The Impacts of the Credit Default Swap on the Stock Index: Asymmetric Causality Approach for BRIC Countries

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Abstract

In this study, Granger and Hatemi-J (2012) tests are used to examine whether or not the credit default swaps (CDS) have causality effects on stock indices in BRIC countries. Although the findings of the study support the fact that a fall in Brazil's country risk leads to a decrease in stock returns, it is implied that stock investors may have a risk-likely behavior. In Russia, contrary to theoretical assumptions, causality analysis shows that capital movements are closely related to the country's CDS, and that the increase / decrease of the country risk may neither reduce nor raise stock indices. Causality analysis reveals that the CDS's do not have a significant influence on international capital flows and risk appetite in Brazil and Russia as well as in India and China, and thus, it can be asserted that political, social and other economic factors may become crucial for investment decisions in stock markets.

Keywords: Cumulative sums approach, causality analysis, CDS, stock index, BRIC countries
JEL classification: E30, E31, F41

Kredi Temerrüt Takasının Hisse Senedi Endeksi Üzerindeki Etkileri: BRIC Ülkeleri İçin Asimetrik Nedensellik Yaklaşımı

Özet

Bu çalışmada, Granger and Hatemi-J (2012) testleri ile BRIC ülke kredi temerrüt takaslarının (KTT) hisse senedi endeksleri üzerinde nedensellik etkisine sahip olup olmadığı incelenmiştir. Çalışmanın bulguları Brezilya'nın ülke riskinin düşmesinin hisse senedi getirilerini düşürdüğünü desteklemekle birlikte, hisse senedi yatırımcılarının risk sever bir yapıya sahip olabileceğini ima etmektedir. Rusya'da ise teorik varsayımlara aykırı olarak, sermaye hareketlerinin ülke KTT ile yakından ilişkili olmadığı ve ülke riskinin artmasının/azalmasının hisse senedi getirilerini düşürebileceği/yükseltebileceği yönünde bulgulara rastlanılmamıştır. Nedensellik analizi ile KTT'lerin Brezilya ve Rusya'da olduğu gibi Hindistan ve Çin'de de uluslararası finansal sermaye akımları ve risk iştahı üzerinde belirgin bir etkiye sahip olmadığı saptanmış ve hisse senedi piyasalarındaki yatırım kararları için politik, sosyal ve diğer ekonomik faktörlerin önemli olabileceği iddia edilmiştir.

Anahtar Kelimeler: Kümülatif toplamlar yaklaşımı, nedensellik analizi, KTT, hisse senedi endeksi, BRIC ülkeleri
JEL sınıflaması: E30, E31, F41

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1. Introduction & Literature Review

It has been acknowledged that variations in stock returns can be under the influence of various macroeconomic and financial factors. Based on these factors, economic policy uncertainty (EPU), country risk and fear gauge in financial markets can be derived and they are regarded as crucial factors in terms of the stock market dynamics, particularly after the 2008-2009 global financial crisis. Thus, quantitative models, investigating the interactions between stock returns and other macroeconomic and financial factors, can be enhanced by the inclusion of the EPU, country risk and fear gauge (Sarwar, 2012; Bouri et al., 2018; Tolikas and Topaloglou, 2017; Tsai, 2014). Additionally, stock market indices can be classified on sectoral basis and those sectoral dynamics also affect stock markets as a whole. Precisely, one of the sectors could be the leading sector and thus, it may highly interact with the EPU, country risk and fear gauge in financial markets. This phenomenon also applies to emerging markets, and it is important to determine which sector is in the center of triggering financial fragilities. According to the country-specific economic dynamics, the key financial sector can vary and thus causality relationship among stock returns and the EPU, country risk and fear gauge may change. For instance, Manioglu (2018) determined the important sectors in stock markets interacting with the macroeconomic variables.

On the other hand, each developing country may not have the same macroeconomic characteristics and thus, the leading sector in stock markets may not be common among emerging markets. Therefore, the critical sector in each stock market is not determined unlike that of Manioglu (2018) and the causality relationship between credit default swap (CDS) and stock indices is explored mutually for BRIC countries.[4] Because asymmetry can play a crucial role in the causality relationship between macroeconomic and financial variables (Bahmani-Oskooee et al., 2016; Shah et al., 2017; Shahzad et al., 2018; Pragidis et al., 2018), the cumulative positive and negative sums are generated for stock indices and the CDS's of each country in line with Hatemi-J and El-Khatib (2016). Herein, based on Toda and Yamamoto (1995), Granger and Hatemi-J (2012) causality tests are employed to verify the hypothesis of the study. The first hypothesis of the study is whether the relevant stock market index is influential on the CDS or not. The second hypothesis of the study tests whether the CDS has a significant impact on the stock market index or not, whereupon macroeconomic country risks of each BRIC country are considered.

[4] This work has been developed based on the results of Manioglu (2018).

2. Literature Review

Country risk is a crucial financial variable, mostly dependent on macroeconomic and political developments. Interest rate risk premium can be regarded as the most fundamental country risk indicator. Changes in the risk premium have also consequences on investment decisions in financial markets. It is generally acknowledged that incoordination of the EPU leads to an increase in interest rate risk premium. As a consequence, debt stock of economic agents increases which in turn the possibility of financial crisis is raised. The risk of financial crisis can be related to the success of the debt management and maintenance of financial stability. The CDS reflects the risk associated with sustainable debt management while the market volatility index (VIX) refers to the future short-term financial stability in equity markets.

In terms of the impacts on stock returns, VIX can be assumed as having a more direct effect than that of the CDS. The study by Sarwar (2012) is a pioneering approach investigating the intertemporal relationships between VIX and stock market returns of BRIC countries by using the VIX-returns analysis for the 1993–2007 period. Sarwar (2012) found a strong negative contemporaneous relation between daily changes (innovations) in VIX and the US stock market returns when VIX is higher and more volatile. Moreover, the results showed a strong asymmetric relation between innovations in VIX and daily stock market returns in the US, Brazil, and China, exposing that VIX was more of a gauge of investor fear than investor positive sentiment. Sarwar (2012) concluded that VIX was not only an investor fear gauge for the US stock market but also for the equity markets of China, Brazil, and India. In a similar effort, Sarwar (2014) examined the cross-market differential relations of the US stock market uncertainty (VIX) with the US and the European stock market returns before and during the European equity market crisis. Sarwar (2014) revealed a strong negative contemporaneous relation between the VIX changes and European stock returns and concluded that the fear gauge triggered by VIX persisted longer in the European markets than in the US market. Most recently, Bouri et al. (2018) employed the Bayesian Graphical Structural Vector Autoregressive (BGSVAR) model to forecast BRICS stock market returns using the VIX index as a predictor along with other macroeconomic and financial variables. By using daily data, Bouri et al. (2018) found that individual implied volatilities in BRICS were generally under the influence of both global and within the group stock market implied volatilities.

Considering the transmission of exchange rate dynamics into inflation, the phenomenon of asymmetry has become popular in open-economy macroeconomics. It is suggested for it to be examined in terms of the interactions between macroeconomic and financial variables.

Dennis et al. (2006), Low (2004) and Talpsepp and Rieger (2010) found results supporting the asymmetric return-volatility relationship; more precisely, volatility might respond heavily to negative return shocks rather than positive. In one of the recent studies, Bekiros et al. (2017) studied the asymmetric relationship between returns and implied volatility for 20 developed and emerging international markets. Their estimations are based upon the leverage and volatility feedback effects from several competitive parametric models and they revealed that the magnitude of these effects was sensitive to the underlying model used for their analysis. Moreover, Bekiros et al. (2017) found that there was an asymmetric and reverse return-volatility relationship in many advanced, Asian, Latin American, European and South African markets, which could be related to cultural and societal characteristics. Economou et al. (2017) employed hidden co-integration approach in order to explore the relationship between the fear indices and the stock market indices for the cases of the US, Germany and the UK. Their results suggested that there was an asymmetric reaction of the fear indicator to stock market innovations for the US market. Additionally, they found that the asymmetry in case of the UK and Germany was related mainly to the size and the time span of the adjustment process. On the other hand, it can be assumed that there exist spill-over effects in developed stock markets in the era of financial liberalization. In this context, Tsai (2014) confirmed that information transmission and co-movement of stock returns in the US, Germany, the UK, Japan, and France were highly dependent on VIX. Byström (2018) analyzed long-term stock return expectations for individual firms by using information backed out from the credit derivatives market. Following a theoretical approach, Byström (2018) demonstrated that there existed a close relationship between credit-implied stock return expectations and future realized stock returns.

In terms of the co-movements between stock markets of various countries, CDS stands out among the indicators that reflect the country risk. In this respect, Tolikas and Topaloglou (2017) conducted one of the most prominent studies, which analyzes whether default risk is priced faster in the CDS market or the stock market in the main economic sectors of North America, Europe, the UK, and Asia. More specifically, they acknowledged that the prices of CDS and stock prices could be closely related due to the dependence on the distribution of the market value of the firm's corporate assets. By using Vector Autoregressive (VAR) model, they found that the documented lead-lag relation was both not regime-dependent and stronger for negative stock market news. Tolikas and Topaloglou (2017) also obtained empirical results implying that stock market reaction to changing credit conditions was faster that of the CDS market in contrast to the theoretical predictions. Furthermore, they classified traders into informed and uninformed categories and stressed that informed ones prefer to trade default risk mostly in the stock market but uninformed traders mostly in the

CDS market. In a similar approach, Fei et al. (2017) used the theoretical credit risk model assumptions of Merton (1974). More precisely, they employed a flexible empirical Markov-switching bivariate copula allowing for distinct time-varying dependence between CDS spreads and equity prices in different periods for European markets. Fei et al. (2017) found empirical results supporting the consistency of high-dependence regimes in accordance with the recent credit crunch and the European sovereign debt crises and imposing within-regime constant dependence or no regime-switching. On the other hand, stock options and CDS's can be used together in risk management according to Al-Own et al. (2018). Their study supported the empirical results for the role of stock options in restraining the use of the CDS for hedging purposes. Their findings implied that decreasing the use of stock options can encourage hedging with CDS in countries where systemic credit risk was high. An increase in systemic credit risk can be regarded as a crucial factor triggering country risk and fear gauge in financial markets. However, country risk can be regarded as a basic factor affecting the co-movements between credit and stock markets, particularly in emerging countries. Thus, it can be suggested that the CDS's and stock options could be used jointly rather than separately as a part of the hedging strategy. The relevant assumption constitutes a base for our study and we do not classify traders in contrast to the study of Tolikas and Topaloglou (2017). Country risk is a pioneering factor simultaneously triggering stock market and credit default risk as in BRIC countries; in this study, we focus on the possible asymmetric relationship between stock returns and CDS in line with Fei et al. (2017) who implied the consistency of high-dependence regimes between credit and stock markets.

3. Empirical Methodology

3.1 Empirical model

Econometric models used to explain economic relations acknowledge that the relationships among variables have functional dynamics. In the relevant models, there is a distinction between dependent and independent variables as $y = f(x)$. Nevertheless, the relationships between macroeconomic variables are not always expressed within the above functional framework. The systems of simultaneous equations in which the macroeconomic variables are in mutual interaction and the dependent variable variance is not clearly defined can be used for macroeconomic analysis. Therefore, VAR-type models are used for this purpose, and possible relationships between two or more variables can be examined by means of causality analysis, impulse-response functions and variance decomposition analysis. Granger causality analysis is the most fundamental tool of VAR-type models, and it can be determined at a basic level whether or not a variable has an effect on the other variable for subsequent periods. According to the causality analysis developed by Toda and Yamamoto (1995), non-stationary variables in the VAR-type model are included as external variables.

The variables in the empirical analysis are the CDS (cds_t) and the logarithmic stock index (sto_t) for BRIC countries and the relevant variables are monthly for the period 2010: 01-2018:03. The cumulative sums were obtained according to Hatemi-J (2012) and Hatemi-J and El-Khatib (2016) for both variables and the TDICPS module working under the Matlab program was adapted for the required process. cds_t^+, cds_t^-, sto_t^+, sto_t^- are obtained for BRIC countries, and whether variations in stock indices are due to the changes in CDS. In this context, the existence of asymmetric effects between the variables is taken into account and the possible outcome of debt management risk associated with CDS on capital markets is evaluated. Thus, VAR models with cds_t^+, cds_t^-, sto_t^+, sto_t^- are estimated with monthly data for the period 2010:02-2018:03. All data was obtained from statistical databases of Thomson Reuters and empirical exercises were performed with Gauss, Matlab and E-VIEWS 10.

3.2 VAR model

VAR model includes the K-dimensional and exogenous variables account for the simultaneous relations between variables, whereas the $VAR(p)$ model can be expressed as follows.

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + D_t + u_t \tag{1}$$

where; $t = 1, 2, \ldots T$ and, p shows the lag length of the VAR model. $y_t = (y_{1t}, \ldots, y_{Kt})'$ is a vector with K elements, containing endogenous variables of the model. In this framework, the coefficient matrix of the relevant variables is defined by A_i, which is in dimension $(K \times K)$. In equation 1, the vector D_t is composed of deterministic terms, fixed term, linear trend term, and dummy variables. Error terms of the model are represented by u_t, where $u_t = (u_{1t}, \ldots, u_{Kt})$ is opposed to white noise $k \times 1$ shock process. $E(u_t) = 0$ and it has positive covariance matrix as $E(u_t, u_t^{'}) = \Sigma_u$ (Lütkepohl, 2005: 13).

The above-described $VAR(p)$ model can also be expressed using matrix operations, so that the operation of the Granger causality analysis can be clarified more clearly. According to the Granger causality relationship, y_{1t} has a causal relationship with y_{2t}, and thus y_{1t}

improves y_{1t}'s future estimates. The hypothesis suggesting that y_{1t} does not Granger cause y_{2t} (H_0) is tested in terms of $\alpha_{21,i} = 0$, $i = 1, 2, ..., p+1$. In line with the Equation 2, it can be accepted that y_{1t} does not Granger cause y_{2t} if the lagged values of y_{1t} are not included in the y_{2t} part of the model (Lütkepohl, 2007: 167).

$$\begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \sum_{i=1}^{p+2} \begin{bmatrix} \alpha_{11,i} & \alpha_{12,i} \\ \alpha_{21,i} & \alpha_{22,i} \end{bmatrix} \begin{bmatrix} y_{1,t-i} \\ y_{2,t-i} \end{bmatrix} + CD_t + \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix} \tag{2}$$

Within the matrix operations in Equation 2, Toda and Yamamoto (1995) type Granger causality analysis can also be performed. Toda and Yamamoto (1995) type causality analysis is based on the VAR model with the lag length suggested by the appropriate statistical information criteria. The exogenous variables of the model and their lagged values are determined and included in the model in line with the stationarity level of the variables. In other words, the weakness of a VAR model including first differenced variables with no co-integration relationship is reduced (Mavrotas and Kelly, 2001). The model presented in Equations 1 and 2 can be rewritten with exogenous variable vector x_{t-d} and its coefficient matrix B_j. Finally, $d_{\max}$ shows the maximum lag length of the exogenous variable.

3.3 Cumulative sums approach

Causality analysis between variables in VAR-type models can be performed in line with the cumulative sums approach. Thus, the following two equations in (3) and (4) can be derived if y_{1t} and y_{2t} are subject to the random walk process (Hatemi-J, 2012: 449).

$$y_{1t} = y_{1t-1} + u_t = y_{10} + \sum_{i=1}^{t} \varepsilon_{1i} \tag{3}$$

$$y_{2t} = y_{2t-1} + u_t = y_{20} + \sum_{i=1}^{t} \varepsilon_{2i} \tag{4}$$

In equations 3 and 4, the constant terms y_{10} and y_{20} also show the initial values of both random walk processes and ε_{1i} and ε_{2i} define the white noise distribution terms of both equations. Positive and negative shocks that are separated by the cumulative sums approach can be written as $\varepsilon_{1i}^{+} = \max(\varepsilon_{1i}, 0)$, $\varepsilon_{2i}^{+} = \max(\varepsilon_{2i}, 0)$, $\varepsilon_{1i}^{-} = \min(\varepsilon_{1i}, 0)$ and $\varepsilon_{2i}^{-} = \min(\varepsilon_{2i}, 0)$ (Hatemi-J, 2012: 449). In this respect, the models below can be defined.

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{10} + \sum_{i=1}^{t} \varepsilon_{1t}^{+} + \sum_{i=1}^{t} \varepsilon_{1t}^{-} \tag{5}$$

$$y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{20} + \sum_{i=1}^{t} \varepsilon_{2t}^{+} + \sum_{i=1}^{t} \varepsilon_{2t}^{-} \tag{6}$$

With equations 5 and 6, y_{1t} and y_{2t} can be expressed cumulatively as; ($y_{1t}^{+} = \Sigma_{i=1}^{t} \varepsilon_{1i}^{+}$, $y_{1t}^{-} = \Sigma_{i=1}^{t} \varepsilon_{1i}^{-}$, $y_{2t}^{+} = \Sigma_{i=1}^{t} \varepsilon_{2i}^{+}$ and $y_{2t}^{-} = \Sigma_{i=1}^{t} \varepsilon_{2i}^{-}$), and it is accepted that positive and negative shocks may have a permanent effect on other variables. When the causality of the positive cumulative shocks is evaluated, $y_{1t}^{+} = (y_{1t}^{+}, y_{2t}^{+})$ is accepted and causality analysis is performed within the VAR model below (Hatemi-J, 2012: 449). In this framework, a 2-variable VAR model can be derived as follows:

$$y_t^{+} = v + A_1 y_{t-1}^{+} + \ldots + A_p y_{t-1}^{+} + u_t^{+} \tag{7}$$

where y_t^{+} refers to the 2×1 vector of variables and constant terms of the model are included in 2×1 vector v. On the other hand, trend and exogenous variables are ignored in (7) opposite to (1). In equation (7) the hypothesis that the k^{th} element of y_t^{+} does not Granger-cause ζ^{th} element of y_t^{+} is tested.

4. Empirical Data and Analysis

4.1 Empirical data

Identification of the stationary properties of the variables in the advanced time series models is necessary for the determination of the most suitable model type. According to the stationarity properties of the variables, VAR, VEC or ARDL models can be employed to analyze the economic relations between model variables. Moreover, the estimation process of these models can be carried out with certain constraints deriving from economic theory. Following the scientific literature, the Augmented Dickey-Fuller (ADF) test was primarily used in this study. The deterministic terms that can be included in the regression model of the ADF test are chosen in accordance with the principle developed by Pantula (1989); because changes in the specifications of the regression model can lead to different unit root test results. The maximum lag length in the regression model of the ADF test is 8; moreover, increasing the relevant lag length did not cause any change in the test results. Table 1 shows the ADF test results, suggesting that all variables are not stationary at levels and they become stationary in first differences.

Table 1. ADF unit root test results

Variables	ADF-test statistics	Lag length
sto_t^{+br} (c,t)	-1.021804	2
Δsto_t^{+br} (c)	-7.500817	1
sto_t^{-br} (c,t)	-1.626528	1
Δsto_t^{-br} (c)	-8.297070	0
sto_t^{+ru} (c,t)	-2.970907	0
Δsto_t^{+ru} (c)	-9.087846	0
sto_t^{-ru} (c,t)	-1.182190	0
Δsto_t^{-ru} (c)	-9.837297	0
sto_t^{+in} (c,t)	-2.387983	0
Δsto_t^{+in} (c)	-9.576881	0
sto_t^{-in} (c,t)	-1.600836	0
Δsto_t^{-in} (c)	-9.183873	0
sto_t^{+ch} (c,t)	-2.125231	4
Δsto_t^{+ch} (c)	-3.893063	3
sto_t^{-ch} (c,t)	-3.566305	7
Δsto_t^{-ch} (c)	-8.209774	0
cds_t^{+br} (c,t)	-0.884866	0
Δcds_t^{+br} (c)	-9.074837	0
cds_t^{-br} (c,t)	-3.613283	0
Δcds_t^{-br} (c)	-6.902589	3
cds_t^{+ru} (c,t)	-1.029811	1
Δcds_t^{+ru} (c)	-7.599685	0
cds_t^{-ru} (c,t)	-3.466524	0
Δcds_t^{-ru} (c)	-5.578975	6
cds_t^{+in} (c,t)	-2.614423	1
Δcds_t^{+in} (c)	-8.606888	0
cds_t^{-in} (c,t)	-1.481205	2
Δcds_t^{-in} (c)	-9.315610	1
cds_t^{+ch} (c,t)	-1.617766	0
Δcds_t^{+ch} (c)	-9.057744	0
cds_t^{-ch} (c,t)	-1.988329	0
Δcds_t^{-ch} (c)	-10.27408	0

Notes: The 1%, 5% and 10% critical values for the unit-root tests with constant terms (c) are −3,47, −2,88 and −2,57, respectively. The 1%, 5% and 10% critical values for the tests with constant and trend (c,t) terms are −4,02, −3,44 and −3,14, respectively. The number of lagged differences in the regression models of the tests was selected by the Akaike Information Criterion (AIC) and the critical values are in line with MacKinnon (1996).

On the other hand, structural breaks can become crucial factors in determining the stationary properties of the variables. In this respect, structural breaks in time series can be determined by statistical techniques and stationary analysis. In the context of our paper, we can assume that CDS and stock indices are opposed to structural breaks, especially after the 2008-2009 global financial crisis. Additionally, we also employ unit root test, incorporating statistically suggested structural break dates. The maximum lag length of the model considered for the structural break unit root test is set to 8 in accordance with the ADF test. Parallel to the ADF test results, the structural break unit root test results, as seen in Table 2, also indicate that the series are not stationary at levels.[5]

[5] Johansen cointegration test results are available upon request.

Table 2. Structural break unit root test results

Variables	Test statistics	Lag length	Suggested break date
$sto_t^{+br}\ (c,t)$	-4.17	1	2016 M02
$\Delta sto_t^{+br}\ (c)$	-9.29	1	2016 M03
$sto_t^{-br}\ (c,t)$	-4.36	1	2015 M11
$\Delta sto_t^{-br}\ (c)$	-9.74	0	2016 M01
$sto_t^{+ru}\ (c,t)$	-5.32	3	2014 M12
$\Delta sto_t^{+ru}\ (c)$	-10.73	0	2015 M02
$sto_t^{-ru}\ (c,t)$	-3.67	0	2014 M02
$\Delta sto_t^{-ru}\ (c)$	-10.85	0	2012 M05
$sto_t^{+in}\ (c,t)$	-5.41	0	2014 M02
$\Delta sto_t^{+in}\ (c)$	-10.36	0	2012 M02
$sto_t^{-in}\ (c,t)$	-4.82	0	2013 M09
$\Delta sto_t^{-in}\ (c)$	-11.54	0	2010 M07
$sto_t^{+ch}\ (c,t)$	-4.26	2	2014 M11
$\Delta sto_t^{+ch}\ (c)$	-8.48	0	2010 M07
$sto_t^{-ch}\ (c,t)$	-4.65	3	2015 M06
$\Delta sto_t^{-ch}\ (c)$	-8.90	0	2016 M01
$cds_t^{+br}\ (c,t)$	-5.66	0	2015 M07
$\Delta cds_t^{+br}\ (c)$	-10.56	0	2015 M09
$cds_t^{-br}\ (c,t)$	-4.91	0	2015 M05
$\Delta cds_t^{-br}\ (c)$	-12.60	0	2011 M10
$cds_t^{+ru}\ (c,t)$	-5.69	1	2014 M10
$\Delta cds_t^{+ru}\ (c)$	-8.69	0	2014 M12
$cds_t^{-ru}\ (c,t)$	-5.61	0	2011 M09
$\Delta cds_t^{-ru}\ (c)$	--1.07	0	2014 M05
$cds_t^{+in}\ (c,t)$	-5.32	1	2011 M07
$\Delta cds_t^{+in}\ (c)$	-10.32	0	2011 M09
$cds_t^{-in}\ (c,t)$	-4.82	0	2013 M09
$\Delta cds_t^{-in}\ (c)$	-11.54	0	2010 M07
$cds_t^{+ch}\ (c,t)$	-3.85	0	2011 M07
$\Delta cds_t^{+ch}\ (c)$	-12.48	0	2011 M09
$cds_t^{-ch}\ (c,t)$	-3.93	0	2012 M08
$\Delta cds_t^{-ch}\ (c)$	-11.30	0	2011 M10

Notes: The 1%, 5% and 10% critical values for the structural break unit-root tests with constant terms (c) are −4,94, −4,44 and −4,19, respectively. The 1%, 5% and 10% critical values for the structural break unit-root tests with constant and trend (c,t) terms are –5,71, −5,17 and −4,89, respectively. The number of lagged differences in the regression models of the tests was selected by the Akaike Information Criterion (AIC) and the critical values are determined according to Vogelsang (1993).

4.2 Empirical analysis

In this study, the relationship between CDS and stock indices for BRIC countries were analyzed with the help of causality tests of Granger and Hatemi-J (2012). According to the maximum lag length of the ADF test (8), the same lag length was used in the VAR models which were the basis for Granger and Hatemi-J (2012) tests. However, in both tests, the cumulative sums approach has been investigated in terms of asymmetric effects that may be related to the relationship between variables. In the Toda and Yamamoto (1995) causality analysis, the non-stationary variables at levels were included in the model and the lagged values of the variables were evaluated in the estimation process of the model as external variables. The lag length of the VAR model was proposed by AIC and the lag length of the external variables of the model defined as $d_{\max}$ in the Toda and Yamamoto (1995) test was determined in accordance with the stationary order of the variables. The stationarity analysis expressed in Table 1 and 2 shows the value of $d_{\max}$ of VAR models. Thus, 4 types of vectors such as $(cds_t^+, sto_t^+)'$, $(cds_t^-, sto_t^-)'$, $(cds_t^+, sto_t^-)'$, $(cds_t^-, sto_t^+)'$ were found. For each country, VAR models were estimated over the lag length determined by AIC. In the Hatemi-J (2012) causality test, the Gaussian module developed by Hatemi-J (2011) has been enhanced with respect to the non-normality of the residuals and the ARCH effects. In other words, a causality analysis was performed according to the bootstrap approach, considering that standard methods based on normality and constant variance hypothesis would not produce robust results.

4.3 Causality analysis

In the context of causality analysis, Granger and Hatemi-J (2012) tests are carried out and the following periods analyze whether the change in CDS is an important determinant of the variation in stock indices of BRIC countries. Therefore, the impacts of the shocks on the CDS in the following periods on the stock indices will be examined bearing in mind the solvency and debt management of each BRIC country. The results of the Granger and Hatemi-J (2012) tests, which take into account the asymmetric effects with the help of cumulative positive and negative sums according to Hatemi-J and El-Khatib (2016), are presented in Table 3.

Table 3. Granger and Hatemi-J (2012) Causality Test Results

	Granger Causality Test			Hatemi-J (2012) Causality Test			
H_0 hypothesis	Lag length	Test statistics	p-value	Test value	Bootstrap critical value at 1% level	Bootstrap critical value at 5% level	Bootstrap critical value at 10% level
$cds_t^{+br} \neq> sto_t^{+br}$	2	6.343	0.042	2.360	10.623	6.350	4.727
$cds_t^{-br} \neq> sto_t^{-br}$	6	19.207	0.004	23.707	19.795	14.299	11.791
$cds_t^{-br} \neq> sto_t^{+br}$	2	1.762	0.414	8.790	12.714	8.202	6.428
$cds_t^{+br} \neq> sto_t^{-br}$	3	16.695	0.042	7.878	12.725	8.311	6.508
$cds_t^{+ru} \neq> sto_t^{+ru}$	3	13.717	0.003	1.815	12.458	8.341	6.495
$cds_t^{-ru} \neq> sto_t^{-ru}$	3	6.116	0.106	18.581	12.862	8.610	6.779
$cds_t^{-ru} \neq> sto_t^{+ru}$	1	4.274	0.039	0.087	7.009	3.972	2.742
$cds_t^{+ru} \neq> sto_t^{-ru}$	1	0.129	0.720	4.728	8.029	4.035	2.700
$cds_t^{+in} \neq> sto_t^{+in}$	1	0.319	0.573	0.353	7.129	3.888	2.808
$cds_t^{-in} \neq> sto_t^{-in}$	5	12.375	0.030	10.557	16.641	11.694	9.712
$cds_t^{-in} \neq> sto_t^{+in}$	1	2.794	0.095	0.002	6.826	3.973	2.753
$cds_t^{+in} \neq> sto_t^{-in}$	1	0.318	0.573	3.686	7.772	4.034	2.812
$cds_t^{+ch} \neq> sto_t^{+ch}$	5	9.162	0.103	2.311	17.483	12.414	10.113
$cds_t^{-ch} \neq> sto_t^{-ch}$	2	7.766	0.021	3.349	11.834	6.670	4.945
$cds_t^{-ch} \neq> sto_t^{+ch}$	2	1.369	0.504	1.899	10.251	6.382	4.764
$cds_t^{+ch} \neq> sto_t^{-ch}$	1	5.367	0.021	0.486	7.804	3.881	2.616

In this study, the causality relationship between CDS and stock indices in BRIC countries was examined using Granger and Hatemi-J (2012) tests, which included variables that would have asymmetric effects. Whether or not the changes in the CDS will lead to changes in stock indices in the following periods may vary depending on different significance levels. According to the 95% significance level, the Hatemi-J (2012) test does not reject the hypothesis that the increase in the Brazilian CDS does not have a causal effect on the increase in stock index. Thus, it can be argued that an increase in the risk premium of the country in terms of debt management will not affect the increase in stock index. However, Granger causality test result implies that the increase in CDS also may contribute to the increase in stock index at the 95% significance level. In this regard, it can be said that investors' risk likeliness may not be explained by the increase in the country risk. In this framework, it can be argued that the decrease of the country risk can lower the stock indices in the following periods. According to Granger and Hatemi-J (2012) causality tests, the hypothesis that the fall of CDS's will not reduce stock indices is rejected at the 95% significance level. These findings suggest that the decrease in the Brazilian economy's vulnerability to its debt level is heavily accounted by the international investors. In other words, it can be argued that the fall of the country risk reduces investors' risk likeliness and also capital flows to the Brazilian economy are speculative.

On the other hand, it can be assumed that the rise / fall of CDS lead to capital outflows / inflows in accordance with economic theory. Our findings show contradictory causality tests results at the 95% significance level in that respect. According to the results of the Granger and Hatemi-J (2012) causality tests conducted for the Russian economy, the most emphasizing outcome is that the decrease / increase in country risk may suggest that it does not raise / lower stock indices. The results of both tests for Russia contradict each other at the 95% significance level, and based on economic factors, change in Russia's country risk cannot be recognized as a major factor of country's capital inflows and outflows. Additionally, the hypothesis that the increase in CDS's will not increase stock indices is rejected according to 95% significance level by Granger test; and Hatemi-J (2012) test does not reject the hypothesis that the increase in CDS's will not increase stock indices at the 95% significance level. Therefore, it can be inferred that the capital flows towards the Russian economy and investors' risk-taking behavior may also be related to non-economic factors.

CDS is a crucial indicator for economic agents, and the changes in the CDS may have adverse impacts on the economy. More specifically, the increase / decrease in CDS lowers / raises net capital inflows or increases / decreases risk likeliness. Impact on stock indices may vary depending on the impact of net capital inflows and changes in risk likeliness. For the case of India and China, our test results verify that decreases in CDS do not lead to considerable amount of capital inflows and thus, do not increase stock indices. Additionally, the increase in Chinese CDS does not raise stock indices via the increase in the risk appetite. In this respect, we detected asymmetric properties in terms of risk-taking behavior and capital flow channels. More specifically, two causality tests confirm that decreases in CDS do not lead to considerable amount of capital inflows in India and China. However, Granger causality test result shows that the increase in CDS may lead to considerable amount of capital outflows from Chinese stock market.

5. Conclusion

Risk premium, which varies depending on the macroeconomic conditions of countries, is an important indicator for consumption and investment decisions. Depending on the risk premium, the money multiplier may change and monetary aggregates may increase or decrease. Additionally, the country risk is also a determinative factor in financial markets, affecting investors' risk likeliness and influencing stock returns through international capital flows. Theoretically, it can be argued that the increase / decrease of country risk premiums leads to lowering / raising capital inflows which in turn decrease / increase stock returns. However, an increase / decrease in the risk premium may affect the risk likeliness positively / negatively. Accordingly, possible asymmetric effects were also taken into consideration by the cumulative sums approach and the causality analysis for BRIC countries.

In the case of the Brazilian economy, the theoretical assumption of the above-mentioned international capital movements was not strongly supported at the 95% significance level with both causality tests. It has been suggested that the decline in CDS may be the reason for the decrease in stock indices and it is implied that economic investors in Brazilian capital markets may have a risk-likely attitude. In other words, the decline in CDS's, which pointed to the changes in country risk, affected the risk likeliness of investors in Brazilian capital markets in the negative direction.

In the case of Russia, Granger and Hatemi-J (2012) causality tests also showed that the hypothesis, that the increases / decreases in CDS will not be the cause of any changes in stock indices at the 95% significance level, since both tests contradict each other. Therefore, it can be argued that international capital inflows and outflows to and from Russian capital markets may not be related to debt management risks. Both of the causality tests for Russia did not find any strong causality relationship from cds_t^{+ru} to sto_t^{+ru} and from cds_t^{-ru} to sto_t^{-ru} for 95% significance level. More specifically, it was found that risk behavior of the investors in the Russian capital markets might not depend on the changes in CDS. The findings of our study show that CDS's of the Russian economy will not affect the depth of the stock market through international capital inflows and outflows and will not result in the level of financial development and monetary aggregates.

The majority of test results reveal that there are not strong causality effects among CDS and stock indices in BRIC countries. It can be implied that other macroeconomic factors, such as GDP, inflation, exchange rate, can be dominant in explaining the variations in stock markets. Furthermore, it can be revealed that foreign direct capital inflows become an indispensable factor to sustain macroeconomic and financial stability in BRIC countries. According to the findings of our study, macroeconomic stability cannot be strengthened in economies where there is no increase in innovation and total factor productivity and the indicators of country risk will become an important determinant in the stock market.

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