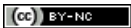"Hype vs Reality on US and BRICS stock markets going their separate ways: post-crisis evidence"

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BUSINESS PERSPECTIVES

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HYPE VS REALITY ON US AND BRICS STOCK MARKETS GOING THEIR SEPARATE WAYS: POST-CRISIS EVIDENCE

Abstract

This paper examines the long-term relationship between BRICS and US stock markets by employing the cointegration technique and Granger causality to investigate the cointegration and causality direction in the capital markets. The impulse response function it is also employed to evaluate the persistence of the shocks. In the analysis, daily spot stock index returns are used from 2010 till 2017. The main findings of the cointegration analysis indicate that the US and BRICS stock markets are cointegrated and at least one cointegration vector exists among them. The Granger causality test shows that unidirectional causality runs from the US market towards the Russian, South African and Indian stock markets, while there is a bidirectional causal relation between US and Brazil stock markets.

Keywords	BRICS, stock markets, stock index, emerging economies, integration
JEL Classification	C22, G12, G15

INTRODUCTION

The world of finance has undergone major changes over the last three decades mainly due to the rapid technological advancement and new financial products joined together with the liberalization and deregulation of financial markets that have increased financial integration across the globe (Aktan & Icoz, 2009). In this period, large stock price fluctuations were observed in US, EU and Asian financial markets as a result of integration of the markets around the globe. Increased integration along with financial liberalization has resulted in stronger mutual influence and interdependence of stock markets. Ayuso and Blanco (2001) pointed out that financial markets' integration increased in the 1990s, causing investors to pay more attention to the global markets.

Investors, who are deemed to make investment decisions based mainly on risk return, consider, however, other criteria too while diversifying their portfolios worldwide: the level of development; commercial, political and economic relations, cultural and geographical proximity of markets, etc. Interaction of international stock markets in general can be examined operating features such as interdependence of stock markets, co-integration, volatility spillovers and presence of contagion (Tan, 2012). Over the last two decades especially studies on cointegration amongst the stock markets worldwide have attracted considerable attention. The main reasons behind this increased interest are those of the size of international funds, convergence trends on stock markets, technological developments, liberalization of the money and capital markets, as well as globalization overall. The main point of the

research on capital markets' integration is the question of why capital markets provide investors with various expected returns. The answer to this question undoubtedly is that each capital market has different risk level. If assets with the same risk levels on different markets have similar expected returns on other markets at the same time, these markets are considered to be fully integrated. There is a common return to risky assets on integrated capital markets.

The rest of the paper is organized as follows. Section 1 reviews the literature, Section 2 presents the data and methodology. Section 3 discusses the empirical results and the last section provides the concluding remarks.

1. LITERATURE REVIEW

There has been a wealth of literature covering stock market integration. For instance, Beine et al. (2008) emphasized the importance of co-integration studies in terms of revealing long-term interactions of stock markets. This causality provides useful information on market return dynamics for market specialists and investment policymakers. These studies mainly examined the co-integration of markets, considering the selected group of countries such as the G7 and/or BRICS, the regional unions such as the EU or ASEAN, and the level of development. These studies on cointegration tend to focus either on the stock markets of developed countries to measure their short- and long-term dynamics (Eun & Shim, 1989; Koch & Koch, 1991; Masih & Masih, 1997; Longin & Solnik, 2001; Bessler & Yang, 2003; Lafuente & Ordonez, 2009), or on the comparison between developed and developing countries (Arshanapalli et al., 1995; Choudhry, 1997; Manning, 2002; Chen et al., 2002; Fadhlaoui et al., 2008).

Lafuente and Ordonez (2009) studied the stock markets of Britain, Germany, Italy, France and Spain using the time-varying co-integration test. In the study for the period 1993–2004, they found that portfolio diversification for the markets examined in all the periods would not protect them against the risk because the co-integration relationship exists only in some periods. Metin and Muradoglu (2001) in the study on weekly data between 1988 and 1998 showed that all developing countries are affected by three developed markets, namely, the US, Japan, and the UK and additionally by the continental leaders. Menezes et al. (2012) studied the integration of the stock markets of G7 countries using the VEC model and the Granger causality and suggested that the markets of these countries are integrated.

Fadhlaoui et al. (2008) discussed the stock markets of seven developed markets, namely, the US, Canada, the UK, France, Germany, Italy and Japan and three emerging markets – Czech Republic, Hungary and Poland. According to their findings, financial integration in all these countries could be found neither in short, nor in the long term. Mukherjee and Kumar (2010) investigated the effect of volatility spread between Asian countries and India, determining that there is a mutual interaction between Asian countries and India.

Guidi (2012) examined the relationship between the stock market of India and the markets of the selected developed countries (Hong Kong, Japan and Singapore) in Asia using the Johansen co-integration test, which did not take structural breaks into account, and the Gregory-Hansen co-integration test, which allowed structural breakdown. The study found no relation according to the Johansen test, while according to the Gregory-Hansen test there was a long-lasting relationship among these stock markets. This suggests that a healthier outcome can be achieved if structural breaks are considered.

Ewing et al. (1999) examined the integration between the North American stock markets, using monthly data during the period 1987–1997. As a result of this analysis, no cointegration was found. Their results also showed that the transition period to the North American Free Trade Agreement did not increase integration among the related markets.

Patel and Sarkar (1998) tested how developed and emerging stock markets behave in financial crises and whether they interacted with each other during the period 1970–1997. For this purpose, monthly data were considered for eight developed

and ten emerging markets. The authors found that developed and emerging markets show similarities in crises, with one crisis generally following another one.

Horvath and Petrovski (2013) applied BEKK-GARCH model to test the relationship between Central Eastern European markets, namely, Macedonia, Serbia, Croatia and Central Western European ones, namely, Bulgaria, Poland and Czech Republic. Equity markets have been studied by these authors. Although the relationship between Central Eastern and Central Western European equity markets is low, they found that Croatia is more associated with other markets than other Western European countries.

After the review of the previous studies, it has been concluded that there is no consensus amongst them due to some factors such as differences in methods/techniques adopted; the choice of markets for studies, the time period analyzed and the frequency of the data set – all these parameters differ very much from one study to another. However, as time goes, markets show higher long-term relationship with each other, which results in limitation of possible benefits from international portfolio diversification.

The purpose of this study is to examine the interactive relationship between the broadest indicator for the US stock market (Wilshire 5000 index) and the stock market indices of BRICS countries: Brazil (IBOV), Russia (MICEX), India (NIFTY), China (SHCOMP), and South Africa (JALSH) from January 2010 till December 2016. The study employs unit root tests, Johansen cointegration and causality tests as well as Impulse Response Function (IRF) in its graphical form to demonstrate the effects of shock spill-overs.

2. DATA AND METHODOLOGY

For this study, the daily stock market data is obtained from Bloomberg. The dataset starts from January 5, 2010 and ends on December 29, 2016. The dataset consists of 1,311 observations, on average, per market. The natural log difference is used to compute the returns on indices. Time series properties of the data are examined and estab-

lished their order of integration by using two-unit root tests – Augmented Dickey Fuller (ADF) and Phillips and Perron (PP) tests, and one stationary test – Kwiatkowski, Phillps, Schmidt and Shin (KPSS). In testing, intercept and trend terms are included.

The null hypothesis ($H0$) is that indices are non-stationary, while the alternative hypothesis ($H1$) states that indices are stationary and integrated in the same order. In order to identify the probable stationarity order, Schwartz Information Criterion (SIC) is used to estimate the appropriate number of lags before performing these tests. The latter are conducted at the level, and first differences in cases when the indices have unit root at levels (Glynn et al., 2007).

If the indices are stationary and integrated in the same order, Johansen cointegration test is carried out to investigate the existence of long-run equilibrium among the indices under study. The Johansen test includes two statistic sub-tests, which are:

A. Trace eigenvalue: The null hypothesis of the trace test is that the cointegration vectors number is $r = r^\star < k$, while the alternative hypothesis is that $r = k$, this test proceeds sequentially for $r^\star = 1, 2, 3, \ldots, n$.

B. Max eigenvalue test, where its null hypothesis is $r = r^\star < k$ versus the alternative hypothesis which is $r = r^\star + 1$.

If the p-value is less than 0.05, the null hypothesis is rejected, and accepted if at least one cointegration vector exists among the variables (Erik & Par, 2007).

In order to find the direction of causality among the stock market indices, Granger (1969) causality test is employed that determines whether one-time series is useful to predict another one. This test is based on two principles. First, the cause would happen prior to its effect. Second, the cause has unique information about the future values of its effects.

The null hypothesis of Granger test is that index z does not Granger index m, and the alternative

hypothesis is that index z does Granger cause index m. Fisher statistics is used to investigate the direction of causality among the indices by comparing the p-value with 0.05 significant levels. The results of Granger test can show that neither index Grange causes the other, or each of the two indices Granger causes the other (Rod & Glenn, 1984).

To complete the interaction analysis among the stock market indices, the impulse response reaction of each index is investigated in relation to some external changes. Impulse response function is "a method employed to show the responsiveness of one variable to shocks, a function of time or of some other independent variables" (Hatemi, 2014, p. 22). If there is a reaction of one index to an impulse in another one, this means that the latter is causal in relation to the former, while the impulse responses are zero if one index does not Granger cause the other indices taken as a group. Accordingly, the effect of an exogenous shock in one index on other indices is traced. The main assumption of the impulse responses analysis is that a shock happens only in one index at a time (David, 2011, pp. 9-10).

3. EMPIRICAL RESULTS AND DISCUSSION

3.1. Descriptive analysis

A descriptive analysis of the data is conducted and presented in Table 1, which shows the volatility and distribution of analyzed indices. It is interesting to note that the returns for all the indices are negatively skewed. All the distributions are also leptokurtic (fatter tails than assumed under normality), indicating that in the analyzed period the returns on these indices were not normally distributed, a fact which is confirmed by the Jarque-Bera normality test. Based on the values of skewness and fatness of tails, the Chinese SHCOMP index stands out as the riskiest one, since it has the most negative skew, fattest tail and highest volatility.

In order to calculate the correlation coefficients between the indices, one day lagged values of the US index are taken into consideration because of the differences in time zones between US on one side and China, India on the other. Table 2 shows the correlation matrix of the indices. The highest positive correlation is between W5000 and IBOV (0.588), meaning that these markets are quite correlated, and that Brazil stock market offers little diversification potential for US investors. The beginning of integration between these two stock markets coincided with the beginning of liberalization in Brazil (Lahrech & Sylwester, 2008, p. 21). The lowest correlation is recorded between W5000 and Chinese SHCOMP (0.164), offering the greatest diversification potential. Such low correlation between Chinese and US stock market indices has several explanations, but the policy based one is that Chinese stock market is controlled by the government that primarily seeks to keep it stable, and its movements are depend on government investment cycles and its consumer-based economy. The US stock market depends to a greater extent on the overall state of the country's economy, including, inter alia, employment rate, agricultural production, consumer spending and the state of the housing market. Moreover, a comparatively larger share of Chinese investments is leveraged through the widespread use of margin loans. This great dependence on margin loans is one of the reasons for more frequent stock market crashes, since during the downturns, investors have a hard time meeting their margin calls (Wang, 2010).

Table 1. Basic statistical properties of US and BRICS stock market indices, 2010–2017

Source: Author's calculations based on Bloomberg data.

Indices	Mean	Max.	Min.	Std. dev.	Skewness	Kurtosis	Jarque-Bera	Prob.	Obs.
W5000	0.0005	0.055	−0.073	0.0115	−0.3879	7.0914	947.29	0.000	1311
MICEX	0.0003	0.076	−0.081	0.0148	−0.3795	5.6538	416.20	0.000	1311
JALSH	0.0004	0.051	−0.048	0.0112	−0.1374	4.653	157.917	0.000	1311
SHCOMP	−0.0004	0.100	−.106	0.0170	−0.724	8.963	2057.4	0.000	1311
NIFTY	0.0003	0.065	−0.061	0.0121	−0.215	5.416	329.02	0.000	1311
IBOV	−0.0001	0.086	−0.084	0.0169	−0.128	4.905	202.02	0.000	1311

Table 2. Correlation matrix

Indices	W5000	MICEX	JALSH	SHCOMP	NIFTY	IBOV
W5000	1	0.411	0.530	0.164	0.323	0.588
MICEX	–	1	0.526	0.188	0.373	0.405
JALSH	–	–	1	0.241	0.444	0.445
SHCOMP	–	–	–	1	0.237	0.173
NIFTY	–	–	–	–	1	0.298
IBOV	–	–	–	–	–	1

Table 3. Unit root tests

Indices	ADF test T-statistics		PP test Adj. t-stat		KPSS test LM-stat	
	At level	First difference	At level	First difference	At level	First difference
LW5000	−0.694*	3.790	−0.5249	−3.848	4.187**	0.4265
LMICEX	−0.8567	−3.606	−0.8567	−3.607	1.901	0.1106
LJALSH	−1.196	−2.800	−1.101	−3.797	4.193	0.0971
LSHCOMP	−1.758	−3.539	−1.937	−3.546	1.025	0.1797
LNIFTY	−0.9515	−3.543	−0.9619	−3.542	3.636	0.0593
LIBOV	−2.645	−3.691	−2.544	−3.701	2.636	0.0987

Note: *MacKinnon (1996), one-sided *P*-value, ADF test critical values at 1% level (−3.435), at 5% level (−2.863), and at 10% level (−2.567). **KPSS (1992), asymptotic critical values at 1% level (0.739), at 5% (0.463), and at 10% (0.347).

3.2. Unit root tests

Table 3 shows the results of the ADF, PP and KPSS tests on the levels and at first differences. ADF and PP show that all the indices (except for LIBOV) are non-stationary at level, where the statistic value is less than the critical ones, while in KPSS test the LM statistic value is higher than the critical value at the 0.05 level of significance. Therefore, the study performs the tests on first differences for all

the indices. All three tests reject the null hypothesis that means all series are stationary at first differences, and they are integrated in order one I(1).

Figure 1 illustrates the stationarity of time series for the indices under study after taking its first differences and it confirms the tests' outcomes, where upward and downward trends are nearly the same for all the indices throughout the study period. This means they might have a long-run relationship.
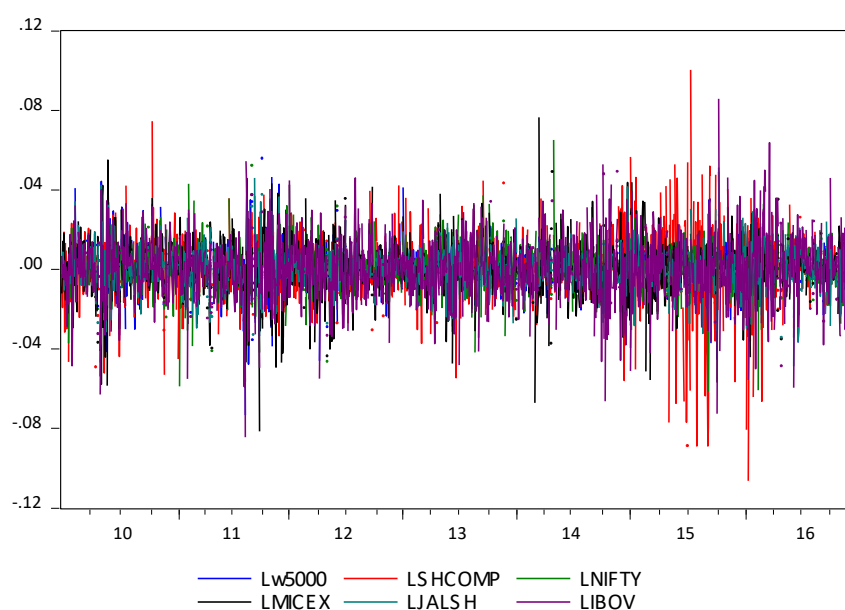

Figure 1. Stationary series data at first differences

Table 4. Johansen cointegration test results

Unrestricted cointegration rank test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace statistics**	**0.05 Critical value**	**Pro. ****
None*	0.2482	107.193	95.753	0.0301
At most 1	0.0191	63.523	69.818	0.1434
At most 2	0.0134	38.346	47.856	0.2871
At most 3	0.0098	20.618	29.797	0.3818
At most 4	0.0035	7.687	15.494	0.4994
At most 5	0.0023	3.011	3.841	0.0827
Unrestricted cointegration rank test (Max. Eigen)				
Hypothesized no. of CE(s)	**Eigenvalue**	**Max. eigen statistics**	**0.05 Critical value**	**Pro. ****
None*	0.2482	42.669	40.077	0.0301
At most 1	0.0191	25.177	33.876	0.3731
At most 2	0.0134	17.727	27.584	0.5179
At most 3	0.0098	12.931	21.131	0.4585
At most 4	0.0035	4.675	14.264	0.7821
At most 5	0.0023	3.011	3.841	0.082

Note: * Denotes rejection of the hypothesis at the 0.05 level. ** Mackinnon-Huge-Michelis (1999) p-value.

Table 5. Pairwise Granger causality test

| Null Hypothesis	F-Stat.	Prob.	Obs.
W5000 index does not Granger cause MICEX index	16.865	0.0006	1,309
MICEX index does not Granger cause W5000 index	0.424	0.654	1,309
W5000 index does not Granger cause IBOV index	5.388	0.037	1,309
IBOV index does not Granger cause W5000 index	3.201	0.045	1,309
W5000 index does not Granger cause JALSH index	37.13	0.0002	1,309
JALSH index does not Granger cause W5000 index	1.764	0.171	1,309
W5000 index does not Granger cause SHCOMP index	0.747	0.473	1,309
SHCOMP index does not Granger cause W5000 index	22.96	0.0002	1,309
W5000 index does not Granger cause NIFTY index	32.221	0.00002	1,309
NIFTY index does not Granger cause W5000 index	0.343	0.709	1,309
MICEX index does not Granger cause IBOV index	0.527	0.590	1,309
IBOV index does not Granger cause MICEX index	12.885	0.0003	1,309
MICEX index does not Granger cause JALSH index	0.087	0.916	1,309
JALSH index does not Granger cause MICEX index	1.929	0.145	1,309
MICEX index does not Granger cause SHCOMP index	3.614	0.027	1,309
SHCOMP index does not Granger cause MICEX index	0.909	0.403	1,309
MICEX index does not Granger cause NIFTY index	5.043	0.009	1,309
NIFTY index does not Granger cause MICEX index	0.266	0.765	1,309
IBOV index does not Granger cause JALSH index	24.389	0.0004	1,309
JALSH index does not Granger cause IBOV index	0.108	0.989	1,309
IBOV index does not Granger cause SHCOMP index	12.961	0.0003	1,309
SHCOMP index does not Granger cause IBOV index	1.007	0.367	1,309
IBOV index does not Granger cause NIFTY index	29.205	0.0004	1,309
NIFTY index does not Granger cause IBOV index	0.149	0.861	1,309
JALSH index does not Granger cause SHCOMP index	4.736	0.008	1,309
SHCOMP index does not Granger cause JALSH index	0.021	0.978	1,309
JALSH index does not Granger cause NIFTY index	4.387	0.009	1,309
NIFTY index does not Granger cause JALSH index	0.498	0.607	1,309
SHCOMP index does not Granger cause NIFTY index	1.0851	0.338	1,309
NIFTY index does not Granger cause SHCOMP index	2.882	0.0563	1,309
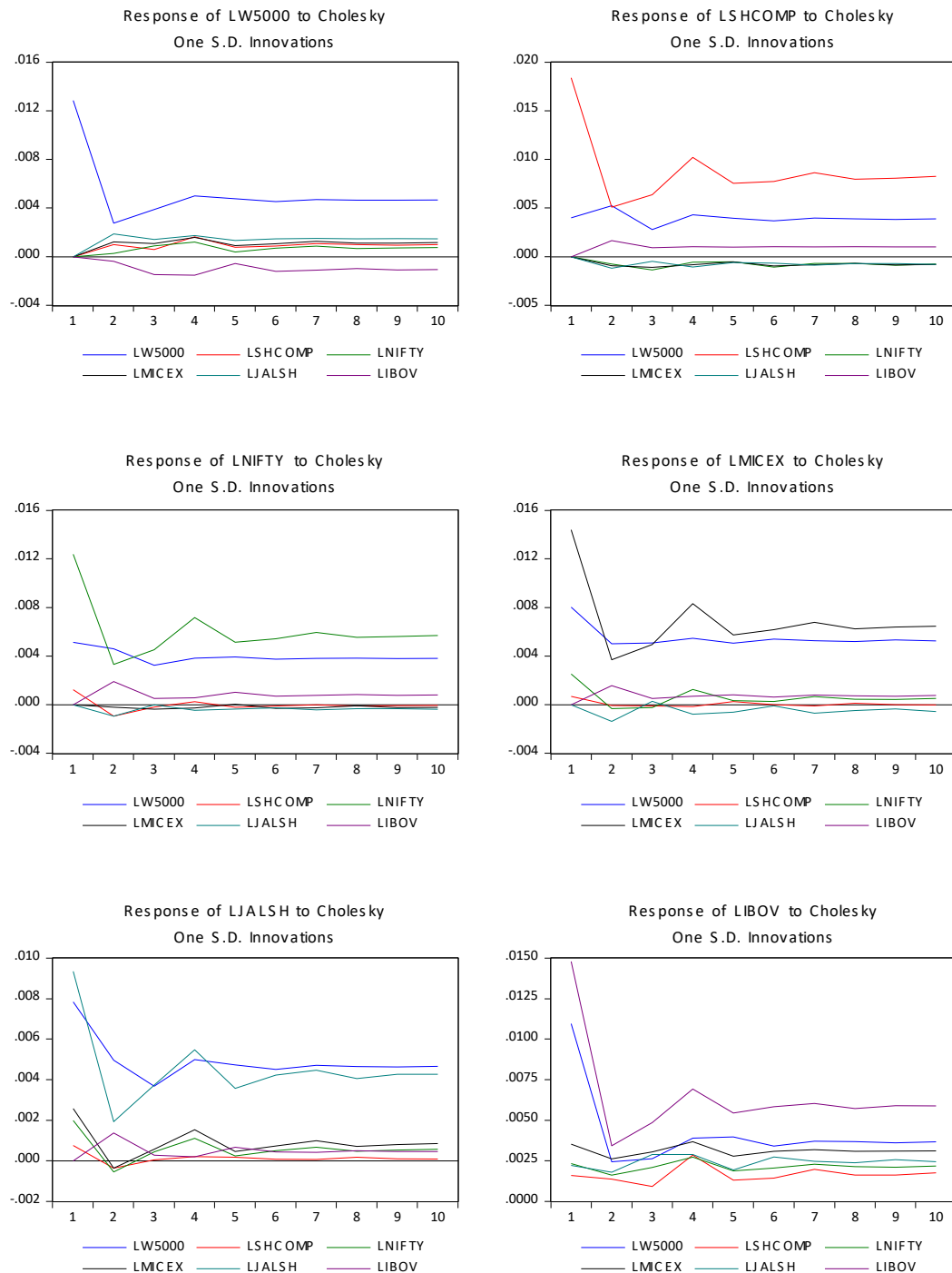
Figure 2. Impulse response function outcomes

3.3. Multivariate cointegration

Since the time series have been integrated to I(1), Johansen cointegration procedure is performed. The results of maximum and trace statistics shown in Table 4 clearly illustrate that maximum and trace eigenvalue tests hypothesis of one cointegrated vector is not rejected for the stock market indices.

3.4. Causality

In order to identify the direction in causal linkages among the indices, the pairwise Granger causality test is used. Table 5 shows the unidirectional causal relationship runs from the US stock market to Russian, South African and Indian stock markets, while a unidirectional causality runs from China's

to the US stock market, also, there is a bidirectional causality between US and Brazil stock markets. Moreover, there is a unidirectional causal relationship running from Brazil stock market to South African, Chinese, Russian and Indian stock markets at the 5% significance level at two lags.

3.5. Impulse response function

Figure 2 shows the 10-month effect and the impulse response function of one index on the others, where each index represents an exogenous variable in relation to other indices. The impulse response functions show that the adjustment process of the US stock market is not complete within these ten months due to various shocks on all of the markets.

Initially, a shock on the US stock market leads to relatively positive week influences on Russian, South African, and Indian stock markets af-

ter the first month, where the effect was less than 1%. This result is in line with the correlation matrix and Granger test outcomes. The findings provide evidence that the international investors' mindset changes towards profitable emerging markets after the shock. On the contrary, shock on the US stock market influences negatively Brazil's stock market starting from the second month. This may provide an opportunity to the global investors in terms of diversification.

Following the same procedure, positive shocks on Brazil's stock market affect positively the US, South African, Indian and Russian stock markets starting from the first month, while a positive shock on Russian stock market has negative effect on China's and India's stock markets starting from the second month, noteworthy, starting from the fifth month the same shock has positive effect already.

CONCLUSION

In the past three decades, particularly in the wake of globalization efforts of 80s, concepts such as financial integration, liberalization, financial innovation, deregulation and short-term capital flow or hot money became the main topics of countries and the markets witnessed dramatic financial crises affecting almost every region and country itself due mainly to increased financial integration across the markets. In this paper, the movement among the five major emerging markets, the so-called big 5, and the US in the post-crisis period is examined for possible portfolio diversification opportunities for the investors. For this purpose, cointegration technique together with causality are employed to explore the causation and causality direction among the indices. Impulse response test is also applied to evaluate the persistence of shocks. The main findings indicate that the stock markets are cointegrated and at least one cointegration vector exists. Causality test shows that unidirectional causality runs from the US stock market to Russian, South African and Indian stock markets, while there is a bidirectional causal relation between US and Brazil. In addition, the impulse response functions point out that the adjustment process of the US market is not completed within ten months due to various shocks present on these markets. To sum it up, very little has changed, in terms of intermarket dynamics, after the 2008 crisis, and the US market still dominates the global scene, influencing, to a greater or lesser extent, all of the main global markets.

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