European Union membership and exchange rate convergence in Central and Eastern Europe

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The enlargement of the European Union in 2004 and 2007, with the accession of twelve Central and South-Eastern European countries, out of which ten are former-communist states, marks an economic and political experiment that is radically different from all previous EU adhesions. The integration process of these countries will directly influence their monetary and financial markets, considering their specific objective of adopting the Euro as common currency. The paper analyses the degree of homogeneity degree of exchange rates evolutions in Central and Eastern European countries that joined EU in 2004, based on the hypothesis of eventual Euro adoption and by taking into account their participation in the Exchange Rate Mechanism II. The results indicate that from the exchange rate perspective, the eight countries have entered into a homogeneity and convergence process, the only exceptions being Hungary and Poland.

Field of Research: Foreign exchange, International Economics

1. Introduction

The enlargement of the European Union in May 2004, with the accession of ten Central and South-Eastern European countries, out of which eight are former-communist states (Czech Republic, Hungary, Poland, Estonia, Lithuania, Latvia, Slovakia and Slovenia) was followed by a second integration wave on January 1, 2007, when Romania and Bulgaria joined the EU. This marks an economic and political experiment that is radically different from all previous EU adhesions, which stems not only from the diversity of the countries, in terms of culture, population and territorial size, but also from their macroeconomic particularities. Moreover, the adoption of the Euro is by far the greatest challenge these states are facing, and the introduction of the Euro as common currency in Slovenia in 2007 and Slovakia in 2009 proves that meeting the convergence criteria imposed by the adoption of the European currency is feasible.

The purpose of our research is to analyze the degree of homogeneity of exchange rate evolutions in the Central and Eastern European (CEE) countries that they will eventually adopt the common European currency and taking into account their current and potential participation in the Exchange Rate Mechanism II (ERMII). The

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convergence analysis of exchange rates evolution is based on the exchange rate regimes in force in these states, which are summarized in Table 1.

Table 1. Exchange rate regimes in CEE countries

Country	*Currency*	*Exchange rate regime*	*ERMII participation since*
Czech Republic	Koruna (CZK)	Traditional administered floating	NO
Hungary	Forint (HUF)	Exchange rate varies with the Euro within ±15%	NO
Poland	Zloty (PLZ)	Independent floating	NO
Slovenia	Tolar (SIT)	Euro	2004
Slovakia	Koruna (SKK)	Managed floating	2006
Latvia	Lats (LVL)	Exchange rate fixed to currency basket	2005
Lithuania	Litas (LTL)	Monetary council	2004
Estonia	Koruna (EEK)	Monetary council	2004
Romania	Leu (RON)	Managed floating	NO

Source: IMF, European Central Bank

The diversity of exchange rate regimes in these countries may be explained by the structural diversity of the group and by their need to actively control inflation and exchange rates. In the past ten years, four of the CEE emerging economies changed their monetary policy rule by adopting the inflation targeting regime: the Czech Republic in 1998, Poland in 1999, Hungary in 2001 and Romania in 2005. Nonetheless, all these countries will see their currencies replaced by the Euro, but not before their currencies perform for at least two years in the Exchange Rate Mechanism (ERMII). This multilateral exchange rate arrangement, similar to the mechanism which led to the introduction of the Euro, was put in place on January 1st, 1999, with the purpose of insuring the convergence of the economies that were participating in the system. The final goal is a smoother adoption of the Euro, by inducing higher stability of exchange rates against the Euro. Participation in ERMII is voluntary for the countries outside the Euro zone; however, because the two-year minimum period requirement represents one of the convergence criteria imposed for Euro adoption, all countries wishing to replace their national currencies with the Euro are compelled to adhere to this system. Joining the ERMII presupposes the establishment of a fixed exchange rate of the respective currency against the Euro with a fluctuation margin of ±15%. The countries that are currently engaged in ERMII are Denmark (with a lower margin, of only ±2,5%) and Lithuania, Estonia and Latvia (all with a margin of ±15%). In reality, there is a significant difference between the theoretical margin of ±15% and the effective margin followed by these currencies: the Danish krone operates at a margin lower than 1%, the Latvian lats at a 1% margin, while the Estonian kroon and the Lithuanian litas have 0% margins. This indicates a higher commitment of the central banks in these countries to ensure the highest possible level of stability of their currencies' exchange rates against the euro.

2. Data and research methodology

Our approach for the testing of convergence between the eight countries is based on cluster analysis, as a mean for identifying, hypothetically, a higher similarity between countries after their accession to EU, as compared to the before-accession period. Cluster analysis offers a solution to the general issue of classifying entities in groups called clusters, in such a manner as to find closer entities from the perspective of used attributes within the cluster, as compared to entities included in another cluster. The goal resides in identifying natural clusters depending on specific criteria, without knowing a priori the fitting of entities in the formed clusters. These criteria are based on a measure of similarity or closeness between studied entities, while the grouping of entities into clusters is made with respect to two conditions: (1) the similarity between the grouped entities, taking into account the variables considered and (2) the differentiation between the entities included in a cluster and the entities included in other clusters.

Cluster analysis has been used in economic and financial research, either at a macroeconomic level or at the microeconomic one. Farrell (1974) pioneered the use of cluster analysis in portfolio management, by analysing the covariance of stock returns and its relevance for asset allocation within portfolios of stocks. Arnott (1980) and Farell (1986) continue this line of research. More recently, Pandit et al. (2001) examine the cluster building mode in the financial services industry in Great Britain and study the effect of the cluster power in explaining companies' growth and their survivorship rates on the market. Fifield et al. (2002) investigate the measure in which the global and local factors can explain the returns on the emerging markets, the factors being identified through the principal component analysis. Bensmail and DeGennaro (2004) apply cluster modelling to financial data, their purpose being that of analyzing the missing data and identifying homogenous groups in the interior of the available data.

The effective use of cluster analysis raises two issues: the first one is the tool used to measure the distance between entities, while the second one is the algorithm employed for cluster identification. For what concerns the measurement of the distance (we will denote the entities by *i* and *j*, with coordinates (X_{1i}, X_{2i}) and (X_{1j}, X_{2j}), respectively, depending on the attributes X_1 and X_2 considered in the analysis), cluster analysis uses the following tools: (1) *Euclidian distance* – it measures the distance between points *i* and *j* as the hypotenuses of a triangle they form, using the formula $D(i,j)=\sqrt{(X_{1i}-X_{1j})^2+(X_{2i}-X_{2j})^2}$; (2) *quadratic Euclidian distance* – defined as the square of the Euclidian distance, using the formula $D(i,j)=(X_{1i}-X_{1j})^2+(X_{2i}-X_{2j})^2$; and (3) *Manhattan distance* – defined as $D(i,j)=\left|X_{1i}-X_{1j}\right|+\left|X_{2i}-X_{2j}\right|$.[i] For all the three measures, an *i* observation is considered to be closer to observation *j* if D(i,j) < D(i,k). Alternatively, weights can be considered, in order to reflect the importance of variables taken into account, with a weighted measure of distance being computed. All distance measures depend on the measurement units of variables X_1 and X_2 and are influenced by the characteristics or variables with high values. Due to this reason, the variables are standardized before starting the analysis.

Clustering algorithms can be divided in two main categories, depending on their hypotheses and the nature of results. As such, hierarchical and iterative algorithms can be employed – the hierarchical algorithms include aggregation clustering and division clustering, the best known being the single linkage method, the complete linkage method, the centroid method, the average linking method or Ward's method; the iterative clustering algorithms include the k-means method, CLARA algorithm or fuzzy algorithm.

Our convergence analysis is based upon the identification of homogeneous groups formed of the eight countries – Czech Republic, Hungary, Poland, Slovenia, Slovakia, Latvia, Lithuania and Estonia, according to the evolution of the nominal and real exchange rates of their currencies against the first 12 and 25 trading partners. The clusters will be formed before and after their accession to the European Union in May 2004. The time frame covers the fourth quarter in 2000 until the fourth quarter in 2006, split into two sub-periods, as follows: the first sub-period extended between the fourth quarter in 2000 and the first semester in 2004, while the second covers the time between the second semester in 2004 and the fourth semester in 2006. All data was collected from the EUROSTAT database, and we used monthly frequency for the nominal and real exchange rates.

The exchange rates used in our analysis were the real effective exchange rates (REER) calculated by taking into account twelve European countries – REER12[ii] - and a larger group of 25 European countries[iii] - REER25. Before applying clustering algorithms, all variables were standardized. The amalgamation techniques used were hierarchical: single linkage and Ward's method, while using Euclidian distances.

From the exchange rate point of view one has to distinguish between nominal rates and real rates. The effects of relative inflation rates between the home economy and the foreign economy influence the exchange rate between the two countries. When the foreign inflation is higher and the home inflation does not change, the foreign currency is expected to depreciate against the home currency. Although the foreign currency will cost less now in home currency terms, this does not necessarily imply that the real value of goods and services purchases across borders decreased. The explanation resides in the fact that the increase in foreign prices for goods and services has exactly offset the decline in the value of the foreign currency, given higher inflation rates abroad than at home. Another way of describing this phenomenon is to say that purchasing power remains the same in the two countries. In this case, while the foreign currency has undergone a nominal depreciation, it has not undergone a real depreciation. Therefore, what eventually matters for purchasing power between any two countries is not the simple change in the nominal exchange rate, but the change in nominal rates after adjustments for the changes in the relative inflation rates between the two countries took place. The *real exchange rate* is defined as the nominal exchange rate that takes into account the inflation differentials among the countries.

The *real effective exchange rate* (REER) assesses the competitiveness of a country in terms of prices or costs against the competitiveness of its main competitors on foreign markets. The changes in competitiveness are identified by taking into

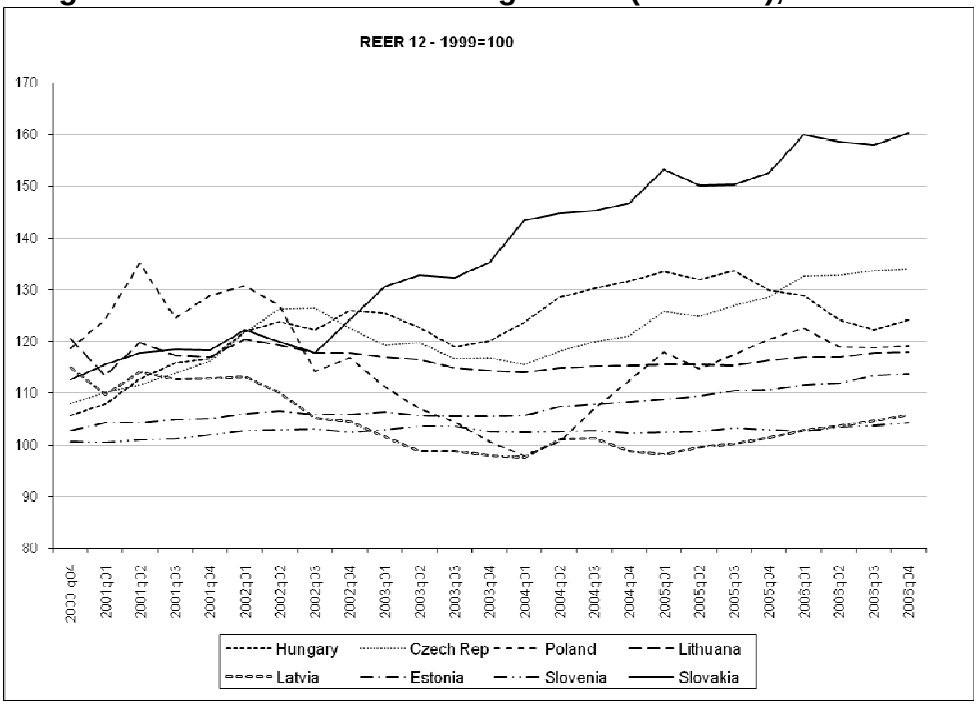
account not only changes in the nominal exchange rate, but also changes at the level of costs and prices in the respective countries. REER corresponds to NEER deflated by the nominal labour average costs (at economy level) and by the consumer prices (consumer price index/harmonized consumer price index HICP). An increase in REER indicates a decrease of country's competitiveness on foreign markets, while a decrease in REER points toward an increase of competitiveness.

3. Results and discussion of findings

Before discussing the results offered by cluster analysis, we provide an overview of exchange rates' evolutions in these countries using 1999 (the year of euro introduction) as a reference year.

We observe, in Figure 1, that the currencies of all the eight countries recorded real appreciations during the 2000-2006 period, the highest appreciation being in the case of the Slovak currency (approximately 60%) and the lowest in the case of the Slovenian currency (only 4%). After the fourth quarter in 2000, the currencies of Slovakia, Hungary, Czech Republic, Estonia and Slovenia have appreciated in real terms, in comparison with the end of 2000, while Latvia and Lithuania's currencies have depreciated in real terms. From the competiveness point of view, it results that, Slovakia, Hungary, Czech Republic, Estonia and Slovenia have reduced slowly their competitiveness against the twelve trade partners, while Latvia and Lithuania have seen their competiveness increase. The evolution of Poland's currency is an interesting one, and different than any other: the Polish currency depreciated in real terms by the beginning of 2004. After this time the currency slowly started to appreciate in real terms. By the end of 2006, the real exchange rate had practically the same value as at the end of year 2000. This indicates that the Polish economy lost part of the gained competiveness until 2004, being closer and closer from other economies of the region.

Figure 1. Real effective exchange rates (REER12), 2000-2006



The real exchange risk analysis by taking into account 25 trade partners confirms the above conclusions. Under these circumstances, compared with year 1999, all the eight currencies appreciated in real terms. This indicates a decrease of their competiveness degree. The highest appreciation, in real terms, was recorded by the Slovak koruna, while the lowest appreciation belong to the Slovenian currency. Comparing with the fourth quarter in 2000, the evolutions are similar: Latvia is the only country that succeeded to increase its competiveness. All the others, with currencies being within an obvious process of appreciation in real terms, were decreasing their competiveness on foreign markets[iv].

The cluster analysis that takes into account the real exchange rate offers supplementary interesting indications, as far as the evolution of these eight economies is concerned. Taking into consideration REER 12 (see Figure 2a-b), we may observe a diminishment of the minimum and maximum linkage distances between cases before and after integration: the lowest distance is 1.6886 in the first sub-period and 0.9585 in the second sub period. After the application of the Ward method we may observe the reduction of the minimum linkage distance from 1.6886 to 0.9585 - from one sub-period to the other - and the reduction of the minimum linkage distance from 17.4296 to 9.1975. Consequently, the distance amplitude reduces from 3.9139 to 1.8144 when the simple linkage method is used and from 15.7410 to 8.2390 when the Ward method is applied. This indicates an increase of the homogeneity of foreign exchange evolutions, as a reflection of the competiveness in the region.

Figure 2. Linkage distances for clusters using REER 12

a. Q4 2000 – Q1 2004 b. Q2 2004 – Q4 2006

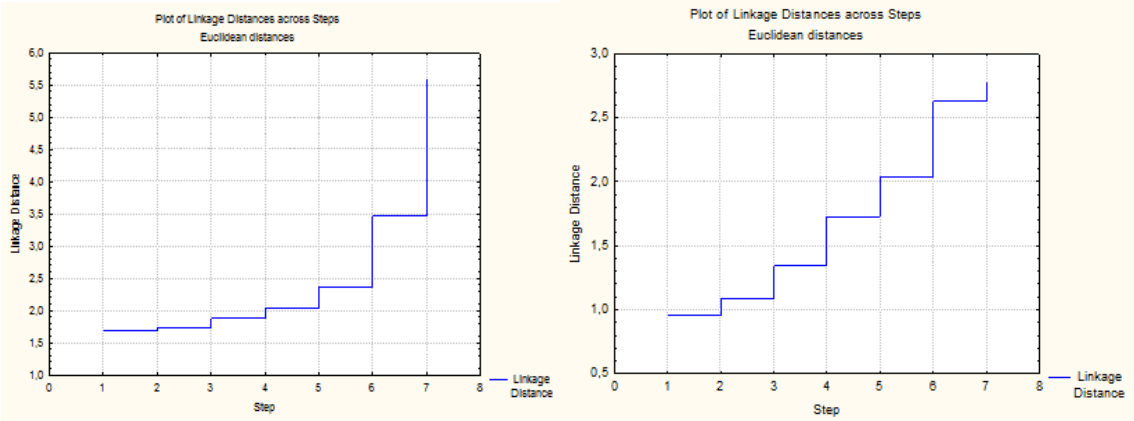
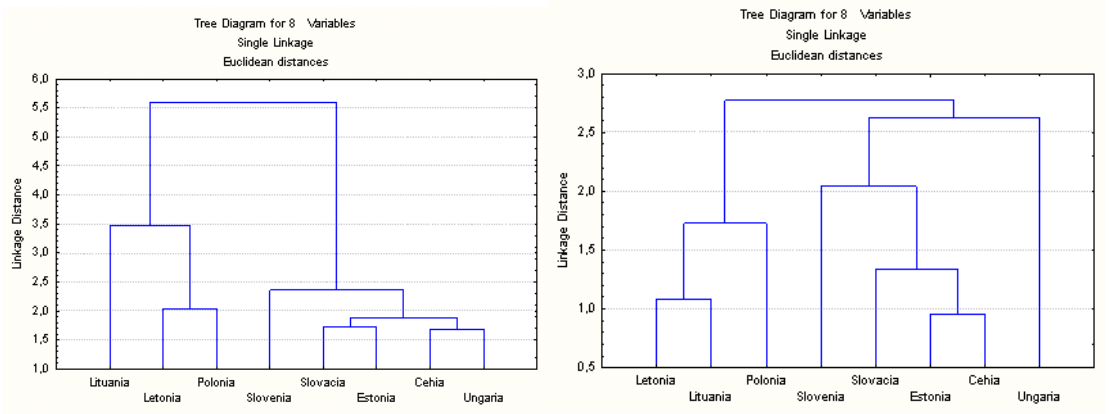


Figure 3 shows the clusters before and after the countries' accession to EU in 2004. Both clustering methods indicate the presence of two strong clusters before the EU integration. At the first iteration the cluster of Hungary - Czech Republic is identified (with a linkage distance between its components of 1.6886 in the case of both methods), while at the second iteration the cluster Estonia – Slovakia is identified (with a linkage distance between its components of 1.7245 in the case of both methods). The Ward method also determines the presence of a third strong cluster, identified at the third iteration, and formed between Poland and Latvia (this is identified only in the case of the forth iteration when the simple linkage distance method is being used). None of the previous formed clusters exists after integration.

In the after-integration period, the most homogeneous one is the cluster Czech Republic – Estonia (cluster indentified at the first iteration by both methods, with a distance between components of 0.9585), followed by Lithuania and Latvia (cluster identified at the second iteration, with a distance of 1.0820 by both methods). The country that enters the latest in the clustering algorithm is Lithuania in the first sub-period, as indicated by the results of both methods, and Hungary after the integration.

Figure 3. Cluster aggregation using REER 12, 2000-2006

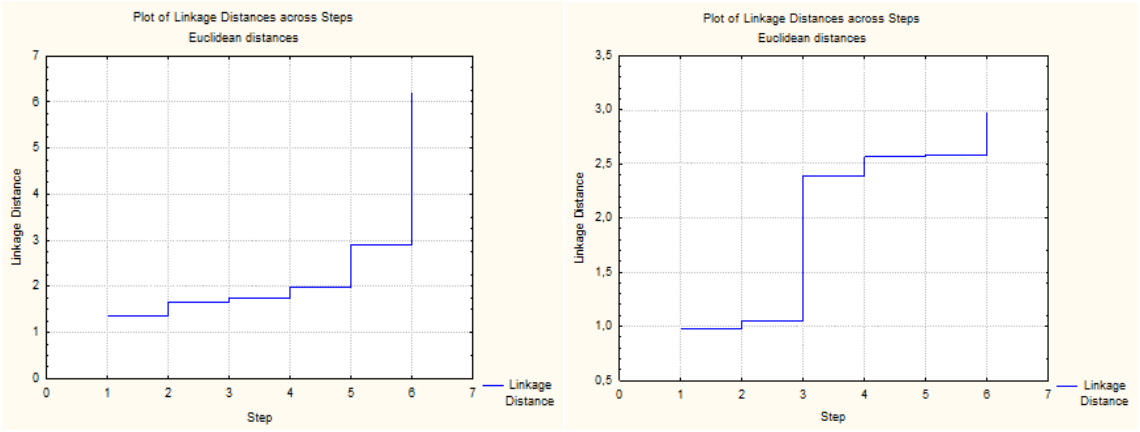
a. Q4 2000 – Q1 2004 b. Q2 2004 – Q4 2006



When REER 25 is used, the conclusions that we may draw are similar to the previously identified ones, as the homogeneity of these eight countries increases, being emphasized by the reduction of the minimum and the maximum linkage distances. In these circumstances, when the single linkage method is applied, the minimum linkage distance decreases from 1.3730 in the first sub-period to 0.97171 in the second sub-period, while the maximum linkage distance declines from 6.2286 to 2.9805 in the second sub period (see Figure 4a-b). The Ward method also indicates a decrease of both distances: the minimum from 1.3730 during the first sub-period to 0.9171 in the second sub-period, and the maximum from 16.4527 to 6.7985. As such, the distances range declines, which suggests an increase in the homogeneity between the considered countries and economies.

Figure 4. Linkage distances for clusters using REER 25

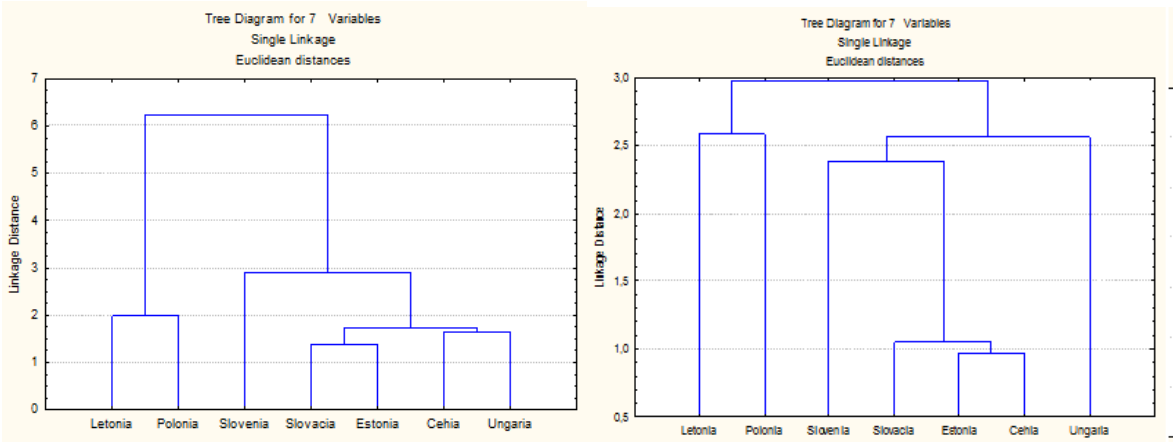
a. Q4 2000 – Q1 2004 b. Q2 2004 – Q4 2006



As in the case of REER12, the two methods indicate the presence of two strong cluster before integration: the first one is formed between Estonia and Slovakia (at the first iteration with a linkage distance of 1.3730 in both methods), and the second one involves Hungary and Czech Republic (at the second iteration in both methods, with a distance of 1.6528. Also similar to the previous results, these clusters are destroyed in the post-integration period, during this time the strongest clusters and, consequently, the closest countries from the exchange rate evolution perspective being Czech Republic and Estonia (first iteration), accompanied by Slovakia (second iteration). Slovenia displays the lowest homogeneity level before the 2004 integration, and Hungary after the integration (see Figure 5a-b).

Figure 5. Cluster aggregation using REER 25, 2000-2006

a. Q4 2000 – Q1 2004 b. Q2 2004 – Q4 2006



5. Concluding remarks

The objective of our research was to analyse the degree of homogeneity of the currencies evolutions in the case of 8 Central and Eastern countries that became part of the European Union in 2004 – Czech Republic, Hungary, Poland, Slovakia, Latvia, Lithuania and Estonia, taking into account their premises of adopting EURO and their participation in the European Exchange Mechanism II. The convergence analysis involved the identification of similar groups, as much as possible, formed by these eight countries according to the evolution of the real exchange rates of their currencies in comparison with the first 12 and 25 trade partners, respectively, before and after the moment of entering EU (May 2004). Our results reveal that from the exchange rate point of view, these eight countries entered in a process of homogenisation and convergence, Hungary and Poland, being, maybe, the only exceptions. The main explanation for this homogeneous behaviour, in our opinion, is related to the macroeconomic convergence process that these countries are part of, as a result of the integration in the European Union. At the same time, the entrance of some of these currencies in ERMII, as a condition of a future EURO adoption, may provide a useful explanation for these evolutions. For what concerns the business environment risks, a higher similarity of foreign exchange evolutions indicates a decrease of the risk in the case of these countries, considered as a group, along with the diminishment of exchange rate risk, generated by the currencies adoption of a fixes exchange rate regime.

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[i] Other measures of distance may be employed, such as Cebisev, Minkovski, Canberra, Mahalanobis, Person or Jambu.

[ii] Belgium, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, Holland, Austria, Portugal, Finland

[iii] Besides the countries included in NEER12 and RRER12, it includes Denmark, Sweden, United Kingdom Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovakia

[iv] Due to lack of data, Lithuania was not included in the analysis using REER25.