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Transmission of shocks through stock markets channel: the case of the CEECs

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Abstract

Many scientists and economists state that the degree of global integration of the Central and Eastern European countries (CEECs) stock markets is very low. However, the recent turmoils in the major financial centers in USA, China, etc. raise the question about the possible transmission of the global shocks to the CEECs stock markets despite the low degree of financial integration. The main research questions are: can the spillover effect transmit from the major stock markets on the CEECs stock markets and what type of shocks cause the cross-border contagion risk transmission to the CEECs stock markets? The objective of this study – to identify the transmission of global shocks through stock markets channel in the CEECs. The research methods: the systemic, logical and comparative analysis of the scientific literature and statistical methods: Dynamic Conditional Correlation Generalized Autoregressive Conditional Heteroskedasticity (DCC-GARCH) model. The empirical results of this study suggest that the highest degree of global and regional integration of the stock markets was observed in Poland's, Czech Republic's, and Hungary's stock markets that can be explained by higher development level of these stock markets comparing to other CEECs. The collapse of Lehman Brothers bank in United States in 2008 was the most significant shock transmitted to CEECs stock markets. The empirical results also suggest that the transmission of other systemic shocks (e.g. the Middle East financial markets crash (May 2006), Greek debt crisis (April 23, 2010), Portugal's debt crisis (May 16, 2011)) was also observed on some of the CEECs countries.

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Keywords: global shocks; global integration, stock markets, the CEECs

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1. Introduction

The global and regional integration of the CEECs stock markets was investigated in many empirical studies (Mateus (2004), Maneschiold (2006), Nielsson (2007), Masood et al. (2010), Brannas et al. (2012), etc.). The results of the aforementioned scientific studies show that the degree of global integration of the CEECs stock markets is very low confirming that most of emerging stock markets (including CEECs) are less integrated at the global level. Many international investors have seen investment in emerging stock markets as a good portfolio diversification opportunity, however, the recent global shocks in USA's and China's stock markets raise the question about portfolio diversification opportunities during financial turmoil and the possible system wide global shocks transmission to the CEECs stock markets despite the low degree of global integration. The main research questions are: can the spillover effect from the major stock markets transmit on the CEECs stock markets and what type of shocks cause the spillover effect transmission? The objective of this study – to identify the shocks transmission through stock markets channel in the CEECs. The research object – stock markets in the CEECs. The research methods: the systemic, logical and comparative analysis of the scientific literature and statistical method: Dynamic Conditional Correlation Generalized Autoregressive Conditional Heteroskedasticity (DCC-GARCH) model.

2. Literature review

Many scientists and economists investigated the regional and global integration of the CEECs stock markets. However, only a few scientists (Soultanaeva (2008), Dubinskas and Stunguriene (2010), Syllignakis and Kouretas (2011), Kuusk et al. (2011), Brannas and Soultanaeva (2011), Nikkinen et al. (2012)) analyzed the transmission of shocks through stock markets channel in the CEECs countries.

Soultanaeva (2008) investigated the spillover effect of the political events from the Russian stock market to the Baltic stock markets. The main findings suggest that the reaction of the Baltic stock markets to political news and events in Russia decreased over time. Despite common characteristics of the Baltic stock makers there are significant differences among three stock markets in terms of market reaction to political events and news. Soultanaeva (2008) argues that the Baltic stock market reaction depends on the rate of information arrival as well as on differences in investors' interpretations of news announcements and opinions. Dubinskas and Stunguriene (2010) also focus on the causality among the stock markets of Russia and the Baltic States. The empirical results demonstrate a strong cointegration among all Baltic stock markets. The empirical study shows that the external shocks affect significantly the Estonian and Latvian stock markets while the reaction of investors in the Russian and Lithuanian stock markets remains more conservative. The empirical results confirm that during financial turmoils the expectations and interests of investors are related to largest stock markets that are normally considered more resilient and reliable. Syllignakis and Kouretas (2011) investigated the contagion effects among the CEECs stock markets and the German, USA, and Russian stock markets. The empirical study provides substantial evidence that transmission of contagion effect to the CEECs stock markets can be explained by the herding behavior of investors. These findings suggest that the contagion transmission from the major stock markets is a result of an increased financial liberalization, as well as an increased participation of foreign investors in the CEECs stock markets. Kuusk et al. (2011) investigated the financial contagion from the US stock market to the Baltic stock markets during the recent financial crisis. The results support the contagion hypothesis and suggest that linkages between the USA and the Baltic stock markets have become stronger after the collapse of Lehman Brothers bank in USA in 2008. Brannas and Soultanaeva (2011) investigated the impact of news from the Russian and USA stock markets on returns and volatilities of Baltic stock markets. They found no evidence of asymmetric impact of news from USA stock market on returns in the Baltic countries, however, the volatility spillovers from New York on Tallinn stock exchange was identified. Nikkinen et al. (2012) investigated the linkages between emerging Baltic stock markets and developed European stock markets. The empirical results indicate that the Baltic stock markets are closely related to the major European stock markets. The empirical study also provides substantial evidence on high degree of Baltic stock markets regional integration especially during the recent financial crisis period.

In summary, the empirical studies suggest that despite the low global integration of the CEECs stock markets the spillover effect from the major stock markets on the CEECs stock markets was identified. The main research questions of this empirical study are: can the spillover effect transmit from the major stock markets on the CEECs

stock markets despite the low degree of international integration and what type of shocks cause the cross-border contagion risk transmission to the CEECs stock markets? This empirical study also attempts to identify the episodes of shocks transmission through stock markets channel in the CEECs.

3. Research methodology and data

This empirical study applies the Dynamic Conditional Correlation Generalized Autoregressive Conditional Heteroskedasticity (DCC-GARCH) model in order to identify the spillover effect from the major stock markets on the CEECs stock markets and assess the global and regional integration of the CEECs stock markets.

The DCC-GARCH (p, q) model that was introduced by Engle (2002) is an econometric tool used to model correlation between two or more data series. The standard DCC-GARCH (1,1) model was applied in this empirical study (see Engle (2009), Nakatani and Terasvirta (2009)). The estimation of a GARCH (1,1) model is an intermediate step in order to derive inputs for the DCC-GARCH (1,1) model that was used to model correlation between two particular stock markets indexes.

The return vector of 11 CEECs' stock markets indexes and two global indexes is a column vector $\varepsilon_t = (\varepsilon_{1t},\ldots,\varepsilon_{nt})'$ with assumptions $\varepsilon_t | F_{t\ 1} \sim N(0, H_t)$. That is, $E[\varepsilon_t | F_{t-1}] = 0$ and $E[\varepsilon_t' \varepsilon_t | F_{t-1}] = D_t P_t D_t = H_t$. Nakatani and Terasvirta (2009), Engle (2009) define DCC-GARCH (1,1) model as follows:

$$Y_t = \mu_t + \varepsilon_t, \tag{1}$$

$$\varepsilon_t = D_t z_t, \tag{2}$$

here: Y_t – *n*-dimensional vector of logarithmic returns of the stock exchanges indexes at time *t*;

μ_t – *n*-dimensional vector of the expected value of the conditional Y_t ($\mu_t = E(Y_t | F_{t-1})$);

ε_t – *n*-dimensional vector of mean-corrected logarithmic returns of the stock exchanges indexes at time *t*;

$D_t = diag\left\{\sqrt{h_{1t}},\ldots,\sqrt{h_{nt,}}\right\}$, and $\sqrt{h_{it}}$ is the conditional standard deviation of ε_{it}. The conditional variance follows a univariate GARCH process: $h_{it} = \alpha_{i0} + \sum_{j=1}^{q} \alpha_{ij} \varepsilon_{i,t-j}^2 + \sum_{j=1}^{p} \beta_{ij} h_{i,t-j}$;

z_t – *n*-dimensional vector of iid errors with $E[z_t | F_{t-1}] = 0$ and $E[z_t' z_t | F_{t-1}] = P_t = [\rho_{ij,t}]$, where F_{t-1} is the information set up to and including time *t-1*;

H_t – time-varying conditional covariance matrix of the process ε_t ($[H_t]_{ij} = h_{it} h_{jt} p_{ij,t}, i \neq j$, where $1 \leq i, j \leq n$);

P_t – time-varying positive definite conditional correlation matrix of the process ε_t.

$$p_{ij,t} = E[z_{it} z_{jt} | F_{t-1}] = \frac{E[z_{it} z_{jt} | F_{t-1}]}{\sqrt{E[z_{it}^2 | F_{t-1}] E[z_{jt}^2 | F_{t-1}]}} = \frac{E[\varepsilon_{it} \varepsilon_{jt} | F_{t-1}]}{\sqrt{E[\varepsilon_{it}^2 | F_{t-1}] E[\varepsilon_{jt}^2 | F_{t-1}]}} = corr[\varepsilon_{it}, \varepsilon_{jt} | F_{t-1}]$$

This empirical study focuses on daily stock market indexes data for 11 CEECs': Bulgaria (BGR), Czech Republic (CZE), Croatia (HRV), Estonia (EST), Hungary (HUN), Latvia (LVA), Lithuania (LTU), Poland (POL), Romania (ROM), Slovakia (SVK), and Slovenia (SVN). In order to investigate the global and regional integration of CEECs stock markets two global indexes: STOXX EUROPE 600 Index and MSCI ACWI Index were also included in data sample (see Table 1).

Statistical data for 15 years period (1/03/2000-9/11/2015) have been obtained from Bloomberg. Due the data availability in Bloomberg there are some exceptions: the statistical data for the Slovenian SBI TOP Index starts since 4/01/2003, for the Croatian Zagreb Stock Exchange Crobex Index – since 6/17/2002, and for the Bulgarian Stock Exchange Sofix Index – in 10/24/2000.

Table 1. A list of countries and stock market indexes included in data sample

Country (country code)	Stock market index	Description of stock market index
Bulgaria (BGR)	SOFIX Index	The Bulgaria Stock Exchange Sofix Index is a free float market capitalization weighted index representing the most liquid companies listed on the exchange. The market capitalization of each company should not be less than BGN 50 million.
Czech Republic (CZE)	PX Index	The Prague Stock Exchange PX Index is the official index of the Prague Stock Exchange. The index was calculated for the first time on March 20, 2006 when it replaced the PX50 and PX-D indices. The index took over the historical values of the PX50 index. The starting date was April 5, 1994 with a base of 1000 points. As of 24 Sep 2012, composition fully reflects the free float of members due to methodology changes.
Croatia (HRV)	CROBEX Index	Croatia Zagreb Stock Exchange Crobex Index is a capitalization-weighted index, capped at a maximum 20% weighting of the index capitalization. The index was designed to measure price movements of shares listed on the Zagreb Stock Exchange. CROBEX was developed with a base level of 1000 for the base period beginning September 1, 1997.
Estonia (EST)	OMX TALLINN Index	The Estonia Stock Exchange OMX Tallinn Index is a capitalization weighted chain-linked total return index which includes all the shares listed on the Main & Secondary lists on the Tallinn Stock Exchange. The aim of the index is to reflect the current status & changes on the Tallinn market (base date is June 3, 1996, with value of 100).
Hungary (HUN)	BUX Index	The Budapest Stock Exchange BUX Index is a capitalization-weighted index adjusted for free float. The index tracks the daily price only performance of large, actively traded shares on the Budapest Stock Exchange. The shares account for 58% of the domestic equity market capitalization. The index has a base value of 1000 points as of January 2, 1991.
Latvia (LVA)	OMX RIGA Index	The Latvia Stock Exchange OMX Riga Index is an all-share index consisting of all the shares listed on the Main & Secondary lists on the Riga Stock Exchange in Latvia with exception of the companies where a single shareholder controls at least 90% of the outstanding shares. The aim of the index is to reflect the current status & changes on the Riga market (base date is December 31, 1999, with a value of 100).
Lithuania (LTU)	OMX VILNIUS Index	The Lithuania Stock Exchange OMX Vilnius Index is a total return index which includes all the shares listed on the Main & Secondary lists on the Vilnius Stock Exchange. The aim of the index is to reflect the current status & changes on the Vilnius market (base date is December 31, 1999, with value 100).
Poland (POL)	WARSAW GENERAL Index	Warsaw Stock Exchange WIG Index is a total return index which includes dividends and pre-emptive rights (subscription rights). Index includes all companies listed on the main market, excluding foreign companies and investment funds (the index base value is 1000.00 as of April 16, 1991).
Romania (ROM)	BET Index	Bucharest Exchange BET Index is a capitalization weighted index, comprised of the 10 most liquid stocks listed on the BSE tier 1. The index is a price index and was developed with a base value of 1000 as of September 22, 1997.
Slovakia (SVK)	SAX index	The Slovak share SAX Index is a capital-weighted total return index that compares the market capitalization of a selected set of shares with the market capitalization of the same set of shares as of a given reference day. The index was developed with a base level of 100 on September 14, 1993.
Slovenia (SVN)	SBITOP Index	The Slovenia SBI TOP Index is the Slovenian blue-chip index. It is a free-float capitalization-weighted index comprising the most liquid shares traded at Ljubljana Stock Exchange. Each stock's weighting is capped at 30%. The index was developed with a base level of 1000 as of March 31, 2006.
Europe (EUR)	STOXX EUROPE 600 Index	The STOXX Europe 600 Index is derived from the STOXX Europe Total Market Index (TMI) and is a subset of the STOXX Global 1800 Index. With a fixed number of 600 components, the STOXX Europe 600 Index represents large, mid and small capitalization companies across 18 countries of the European region.
World (WRD)	MSCI ACWI Index	The MSCI ACWI Index is a free-float weighted equity index. It was developed with a base value of 100 as of December 31 1987. The index includes both emerging and developed world markets.

Source: Bloomberg

4. Research results

The trends of logarithmic returns of the CEECs stock exchanges indexes suggest that there are two episodes of extreme turmoil. The first episode of turmoil in CEECs stock markets can be identified during the period of 2000-

2002 while the second episode – during the period of 2008-2010. The dynamics of logarithmic returns of CEECs stock indexes suggest that these episodes could be resulted by common and system-wide external shocks.

The dynamic conditional correlation among the logarithmic returns of the CEECs stock indexes and two global indexes: STOXX EUROPE 600 Index and MSCI ACWI Index derived from DCC-GARCH (1,1) model suggest that the most integrated CEECs stock markets at regional level are Poland's, Czech Republic's, and Hungary's stock markets. However, the empirical results of this study show that the degree of regional integration of CEECs stock markets increases during financial turmoil periods, e.g. after the collapse of Lehman Brothers bank in United States (September-October, 2008), the Middle East financial markets crash (May 2006), Greek debt crisis (April 23, 2010), Portugal's debt crisis (May 16, 2011).

The empirical results of the dynamic conditional correlation suggest that the most integrated CEECs stock markets at global level are Poland's and Hungary's stock markets. Besides, the degree of global integration of CEECs stock markets are significant lower than regional integration. The higher degree of global and regional integration of Poland's, Czech Republic's, and Hungary's stock markets can be explained by higher development level of these stock markets comparing to other CEECs. The largest number of listed companies is on the Warsaw's stock exchange and the number is increasing every year and has reached 844 at the end of the 2012 suggesting about increasing potential of this stock market. The highest market capitalization/GDP ratio is observed in Warsaw's and Zagreb's stock exchanges (about 40 percent) while in other CEECs this ratio ranges between 4 percent in Latvia and 18 percent in Czech Republic. The largest stock market in the Central and Eastern Europe in terms of market capitalization is Warsaw's stock exchange (178 million of USD in 2012). The market capitalization of Warsaw's stock exchange increases every year. However, the size of other CEECs stock markets is relative small and ranges between 1 million of USD in Latvia and 37 in millions of USD in Czech Republic. The other stock market development indicators (turnover of stock market and turnover ratio) show that stock markets in Poland, Czech Republic and Hungary is more developed comparing to other CEECs stock markets. Overall, the indicators of stock market development demonstrate that stock markets in Poland, Czech Republic, Hungary, and Croatia are more developed comparing to other CEECs. The EU enlargement process, the introduction of the euro and the removal of exchange rate risk in most of the CEECs had only short lasting effect on CEECs stock markets.

The dynamic conditional standard deviations of the logarithmic returns of the CEECs stock indexes derived from DCC-GARCH (1,1) model suggest that dynamic conditional standard deviations of the logarithmic returns of the CEECs stock indexes are very unstable and time-varying except the Slovak share SAX Index and Warsaw Stock Exchange WIG Index. A high and time-stable value of the dynamic conditional standard deviation of the logarithmic return of the Slovak share SAX Index can be explained by the fact that the degree of regional and global integration of this stock market is very low. For this reason the impact of the external shocks on the Slovak stock market is very limited. The low and time-stable value of the dynamic conditional standard deviation of the logarithmic return of the Warsaw Stock Exchange WIG Index can be explained by the fact that the degree of global and regional integration of this stock market is the highest comparing to other CEECs countries. For this reason daily co-movements in major global stock markets reflect immediately on the Warsaw Stock Exchange and the impact of system-wide external shocks are less extreme. However, the highest value of conditional standard deviation of most CEECs stock markets was observed on 10/15/2008, a month after the collapse of Lehman Brothers bank in United States (September 15, 2008) suggesting that the beginning of banking crisis in USA was the most significant systemic shock transmitted to CEECs stock markets. In addition, the impact of other systemic events (the Middle East financial markets crash (May 2006), Greek debt crisis (April 23, 2010), Portugal's debt crisis (May 16, 2011)) was observed on some of CEECs countries.

5. Conclusions

The empirical results of this study suggest that the highest degree of global and regional integration of the stock markets was observed in Poland's, Czech Republic's, and Hungary's stock markets that can be explained by higher development level of these stock markets comparing to other CEECs. The collapse of Lehman Brothers bank in United States in 2008 was the most significant shock transmitted to CEECs stock markets. The empirical results also suggest that the transmission of other systemic shocks (the Middle East financial markets crash (May 2006), Greek debt crisis (April 23, 2010), Portugal's debt crisis (May 16, 2011)) was observed on some of CEECs countries.

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References

Baek, I.-M., & Jun, J. (2011). Testing Contagion of the 1997–98 Crisis in Asian Stock Markets with Structural Breaks and Incubation Periods. *Journal of Asian Economics*, 22(5), 356–368. doi:http://dx.doi.org/10.1016/j.asieco.2011.05.005

Brannas, K., De Gooijer, J. G., Lonnbark, C., & Soultanaeva, A. (2012). Simultaneity and Asymmetry of Returns and Volatilities: The Emerging Baltic States' Stock Exchanges. *Studies in Nonlinear Dynamics & Econometrics*, 16(1), 1–24. doi:http://dx.doi.org/10.1515/1558-3708.1855

Brannas, K., & Soultanaeva, A. (2011). Influence of News from Moscow and New York on Returns and Risks of Baltic States' Stock Markets. *Baltic Journal of Economics*, 11(1), 109–124. doi:http://dx.doi.org/10.1080/1406099x.2011.10840493

Dubinskas, P., & Stunguriene, S. (2010). Alterations in the Financial Markets of the Baltic Countries and Russia in the Period of Economic Downturn. *Technological and Economic Development of Economy*, 16(3), 502–515. doi:http://dx.doi.org/10.3846/tede.2010.31

Engle, R. (2002). Dynamic Conditional Correlation: A Simple Class of Multivariate Generalized Autoregressive Conditional Heteroskedasticity Models. *Journal of Business and Economic Statistics*, 20(3), 339–350. doi:http://dx.doi.org/10.1198/073500102288618487

Eun, C., & Shim, S. (1989). International Transmission of Stock Market Movements. *Journal of Financial and Quantitative Analysis*, 24, 241–256. doi:http://dx.doi.org/10.2307/2330774

Favero, C. A., & Giavazzi, F. (2002). Is the International Propagation of Financial Shocks Non-linear? Evidence from the ERM. *Journal of International Economics*, 57(1), 231–246. doi:http://dx.doi.org/10.1016/s0022-1996(01)00139-8

Koch, P. D., & Koch, T. W. (1991). Evolution in Dynamic Linkages across Daily National Stock Indexes. *Journal of International Money and Finance*, 10, 231–251. doi:http://dx.doi.org/10.1016/0261-5606(91)90037-k

Kuusk, A., Paas, T., & Viikmaa, K. (2011). Financial Contagion of the 2008 Crisis: Is There Any Evidence of Financial Contagion from the US to the Baltic States. *Eastern Journal of European Studies*, 2(2), 61–76. doi:http://dx.doi.org/10.1108/17465261211195883

Liu, A., & Pan, M-S. (1997). Mean and Volatility Spillover Effects in the US and Pacific-Basin Stock Markets. *Multinational Finance Journal*, 1, 47–62. doi:http://dx.doi.org/10.17578/1-1-3

Maneschiold, P. O. (2006). Integration between the Baltic and International Stock Markets. *Emerging Markets Finance and Trade*, 42(6), 25–45. doi:http://dx.doi.org/10.2753/ree1540-496x420602

Masood, O., Bellalah, M., Chaudhary, S., Mansour, W., & Teulon, F. (2010). Cointegration of Baltic Stock Markets in the Financial Tsunami: Empirical Evidence. *International Journal of Business*, 15(1), 119–132.

Mateus, T. (2004). The Risk and Predictability of Equity Returns of the EU Accession Countries. *Emerging Markets Review*, 5, 241–266. doi:http://dx.doi.org/10.1016/j.ememar.2004.03.003

Nakatani, T., & Terasvirta, T. (2009). Testing for Volatility Interactions in the Constant Conditional Correlation GARCH Model. *Econometrics Journal*, 12(1), 147-163. doi:http://dx.doi.org/10.1111/j.1368-423x.2008.00261.x

Nielsson, U. (2007). Interdependence of Nordic and Baltic Stock Markets. *Baltic Journal of Economics*, 6(2), 9–27. doi:http://dx.doi.org/10.1080/1406099x.2007.10840434

Nikkinen, J., Piljak, V., & Aijo, J. (2012). Baltic Stock Markets and the Financial Crisis of 2008–2009. *Research in International Business and Finance*, 26, 398–409. doi:http://dx.doi.org/10.1016/j.ribaf.2012.03.003

Soultanaeva, A. (2008). Impact of Political News on the Baltic State Stock Markets. *Umea Economic Studies*, 735, 1–21.

Syllignakis, M. N., & Kouretas, G. P. (2011). Dynamic Correlation Analysis of Financial Contagion: Evidence from the Central and Eastern European Markets. *International Review of Economics and Finance*, 20, 717–732. doi:http://dx.doi.org/10.1016/j.iref.2011.01.006