INTEGRATION OF STOCK MARKETS IN THE CONTEXT OF THE COVID 19 PANDEMIC

Petr Seďa – María-Salomé Ochoa-Rico – Arnaldo-Andrés Vergara Romero – Lorena Caridad Lopéz del Río

Abstract

Structural changes in the environment, such as the synchronization of economies or financial integration, affect economic agents and institutions both individually and systemically. Whether the benefits of financial integration outweigh its risks and whether this process will increase financial stability depends on the resilience and flexibility of the financial system itself. The aim of this paper is an empirical analysis of the development of financial integration of the Czech, Hungarian and Polish stock markets with the euro area market during the periods of financial (in)stability including the COVID 19 pandemic period. Following the definition of financial integration that is based on the law of one price, the price-based and news-based measures will be applied in this paper. The empirical analysis will be provided on weekly data in the period from 2004 to 2022. Based on price measures, the overall results indicate that the global financial crisis has caused relatively significant price divergence of the CEE stock markets with the euro area, while the impact of the COVID 19 pandemic was only temporal and its impact was significantly smaller. On the contrary, the concept of asset price sensitivity shows that financial instability contributes to increasing financial integration.

Key words: Central Europe, COVID 19 pandemic, financial crisis, integration, stock markets

JEL Code: F36, G01, G15

Introduction

The European Central Bank emphasizes the importance of assessing the degree of financial integration across euro area member states. In a monetary union, the integration of financial markets plays an important role in ensuring the transmission of the common monetary policy. The analysis of the integration of financial markets with the markets of euro area countries is also important in the case of the new EU member states that have committed themselves adopting the euro. Central banks are responsible for monitoring the stability of the financial system. Assessing financial integration in times of instability thus provides additional

motivation. Current structural transformation in the economic environment, such as the synchronization of economies or financial integration, affect economic subjects and institutions both individually and systemically (Agrawal, 2017):

(i)   The integration of financial markets can increase its investment opportunities by enabling a higher return at the same level of risk. However, if individual financial institutions are exposed to the same risks, the risks of their portfolios as a whole may not be substantially diversified at all.

(ii) In addition, the financial sector as a whole may be more vulnerable to systemic and contagion risk in conditions of a high degree of geographical and sectoral interconnectedness of the financial market.

Whether the benefits of financial integration outweigh its risks and whether this process will increase financial stability depends to a large extent on the resilience of the financial system itself. A financial market is fully integrated for a given number of financial instruments and services if all potential market participants with the same relevant characteristics face the same set of rules when deciding to operate financial instruments and/or services (Weber, 2006).

Most definitions of financial integration are closely linked to the law of one price (i.e. assets bearing identical risk and return should be valued equally regardless of where they are traded). The adoption of the law of one price enables the quantitative measurement of financial integration. Integration brings benefits and costs to individual entities (Sucháček et al., 2021).

The benefits of financial market integration include smoothing of consumption due to international risk diversification, the positive impact of capital flows on investment and economic growth, increasing the efficiency of the financial system and increasing the prudent behavior of financial market participants and achieving a higher degree of financial stability.

On the other hand, there exist also the following significant costs of financial integration such as insufficient access to financial resources in times of financial instability, inadequate allocation of capital flows, potential loss of macroeconomic stability and possible herd behavior among investors, financial contagion and high volatility of cross-border capital flows.

In this article, we will focus just on stock markets. Previous scientific research has suggested that the level of dependence of the new EU member states´ stock markets on the euro area stock market is growing (Grabowski, 2019). However, professional papers dealt relatively marginally with the issue of the interconnectedness of the stock markets of the new EU member states. It is therefore not clear whether stock markets are affected solely by international or rather regional events. Babecký, Komárek and Komárková (2013) analyzed the degree of integration of the Czech, Hungarian and Polish markets just with the euro area, but not with the

global stock market. They have empirically proved that financial integration has been gradually increasing in all markets since the late 1990s. In their study, they utilized data from 1999 to 2010. During the global financial crisis in 2007-2009, they experienced a temporary divergence of Central European stock markets from the euro area.

The aim of this paper is to perform an empirical analysis of the development of financial integration of the Czech, Hungarian and Polish stock markets (new EU member states) with the euro area market in the years 2004-2021, i.e. in the periods of financial (in)stability. More precisely, an analysis of changes in integration will be performed both in terms of the level and speed of market convergence, but also in terms of the sensitivity of asset prices to global news. The novelty of our paper can be seen in the following aspect. An empirical investigation will be carried out on a data sample covering four different sub-periods. Previous papers were focused on the comparison of the pre-crisis and global financial crisis periods only. We will especially emphasize the impact of the global financial crisis of the 2007-2009 years and the COVID 19 pandemic period and compare them with the other two sub-periods of financial stability.

2   Methodology

In accordance with the definition of financial integration that is based on the law of one price, the price-based and news-based measures will be utilized in this paper (Baele et al., 2004). When applying these methods, the following prerequisites should be met:

  (i)   The more the individual financial market segments of the EU candidate countries are integrated with the euro area market, the more these prices will be influenced by common (global) factors rather than local (national) factors;

 (ii)   It can also be expected that with increasing integration, individual financial market segments will be less likely to be a source of asymmetric shocks;

(iii)   The process of financial integration was supported by the development of financial innovations; the securitization of assets was one of the incentives for financial integration, but also the cause of the global financial crisis.

Measurements based on price indicators contain the so-called concept of beta- and sigma-convergence (Adam et al., 2002; Babecký, Komárek and Komárková, 2013):

  (i)   Beta-convergence – the speed with which the differences in returns in individual financial markets are eliminated. The level of the beta coefficient then expresses the achieved speed of convergence.

(ii)   Sigma-convergence – the dispersion of the differences between the yields on identical assets in different countries at a given moment in time. The sigma parameter thus identifies the degree of convergence that stock markets in the monitored countries have achieved towards the euro area.

Beta-convergence may, but need not, be accompanied by sigma-convergence. Thus, it is necessary to monitor both of these concepts simultaneously.

News-based measurements are based on the paper of Baele et al. (2004) and simply monitor the sensitivity of asset prices to local and global news:

(i)   Asset price sensitivity – sensitivity is measured for individual countries by the gamma parameter, which expresses the degree of similarity of the response to events in the prices of domestic assets with benchmark assets.

To quantify beta-convergence, it is necessary to estimate the following equation using classical or panel regression analysis:

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

where $R_{i,t} = Y_{i,t} - Y_{i,t}^B$ is the difference between the return on the asset of the i-th country and the selected benchmark country at time t, Δ is the difference operator, α_i represents the constant for the i-th country, L means maximum lag and $\varepsilon_{i,t}$ is then a random component. The value of the coefficient β_i measures the speed of convergence, i.e. the speed with which the differences in returns on individual financial markets are eliminated. Convergence is achieved if the beta value is negative. Full convergence is achieved when beta converges to -1. If the value of beta fluctuates in the range (-1, 0), the convergence is monotonic. If beta reaches the range (-2, -1), it is oscillating convergence.

When quantifying sigma-convergence, it is necessary to calculate the cross-sectional standard deviation $\sigma_{i,t}$:

$$\sigma_{i,t} = \sqrt{\left(\frac{1}{N}\right)\sum_{i=1}^{N}\left[Y_{i,t} - \overline{Y_t}\right]^2}, \qquad (2)$$

where $Y_{i,t}$ is the yield of the i-th asset at time t, $\overline{Y_t}$ represents the cross-sectional mean value of the yield at time t, the index i is then the number of the individual country ($i = 1, 2, ...,$ N). In our analysis, $N = 2$, i.e. we verify the development of sigma-convergence $\sigma_{i,t}$ between the euro area and one of the selected countries. The value of sigma must be positive, a

decreasing sigma value means an increasing level of convergence, and vice versa. Full convergence is achieved when the standard deviation is zero.

To quantify the sensitivity of asset prices, it is necessary to estimate the following equation using regression analysis:

$$\Delta Y_{i,t} = c_{i,t} + \gamma_{i,t}^{B} \Delta Y_{B,t} + \gamma_{i,t}^{US} \Delta Y_{US,t} + \vartheta_{i,t},\qquad (3)$$

where $Y_{i,t}$ is the yield of the i-th asset at time t, B means the benchmark country (euro area), US then the United States, $c_{i,t}$ represents the constant for the i-th country, Δ is the difference operator, and $\vartheta_{i,t}$ it is then a random component. The values of $\gamma_{i,t}^{B}$ express the degree of identical response of an asset of a selected country and a comparable benchmark asset to certain news. Time-varying parameters $\gamma_{i,t}^{B}$ will be estimated using recursive estimation. Full sensitivity is reached when $\gamma_{i,t}^{B}$ is equal to 1. If $\gamma_{i,t}^{B}$ is greater than 1, the multiplication effect occurs, i.e. a stronger reaction of the price of a local asset in relation to a benchmark asset. Contrary to that, a negative value of $\gamma_{i,t}^{B}$ means an asymmetric effect.

3   Empirical results and discussion

All calculations will be performed on weekly data of Czech, Hungarian and Polish stock markets in the period from January 2004 to December 2021. More precisely, their main indices were chosen as an approximation of the development of stock markets. In particular, we will deal with PX (CZE), BUX (HUN) and WIG 20 (POL) indexes. The EURO STOXX 50 (EUROZONE) and S&P 500 (USA) indexes then represent benchmark markets.

In order to analyze the impact of financial (in)stability on financial integration, the basic testing period was divided into four subperiods (Seďa, 2012):

 (i)   The pre-crisis period from January 2004 to July 2007;

 (ii)   The global financial crisis period from August 2007 to June 2009 (according to the National Bureau of Economic Research in the USA);

(iii)   The post-crisis period from July 2009 to February 2020,

(iv)   The COVID 19 pandemic period from March 2020 to December 2021.

We now proceed with empirical calculations based on the formulas given in Chapter 2. Let's start with the beta coefficient, which measures the speed of convergence. The results are shown in Tab. 1. All beta values are statistically significant at the 1% level of significance, the optimal lag in equation (1) was based on Schwarz's information criterion.

Tab. 1: Development of beta coefficients

Country	2004-07/2007 (pre-crisis)	08/2007-06/2009 (financial crisis)	07/2009-02/2020 (post-crisis)	03/2020-2021 (COVID 19)
CZE (PX)	-1,14***	-1,23***	-1,13***	-1,15***
POL (WIG20)	-0,95***	-1,18***	-0,97***	-1,04***
HUN (BUX)	-0,93***	-1,27***	-0,96***	-1,03***

Source: own calculations in EViews

In the pre-crisis period, the beta values suggest that the stock markets of individual countries integrated with the euro area markets relatively quickly, the beta values were quite similar in Hungary and Poland. The global financial crisis has had a negative impact on the speed of market integration, albeit with varying intensity. This period can be characterized by increased nervousness, volatility, reduced market activity, and preferences for domestic assets. Thanks to the measures taken by central banks and governments, optimistic expectations and calming occurred in the post-crisis period. During the COVID 19 pandemic, the beta coefficient increased again towards oscillating convergence. However, the growth was not as big as during the global financial crisis.

**Fig. 1: Development of sigma coefficients**
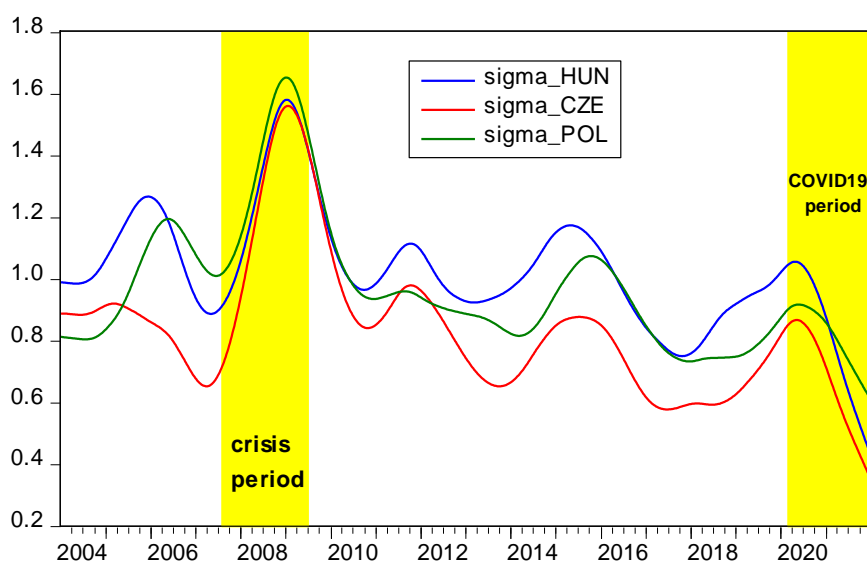
Source: own calculations in Eviews

Fig. 1 shows the evolution of sigma coefficients for all investigated markets. The values of sigma were calculated according to equation (2) and smoothed by the Hodrick-Prescott filter. The value of the lambda coefficient is 270,400 for weekly data. Fig. 1 confirms that the values

increased significantly in all markets during the global financial crisis period. This period can be characterized by increased nervousness of market participants and volatility of asset prices. Investors reduced their activity, including cross-border activity, and preferred domestic assets, so that the integration process weakened. The convergence direction was restarted after the adoption of central bank measures to reduce credit and liquidity risk at the end of 2008 and the beginning of 2009. The values of sigma started to decline. During the post-crisis period, the trend is slightly declining in all markets. The lowest level of convergence was observed on average in the Hungarian market, the highest in the Czech Republic. At the beginning of the COVID 19 pandemic, there was a temporary increase of sigma coefficients in all monitored markets. However, then the sigma values began to decline sharply in all markets, implying a strong convergence trend.

Fig. 2: Development of gamma coefficients
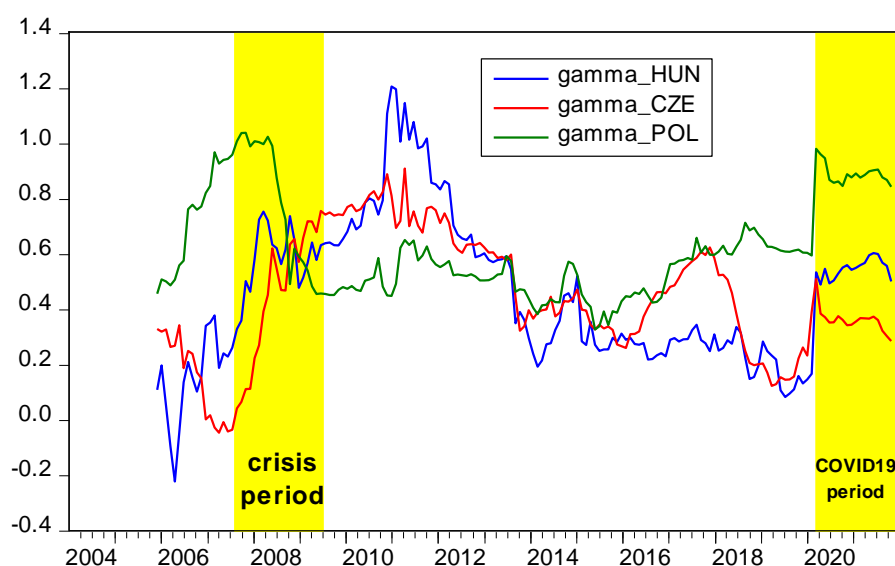
Source: own calculations in EViews

In terms of price sensitivity to global news, the results are shown in Fig. 2. Gamma coefficients were estimated according to equation (3) using recursive regression. Event-based convergence analysis suggests that gamma values are relatively low in the pre-crisis period in Czech and Hungarian markets. During the crisis period, the degree of integration rises sharply in both markets. It seems that financial instability increases the integration of the monitored countries. In Poland, the values of gamma coefficient increased significantly already in the pre-crisis period, while they decreased in the crisis period. In the post-crisis period, the development of stock markets is different. In the Czech Republic and Hungary, the sensitivity, after slight growth in 2011, decreased, while in Poland it was relatively stable. During the COVID 19

pandemic, one can observe a clear stabilization after the initial growth in all markets. The highest values were observed in Poland followed by Hungary. In the Czech Republic, the values of gamma coefficients started to decline.

To sum up, it can be stated that since 2004 the process of gradual stabilization of financial integration of stock markets in the Czech Republic has been ongoing. Similar results were generally obtained for the other inflation-targeting countries (Hungary and Poland). The results of beta and sigma convergences show that the global financial crisis has caused temporary price divergence of these markets with euro area markets. The concept of asset price sensitivity shows that financial instability contributes to increasing financial integration. The overall consequences of the global financial crisis on financial stability were the least significant in the Czech market. It happened thanks to restraint in the use of financial innovations, the overall health and prudent behavior of financial institutions in the Czech Republic. During the COVID 19 pandemic period, one could observe only a partial and time-limited fluctuation in integration, which was very quickly eliminated. The stock markets of the monitored countries reacted similarly, but not in the same way. It may be due to their mutual economic and property interconnectedness to the benchmark territory. However, the intensity with which the markets reacted is different, which may be explained by a change in the composition of market participants in times of crisis, different maturity of markets, and preferences to diversify overall portfolio risk by country rather than by sector.

Conclusion

Financial integration and financial (in)stability represent interconnected processes. Increasing financial integration may not lead to financial (in)stability and financial (in)stability may not lead to financial market segmentation in the long run. In recent years, financial integration has been stimulated by the development and implementation of financial innovations.

The evaluation of financial integration during the global financial crisis and COVID 19 pandemic has further modified the perception of the integrated market. It is appropriate to focus on integration across the various segments of the financial market and to suppress the emphasis on examining integration from a national market perspective. The integration of financial markets has implications for two groups of entities. First, for regulators who monitor the degree of uncertainty in other markets. The second group represents investors for whom the assessment of the degree of financial integration is important in terms of the possible transmission of the

financial contagion, portfolio diversification, arbitrage opportunities, and information efficiency as well.

The methods of measuring stock market integration utilized in this paper do not represent the only option. The current methodology can be extended by including also the money, foreign exchange and bond markets. In addition, it is possible to model the beta-convergence dynamics (state-space model). However, there exist also alternative approaches for quantifying financial integration such as linear factor models that allow the quantification of the integration index and decomposition of risk into systematic and unsystematic parts (Nardo et al., 2017). Another option represents a regression of the integration index on several categories of explanatory variables such as market openness, institutions, financial development, relation to risk, etc. (Lehkonen, 2015).

Acknowledgment

References

Adam, K., Jappelli, T., Menichini, A. M., Padula, M., & Pagano, M. (2002). *Analyse, Compare, and Apply Alternative Indicators and Monitoring Methodologies to Measure the Evolution of Capital Market Integration in the European Union* (pp. 1–60). Salerno, Italy: Centre for Studies in Economics and Finance (CSEF).

Agrawal, G. (2017). G*lobal Financial Markets Integration: A Comparative Study Between Developed and Emerging Economies*. Palgrave Macmillan.

Babecký, J., Komárek, L., & Komárková, Z. (2013). Financial Integration at Times of Financial Instability. *Finance a úvěr – Czech Journal of Economics and Finance*, 60(1), 25–45.

Baele, L., Ferrando, A., Hördahl, P., Krylova, E., & Monnet, C. (2004). *Measuring Financial Integration in the Euro Area* (Vol. 14, Ser. Occasional Paper Series, pp. 1–93). Frankfurt, Germany: European Central Bank.

Grabowski, W. (2019). Givers or Recipients? Co-Movements between Stock Markets of CEE-3 and Developed Countries. *Sustainability*, 11(22), 6495.

Lehkonen, H. (2015). Stock market integration and the global financial crisis. *Review of Finance*, 19(5), 2039-2094.

Nardo, M., Ossola, E., Papanagiotou, E., & Rossi, E. (2017). *Monitoring financial integration by using price-based indicators*. (pp. 1–40). The European Commission, JRC Science for Policy Report.

Seďa, P. (2012). Impact of the Global Financial Crisis on Stock Market Volatility: Evidence from Central European Stock Market. In *Proceedings of 30th International Conference Mathematical Methods in Economics* (pp. 787–792). Karviná, Czech Republic; Silesian University, School of Business Administration.

Sucháček, J., Koutský, J., Caridad Lopéz del Río, L., & Seďa, P. (2021). Econometric analysis of integration of selected new EU member CEE stock markets with global stock market and eurozone: impact of global financial crisis. *Amfiteatru Economic*, 23(58), 824-842.

Weber, A. A. (2006). *European Financial Integration and (its Implications for) Monetary Policy*. (pp. 1–6). Amsterdam, Netherlands: Bank for International Settlements.

Contact

Petr Seďa

Faculty of Economics

VŠB-Technical University of Ostrava

17. listopadu 2172/15, 708 00 Ostrava, Czech Republic

petr.seda@vsb.cz

María-Salomé Ochoa-Rico

Faculty of Law and Economic and Business Sciences

University of Cordoba

Plaza de Puerta Nueva, s/n, 14002 Córdoba, Spain

salomenochoa@hotmail.com

Arnaldo-Andrés Vergara Romero

Center for Studies for Sustainable Development

Ecotec University

Via Principal Campus Ecotec, Samborondón 092302, Ecuador

avergarar@ecotec.edu.ec

Lorena Caridad Lopéz del Río

Faculty of Law and Economic and Business Sciences

University of Cordoba

Plaza de Puerta Nueva, s/n, 14002 Córdoba, Spain

lcaridadlr@gmail.com