FINANCIAL INTEGRATION IN THE CEE COUNTRIES

Iulian-Cornel LOLEA
Bucharest University of Economic Studies
6 Piata Romana, Sector 1, Bucharest, Romania
loleaiulian@gmail.com

Radu PETRARIU
Bucharest University of Economic Studies
6 Piata Romana, Sector 1, Bucharest, Romania
radu.petrariu@rei.ase.ro

Abstract. *This paper aims to analyze the level of financial integration for the new member states of the European Union from Central and Eastern Europe: Romania, Poland, Hungary and the Czech Republic. There was implemented an analysis of sigma-convergence and beta-convergence for different economic periods (recession or economic growth). The results were in line with the initial expectations. It has come to the conclusion that the level of financial integration for the capital markets of these countries increases in good economic times and decreases in times of crisis when the volatility in equity markets increases. It was also observed that Romania was the country that recorded the most important progress, both in terms of sigma-convergence (which captures the reduction of discrepancies) and in terms of beta-convergence (speed of convergence). Also, the past few years have come together with the highest level of integration in capital markets in CEE countries, mainly due to the strong recovery after the recession from 2008, but also due to the improvements that each country has made in the field of correlating its business cycle with Euro Zone. Further, the methodology can be extended in order to cover the forex market, the money market or the bond market.*

Keywords: *equity markets; integration; volatility; convergence; economic downturn; time-series.*

Introduction

The financial integration of the countries that have recently joined the European Union is a hot topic and an extremely difficult issue to quantify. It is widely accepted that financial integration should be analyzed in different market conditions at different times, because the behavior of financial market is different during times of crisis compared to normal market situations. The level of financial integration is decisive for the accession of these countries to the Eurozone, but also for the health of the Eurozone and for how the business cycles of these countries are correlated. At the same time, a strong correlation also brings disadvantages such as the more rapid transmission of negative shocks and, implicitly, of economic crises to all member countries.

This paper will analyze the level of financial integration for the countries from the Central and Eastern Europe (Romania, Poland, Hungary and the Czech Republic) taking into consideration the evolution of their capital markets. Thus, the level of convergence (sigma-convergence and beta-convergence) of the capital markets in these countries relative to the Eurozone will be analyzed. This paper will try to highlight some

differences between countries in terms of integration level, but also to highlight the time differences of the integration level. The analysis was carried out over 3 different periods: pre-crisis (2000-2006), crisis period (2007-2011), post-crisis period (2012-2018).

The novelty of this research is represented by the inclusion of Romania in the study, which is one of the newest members of the European Union. Another novelty element is represented by the division of the analyzed period into 3 sub-intervals in order to capture the evolution of the convergence in three different markets: exuberance before the crisis, panic during the crisis, and post-crisis caution. Having this division and applying the classical methodology revealed by the scientific literature, we expect to obtain results relevant to the desired approach. Thus, we expect the level of integration to decline in the period of crisis and to improve later, as volatility and market panic decrease. At the same time, we expect to have a higher level of convergence in the post-crisis period, given the fact that most of the countries considered for the analysis will be members of the E.U. for at least 10 years, and the integration should have been achieved to a large extent.

Taking all of these expectations and hypotheses into consideration, we will go further towards the study. In the end, we will try to identify ways to extend idea in a future research. At the same time, it is very important to recall the importance of this research and the importance of this current contextual theme in the European Union, having in mind all the talks on reforming the union. All these debates will pose a challenge for the integration of financial markets, leading to mistrust among investors, which could finally lead us to a decrease in convergence in the coming periods, accompanied by an increase in market volatility.

Literature review

Financial integration at the E.U. level has been an important and constantly debated issue in recent years in the relevant literature. At the same time, such a theme was the starting point for many papers published by the EC's economists, balancing both the costs and the benefits of higher financial integration. Such works could be based on Baele et al. (2004) or Agenor (2003) publications, which introduce quantitative concepts and qualitative measures to capture the level of integration and convergence such as price-based measures, quantity-based measures or news-based measures.

The level of financial integration can be studied together with another problem: contagion in the financial markets. In this regard, we can mention the researches of Egert and Koubaa (2004), through which financial market contagion is studied using GARCH (conditional heteroscedasticity) models. Syllignakis and Kouretas (2006), or Egert and Kocenda (2005), may also be reminded, as they focus more on the phenomenon of cointegration in the financial markets. They also brought attention to the usefulness of applying the Granger test for causality on the Polish capital market to highlight how it reacts to a shock on another market.

An extremely important previous work for our paper is that published by Babetskii, Komarek and Komarkova (2007), which addresses the issue of financial integration in the countries of the Central and Eastern Europe. This paper addresses the two well-kwon convergence theories from the relevant literature: beta-convergence and sigma-convergence. The analysis is very useful, because it was detailed and expanded at the

level of the economic sectors which are represented on the stock exchanges. Also, the same topic was analyzed by Babecky, Komarek and Komarkova (2013). They made a more recent research regarding the level of integration based on the sigma-convergence and beta-convergence, but this time they expanded it to other financial markets, alongside the capital market: the forex market, the money market and the bond market. Considering all these facts, they have been able to raise an important topic and have been able to draw a series of relevant conclusions regarding the level of financial integration in the countries from the Central and Eastern Europe.

The experience of the most recent economic and financial crisis has proven to us that markets can be atypical at times of tension and thus the level of integration may vary from time to time, depending on the overall economic situation. Therefore, the level of integration and stability of markets may be dependent on the economic situation, but there is a possibility that the situation may be in the opposite direction. We can also talk about a dependence of the economic conditions on the situation on the financial markets, on the stability of the financial markets. A paper addressing this issue is that of Mendoza et al. (2009), but the literature is rather poorly developed in this direction. Therefore, the present research will also highlight the variation in time of the level of integration and stability of the financial markets depending on the economic period, depending on the economic evolution.

The research will be continued by studying beta-convergence and sigma-convergence in accordance with the methodology proposed by Adam et al. (2002) and later extended by Babetskii, Komarek and Komarkova (2007) and Babecky, Komarek and Komarkova (2013). This methodology will be applied to countries from the Central and Eastern Europe (Romania, Hungary, Poland and the Czech Republic). Also, we will take into account the research of Mendoza et al. (2009) regarding the time variation of the level of integration and stability of the financial markets according to the economic conditions and we will try to emphasize how the financial integration can change over time depending on the economic conditions.

Methodology

Financial integration can be analyzed using two methods, based on the law of one price: a) price-based measures and b) news-based methods, but this paper focuses only on the first method. It may be extended in the future to take into account the news-based methods.

We are going to apply price-based methods in accordance with Adam et al. (2002) and Babecky et al. (2013), who described and used the concepts of sigma-convergence and beta-convergence applied for the financial markets, which is the case for this paper. Beta-convergence shows us the speed at which the differences between indices' returns are eliminated. A negative value for the beta coefficient reveals that the convergence is taking place. This coefficient has to be as close as possible to -1. The closer to -1, the higher is the speed of convergence.

The second concept is the sigma-convergence which reveals the dispersion between the yields of some asset classes or some instruments (in this case stock markets indices). The sigma-convergence takes place when the coefficient falls to zero. Hence, the value of sigma has to be as close as possible to 0.

In order to calculate daily returns we are going to use the following formula:

$$r_t = \ln(\frac{S_t}{S_{t-1}})$$

Where r_t – is the return at moment "t", S_t- is the price of the index at moment "t" and S_{t-1} - is the price of the index at moment "t-1"

Based on these notation, we can use the following formula for quantifying beta-convergence as Babecky et al. (2013) did:

$$\Delta R_{i,t} = \alpha_i + \beta R_{i,t-1} + \sum_{l=1}^{L} \gamma_l \Delta R_{i,t-l} + \varepsilon_{i,t}$$

Where $R_{i,t} = r_{i,t} - r_t^B$ is a difference between the return for an index for a specific country "i" and the return for the benchmark index for the Euro Zone, all of them at time "t". L is the maximum number of lags taken into consideration for the analysis. In this paper we are going to use L=3. The last term, $\varepsilon_{i,t}$ is a white noise, an error term which is normally distributed with mean zero and variance 1.

The above regression is going to be estimated a few times for each country, for different sub-intervals, in order to get relevant values for the beta coefficient. As stated above, a negative beta coefficient reveals that the convergence occurs. The closer the value for this coefficient is to -1, the higher the speed the convergence.

Further, we need to present the methodology for sigma-convergence. Hence, we are going to use the following formula, as it was stated in a lot of scientific articles:

$$\sigma_t = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(r_{i,t} - \overline{r_t}\right)^2}$$

Where $\overline{r_t}$ is the average return over time and N represents the number of countries taken into consideration for the sigma-convergence approach. For this paper, we are going to use N=2 in order to analyze the sigma-convergence over time for each country related to the Euro Zone (Euro Stoxx 50). As it was stated at the beginning of this chapter, the sigma-convergence appears when the value for this coefficient is getting closer to zero. Also, it has to be noted that it takes only positive values.

The paper will present the evolution of the sigma convergence for the 4 countries compared to the Euro zone, for three different time periods:
- 13/12/1999 - 31/12/2006 - the period before the economic and financial crisis;
- 01/01/2007 - 31/12/2011 - the period of the economic crisis and the sovereign debt crisis in the Euro Zone;
- 01/01/2012 - 20/09/2018 - the post-crisis period - the period of economic growth and stability in the financial markets.

For a more appropriate graphical illustration and in order to better capture the trend in financial integration from each sub-interval, we are going to use the Hodrick-Prescot filter with a smoothing parameter: λ = 270,400, as it was recommended by Babetskii et al. (2007) and as Babecky et al (2013) did.

The data

There have been used daily observations for the equity market indices for each country from the Central and Eastern Europe (Romania, Poland, Hungary and the Czech Republic) and the Eurozone.

Euro Zone: Euro Stoxx 50
Romania: BET index
Czech Republic: PX Index
Hungary: BUX Index
Poland: WIG20
Period: 10/12/1999 - 20/09/2018

Data for the equity market indices were processed in order to obtain daily returns, which were then used in identifying the two types of convergence: sigma and beta.

For a better knowledge of the datasets used, we are going to present further a few charts for the evolution of the equity market indices:

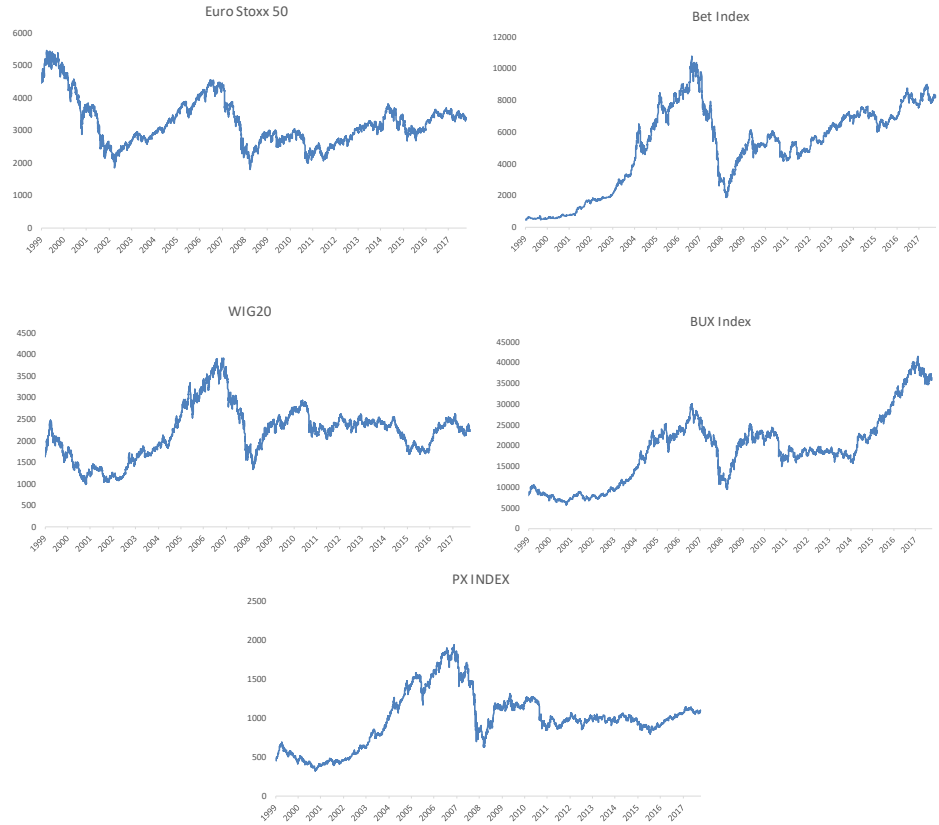

Figure 1. Evolution of the selected equity market indices: Euro Stoxx 50, Bet Index, WIG20 Index, BUX Index and PX Index
(Authors' own computation based on yahoo finance data)

Similar developments can be observed using these graphs, but also periods of divergence between the markets considered. A common and very easy to observe is the

impact of the 2008 economic and financial crisis on all capital markets, with a strong correction for each of the five equity indices. However, a simple comparative analysis of the evolution of the five indices cannot provide us with much information about the convergence of the capital markets in these countries. In order to deepen the discussion, it is necessary to move on to the analysis of daily returns to see how large the movements in these markets were in the chosen period of time.

Further, we'll look at the daily returns for the 5 indices. It can be noticed that there were two very high volatility periods: between 2001-2002 (dot.com crisis) and 2007-2008 (global economic crisis). During these periods there were daily returns ranging between -10% and 10% for 4 out of 5 indices. The BET index of the Romanian stock exchange registered the highest daily fluctuations ranging from -20% to 20% in the period 2001-2002. On the other hand, Poland's WIG20 stock index recorded the slightest fluctuations, with daily yields ranging from -8% to 8% for the entire period under review.

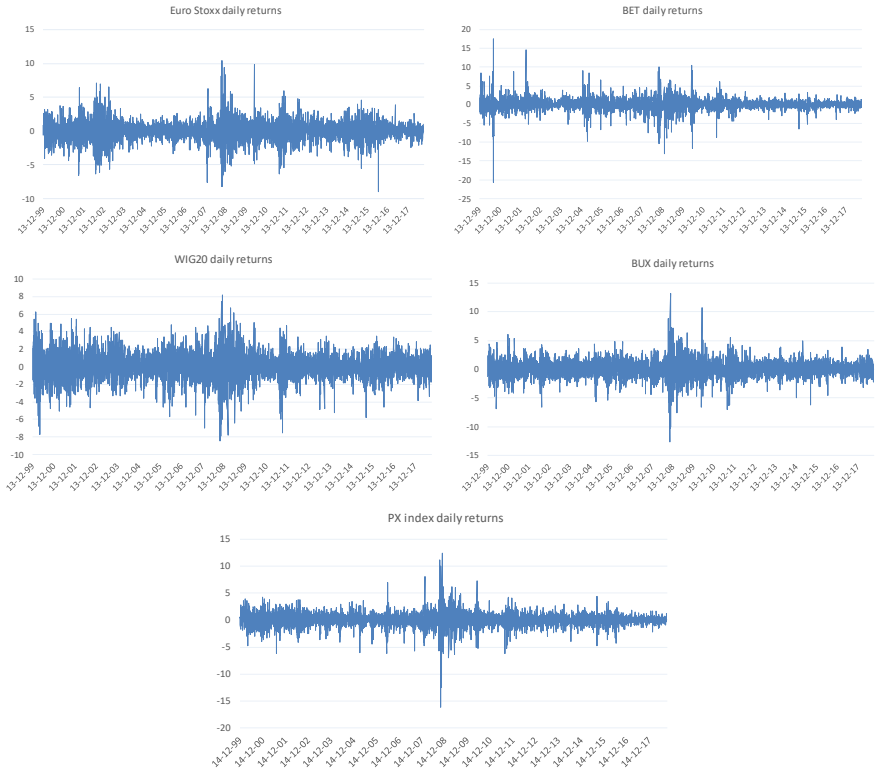

Figure 2. Daily returns of the selected five equity indices: Euro Stoxx 50, Bet Index, WIG20 Index, BUX Index and PX Index
(Authors' own computation based on yahoo finance data)

Results

First of all, we will present the evolution of coefficients for sigma convergence for each of the sub-interval for the analysis: (i) the period before the crisis, (ii) the crisis period (economic and sovereign debt crisis in Europe), and (iii) the post-crisis period in Europe. For a better illustration of the sigma coefficient trend in these periods it was used the Hodrick-Prescot filter with a smoothing parameter $\lambda = 270,400$, as specified in

the methodology chapter. We recall that the result of the analysis should be as close as possible to zero in order to achieve the sigma convergence.

Before global economic crisis – 13/12/1999 – 31/12/2006

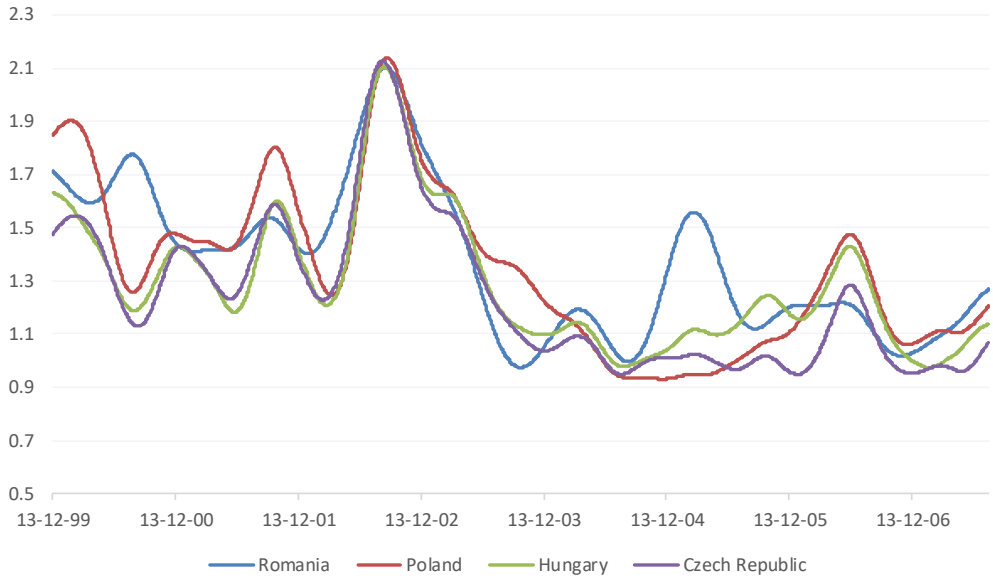

Figure 3. Evolution of the sigma coefficients for Romania, Poland, Hungary and Czech Republic in the pre-crisis period
(Authors' own computation based on yahoo finance data)

The results obtained show that in the period before crisis, but also in the period prior to the accession of these countries to the European Union, the level of integration measured by the sigma convergence was quite low, and the turmoil periods on the financial markets have reduced this convergence. This can be noticed by the significant increase of the coefficient in 2001-2002 (dot.com bubble on the equity markets). Subsequently, as the economic situation has improved and some of the countries have joined the European Union, the level of convergence has improved significantly. During this first period it can be noticed that Romania is the country that made most of the times the discordant note against the others, being the only one that had not yet joined the European Union.

Therefore, during this period, we noticed a dependence of the level of convergence and financial integration on the economic conditions, but also on the membership in the E.U. Romania was the most decorelated country, being the only one that was not a member of U.E. in the analyzed period.

Global financial crisis period and sovereign debt crisis in Europe (01/01/2008 – 31/12/2011)

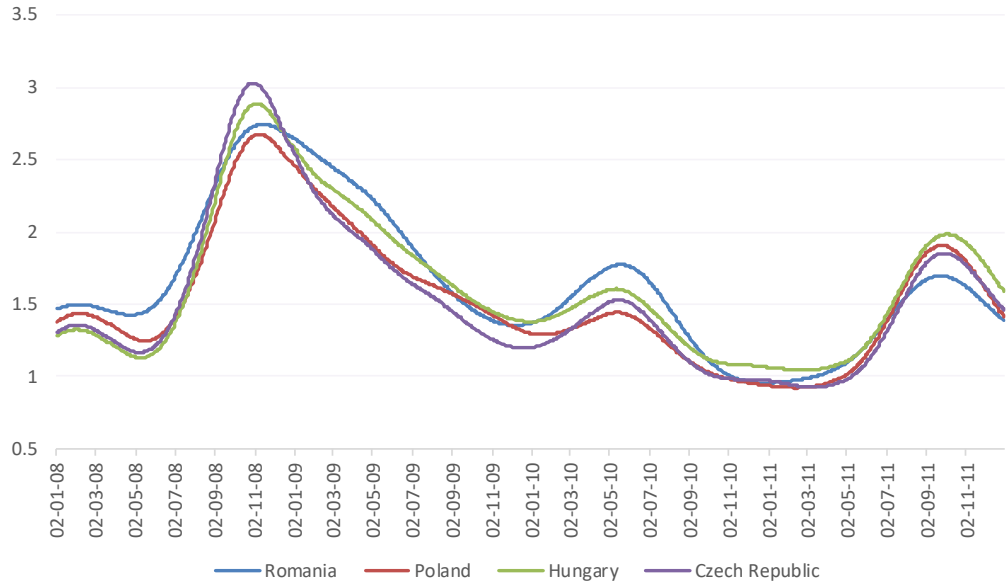

Figure 4. Evolution of the sigma coefficients for Romania, Poland, Hungary and Czech Republic in the crisis period
(Authors' own computation based on yahoo finance data)

As a result of the estimates for the second sub-interval (the crisis period), it was again confirmed that in times of turmoil on capital markets the level of integration decreases, reaching a minimum of convergence for all four CEE countries at the end of 2008. It can also be noticed that Romania registered again the biggest divergence from the Euro Zone equity market. As the effects of the economic and financial crisis dissipated, we saw an increase in the degree of convergence gradually towards the end of the period. On the other hand, a new downturn in integration has emerged in 2011 as the sovereign debt crisis erupted, which has again brought tension and nervousness to the financial markets.

Post-crisis period (01/01/2012 – 20/09/2018)

The last analyzed period was represented by the last 6 years, a period characterized by sustained economic growth in the countries of Europe and especially in the countries of Central and Eastern Europe. Thus, we have had a period of low tension on the financial markets, a period of low volatility, which has helped the equity markets from Romania, Poland, Hungary and Czech Republic to increase the degree of convergence with the Eurozone.

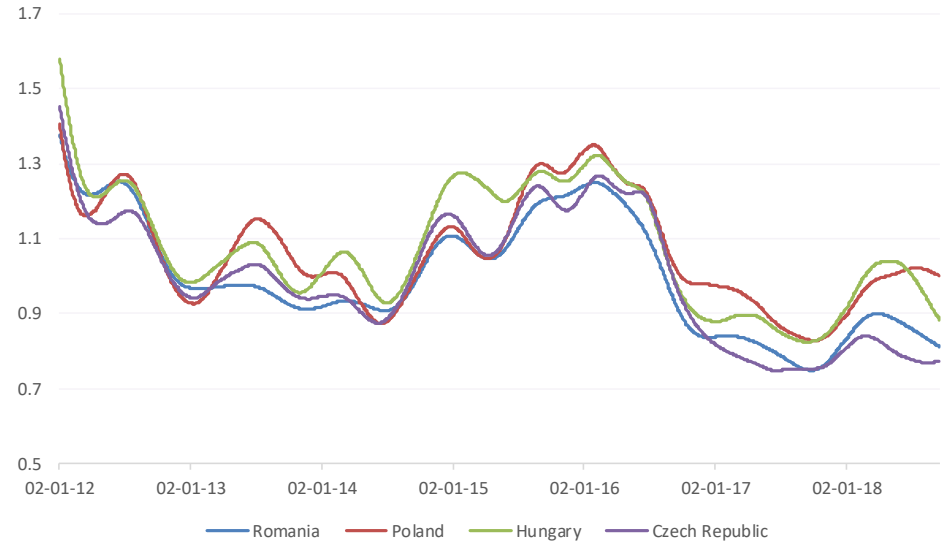

Figure 5. Evolution of the sigma coefficients for Romania, Poland, Hungary and Czech Republic in the post-crisis period
(Authors' own computation based on yahoo finance data)

Initial expectations that the level of integration of financial markets in the Central and Eastern European countries is growing during periods of economic growth is also confirmed by this last figure. Thus, at the end of 2017 was recorded the lowest value for the sigma convergence coefficient over the entire analyzed period and we can say that the financial integration for these markets has increased significantly. Consequently, the sigma- convergence has been achieved to a good extent. Furthermore, it is worth noting that a significant improvement has been registered by Romania. For the case of this country there was registered the lowest value for sigma convergence in this last period, highlighting the most integrated and correlated equity market with the Euro Zone capital market in this period.

Further, the results obtained after studying the beta-convergence for the same sub-intervals are presented using the below table (Table 1):

Table 1. Beta Coefficient - speed of convergence
(Authors' own computation based on yahoo finance data)

	Equity Market		
	Sep 1999 - Dec 2006	Jan 2007 - Dec 2011	Jan 2012 - Sep 2018
RO	-0.71	-0.64	-0.84
HU	-0.82	-0.87	-0.88
PL	-0.87	-0.81	-0.86
CZ	-0.83	-0.76	-0.82

We recall that the beta coefficient must be negative and close to -1. It shows the speed at which the convergence is achieved for each of the four countries relative to the Eurozone (benchmark).

Based on the above results, we can see that for 3 out of 4 countries the convergence rate decreased during the crisis period compared to the pre-crisis period, so that it would return to similar or better levels later. The best performance in terms of increasing convergence rate was registered by Romania, where the beta convergence coefficient has improved from -0.71 to -0.84, being much closer to -1. Improvements have also been registered by Hungary, while Poland and the Czech Republic have returned to the beta levels similar to those prior to the post-crisis period.

Conclusions

This paper aims to highlight the way in which the level of financial integration in the Central and Eastern European countries relative to the Eurozone is changing. Thus, it was analyzed the evolution of integration level in three different periods on the capital markets of these countries: the pre-crisis period (2000-2006), the crisis period (2007-2011) and the post-crisis period (2012-2018). For these periods, two concepts were studied to quantify the integration level: sigma- convergence and beta-convergence.

Following the analysis performed using the sigma-convergence coefficient, a number of facts were observed:
- the level of convergence sharply decreases in times of crisis in times of stress on financial markets and in times of economic stability this level is improving;
- in the period before the crisis and during the crisis period, the lowest level of convergence was registered for the case of Romania;
- on the other hand, in the period prior to the crisis, Romania recorded the best level of sigma convergence, signaling a significant progress towards the pre-accession countries. and the crisis period.

Following the analysis of beta-convergence using the beta coefficient, we obtained a series of conclusions that lead us in the same direction:
- in times of crisis and tensions in the markets, the level of convergence is decreasing, so that it can improve as the economic situation stabilizes;
- the speed at which the convergence was recorded in Romania during the pre-crisis period and during the economic crisis was the lowest of the analyzed countries. Subsequently, in the post-crisis period, the situation improved significantly for Romania, registering the greatest improvement.

In conclusion, we have succeeded in highlighting that in recent years, in the post-crisis period, a large convergence has been achieved for the equity markets from Central and Eastern European countries. However, we cannot say that it is sufficient for financial market convergence. In order to complete the study and to get significant conclusions about the level of integration of the financial markets in these countries, it is necessary to expand this research in the future. Thus, a similar analysis is needed for the money market, the bond market or the foreign exchange market in these countries. Considering these three markets and the equity market, a deeper conclusion could be reached regarding the level of integration of the financial markets in these countries relative to the Eurozone and the EU.

References

Adam, K., et al. (2002). Analyse, Compare, and Apply Alternative Indicators and Monitoring Methodologies to Measure the Evolution of Capital Market

Babetskii, I., Komárek, L., & Komárková, Z. (2007). Financial Integration of Stock Markets among New EU Member States and the Euro Area. Finance a úvěr-Czech *Journal of Economics and Finance*, 57(7-8), 341–362.

Babecky, J., Komarek, L., & Komarkova Z. (2013). Financial Integration at Times of Financial Instability. *Czech Journal of Economics and Finance*, 63(1).

Baele, L., et al. (2004). Measuring Financial Integration in the Euro Area. ECB, Working Paper, no. 14.

Brooks, C. (2008). *Introductory econometrics for finance*, Cambridge: Cambridge University Press.

Dumitru, I., & Dumitru, I. (2010), Business cycle correlation of the new member states with Eurozone-the case of Romania. *Romanian Journal of Economic Forecasting*, 13(4), 16-31.

Edison, H. J., Levine, R., Ricci, L., & Sløk, T. (2002). International financial integration and economic growth. *Journal of International Money and Finance*, 21(6), 749-776.

Égert, B., & Kočenda, E. (2005). Contagion Across and Integration of Central and Eastern European Stock Markets: Evidence from Intraday Data. William Davidson Institute Working Paper, no. 798.

Égert, B., & Koubaa, Y. (2004). Modelling Stock Returns in the G-7 and in Selected CEE Economies: A Nonlinear GARCH Approach. William Davidson Institute Working Paper, no. 66.

Hartmann, P., Mandaloni, A., & Manganelli, S. (2003). The euro area financial system: structure, integration and policy initiatives. *Oxford Review of Economic Policy*, Spring, 19(1), 180-213.

Komarkova, Z. (2006). *Financial Market Integration between the Czech Republic and the Euro Area*. Ph.D thesis, Prague School of Economics.

Mendoza, E.G., Quadrini, V, & Rios-Rull, J-V. (2009). Financial Integration, Financial Development, and Global Imbalances. *Journal of Political Economy*, 117(3), 371–416.

Pattnaik, M., & Gahan, P. (2018). Stock Market Growth Link in Asian Emerging Countries: Evidence from Granger Causality. Advances in Growth Curve and Structural Equation Modeling: Topics from the Indian Statistical Institute on the 125th Birth Anniversary of PC Mahalanobis, 21.

Schindler, M. (2009). Measuring financial integration: A new data set. *IMF Staff Papers*, 56(1), 222-238.

Syllignakis, M., & Kouretas, G. (2006). Long and Short-Run Linkages in CEE Stock Markets: Implications for Portfolio Diversification and Stock Market Integration, William Davidson Institute Working Papers Series wp 832, William Davidson Institute at the University of Michigan.