can recognize effect of the moving averages which smooth fluctuations and contracts the fluctuation band. Despite this smoothing the width of the fluctuation bands remains excessive on the appreciation side.

Conclusion

This paper assesses exchange rate volatility in four NMS and Romania. It applies moving average standard deviations of annualized daily returns and a two-year simulation of the ERM II participation on data of nominal bilateral exchange rates of national currencies vis-à-vis the euro. This kind of analysis gains importance when participation in ERM II and fulfillment of the ERSC are taken into account.

The results obtained suggest that volatility of all exchange rates analyzed declined substantially. The volatility data also show that Slovakia which has already started ERM II participation**,** entered the mechanism at the optimal time. It was characterized by stable exchange rate development and low exchange rate volatility. The exchange rate volatility of the SKK/EUR exchange rate was the smallest among all countries and there was no sign of intensive SKK depreciation in the future. On the contrary, an upward realignment of the central parity is possible due to the general appreciation of the Slovak koruna in the last years.

Although the volatility measures of the four remaining exchange rates are not substantially higher than in Slovakia, in particular CZK and PLN still seem inclined to further appreciation which may be excessive in ERSC terms. As a consequence, Czech Republic, Poland, and Hungary should not follow Slovakia but stay out of ERM II for some time to come. Romania as a candidate country witnessed a development of the exchange rate volatility very similar to the development in NMS. Thus, one can expect that Romania could apply experience of current NMS to define its own national strategy to join European Economic and Monetary Union and implement the euro as a legal tender.

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