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THE DEGREE OF INTEGRATION OF EQUITY MARKETS IN CENTRAL EUROPE (NEW MEMBER EU COUNTRIES) WITH THE US AND UK EQUITY MARKETS

Abstract

The aims of paper are to aanalyze how closely Central European stock markets are integrated with the stock markets in the US,UK and the euro area and to investigate the correlation of changes in the US S&P500, UK FTSE100, DJ EUROSTOXX 50 yields on the yields of the Polish and other main Central European stock exchange markets. The authors has formulated following hypothesis: Czech, Hungarian and Polish equity markets are more integrated with the US and UK equity markets then with the euro area market. What are the implications of such close integration. What are the implications of such close integration. The econometric methods are applied in analysis. The analysis has confirmed hypothesis.

JEL Classification Code: **O52**.

Keywords: international financial market integration, financial markets, measures of financial markets integration, equity market, news-based measures.

Introduction

A key concept at the heart of every introductory economics text book is the issue of scarcity and the need to make choices. Every choice made has costs associated with it and agents make decisions based on all the available information to them at that point in time (Sloman, et.al 2014). In terms of financial markets this basic economic idea has become increasingly important as the ease of mov-

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ing funds between locations has improved dramatically. If capital markets are efficient then we will see an optimal allocation of money and credit as it searches out opportunities that will yield the maximum return compared to the related risks involved. Transactions costs will thus fall and growth potential will increase.

Up until the financial crisis that came to head 15 days after Lehman Brothers became the world's largest ever bankruptcy, markets had increasingly become more correlated. However, after September 29th 2008, this level of integration has gone into reverse. Added to this, central bank intervention has potentially distorted how financial resources are allocated by affecting the price of money (interest rates) and the free functioning of related markets.

This paper looks at how a number of stock markets in Eastern Europe have performed in relation to the major markets of the US, UK and the euro area. We consider how well integrated they became and analyse the impact of shocks across these financial markets over the period 1999 to 2015. We then consider the links relating to the respective yields of each market. Finally we analyse the actual and potential implications of these developments on the capital markets involved and how resource allocation (diversification) decisions might be affected.

The two main research aims of this paper are:

1. Analyse how closely Central European stock markets are integrated with the stock markets in the US, UK the euro area.
2. Investigate the correlation of changes in the US S&P500, UK FTSE100, DJ EUROSTOXX 50 yields on the yields of the Polish and other main Central European stock exchange markets.

The hypothesis tested is: Czech, Hungarian and Polish equity markets are more integrated with the US and UK equity markets then with the euro area market.

What are the implications of such close integration?

With financial deregulation that emerged initially in the UK and the US under the Thatcher and Reagan regimes and was further driven by globalisation forces after 1989, there has been increased integration between financial centres and capital flows (see Authers J. 2010). These more open markets coupled with central bank interventions have driven a number of coordinated global asset bubbles that reflect the increased integration and herding of capital flows. Our analysis into the linkages between stock markets will assist the development of understanding into issues over diversifying across different capital markets to mitigate risks. As Keynes wrote in 1934 it is important to understand in detail what you are investing and in where rather than just relying on diversification. As his biographer Harrod states (1951) „He selected investments with great care and boldly adhered to what he had chosen through evil days." This study, over the period 1999-2015, allows us to investigate how such correlations between two of the major financial centres could be related to some of the lesser developed ones. By analysing such

markets and correlations allows investors to understand how risk management techniques (such as diversification) can amplify risk rather than mitigate it. The role of regulators can also be questioned given the fact that it is so hard to know and understand what is going on in the markets that they cover and the interlinkages involved. Post Lehman Brothers many market participants are still using old ideas and past behaviours. The political risks involved are rising.

1. The concept and measures of the international stock market integration

To understand what the future might hold one must analyze the risks and opportunities within markets. If markets are mispricing risk it is vital to understand where we currently are, how we arrived here and what the future might hold. All major financial crises have been followed by political, social and cultural changes as societies take time to understand and adapt to the events and alterations occurring (see Ferguson 2008). This is especially true for the former communist countries who are still adapting to the market forces of capitalism that emerged just a generation ago. A result of this is that their stock markets are still evolving as a way of offering companies the opportunity to list and raise money to fund growth plans.

Well-functioning and well regulated markets still provide the best mechanism for organizing, valuing and allocating scarce resources. Thus it is important to understand how different stock markets work and interact with each other. At times markets can become overly synchronised and overshoot. Our analysis will help us to understand how markets can be made to work better and thus improve national and global welfare.

The so called 'great moderation' which saw the longest periods of uninterrupted economic growth in the US and the UK led to the belief that macroeconomic policy could manage the business cycle and lead to an end of 'boom and bust.' As a result the correlation between asset classes within and across countries rose.

The following chart from Haldane (2013) illustrates one measure of global market integration over the past 100 years – „the correlation between national saving and investment rates in a set of countries. A value of one signals financial autarky – countries fully reliant on domestic saving to finance investment. A value of zero signals perfect financial integration – countries financing local investment globally." Up until the 1980s global financial integration was limited. Post 1980 with increased financial liberalization correlations between national saving and investment began falling. In 2007 they reached zero, „bliss point for global capital market integration." Since then this trend has gone into reverse as nation states brought money home.

Haldane (2013) then comments on the possible costs of such a retreat with reference to the impacts in the aftermath of the First World War when „trade barriers were erected, capital flows restricted, [and] immigration controls imposed."

Globalisation had appeared to have led to liquid markets that could accurately price risk and these risks could then be traded and passed on to those willing to take them on. Correlations rose across different markets and not just across stock exchanges. Up until 2000 such correlations were rare as stocks were mainly just traded and owned by those within that country. Authers (2010) claims that such diverse markets should not have shown such close correlations „as they should have nothing in common, this implies that neither market is being priced effectively. Instead, these entangled markets are driven by the same investors, using the same flood of speculative money."

Despite the level of correlation falling many financial markets remain highly correlated by historic standards. Often these correlations are driven by the actions of unelected central bankers. The events of September 2008 can be claimed to be the first truly global event as all markets crashed together. Thus if increased integration is being artificially enforced the consequences of any correction/s could be extremely severe as capital makes a flight to liquidity and 'safe' havens. This investigation will consider the integration between a number of Central European markets and those in the UK and the UK so to give insights into this process over the period 1999 to 2015.

If central bank intervention is driving asset prices away from their fundamental values then it is only a matter of time before the next global crash. Quantitative easing and a zero interest rate policy could be leading to a misallocation of scarce resources and further booms and busts. The end results could have huge social costs. So understanding the linkages between stock markets will offer insights for risk management and the protection of value at a national and individual level. If all markets are correlated then the ability to diversify and manage risks becomes more limited.

Fundamentals should drive asset prices (Malkeil 2008). This paper will consider whether such fundamental drivers of value such as yields have changed across nations, and whether increased correlations are a concern.

Financial integration has costs as well as benefits but most studies agree that the benefits outweigh the costs (see Agenor 2003). With the launch of the euro this is of increasing importance. Work on optimal currency areas (OCAs) led by Mundel (1961) state that for a currency area to work there has to be significant integration and synchronization between participating nations. Financial integration is a key requirement. As Babecky et al. (2008) state, „The more integrated financial markets are, the more effectively monetary policy is transmitted through the financial system."

With integration and synchronization macro shocks can be countered by common monetary policy. „In the case of new EU member states, which are committed to adopting the euro at some point, it is especially important to analyze the alignment of their markets, including financial ones, with those of the euro area countries." (Babecky et al. 2008).

The example of recent events in Greece illustrate the huge social costs if such integration is not in fact there (for example see Basu & Stuckler, 2014)

The concept of financial market integration and its degree is widely defined. All stock markets differ in terms of maturity, liquidity, openness, size, regulation, etc. Baele et al. (2004) propose to quantify financial integration using three different dimensions. Firstly, price based methods which involves a direct check of the law of one price on the condition that the compared assets have similar characteristics. Secondly by news-based methods that makes possible the identification of existing market imperfections such as frictions and barriers. Lastly via quantity based methods which qualifies the effects of mainly legal and other non-price barriers from both the demand and supply sides of the investment decision making process.

In this paper we will use a price and news based approach but it is important to understand that other methods are possible.

Stock market integration can be defined in the narrow way according to the law of one price. Application of the law of one price means that the assets generating identical monetary flows have the same price (rate of return/yield). In the case of shares in two countries (regions) the price of the capital raised on financial markets by issuing shares should be the same (see: Adam et. al., p. 4). In accordance with the broader definition of the financial market integration put forward by Baele et.al (see: Baele et. al, 2004, pp. 6-7), stock markets are considered fully-integrated if all the possible economic agents involved in transactions at the same price:

- are governed by the same rules when they decide to participate in share trading,
- have equal access to shares,
- are treated equally when they operate on the market, that is all have equal access to the information available.

Such a broad approach to financial market integration implies also the functioning of the law of one price. The law of one price states that assets are characterized by identical risks and yields. The quoted definition comprises the law of one price. If the law of one price is not met then there is room for arbitrage which restores validity of the law (on condition there are no barriers for the financial market integration) (see: Baele et.al., 2004, p. 7; Kowalak, 2006, pp. 34-38).

The following measures of the stock market integration degree can be distinguished:

- price and yield based measures,
- news-based measures.

Price and yield based measures include measures of spreads between prices and yields on assets across different national financial markets. The theoretical basis for the construction of such indices is the law of one price. The indices let us test the degree to which the law is implemented on the international scale. If assets have the same or similar characteristics then we can directly compare prices or yields. Otherwise, the measures of this type must also reflect the influence of factors specifically related to the markets in particular countries, differences in the systematic risk levels and the degree of liquidity.

News-based measures analyse the impact of information concerning shocks on financial markets and the investment risk related to them. In fully integrated markets investment portfolios should be well-diversified. The information coming from local markets should not have a significant effect on prices of assets contrary to global news concerning the entire integrated market, which has a significant effect on price changes. The degree of systematic risk is the same in different countries whose markets have become integrated. Thus, the measures from this group indicate to what extent the information specific for the local financial market is essential for the remaining markets in comparison to the effect of the information of global nature that impacts all markets (see: Baele et.al, 2008, p. 20; Kowalak 2006, p. 38 and onwards). In the case of the stock market, a model of the „increased impact of the common news component on stock market yields" is such a measure. The „common news component" is the news concerning changes in yields from the US stock market indices (global news). In the euro area the common news component is the news concerning changes in yields from the broad stock exchange index DJ EUROSTOXX corrected by the influence of the global „news" impact, i.e. from the US stock market. Similarly with regards the UK stock market, Europe's largest and most developed. The higher the degree of particular countries' stock market integration with the global market, the lower the impact of local (domestic) turbulences on shaping the yields on assets in that country but the higher is the impact of global factors (information, signals) coming from the United States.

In the case of the euro area countries, the larger the impact of common factors (the common „news" component) for the euro area than the local (specific for the particular countries of the euro area) ones on shaping the yields in the domestic stock markets, the higher the integration degree for these countries is. Similarly, if the examined countries are from outside the euro area, then the larger the impact of the common component for the euro area on shaping the stock market yields in these countries, the higher the integration degree between their markets and the euro area market. On the other hand, the impact of the „news" from the US market will define the integration degree between a given market and the global market (see: Bukowski 2011, p. 46-47).

The model of the „increased impact of the common news component on stock market yields" assumes the following form (see: Baele et.al., 2004, p. 20-21; Baltzer et. al., 2008, p. 8-10):

$$R_{i,t} = \mu_{i,t} + \varepsilon_{i,t}$$

where: $R_{i,t}$ – is the rate of return on assets (yield from the stock exchange index) for a country i at time t, expected yield element $\mu_{i,t} = \alpha_{i,t} + \gamma R_{i,\,t-1}$, $\varepsilon_{i,t}$ – unexpected yield element.

The unexpected element ($\varepsilon_{i,t}$) can be further decomposed into a purely local shock $e_{i,t}$ at the stock exchange of a given country i at time t and the stock exchange response in a given country i over time t to the information from the euro area stock exchanges ($e_{eu,t}$) and global stock exchanges ($\varepsilon_{us,t}$) (from the US stock exchanges):

$$\varepsilon_{i,t} = e_{i,t} + \beta_{i,t}^{eu} e_{eu,t} + \beta_{i,t}^{us} \varepsilon_{us,t}$$

where: $\beta_{i,t}^{eu}$ and $\beta_{i,t}^{us}$ indicate dependent on a country i at time t sensitivity to information concerning yields in the euro area and the United States (global), respectively. The magnitude of both coefficients is a measure of the intensity with which the shocks originating in the euro area and the United States (global shocks), respectively, spread to the markets of a country i.

To compare the relationship between shocks in the euro area and in the United States and the yields in particular countries we calculate the proportion of yield variances in the market of a given country explained by the shocks in the euro area and the United States.

Assuming that local shocks in a country i are of idiosyncratic nature (they are not correlated with shocks in other countries or indices in the euro area and the United States, adopted as a benchmark), we can calculate the variance for a country i.

$$\sigma_{i,t}^2 = h_{i,t} + (\beta_{i,t}^{eu})^2 \sigma_{eu,t}^2 + (\beta_{i,t}^{us})^2 \sigma_{us,t}^2$$

where $h_{i,t}$ is the conditional variance of the local shock element, $\sigma_{eu,t}^2$ is the conditional variance for the euro area market, $\sigma_{us,t}^2$ – is the conditional variance for the US market. On this basis the following ratios are computed which give, respectively the proportion of variance for country i equity returns explained by euro area wide and global factors:

– Euro area variance ratio

$$VR_{i,t}^{eu} = \frac{(\beta_{i,t}^{eu})^2 \sigma_{eu,t}^2}{\sigma_{i,t}^2} = \rho_{i,eu,t}^2$$

– Global variance ratio

$$VR_{i,t}^{us} = \frac{(\beta_{i,t}^{us})^2 \sigma_{us,t}^2}{\sigma_{i,t}^2} = \rho_{i,us,t}^2$$

The conditional variances for the euro area, the United States and the local stock market are obtained from the standard GARCH(1,1) model.

The higher the value of the yield variance proportion (the higher the ratio of the euro area or the US shock to the local shock impact), the higher the degree of stock market integration.

2. Analysis of the equity market integration – USA, UK, euro area and Central European new EU member countries including Poland

2.1. Data and model

In our examinations we used monthly data for the period: 1990:1 – 2015:8 concerning yields of the following indices:

1. S&P 500
2. DJ EUROSTOXX 50
3. FTSE 100
4. CECE EUR
5. WIG 20

Changes in yields on the S&P 500 were treated as global news (signal/shock), as in the case of the investigations and statistics of the European Central Bank concerning equity market integration (see: Financial Integration in Europe, April, Statistical Annex. ECB 2015). The DJ EUROSTOXX 50 is an index based around 50 euro area blue chip companies. The CECE EUR is a proxy of equity markets in Central European countries. This index covers the main companies from Poland, Hungary and the Czech Republic. The FTSE 100 represents the UK equity market and the WIG 20 the Polish stock market. The data sources utilised were the ECB database (Statistical Data Warehouse) and data from the Warsaw Stock Exchange[3].

To measure the degree of stock exchange integration we applied the measures based on a model of the „increased impact of the common news component on equity market yields" i.e. the above mentioned measures of the global shock spillover and yield variance proportion. We constructed the following 6 models:

1. US - euro area v CE which covers the integration of the US and the euro area markets with the Central European equity market.

[3] www.stooq.pl and www.stoxx.com

2. US - UK v CE which covers the integration of the US and the UK markets with the Central European equity market.
3. US - euro area v PL which covers the integration of the US and the euro area markets with the Polish equity market.
4. US - UK v PL which covers the integration of the US and the UK markets with the Polish equity market.
5. US – euro area- UK v CE which covers the integration of the US and the UK markets with the Central European equity market.
6. US - euro area- UK v PL which covers the integration of the US, euro area and the UK markets with the Polish equity market.

The models were estimated in three stages by means of the GARCH (1,1) process[4]. Firstly, the equation for the US market yields was estimated[5]:

$$R_{us,t} = \mu_{us,t} + \varepsilon_{us,t}$$

where: $R_{us,t}$ – equity market yield (on the stock exchange index) in the US over time t,
the expected yield component $\mu_{i,t} = \alpha_{i,t} + \gamma_i R_{us,t-1}$,
$\varepsilon_{i,t}$ – the unexpected yield component.

Secondly the conditional variance for the US market was estimated:

$$E(\varepsilon^2_{us,t}) \equiv \sigma^2_{us,t}$$

where $E(.)$ is the expected value operator.

Then we establish an estimation of the euro area market yield equation and UK yield equation:

Euro area market yield equation:

$$R_{eur,t} = \mu_{eur,t} + \varepsilon_{eur,t}$$

where: $\mu_{eur,t} = \alpha_{eur,t} + \gamma_{eur} R_{eur,t-1}$,
and $\varepsilon_{eur,t} = \beta^{us}_{eur}\, \varepsilon_{us,t} + e_{eur,t}$,
$e_{eur,t}$ – pure local shock.

The conditional variance takes the form of:

$$E(\varepsilon^2_{eur,t}) \equiv \sigma^2_{eur,t}$$

[4] With regards the subject of the GARCH (1,1) model application for examining the relationships between the yields on equity market indices see more in: (Brzeszczyński, Kelm, 2002: 95-119; Jajuga, 2008; Mills, Markellos, 2008: 182, 323 and onwards).

[5] With regards the model of the „increased impact of the common news component on the equity market yields" see more: (Baele et al., 2004: 20-21; Baltzer et al., 2008: 8-10, Bukowski, 2011: 46-47).

UK market yield equation:

$$R_{uk,t} = \mu_{uk,t} + \varepsilon_{uk,t}$$

where: $\mu_{uk,t} = \alpha_{uk,t} + \gamma_{uk} R_{uk,t-1}$,

and $\varepsilon_{uk,t} = \beta_{uk}^{us} \varepsilon_{us,t} + e_{uk,t}$,

$e_{uk,t}$ – pure local shock.

The conditional variance takes the form of:

$$E(\varepsilon_{uk,t}^2) \equiv \sigma_{uk,t}^2$$

In the last stage the yields for the Central European market (eur) and the Polish (pl) equity market were estimated (i= ce, pl respectively):

$$R_{i,t} = \mu_{i,t} + \varepsilon_{i,t}$$

where: $\varepsilon_{i,t} = \beta_i^{us} \varepsilon_{us,t} + \beta_i^{eur} e_{eur,t} + e_{i,t}$,

$\mu_{i,t} = \alpha_{i,t} + \gamma_{i,t} R_{i,t-1}$,

or if UK market is included:

$$\varepsilon_{i,t} = \beta_i^{us} \varepsilon_{us,t} + \beta_i^{eur} e_{eur,t} + \beta_i^{uk} e_{uk,t} + e_{i,t}$$

$\mu_{i,t} = \alpha_{i,t} + \gamma_{i,t} R_{i,t-1}$,

$e_{i,t}$ – pure local shock and the conditional variance $E(\varepsilon_{i,t}^2) \equiv \sigma_{i,t}^2$.

$\beta_{i,t}^{eur}$ and $\beta_{i,t}^{us}$ indicate a dependence on the Central European or Polish market over time t sensitivity to information concerning yields in the euro area and the United States, respectively. The magnitude of both coefficients is a measure of intensity with which the shock originating in the euro area and the United States (global shocks), respectively, spillover into the Polish or Central European equity markets.

Then the variance ratio was computed:

$$VR_{i,t}^{eur} = \frac{(\beta_{i,t}^{eur})^2 \sigma_{eur,t}^2}{\sigma_{i,t}^2} = \rho_{i,eur,t}^2, \quad VR_{i,t}^{us} = \frac{(\beta_{i,t}^{us})^2 \sigma_{us,t}^2}{\sigma_{i,t}^2} = \rho_{i,us,t}^2, \quad VR_{i,t}^{uk} = \frac{(\beta_{i,t}^{uk})^2 \sigma_{uk,t}^2}{\sigma_{i,t}^2} = \rho_{i,uk,t}^2$$

Conditional variances for the euro area, the United States, UK and the local equity market are obtained from the standard GARCH (1,1) model.

The higher the value of the yield variance ratio (the higher the ratio of the euro area or US shock to the local shock impact) implies the higher the Polish and Central European equity market integration degree with the one or the other equity market is.

2.2. Results

2.2.1. Time series cointegration

The Engle-Granger cointegration test indicates that time series of the yields of S&P 500 Index (R_{us}), DJ Eurostoxx 50 Index(R_{eur}), WIG 20 – Warsaw Stock

Exchange 20 Index (R_{pl}), over the period 1999:1-2015:8 are cointegrated. Time series of yields of S&P 500 Index (R_{us}), DJ Eurostoxx 50 Index (R_{eur})and yields of CECE EUR index (R_{ce}) are also cointegrated. The same concern the time series of S&P 500 Index (R_{us}), DJ Eurostoxx 50 Index (R_{eur}), FTSE 1000 (R_{uk}), time series of yields from S&P 500 Index (R_{us}), FTSE 100 (R_{uk}), CECE EUR index (R_{ce}), of yields from S&P 500 Index (R_{us}), FTSE 1000 (R_{uk}), WIG 20 – Warsaw Stock Exchange 20 Index (R_{pl}) (see table below).

Table 1. Results of Engle-Granger cointegration tests for periods: 1999:2-2015:8, sample N = 199

Period	1999:1-2015:8
Time series	R_{us}, R_{eur}, R_{ce}
Model:	(1-L)y = (a-1)·y(-1) + ... + e Test with constant and linear trend
Autocorrelation of first rank =	0,0024
Estimated value (a-1) =	-0,85596
Test statistics tau =	-3,45684
Asymptotic value p =	0,2152
Critical value tau = (Dickey-Fuller tables)	-3,43 with significance level = 0,05
Time series	R_{us}, R_{eur}, R_{pl}
Model:	(1-L)y = (a-1)·y(-1) + ... + e Test with constant and linear trend (first differences)
Autocorrelation of first rank =	0,026
Estimated value (a-1) =	-0,84465
Test statistics tau =	-3,59784
Asymptotic value p =	0,1651
Critical value tau = (Dickey-Fuller tables)	-3,43 with significance level = 0,05
Time series	R_{us}, R_{uk}, R_{ce}
Model:	(1-L)y = (a-1)·y(-1) + ... + eTest with constant and linear trend (first differences)
Autocorrelation of first rank =	0,066
Estimated value (a-1) =	-0,948103
Test statistics tau =	-5,27356
Asymptotic value p =	0,001063
Critical value tau = (Dickey-Fuller tables)	-3,43 with significance level = 0,05
Time series	R_{us}, R_{uk}, R_{pl}
Model:	(1-L)y = (a-1)·y(-1) + ... + eTest with constant and linear trend (first differences)
Autocorrelation of first rank =	0,011
Estimated value (a-1) =	-0,960073
Test statistics tau =	-5,35751
Asymptotic value p =	0,0007546
Critical value tau = (Dickey-Fuller tables)	-3,43 with significance level = 0,05

Table 1 continued.

Time series	R_{us}, R_{eur}, R_{uk}
Model:	(1-L)y = (a-1)·y(-1) + ... + eTest with constant and linear trend (first differences)
Autocorrelation of first rank =	0,018
Estimated value (a-1) =	-0,853134
Test statistics tau =	-3,46054
Asymptotic value p =	0,2138
Critical value tau = (Dickey-Fuller tables)	-3,43 with significance level = 0,05

Source: own calculations.

2.2.2. The yields in the first glance

The analysis of fig. 1 substance indicates interesting results about correlations in yields of indexes. First of all, we can observe that yields of S&P 500 DJ Eurostoxx 50 Index and FTSE 100 are highly correlated. The yield of the CECE EUR index, WIG 20 are less correlated with the yields of the S&P 500, DJ Eurostoxx 50 Index and the FTSE 100.

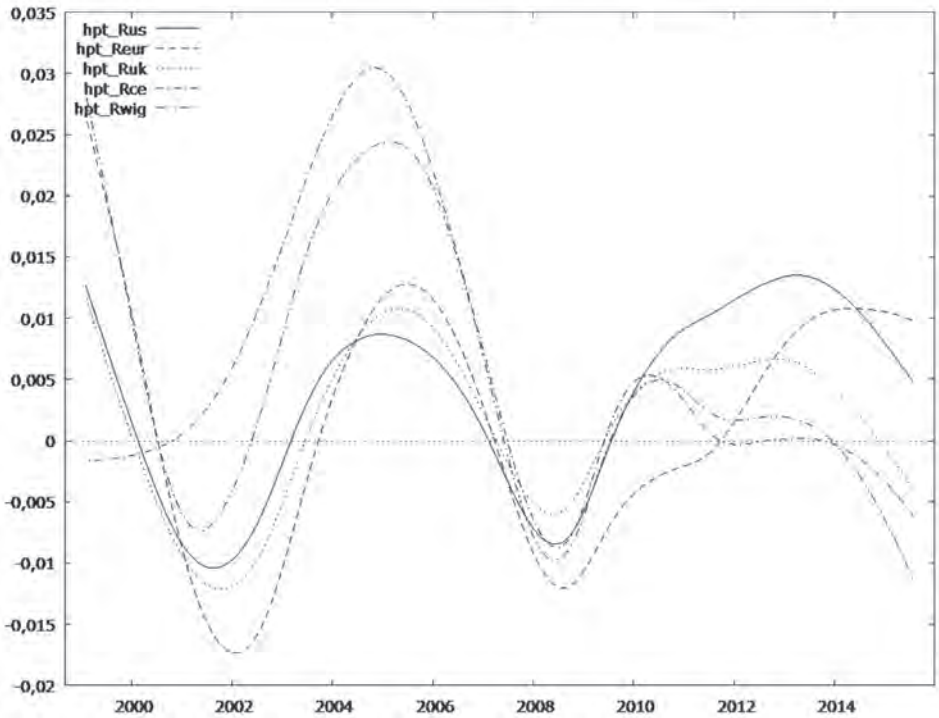

Figure 1. Yields of S&P 500 (R_{us}), DJ Eurostoxx 50 Index(R_{eur}), FTSE 100 (R_{uk}), CECE EUR index (R_{ce}), WIG 20 (R_{pl}), ver the period 1999:2-2014:12, smoothed by means of the Hodrick- Prescott (λ=14400) filter

Source : own.

2.2.3. Model: US – euro area v CE. The integration of the US and the euro area markets with the Central European equity market

The analysis of the results of this model emphasise that the intensity of US shock spillover effects are stronger then the intensity of euro area shock spillover effects (see fig. 3).

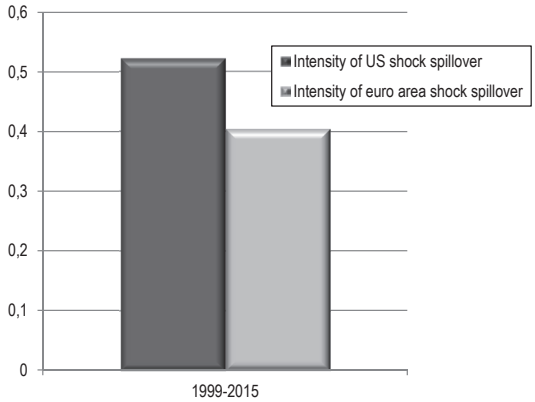

Figure 2. Intensity of the global shock spillover (from the United States) and the euro area shock spill-overs on the Central European market – new members equity market, measured by $\beta_{ce,t}^{us}$, $\beta_{ce,t}^{eur}$ coefficients in the period of 1999-2015

Source: author's own compilation on the basis of the estimation of the model of the „increased impact of the common news component on the equity market yield" with the use of the GRETL program.

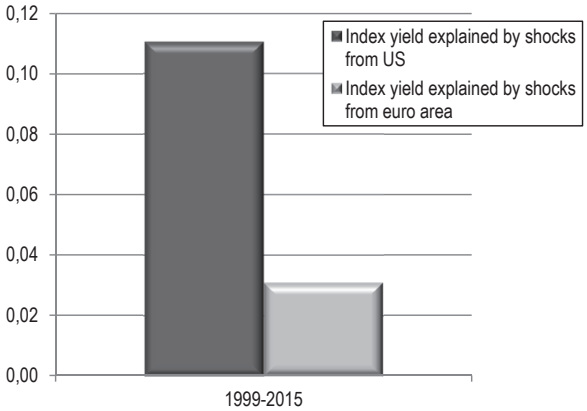

Figure 3. Central European – new member countries equity market – variance ratio for the CECE EUR index yield explained by shocks from the euro area ($VR_{ce,t}^{eur}$) and the United States ($VR_{ce,t}^{us}$) in the period 1999-2015

Source: author's own compilation on the basis of the estimation of the model of the „increased impact of the common news component on the equity market yield" with the use of the GRETL program.

The yields of the index for the CECE EUR is explained generally by the changes in the yields of S&P 500 index. Only in about 3,5% of the changes in the yields of DJ EUROSTOXX is explained in the research period due to the changes of the yields of the CECE EUR index (see fig. 2).

2.2.4. Model: US –UK v CE which covers the integration of the US and the UK markets with the Central European equity market.

It is interesting to note that shocks from the UK market (measured by the changes of yields of FTSE 100) have a much stronger influence on changes of yields in Central European Countries (Poland, Hungary, Czech) compared with shocks from the US market (see fig. 4 and 5).

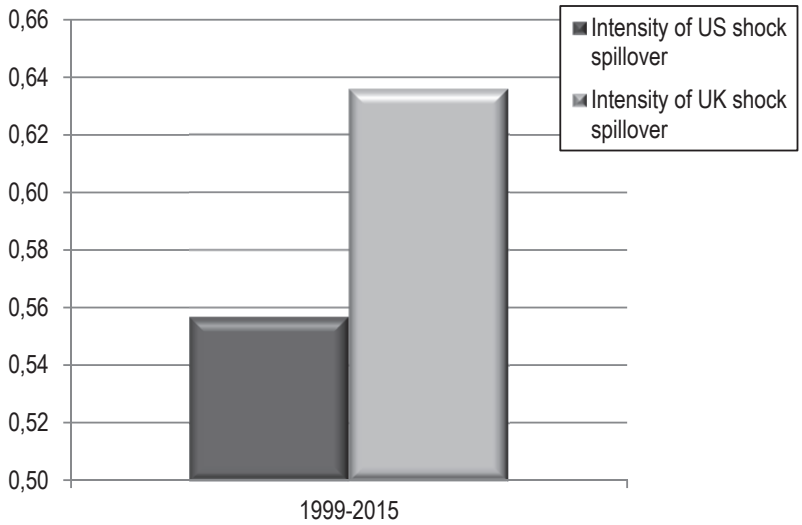

Figure 4. Intensity of the global shock spillover (from the United States) and the UK shock spillover on the Central European market (new members equity market) measured by $\beta_{ce,t}^{us}$, $\beta_{ce,t}^{uk}$ coefficients in the period of 1999-2015

Source: author's own compilation on the basis of the estimation of the model of the „increased impact of the common news component on the equity market yield" with the use of the GRETL program.

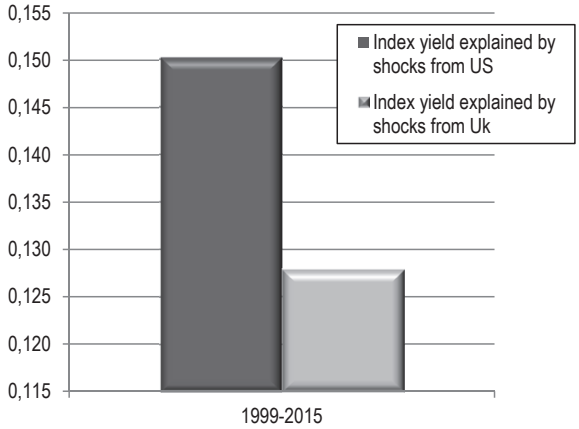

Figure 5. Central European – new member countries equity market – variance ratio for the CECE EUR index yield explained by shocks from the United Kingdom ($VR^{uk}_{ce,t}$) and the United States ($VR^{us}_{ce,t}$) in the period 1999-2015

Source: author's own compilation on the basis of the estimation of the model of the „increased impact of the common news component on the equity market yield" with the use of the GRETL program.

2.2.5. Model: US - euro area v PL which covers the integration of the US and the euro area markets with the Polish equity markets

In the case of Poland the situation is similar. The intensity of US shocks spillover is higher then the intensity of euro area shocks (see fig. 6 and 7).

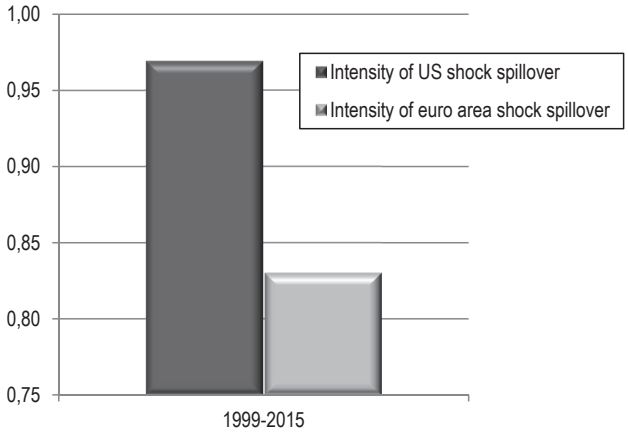

Figure 6. The intensity of global shock spillover (from the United States) and the euro area shock spillovers on the Polish equity market, measured by $\beta^{us}_{pl,t}$, $\beta^{eur}_{pl,t}$ coefficients in the period of 1999-2015

Source: author's own compilation on the basis of the estimation of the model of the „increased impact of the common news component on the equity market yield" with the use of the GRETL program.

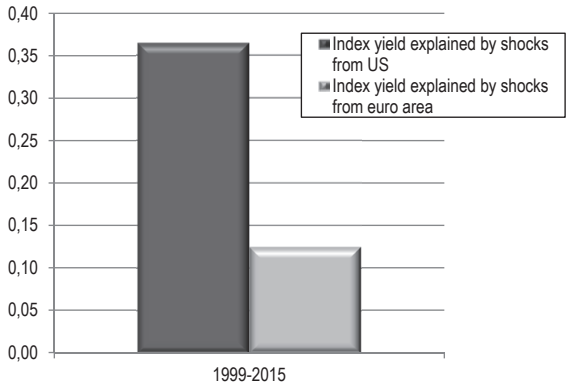

Figure 7. Polish equity market – variance ratio for the WIG 20 index yield explained by shocks from the euro area ($VR^{eur}_{pl,t}$) and the United States ($VR^{us}_{pl,t}$) in the periods 1999-2015

Source: author's own compilation on the basis of the estimation of the model of the „increased impact of the common news component on the equity market yield" with the use of the GRETL program.

Changes of the yields of WIG 20 are explained especially by shocks from US. The influence of those shocks is much stronger then shocks from euro area.

2.2.6. Model: US-UK v PL which covers the integration of the US and the UK markets with the Polish equity market

The intensity of shocks from the UK market impacting the equity market in Poland is much higher than for shocks from the US (see fig. 8).

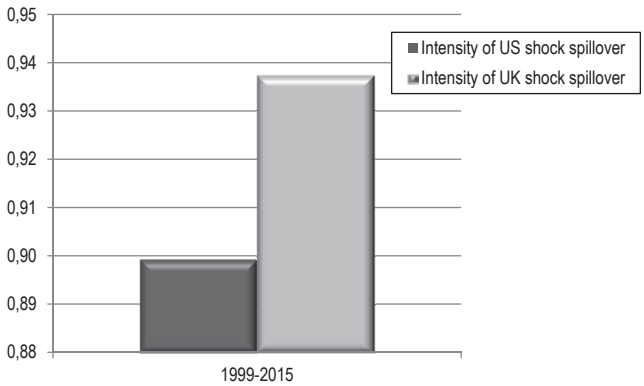

Figure 8. Intensity of global shock spillovers from the United States and the United Kingdom on the Polish equity market, measured by $\beta^{us}_{pl,t}$, $\beta^{uk}_{pl,t}$ coefficients in the period 1999-2015

Source: author's own compilation on the basis of the estimation of the model of the „increased impact of the common news component on the equity market yield" with the use of the GRETL program.

The changes in the yields of the WIG 20 are in higher degree explained by shocks from US then from UK (see fig. 9).

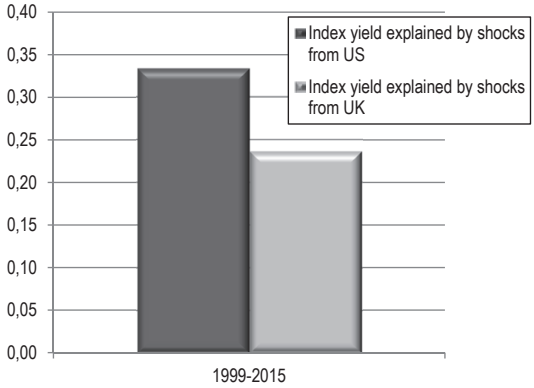

Figure 9. Polish equity market – variance ratio for the WIG 20 index - yield explained by shocks from the United Kingdom ($VR_{pl,t}^{uk}$) and the United States ($VR_{pl,t}^{us}$) in the period 1999-2015

Source: author's own compilation on the basis of the estimation of the model of the „increased impact of the common news component on the equity market yield" with the use of the GRETL program.

2.2.7. Model: US – euro area – UK v CE which covers the integration of the US, the UK and the euro area markets with the Central European equity market

In this model the whole influence of shocks from the US, the UK and the euro area markets has been taken into account (see fig. 10 and 11).

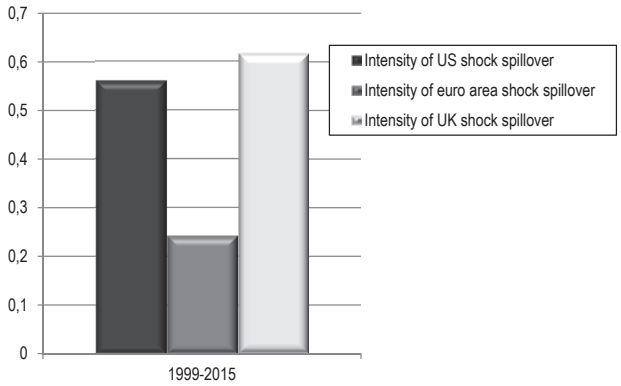

Figure 10. The intensity of global shock spillover (from the United States), the euro area and the United Kingdom on the Central European, new members, equity markets, measured by $\beta_{ce,t}^{us}$, $\beta_{ce,t}^{eur}$, $\beta_{ce,t}^{uk}$ coefficients in the period of 1999-2015

Source: author's own compilation on the basis of the estimation of the model of the „increased impact of the common news component on the equity market yield" with the use of the GRETL program.

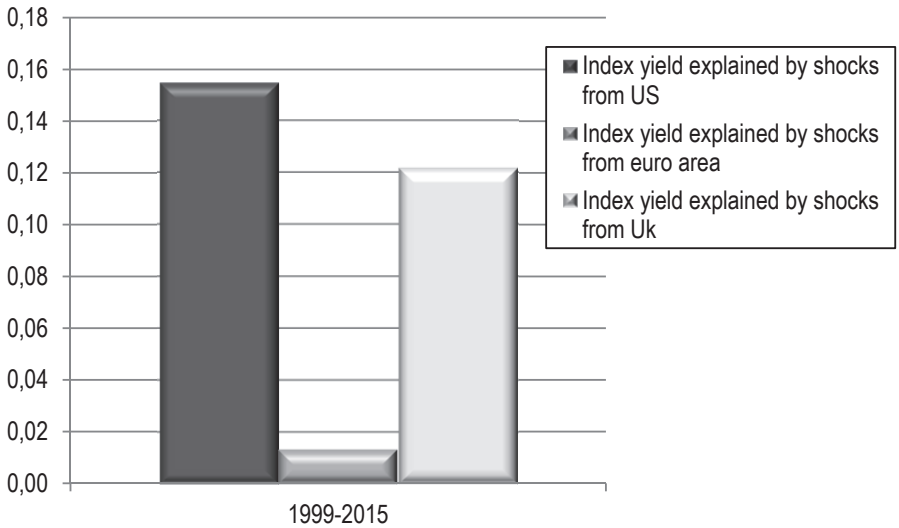

Figure 11. Central European – new member countries equity market – variance ratio for the CECE EUR index yield explained by shocks from the euro area($VR^{eur}_{ce,t}$), United Kingdom ($VR^{uk}_{ce,t}$) and the United States ($VR^{us}_{ce,t}$) in the period 1999-2015

Source: author's own compilation on the basis of the estimation of the model of the „increased impact of the common news component on the equity market yield" with the use of the GRETL program.

The intensity of the UK shock spillover is higher than the intensity of the US and the euro area shock spillovers.

It is remarkable that the intensity of euro area shock spillover is much lower then in the influence of US shocks and UK shocks given the expected closer integration in this area due to the closer locations. This results illustrates the importance of the developed markets in the US and the UK in influencing other markets and capital flows. The changes of the yields of CECE EUR index are explained in the main part by the shocks from US and UK.

2.2.8. Model: US - euro area- UK v PL which covers the integration of the US, euro area and the UK with the Polish equity market

In the case of Poland situation is similar to that described above (see fig. 12 and 13). There is a clear domination intensity of the strength of the US and UK shock spillovers when compared to those spillovers emanating from the euro area markets.

The changes in the yields of WIG 20 are explained generally by the shocks from US and UK. The influence of the shocks from euro area is very low.

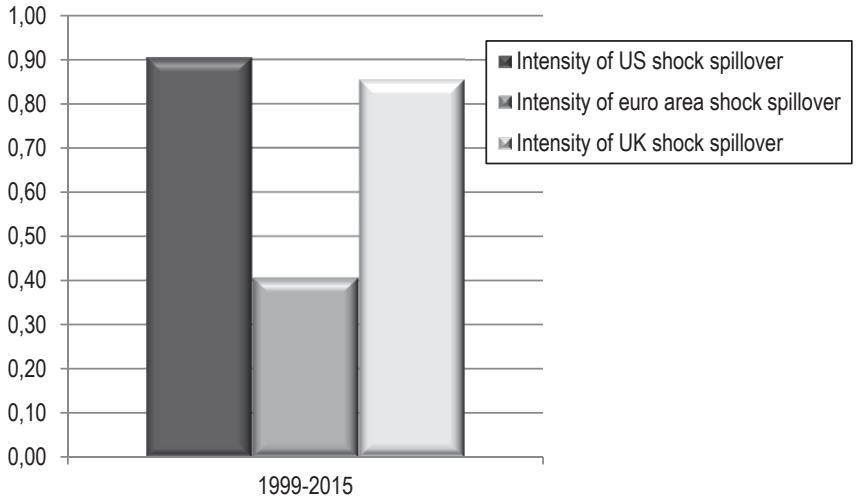

Figure 12. The intensity of global shock spillovers (from the United States), the euro area and the United Kingdom on the Polish equity market, measured by $\beta_{ce,t}^{us}$, $\beta_{ce,t}^{eur}$, $\beta_{ce,t}^{uk}$ coefficients in the period of 1999-2015

Source: author's own compilation on the basis of the estimation of the model of the „increased impact of the common news component on the equity market yield" with the use of the GRETL program.

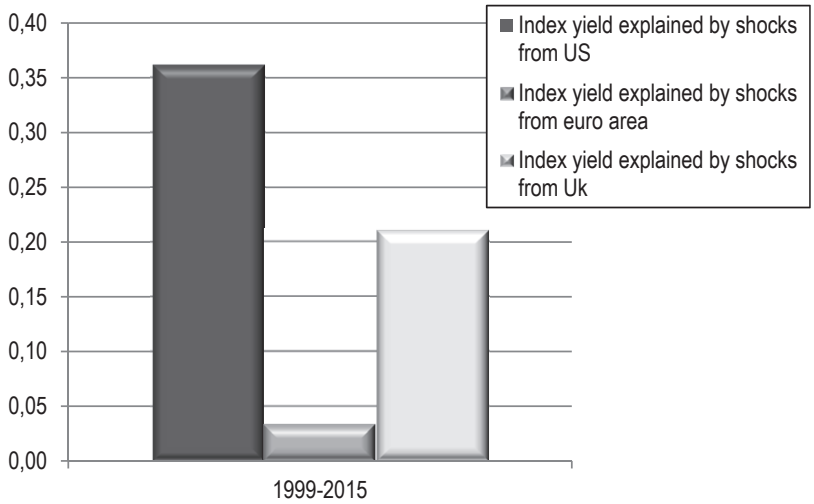

Figure 13. Polish equity market – variance ratio for the CECE EUR index yield explained by the shocks from the euro area ($VR_{ce,t}^{eur}$), United Kingdom ($VR_{ce,t}^{uk}$) and the United States ($VR_{ce,t}^{us}$) in the period 1999-2015

Source: author's own compilation on the basis of the estimation of the model of the „increased impact of the common news component on the equity market yield" with the use of the GRETL program.

Conclusions

The hypothesis tested within this paper analysed the linkages between the Polish, Hungarian and Czech equity markets with those in the US, the UK and the euro area. The key finding is that these emerging markets stock markets are more closely integrated with US equity market and UK equity market then with the euro area equity market, their closer neighbour. What are the possible reasons?

It is very difficult to find answer in regards to the framework of the classical theories of finance. Also, as stated, it is hard to fully compare markets due to differences in their composition, liquidity and regulation. Further investigation in the realms of behavioural finance (complex adaptive systems) and the psychology of financial markets could offer deeper explanations. The increased importance of the US market could also be explained by the power of the Federal Reserve and the policies that it has followed after the collapse of Lehman Brothers on 14-9-15.

Investors can be relatively firmly convinced of the determined big financial markets' news significance and its impact on the financial instruments yields, especially equities. The signals from American market are treated as signals from the global market. The American economy is a very attractive economy with specific features: a high level of competition and economic freedom, property law protection, high levels of technology, labor mobility, market flexibility and a relatively high dynamics of economic growth. Those features explained the dollar's role as the world's primary reserve currency. It is very important that American sovereign debt is denominated in American dollars. 80% of official central bank reserves in the world are denominated in American dollars. As a result investors treat information and signals from American market as a most important for their investment decisions. This role of possessing the world's reserve currency also gives America an „exorbitant privilege" that could explain it's influence. Investors from Czech Republic, Hungary and Poland can be convinced that many changes in the financial markets across the world are caused by changes in the global, American market. Similarly it can be said in the case of the influence of the UK equity market. Investors from those countries can be convinced that one of the main and broad international equity market based in the City of London has a stronger impact on other equity markets in the Europe then the markets of the euro area.

It is interesting that the same situation exists in Slovenia. The degree of equity market integration in that country with the American equity market is higher than with the euro area equity market. The case of Slovenia is important as it is a member of euro area (see: Bukowski, 2013).

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