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Professional paper

## **SPEED OF FINANCIAL INTEGRATION BEFORE AND AFTER EUROPEAN UNION MEMBERSHIP**

*This paper investigates financial integration of developing equity markets of European Union members which are Romania, Bulgaria and Croatia with global dominant equity markets. The analysis is performed at the country level using daily (five days) and monthly national stock market indices for three different periods: period before EU membership, period after EU membership, and whole period starting from September 1997 to December 2012. Augmented Dickey-Fuller test statistic, Granger causality, Granger cointegration test and recursive cointegration methods are employed. Empirical results show that all indices are integrated of order one. The relationship is more significant in the period after European Union membership, but not significant in the period before European Union membership. For Croatia, US's S&P500 index has the strongest impact on CROBEX in whole period. The result implies that European Union membership has strong positive impact on the integration of developing European Union countries.*

*Keywords: Financial Integration, European Union, Equity Market, Unit Root Test, Granger Causality, Cointegration, Recursive Cointegration*

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## 1. Introduction

Integration of financial markets (with focus on stock markets) plays the key role and objective in the EU, because stock markets should first and foremost represent important instrument of declaring the real price or value of a market according to the successfulness of its business. This study focuses on financial integration between stock exchange markets in developed equity markets: U.S.A., Germany and England, and the three new EU member states: Romania Bulgaria, and Croatia.

This study aims to examine the cointegration of stock markets using the latest data to investigate which countries are the least integrated and hence provide with the most diversification opportunity. Because of important implications for investors, the study of cointegration of stock markets is essential. Cointegration is defined as a situation where linear combinations of non-stationary time series are stationary. That implies the existence of a long-run equilibrium between the variables. We want to present the cointegration of international stock markets of various countries between 1997 and 2012. The focus is on Croatian stock exchange. To test and determine the degree of financial integration on stock markets, using their indices, we will divide data set of these markets in three categories:

1. SOFIX, FTSE, S&P 500, and DAX
2. CROBEX, FTSE, S&P 500 and DAX
3. BET, FTSE, S&P 500 and DAX,

Using national stock exchange indices as a part of empirical analysis, we focus on two different periods: before membership of EU and after that period, and our purpose is to show that degree of integration of developing EU member states, Romania and Bulgaria, has increased in their process towards EU accession, and also consider a whole period of Croatia, as a recent EU member. Although Croatia recently joined EU, the main reason for choosing and focusing on Croatia is a fact of its so-called weak-form stock market efficiency (Kumar & Kamaiah, 2014). The Croatian stock market has existed for more than twenty years and has developed a solid infrastructure.

### *1.1. European integration*

Looking to the history facts, we can find that Western European countries have reached the highest degree of regional integration on the globe so far and that the purpose of European Union (EU) is to achieve stock market integration or

cooperation in securities issues. For understanding the context within which the EU moved toward stock market integration, it is necessary to show one necessary background, related European integration.

In trying to understand and assess the achievements of the EU in integrating its stock markets, attention should be paid to the institutional framework that has set its direction and pace. Controversy and conflict of interests between stock markets are commonplace and were also abundant in the negotiations on the European Investment Services Directive, for instance. It is the general framework of the EU that has kept Member States at the negotiations table for several years until some agreed version was reached. Absent such long-term commitment to an integrative institutional framework, it is doubtful whether any material agreement could have been reached within a comparable period of time. (Amir N. Licht, 1997)

Using a different literature related with stock market integration in Europe, we can find that number of equity markets was rising recently. When we compare the situation of European stock exchanges today and before ten or more years, it is clearly that these markets are different than it was just a little more than a decade ago. That means that the process of integration is an integral part of a broader process of economic and political integration which EU countries have been pursuing for almost 40 years. So, the argument is that stock market integration in the EU can only be understood in this context.

### *1.2. Impact of EU membership on the financial integration*

The most studies of cointegration have as a purpose to examine results over crisis, or some other important period, such as, for instance, affiliation in one of the three economic blocks namely Association of Southeast Asian Nations (ASEAN blocks), the European Union (EU), or the North Atlantic Free Trade Agreement (NAFTA).

The reason of this consideration is clear, because the countries of these blocks play a key role in the global economy. So, in our case EU membership has a huge impact on financial integration, with special emphasis on stock markets. Considering earlier results of the EU member states, with special emphasis on new EU members, we can find that the integration of these markets increased during the process of EU accession. Our results show differences between the period before and after EU membership, for Romania and Bulgaria. For Croatia, the relationship between CROBEX and developed stock market indices increases in last 5 years.

## 2. Literature review

The literature in this field and different consideration and author's opinion related with published studies on the topic is sufficiently vast. Indeed, we focus here on the most influential papers that have been written on the issue of equity market integration among the world's developed markets. Kearney and Lucey (2004) define, measure draw some implications of equity market integration among the developed markets have frequently served as the intellectual base for numerous studies of integration among the developing and emerging equity markets, and between these and the developed markets.

Some of studies cover many of the important developing and emerging market regions including Asia, Central Europe, and Latin America. In addition, these papers provide reviews of the relevant literature on integration among the developing and emerging markets with comprehensive reviews. Many of the previous studies have focused on only developed or developing countries, but this study takes into account some of the leading developed countries and developing countries, including Croatia.

### 2.1. *Financial integration among EU member states*

The term 'International stock market integration' represents a broad area of research in financial economics that encompasses many different aspects of the interrelationship across equity markets. We employ the term to focus on one aspect - the nature and extent of interdependence across the daily asset returns for a pair of national equity markets. If two markets demonstrate greater co-movement on the same day, or a stronger lead/lag relationship across days, we interpret this to represent greater integration between the two stock markets. (Kevin Bracker, Diane Scott Docking and Paul D. Koch, 1999.)

According to this title, we can find a lot of previous empirical studies and works, that are generally focused on identifying and explaining how the stock markets of different countries are related and why different pairs of national equity markets display differing degrees of comovement over time. That means that greater degree of comovement reflects greater stock market integration. Another important thing is that all authors in the process of comparing data of stock market co-movements used different source of information, so as methodology and different type of measures.

Numerous recent studies (e.g., Eun and Shim, 1989; Koch and Koch, 1991; Brocato, 1994; Leachman and Francis, 1995; Francis and Leachman, 1998; and

Bessler and Yang, 2003) have explored the long-term cointegration relations and/or short-term dynamic interactions among major international stock markets, which also involve some major European stock markets. Parallel to these studies on major international stock markets, there is also a growing literature with a focus on stock markets within Europe. Taylor and Tonks (1989) and Corhay, Rad and Urbain (1993) found much evidence for cointegration among several major European stock markets in the late 1970s and 1980s.

Dickinson (2000) argued that a cointegrating relationship among the major European stock markets exists after the 1987 stock crash and it may be partly driven by the long-run relationships of macroeconomic fundamentals among these countries.

Dickinson (2000) also observed that short-run international linkages among major European markets which do not appear in their long-run relationship increased greatly during that period. By contrast, Chan, Gup and Pan (1997) found little evidence for cointegration among several major European stock markets and among most European Economic Community member countries, particularly during the period after the 1987 crash. Gerrits and Yuce (1999) documented that the long-run relationship among major European markets has weakened during the period 1990–1994. Pynnonen and Knif (1998) and Knif and Pynnonen (1999) extended consideration to small European (developed) markets. Pynnonen and Knif (1998) reported little interaction between two Scandinavian stock markets, while Knif and Pynnonen (1999) found some positive evidence on the interdependence among small European markets. Thus, the existing findings are inconclusive and further analysis is warranted.

Second, the study of Jian Yang, Insik Min and Qi Li allows for inference on international market integration from three different perspectives: contemporaneous, the short-run and the long-run. Except Taylor and Tonks (1989), Brocato (1994) and Bessler and Yang (2003), the contemporaneous structure of international market integration based on return innovations has not been much analyzed in previous studies employing time series analysis, though Mahmoud and Malek (1993) reported that stock market responses within Europe may be predominantly contemporaneous. The existence of strong contemporaneous correlations further motivates our modeling the short-run dynamic linkage with the generalized impulse response analysis/forecast error variance decomposition originally developed by Koop, Pesaran and Potter (1996) and Pesaran and Shin (1998). This approach is invariant to the ordering of the variables when conducting vector autoregression (VAR) innovation accounting analysis, while the widely used Choleski factorization is known to be sensitive to the ordering of the variables. Recently, generalized VAR analysis has been argued to give a more realistic description of stock market linkages (Dekker, Sen and Young, 2001; and Yang, Kolari and Min, 2003). In addition, a tool developed by Pesaran and Shin (1996) is employed to

examine the impact of the EMU on the long-run structure of integration among European stock markets.

Evidence of stock market integration among EU member states in comparison with the Euro area is examined by authors Babecký, Komárek and Komárková (2007). Using correlation analysis, they considered empirical dimension of financial integration among four new EU members: The Czech Republic, Hungary, Poland, and Slovakia. Empirical analysis in their case was conducted not just at the country level, that means using national stock exchange indices, but also for the sectoral level, considering banking, chemical, electricity and telecommunications indices. Their results show a stock market integration on both the national and sectoral levels between these mentioned countries, and their measures of financial integration are built upon complementary concepts,  $\beta$  convergence (measuring the speed of convergence) and  $\sigma$  convergence (measuring the degree of financial integration). This methodology represents an advantage of their study, the opinion is of this authors.

David Büttner and Bernd Hayo estimated determinants of stock market integration among EU member states for the period 1999-2007. They group countries based on their European integration status into euro area member (EMU), old EU member states without the euro (OMS) and new EU member states (NMS). After grouping they evaluate the impact of euro introduction and the European unification process on stock market integration. Their results show a significant trend toward more integration for almost all groups.

Furthermore, impact of EU membership process on equity market integration was examined by Turkish author Halil Kiyamaz (2008). He investigated interaction among Turkey and eleven original EU countries during the full membership journey of Turkey to EU by using cointegration methodology. Starting accession negotiation in 2005 has resulted in greater integration between Turkish and European markets, as the results of this study showed. The results also indicate there are two cointegration relationship between the returns on European equity market indices and Turkish index during the pre-candidacy period, while the number of cointegration vector increases to 11 during the accession negotiation period. That means there are closer ties in market movement between European equity markets, Turkish market and other major markets after 2005.

## *2.2. Stock market integration of Croatia, as a prospective member of EU*

Related with investigation about Croatian stock market indices, we can find only few researchers that examined the degree of integration and cross market

relation between Crobex and non- Croatian indices. Croatia is one of the prospective members of EU, so the main reason for choosing and focusing on Croatia is a fact of its so-called weak-form stock market efficiency. The Croatian stock market has existed for more than twenty years and has developed a solid infrastructure. The first steps in testing its efficiency by measuring autocorrelation of returns started only recently (Barbić, 2010). The results of official stock index data of the Zagreb Stock Exchange (CROBEX) were obtained and compared with findings on a more developed equity market (U.S.A), using its S&P 500 index as a key representative American index.

The usual assumption is that the U.S. market, which is several thousand times more liquid than the Croatian market should be much more efficient. Numerous empirical studies of both developing and developed countries confirmed such a relationship, the literature mainly discussing whether a lower degree of institutional development and liquidity (i.e. higher market risk in developing countries) may account for a higher return on investment in stocks listed on these markets (Barbić, 2010).

Few years ago, Erjavec and Cota (2007) examined the impact of European and American indices on Zagreb Stock Exchange's main index – Crobex, using GARCH models on a dataset from the period of January 4th 2000 to December 31st 2004. The estimates of the dynamic GARCH (1.1) models confirmed that one day lagged (as a consequence of different time zones) movements of DJIA and NASDAQ provide signals for the direction of change of the Crobex. The positive impact of DAX30 and FTSE100 on Crobex is also confirmed, but is significantly lower, which indicates that American markets have a stronger impact on Crobex than the European markets. Bearing in mind the inter-relationships between the Croatian and European financial systems, this has to be qualified as an intrigue conclusion.

Dadić and Vizek (2006) examined the bilateral and multilateral integration of equity markets of selected Central Eastern European (CEE) countries including Croatia, and the German equity market for the period of January 2nd 1997 to June 10th 2005. Their results indicate the multilateral integration among CEE countries and between the group of CEE countries and the German equity market. Contrary to the findings of Erjavec and Cota (2007), no evidence of bilateral integration between Crobex and DAX was found.

First and foremost, it is clear that the impact of American, ASEAN or European Stock markets and their respective indices on other financial systems is enormous. An interdisciplinary approach, combining econometrics with behavioural finance, was used to examine and to explain the behaviour of investors on the Croatian stock market by Sajter and Ćorić (2009). Following the methodology and findings of Erjavec and Cota (2007), the dependency of the Crobex index

to the main US indices (DJIA, S&P500, NASDAQ) is further examined in their paper. However, that study uses data from a different period, including the data from the beginning of the World Financial Crisis followed by extreme volatility shocks. The econometric study is widened, and the persistent relationship between Croatian and American indices is additionally elaborated using ARIMA and GARCH models.

Considering and comparing the stock market indices between American Stock Exchange and Croatian Stock exchange, Sajter and Ćorić (2010) used Yahoo Finance and Zagreb Stock Exchange websites. Corrections were done for non-mutual national holidays and non-working days. They included only common parallel workdays. Dataset has 935 observations from January 3rd 2005, to November 6th 2008. This particular dataset was used because it begins where the dataset of Erjavec and Cota (2007) ends. Using ARIMA and GARCH models, authors found that Croatian stock market dominantly rely on American indices movement, and found connection between S&P500, as a key representative American index, but also a similar results were obtained with other two American indices: DJIA and NASDAQ, because they are highly correlated with S&P500.

Šonje, Alajbeg and Bubaš (2010) estimated efficient market hypothesis: is the Croatian stock market as (in) efficient as the U.S. market. The analysis was based on CROBEX, as we mentioned earlier, official stock index data of the Zagreb Stock Exchange. These data were estimated from Jan 2nd 1997 to June 2nd 2010. The purpose was to compare results for Croatia and the U.S. Lo's (2004) data and Shiller's (2010) database using statistical test of autocorrelation of successive price changes. According to given results, the authors concluded that analysis of autocorrelation at daily frequencies shows that both markets are inefficient in statistical terms but conclusion differs for the pre-crisis period when the U.S. market appears to be efficient, while it is impossible to prove the inefficiency of the Croatian market with a high level of confidence. The observation of monthly data in the pre-crisis period shows market efficiency in both countries: U.S. as in Croatia.

### 3. Methodology

The analyses of series consist of three stages. In the first stage we use Unit root test, second stage includes Granger causality test, and the third part displays graphs of recursive cointegration method based on recursive OLS. Using the daily data in testing Unit root and Granger causality, we obtained dataset for SOFIX with 2919 observations, 1482 observations before EU membership, and 1437 af-



ter September 2007, period after EU membership. Dataset for BET have 3633 observations, 2189 before EU membership, and 1444 after EU membership.

For Croatian CROBEX we examine just whole period, because of Croatian path in EU. In that case we obtained 3656 observations from establishing its index, CROBEX, from 1997 to 2012. In testing of Unit root and Granger causality, we use EViews software, while in testing recursive cointegration, we use Microfit software, by modification our daily dataset into monthly for all indices, because testing of cointegration requires monthly not daily data.

#### 4. Empirical results

##### 4.1. Unit root test

ADF test is used to check whether series are nonstationary in the levels, and stationary in the first difference, considering three periods: whole, period before EU membership and third, period after EU. ADF test was tested on 5% significance level of significance. First differences of not-stationary ones were differenced from the unit root by taking I (1). Unit root tests can be implemented on the level and first difference variables:

$$\Delta y = \alpha_1 y_{it-1} + \sum_{j=1}^{p_t} \beta_{ij} \Delta y_{it-j} + x_{it} \delta + \varepsilon_t$$

Table 1.

#### ADF UNIT ROOT TEST FOR WHOLE PERIOD

<b>H0: Index has a unit root</b>				
	<b>Data level</b>		<b>1<sup>st</sup> difference</b>	
	<b>t-Statistic</b>	<b>Prob.*</b>	<b>t-Statistic</b>	<b>Prob.*</b>
<b>BET</b>	-1.59016	0.4875	-52.375	0.0001*
<b>DAX</b>	-1.90077	0.3322	-39.6169	0.0000*
<b>FTSE</b>	-2.19471	0.2084	-22.9595	0.0000*
<b>S&amp;P500</b>	-2.08919	0.2492	-42.1172	0.0000*
<b>SOFIX</b>	-0.705566	0.8435	-43.5303	0.0000*

DAX	-1.57849	0.4935	-51.7862	0.0001*
FTSE	-2.40712	0.1398	-53.3038	0.0001*
S&P500	-2.35289	0.1556	-56.1615	0.0001*
<b>CROBEX</b>	-0.445662	0.8989	-54.4164	0.0001*
DAX	-1.2605	0.6500	-39.9715	0.0000*
FTSE	-2.21999	0.1992	-34.2444	0.0000*
S&P500	-1.61288	0.4758	-41.9579	0.0000*

Source: author's calculation , Notes: \*denotes significance at 5% level

*Table 2.*

ADF UNIT ROOT TEST FOR THE PERIOD BEFORE EU MEMBERSHIP

<b>H0: Index has a unit root</b>				
	<b>Data level</b>		<b>1<sup>st</sup> difference</b>	
	<b>t-Statistic</b>	<b>Prob.*</b>	<b>t-Statistic</b>	<b>Prob.*</b>
FTSE	-1.13990	0.7019	-43.9676	0.0001*
S&P500	-1.21958	0.6681	-44.452	0.0001*
<b>SOFIX</b>	2.30552	1.0000	-31.6980	0.0000*
DAX	-1.17647	0.6866	-38.4920	0.0000*
FTSE	-1.19835	0.6773	-39.2003	0.0000*
S&P500	-1.55618	0.5048	-38.1551	0.0000*
<b>CROBEX</b>	-0.445662	0.8989	-54.4164	0.0001*
DAX	-1.2605	0.6500	-39.9715	0.0000*
FTSE	-2.21999	0.1992	-34.2444	0.0000*
S&P500	-1.61288	0.4758	-41.9579	0.0000*

Source: author's calculation, Notes: \*denotes significance at 5% level

Table 3.

## ADF UNIT ROOT TEST FOR THE PERIOD AFTER EU MEMBERSHIP

<b>H0: Index has a unit root</b>				
	<b>Data level</b>		<b>1<sup>st</sup> difference</b>	
	<b>t-Statistic</b>	<b>Prob.*</b>	<b>t-Statistic</b>	<b>Prob.*</b>
<b>BET</b>	-1.84953	0.3566	-34.0092	0.0000*
DAX	-1.83232	0.3650	-35.2416	0.0000*
FTSE	-1.46241	0.5525	-15.1456	0.0000*
S&P500	-1.28806	0.6371	-27.3762	0.0000*
<b>SOFIX</b>	-0.49265	0.8901	-30.4872	0.0000*
DAX	-1.54258	0.5118	-24.8722	0.0000*
FTSE	-2.10604	0.2424	-36.7419	0.0000*
S&P500	-1.59585	0.4844	-40.2441	0.0000*

Source: author's calculation, Notes: \*denotes significance at 5% level

As shown from the previous tables the series has a unit root at levels and first difference during whole three periods at a significance level of 5%. The first difference variables (\*) and the level values were used.

#### 4.2. Granger Causality

The basic idea in Granger model is that a variable X Granger causes Y if past values of X can help explain Y. Of course, if Granger causality holds this does not guarantee that X causes Y. This is why we say "Granger causality" rather than just "causality". Nevertheless, if past values of X have explanatory power for current values of Y, it at least suggests that X might be causing Y. Granger causality is only relevant with time series variables. To illustrate the basic concepts we will consider Granger causality between two variables (X and Y) which are both stationary. (Gary Koop, 2010).

*Table 4.*

GRANGER CAUSALITY FOR INDICES IN PERIOD  
 BEFORE EU MEMBERSHIP

<b>Null Hypothesis:</b>	<b>Obs.</b>	<b>F-Statistic</b>	<b>Prob.</b>
DAX does not Granger Cause BET	2185	0.52643	0.7163
BET does not Granger Cause DAX		0.94451	0.4371
FTSE does not Granger Cause BET	2185	0.78950	0.5319
BET does not Granger Cause FTSE		0.81350	0.5164
S_P500 does not Granger Cause BET	2185	0.44879	0.7733
BET does not Granger Cause S_P500		0.32691	0.8600
SOFIX does not Granger Cause DAX	1478	2.38624	0.0493
DAX does not Granger Cause SOFIX		0.15075	0.9627
SOFIX does not Granger Cause FTSE	1478	2.21060	0.0657
FTSE does not Granger Cause SOFIX		0.27737	0.8927
SOFIX does not Granger Cause S_P500	1478	2.23560	0.0631
S_P500 does not Granger Cause SOFIX		0.54088	0.7057

Source: author's calculation

Table 4 reports F-Statistic and Probability values for Granger causal relationship. The F values indicate that one way Granger causality doesn't exist from DAX, SP500 and FTSE to BET and SOFIX in the period before their becoming EU member states. In our case that means that we don't have enough evidence to reject H0 hypothesis (DAX, S&P500, and FTSE do not Granger cause BET or SOFIX). In the table above, the considered period for BET is from September 1997 to December 2007, including 2189 observations, for SOFIX it is also from September 1997 to December 2007, including 1482 observations.

Table 5.

GRANGER CAUSALITY FOR INDICES IN PERIOD  
AFTER EU MEMBERSHIP

Null Hypothesis:	Obs	F-Statistic	Prob.
DAX does not Granger Cause BET	1440	<b>11.3978</b>	4.E-09
BET does not Granger Cause DAX		0.22359	0.9253
FTSE does not Granger Cause BET	1440	<b>12.2858</b>	8.E-10
BET does not Granger Cause FTSE		0.21058	0.9326
S_P500 does not Granger Cause BET	1440	<b>43.4225</b>	2.E-34
BET does not Granger Cause S_P500		0.39924	0.8093
SOFIX does not Granger Cause DAX	1433	1.68036	0.1520
DAX does not Granger Cause SOFIX		<b>16.8416</b>	2.E-13
SOFIX does not Granger Cause FTSE	1433	2.13207	0.0746
FTSE does not Granger Cause SOFIX		<b>17.3241</b>	7.E-14
SOFIX does not Granger Cause S_P500	1433	<b>2.49641</b>	0.0411
S_P500 does not Granger Cause SOFIX		37.0125	2.E-29

Source: author's calculation

In the table reports F-Statistic and Probability values for Granger causal relationship in the period after EU membership. The F values indicate that one way Granger causality exists from DAX, SP500 and FTSE to BET and SOFIX. Results from table indicate that we have enough evidence to reject H0 hypothesis (DAX, S&P500, and FTSE do not Granger cause BET or SOFIX), because using the 5% level of significance; our results show that P-value is less than 0.05. In the period after EU membership, we can see strong impact of these developed stock market indices on BET and SOFIX, which shows that previous day's price movement in the America, Germany and England markets have a positive impact on the following day's price movement in the Romanian and Bulgarian markets. The considered period from both indices is from September 2007 to December 2012, a number of observation for BET is 1444, and for SOFIX 1437.

Table 6.

GRANGER CAUSALITY FOR CROBEX

Null Hypothesis:	Obs.	F-Statistic	Prob.
DAX does not Granger Cause CROBEX_	3652	5.82527	0.0001
CROBEX_ does not Granger Cause DAX		0.30715	0.8733
FTSE does not Granger Cause CROBEX_	3652	4.11344	0.0025
CROBEX_ does not Granger Cause FTSE		0.32024	0.8646
S_P500 does not Granger Cause CROBEX_	3652	42.1679	1.E-34
CROBEX_ does not Granger Cause S_P500		1.86003	0.1146

Source: author's calculation

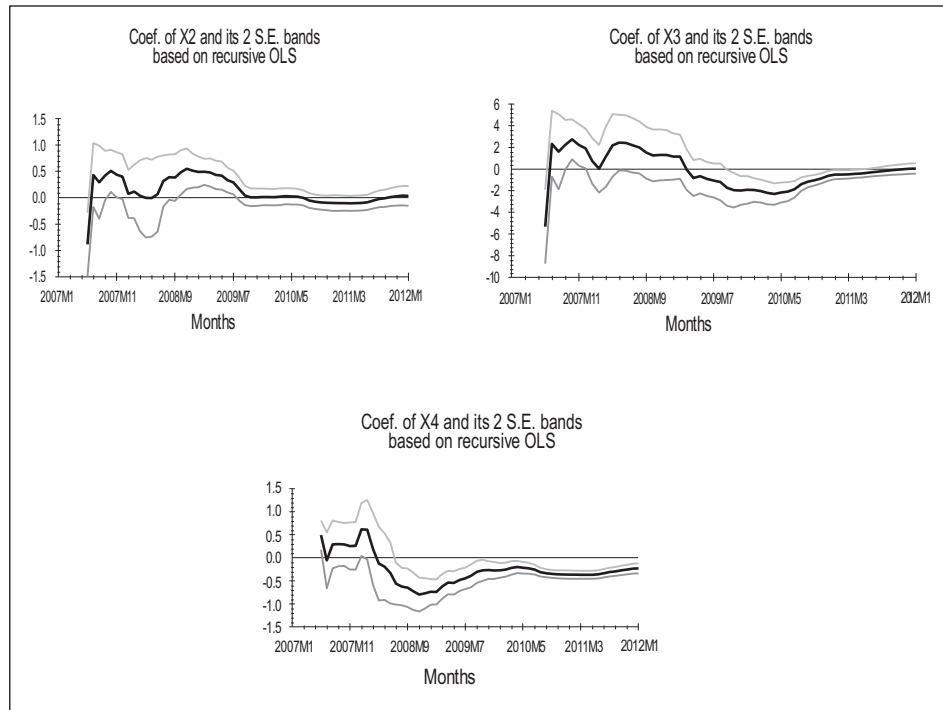
The Table 6 shows Granger causality for CROBEX related with period from September 1997 to December 2012. That means that the considered values represent period of Croatian stock market index before EU membership. A known fact is that Croatia doesn't become a member state of EU, so in this case we will estimate just the period before integration. Related with results, even in this situation we can find strong impact of leading countries on CROBEX, especially the impact of S&P500 index, with very high value of F-statistic that is drastically higher than impact of other international indices. As considered earlier by Sajter and Ćorić (2010), Croatian stock market dominantly rely on American indices movements with high level of connection between them.

**4.3. Recursive cointegration**

Considering the period after EU membership, following graphs display relationship and impact of FTSE, S&P500 and DAX on SOFIX and BET.

Figure 1.

## RECURSIVE OLS FOR SOFIX

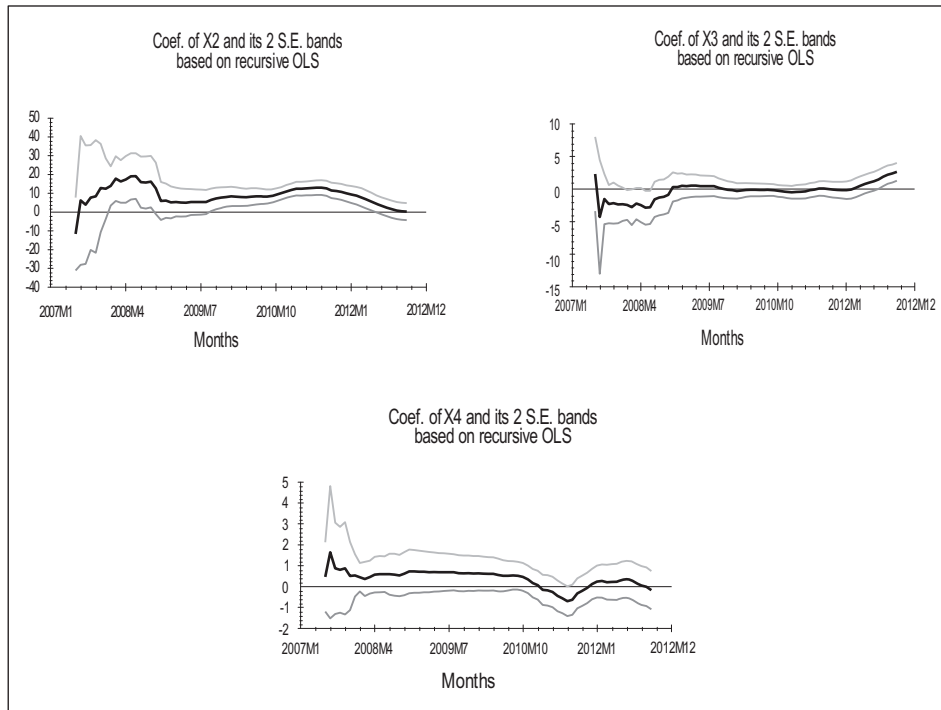


Source: author's calculation

Considering the period after EU membership, the graphs above display long-run relationship between SOFIX index and  $X2=FTSE$ ,  $X3=S\&P500$  and  $X4=DAX$ , based on recursive OLS. All series are nonstationary. Before EU membership, a relationship between indices is not so significant, while after Bulgarian entrance into EU, there is evidence of positive significance relationship and impact FTSE, S&P500 and DAX on SOFIX, but during the global financial crisis in 2007-2008 relationship disappears, or becomes negative as a result of financial crisis in UK.

Figure 2.

RECURSIVE OLS FOR BET

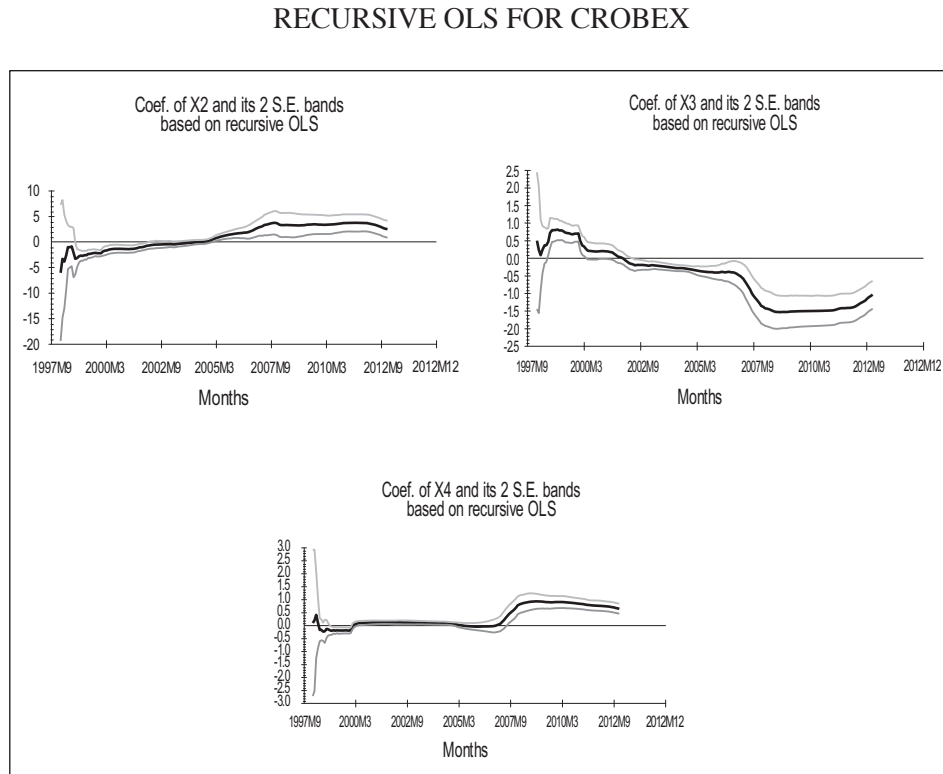


Source: author's calculation

The graphs above display long-run relationship between BET index and  $X2=S\&P500$ ,  $X3=FTSE$  and  $X4=DAX$ , based on recursive OLS. All series are nonstationary. As it can be seen from the graphs, becoming a member of EU, a positive relationship between BET and S&P500 and BET and DAX, while it is not the case with BET and FTSE, even after EU membership. During the global financial crisis the relationship is not so significant, in some periods it becomes negative.



Figure 3.



Source: author's calculation

Graphs above is based on recursive OLS, and displays relationship between CROBEX and  $X2=S\&P500$ ,  $X3=FTSE$  and  $X4=DAX$  in whole period. After 2007, we can notice positive significant relationship between CROBEX and S&P500, and CROBEX and DAX. During the period from 1997 to 2012, there is a significant negative relationship between CROBEX and FTSE, as a result of financial crisis in UK.

## 5. Conclusion

In this study, we examined speed of financial integration with focus on stock markets of developed stock market indices: S&P500, FTSE and DAX on develop-

ing stock market indices: SOFIX, BET, and CROBEX. We studied market integration and cointegration dynamics for the time period spans from 1997 to 2012 using econometric techniques. Three periods were considered: period before EU membership, period after EU membership and whole period. Daily data on stock market index prices was obtained from Yahoo Finance, Bulgarian and Romanian stock exchanges and official webpage of Croatian stock market. Prices were denominated in local currencies. Our first step was to make sure that all dataset are I(1). Empirical results indicate that there is strong evidence that stock market integration between emerging and developed countries are increasing, and strong positive impact of EU membership on the integration of developing countries exists. The impact of EU membership is more robust between CROBEX and developed countries' stock markets.

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## FINANCIJSKA INTEGRACIJA PRIJE I NAKON ČLANSTVA U EU

### Sažetak

*Ovaj rad istražuje dimenziju financijske integracije među zemljama u razvoju koje su članice EU (Rumunija, Bugarska i Hrvatska), metodom usporedbe burzovnih indeksa s globalnim i dominantnim tržištem vrijednosnih papira. Prilikom analize podataka korištene su dnevne i mjesečne vrijednosti indeksa na burzi na nivou države, odnosno podaci o trgovini na kraju dana/mjeseca. Za pristup podacima koristili smo službenu web stranicu Yahoo Finance i to za američki S&P500 indeks, engleski FTSE indeks i njemački DAX indeks; podatke za bugarski SOFIX indeks i rumunjski BET indeks primili smo od osoblja njihovih burzi. Na stranici Zagrebačke burze dostupni su podaci o trgovanju na burzi, pa smo tu pronašli podatke za CROBEX indeks. Zaključne vrijednosti/cijene indeksa su predstavljene u domaćoj valuti i razmatrane su unutar tri različita razdoblja: razdoblje prije članstva u EU, razdoblje poslije članstva, te sveobuhvatno razdoblje počevši od rujna 1997., zaključno s prosincem 2012. godine. Uspoređuju se zaključne, dnevne vrijednosti indeksa Hrvatske, Bugarske i Rumunjske sa razvijenim i globalnim burzama kako bi se istražila kratkoročna i dugoročna dinamika na tržištu vrijednosnih papira zemalja u razvoju, koje su već članice ili su potencijalne članice EU, sa SAD, Njemačkom i Engleskom koje igraju bitnu ulogu na međunarodnom i globalnom tržištu vrijednosnih papira, burzi, jer su svi međunarodni investicijski tokovi pod utjecajem ovih dominirajućih tržišta. Metode koje su korištene prilikom analize financijske integracije su: Unit root test, Augmented Dickey-Fuller test, Granger test uzročnosti, Granger kointegracijski test i Recursive kointegracijska metoda. Empirijski rezultati pokazuju integriranost svih*

*indeksa u sveobuhvatnom razdoblju. Pokazuje se značajna veza među indeksima nakon članstva u EU, iako se ista veza ne može primijetiti u razdoblju prije članstva. U slučaju Hrvatske, S&P500 indeks ima najveći utjecaj na CROBEX u cjelokupnom periodu. Rezultati analize pokazuju da članstvo unutar EU doprinosi jakom i pozitivnom utjecaju na integraciju onih zemalja u razvoju koje su članice EU, promatrano kroz ADF test i Granger test uzročnosti.*

*Ključne riječi: Financijska integracija, EU, Burza, Unit Root Test, Granger test uzročnosti, Granger kointegracijski test, Recursive kointegracija.*