Stock market integration and diversification possibilities during financial crises: Evidence from Balkan countries

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Abstract

This paper investigates the short- and long-term linkage among the Macedonian, Croatian, Slovenian, Serbian, and Bulgarian equity markets during the period of 4 October 2005 to 31 December 2015. In order to assess the impact of the recent financial crises on the interconnection among the examined Balkan stock markets, the studied period is segmented into pre-, during, and post-crisis period. Johansen cointegration test finds no evidence of cointegration during the pre- and post-crisis periods. However, during the latest financial crises, the empirical findings support the existence of three cointegration vectors. This means that the recent global financial crisis and the subsequent euro crisis strengthened the connection between the investigated stock markets, thus decreasing the diversification possibilities that can be acquired in these markets. Furthermore, innovation accounting analysis reveals that during periods of financial turmoil, the Macedonian stock market is positively and actively influenced by the Croatian and Serbian markets. A significant implication of these results is that the integration between Balkan stock markets tends to alter over time, particularly during stages of financial disturbances.

Keywords: *Balkan stock markets, Diversification, Financial crises, Cointegration, Innovation accounting*
JEL classification: *C51, G01, G11, G15*

1. Introduction

The recent introduction of the SEE link platform with the aim of creating a regional infrastructure for trading of securities listed on the regional Balkan stock markets inevitably raises the question whether the Macedonian investors can really gain diversification benefits of investing their savings in the companies that are listed on the other participating stock markets. If a group of stock market indexes is cointegrated, there will not be any real benefits of holding a portfolio of stocks in these countries, compared to holding stocks in just one country. This cointegration methodology first time introduced by Engle and Granger (1987) and Johansen (1988) has been widely used in order to study the long-term relationship between international equity markets. A great percent of these studies have primarily concentrated on the advanced economies and there is little or no research on the less developed Balkan countries. This paper tries to fill this gap by examining five Balkan countries (Macedonia, Croatia, Slovenia, Serbia, and Bulgaria) during the period of 4 October 2005 to 31 December 2015. In order to study the impacts that the global financial crisis and the subsequent euro crisis had on the interconnection between investigated stock markets, in the paper the studied period is divided into three sub-periods, namely the pre-crisis, during crisis, and post-crisis period. The long-term interdependence between considered markets is tested with the help of the Johansen cointegration technique. Furthermore, in order to scrutinize the short-term effects that the rest studied markets have on the Macedonian stock market, impulse responses and variance decomposition analysis are applied.

This paper tries to examine the following three questions: First, it analyses the potential diversification benefits that Macedonian investors can acquire by investing savings in the Balkan stock market; Second, this paper investigates whether the long-run relationship between Balkan equity markets changed during and after the global financial crisis and the following euro crisis; Finally, it explores how the Macedonian stock market reacts on the short-term to the shocks in the other four studied markets. The rest of the research paper is structured as follows. The next section elaborates the relevant empirical literature about the interconnection between international stock markets. Section 3 describes the data used in this

analysis. Section 4 explains the empirical methodology and presents the empirical results. The final section gives conclusion remarks.

2. Review of literature

Many researchers have studied the interdependence among worldwide financial markets. The primary focus of the earliest empirical research has been the connection between developed equity markets. Jeon and Chiang (1991) examine the world's four largest stock exchanges and imply that these stock markets share one long-run equilibrium relationship. Kasa (1992) finds evidence that a single common stochastic trend lies behind the long-run comovement of the equity markets in the United States (US), Japan, England, Germany, and Canada. Blackman et al. (1994) analyze the stock markets of 17 countries and record that financial deregulation and technological changes that had happened in the early 1980s contributed to a stronger connection among these markets in the late 1980s compared to 1970s. Masih and Masih (2001) point out to significant interdependencies between the established OECD and the emerging Asian markets. In the following years, this research topic has also extended on investigating the behavior of the Central and Eastern European countries. Voronkova (2004) shows that the stock markets of Hungary, Poland, and the Czech Republic are linked by a single, common long-run relation. In addition, she implied to the existence of significant cointegrating relationships between these three emerging markets and each of the developed capital markets of Britain, France, Germany, and US. This cointegration relation between the emerging Central European countries (Poland, Czech Republic, Hungary, Slovakia) and developed markets (Germany, US) was further confirmed by Syriopoulos (2007) in both the pre-EMU and post-EMU period. Moreover, Syriopoulos (2011) studies six Balkan countries and finds that both domestic and external forces affect these equity markets and shape their long-run equilibrium path. Kenourgios and Samitas (2011) using the Johansen cointegration test prove that the stock markets of the five examined Balkan emerging countries, US, Germany, United Kingdom, and Greece are cointigrated. Several studies have also demonstrated that the integration among stock markets tends to change over time, especially in times of financial turmoil. Arshanapalli and Doukas (1993) suggest that the link between the major stock

exchanges has been very weak before the stock market crash that happened in October 1987, but has substantially increased after this period. Sheng and Tu (2000) imply that there is no cointegration relationship between the Asian-Pacific countries in the period before the Asian financial crisis, but they found one cointegration relationship among the analyzed stock indexes during the period of this crisis. Ratanapakorn and Sharma (2002) using cointegration analysis, Granger causality tests, and innovation accounting analysis investigated the relationships among stock indexes of the US, Latin America, Europe, Asia, and Eastern Europe–Middle East for the pre-Asian crisis period and during the crisis period. They conclude that during the crisis period, a long-run relationship is observed among these indexes and thus the regional market efficiency hypothesis is violated during this period. Majid and Kassim (2009) focus on the connection of the emerging Asian markets with the developed stock markets during the 2007 global financial crisis and find that the analyzed stock markets have become increasingly cointegrated at the time of this financial crisis. Cheung et al. (2010) investigate the impact of the 2007–2009 global financial crisis on the interrelationships among global stock markets and document that the linkage between the US market and other global markets, both the short-term causal relationship and long-term cointegrating equilibrium, strengthened during the global financial crisis.

3. The data

The data sample considered in this research paper consists of daily closing prices of five Balkan stock markets (Macedonia, Croatia, Slovenia, Serbia, and Bulgaria) for the period of 4 October 2005 to 31 December 2015, including 2655 observations. The indexes, transformed in natural logarithms, used in the analysis are: MBI10 for Macedonian, CROBEX for Croatia, SBITOP for Slovenia, BELEX15 for Serbia, and SOFIX for Bulgaria. A range of descriptive statistics for the data set, which was collected from the official web sites of the analyzed stock exchanges, is presented in the Table 1. When a national stock exchange was closed due to a national holiday, the index level was assumed to remain the same as that on the previous working day and all of the evaluated indexes are expressed in the national currencies.

Table 1. Descriptive statistics

	MBI10	CROBEX	SBITOP	BELEX15	SOFIX
Pre-crisis period					
Mean	8,209	8,007	7,190	7,322	6,947
Median	8,226	8,040	7,156	7,158	6,852
Maximum	9,019	8,545	7,855	8,103	7,384
Minimum	7,656	7,584	6,754	6,906	6,684
Standard dev.	0,387	0,302	0,290	0,395	0,202
Skewness	0,534	0,249	0,438	0,705	0,446
Kurtosis	2,123	1,858	2,233	1,962	1,660
Jarque-Bera	37,899	30,779	26,867	60,821	51,405
Probability	0,000	0,000	0,000	0,000	0,000
Observations	476	476	476	476	476
During crisis period					
Mean	8,010	7,744	6,916	6,681	6,220
Median	7,837	7,633	6,802	6,504	6,013
Maximum	9,216	8,593	7,892	7,976	7,577
Minimum	7,377	7,141	6,236	5,870	5,560
Standard dev.	0,472	0,353	0,450	0,538	0,574
Skewness	1,146	1,075	0,764	1,097	1,173
Kurtosis	3,006	2,925	2,623	3,021	2,888
Jarque-Bera	283,338	249,834	133,721	259,860	297,696
Probability	0,000	0,000	0,000	0,000	0,000
Observations	1295	1295	1295	1295	1295
Post-crisis period					
Mean	7,458	7,487	6,538	6.361	6,130
Median	7,455	7,480	6,540	6.360	6,149
Maximum	7,579	7,613	6,733	6,616	6,434
Minimum	7,350	7,407	6,217	6,063	5,746
Standard dev.	0,048	0,042	0,127	0,134	0,177
Skewness	0,019	0,788	-0,293	-0,404	-0,586
Kurtosis	2,125	3,394	2,218	2,404	2,629
Jarque-Bera	28,249	97,296	35,174	37,175	55,696
Probability	0,000	0,000	0,000	0,000	0,000
Observations	884	884	884	884	884

Notes: MBI10 represents the Macedonian stock market; CROBEX represents the Croatian stock market; SBITOP represents the Slovenian stock market; BELEX15 represents the Serbian stock market; SOFIX represents the Bulgarian stock market; all of the index values are transformed into natural logarithms

Expressing stock price indexes in domestic currencies restricts their variations exclusively to stock price movements and avoids potential distortions induced by devaluations of the respective exchange rates. This same method was also used in Voronkova (2004) and Kenogori (2011). Furthermore, because most of the markets are operating in the same time zones, the issue of non-overlapping trading hours does not considerably arise. In order to analyze the impact of the global financial crisis and the subsequent euro crisis on the interconnection among the analyzed equity markets, in the research paper, the examined time period is divided into three sub-samples. The first sub-sample representing the pre-crisis period contains data from 4 October 2005 to 6 August 2007, since it is commonly held that the first disruption of the

credit markets, which has happened as a result of the US sub-prime mortgage crisis, occurred on 7 August 2007, when the French bank BNP Paribas suspended redemption of shares held in some of its money market funds (Mishkin, 2011). The second sub-period exploring the during crisis period spans from 7 August 2007 to 1 August 2012 when the acute phase of the euro crisis came to an end with the introduction of the Outright Monetary Transactions program by the Governing Council of the European Central Bank on the following day (Eichengreen, 2015). The third sub-sample elaborates the post-crisis stage, incorporating the time period from 2 August 2012 to the end of the study period on 31 December 2015. This organizing of the data into the above-mentioned three sub-periods is done in order to see whether the interdependence among the stock markets has changed because of the most recent global financial crises.

4. Methodology and empirical results

4.1. Unit root test results

In order to test the existence of stochastic non-stationarity in the data, the integration of the individual time series is examined using two unit root tests, the Augmented Dickey-Fuller (ADF) test, and the Phillips and Perron (PP) test. The ADF test takes the following form:

$$\Delta y_t = \beta' D_t + \pi y_{t-1} + \sum_{j=1}^{p} \psi_j \Delta y_{t-j} + \varepsilon_t \quad (1)$$

Where Δ indicates the first differences of the series, D_t is a vector of deterministic terms (constant, trend etc.), and ε_t is the white noise term. The null hypothesis suggests that Δy_t is I(0), which implies that π = 0, on the other hand rejection of the null hypothesis implies a stationary series. The optimal number of lags of the dependent variable in the test regression is based on the Schward criterion. The PP unit root test differs from the ADF test mainly in how it deals with the serial correlation and heteroskedasticity in the error term, and its regression is given by the following equation:

$$\Delta y_t = \beta' D_t + \pi y_{t-1} + \mu_t \quad (2)$$

Table 2. Unit root tests

	ADF Test				PP Test			
	Level		First differences		Level		First differences	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Panel A								
MBI10	1,182	-2,177	-12,058*	-11,692*	1,313	-1,973	-11,891*	-11,864*
CROBEX	0,812	-3,222	-19,088*	-19,165*	0,616	-3,002	-19,433*	-19,476*
SBITOP	1,673	-0,762	-15,827*	-15,976*	2,082	-0.614	-16.624*	-16,736*
BELEX15	0,410	-1,796	-15,335*	-15,383*	0,605	-1,616	-15,135*	-15,172*
SOFIX	1,283	-2,150	-17,870*	-18,064*	1,294	-2,164	-18,072*	-18,171*
Panel B								
MBI10	-1,924	-1,496	-23,504*	-23,543*	-1,870	-1,515	-25,507*	-25,236*
CROBEX	-2,053	-1,627	-18,950*	-18,997*	-2,025	-1,586	-32,736*	-32,727*
SBITOP	-1,528	-1,847	-31,161*	-31,170*	-1,516	-1,689	-30,930*	-30,924*
BELEX15	-2,257	-1,747	-25,730*	-25,782*	-2,248	-1,734	-25,730*	-25,863*
SOFIX	-1,848	-1,217	-13,922*	-13,996*	-1,910	-1,231	-33,447*	-33,263*
Panel C								
MBI10	-2,387	-2,249	-23,905*	-23,919*	-2,168	-2,046	-23,880*	-23,888*
CROBEX	-1,774	-2,388	-28,485*	-28,507*	-2,084	-2,626	-28,726*	-28,690*
SBITOP	-2,342	-1,763	-26,061*	-26,129*	-2,263	-1,592	-25,915*	-25,946*
BELEX15	-1,892	-1,551	-25,247*	-25,285*	-1,956	-1,720	-25,651*	-25,559*
SOFIX	-2,343	-0,964	-28,286*	-28,490*	-2,332	-0,964	-28,263*	-28,478*

Notes: (1) represents model with constant (2) represents model with constant and trend; ADF-PP Critical values - with constant -3,444 at 1%, -2,867 at 5%, -2,570 at 10%; with constant and trend -3,978 at 1%, -3,419 at 5%, -3,132 at 10%; *indicates significance at 5% significance level

Table 2 summarizes the results from the ADF and PP tests in levels as well as in first differences of the each of the examined national stock market indexes. Panels A, B, and C of the Table 2 show the test results for the pre-crisis, during crisis, and post-crisis period, respectively. The reported results indicate that the null hypothesis of a unit root in each of the five Balkan stock indexes cannot be rejected. However, there is no indication to support the existence of a unit root in first differences of the stock price indexes. In other words, the null hypothesis of a unit root in the equity indexes is rejected at the 5% significance level by both tests for all of the analyzed sub-periods. This finding is consistent with the widely held assumption that the national stock index series are individually integrated of order one, I(1).

4.2. Johansen cointegration test results

Cointegration method is often used to investigate the dynamic interdependence between financial time series. If the examined stock indexes are found to be cointegrated, then stationary linear combinations of these variables may exist even though the variables themselves are individually non-stationary. In other words, contegration will allow us to

determine whether the five Balkan stock indexes move together over the long-run, while providing for the possibility of short-run divergence. Alternatively, the absence of cointegration will suggest that the stock indexes involved have no long-run interdependence and can drift arbitrarily away from each other. In order to study the long-run relationships among the variables in the model, in the research paper is employed the Johansen multivariate cointegration test. The Johansen procedure is based on Vector Error Correction Model (VECM) to examine whether there is at least one long-run relationship between variables, and the VECM is described by the subsequent equation:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-k} + \mu + \Phi D_t + \varepsilon_t \quad (3)$$

where

$$\Gamma_i = -(I - \Pi_1 - \ldots - \Pi_i), \quad (\mathrm{i} = 1, \ldots, \mathrm{k}\text{-}1), \quad (4)$$

and

$$\Pi = -(I - \Pi_1 - \ldots - \Pi_k) \quad (5)$$

The matrix Γ_i comprises the short-term adjustment parameters, and matrix Π contains the long-term equilibrium relationship information between the X variables. Π is defined as the product of two matrices, α and β'. The matrix β gives the cointegrating vectors, while α gives the amount of each cointegrating vector entering each equation of the VECM, also known as the "adjustment parameters". Johansen specified two tests of the hypothesis that there are at most r cointegrating relationships, the trace statistics (λ_{trace}) and the maximum eigenvalue statistics (λ_{max}). The λ_{trace} tests the null hypothesis of r = 0 against the alternative that r > 0. On the other hand, the λ_{max} test the null hypothesis that the number of cointegrating vectors is r against the specific alternative of r + 1 cointegrating vectors. The optimal lag-length was determined by Akaike Information Criterion (AIC). According to this test the most appropriate number of lags for the pre-crisis period is two, for the during crisis period is three, and for the post-crisis period is two. Next, impulse responses and variance decompositions analysis are applied. Impulse responses trace out the responsiveness of the dependent variables in the vector autoregression (VAR) model to shocks to each of the variables. On the other hand, variance decomposition gives the proportion of the movements in the dependent variables that are due to their "own" shocks, versus shocks to the other variables.

Table 3. Johansen cointegration test

Null	Eigenvalue	λ_{trace} test	Critical values	Null	λ_{max} test	Critical values
Panel A						
r=0	0,042	54,665	69,819	r=0	20,423	33,877
r≤1	0,033	34,242	47,856	r=1	16,013	27,584
r≤2	0,023	18,229	29,797	r=2	10,825	21,132
r≤3	0,013	7,404	15,495	r=3	6,162	14,265
r≤4	0,003	1,242	3,841	r=4	1,242	3,841
Panel B						
r=0	0,039	124,333*	69,819	r=0	51,612*	33,877
r≤1	0,028	72,721*	47,856	r=1	36,665*	27,584
r≤2	0,024	36,056*	29,797	r=2	30,736*	21,132
r≤3	0,004	5,320	15,495	r=3	4,967	14,265
r≤4	0,000	0,353	3,841	r=4	0,353	3,841
Panel C						
r=0	0,037	65,546	69,819	r=0	33,055	33,877
r≤1	0,018	32,490	47,856	r=1	16,068	27,584
r≤2	0,009	16,422	29,797	r=2	8,018	21,132
r≤3	0,007	8,403	15,495	r=3	6,039	14,265
r≤4	0,003	2,365	3,841	r=4	2,365	3,841

Notes: *indicates significance at 5% significance level

Because all of the analyzed time series were found to be integrated of order one, the analysis could proceed with the Johansen test of cointegration. The results of this test are presented in the Table 3. Panel A of the Table 3 summarizes the findings for the pre-crisis period. As it is shown in the table, both the λ_{trace} test and λ_{max} test performed on the five examined markets failed to detect cointegration during this period, since the null hypothesis of no cointegration cannot be rejected at 5% significance level. However, during the crisis period the null hypothesis that the Macedonian, Croatian, Slovenian, Serbian, and Bulgarian stock markets are not cointegrated against the alternative hypothesis that there is one or more cointegrating vectors is rejected at the 5% significance level, because the λ_{trace} test statistics exceeds the critical values at this level. Furthermore, this result is also confirmed by the λ_{max} test. Both tests also showed that there are three cointegrating vectors during this period. This finding has serious implications from the international diversification perspective. During periods of financial turmoil, Balkan stock markets tend to move more closely together and the long-term benefits from the possibility of diversification by investing in these markets is seriously mitigated. But, still there is an opportunity to exercise short-term gains by investing in these markets. This conclusion is in line with the earlier findings, showing that at the times of financial crises, regional stock markets lean to move together (Sheng and Tu, 2000; Majid and Kassim, 2009). The last part of the Table 3 presents the results for the post-crisis period. In the

post-crisis period the long-term relationship that thrived during the crisis period seems to disappear, as the null hypothesis of no cointegration cannot be rejected at the 5% significance level.

4.3. Innovation accounting analysis

In the following part of the research paper, the results from the short-term relationship between MBI10 and the other four studied stock markets during the period of the latest financial crises are presented. First, the outcome of the variance decomposition analysis is exhibited. This test gives information about the percent of the forecasted error variance of MBI10 that can be attributed to the changes in the other four Balkan stock indexes. Table 4 summarizes the findings of the conducted variance decomposition analysis. As it can be concluded from the table, at the 6 day time horizon, 88,31% of the Macedonian stock index variance can be attributed to its own movements. This percent gradually declines, and after 24 days the Macedonian stock index accounts for 64,34% of its own changes. Furthermore, at this time period, a substantial fraction of the MBI10 variance is associated with CROBEX and BELEX15 innovations, meaning that these stock markets actively influenced the Macedonian stock market during the period of the global financial crisis and the following euro crisis.

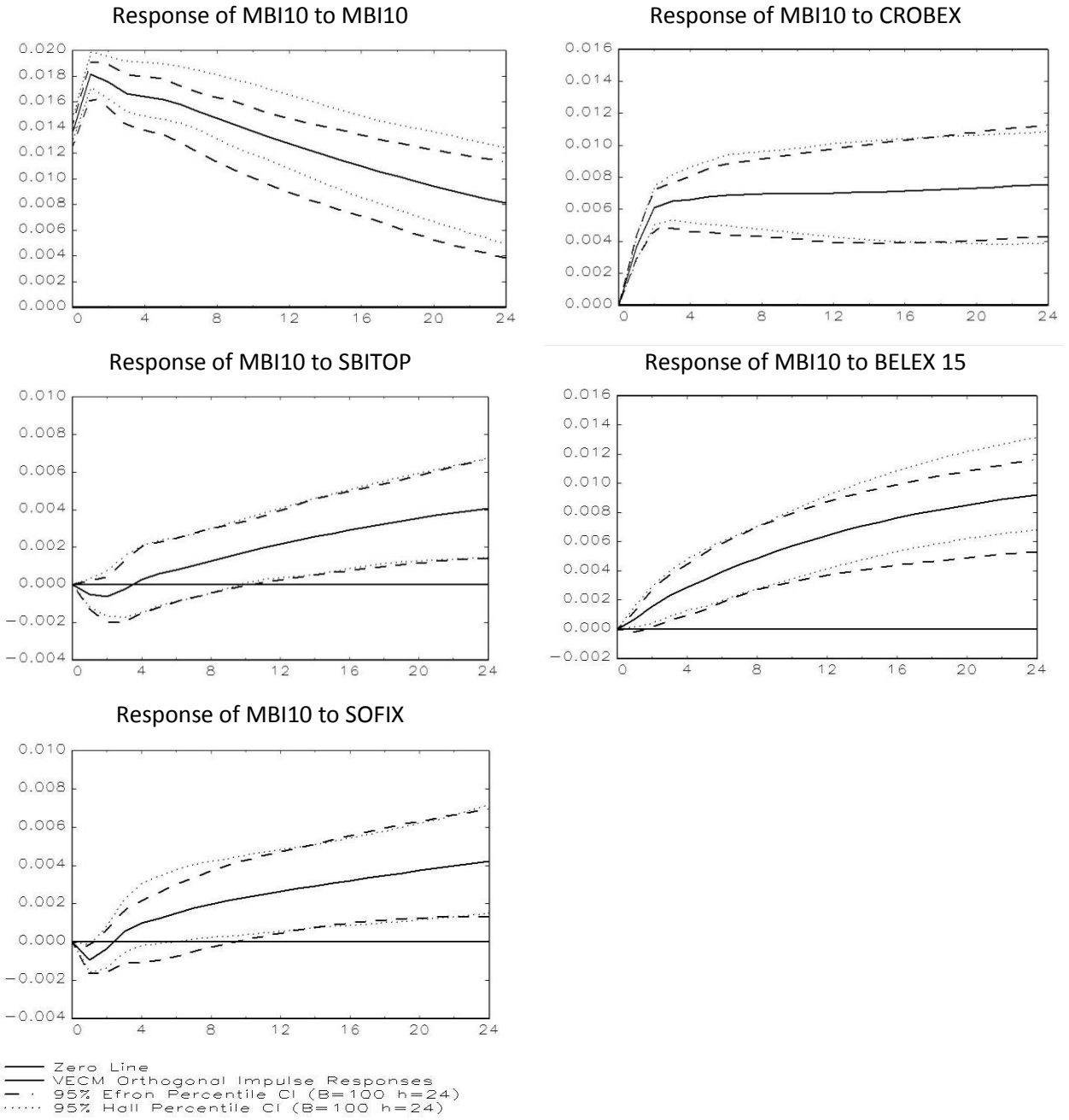
Impulse responses pursue the reaction of the dependent variables in the VAR to shocks to each of the variables. So, for each variable from each equation separately, a unit shock is applied to the error, and the effects upon the VAR system over time are noted (Brooks, 2014). The test results of the impulse responses functions of Croatian, Slovenian, Serbian, and Bulgarian stock markets on the Macedonian stock market during the examined financial crises are exposed in the Figure 1. During this period, the impact of a shock of the

Table 4. Variance decomposition analysis

Horizon (days)	Percentage of forecast error variance by innovations in:				
	MBI10	CROBEX	SBITOP	BELEX15	SOFIX
6	88,305	9,905	0,062	1,521	0,207
12	80,527	13,149	0,376	5,135	0,813
18	72,470	15,134	1,088	9,680	1,627
24	64,336	16,739	2,039	14,307	2,579

MBI10 has immediate and consistent positive effect that does not die away even after the 24 day time horizon. A disruption to the both CROBEX and BELEX15 has positive and constant influence on the MBI10. At the beginning, a shock to SBITOP as well as to SOFIX does not have a steady impact on the MBI10, but after 11 days this effect translates into a positive impact. Also, all of the shocks in the system are constant during the whole analyzed 24 day time frame.

Figure 1. Impulse responses analysis in the during crisis period



5. Conclusion

This research paper scrutinizes the short- and long-term relationship among the Macedonian, Croatian, Slovenian, Serbian, and Bulgarian equity markets. In order to investigate the possible consequences that the global financial crisis and the subsequent euro crisis might have on the linkage among the considered stock markets, the investigated time frame is divided into three sub-periods, particularly, the pre-crisis, during crisis, and post-crisis period. Next, the Johansen cointegration test is employed to inquiry the long-run comovement between the examined Balkan stock markets. This test fails to find evidences of cointegration relationships among the markets during the pre- and post-crisis stages. However, there are evidences of cointegration among Macedonian, Croatian, Slovenian, Serbian, and Bulgarian stock markets during the crisis period. So, during periods of financial turbulences these Balkan stock markets tend to become more integrated and the market efficiency hypothesis is seriously put into question. From a perspective of Macedonian investors, this means that there possibilities to gain diversification benefits of investing savings in the other four investigated stock markets are vigorously diminished. Furthermore, during periods of financial disturbances a considerable fraction of the MBI10 forecasted error variance can be attributed to innovations in CROBEX and BELEX15. In other words, on the short-term Macedonian stock markets is considerably influenced by the Croatian and Serbian equity markets. Also, at times of financial crisis, shocks to CROBEX and BELEX15 have positive and constant influence on the MBI10. These results further strengthen the hypothesis that during periods of financial crises, regional markets become increasingly integrated with each other.

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