INFLUENCE OF FRONTIER CAPITAL MARKETS INTERDEPENDENCE AND EFFICIENCY ON SHAPING INVESTMENT STRATEGY UNDER THE FINANCIAL CRISIS CONDITIONS

Damir Bećirović[1], Emira Kozarević[2]

ABSTRACT

This research analyzes interdependence and low efficiency of the selected capital markets in the period before and after the escalation of the global financial crisis. The aim is to show, based on the obtained results, the position that can be taken by potential investors in frontier capital markets of the Western Balkan countries. The sample included the daily values of the selected stock market indices for the period October 04, 2005 to October 25, 2012. The results showed that during the crisis potential benefits of international diversification based on investments in the observed frontier capital markets decrease as the correlations among capital markets during the crisis are higher than expected, which is marked as the "contagion effect". In terms of low efficiency, it can be concluded that the results for the period before the crisis are expected, meaning that all the selected capital markets of the Western Balkans were inefficient. Efficiency tests for the period after the escalation of the crisis show somewhat contradictory results due to the characteristics of these markets and the effect of exogenous shock such as the financial crisis.

Keywords: frontier capital markets, investment strategy, efficient market hypothesis, interdependence of capital markets

JEL: G01, G14, G15

1. INTRODUCTION

Capital markets are basically classified into developed capital markets, emerging capital markets, and frontier capital markets. The very term "frontier capital markets" was introduced to mark all the markets that, due to their specificities, cannot still be grouped into emerging capital markets. Frontier capital markets are characterized by short history of trading, low market capitalization, asynchronous trading, difficult identification of proper market indices, increased risk due to higher return expected, higher transaction costs, low liquidity problem, and the undeveloped secondary capital markets. Hence, the capital markets of the Western Balkan countries, which are the subject of this paper, are categorized as frontier capital markets and the research focused on the issue of shaping portfolio investment strategies on these markets.

The shaping of investment strategy is affected by market specificities, investment goals set, and investors' attitude towards risk. In this regard, capital market efficiency and interdependence were observed as a part of the information set used for creating a detailed investment strategy. The efficient market hypothesis (EMH) is a dominant theoretical and methodological approach with the key role in shaping investment strategy on capital markets. From a theoretical point of view, there are no undervalued or overvalued stocks on an efficient market and investors are unable to generate above average return from their portfolios. Capital market interdependence is observed in the context of realizing potential effects of international portfolio diversification. Investing into the markets that are more correlated reduces the effects of international portfolio diversification when compared to less correlated markets, and *vice versa*.

The research included the selected frontier capital markets of the Western Balkan countries. The research subject refers to the specific features of shaping investment strategies in frontier capital markets, in the context of markets interdependence and efficiency, under the conditions of the global financial crisis in 2008. The global financial crisis is considered to be the most serious financial crisis after the Second World War. It started in 2007 in the USA and by 2008 it quickly transferred to the rest of

[1] *International Business Information Academy of Tuzla, 75000 Tuzla, e-mail: damirbeci@hotmail.com*
[2] *University of Tuzla, Univerzitetska 8, 75000 Tuzla, e-mail: emira.kozarevic@untz.ba*

the world (Bećirović, Kozarević & Balić, 2017). It should be mentioned that rather than on the global financial crisis, the research focuses on establishing whether an exogenous shock, such as this crisis, affects the results of testing capital markets interdependence and efficiency, aimed at showing certain dynamics of this phenomenon.

2. LITERATURE REVIEW

Based on preliminary knowledge, a relatively small number of science articles were published covering the shaping of investment strategy of securities portfolio in frontier capital markets. There is somewhat more interest in research into interdependence of emerging and frontier capital markets on the one side and developed capital markets on the other, regarding potential benefits of international portfolio diversification.

Investment strategies in frontier capital markets and the problem of optimizing stock portfolios in these markets were the subject of the research conducted by Latković and Barac (1999). The empirical part of the research is related to the application of Markowitz's Modern portfolio theory (MPT) on the Croatian capital market characterized as frontier capital market. The risk of stock illiquidity has been particularly analyzed. Model correction by means of illiquidity risk inclusion results in the movement of the efficient frontier to the right. In addition, the length of efficient frontier is reduced due to lower possibility to construct efficient portfolios. Lower level of diversification on frontier capital markets can be assigned to illiquidity risk and lower number of stocks traded on these markets.

Čondić-Jurkić and Dadić (2008) analyzed the strategies of investment funds active on the Croatian capital market in order to examine to what extent Croatian investment funds, none of which is solely the index fund, replicate the benchmark Crobex index. Their empirical results showed that four out of ten investment funds analyzed co-integrate with the benchmark Crobex index. This actually means that the funds had passive investment strategies although they were declared as actively managed funds. In their research, Čondić-Jurkić and Dadić examined the multilateral and bilateral integration of capital markets of the selected countries of Central and Eastern Europe (Croatia, Slovenia, Hungary, the Czech Republic, and Poland) and the German capital markets. The results indicate multilateral integration of the selected capital markets in the countries of Central and Eastern Europe, but also between this group of countries and the capital market in Germany.

Financial integration of European emerging capital markets has been analyzed by Nikkinen, Piljak, and Rothovius (2008). The results showed a significant level of financial integration of capital markets in Croatia, Slovenia, and Estonia when compared to the world capital market, while the results were different for the capital markets in Romania and Slovakia. In terms of testing the interdependence of the observed emerging capital markets, a significant level of interdependence was identified of capital markets in Croatia and Slovenia.

Zahirović, Rovčanin, and Okičić (2009) examined the correlations between the S&P 500 Index, as one of the main indicators of capital market change, on the one side, and the stock market indices in Bosnia and Herzegovina, Serbia, Montenegro, Slovenia, and Croatia, on the other. Based on the presented results, no significant correlation was identified in the changes of the S&P 500 Index and the indices SASX-10, MBI, MOSTE, BELEX and BIRS, while there was a significant correlation between the S&P 500 and the indices CROBEX and SBI 20. Besides, in her paper Okičić (2011) showed the exogenous shock (the global financial crisis to be specific) affected the capital markets of the Western Balkans and resulted in increased correlation.

Kunovac (2011) investigated the relationship between the Croatian market and the capital markets of the European Union countries. When compared to the markets of the European Union countries, correlation of returns significantly higher in times of market turbulence than in the periods of market calm, which reduces positive effects of international diversification during market turbulence.

Interdependence of capital markets in Central and South-East Europe compared to the Western European capital market was the subject of the study conducted by Horvath and Petrovski (2012). The comparison of these groups of countries showed that capital market interdependence in Central Europe, when compared to developed

capital markets in Western Europe, is much higher than for capital markets in South-East Europe (SEE). The example is the Croatian capital market that shows higher interdependence on the capital market of Western Europe than the capital markets of other observed countries in SEE (Serbia and Macedonia).

Dimitriou and Kenourgios (2012) investigated the opportunities for international portfolio diversification based on investment in capital markets of the Balkan countries. They studied the mutual dependence of these markets as well as their interdependence on the developed capital markets. The results indicate the long term dependence of capital markets in Croatia and Bulgaria on the developed capital markets while there was no cointegration with developed capital markets and the Romanian capital market.

A comparative analysis of the dependence of the European capital market on the Dow Jones Industrial Average was the main topic of the research made by Tomić, Sesar, and Džaja (2014). Their results indicated a high level of dependence of this market on the Dow Jones Industrial Average, other than the CROBEX Index.

Zaimović, Arnaut Berilo, and Mustafić (2017) tested portfolio diversification possibilities on South-East European equity markets. The results indicate that there is a possibility of expanding portfolio investments from the national stock markets to the SEE region. Regional capital markets offer significant diversification opportunities. In addition, there is a limited diversification benefit from spreading out the investments from the SEE market to the leading world capital markets, and *vice versa*, due to the high integration of the SEE market with leading world markets. The high integration of international capital markets and fewer diversification possibilities are a consequence of the financial crisis.

3. THEORETICAL FRAMEWORK

From investors' perspective, EMH is the dominant theoretical and methodological approach that has the key role in shaping investment strategy for securities portfolio. Depending on their perception that a capital market is efficient, while constructing investment portfolio, investors decide on the application of passive or active investment strategy (Brzaković, 2005). The American economist Eugene Fama, who developed EMH, believes that capital market is efficient if its prices completely reflect all available and relevant information. According to EMH, all the relevant information on the capital market is completely and immediately built into securities prices. This actually means that using the fundamental and technical analysis or insider information is completely useless on the efficient market as it cannot generate above average return to investor. As the active investment strategy is based on the application of the technical and fundamental analysis aimed at identifying the stocks that might yield above average return, the idea that capital market is efficient means that in that case investor shall decide on the passive investment strategy and most likely construct his portfolio by following the structure of stock market index that best reflects the given capital market.

Apart from capital market efficiency, the paper also observed the interdependence and correlation of individual capital markets for the purpose of achieving international diversification of investment portfolio. The world capital market becomes increasingly integrated. Consequently, positive effects of financial integration include the possibility of risk dispersion and diversification, better capital allocation, and potential for higher growth.

Low level of capital market efficiency	**There is no**	**There is**
There is	*It is not possible to generate above average return but the effect of international diversification is positive*	*It is not possible to generate above average return and the effects of international diversification are reduced*
There is no	*Opportunity to generate above average return with a positive effect of international diversification*	*Opportunity to generate above average return with reduced effects of international diversification*

Capital market interdependence

Figure 2.1. Matrix of investor positioning in relation to interdependence and (in)efficiency of capital markets

Source: Authors based on the conducted theoretical research

The given theoretical assumption opens space for the formulation of the appropriate investment matrix (Figure 2.1), which acts as the framework for investors' positioning in relation to the interdependence and (in)efficiency of capital markets. This is a simple model which includes two dependent variables and enables, by the assumption of *ceteris paribus*, investors' positioning based on the testing of these variables. The benefits of international capital market investment might be illustrated by the research conducted by Solnik (1974). He showed that systemic risk was reduced after the portfolio consisting of the American stocks only included the stocks from other capital markets. International stocks included in the portfolio were not in correlation with the American stock market and they were not affected by the variables present on the American capital market, which consequently enabled investors to reduce a part of systemic risk.

3. METHODOLOGY OF THE EMPIRICAL RESEARCH

The empirical part of the paper used the data on the following stock market indices quoted on frontier capital markets in the Western Balkan countries: BIRS and SASX-10 (Bosnia and Herzegovina), BELEX15 (Serbia), CROBEX (Croatia), MONEX20 (Montenegro), MBI10 (Macedonia), and SBI TOP (Slovenia). The selected stock market indices might be observed as the approximation of the position and fluctuation in stock prices on the given capital markets. The results of testing the selected stock market indices on frontier capital markets in the sample were compared to the results of testing the indices on developed capital markets used as the benchmark: CAC-40 (France), S&P 500 (the USA), DAX (Germany), NIKKEI 300 (Japan), and FTSE 100 (Great Britain).

The time series tested in this paper are the financial time series of closing daily values of the stock market indices on the selected frontier capital markets of the Western Balkans and the selected developed capital markets, transformed into the logarithmic return series. The daily values of stock market indices were taken for the period October 04, 2005 – October 25, 2012. The starting date of the selected time series was defined based on the limitation in terms of the availability of the data on the fluctuation of certain stock market indices. The time series does not include the period after October 25, 2012 as the aim of the research was to show the effect of the crisis and the period after 2012 marks the start of capital market recovery. Using financial time series of daily return of the selected indices is more appropriate than the series representing the closing daily values of stock market indices as the closing daily value series may show the growth or decline trend. In addition, transformation into time series of return achieves series stationarity, which is a precondition for testing interdependence and low efficiency.

In order to fully present the effect of interdependence and low efficiency on shaping investment strategy of securities portfolio on the selected frontier capital markets, the entire period covered by this research was divided into two segments. The first segment refers to the period October 04, 2005 – October 08, 2008, until the escalation of the global financial crisis. The second segment covered the period October 08, 2008 – October 25, 2012 or the period marked by the global financial crisis. October 08, 2008, the date when Lehman Brothers Treasury Co. B. V. declared bankruptcy was selected as the turning point, as that is the date when the global financial crisis escalated. The idea was to show in what way the financial crisis affected the shaping of portfolio investment strategies primarily for the frontier capital markets, taking into consideration interdependence and low efficiency of the selected capital markets, by the assumption of *ceteris paribus*. The primary method used in the empirical part of the research is the modeling method with the usage of statistical analysis. Within the framework of the modeling method, in efficiency testing, an autoregressive model AR(p) was used, combined with the statistical testing of independence.

The method of statistical analysis included descriptive statistical analysis, the Granger causality test for determining interdependence of the selected capital markets, and autocorrelation that belongs to statistical independence tests. In order to test low efficiency of the selected capital markets, an augmented Dickey-Fuller test (ADF test) was

used, aimed at determining the stationarity of financial time series.

4. DISCUSSION AND INTERPRETATION OF THE RESULTS

The first step in the interpretation of the research results refers to the descriptive statistical analysis. Table 4.1 shows the results of the descriptive statistical analysis referring to the period prior to the escalation of the financial crisis, while Table 4.2 presents the parameters of the descriptive statistical analysis for the period after the financial crisis escalated.

In the period after the financial crisis escalated, the average daily returns of stock market indices for all the selected frontier capital markets had negative values. In the period prior to the crisis escalation, CROBEX, SBI TOP, MONEX20, and MBI10 indices registered a positive average daily return. Hence, it is evident that the exogenous shock, by the assumption of *ceteris paribus*, reduced the average daily returns of the stock market indices on the selected frontier capital markets in the Western Balkans.

4.1. Results of Testing Interdependence and Correlation Among the Capital Markets in the Western Balkan countries

Testing interdependence and efficiency of capital markets is preceded by testing the stationarity of the selected financial time series by using the ADF test for examining the presence

Table 4.1. Basic parameters of descriptive statistical analysis prior to the escalation of the financial crisis

Indices	Parameters								
	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
SASX-10	-0.00021	0.00000	0.08198	-0.08840	0.01688	-0.10653	7.82771	719.0516	0.000000
BIRS	-0.00005	-0.00008	0.07319	-0.05009	0.01295	0.34290	6.37042	356.8724	0.000000
CROBEX	0.00030	0.00054	0.07610	-0.06615	0.01230	-0.36859	8.01542	801.9894	0.000000
BELEX15	-0.00029	0.00009	0.12158	-0.10861	0.01556	-0.02583	16.95852	6138.223	0.000000
MONEX20	0.00088	0.00012	0.09670	-0.06739	0.01845	0.55608	6.34115	382.3391	0.000000
SBITOP	0.00051	0.00045	0.06753	-0.06637	0.01254	-0.12471	8.33789	386.4038	0.000000
MBI10	0.00058	0.00030	0.05651	-0.08769	0.01586	-0.23444	7.64513	673.2715	0.000000
CAC-40	-0.00029	0.00043	0.08868	-0.09472	0.01295	-0.44766	11.05109	2099.894	0.000000
S&P500	-0.00026	0.00079	0.05272	-0.09200	0.01150	-1.03375	11.28327	2298.824	0.000000
DAX	0.00005	0.00077	0.05761	-0.07434	0.01176	-0.69185	8.38581	1011.393	0.000000
NIKKEI300	-0.00041	0.00000	0.04910	-0.09728	0.01413	-0.66623	6.64410	482.3840	0.000000
FTSE100	-0.00023	0.00000	0.08459	-0.08178	0.01221	-0.24433	9.99835	1558.497	0.000000

Source: Authors based on the data available on the official websites of the selected stock market indices

Table 4.2. Basic parameters of descriptive statistical analysis after to the escalation of the financial crisis

Indices	Parameters								
	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
SASX-10	-0.00066	-0.00037	0.08757	-0.06940	0.01300	0.55783	10.1195	2196.265	0.000000
BIRS	-0.00004	0.00000	0.03842	-0.03644	0.00724	-0.08766	7.0399	348.8362	0.000000
CROBEX	-0.00040	-0.00010	0.14779	-0.10764	0.01606	0.13937	16.9885	8270.704	0.000000
BELEX15	-0.00052	-0.00078	0.12034	-0.09635	0.01532	0.32624	12.1015	3628.897	0.000000
MONEX20	-0.00044	-0.00073	0.11286	-0.09708	0.01660	0.80436	12.6802	4024.280	0.000000
SBITOP	-0.00076	-0.00060	0.08358	-0.08431	0.01249	-0.65990	11.3578	3027.840	0.000000
MBI10	-0.00082	-0.00084	0.06610	-0.10283	0.01430	-0.57688	12.1215	3494.057	0.000000
CAC-40	-0.00009	0.00003	0.10957	-0.08048	0.01826	0.19702	7.3397	823.6056	0.000000
S&P500	0.00034	0.00083	0.10798	-0.09470	0.01661	-0.11292	10.4844	2387.528	0.000000
DAX	0.00029	0.00070	0.10798	-0.07270	0.01760	0.23133	7.9562	1073.707	0.000000
NIKKEI300	-0.00027	0.00000	0.12951	-0.10269	0.01628	-0.32888	13.1618	4411.380	0.000000
FTSE100	0.00023	0.00035	0.09384	-0.09255	0.01485	-0.07118	9.2448	1663.153	0.000000

Source: Authors based on the data available on the official websites of the selected stock market indices

of the unit root in financial time series. The analysis of the results of the ADF test of the unit root for the two selected segments (before and after the escalation of the financial crisis) shows that the values of the ADF test for the observed stock market indices are in all cases lower than the critical values of the test for the significance levels of 1%, 5%, and 10% (see Appendix 1 and 2). This leads to the conclusion that the null hypothesis is rejected for all these indices and the alternative hypothesis is accepted which states that the tested financial time series are stationary.

Following the testing of financial time series stationarity, the next step in analyzing interdependence of capital markets is to test the correlation of the selected stock market indices, whereby the tested financial time series of daily returns of stock market indices are organized and matched by dates.

Table 4.3. Correlation matrix of daily returns prior to the escalation of the financial crisis

Indices	BELEX15	BIRS	CAC-40	CROBEX	DAX	FTSE 100	MBI10	MONEX20	NIKKEI 300	S&P 500	SASX-10	SBITOP
BELEX15	1	0.10643**	0.09585*	0.13750**	0.10663**	0.068695	0.045433	0.042962	0.057907	0.004104	0.056966	-0.011821
BIRS		1	-0.004335	0.067636	0.018123	-0.022626	0.08869*	0.08912*	-0.004814	-0.014177	0.34409**	0.09557*
CAC-40			1	0.40457**	0.9243**	0.85066**	0.038956	0.046641	0.36033**	0.4733**	0.001315	0.15709**
CROBEX				1	0.40113**	0.41271**	0.18776**	0.17610**	0.31732**	0.12950**	0.13917**	0.28565**
DAX					1	0.77538**	0.030271	0.08889*	0.36861**	0.45781**	0.016509	0.14492**
FTSE 100						1	0.002601	0.08704*	0.31029**	0.43086**	0.012473	0.13403**
MBI10							1	0.13940**	0.026035	0.03402*	0.008161	0.13260**
MONEX20								1	0.038795	0.038382	0.21601**	0.15674**
NIKKEI 300									1	0.08909*	-0.010182	0.25642**
S&P 500										1	-0.005324	0.060305
SASX-10											1	0.10794**
SBITOP												1

Note: ** Correlation is significant for the level of 1% (two tailed test)

* Correlation is significant for the level of 5% (two tailed test)

Source: Authors based on the data available on the official websites of the selected stock market indices

Table 4.4. Correlation matrix of daily returns after the escalation of the financial crisis

Indices	BELEX15	BIRS	CAC-40	CROBEX	DAX	FTSE 100	MBI10	MONEX20	NIKKEI 300	S&P 500	SASX-10	SBITOP
BELEX15	1	0.10235**	-0.000271	0.08721*	0.013522	-0.020437	0.09875**	0.23706**	-0.006702	0.018005	0.16230**	0.08376*
BIRS		1	0.07791*	0.17937**	0.069976	0.08100*	0.07912*	0.17896**	0.21489**	-0.023489	0.14994**	0.26949**
CAC-40			1	0.51035**	0.90972**	0.91300**	0.2229**	0.005450	0.32157**	0.57836**	0.08300*	0.28270**
CROBEX				1	0.52761**	0.52052**	0.30709**	0.17750**	0.33218**	0.37005**	0.18847**	0.33203**
DAX					1	0.87932**	0.21079**	0.06957*	0.29701**	0.62766**	0.07942*	0.25285**
FTSE 100						1	0.23669**	0.09066**	0.33416**	0.55740**	0.07098*	0.28582**
MBI10							1	0.07138*	0.18398**	0.16029**	0.09060**	0.19771**
MONEX20								1	0.12861**	0.051214	0.13854**	0.19316**
NIKKEI 300									1	0.005947	0.16625**	0.40071**
S&P 500										1	0.08031*	0.055515
SASX-10											1	0.19083**
SBITOP												1

Note: ** Correlation is significant for the level of 1% (two tailed test)

* Correlation is significant for the level of 5% (two tailed test)

Source: Authors based on the data available on the official websites of the selected stock market indices

Comparative analysis of the given correlation matrices related to the period before and after the escalation of the financial crisis shows that the number of statistically significant correlation coefficients after the escalation of the global financial crisis significantly increased. The analysis of correlation coefficient of the frontier capital market indices compared to benchmark indices of the developed capital market also increased the number of significant correlation coefficient, with the exception of the BELEX15 index, which does not have statistically significant correlations with the developed capital market indices in the period after the escalation of the financial crisis. When observing exposure and values of these significant correlations and comparing the two observed period segments, one can see that correlation coefficients are mainly more expressed in the period after the escalation of the financial crisis. However, in both observed periods, when it comes to the stock market indices of frontier capital markets, there is a poorly expressed correlation.

In order to further analyze the interdependence of the selected frontier capital markets, the Granger causality test was made. The null hypothesis was tested that *x* "Granger does not cause" *y*. In case the null hypothesis is rejected (if $p<\alpha$, with the significance level of 5%), the alternative hypothesis is that the *x* variable "Granger-causes" the *y* variable (Granger, 1969). Complete detailed results of the Granger causality test are given in Table 4.5.

Table 4.5. Overview of the Granger-caused correlations between the stock market indices

Indices	*BEFORE THE ESCALATION OF THE CRISIS*	*AFTER THE ESCALATION OF THE CRISIS*
SASX-10	BELEX15 and SASX-10 (interdependence), BIRS and SASX-10 (interdependence), CAC-40 "Granger-causes" SASX-10, CROBEX and SASX-10 (interdependence), DAX and SASX-10 (interdependence), FTSE 100 "Granger-causes" SASX-10, MBI10 and SASX-10 (interdependence), S&P 500 "Granger-causes" SASX-10, SBI TOP and SASX-10 (interdependence)	BELEX15 and SASX-10 (interdependence), BIRS "Granger causes" SASX-10, CAC-40 and SASX-10 (interdependence), CROBEX and SASX-10 (interdependence), DAX and SASX-10 (interdependence), FTSE 100 and SASX-10 (interdependence), MBI10 "Granger-causes" SASX-10, NIKKEI 300 and SASX-10 (interdependence), S&P 500 and SASX-10 (interdependence), SBI TOP and SASX-10 (interdependence)
BIRS	MBI10 and BIRS (interdependence), MONEX20 and BIRS (interdependence), NIKKEI 300 "Granger-causes" BIRS, SASX-10 and BIRS (interdependence)	BELEX15 and BIRS (interdependence), CAC-40 "Granger causes" BIRS, CROBEX and BIRS (interdependence), DAX and BIRS (interdependence), FTSE 100 and BIRS interdependence), MBI10 "Granger-causes" BIRS, MONEX20 "Granger-causes" BIRS, NIKKEI 300 and BIRS (interdependence), S&P 500 and BIRS (interdependence), SBI TOP "Granger-causes" BIRS
CROBEX	BIRS "Granger-causes" CROBEX, MBI10 "Granger-causes" CROBEX, S&P 500 and CROBEX (interdependence), SASX-10 and CROBEX (interdependence)	BIRS and CROBEX (interdependence), MBI10 and CROBEX (interdependence), NIKKEI 300 and CROBEX (interdependence), S&P 500 and CROBEX (interdependence), SASX-10 and CROBEX (interdependence), SBI TOP and CROBEX (interdependence)
BELEX15	BIRS "Granger-causes" BELEX15, CAC-40 "Granger causes" BELEX15, CROBEX "Granger-causes" BELEX15, FTSE 100 "Granger-causes" BELEX15, MBI 10 "Granger-causes" BELEX15, MONEX20 "Granger-causes" BELEX15, SASX-10 and BELEX15 (interdependence), SBI TOP "Granger-causes" BELEX15	BIRS and BELEX15 (interdependence), CAC-40 "Granger-causes" BELEX15, CROBEX "Granger-causes" BELEX15, DAX and BELEX15 (interdependence), FTSE 100 "Granger-causes" BELEX15, MBI 10 "Granger-causes" BELEX15, MONEX20 "Granger-causes" BELEX15, NIKKEI 300 "Granger-causes" BELEX15, S&P 500 and BELEX15 (interdependence), SASX-10 and BELEX15 (interdependence), SBI TOP "Granger-causes" BELEX15
MONEX20	BIRS and MONEX20 (interdependence), CAC-40 "Granger-causes" MONEX20, CROBEX "Granger-causes" MONEX20, MBI10 "Granger-causes" MONEX20, S&P 500 "Granger-causes" MONEX20, SBI TOP "Granger-causes" MONEX20	CROBEX "Granger-causes" MONEX20, NIKKEI 300 "Granger-causes" MONEX20
SBI TOP	CAC-40 "Granger-causes" SBI TOP, CROBEX "Granger-causes" SBI TOP, DAX "Granger-causes" SBI TOP, FTSE 100 "Granger-causes" SBI TOP, MBI10 "Granger-causes" SBI TOP, NIKKEI 300 "Granger-causes" SBI TOP, S&P 500 "Granger-causes" SBI TOP, SASX-10 and SBI TOP (interdependence)	CAC-40 "Granger-causes" SBI TOP, CROBEX and SBI TOP (interdependence), DAX and SBI TOP (interdependence), FTSE 100 "Granger-causes" SBI TOP, MBI10 "Granger-causes" SBI TOP, NIKKEI 300 "Granger-causes" SBI TOP, S&P 500 "Granger-causes" SBI TOP, SASX-10 and SBI TOP (interdependence)
MBI10	BIRS and MBI10 (interdependence), SASX-10 and MBI10 (interdependence)	CAC-40 "Granger causes" MBI10, CROBEX and MBI 10 (interdependence), DAX "Granger-causes" MBI10, S&P 500 "Granger-causes" MBI10
CAC-40	MBI10 "Granger-causes" CAC-40, S&P 500 and CAC-40 (interdependence)	CROBEX "Granger-causes" CAC-40, DAX "Granger-causes" CAC-40, NIKKEI 300 and CAC-40 (interdependence), S&P 500 and CAC-40 (interdependence), SASX-10 and CAC-40 (interdependence)

S&P 500	BIRS "Granger-causes" S&P 500, CAC-40 and S&P 500 (interdependence), CROBEX and S&P 500 (interdependence), DAX and S&P 500 (interdependence), FTSE 100 and S&P 500 (interdependence)	BELEX15 and S&P 500 (interdependence), BIRS and S&P 500 (interdependence), CAC-40 and S&P 500 (interdependence), CROBEX and S&P 500 (interdependence), DAX and S&P 500 (interdependence), FTSE 100 and S&P 500 (interdependence), NIKKEI 300 and S&P 500 (interdependence), SASX-10 and S&P 500 (interdependence)
DAX	BIRS "Granger-causes" DAX, FTSE 100 "Granger-causes" DAX, MBI10 "Granger causes" DAX, S&P 500 and DAX (interdependence), SASX-10 and DAX (interdependence)	BELEX15 and DAX (interdependence), BIRS and DAX (interdependence), CROBEX "Granger causes" DAX, FTSE 100 and DAX (interdependence), NIKKEI 300 and DAX (interdependence), S&P 500 "Granger-causes" DAX, SASX-10 and DAX (interdependence), SBI TOPI and DAX (interdependence)
NIKKEI 300	CAC-40 "Granger-causes" NIKKEI 300, DAX "Granger-causes" NIKKEI 300, FTSE 100 "Granger causes" NIKKEI 300, S&P 500 "Granger-causes" NIKKEI 300	BIRS and NIKKEI 300 (interdependence), CAC-40 and NIKKEI 300 (interdependence), CROBEX and NIKKEI 300 (interdependence), DAX and NIKKEI 300 (interdependence), FTSE 100 and NIKKEI 300 (interdependence), MBI10 "Granger-causes" NIKKEI 300, S&P 500 and NIKKEI 300 (interdependence), SASX-10 and NIKKEI 300 (interdependence)
FTSE 100	MBI10 "Granger-causes" FTSE 100, S&P 500 and FTSE 100 (interdependence)	BIRS and FTSE 100 (interdependence), CROBEX "Granger-causes" FTSE 100, DAX and FTSE 100 (interdependence), NIKKEI 300 and FTSE 100 (interdependence), S&P 500 and FTSE 100 (interdependence), SASX-10 and FTSE 100 (interdependence)

Source: Authors based on the data available on the official websites of the selected stock market indices

Based on the comparison of the results for the two segment periods, it is evident that the period after the escalation of the financial crisis increased the number of "Granger-caused" correlations for most of the selected stock market indices. This is particularly interesting and important from the aspect of potential effects of international portfolio diversification in the period after the escalation of the financial crisis or other exogenous shocks on the capital market. In this period, the SASX-10 index is, in terms of Granger, most prominently under the influence of other frontier capital market indices. This index is "Granger-caused" by BIRS, CROBEX, MBI10, and SBI TOP indices. Apart from the SASX-10 index, strongly affected by the indices on other frontier capital markets are the BIRS index ("Granger-caused" by BELEX15, CROBEX, MBI10, MONEX20, and SBI TOP) and the BELEX15 index ("Granger-caused" by BIRS, CROBEX, MBI10, MONEX20, and SBI TOP).

In the period after the escalation of the financial crisis, we registered increased influence of the indices of the developed capital markets on the indices of the frontier capital market. This is evident from the presented results which show that SASX-10, BIRS, BELEX15, and SBI TOP are "Granger-caused" by all the developed capital market indices. In line with the previously stated facts, in the period during the financial crisis the observed developed capital markets also saw the increased number of mutual "Granger-causes".

4.2. Tests of Low Efficiency of the Capital Markets in the Western Balkan Countries

In this paper we use autocorrelation and autoregressive model AR(p) for testing low EMH for the selected frontier capital markets.

The results referring to the period before the escalation of the global financial crisis (Table 4.6) show the values of autocorrelation test or Q statistics, which indicate the rejection of the null hypothesis (stating that autocorrelation equals zero) for all the selected stock market indices on frontier capital markets for the given 5% significance level and for all lags as well as the acceptance of the alternative hypothesis about the existence of autocorrelations significantly different from zero. The rejection of the null hypothesis also means the rejection of the random walk hypothesis and implies the rejection of low efficiency. Looking at the results of autocorrelation for the selected developed capital markets, one can see that in the period before the escalation of the financial crisis almost all stock market indices have the correlation significantly different from zero, with a 5% significance level. For CAC-40, S&P 500, and FTSE 100, autocorrelation is significantly different from zero for all five lags. The only exception is the NIKKEI 300 index for which the null hypothesis is confirmed for all five lags, meaning that the correlation values are not significantly different from zero.

Table 4.6. Results of autocorrelation test for the period before the escalation of the financial crisis

Indices	Lag									
	1		2		3		4		5	
	Q-Stat	p	Q-Stat	p	Q-Stat	p	Q-Stat	p	Q-Stat	p
SASX-10	110.89	0.000	111.36	0.000	113.27	0.000	113.77	0.000	114.39	0.000
BIRS	134.97	0.000	157.69	0.000	158.48	0.000	106.34	0.000	167.65	0.000
CROBEX	14.117	0.004	16.794	0.000	20.633	0.000	21.721	0.000	32.577	0.000
BELEX15	96.703	0.000	115.74	0.000	115.97	0.000	115.97	0.000	117.61	0.000
MONEX20	97.313	0.000	98.193	0.000	99.366	0.000	101.26	0.000	106.85	0.000
SBITOP	64.111	0.020	66.974	0.000	70.933	0.000	71.054	0.000	71.065	0.000
MBI10	163.22	0.000	16.06	0.000	171.15	0.000	172.26	0.000	172.26	0.000
CAC-40	20.009	0.657	20.902	0.000	21.277	0.000	21.288	0.000	21.371	0.001
S&P500	16.607	0.000	19.206	0.000	21.759	0.000	21.819	0.000	22.472	0.000
DAX	6.1011	0.014	9.4407	0.009	9.672	0.022	9.717	0.045	10.041	0.074
NIKKEI300	0.4161	0.519	0.7949	0.672	1.0693	0.785	1.6955	0.792	1.9726	0.853
FTSE100	17.931	0.000	17.959	0.000	19.689	0.000	19.697	0.001	20.247	0.001

Source: Authors based on the data available on the official websites of the selected stock market indices

In terms of the autocorrelation test values for the stock market indices on the frontier capital markets for the period after the escalation of the global financial crisis (Table 4.7), it can be concluded that autocorrelation is significantly different from zero for all the indices, which means the rejection of the null hypothesis. In the case of the BIRS index autocorrelation is significantly different from zero only for the second lag (*t-2*) while for the remaining indices this is the case for all five lags.

The results for the period after the escalation of the financial crisis on the selected developed capital markets indicate the rejection of the null hypothesis for all stock market indices, with the autocorrelation value for the indices CAC-40, DAX, NIKKEI 300, and FTSE 100 being significantly different from zero, starting from the first lag (*t-2*).

It was previously concluded that the testing of low efficiency of the selected capital markets includes autocorrelation and the autoregressive model AR(p). As stated, the autoregressive model AR(p) examines the existence of the statistically significant correlation (different from zero) between the value of the process and the value

Table 4.7. Results of autocorrelation test for the period after the escalation of the financial crisis

Indices	Lag									
	1		2		3		4		5	
	Q-Stat	p	Q-Stat	p	Q-Stat	p	Q-Stat	p	Q-Stat	p
SASX-10	98.310	0.000	101.22	0.000	101.59	0.000	104.57	0.000	109.52	0.000
BIRS	3.7171	0.054	8.1506	0.017	8.4208	0.038	9.0973	0.059	10.726	0.057
CROBEX	8.4546	0.004	22.246	0.000	31.035	0.000	33.318	0.000	33.629	0.000
BELEX15	80.352	0.000	96.101	0.000	96.617	0.000	98.908	0.000	99.347	0.000
MONEX20	48.417	0.000	49.072	0.088	50.48	0.000	55.249	0.000	55.821	0.000
SBITOP	5.4068	0.020	6.0863	0.048	6.1377	0.105	7.3911	0.117	9.6279	0.086
MBI10	112.33	0.000	112.33	0.000	113.6	0.000	114.68	0.000	114.77	0.000
CAC-40	0.197	0.657	8.0166	0.018	14.612	0.002	16.457	0.002	19.299	0.002
S&P500	12.512	0.000	19.886	0.000	20.488	0.000	20.500	0.000	26.965	0.000
DAX	0.9561	0.328	9.6982	0.008	13.793	0.003	15.238	0.004	17.114	0.004
NIKKEI300	0.0372	0.847	10.322	0.006	12.227	0.007	12.402	0.015	12.504	0.028
FTSE100	0.0023	0.961	10.727	0.005	16.833	0.001	25.303	0.000	30.522	0.000

Source: Authors based on the data available on the official websites of the selected stock market indices

of the same variable with time lag. It needs to be mentioned that the aim of this paper was not to formulate the model which would best describe the fluctuation of returns of the selected stock market indices. The AR(p) model is used for examining the opportunities to achieve above average returns based on the information on historical daily returns. The models observed were AR(1), AR(2), AR(3), AR(4), and AR(5). The AR(p) indicators for the period before the escalation of the financial crisis are given in the appendices (Appendix 3). In the period before the escalation of the financial crisis, when only frontier capital markets in the sample are observed, statistically significant autoregression coefficients were identified for all the selected stock market indices and all AR models. The significance level taken into consideration was 5%. If the *p* value is lower than α, the null hypothesis stating that there are no significant autoregression coefficients, meaning that their value is zero, is rejected for the given significance level.

In terms of stock market indices for developed capital markets, statistically significant autoregression coefficients were identified for the indices CAC-40, S&P 500, DAX, and FTSE 100. On the other hand, significant autoregression coefficients were not identified for the NIKKEI 300 index, which is why the null hypothesis cannot be rejected.

The results of the AR(p) model for the frontier capital markets in the period after the escalation of the financial crisis (Appendix 4) show statistically significant autoregression coefficients (for the 5% significance level) for the indices SASX-10, CROBEX, BELEX15, MONEX20, SBI TOP, and MBI10 and the models AR(1), AR(2), AR(3), AR(4), and AR(5). It is interesting that no statistically significant autoregression coefficients were identified for the BIRS index for the given significance level and the null hypothesis is not rejected. However, if the 10% significance level is taken, then statistically significant autoregression coefficients are identified for the BIRS index as well.

Unlike the previously analyzed period before the escalation of the global financial crisis, the results of AR(p) model for the indices on developed capital markets after the escalation of the financial crisis indicate the existence of statistically significant autoregression coefficients for all the observed indices. For the indices CAC-40, DAX, NIKKEI 300, and FTSE 100, significant coefficients were estimated for the models AR(2), AR(3), AR(4), AR(5), starting from the second lag (*t-2*), while for the S&P 500 index, the significant autoregression coefficient was estimated for the AR(1) model.

5. CONCLUSION

The shaping of investment strategy on frontier capital markets is affected by a series of variables. In this paper we focused on the influence of interdependence and low efficiency of frontier capital markets as well as on the influence of the financial crisis on these parameters.

In order to test the interdependence and correlation between the selected capital markets, we used the Granger causality test, while the level of correlation was determined by the appropriate correlation coefficient. The obtained results show the interdependence among the selected frontier capital markets of the Western Balkans although the registered correlation is extremely low. A comparative analysis of the obtained results of the appropriate tests and models in the period before and after the escalation of the financial crisis shows that the period after the escalation of the financial crisis mainly saw the increase in interdependence among the observed capital markets. This is indeed true for the mutual relationship of the capital markets of the Western Balkans as well as in comparison to the selected developed capital markets. This phenomenon of capital market correlation during the crisis being higher than expected is called the "contagion effect". This actually means that in the period of crisis, potential benefits of international diversification based on investment on the observed frontier capital markets are reduced, which is an important input for investors who want to invest in selected capital markets.

The results of testing low efficiency indicate that the frontier capital markets of the Western Balkans cannot confirm low EMH. This is clearly indicated by the results of autocorrelation and autoregressive AR(p) model, which showed statistically significant coefficients of autocorrelation and autoregression. It can

be concluded that the period before the crisis is characterized by the expected results. This means that capital markets of the Western Balkans are inefficient while Japanese and German capital markets have low efficiency. The obtained results indicate that after the escalation of the financial crisis all the selected developed capital markets are inefficient, while in the case of frontier capital markets it was revealed that low EMH cannot be rejected for the BIRS index. This can be explained by the fact that the results of testing low efficiency of frontier capital markets are often contradictory, which is conditioned by the characteristics of these markets such as: low market capitalization, asynchronous trading, low liquidity, and short history of trading. These characteristics of frontier capital markets along with the influence of an exogenous shock, such as the financial crisis, explain for the obtained results. The results of the low efficiency test show that, with the condition *ceteris paribus*, investors in the marginal capital markets of the Western Balkans can implement an active investment strategy. By using the methods of technical and fundamental analysis it is possible to identify underestimated or overvalued shares and achieve above-average returns.

REFERENCES

1. Bećirović, D., Kozarević, E. & Balić, A. (2017) The Effects of the Financial Crisis on the Securities Markets of Bosnia and Herzegovina: Institutional Investors' Perspective. *5th International Scientific Conference "Economy of Integration" – "The Role of Economic Thought in Modern Environment"*, Tuzla, December 7-9. In: Kozarević, E. & Okičić, J. (*Eds.*), Proceedings, Tuzla: Ekonomski fakultet.
2. Brzaković, T. (2005) Proces investiranja i investicione strategije na tržištu kapitala. *Bankarstvo*. 9/10, pp. 30-38.
3. Dimitriou, D. & Kenourgios, D. (2012) Opportunities for international portfolio diversification in the Balkans' markets. *International Journal of Economics and Research.* 1(3), pp. 1-12.
4. Čondić-Jurkić, I. & Dadić, T. (2008) Investicijski fondovi na hrvatskom tržištu kapitala: Strategije trgovanja i kretanje tržišta. *Zbornik Ekonomskog fakulteta u Zagrebu*. 6, pp. 61-77.
5. Fama, E. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *Journal of Finance.* 2, pp. 383-417.
6. Granger, C. (1969) Investigating Causal Relations by Econometric Models and Cross-spectral Methods, *Econometrica.* 37(3), pp. 424-438.
7. Horvath, R. & Petrovski, D. (2012) International Stock Market Integration: Central and South Eastern Europe Compared. William Davidson Institute, Working Paper 1028.
8. Kunovac, D. (2011). Asymmetric correlation on the Croatian equity market. *Financial Theory and Practice*. 35(1), pp. 1-24.
9. Latković, M. & Barac, Z. (1999) Optimizacija dioničkih portfelja na rubnim tržištima kapitala. [Online]. Available at http://www.phy.pmf.unizg.hr/~laci/art/portfolio.pdf [Accessed: October 20, 2017]
10. Nikkinen, J., Piljak, V. & Rothovius, T. (2008) Financial Integration of the European Frontier Emerging Markets. [Online]. Available at http://economics.soc.uoc.gr/macro/docs/Year/2011/papers/paper_3_124.pdf [Accessed: November 27, 2017]
11. Okičić, J. (2011) Ispitivanje uticaja egzogenog šoka na integrisanost tržišta kapitala zemalja Zapadnog Balkana. Z*bornik radova sa Druge međunarodne naučne konferencije Ekonomija integracija.* pp. 517-528.
12. Solnik, B. (1974) Why not diversify international rather than domestically? *Financial Analysts Journal.* 30(4), pp. 48-54.
13. Tomić, B., Sesar, A. & Džaja, T. (2014) Komparativna analiza europskog tržišta kapitala i Dow Jones Industrial Average indeksa. *Accounting and Management 15th International Scientific and Professional Conference.* pp. 265-283.
14. Vizek, M. & Dadić, T. (2006) Integration of Croatian, CEE and EU Equity Markets: Cointegration Approach. *Ekonomski pregled.* 57(9-10), pp. 631-646.
15. Zahirović, S. & Okičić, J. (2016) Effects of risk aversion on securities portfolio performance in underdeveloped capital markets: the case of the capital market of Bosnia and Herzegovina. *Economic research - Ekonomska istraživanja.* 29(1), pp. 343-359.

16. Zahirović, S., Rovčanin, A. & Okičić, J. (2009) Beta Coefficient Analysis on the Capital Market of Bosnia and Herzegovina. *Economic research - Ekonomska istraživanja.* 22(4), pp. 30-39.

17. Zaimović, A., Arnaut Berilo, A. & Mustafić, A. (2017) Portfolio Diversification in the South-East European Equity Markets. *The South East European Journal of Economics and Business.* 12(1), pp. 99-108.

APPENDICES

Appendix 1. ADF test for the period before the escalation of the crisis

Indices	ADF t-value	Test critical value (1%)	Test critical value (5%)	Test critical value (10%)
SASX-10	-17.67618	-3.970553	-3.415926	-3.130233
BIRS	-9.968557	-3.970867	-3.416079	-3.130324
CROBEX	-9.618202	-3.970435	-3.415868	-3.130199
BELEX15	-4.122827	-3.970485	-3.415893	-3.130213
MONEX20	-7.431161	-3.970656	-3.415976	-3.130262
SBITOP	-19.2716	-3.970451	-3.415876	-3.130203
MBI10	-16.56719	-3.970519	-3.415909	-3.130223
CAC-40	-32.75149	-3.970031	-3.415686	-3.130091
S&P500	-4.657324	-3.970485	-3.415893	-3.130213
DAX	-19.29319	-3.969815	-3.415565	-3.130019
NIKKEI300	-28.48784	-3.970046	-3.415678	-3.130086
FTSE100	-32.27816	-3.970189	-3.415748	-3.130127

Appendix 2. ADF test for the period after the escalation of the crisis

Indices	ADF t-value	Test critical value (1%)	Test critical value (5%)	Test critical value (10%)
SASX-10	-9.055668	-3.967224	-3.414300	-3.12927
BIRS	-5.520171	-3.976554	-3.418852	-3.131965
CROBEX	-6.195266	-3.967317	-3.414345	-3.129297
BELEX15	-5.835647	-3.966991	-3.414186	-3.129202
MONEX20	-7.109179	-3.967393	-3.414382	-3.129319
SBITOP	-13.69452	-3.96716	-3.414269	-3.129251
MBI10	-15.87511	-3.967355	-3.414364	-3.129308
CAC-40	-16.08487	-3.966931	-3.414157	-3.129185
S&P500	-10.46542	-3.967178	-3.414278	-3.129257
DAX	-15.58386	-3.966939	-3.414161	-3.129187
NIKKEI300	-32.5007	-3.967071	-3-414225	-3.129225
FTSE100	-15.70298	-3.967088	-3.414234	-3.12923

Appendix 3. Autoregressive model AR(p) (period before the escalation of the crisis)

Model		SASX-10		BIRS		CROBEX		BELEX15		MONEX20		SBITOP	
Parameter		p value	Parameter	p value	Parameter	p value	Parameter	p value	Parameter	p value	Parameter	p value	
AR(1)	r_{t-1}	0.3884	0.0000	0.4322	0.0000	0.1397	0.0001	0.3819	0.0000	0.3676	0.0000	0.2850	0.0000
AR(2)	r_{t-1}	0.4457	0.0000	0.4371	0.0000	0.1342	0.0002	0.3649	0.0000	0.4083	0.0000	0.3444	0.0000
	r_{t-2}	-0.1476	0.0000	-0.0114	0.7599	0.0478	0.2019	0.0516	0.1736	-0.1117	0.0024	-0.1607	0.0000
AR(3)	r_{t-1}	0.4449	0.0000	0.4366	0.0000	0.1312	0.0003	0.3709	0.0000	0.4068	0.0000	0.3438	0.0000
	r_{t-2}	-0.1453	0.0003	0.0098	0.8085	0.0408	0.2793	0.0861	0.0298	-0.1065	0.0075	-0.1595	0.0000
	r_{t-3}	-0.0050	0.8907	0.0487	0.1916	0.0633	0.0916	-0.1095	0.0039	-0.0127	0.7319	-0.0035	0.9234
AR(4)	r_{t-1}	0.4449	0.0000	0.4401	0.0000	0.1300	0.0004	0.3747	0.0000	0.4074	0.0000	0.3439	0.0000
	r_{t-2}	-0.1449	0.0003	0.0091	0.8222	0.0400	0.2882	0.0828	0.0374	-0.0969	0.0152	-0.1542	0.0000
	r_{t-3}	-0.0062	0.8786	-0.0791	0.0517	0.0607	0.1077	-0.1212	0.0023	-0.0484	0.2254	-0.0145	0.7097
	r_{t-4}	0.0025	0.9453	0.0697	0.0618	0.0232	0.5371	0.0366	0.3362	0.088	0.0177	0.0334	0.3686
AR(5)	r_{t-1}	0.4448	0.0000	0.4348	0.0000	0.1266	0.0005	0.3725	0.0000	0.4040	0.0000	0.3451	0.0000
	r_{t-2}	-0.1447	0.0002	0.0154	0.7039	0.0325	0.3874	0.0912	0.0225	-0.0952	0.0172	-0.1546	0.0000
	r_{t-3}	-0.0005	0.9865	-0.0799	0.0488	0.0575	0.1256	-0.1275	0.0014	-0.0443	0.2692	-0.0196	0.1694
	r_{t-4}	-0.1470	0.7072	0.0355	0.3815	0.0102	0.7851	0.0135	0.7344	0.0715	0.0742	0.0443	0.2576
	r_{t-5}	0.0388	0.2929	0.0780	0.0369	0.1157	0.0021	0.0712	0.0613	0.0405	0.2763	-0.0331	0.3734
Parameter		MBI10		CAC-40		DAX		S&P 500		NIKKEI 300		FTSE 100	
		p value	Parameter	p value	Parameter	p value	Parameter	p value	Parameter	p value	Parameter	p value	
AR(1)	r_{t-1}	0.4867	0.0000	-0.1605	0.0000	-0.0880	0.0136	-0.1527	0.0000	-0.0224	0.5340	-0.1529	0.0000
AR(2)	r_{t-1}	0.5783	0.0000	-0.1590	0.0000	-0.0822	0.0216	-0.1689	0.0000	0.0231	0.5226	-0.1556	0.0000
	r_{t-2}	-0.1915	0.0000	0.0100	0.7887	0.0603	0.1004	-0.0916	0.0145	-0.0225	0.5354	-0.0182	0.6263
AR(3)	r_{t-1}	0.5728	0.0000	-0.1588	0.0000	-0.0818	0.0226	-0.1654	0.0000	-0.0236	0.5134	-0.1565	0.0000
	r_{t-2}	-0.1751	0.0000	0.0076	0.8399	0.0596	0.1048	-0.0847	0.0268	-0.0233	0.5220	-0.0260	0.4921
	r_{t-3}	-0.0289	0.4418	-0.0167	0.6565	-0.0071	0.8456	0.0339	0.3681	-0.0202	0.5806	-0.0533	0.1550
AR(4)	r_{t-1}	0.5742	0.0000	-0.1590	0.0000	-0.0818	0.0227	-0.1654	0.0000	-0.0230	0.5251	-0.1571	0.0000
	r_{t-2}	-0.1682	0.0000	0.0075	0.8413	0.0596	0.1061	-0.0852	0.0271	-0.0224	0.5391	-0.0264	0.0000
	r_{t-3}	-0.0515	0.2321	-0.0181	0.6330	-0.0069	0.8500	0.0329	0.3936	-0.0190	0.6035	-0.0551	0.1463
	r_{t-4}	0.0402	0.2848	-0.0100	0.7887	0.0026	0.9428	-0.0045	0.9049	0.0275	0.4520	-0.0121	0.7460
AR(5)	r_{t-1}	0.5743	0.0000	-0.1589	0.0000	-0.0818	0.0227	-0.1648	0.0000	-0.0225	0.5346	-0.1568	0.0000
	r_{t-2}	-0.1684	0.0000	0.0077	0.8380	0.0600	0.1041	-0.0848	0.0280	-0.0227	0.5331	-0.0251	0.5077
	r_{t-3}	-0.0521	0.2316	-0.0180	0.6342	-0.0081	0.8259	0.0378	0.3314	-0.0195	0.5932	-0.0541	0.1541
	r_{t-4}	0.0423	0.3268	-0.0086	0.8197	0.0044	0.9039	0.0035	0.9269	0.0268	0.4648	-0.0083	0.8263
	r_{t-5}	-0.0036	0.9215	0.0101	0.7875	0.0244	0.5076	0.0363	0.3418	-0.0180	0.6236	0.0266	0.4785

Appendix 4. Autoregressive model AR(p) (period after the escalation of the crisis)

Model		SASX-10		BIRS		CROBEX		BELEX15		MONEX20		SBITOP	
Parameter		p value	Parameter	p value	Parameter	p value	Parameter	p value	Parameter	p value	Parameter	p value	
AR(1)	r_{t-1}	0.3123	0.0000	0.0849	0.0546	0.0916	0.0034	0.2775	0.0000	0.2198	0.0000	0.0759	0.0155
AR(2)	r_{t-1}	0.3269	0.0000	0.0776	0.0791	0.1031	0.0009	0.2635	0.0000	0.2249	0.0000	0.0780	0.0131
	r_{t-2}	-0.0466	0.1380	0.0861	0.0516	-0.1254	0.0000	0.0503	0.1039	-0.0234	0.4586	-0.0281	0.3702
AR(3)	r_{t-1}	0.3258	0.0000	0.0769	0.0834	0.1181	0.0001	0.2648	0.0000	0.2258	0.0000	x	x
	r_{t-2}	-0.0391	0.2359	0.0854	0.0544	-0.1377	0.0000	0.0570	0.0749	-0.0322	0.3205	x	x
	r_{t-3}	-0.0227	0.4705	0.0085	0.8479	0.1197	0.0001	-0.0253	0.4134	-0.0389	0.2183	x	x
AR(4)	r_{t-1}	0.3249	0.0000	0.0767	0.0845	0.1168	0.0002	0.2659	0.0000	0.2237	0.0000	0.0780	0.0132
	r_{t-2}	-0.0408	0.2173	0.0832	0.0621	-0.1363	0.0000	0.0544	0.0895	-0.0304	0.3479	-0.0292	0.3571
	r_{t-3}	-0.0093	0.7778	0.0065	0.8840	0.1184	0.0001	-0.0373	0.2441	0.0263	0.4157	0.0023	0.9406
	r_{t-4}	-0.0411	0.1915	0.0261	0.5561	0.0103	0.7413	0.0452	0.1442	0.0556	0.0784	-0.0321	0.3078
AR(5)	r_{t-1}	0.3232	0.0000	0.0754	0.0899	0.1164	0.0002	0.2659	0.0000	0.2239	0.0000	0.0798	0.0112
	r_{t-2}	-0.0412	0.2127	0.0829	0.0631	-0.1410	0.0000	0.0544	0.0896	-0.0303	0.3496	-0.0292	0.3540
	r_{t-3}	-0.0110	0.7385	0.0023	0.9577	0.1238	0.0001	-0.0373	0.2444	0.0262	0.4178	0.0039	0.8993
	r_{t-4}	-0.0274	0.4060	0.0223	0.6159	0.0057	0.8552	0.0452	0.1461	0.0563	0.0822	-0.0364	0.2485
	r_{t-5}	-0.0419	0.1825	0.0493	0.2670	0.0394	0.2107	-0.0000	0.9965	-0.0030	0.9220	0.0557	0.0767

Parameter		MBI10		CAC-40		DAX		S&P 500		NIKKEI 300		FTSE 100	
		p value	*Parameter*	*p value*	*Parameter*	*p value*	*Parameter*	*p value*	*Parameter*	*p value*	*Parameter*	*p value*	
AR(1)	r_{t-1}	0.3378	0.0000	-0.0137	0.6580	0.0305	0.3243	-0.1100	0.0004	-0.0058	0.8526	0.0017	0.9539
AR(2)	r_{t-1}	0.3793	0.0000	-0.0149	0.6297	0.0334	0.2801	-0.1207	0.0001	-0.0063	0.8381	0.0019	0.9495
	r_{t-2}	-0.1229	0.0001	-0.0867	0.0051	-0.0921	0.0029	-0.0974	0.0018	-0.1000	0.0013	-0.1018	0.0011
AR(3)	r_{t-1}	0.3903	0.0000	-0.0221	0.4753	0.0281	0.3639	-0.1203	0.0001	-0.0108	0.7296	-0.0058	0.8506
	r_{t-2}	-0.1568	0.0000	-0.0879	0.0044	-0.0902	0.0035	-0.0970	0.0020	-0.1000	0.0013	-0.1017	0.0010
	r_{t-3}	0.0892	0.0049	-0.0826	0.0077	-0.0568	0.0671	0.0039	0.8991	-0.0446	0.1545	-0.0771	0.0137
AR(4)	r_{t-1}	0.3912	0.0000	-0.0194	0.5309	0.0300	0.3334	-0.1203	0.0001	-0.0107	0.7327	0.0004	0.9910
	r_{t-2}	-0.1584	0.0000	-0.0850	0.0060	-0.0872	0.0050	-0.0977	0.0020	-0.1000	0.0014	-0.0933	0.0027
	r_{t-3}	0.0931	0.0063	-0.0819	0.0082	-0.0578	0.0629	0.0030	0.9232	-0.0446	0.1550	-0.0766	0.0142
	r_{t-4}	-0.0100	0.7521	0.0319	0.3036	0.0332	0.2853	-0.0078	0.8017	0.0024	0.9375	0.0817	0.0091
AR(5)	r_{t-1}	0.3913	0.0000	-0.0173	0.5755	0.0319	0.3043	-0.1209	0.0001	-0.0106	0.7340	0.0076	0.8073
	r_{t-2}	-0.1591	0.0000	-0.0904	0.0036	-0.0904	0.0036	-0.0975	0.0020	-0.1009	0.0013	-0.1001	0.0013
	r_{t-3}	0.0945	0.0061	-0.0876	0.0048	-0.0627	0.0443	-0.0047	0.8800	-0.0464	0.1407	-0.0849	0.0065
	r_{t-4}	-0.0133	0.6962	0.0306	0.3227	0.0348	0.2618	-0.0174	0.5805	0.0022	0.9424	0.0817	0.0087
	r_{t-5}	0.0084	0.7910	-0.0658	0.0341	-0.0556	0.0734	-0.0791	0.0115	-0.0185	0.5544	-0.0881	0.0048