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ORIGINAL SCIENTIFIC PAPER

Stock Markets Integration between Western Europe and Central and South-Eastern Europe: Latest Trends

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ABSTRACT
The aim of the paper is to examine the stock market integration between Western Europe and selected countries of Central (Austria, Czech Republic, Poland, Hungary, Slovakia, and Slovenia) and South-Eastern Europe (Greece, Croatia, Serbia, Bosnia, Bulgaria, and Romania). In order to achieve this goal, we used a bivariate BEKK model to obtain time-varying covariances and correlations for the period April 15, 2013 - March 29, 2019. Our results showed that Austria has the highest degree of integration among countries in Central Europe, followed by the Czech Republic, Poland and Hungary. Additionally, Greece has the highest degree of integration among all countries in South-Eastern Europe, followed by Romania, and Croatia. Thus, stock markets of Central Europe are more integrated with Western Europe than stock markets of South-Eastern Europe.

Key words: *Stock market integration, Multivariate GARCH, BEKK model, Central Europe, South-Eastern Europe*

JEL Classification: G15, F36, C32, C58, O16

INTRODUCTION

Financial integration is a term used to explain the level and the strength of financial market connectedness across various markets. The higher connectedness usually results in the higher financial and broader economic integration of countries. More precisely, the connectedness measures are tracking the degree of co-movement of market returns and volatility behaviour within and across markets and asset classes. As in Bracker et al. (1999), we interpret a greater degree of co-movement to reflect greater capital market integration. Bekaert & Harvey (1995) found that some emerging markets exhibit time-varying integration. While the integration of financial markets can bring benefits in the form of broader economic integration and connectedness of countries it in parallel may affect the investors' portfolio choices. If "financial integration is high, the benefits of diversification may be reduced. The degrees of financial integration provide valuable insights into capital flows across countries and enhance awareness of market co-movements" (Chen et al., 2014).

The focus of analysis in this paper is financial integration between Central and South-Eastern Europe (SEE) and Western European stock markets. More developed European countries started

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economic and monetary integration decades ago. As a result, significant convergence among interest rates, GDP growth rates and other macroeconomic indicators occurred in the pre-crisis period. After the global financial crises, 2007-2008, many unresolved disbalances came to surface that resulted in a debt crisis in the Eurozone in 2010-2012. The adoption of the euro and unique monetary policy appeared to be insufficient for broader economic integration of euro area member states. Further fiscal integration was necessary for a more stable economic and monetary union. As Bekaert et al. (2013) showed "membership in the EU significantly lowered discount rates and expected earnings growth differentials across countries. In contrast, the adoption of the Euro was not associated with increased integration".

The countries of Central and South-Eastern Europe faced significant changes in the previous three decades. While Central European countries shifted relatively fast from communism and social ownership to market oriented economies, the transition process was slower and more painful in a certain number of South-Eastern European countries especially in the Balkan region. While most of these countries developed bank-based financial systems, their financial markets developed to a certain extent allowing the measurement of co-movements and estimation of the level of financial integration. The stock market of Central Europe is characterised by greater depth and liquidity in comparison to South-Eastern European countries. Although Balkan equity markets have been active for a relatively short period of time, consequently lacking in a substantial market depth regarding the listed companies and capitalisation, inflows of international portfolio investments and trading activity have still been increasing (Syriopoulos, 2011). Marjanović & Đukić (2020) stand out that the Western Balkan region has been an attractive destination for foreign portfolio investment in recent years.

The paper aims to examine the capital market integration for selected countries of Central and South-Eastern Europe. To achieve this goal, we have followed the methodology of Horvath & Petrovski (2013). We used the bivariate BEKK model to obtain time-varying covariance (comovements) and then correlations. We have selected the period from April 15, 2013, to March 29, 2019. For the countries of Central Europe we have investigated: Austria, Czech Republic, Poland, Hungary, Slovakia, and Slovenia, and for South Eastern Europe we have selected: Greece, Croatia, Serbia, Bosnia, Bulgaria, and Romania. Correlation between selected countries of South-Eastern Europe and developed countries is found to be around zero, except for Greece (average correlation coefficient is about 0.4), Croatia whose average correlation coefficient is about 0.2, Bulgaria (with an average correlation coefficient 0.1) and Romania (with average correlation coefficient 0.3). This value of the correlation coefficient (integration) is still much lower in comparison to the selected Central European countries (average value of the correlation coefficient is over 0.7 for Austria, about 0.4 for Hungary and Poland and around 0.5 for the Czech Republic), except for Slovakia and Slovenia. On average, South-Eastern European countries appeared to be less integrated with Western Europe than Central European countries.

The paper consists of five parts. The introduction is presented in the first section. A discussion of related literature is presented in the second section. The third section explains the research methodology and used data. The fourth section contains the results of the analysis, and discussion. The conclusion is presented in the fifth section.

LITERATURE REVIEW

Horvath & Petrovski (2013) examined the stock market integration between Western Europe and selected countries of Central (the Czech Republic, Poland and Hungary) and South-Eastern Europe (Macedonia, Croatia and Serbia). By estimating multivariate GARCH models in the period 2006-2011, they found a higher level of integration between Western and Central Europe. The correlation between SEE stock markets and developed European markets was found to be zero. They also conclude that the crisis period did not significantly change the degree of stock market integration between investigated groups of countries.

Tilfani et al. (2020) used dynamic analysis (or the Detrended Cross-Correlation Analysis, DCCA) in order to investigate "the evolution of integration in Central and Eastern European stock markets". They found that stock markets of "Czech Republic, Hungary, Croatia, Poland and Romania are most integrated, while some of Eastern European stock markets such as Bosnia, Montenegro, Serbia and Slovakia are less integrated".

Büttner & Hayo (2011) analysed "the determinants of stock market integration among EU member states for the period 1999-2007". These authors utilized "bivariate DCC-MGARCH models to estimate dynamic conditional correlations between European stock markets". Further, they tried to explain the comovements by "interest rate spreads, exchange rate risk, market capitalisation, and business cycle synchronisation in a pooled OLS model". Taking care of differences between euro area countries and old and new member states of the EU they evaluated the impact of the introduction of a common currency on financial market integration. They concluded that stock market integration processes are enhanced by the size of market capitalisation but impeded by FX risk between old member states in the EU and the euro area. Interest rate spreads and business cycle synchronization, also help explaining equity market integration. Chen et al. (2014) investigated the stock market integration between the frontier and leading markets over the period 2000–2011. They used time-series analysis and concluded that leading markets could Granger-cause frontier markets. Authors found the frontier markets' relationship with leading markets to be dependent on different regions' characteristics. They stressed that the global financial crisis had largely influenced the causality between the frontier and leading markets.

Chen (2018) investigated the comovements of "stock market returns of a group of 34 countries at the global and regional levels, simultaneously". The author used a Bayesian dynamic latent factor model. He compared the comovements between developed and emerging markets across regions and found the significance of different factors for the fluctuations of stock markets. He found the global factor to be an "important source of fluctuations for most markets and the regional factor as another important reason for the fluctuations in emerging markets, especially markets in South America and East Asia regions, but not in most developed markets". His results suggest "that the degree of a market's comovements with international stock markets is closely associated with its own country's integration into the global economy".

Égert & Kočenda (2007) analysed "comovements among three stock markets in Central and Eastern Europe and interdependence, which may exist between Western European and Central Eastern European" (CEE) stock markets. These authors employed the VAR framework (Granger causality tests) on the 5-minute tick intraday data for stock indices. Their "results showed the bidirectional causality for returns as well as volatility series". They found "no robust cointegration relationship for any of the stock index pairs or for any of the extended specifications".

Fratzscher (2002) followed the integration process of stock markets in Europe since the 1980s. By implementing a trivariate GARCH model with time-varying coefficients, he found that: European stock markets have become significantly integrated from 1996, that euro area got important position among global financial markets and finally, that European stock market integration is to a large extent explained by monetary unification and elimination of FX rate volatility.

Hardouvelis et al. (2006) examined whether the 1990s in Europe, in parallel with regulatory harmonization, and the introduction of the single currency, were characterized by higher stock market integration. They concluded that a decrease in interest rates and inflation rates differentials coincided with higher stock market integration for analysed countries except for the UK that decided not to enter the euro area.

Kenourgios & Samitas (2011) analyse "long-run relationships among five Balkan emerging stock markets (Turkey, Romania, Bulgaria, Croatia, Serbia), the United States, and three developed European markets (UK, Germany, Greece), during the period 2000–2009". They confirm long-run cointegration between Balkan markets within the region and globally. Additionally, they implement "the AG-DCC multivariate GARCH model to capture the influence of the global financial crises on the correlation dynamics among developed and Balkan stock markets". They conclude that stock market dependence is heightened supporting the herding behaviour during the 2008 crisis.

Lean & Teng (2013) examined "the financial integration of the U.S. and Japan and two emerging economies - China and India with the Malaysian stock market". They used "a DCC-MGARCH approach to examine the correlations among these countries in a time-variant manner". According to them, it was apparent that "financial integration between Malaysia and China started to evolve in April 2004. Strong financial integration between the stock markets in India and Malaysia" was examined. On the other hand, "the volatility spillover effect from the US to Malaysia ceased, especially in the short term. Accordingly, the study suggests that in the long run, investors in Malaysia could profit from diversifying their portfolios in China and Japan relative to India and the U.S".

Guidi & Ugur (2014) investigated "the integration between South-Eastern European stock markets (Bulgaria, Croatia, Romania, Slovenia and Turkey) and their developed counterparts (Germany, the UK and the USA)". They analysed the period 2000-2013 and found static cointegration between SEE markets and the German and UK market (but not with the USA market). The dynamic cointegration analysis showed time-varying cointegration among the SEE and developed markets, especially during crisis. They conclude that diversification benefits did exist during the period that included crises, despite evidence of dynamic cointegration during most of the crisis period.

Al Nasser & Hajilee (2016) examined "stock market integration among five selected emerging stock markets (Brazil, China, Mexico, Russia, and Turkey) and the world's major developed stock markets (the US, UK and Germany)" in the period 2001-2014. They used "the bounds testing approach to cointegration and error-correction modelling to determine the short- and long-run relationship between emerging stock market returns and the returns of the developed stock markets". Their results indicate the existence of "short-run integration among stock markets in emerging countries and the developed markets". However, the authors indicate that in the "long-run, stock price indices in all emerging countries show a significant relationship only with Germany stock market index".

Alotaibi & Mishra (2017) assessed "the degree of stock market integration and gained insights on its variation through time for the six member countries of the GCC (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates)". These authors developed an international financial integration index for GCC stock markets and analysed the period from June 2002 to October 2013. They utilized "an international asset pricing model of time-varying market integration and DCC-GARCH methodology". Authors showed that "there are wide ranges in the degree of integration for GCC stock markets and none of them appeared to be under complete segmentation". They found that "trade openness, financial market development, turnover and oil revenue had a significant positive impact on the integration index of GCC stock markets. The global financial crisis had a significant negative impact on the integration index".

Narayan et al. (2014) examined the "patterns and causes of stock market integration of selected emerging Asian countries against the US, Australia, China, and India for the period" 2001-2012. They used the "ARMA-DCC-GARCH framework to derive the correlations for 22 pairs of countries using daily, weekly, and monthly returns". These authors found that the time-varying bilateral correlations were highly volatile. They suggest that apart from the global financial crises (2007-2009), the "underlying economic and financial conditions have also been responsible for the higher correlations between analysed stock markets".

Syriopoulos (2011) examined "the dynamic interdependencies, linkages and causality effects between major Balkan equity markets (Romania, Bulgaria, Croatia, Turkey, Cyprus and Greece) and developed equity markets (the US and Germany)". This author utilized error-correction vector autoregression models to investigate financial integration, causality effects and cointegration vectors. His results show that "the Balkan markets follow a common path of growth and become gradually more integrated with the mature international markets".

METHODOLOGY AND DATA

Data

In this analysis we choose daily closing levels of following indices: the STOXX Europe 600 index, ATXPRIME (Vienna Stock Exchange), PX (Prague Stock Exchange), BUX (Budapest Stock Exchange), WIG (Warsaw Stock Exchange), SAX (Bratislava Stock Exchange), SBITOP (Ljubljana Stock Exchange), ATF (Athens Stock Exchange), CROBEX (Zagreb Stock Exchange), BELEX15 (Belgrade Stock Exchange), BIRS (Bosnian Stock Exchange), SOFIX (Sofia Stock Exchange), and BET (Bucharest Stock Exchange). "The STOXX Europe 600 Index represents large, mid and small capitalization companies across 17 countries of the European region: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, and the United Kingdom".[1] Similar to Horvath and Petrovski (2013), we have used the STOXX Europe 600 index as the benchmark for developed European stock market movements. However, Horvath and Petrovski (2013) used data for the period 2006-2011, and instead of Bosnian, they used the Macedonian index. Compared to paper by Horvath and Petrovski (2013), we have significantly expanded the scope of countries. While these authors used three countries from Central and three countries from South-Eastern Europe, we have selected twelve countries for the period 2013-2019.

The daily closing prices of the indices are chosen from April 15, 2013 to March 29, 2019. The source of data is the website: https://www.investing.com/indices/ (as in Minović, 2022). We study the daily returns, which are represented by the logarithmic difference of prices using the equation:

$$R_t=(\log(P_t)-\log(P_{t-1}))x100, \quad (1)$$

where P_t is the closing price of a stock index on a trading day t, and P_{t-1} is the closing price of a stock index on a trading day t-1.

Table 1 presents the key indicators of all observed stock exchanges, such as the year of establishment, market capitalization, and the relevant index.

Table 1. Key indicators

Central Europe	**Austria**	**Czech Republic**	**Hungary**	**Poland**	**Slovakia**	**Slovenia**
Year of establishment	1771	1993	1990	1991	1991	1989
Market capitalization (EURmill)	102,050	23,574	25,231	140,113	-	-
Index	ATXPRIME	PX	BUX	WIG	SAX	SBITOP
SEE	**Greece**	**Croatia**	**Serbia**	**Bosnia**	**Bulgaria**	**Romania**
Year of establishment	1876	1991	1992	2001	1997	1995
Market capitalization (EURmill)	33,525	18,004	4,576	1,968	13,685	18,160
Index	ATF	CROBEX	BELEX15	BIRS	SOFIX	BET

Source: Federation of European Securities Exchanges Statistics, December 2018; https://investopress.com/european-stock-exchanges; Belgrade Stock Exchange; Banja Luka Stock Exchange; Bratislava Stock Exchange; Ljubljana Stock Exchange.

[1] https://www.investing.com/indices/

Multivariate GARCH model: The BEKK model

"Engle & Kroner (1995) proposed a quadratic formulation for the parameters that ensured positive definiteness of conditional variance-covariance matrix $\sum_t$, and this became known as the BEKK model" (Brooks et al. 2003). According to "this model, the number of parameters increased linearly with the number of assets. Therefore this model is relatively covetous and suitable for a large set of assets" (De Goeij and Marquering, 2004). "The BEKK model follows the following form:

$$\sum_t = C_0 C_0^{'} + \sum_{k=1}^{K}\sum_{i=1}^{q} A_{ki}^{'} \varepsilon_{t-i} \varepsilon_{t-i}^{'} A_{ki} + \sum_{k=1}^{K}\sum_{i=1}^{p} B_{ki}^{'} \sum_{t-i} B_{ki}, \quad (2)$$

where C_0 is a lower triangular matrix, and A_{ki} and B_{ki} are $N \times N$ parameter matrices (Hafner and Herwartz, 2006). Based on the symmetric parameterization of the model, $\sum_t$ is almost surely positive definite on provision that C_0C_0' is positive definite" (Tsay, 2005; Minović, 2009).

As proved by "Engle and Kroner (1995), the necessary condition for the covariance stationarity of the BEKK model is that the eigenvalues, i.e., the characteristic roots of $\sum_{i=1}^{q}\sum_{k=1}^{K}(A_{ik}^{*} \otimes A_{ik}^{*}) + \sum_{i=1}^{p}\sum_{k=1}^{K}(B_{ik}^{*} \otimes B_{ik}^{*})$ should be less than one in modulus". "Hence, the process can still render stationary even if there is an element with a value greater than one in the matrix. This condition is different from the stationary condition required by the univariate GARCH model, that is, the sum of ARCH and GARCH term has to be less than one" (Minović, 2009).

Also, "the BEKK model is not very flexible and can, therefore, be misinterpreted. However, if the covariance demonstrates a different degree of persistence than the volatilities, it is obvious that either the volatility or the covariance process can be misinterpreted" (Baur, 2004; Minović, 2009).

Using the MGARCH model, we obtain time-varying variances and covariances between stock market returns. In this way, it is possible to calculate a time-varying correlation coefficient, i.e., conditional correlations defined by the following equation:

$$\rho_{12,t} = \frac{\sigma_{12,t}}{\sqrt{\sigma_{11,t}\sigma_{22,t}}} \quad (3)$$

Where conditional variances are $\sigma_{11,t}, \sigma_{22,t}$, respectively, and conditional covariance is $\sigma_{12,t}$.

Minović (2008) wrote about "application and diagnostic checking of multivariate GARCH models in Serbian financial market", while Njegić et al. (2018) used three types of "BEKK-GARCH models in order to analyses the dynamic nexus and bidirectional spillover effect between stocks and exchange rates in major emerging markets".

Results and discussion

Table 2 presents the unit root results for the original series (logP) and their daily returns ($r_{i,t}$). The Augmented Dickey-Fuller (ADF) test was used. The results in Table 2 show that the original series in levels are not stationary, while daily returns are stationary. After obtaining the stationary return series, the volatility modeling of the same, followed by employing univariate GARCH models (for detail see Minović, 2022). Subsequently, the MGARCH methodology (BEKK model) was applied to calculate time-varying variances and covariances (Equation (2)). Then, using Equation (3), all the time-varying correlation coefficients presented in Figures 1 and 2 were calculated.

Table 2. Unit root tests

ADF	Europe (STOXX)	Austria (ATXPRIME)	Czech Republic (PX)	Hungary (BUX)	Poland (WIG)	Slovakia (SAX)	Slovenia (SBITOP)
logP	-3.124	-2.099	-2.427	-2.380	-2.334	-2.320	-2.266
return	-38.048	-35.686	-37.771	-38.150	-35.497	-44.806	-37.055
		Greece (ATF)	**Croatia (CROBEX)**	**Serbia (BELEX15)**	**Bosnia (BIRS)**	**Bulgaria (SOFIX)**	**Romania (BET)**
logP		-1.575	-2.433	-2.072	0.155	-1.352	-2.603
return		-22.506	-14.994	-35.711	-37.624	-37.351	-22.627

Source: Authors' estimation

Note: Critical value (at 5% level) is -3.413. Schwarz's automatic selection of the lag length has been used for the unit root tests.

Figures 1 and 2 show the time-varying correlations for indices of selected Central and South-Eastern European countries and the STOXX 600 indices. Table A1 in Appendix A presents descriptive statistics of stock market returns for all analysed indices. Minović (2022) described possible causes of volatility decline or volatility increase for these analysed markets.

The Austrian index is found to have the highest volatility in the second and third quarters of 2015 (correlation ranges from 0.4 to 0.9), followed by the third quarter of 2016, while the STOXX 600 index had the highest volatility in the third quarter of 2015 and the second quarter of 2016. The Czech index had higher volatility at the end of the third quarter of 2015, then in the first and third quarters of 2016. However, the largest variation of the correlation coefficient in the case of the Czech Republic was in the fourth quarter of 2017 (correlation ranges from 0.0 to over 0.7). The Hungarian index had pronounced volatility over the whole observed period, however it was the highest in the third quarter of 2015. Although the average value of the correlation coefficient for Hungary is 0.4, there is a remarkably variable correlation starting from 0.1 to 0.7 in some periods. The Polish index had strong volatility in the first quarter of 2014 and the third quarter of 2015. The average value of the correlation coefficient for Poland is about 0.4, with the value of this coefficient was greatly varying in the first quarter of 2014 and the third quarter of 2016 (the value is 0.1 to 0.8). The Slovak SAX Index had pronounced volatility, especially in the period around the first quarter of 2015. Although the average value of the correlation coefficient for Slovakia is about 0.0, a highly variable value of this coefficient was observed over the analysed period (from -0.4 to over 0.3). The Slovenian index had the highest volatility at the end of the third quarter of 2015, while the largest variation in the correlation coefficient for Slovenia was recorded just then and in the first quarter of 2018. The average value of the correlation coefficient is about 0.1, while this coefficient takes values from -0.05 to 0.4 in individual periods. The correlation coefficients for Slovakia and Slovenia are found to be the lowest among all Central European countries analysed and in terms of values, are closer to the correlation coefficients characteristics of South-Eastern Europe. Judging by the values of correlation coefficients, it can be said that all analysed markets of Central European countries are integrated with the Western European market with the exception of Slovakia.

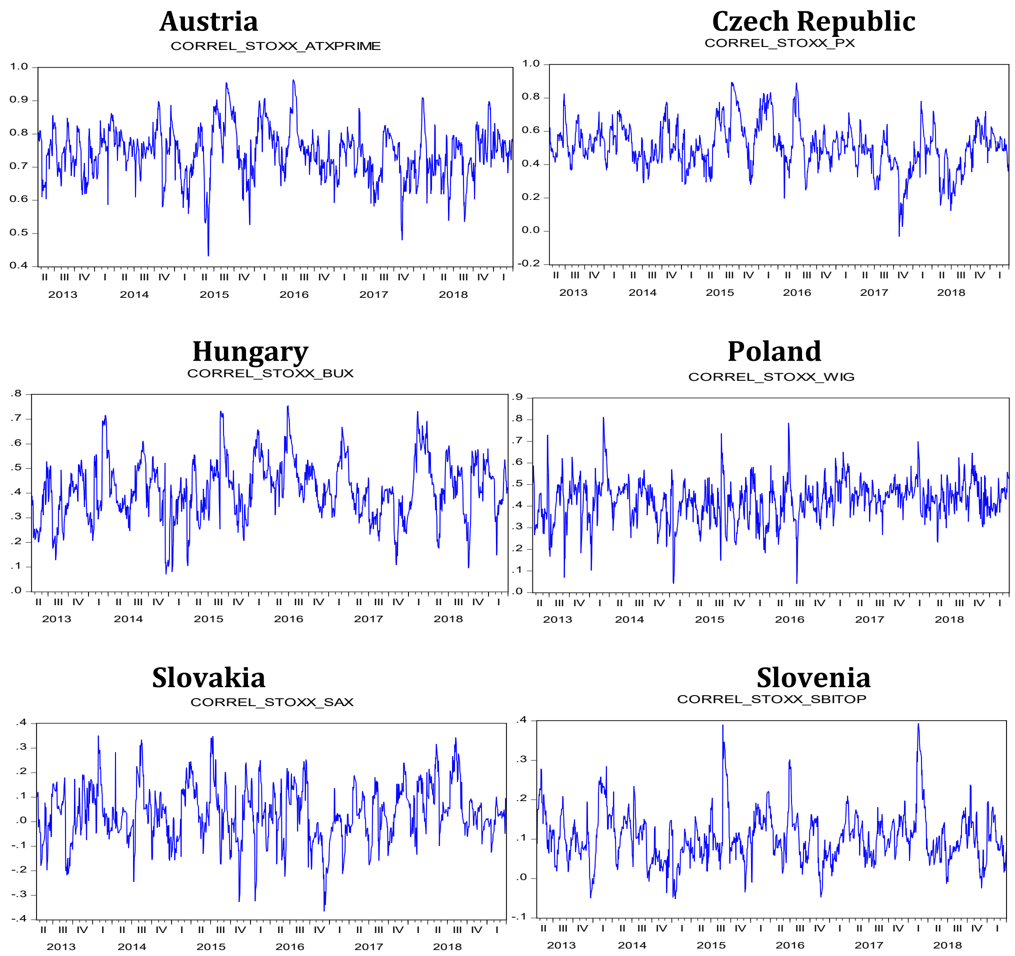

Figure 1. Time-varying correlations for Central Europe

Source: Authors' estimation

The Greek index showed strong volatility, especially in the third quarter of 2015. During this period, the correlation coefficient for Greece varied from -0.2 to 0.6, although the average value of the correlation coefficient for Greece for the whole observed period was about 0.4. The Croatian index had the highest volatility in the second quarter of 2017 (then the correlation coefficient for Croatia is negative). However, the correlation coefficient in the observed period varied greatly from negative values to positive values (from -0.2 to 0.6). The average value of the correlation coefficient for the whole observed period for Croatia is around 0.2. High volatility of the Serbian index was observed, with the highest volatility in the first quarter of 2019. The average value of the correlation coefficient for Serbia is about 0.0 in the whole observed period. Figure 3 shows a highly variable correlation coefficient for Serbia, whose values range from -0.4 to 0.6 in individual periods. Similar to the Serbian index, the Bosnian BIRS index is very volatile and also had the highest volatility in the first quarter of 2019. In addition, a variable property of the correlation coefficient for Bosnia is observed, ranging from -0.5 to 0.4. The average value of the correlation coefficient for Bosnia for the whole observed period was about 0.0. This result implies that the Serbian and Bosnian capital markets are not markets that are integrated with the Western European market. The Bulgarian index had strong volatility, especially in the third quarter of 2014 and the fourth quarter of 2016. The average value of the correlation coefficient for Bulgaria was about 0.1 for the whole observed period. The value of the correlation coefficient for Bulgaria varies greatly from -0.4 to 0.7. The volatility of the Romanian index was highest at the end of the fourth quarter of 2018 and at the beginning of the first quarter of 2019. The average value of the correlation coefficient for the whole observed period for Romania was about 0.3, while in Figure

2 one can observe a highly variable character of the correlation coefficient. The value of the correlation coefficient for Romania ranges from -0.4 to 0.8. From the results obtained for South-Eastern Europe, it can be concluded that the Greek market is the most integrated with the Western Europe market among all other analysed Southeast European markets. According to the level of integration, the Romanian, Croatian and Bulgarian capital markets follow the Greek market.

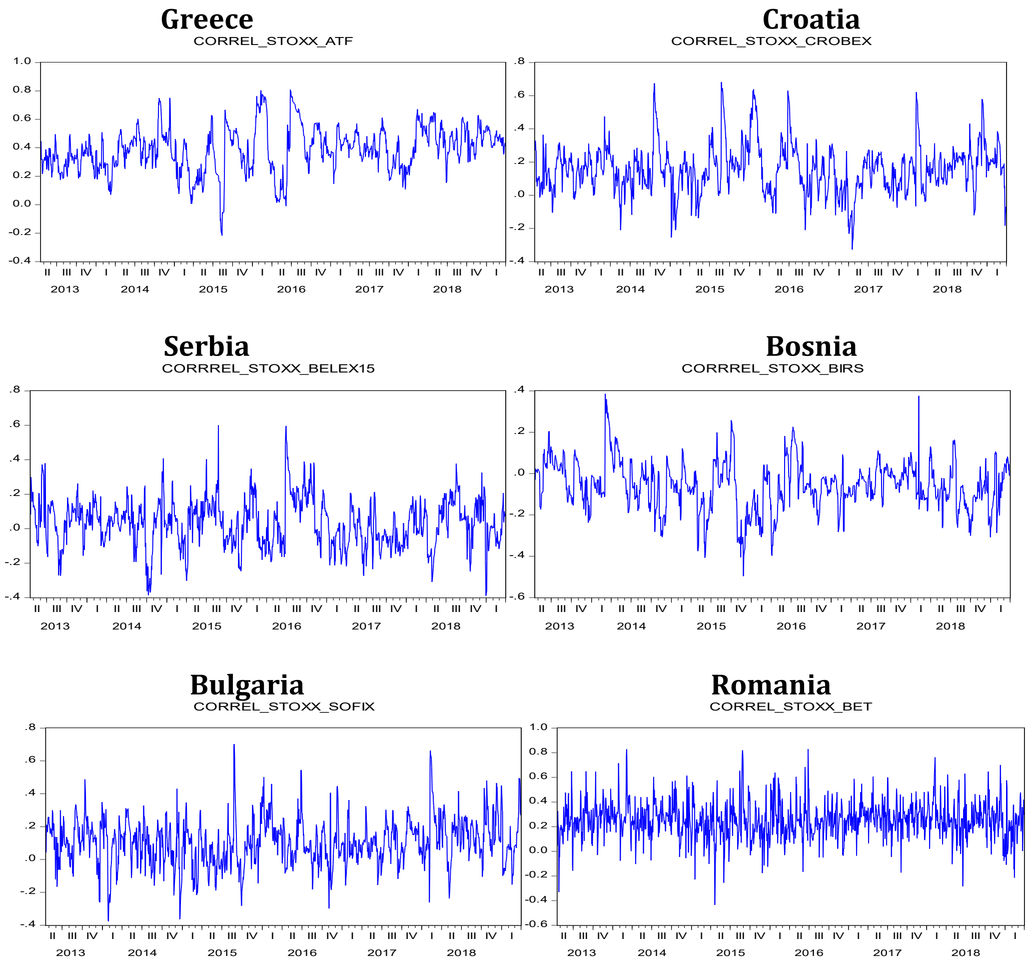

Figure 2. Time-varying correlations for South Eastern Europe

Source: Authors' estimation

Our results are in accordance with those of Horvath & Petrovski (2013), in that the degree of comovements between Western and Central Europe was found to be higher than the degree of comovements between Western and South-Eastern Europe. The correlation between selected countries of South-Eastern Europe and the developed countries is around zero, except for Greece (average correlation coefficient is about 0.4), Croatia whose average correlation coefficient is about 0.2, Bulgaria (with an average correlation coefficient 0.1) and Romania (with an average correlation coefficient of 0.3). This value of the correlation coefficient (integration) is still much lower than for the selected Central European countries (average values of the correlation coefficient are over 0.7 for Austria, around 0.4 for Hungary and Poland and around 0.5 for the Czech Republic), except for Slovakia and Slovenia. Serbian, Bosnian and Slovakian stock markets are not significantly integrated with the Western European market (with an average correlation coefficient 0.0). Additionally, our results coincide with those of Tilfani et al. (2020) about the stock markets of Central and Eastern European integration.

Table 3. The average value of the correlation coefficient

Central Europe	Austria (ATXPRIME)	Czech Republic (PX)	Hungary (BUX)	Poland (WIG)	Slovakia (SAX)	Slovenia (SBITOP)	Aver.
Aver. correl. coeff.	0.74	0.51	0.41	0.43	0.03	0.10	**0.37**
SEE	**Greece (ATF)**	**Croatia (CROBEX)**	**Serbia (BELEX15)**	**Bosnia (BIRS)**	**Bulgaria (SOFIX)**	**Romania (BET)**	**Aver.**
Aver. correl. coeff.	0.39	0.16	0.03	-0.06	0.11	0.25	**0.15**

Source: Authors' calculation

Table 3 presents the average values of the correlation coefficients. The average correlation coefficient of the whole of Central Europe is much higher than the average correlation coefficient of Southeast Europe. From these results, it follows that the stock exchanges of Central European countries are more integrated with Western Europe than the stock exchanges of Southeast European countries.

CONCLUSION

This paper examines the degree of stock market integration for selected Central and South-Eastern European countries from April 15, 2013, to March 29, 2019. We followed the idea and methodology of Horvath & Petrovski (2013). For Central Europe (CE), we have selected the following countries: Austria, Czech Republic, Hungary, Poland, Slovakia, and Slovenia, while for South-Eastern Europe (SEE) we have selected the following countries: Greece, Croatia, Serbia, Bosnia, Bulgaria, and Romania. To obtain the degree of individual market integration, conditional correlation coefficients were calculated for each selected country using the multivariate GARCH model, i.e., bivariate BEKK. Our results showed that Austria (the correlation coefficient of 0.7) has the highest degree of integration among all countries in Central Europe, followed by the Czech Republic (the correlation coefficient is 0.5), Poland and Hungary (the correlation coefficient is 0.4). Additionally, Greece (the correlation coefficient is around 0.4) has the highest degree of integration among all countries in South-Eastern Europe, followed by Romania (the correlation coefficient is around 0.3), and Croatia (the correlation coefficient is around 0.2). This result could be due to Greece's membership in the Eurozone since 2001, which is not the case for the other SEE economies studied. It emphasizes the possible significance of shared monetary (currency) regimes in understanding capital market co-movements. In comparison to other economies in Central Europe like as Austria, Czech Republic, Poland, Hungary, and Slovenia, Slovakia's stock exchange is less integrated with Western Europe (WE) capital markets. This result could be due to Slovakia's geographical, cultural, and institutional distance from Western Europe financial markets, which could lead to reluctance on the part of WE investors to put their money into the Slovakian economy.

When we aggregated the correlation coefficients along the entire territory of Central and South-Eastern Europe, we found that the average value of this coefficient for Central Europe is around 0.4, while the average value of the coefficient for South-Eastern Europe is around 0.1. Serbian, Bosnian and Slovakian stock markets are not significantly integrated with the Western European market. We can conclude that the stock markets of Central Europe are more integrated than the stock markets of South-Eastern Europe. This result coincides with Horvath & Petrovski (2013) but covers a broader range of countries and a different time frame. Our results about the stock markets of Central Europe integration coincide with Tilfani et al. (2020). Similarly to our results Tilfani et al. (2020) found that Serbian, Bosnian and Slovakian stock markets are less integrated.

The research in this paper may be of benefit to potential portfolio investors looking to diversify their portfolios. The obtained results show that the conditional correlation coefficient is negative in most cases, i.e., periods in the case of Slovakia, Serbia and Bosnia. Therefore, it can be concluded that these markets can potentially be good for portfolio diversification but taking into account the fact that SEE markets bear specific types of risks as well as political and strategic factors that could change investor market preferences. Radišić (2011) states that without having the information necessary to plan a strategy for entering a foreign market (and therefore strategies for making an investment decision), it is impossible to imagine the realization of an investment by a portfolio investor. Investors, on the other hand, would not be willing to invest in the shares of corporations if they were to be a part of a highly corruptive society (Radišić, 2011). Goel & Budak (2006) emphasize that comprehensive reforms are needed in transition countries to reduce corruption, while Estrin and Uvalić (2013) state that government instability, frequent early elections, high unemployment rates, high public debt and poor economic recovery are factors which impede foreign investments in the Balkan region. Economic policymakers in SEE countries must make every effort to improve their performances and indicators to make their countries more attractive for investments (Radišić, 2011).

Future research could extend over a longer period to include more countries. Additionally, in future research, it is possible to use some other versions of the MGARCH model instead of the BEKK model.

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APPENDIX

Table A1. Descriptive statistics of stock market returns

	STOXX	**ATXPRIME**	**PX**	**BUX**	**WIG**	**SAX**	**SBITOP**
Mean	0.008	0.008	0.003	0.025	0.008	0.02	0.011
Median	0.023	0.032	0.021	0.031	0.017	0.000	0.003
Maximum	1.785	1.549	1.942	2.158	1.305	3.960	1.507
Minimum	-3.167	-2.865	-2.047	-2.718	-2.530	-4.052	-2.1060
Std. Dev.	0.408	0.450	0.362	0.453	0.397	0.474	0.326
Skewness	-0.527	-0.500	-0.461	-0.1200	-0.541	-0.005	-0.254
Kurtosis	7.825	5.504	6.097	5.027	5.921	12.508	6.055
Jarque-Bera	1554.131	447.457	648.776	263.204	601.564	5586.649	595.553
Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Obs.	1529	1477	1491	1480	1488	1483	1490
	ATF	**CROBEX**	**BELEX15**	**BIRS**	**SOFIX**	**BET**	
Mean	-0.014	-0.003	0.007	-0.003	0.012	0.012	
Median	0.039	0.000	0.003	0.000	0.007	0.017	
Maximum	5.098	0.994	1.217	2.235	2.449	2.961	
Minimum	-7.764	-1.351	-1.739	-2.808	-2.057	-5.164	
Std. Dev.	0.954	0.234	0.283	0.344	0.313	0.385	
Skewness	-0.902	-0.486	-0.275	-0.465	0.076	-1.983	
Kurtosis	13.400	7.121	6.054	13.403	10.408	31.289	
Jarque-Bera	6764.046	1107.717	602.028	6799.445	3378.740	50694.92	
Prob.	0.000	0.000	0.000	0.000	0.000	0.000	
Obs.	1457	1483	1501	1496	1477	1491	

Source: Authors' estimation

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