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## INTEGRATION OF CROATIAN, CEE AND EU EQUITY MARKETS: COINTEGRATION APPROACH

*This paper examines bilateral and multilateral integration of equity markets of selected Central and Eastern European countries including Croatia, and German equity market for the period of January 2<sup>nd</sup>, 1997 to June 10<sup>th</sup>, 2005.*

*Application of the Johansen cointegration procedure indicates existence of multilateral integration between equity markets of analyzed CEE economies, as well as between the group of CEE equity markets and German equity market. This study offers compelling evidence that the forces driving financial integration are quite powerful, and that we are likely to see more substantial movement in the same direction with time and once these countries join EMU, since evidence from this study suggests that bilateral integration between particular CEE equity markets and German equity market is still absent.*

*Key words: equity markets, financial integration, cointegration, CEE.*

### 1. Introduction

There are several ways to define financial integration. One definition states that assets of equal risk provide investors with the same expected return across integrated markets, which in turn relates to the fact that integrated equity markets offer fewer opportunities to diversify portfolios. Equity market integration

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can also be defined by how great is the possibility of asymmetric spill over effects across markets due to equity market interdependence. For the purpose of our study the most useful definition of equity market integration is the one that claims that in integrated markets indices of national markets move together over the long run with possibility of short-run divergence.

Financial integration is subject of perpetual interest to policy makers, investors and academics. The latter interest group has provided strong evidence on interaction among international financial markets. Investors are return oriented and therefore highly interested in studies that examine co-movements of financial markets. Due to tendency of financial integration, investors are incapable to earn extra returns in long term. However, cross border diversification presents remarkable opportunity to maximise profits as well as minimise risks. Policy makers' interest is partly based on prudence caused by possible spill over effects in case of integrated financial markets.

Difference in levels and dynamics of financial integration of European financial market can be observed twofold. Firstly, bond market and money market are more integrated than equity market. In contrast to rather ambiguous results concerning degree of integration of equity market, existing literature provides us with the strong evidence that full convergence in European bond markets and money markets had been achieved by the mid- to late 1990s (Frankel, 1994.).

Secondly, developed equity markets are more integrated than emerging ones. While strong arguments can be made in case of progressive integration of developed European financial markets, where periods of similar trend co-movements of equity market indices are interchanged with periods of short-run country specific volatility (Fratzscher, 2001.), integration between emerging markets as well as between emerging and developed markets is not accompanied with credible empirical evidence.

This paper tests the hypothesis of equity market integration using a cointegration approach analysing multilateral integration between Croatian equity market and other Central and Eastern European emerging equity markets, namely, Polish, Czech, Slovenian and Hungarian. Additionally, multilateral integration between CEE equity markets and German equity market has been examined as well as integration between Croatian equity market and German equity market.

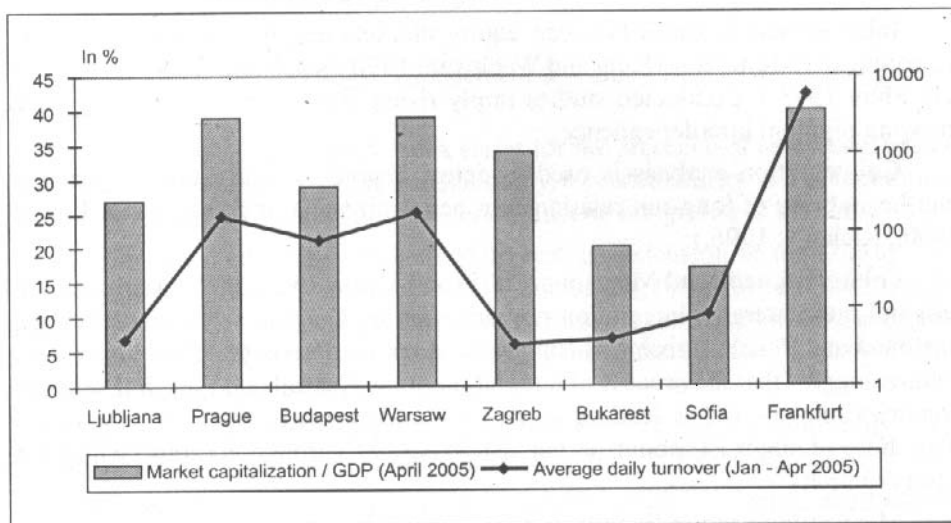
The rest of the paper is organised as follows. After reviewing some of the literature on financial integration in section 2, section 3 presents data and methodology used. Last two sections, 4 and 5, offer discussion of results of the paper and concluding remarks.

Motivation for this paper stems from the fact that Croatian equity market has never been included in the analysis which focuses on dynamics of financial integration between Central and Eastern Europe and EU equity markets, probably

due to the fact that Croatian equity market has gained significance somewhat later when compared with rest of the equity markets considered in this study. Since, in the meantime, Croatian equity market has achieved substantial level of development (see Figure 1), we believe that it should be included in the study. Hopefully, this research will contribute to the ongoing process of determining just how much are the economies in question integrated and it should also help Croatian policy makers to set ground for future monetary union.

Figure 1

SIGNIFICANCE OF SELECTED EQUITY MARKETS



Source: Web pages of equity exchanges and Bloomberg.

2. Literature overview on financial integration

This paper defines financial integration as the international integration of national financial markets. Financial integration of observed equity markets means that assets of equal risk provide investors with the same expected return regardless the domicile. While the case of integrated financial markets confirms price equalization (law of the one price) in long run, in the short run asset diversification

is possible due to the existence of arbitrage opportunities. Financial integration in the short-run is identified with coherence among the markets considered. On the contrary, segmentation is a result of lack of integration.

There is a wide literature that tries to assess the degree of equity market integration. Studies based on price equalisation for financial market assets have used uncovered interest parity (Fratzschner, 2001) or capital asset pricing model (Bekaert and Harvey 1995., Dumas and Solnik 1995., Ferson and Harvey 1991., Hardouvelis et al. 1999.).

Robert Korajczyk (1995) investigated financial integration between equity markets using multifactor equilibrium Arbitrage Pricing Theory to define risk and to measure deviations from the 'law of one price'. According to results of the study, the measure of market segmentation tends to be much larger for emerging markets than for developed markets, which is consistent with large barriers to capital flows into or out of the emerging markets. However, the measure shows tendency to decrease over time, which is in line with growing levels of integration.

International linkages between equity markets can be as well tested with atheoretical VAR models (King and Wadhvani 1990., Koch and Koch 1993., Eum and Shim 1993.). Conducted studies imply rising cross-market correlations and growing regional interdependence.

Cointegration analysis is used to detect degree of integration by measuring the stability of long-run relationships across financial markets in (Dickinson 2000., Richards 1996.).

Gilmore, Lucey and Mcmanus (2005) and Voronkova (2004) examine bilateral and multilateral cointegration properties of the German stock market on the one hand and Polish, Czech and Hungarian stock market on the other hand. Both studies suggest that the process of integration of the Central and Eastern European countries into the EU is leading to a closer integration of their equity markets with those of major EU countries but also in case of Voronkova (2004) with USA equity markets.

Many studies put in line the degree of real integration and financial integration (Fama and French 1989., Ferson and Harvey 1991., Jagannathan and Wang 1996.) emphasising that extent of national financial integration depends on the extent of real and financial convergence with other economies as well as on country's performance. In other words, having more similar business cycles and being more interdependent through trade may raise the degree to which shocks are being transmitted across financial markets. Furthermore, financial integration tends to be highest during periods when observed countries or the dominant country are in recession (Erb et al. 1994., Raganathan et al. 1999.). Some studies conducted in developed and emerging markets provide strong evidence that removal of legal and non-legal barriers to capital flows induces financial integration. (Bekaert and Harvey 1995.).

Fratzscher (2001) conducts trivariate GARCH model with time-varying coefficients for a set of 16 countries some of which being from Euro Area, some of which have not adopted the Euro yet, and five countries from outside the EU. However, study does not include Central and Eastern European countries. Results of the study imply high integration of European equity markets since 1996 as well as considerable increase of importance of Euro area market in world financial markets. Moreover, the integration of European equity markets is mainly attributed to the drive towards EMU, elimination of exchange rate volatility and uncertainty in the process of monetary unification. Finally, the shock transmission across equity markets is found to be asymmetric, i.e. negative shocks are more strongly transmitted, large shocks have a stronger impact than small shocks, and these asymmetry and threshold effects have become larger over time.

### 3. The methodology and the data

As far as the methodology is concerned, this study uses a two step approach to analysis.

The first step is to test each index series for the presence of unit roots, which will show whether the series are nonstationary. Nonstationarity is a precondition for cointegration; additionally, all the series must be integrated of the same order.

The Augmented Dickey-Fuller (ADF) test, an extension of the Dickey and Fuller method, is used. However this test assumes that the errors are statistically independent and have a constant variance. To circumvent these limiting assumptions, Phillips and Perron (1987) developed a generalisation of the Dickey-Fuller test, which is also applied here.

The second step is the well-known methodology of cointegration analysis to test the presence of long-run equilibrium relationships in following cases:

- between the German equity market and the sample of Central and Eastern European equity markets,
- between all Central and Eastern European equity markets in the sample and
- between Croatian and German equity market.

Cointegration method is used to model the dynamic co-independence that is often found in financial market. Cointegration has emerged as a powerful technique for investigating common trends in multivariate time series and provides a sound methodology for modelling both long run and short run dynamics in the system with the help of error correction models (when short run dynamics are being analysed). The fundamental aim of cointegration analysis is to detect any common stochastic trends in the data, and to use these common trends for a dynamic

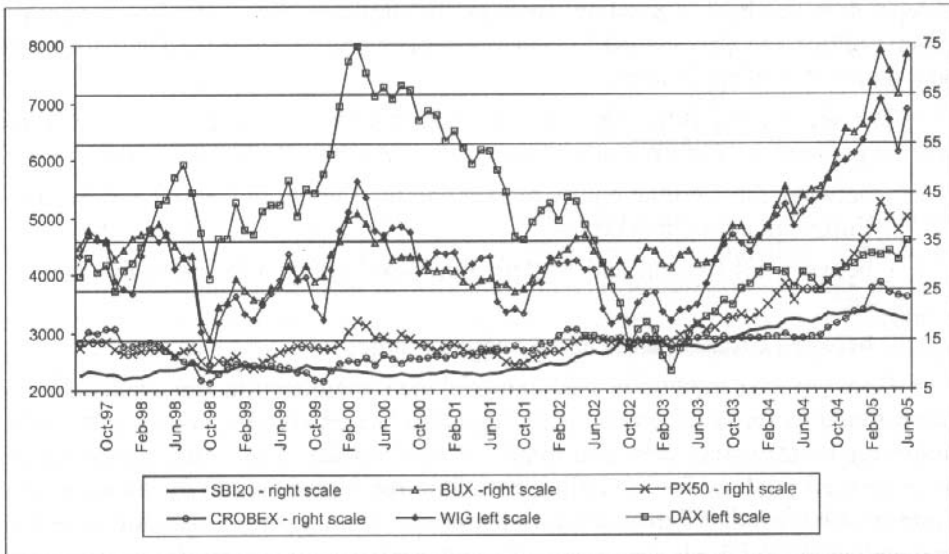
analysis of the correlation in return. Cointegration tests allow us to determine whether stock prices or indices of different national markets move together over the long run, while providing for the possibility of short-run divergence.

In our analysis we use the Johansen testing procedure for testing the presence of cointegration among the stock indices. This test determines the rank of the coefficient matrix of a vector autogression (VAR) of the series, with the rank indicating whether there is cointegration, as well as the number of cointegrating vectors i.e. relationships.

The data consist of daily closing price indices for the Slovenian (SBI20 index), Hungarian (BUX index), Czechs (PX50 index), Polish (WIG index), German (DAX index) and Croatian (CROBEX index) stock markets, for the time period covering January 2<sup>nd</sup>, 1997, through June 10<sup>th</sup>, 2005. The indices are presented in Figure 2. Data source is Bloombergs database. Although the data for the Czech, Hungarian, Polish, Slovenian and German stock market are available for periods prior to 1997, the data range is limited to eight year period because data for the Croatian equity market are available only from January 2<sup>nd</sup> 1997 onwards.

Figure 2

SELECTED EQUITY MARKET DEVELOPMENTS



Source: Bloomberg.

The sample of Central and Eastern European countries is selected to represent congenial emerging markets. On the other hand, German equity market is one of the largest financial markets nowadays. Criteria for choosing Germany as a proxy for EU equity market developments are the following:

- dominant share of CEE countries' export directed towards Germany in total exports of those countries to the EU,
- German equity market is one of the largest and most important in EU area and
- since EU markets are considered to be rather well integrated (e.g. Fratzscher 2001), developments on Frankfurt stock exchange are in fact a good representation of global capital market developments in EU.

In the regards to the above mentioned criteria it is worth noting that although significant share of Croatian total exports to EU is directed towards Germany, recent developments in trade of goods with Germany experienced a notable slowdown. The other important distinction between Croatia and sample Central European countries is EU membership. While Poland, Czech Republic, Hungary and Slovenia became members of the EU on May 1, 2004, Croatia, for now, is a candidate country, while it is likely that the membership status will be granted to Croatia by 2009.

## **4. Results**

### ***4.1. Unit roots tests***

In order to determine whether the time series of indices are stationary in levels, first differences or even in higher differences we used Augmented Dickey-Fuller (ADF) test and Phillips and Perron (PP) test. Results are presented in Table 1 and 2, from which, it is evident that all indices satisfy the precondition for cointegration testing i.e. all indices contain unit root processes in levels while their first differences are stationary at 1% confidence level. Also it is worth noting that this result applies to both, time series of indices with or without trend variable included in test specification.

Since we now know that all indices are  $I(1)$  processes, we can move on to cointegration testing within Johansen framework.

Table 1

## ADF AND PP UNIT ROOT TESTS – IN LEVELS

	Name of the variable	Time period	ADF		PP	
			t-value (trend included)	t-value (no trend)	t-value (trend included)	t-value (no trend)
1.	SVSM	1997:1 -2005:6	-1,591 (10) [0,795]	0,175 (7) [0,971]	1,355 (9) [0,0874]	0,043 (7) [0,962]
2.	BUX	1997:1 -2005:6	-0,450 (10) [0,985]	0,619 (10) [0,988]	-0,290 (10) [0,989]	0,638 (10) [0,989]
3.	PX50	1997:1 -2005:6	0,269 (1) [0,996]	2,308 (1) [0,999]	0,387 (1) [0,997]	2,50 (1) [0,999]
4.	WIG	1997:1 -2005:6	-1,768 (1) [0,719]	-1,217 (1) [0,666]	-1,660 (1) [0,768]	-1,117 (1) [0,708]
5.	DAX	1997:1 -2005:6	-2,137 (1) [0,526]	-1,795 (1) [0,382]	-2,136(1) [0,526]	-1,796 (1) [0,382]
6.	CROBEX	1997:1 -2005:6	-1,324 (1) [0,882]	-0,449 (1) [0,902]	-1,371(1) [0,8692]	-0,534 (1) [0,885]

Note: ADF - Augmented Dickey-Fuller test; PP – Phillips-Peron test; optimal number of time lags determined with Akaike Information Criterion and is presented in parenthesis; P-value in brackets, \* null hypothesis about existence of unit root rejected at 1 percent level.

Table 2

## ADF AND PP UNIT ROOT TESTS – IN DIFFERENCES

	Name of the variable	Time period	ADF		PP	
			t-value (trend included)	t-value (no trend)	t-value (trend included)	t-value (no trend)
1.	SVSM	1997:1 -2005:6	-14,146 (8)* [0,000]	-14,113 (8)* [0,000]	-41,340 (8)* [0,000]	-41,389 (8)* [0,000]
2.	BUX	1997:1 -2005:6	-11,262 (12)* [0,000]	-11,673 (11)* [0,000]	-45,50 (12)* [0,000]	-45,458 (11)* [0,000]
3.	PX50	1997:1 -2005:6	-11,728 (12)* [0,000]	-12,041 (11)* [0,000]	-43,146 (12)* [0,000]	43,012 (11)* [0,000]
4.	WIG	1997:1 -2005:6	-11,971 (12)* [0,000]	-11,908 (12)* [0,000]	-43,711 (12)* [0,000]	-43,70 (12)* [0,000]
5.	DAX	1997:1 -2005:6	-20,889 (4)* [0,000]	-20,867 (4)* [0,000]	-46,904 (4)* [0,000]	-46,894 (4)* [0,000]
6.	CROBEX	1997:1 -2005:6	-12,898 (12)* [0,000]	-12,828 (12)* [0,000]	-49,221 (12)* [0,000]	-49,204 (12)* [0,000]

Note: ADF - Augmented Dickey-Fuller test; PP – Phillips-Peron test; optimal number of time lags determined with Akaike Information Criterion and is presented in parenthesis; P-value in brackets, \* null hypothesis about existence of unit root rejected at 1 percent level.



## ***4.2. Cointegration tests***

In this part of our analysis we test three different cases we consider to be important in attempt to fully understand the integration process of Croatian equity market into equity markets of sample of CEE economies and European equity market.

First we test to see if there is an integration i.e. long-run equilibrium relationship between equity markets of sample of transition economies considered in the paper (i.e. equity markets of Slovenia, Hungary, Czech Republic, Poland and Croatia). Then we test for presence of cointegrating vector between all CE equity markets and German equity market, which we think, is a good proxy for EU equity market developments and is particularly important to CEE economies because of the strong trade and FDI linkages. In the third stage we test to see if there is integration between Croatian and German equity market in order to see just how far in integration process has Croatian equity market already come. The results are presented in the Tables 3, 4 and 5.

The results indicate that there indeed is multilateral integration not only among equity markets of analysed sample of Central and Eastern Europe economies, but there is also evidence of multilateral equity market integration between the entire group of CEE countries and German equity market.

This result is partly in line with results of the study done by Gilmore, Lucey and Mcmanus (2005) and Voronkova (2004). Moreover, it suggests that Croatian equity market, even though it had shorter time span available for development when compared to rest of CEE countries, has achieved certain level of multilateral integration in both cases, with other CEE markets and with CEE markets and the German market together.

There are several potential sources of integration which could provide explanation as to why multilateral integration among examined markets is being found, with liberalisation of capital flow barriers in CEE countries and potentially higher returns offered by equity markets in transition countries (Gilmore et al, 2005.) being the most obvious sources. Nevertheless, the available literature points to several other sources of financial integration that are not financial in nature. In this fashion, deliberate policy coordination of CEE countries with EU policies (Gilmore et al, 2005.) which could have caused a business cycles similarities that in turn lead to greater financial integration; entry of the old EU member countries banks into banking systems of CEE countries (Schmitz, 2004.) which could have propagated Europe-wide systematic risk in equity markets and increasingly strong trade linkages between old EU members and CEE countries and significant FDI inflows from old EU members, could all have had its effect on increasing degree of multilateral financial integration among CEE and EU equity markets.

Multilateral integration among CEE and EU markets may suggest that the competition in these equity markets is increasingly strong and that these markets are becoming more efficient. Also, stronger financial integration among these markets means that there will be fewer opportunities to diversify portfolios within Europe and that individual EU markets are increasingly interdependent and subjected to asymmetric spillovers, with large and negative shocks being transmitted across integrated markets more completely than small and positive shocks. Moreover, policy makers should be particularly concerned about existence of multilateral integration among CEE markets because it could suggest that CEE markets are treated as a single asset and country specific shocks affect investors' sentiment with regard to the region as a whole. From the investors' point of view, stock markets' regional interdependency implies the possibility of partial stock price forecasts using data from the neighboring markets (Voronkova, 2004.).

Table 3

TESTING THE INTEGRATION BETWEEN SVSM,  
BUX, PX50, WIG AND CROBEX

Maximum rank	LL	Eigen value	$\lambda_{\text{trace}}$	5 % critical value	$\lambda_{\text{max}}$	5 % critical value
0	-17475,5	-	78.70	68.52	39.4393	33.46
1	-17455,7	0,0177	39.2663*	47.21	22.5368*	27.07
2	-17444,5	0,01019	16.7295	29.68	9.6858	20.97
3	-17439,6	0,00439	7.0437	15.41	6.7761	14.07
4	-17436,2	0,00308	0.2676	3.76	0.2676	3.76
5	-17436,1	0,00012	-	-	-	-

Note: LL - log likelihood; optimal number of time lags selected using AIC obtained after VAR estimation of all endogenous variables is 2; maximum likelihood estimation includes a constant in order to account for the trend present in the data; \* null hypothesis accepted at 5 percent level.

Table 4

TESTING THE INTEGRATION BETWEEN SVSM,  
 BUX, PX50, WIG, CROBEX AND DAX

Maximum rank	LL	Eigen value	$\lambda$ trace	5 % critical value	$\lambda$ max	5 % critical value
0	-29853.75	-	111.9459	94.15	41.3810	39.37
1	-29833.06	0.01863	70.5649	68.52	32.1983*	33.46
2	-29816.96	0.01453	38.3666*	47.21	23.1987	27.07
3	-29805.36	0.01049	15.1679	29.68	9.9381	20.97
4	-29800.39	0.00451	5.2298	15.41	4.7705	14.07
5	-29798.01	0.00217	0.4593	3.76	0.4593	3.76
6	-29797.78	0.00021	-	-	-	-

Note: LL - log likelihood; optimal number of time lags selected using AIC obtained after VAR estimation of all endogenous variables is 2; maximum likelihood estimation includes a constant in order to account for the trend present in the data; \* null hypothesis accepted at 5 percent level.

Table 5

TESTING THE INTEGRATION BETWEEN CROBEX AND DAX

Maximum rank	LL	Eigen value	$\lambda$ trace	5 % critical value	$\lambda$ max	5 % critical value
0	-17726.555	-	6.0968*	15,41	6.0408*	14,07
1	-17723.534	0.00274	0.0559	3,76	0.0559	3,76
2	-17723.506	0.00003	-	-	-	-

Note: LL - log likelihood; optimal number of time lags selected using AIC obtained after VAR estimation of all endogenous variables is 2; maximum likelihood estimation includes a constant in order to account for the trend present in the data; \* null hypothesis accepted at 5 percent level.

When analysing Croatian and German equity market alone, no evidence of bilateral integration is found. The same result is obtained when trying to examine bilateral integration between other CEE countries in the sample and German equity market (data available upon request from the authors). This result imply that the evidence of financial market integration is mostly found in multilateral

cases where long-run trend co-movements between indices overpowers periods of short-run country specific volatility in equity markets and also it could mean that there are common global underlying factors that are only captured in multilateral cases that drive these markets towards integration. As far as bilateral integration is concerned, obviously domestic factors in case of CEE equity markets prevail (Linne, 1998). Potential constraints that impede bilateral integration among examined markets include: the presence of exchange rate uncertainty and government restrictions on market transaction combined with higher transaction costs and inadequate level of transparency in these equity markets. Obviously, further strengthening of CEE equity market is essential in order for any of examined CEE equity market could fully integrate with far more developed and sophisticated markets in EU.

## 5. Conclusion

This study faces us with the evidence that the forces driving financial integration are quite powerful, and we are likely to see substantial further movement in the direction of more capital mobility and financial institutions with greater geographic scope. There are many factors that have probably speeded up the process of equity market integration of Central Europe countries and EU. Some of them like:

- liberalisation of capital flow barriers in CEE countries which allowed easier flow of capital across borders,
- potentially higher returns offered by equity markets in transition countries (Gilmore, Lucey and Mcmanus, 2005.) made equity markets in Central and East Europe very attractive for EU investors,
- entry of old EU member countries banks into banking systems of Central and East Europe countries (Schmitz, 2004.) could have made these markets more co-ordinated and integrated especially since banks are the single biggest players in emerging countries equity markets,
- increasingly strong trade linkages between old EU members on one hand and new EU countries and candidate countries on the other hand and significant FDI inflows from old EU members to new members and candidate states surely made these countries more co-dependant and equally subjectible to same exogenous shocks
- unexpected, but increasing level of unofficial euroization in Central and East Europe countries (Billmeier and Bonato, 2002.) probably helped subduing exchange rate related risks and uncertainty thus promoting stronger development of particular financial systems and cross border trading (IMF Occasional Paper, 2004.),

surely have facilitated and promoted the process of integration between EU and Central and East European equity markets.

The findings of the paper have important implications for both investors and policy makers. For investors, the high degree of integration means that Europe as a whole has become a more attractive place for investment. However, higher integration also implies that there are fewer opportunities to diversify portfolios within the Euro area, thus providing incentives to focus more on diversifying across sectors or across regions.

For policy-makers, the process of European financial integration poses some challenges. Financial integration has increased competition and market efficiency and, at the same time, continuing financial integration has made individual European markets increasingly interdependent and subjected to spill-overs resulting from endogenous and exogenous shocks. Such rising interdependence may thus require prudential supervisors and security market overseers to increasingly adopt a Euro-area-wide approach.

The adoption of the Euro by the new EU Member States will be the ultimate final step for policy makers pursuing monetary integration. The process of monetary integration can only be successful if it follows the broader process of economic and financial integration. Although, the economic literature shows that economic and financial integration is a process that will go on after entry into the EMU area, a certain degree of economic and financial integration is a prerequisite for first joining ERM II and later for adopting the euro. In line with latter argument, this study clearly demonstrated that some level of multilateral financial market integration between some new EU member states and even candidate countries already exists which should in turn facilitate smoother euro adoption in these countries.

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INTEGRACIJA TRŽIŠTA KAPITALA HRVATSKE, ZEMALJA SREDNJE  
I ISTOČNE EUROPE I EUROPSKE UNIJE:  
KOINTEGRACIJSKI PRISTUP

Sažetak

Autorice u ovome članku ispituju bilateralnu i multilateralnu integraciju odabranih tržišta kapitala srednje i istočne Europe, uključivši Hrvatsku i njemačko tržište kapitala za razdoblje od 2. siječnja 1997. do 10. lipnja 2005.

Primjena Johansenove kointegracijske metode upućuje na postojanje multilateralne integracije, kako među ispitanim tržištima kapitala zemalja srednje i istočne Europe, tako i među tržištima kapitala zemalja srednje i istočne Europe i njemačkoga tržišta kapitala. Stoga, ovaj rad nudi jasan dokaz da su sile koje pokreću financijsku integraciju prilično snažne i da se s vremenom očekuje dalje kretanje ispitanih tržišta kapitala u smjeru još potpunije integracije, osobito pošto zemlje srednje i istočne Europe uđu u Europsku monetarnu uniju. Konačno, izostanak bilateralne integracije između ispitanih tržišta kapitala srednje i istočne Europe i njemačkoga tržišta kapitala naglašava nepotpunost sadašnjega stupnja financijske integracije među ispitanim tržištima kapitala.

Ključne riječi: tržišta kapitala, financijska integracija, kointegracija, zemlje srednje i istočne Europe.