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Crises And Stock Market Integration: Evidence From BRICS Countries

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Abstract

This paper examines the stock market integration in BRICS (a group of Brazil, Russia, India, China and South Africa) countries and explores the effect of two major events; COVID-19 and Russia-Ukraine war on the stock market linkages of these countries. The study is based on weekly observations of BSE SENSEX (India), Bovespa Index (Brazil), MOEX Index (Russia), Shanghai Composite Index (China), and JSE All Share Index (South Africa) collected from Yahoo Finance and Wallstreet Journal from January 2016 to December 2023. We utilize multivariate DCC GARCH (dynamic conditional correlation) model to discern the time varying conditional correlations (TVCCs) between these equity markets. Thereafter, these TVCCs are regressed on the dummy variables to capture the existence of contagion effects among the stock markets of BRICS countries during these major events. The findings of this study indicate the existence of co-movement in the stock markets prices of BRICS countries during the sample period. We find existence of significant contagion effects among the BRICS countries during the COVID period. Results show a significant downfall in the TVCCs between BRICS stock market returns following the beginning of Russia - Ukraine war.

Keywords: Stock Market Volatility. BRICS. Financial Markets. Econometric Analysis.

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1 Introduction

Global economic uncertainties, crisis management learnings from COVID 19, geo-political tensions and a multitude of such reasons make global asset allocation a preferred investment strategy for institutional investors, financial institutions and corporate giants. Prospective stakeholders search for viable investment opportunities by comparing risks and returns posed by unique characteristics of different economies. As stock markets are considered as economic barometers for long, it becomes pertinent to observe their strengths and weaknesses along with their resilience strategies. Macro-economic variables include interest rates, exchange rates, industrial output levels collectively send signals about current status and future prospects of an economy. The indices' response to these variables further strengthens insights about financial stability, economic

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condition and viability of potential investments in such economies. Increased globalization coupled with liberalized stock markets Gallo and Otranto's (2007) have promoted investment beyond domestic borders in both developed and developing economies. Various studies in the past have attempted to investigate the level of stock market integration of developed markets with a lot of them concluding in favour of presence of co-integration (de Santis & Gerard, 1997; Gérard, Thanyalakpark, & Batten, 2003; Gjika & Horvath, 2012; Matar et al., 2021; Mohite & Bhandari, 2022; Neifar, 2020). Stock co-integration studies have a potential role in application of portfolio diversification studies. Optimal diversification strategy should spread asset allocation over diverse economies Vithessonthi and Kumarasinghe's (2016) especially that have low or no co-movement as a part of risk reduction (Devereux & Yu, 2020; H. & Min B., Shrestha, 2010; Irshad VK & Shanmugam, 2017); and hedging strategies. Greater the co-integration, greater is the risk of spill-over effects to be felt across cointegrated markets. This might lead to ineffective performance of domestic markets as international events sweep over the impact of domestic volatility (Devereux & Yu, 2020).

Though there is paucity of literature with emerging markets, several studies have compared the stock market integration of developed vis-a-vis developing economies(Kewal, 2009; Li, Ho, & Yau, 2015; Vardar, Coşkun, & Yelkenci, 2018). These emerging economies by their very definition offer lucrative investment options due to a promising history of stable growth, positive trends in domestic and international trade and ever-growing market size. The present study makes an attempt to study stock market integration of BRICS countries to contribute towards this thin spread. BRICS encompasses major emerging economies showcasing rapid growth. These countries together represent 40 percent of world population spread over one-fourth of world land area. These countries have also been witnessing a reform in regulations, globalized market places, increased capex along with increasing GDP and increasing number of listed companies.

Another important aspect to examine is the causality between stock market cointegration and economic growth (Aydin, Pata, & Inal, 2022). The global pandemic of Covid 19 shook the world markets alike with severe impact on financial markets, increased state expenditure on public health, steep fall in consumer demand for various industries. However, the resilience post COVID and turnaround in businesses reinstated faith in the growth trajectory of these economies. The financial inclusion efforts of these economies are worth noting and banked population is ever increasing. Apart from availability, affordability and usage is also on a rise. Hence there is an increased interest in these stock markets of both domestic and international investors. Hence it is pertinent to examine the presence of cointegration among these markets and the impact of global and regional shocks on their interconnectedness. The study by Fan's (2005) has examined the impact of Asian financial crisis of 1997 over stock market integration. Sheng and Tu's (2000) found one cointegration in five south east countries in pre and during crisis period. Additionally, Fan's (2005) also concluded in favor of cointegration post Asian financial crisis and absence in pre-crisis period. Further, Mishra and Mishra's (2022) have confirmed the existence of equity market integration in BRICS economies both pre and during COVID 19, although with weakened degree of interconnectedness during COVID-19. Another study by Banumathy's (2023) found evidence of a leverage effect in BRICS countries highlighting variations in volatility patterns during the pandemic. The performance of BRICS economies and the size of their markets and GDP showcase favorable investment options. Table 1 captures the size and magnitude of these markets.

Table 1. Key financial parameters of BRICS countries (2023 data unavailable)

Country	Index	MC (US $) (Mn)		MC (GDP %)		Listed companies		Market Liquidity*		Turnover Ratio*	
		2016	2022	2016	2022	2016	2022	2016	2022	2016	2022
Brazil	Bovespa	758,558.9	794,417.9	42.24	41.37	338	361	31.07	67.30	73.56	162.65
China	Shanghai	7,320,738.4	11,469,346.1	65.17	63.85	3052	11497	162.86	180.72	249.91	283.04
India	BSE	1,746,297.4	3,603,482.4	76.10	105.47	5820	2168	35.23	56.64	46.29	53.70
Russian	MOEX	622,051.5	530,104.3	48.72	23.66	242	195	12.54	9.04	25.73	38.21
South Africa	JSE	951,320.3	1,171,748.1	293.99	289.13	303	237	112.80	77.18	38.37	26.69

shares traded as a % of GDP
MC: Market Capitalization
Source: World Development Indicators (WDI)

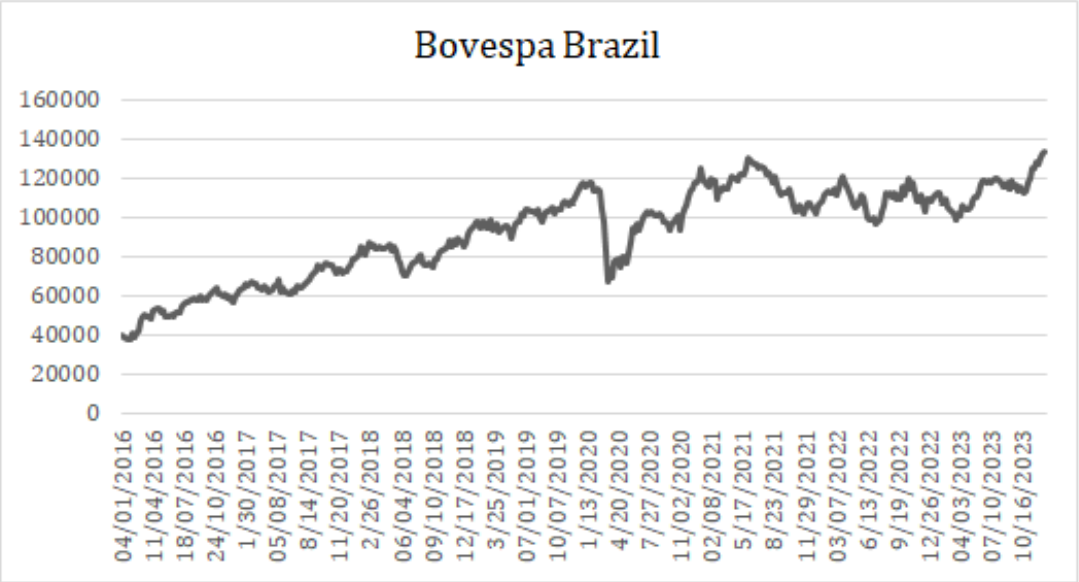

Figure 1. Weekly Stock Price Index Of Brazil Bovespa, January 2016-December 2023

Source: Authors' own elaboration

Market capitalization reflects the magnitude of stock markets in an economy. However, relative comparisons on the basis of market liquidity and turnover ratio draw a clearer picture. Expansion of stock markets may be analyzed through listed companies as well. While the size of the market is a key sign of how developed it is, it's pertinent to note that this numbers do not give a holistic view of financial sector's volatility and maturity. Figure 1, 2 , 3 ,4 , 5 presents the weekly stock price indices of BRICS countries over the study period.

Thus, it is vital to analyse the presence of stock market integration (SMI) during chosen time period in the group of emerging economies i.e., BRICS countries. Further, the impact of global pandemic COVID 19 was felt across countries and continents in all major sectors and also on stock markets at world level. BRICS economies might have faced a unique setback due to Russia Ukraine war since February 2022. As portfolio diversification largely upholds optimum asset allocation in inversely related or unrelated options, it is all the more important to understand the co-movement of these five emerging economies despite these two major disturbances. Both these events might have a contagion effect, this study attempts to capture stock market integration in BRICS economies along with impact of Covid and war. The findings can be significantly contributing towards developing a better understanding of BRICS economies being looked at as one big market comoving together. In this context, the multivariate GARCH DCC model has been applied as it accounts for the heteroscedasticity, ensures a positive covariance matrix and, also does not have convergence issues. Further, OLS estimation is used to examine the impact of COVID and war on the correlations between the BRICS stock markets.

This paper unfolds as follows: Section 2 delves into the literature on SMI in developing economies with few studies having specific focus on BRICS countries too. Further Section 3 outlines the research methodology followed by Section 4 provides detailed exposition of findings. Finally, Section 5 concludes the paper.

Figure 2. Weekly Stock Price Index Of Russia MOEX, January 2016-December 2023

Source: Authors' own elaboration

Figure 3. Weekly Stock Price Index Of India BSE, January 2016-December 2023

Source: Authors' own elaboration

Figure 4. Weekly Stock Price Index Of China SCI, January 2016-December 2023

Source: Authors' own elaboration

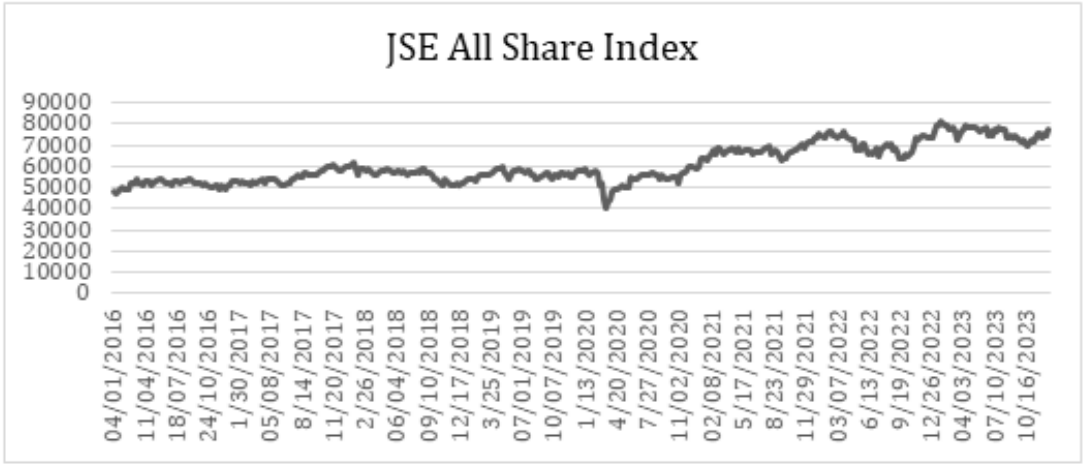

Figure 5. Weekly Stock Price Index Of South Africa JSE, January 2016-December 2023

Source: Authors' own elaboration

2 Literature Review

In this era of globalization combined with blurred geographical boundaries, inter-dependency and linkages of financial markets are inevitable throughout the world. Existing literature has highlighted the common inferences of stock market integration of developed countries at large and few studies on developing countries (including BRICS countries). Appiah and Forson, 2020; Bhutto et al., 2020; Gopane, 2023; Irshad VK and Shanmugam, 2017; Khalid and Ahmad, 2023; Khan et al., 2022; Maiti et al., 2022; Mishra and Mishra, 2022; Sahabuddin et al., 2022 have suggested their insights on equity market integration from BRICS Economies. Aydin2022 ; Mroua and Trabelsi's (2020) analyzed the causality and dynamic links of stock prices with other financial features. The forces of stock market integration and the extent of integration differs over time are the prime concerns for the investors to evaluate their return and risk.

The review of previous researches is associated to co-integration, effects of volatility patterns, causality and the relationship between stock market indices and the impact created on portfolio diversification and asset management (Banumathy, 2023; Gupta, Nel, & Pierdzioch, 2023; Panda, Panda, & Panda, 2023; Samuel, 2021). Panda, Panda, and Panda's (2023) identifies volatility connectedness is significant between specific country pairs, indicating diversification opportunities among BRICS countries' stock markets with MGARCH-BEKK model and Diebold–Yilmaz volatility spill over index over a period of two decades.

The impact of fundamentals and sentiment on stock market volatility during the pandemic was examined through the Quantile machine learning approach by Gupta, Nel, and Pierdzioch's (2023) and finds a significant influence on the performance of the emerging markets like South Africa and BRICS countries. Additionally, GARCH effects are found in the Nigerian stock market, both before and during the COVID-19 with more pronounced volatility and leverage-effects (Samuel, 2021). Another study by Banumathy's (2023) found evidence of leverage effect patterns in the BRICS stock market during the pandemic period. Gopane's (2023) applies a two-step econometric procedure of the BEKK-MGARCH and panel data models to analyze the impact of regional economic integration on stock market linkages within the BRICS economic bloc and finds the positive relationship at times of surplus trade. The impact of economic policy uncertainty on the stock prices was examined by Aydin, Pata, and Inal's (2022) using symmetric and asymmetric causality tests and finds unidirectional permanent causality from EPU to stock prices for Brazil and India, and bidirectional causality for China. Employing Auto-Regressive Distributed Lag (ARDL) model and panel Generalized Method of Moments (GMM) models, Mroua and Trabelsi's (2020) find significant relationship between the exchange rate changes and the volatility of BRICS stock market. Mishra and Mishra's (2022) suggest that equity market integration impacted by the shocks in the weekly and monthly data during pre and Covid 19 pandemic periods in BRICS countries.

Maiti et al.'s (2022) uses wavelet correlation approach and provides evidence for a significant level of long-term co-movement between BRICS nations except China. Using Granger causality tests Irshad VK and Shanmugam's (2017) , explored the extent of integration within BRICS stock markets and found a long term negative co integrative relationship. Employing Auto-Regressive Distributed Lag (A.R.D.L.) methodology Bhutto et al.'s (2020) investigate the short-term and long-term changing patterns and conclude that an investment portfolio diversification may originate significant benefits among the BRICS nations with the merged funds. Using the multivariate Dynamic Conditional Correlation – Fractionally Integrated Asymmetric Power ARCH (DCC-FIAPARCH) model, Dimitriou, Kenourgios, and Simos's (2013) find an increasing co-movement between the BRICS and U.S. markets during the post-crisis period (from early 2009 onwards), implying that the dependence is larger in bullish than in bearish markets. Through a novel DCC decomposing method, and provide strong evidence that the global financial crisis

changed the conditional correlations between the developed (U.S. and Europe) markets and the BRICS stock markets.

Bekiros's (2014) used linear and nonlinear causal linkages to analyze the volatility spill overs among the U.S., the EU and the BRIC markets and find that the BRICs have become more internationally integrated and contagion is further substantiated since the U.S. financial crisis. Gilenko and Fedorova's (2014) use the four-dimensional BEKK-GARCH-in-mean model to investigate the external (with the rest of the world) and the internal (within the group) links (spill overs) of the BRIC stock markets. The authors suggest that the linkages between the developed and the emerging BRIC stock markets have significantly changed after the crisis.Khalid and Ahmad's (2023) uses DCC-MGARCH techniques to study the impact of financial integration and development on stock-bond co-movements in the ASEAN-5 countries. It was concluded in the study that due to the existence of high risks within ASEAN-5 countries, diversification benefits could not be derived by only financial integration. With the same technique, Appiah and Forson's (2020) found dynamic conditional correlation between returns of the various sectors of the Ghanaian economy for portfolio diversification. The changes in the co-movement of stock returns and risk transmission of South Asian stock markets were analyzed by Khan et al.'s (2022) and increased market interactions through volatility spill overs post-SAFE (South Asian Federation of Exchanges) establishment were concluded. Using a wavelet-based approach in a stock market interrelationship study, Younis et al.'s (2020) find the higher frequencies of co-movement patterns and increased short- and long-term benefits for investors during the crisis period in the emerging Asian economies. With the same technique Sahabuddin et al.'s (2022) finds a significant long-term co-movement and lead-lag relationships between conventional and Islamic stock indexes in Bangladesh.

Additionally, a new insight in to the stock market participants was provided by Baek's (2023) through the study on the relationship between the Russian stock market and adjacent Eastern European (EE) countries'(Bulgaria, Czech Republic, Hungary, Poland and Romania) stock markets before and after the war with the daily market index data. The findings indicate that the war had a favourable impact on the causal relationship of Russia and other Bulgarian markets but a negative relationship impact on the Russia and the other EE stock markets. After the war extreme return co-movements have been strengthened in the Russian and the other Bulgarian stock markets and weakened return movements resulted in the Russian and the other EE stock markets. Chauhan and Kasthrui's (2024) studied the financial integration level among the BRICS countries and war crisis by considering indices' price and return movements. The war effect of co-integration, correlation and vector error correction models were applied for pre-and post-crisis period and findings indicate consistent long-term casual association with index returns and not the index prices. BRICS' net index was not found to be associated in the long run in either phase.

3 Research Methodology

3.1 Data

This study uses secondary data with weekly frequency for S&P BSE SENSEX, Bovespa Index (Ibovespa), MOEX Russia Index, Shanghai Composite Index, and JSE all share index sourced from Yahoo Finance and WSJ.com (Wallstreet Journal) from January 2016 to December 2023. Following the empirical literature, all stock prices are converted into logarithmic first differences. The descriptive statistics and unconditional correlations of all five stock market returns (SMR) are given in Table 2. The average weekly returns are highest for Brazil and lowest for China. Furthermore, the Brazilian SMR also has the maximum volatility and the Chinese SMR series

Table 2. Descriptive Statistics and Unconditional Correlations

	RBR	RBSE	RJSA	RMOEX	RSHANGHAI
PANEL A Descriptive Statistics					
Mean	0.286806	0.255710	0.112749	0.138902	-0.011830
Std. Dev	3.214267	2.265614	2.474298	3.147766	2.183302
Skewness	-0.973085	-0.457463	-0.891334	-3.177403	-0.459412
Kurtosis	9.287871	9.054095	9.195470	30.67154	4.476399
Jarque- Bera	750.9650	649.8120	720.4037	13972.36	52.41589
Minimum	-20.92316	-13.10073	-16.42690	-31.73934	-10.08844
Maximum	11.92462	12.16352	8.707754	10.51777	7.056301
PANEL B Unconditional Correlations					
RBR	1				
RBSE	0.54	1			
RJSA	0.54	0.54	1		
RMOEX	0.29	0.34	0.43	1	
RSHANGHAI	0.28	0.28	0.40	0.19	1

Note: RBR represents SMR of Brazil, RBSE represents the SMR of India(BSE), RJSA represents the SMR of South Africa, RMOEX represents the SMR of Russia and RSHANGHAI represents the SMR of China.
Source: Authors' own estimation

has the least volatility among the five SMR. All SMR are positively skewed and has leptokurtic distribution. The unconditional correlation between all SMR is positive.

3.2 Econometric Methodology

Our analysis begins with examining the stationarity properties of all five SMR. For this purpose, we utilize Dickey–Fuller Generalised Least Squares (DF–GLS) test suggested by (Elliott, Rothenberg, & Stock, 1996). The next step entails estimating the multivariate GARCH - DCC specification that produces TVCCs among all SMR pairs. In the final step, "we test for the presence of contagion effects in BRICS SMR" during covid-19 and Russia -Ukraine war using OLS (with robust standard errors) (Dua & Tuteja, 2023) .

- Dynamic Condition Correlation GARCH (DCC-GARCH)
  Multivariate GARCH model was introduced by Bollerslev, Engle, and Wooldridge's (1988) to capture volatility inter-dependence of economic time series. The generalized multivariate GARCH model (also called the VECH-GARCH model) faces convergence issues as it requires estimation of too many parameters. Furthermore, the condition that conditional variances are positive and conditional correlations lie between +1 and -1 may not be met in this model. Engle's (2002) and Tse and Tsui's (2002) developed the DCC-GARCH model that accounts for heteroscedasticity and is capable of estimating large TVCCs. The estimation of this model involves two-steps. In the first step, univariate GARCH models is estimated for all the time series. Thereafter, the standardized residuals derived from the first step are used to estimate the dynamic correlation matrix. As advocated by Engle's (2002) this two-step procedure allows to estimate conditional correlations and conditional volatilities of several economic time series without any computational burden.
  The generalized framework of the DCC-GARCH model is given by:

$$r_t|\mathcal{F}_{t-1} \sim N(0, D_t R_t D_t) \tag{1}$$

$$Q_t = (1-\alpha-\beta)S + \alpha(\epsilon_{t-1}\epsilon_{t-1}^{'}) + \beta Q_{t-1} \tag{2}$$

$$R_t = \text{diag}(Q_t)^{-1} Q_t \text{diag}(Q_t)^{-1} \tag{3}$$

Where r_t are returns, $\mathcal{F}_{t-1}$ stands for the past set of information, $D_t = \text{diag}(h_{11t}^{1/2}, \ldots, h_{NNt}^{1/2})$ is the $N \times N$ diagonal matrix containing standard deviations obtained from univariate GARCH models, and R_t is the $N \times N$ conditional correlations matrix; Q_t is a symmetric positive semi-definite matrix of ε_t; S is the $N \times N$ unconditional variance matrix of ε_t; $\varepsilon_{it} \sim N(0, R_t)$ are the standardized residuals obtained from GARCH models. Scalars α and β satisfy the restriction that $\alpha \geq 0, \beta \leq 1$, and $\alpha+\beta \leq 1$. The estimation of the above model can be done consistently in two steps by maximizing the log-likelihood function.

- Test for the change in conditional correlations due to the covid-19 pandemic and Russia - Ukraine War

  Several studies such as Dua2016 ; Kenourgios, Naifar, and Dimitriou's (2016) have examined the impact of crisis on conditional correlations estimates obtained through DCC-MGARCH model. We study if covid-19 and Russia -Ukraine war has affected the conditional correlations between all the SMR pairs using the OLS estimation (with robust standard errors). The following univariate OLS regression is estimated for ten TVCCs obtained from DCC-MGARCH model:

$$\hat{\rho}_{ij,t} = \gamma_0 + \gamma_1 \text{COVID} + \gamma_2 \text{WAR} + \varepsilon_t \tag{4}$$

  Where $\hat{\rho}_{ij,t}$ is the pairwise correlation coefficient between market i and market j; i and j represent the stock markets of Brazil, India, China, South Africa, and Russia, respectively. Following Dua and Tuteja's (2016)

$$\text{COVID} = \begin{cases} 1 & \text{if } t \in [01/06/2020, 05/01/2023] \\ 0 & \text{otherwise} \end{cases}$$

$$\text{WAR} = \begin{cases} 1 & \text{if } t \in [28/02/2022, 25, 12/2023] \\ 0 & \text{otherwise} \end{cases}$$

  A positive (negative) and significant coefficient γ_i, $i = 1, 2$, implies a significant increase (decrease) in the TVCCs during the COVID-19 pandemic and Russia-Ukraine WAR. As described by Dua and Tuteja's (2023), a significant increase in conditional correlations during turbulent times vis-à-vis normal times is termed as 'contagion', whereas a significant decrease in conditional correlations during the unstable period vis-à-vis the stable period is known as 'flight to quality'. A significant estimate of the intercept coefficient γ_0 signifies strong interdependence between the markets during stable periods.

4 Result

The results of DF-GLS test (Table 3) show that all SMR are stationary. The estimations of Multivariate GARCH DCC model are given in Table 4. As all SMR are non-normal, we utilize t-distribution for the estimation. It can be seen from Table 4 that the estimated t-distribution shape parameter is significant at 1% level of significance. We find that the mean returns are positive for the stock markets of BRICS. Table 4 shows that the GARCH-DCC parameters α and β are significant at 10% and 1% levels of significance (LoS), respectively. This indicates the

Table 3. Unit Root test results

PANEL A	DF-GLS	
Variable	DF-GLS statistic	DF-GLS inference
RBR	-16.431**	Stationary
RBSE	-17.222**	Stationary
RJSA	-17.698**	Stationary
RMOEX	-9.720**	Stationary
RSHANGHAI	-14.118**	Stationary
Critical values		
10%	-2.57	
5%	-2.89	
1%	-3.48	

Note: RBR represents the SMR of Brazil, RBSE represents the SMR of India(BSE), RJSA represents the SMR of South Africa, RMOEX represents the SMR of Russia and RSHANGHAI represents the SMR of China
*,**, *** indicate 10%, 5% and 1% levels of significance (LoS) respectively.
Source: Authors' own estimation

Table 4. Results of MV-DCC GARCH Model

	RBR	RBSE	RJSA	RMOEX	RSHANGHAI
Mean	0.468863***	0.409042***	0.240182**	0.391077***	0.081527
Variance Equations					
Constant	1.253061***	0.416645	0.846118	0.454116**	0.105916
A	0.109336***	0.110884**	0.066419**	0.107238**	0.060759**
B	0.768132***	0.801745***	0.792713***	0.811087***	0.918517***
Persistence	0.877468	0.912629	0.859132	0.918325	0.979276
α	0.006363*				
β	0.956346***				
t-distribution	9.000635***				

RBR represents the SMR of Brazil, RBSE represents the SMR of India(BSE), RJSA represents the SMR of South Africa, RMOEX represents the SMR of Russia and RSHANGHAI represents the SMR of China
*,**, *** indicate 10%, 5% and 1% LoS respectively.

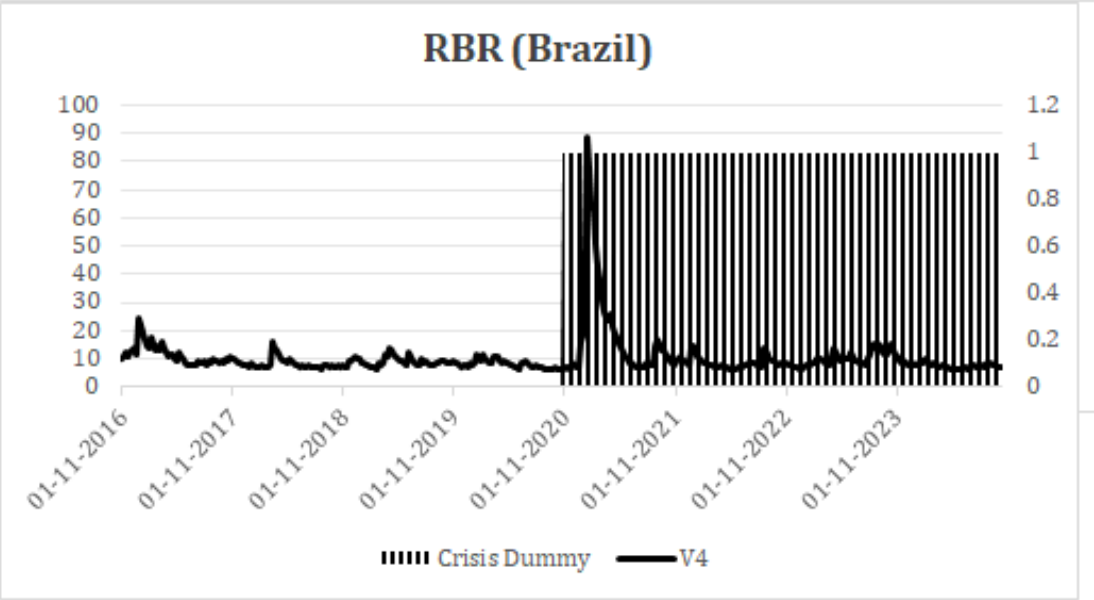

Figure 6. Volatility Estimates of Brazil's Stock Exchange

Source: Authors' own elaboration

existence of strong comovement in the stock prices of BRICS countries. Further, the estimates α and β satisfy the conditions of a mean-reverting process. We find that all five stock returns show very high persistence in volatility (the sum of ARCH and GARCH coefficients is greater than 0.8). Moreover, the ARCH and GARCH coefficients in the volatility equations of all five stock returns are significant at the conventional levels of significance.

The time varying volatility plots and conditional correlations plots of all five SMR estimated from MARCH-DCC model are shown in Figure (6 to 10) and Figure (11 to 20) respectively. Figure (6 to 10) shows that with the surge in covid cases worldwide in January 2020, there was a significant rise in the volatility of all SMR considered in this study. Moreover, there was a evidential jump in the volatility of Russian SMR following the beginning of war with Ukraine. Figure (11 to 20) shows significant variation in the TVCCs over the sample period. Further, Figure (11 to 20) depicts that the conditional correlations between BRICS markets significantly increased with the onset of pandemic in January 2020. Thereafter, there has been the declining trend in all the conditional correlations.

The results of the OLS estimation of Equation 4 to test for the impact of COVID and WAR on the TVCCs across BRICS stock markets are reported in Table 5. It may be seen from the Table 5 that the intercept coefficient for all conditional correlations equations is positive and significant at 1%. This indicates that BRICS markets demonstrate significant correlation during the periods of stability. We find the lowest correlation of 0.185836 between Russia and China and the highest correlation of 0.538499 between India and South Africa. Further, the coefficient of COVID is positive and significant at 1% for all the conditional correlations equations. This implies significant increase in the TVCCs between the BRICS stock markets during the COVID period. It can be seen from Table 5 that except for the regression equation of conditional correlation between SMR of South Africa and China, the coefficient of WAR is negative and significant at 1% for all the conditional correlations. This indicates significant downfall in the TVCCs across BRICS stock markets following the onset of Russia - Ukraine WAR.

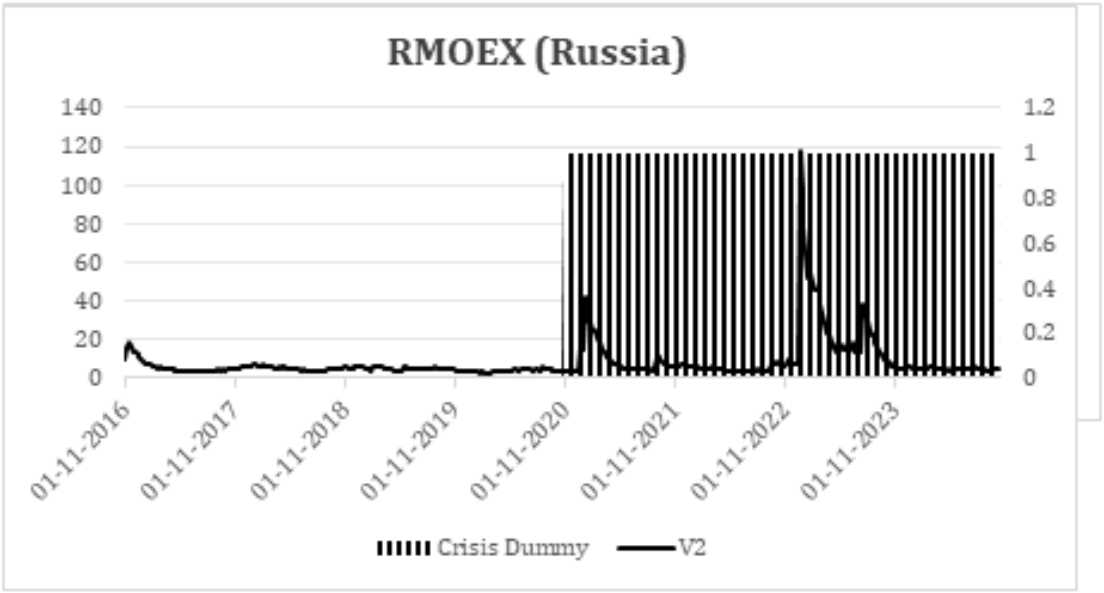

Figure 7. Volatility Estimates of Russia's Stock Exchange

Source: Authors' own elaboration

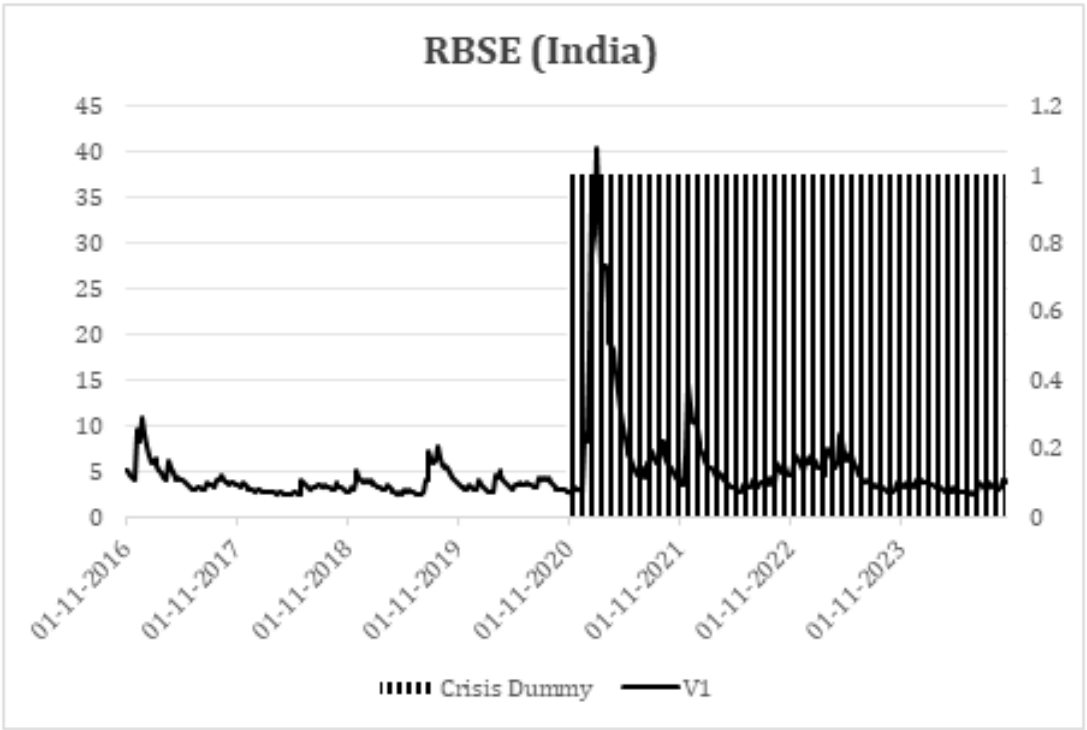

Figure 8. Volatility Estimates of India's Stock Exchange

Source: Authors' own elaboration

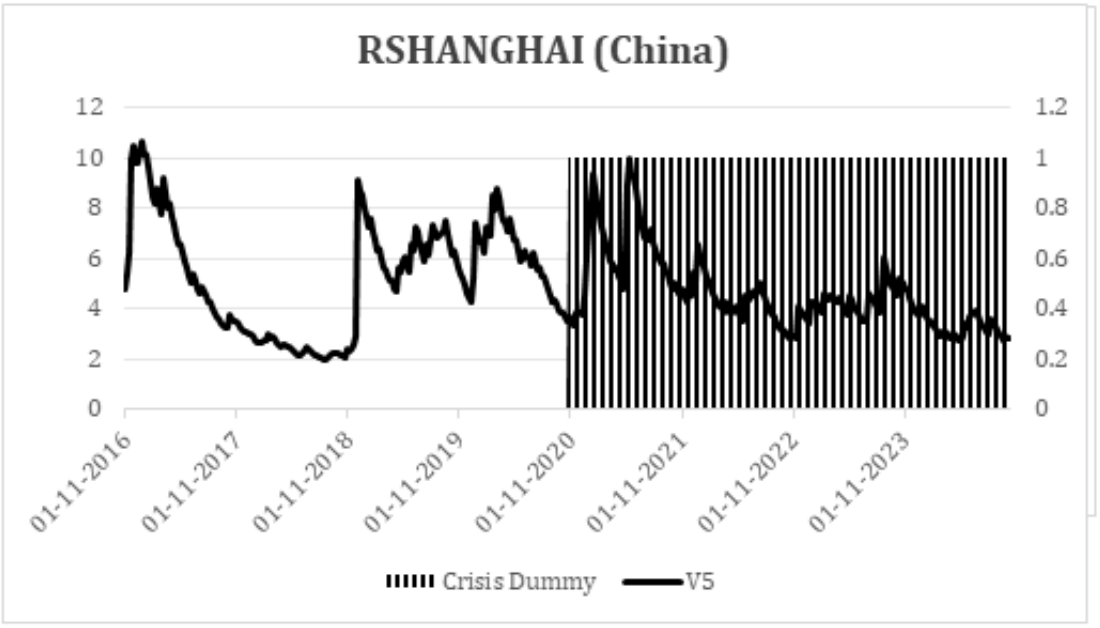

Figure 9. Volatility Estimates of China's Stock Exchange

Source: Authors' own elaboration

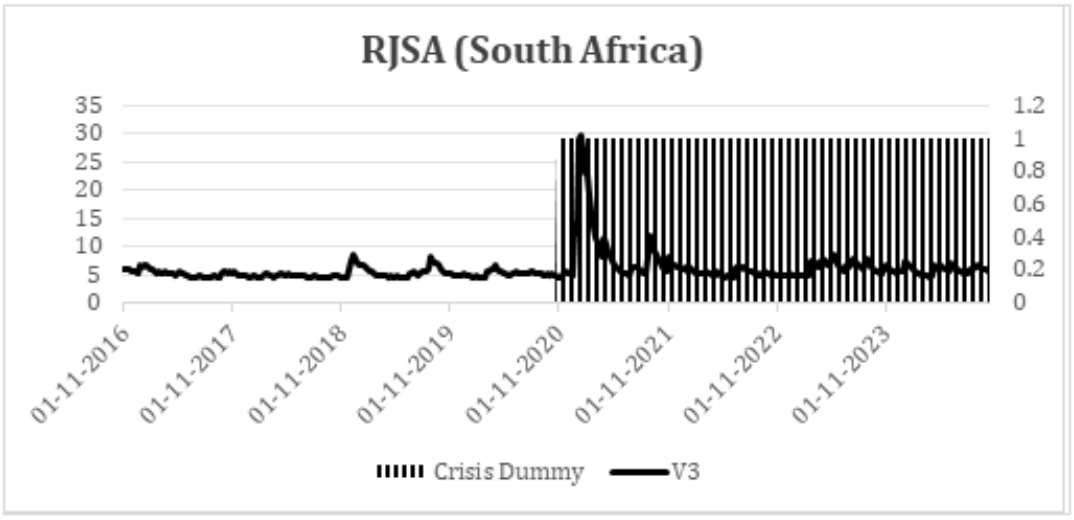

Figure 10. Volatility Estimates of South Africa's Stock Exchange

Source: Authors' own elaboration

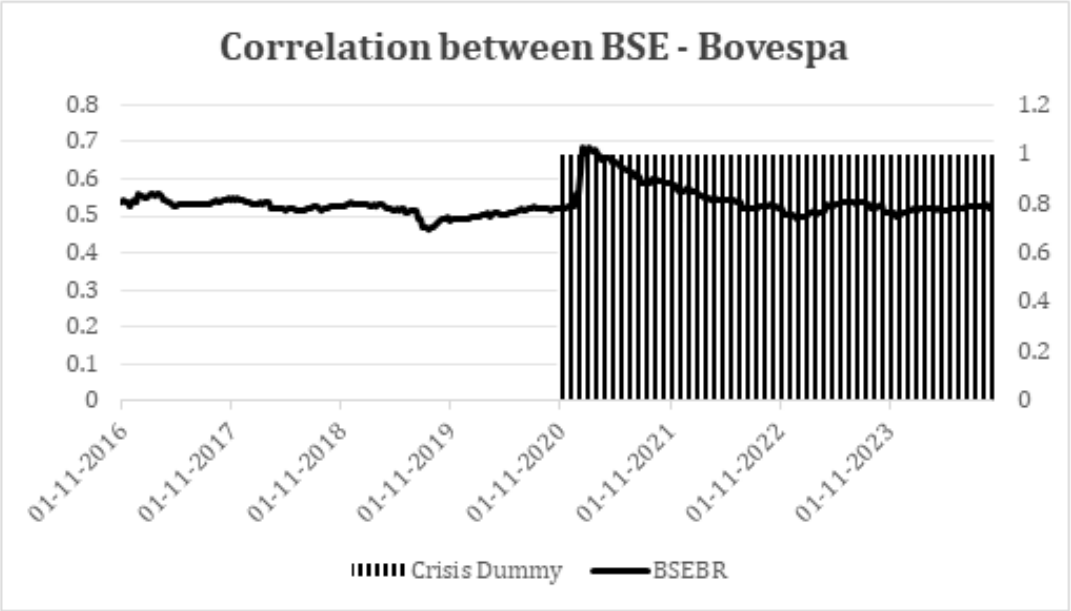

Figure 11. Conditional Correlations Between BSE India And Bovespa Brazil

Source: Authors' own elaboration

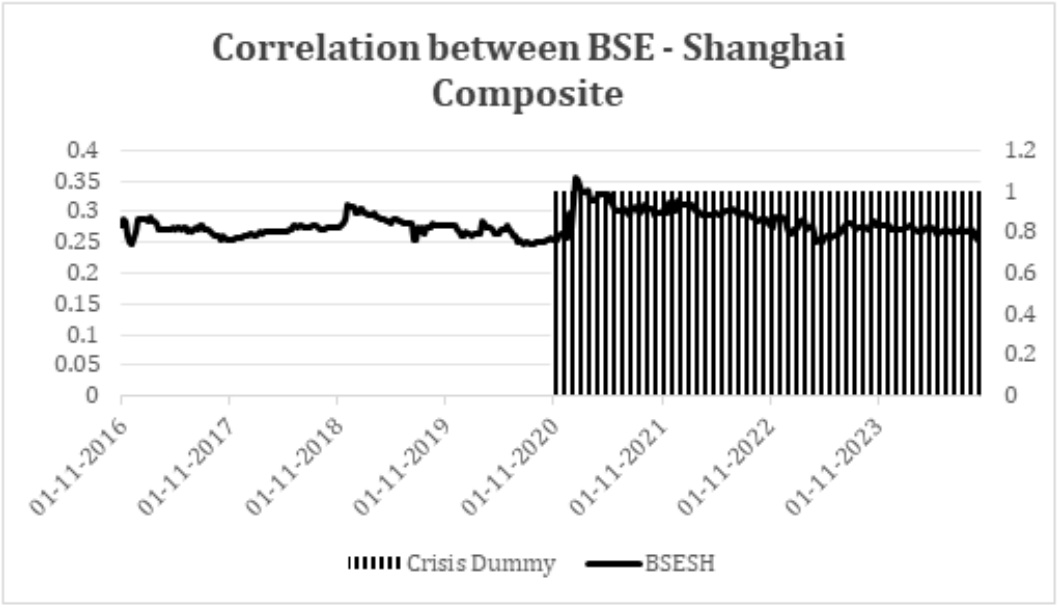

Figure 12. Conditional Correlations Between BSE India And SCI China

Source: Authors' own elaboration

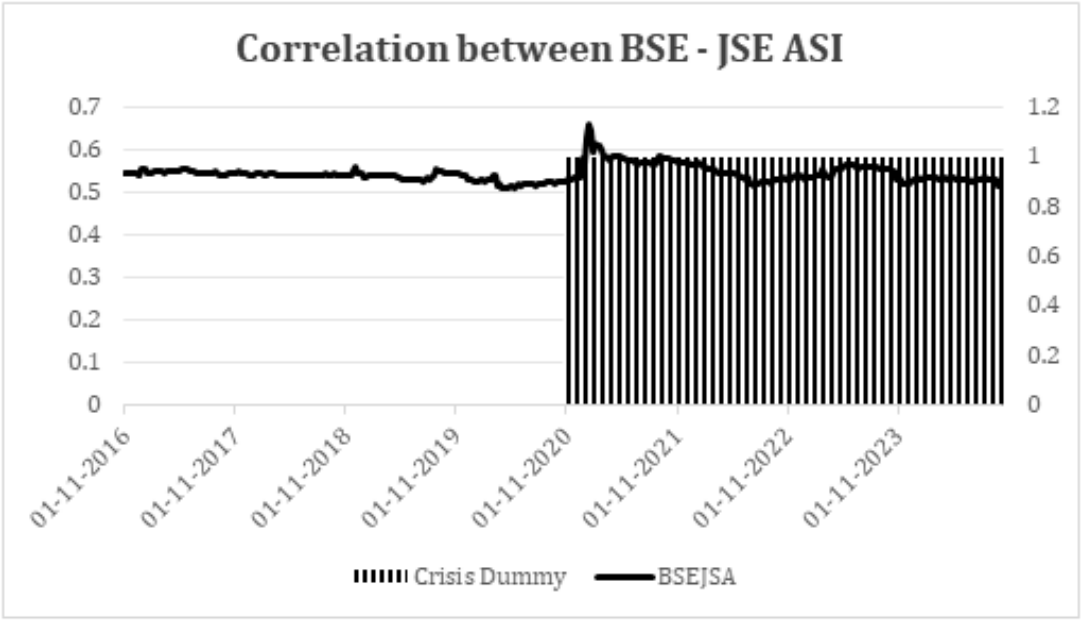

Figure 13. Conditional Correlations Between BSE India And South Africa's JSE

Source: Authors' own elaboration

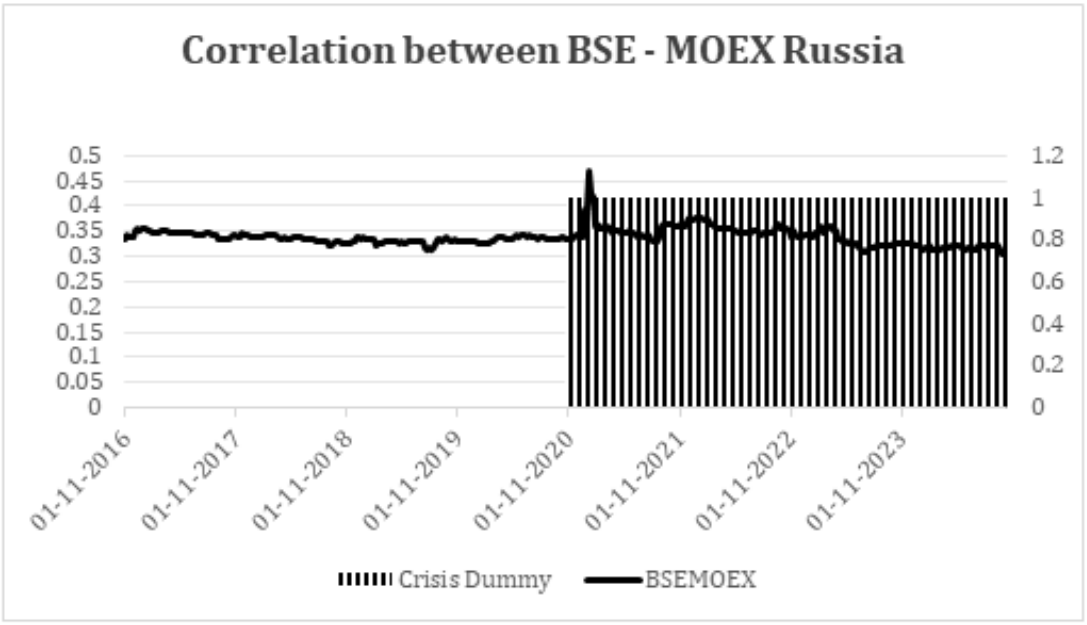

Figure 14. Conditional Correlations Between BSE India And MOEX Russia

Source: Authors' own elaboration

Figure 15. Conditional Correlations Between MOEX Russia And South Africa's JSE

Source: Authors' own elaboration

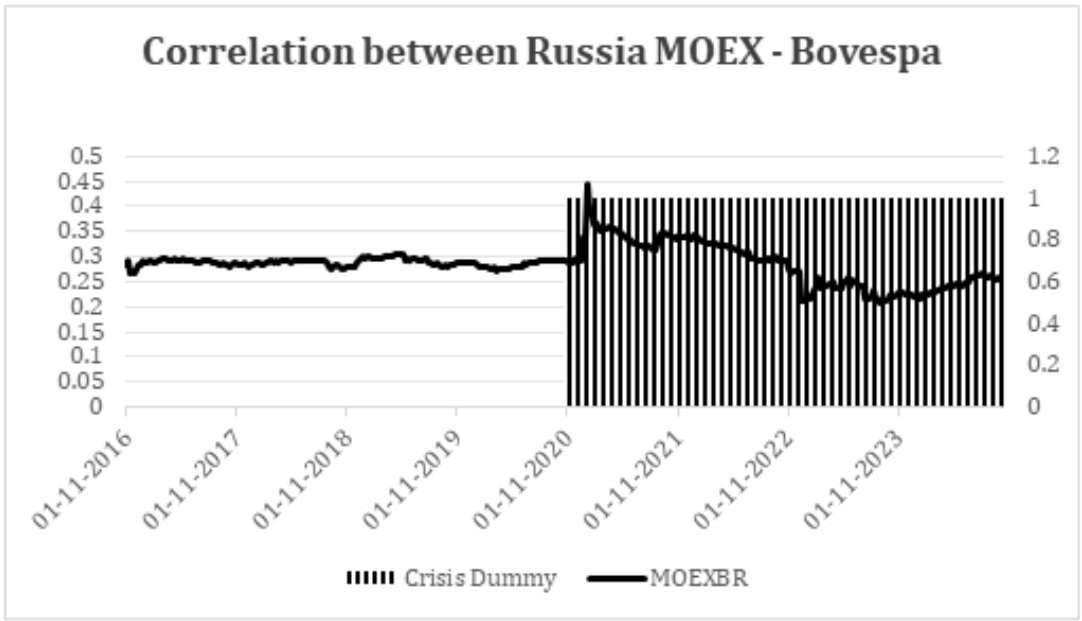

Figure 16. Conditional Correlations Between MOEX Russia And Brazil's Bovespa

Source: Authors' own elaboration

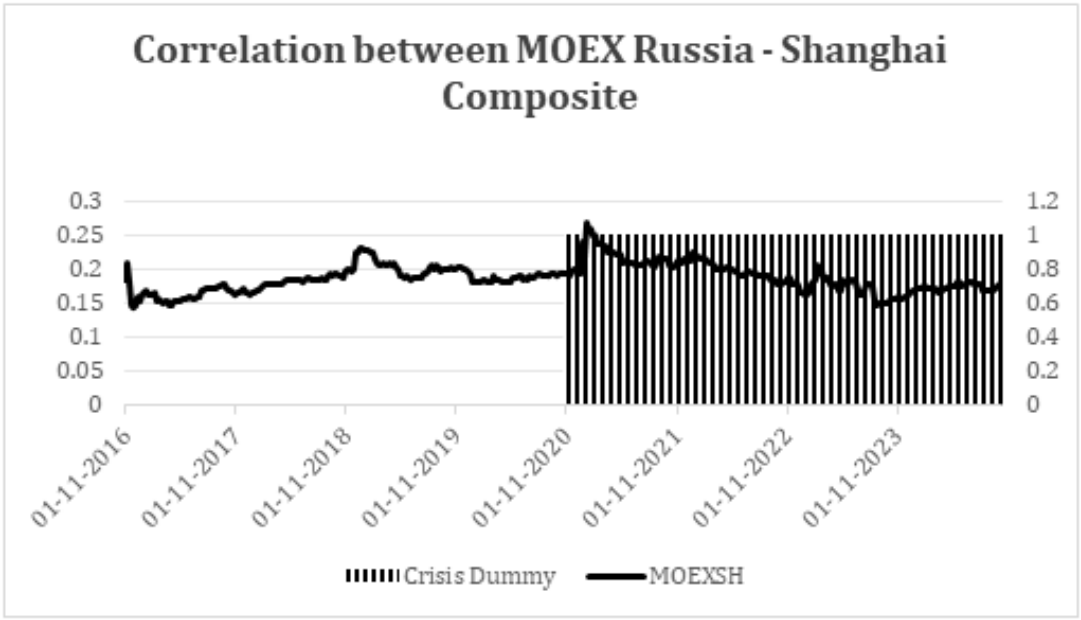

Figure 17. Conditional Correlations Between MOEX Russia And China's SCI

Source: Authors' own elaboration

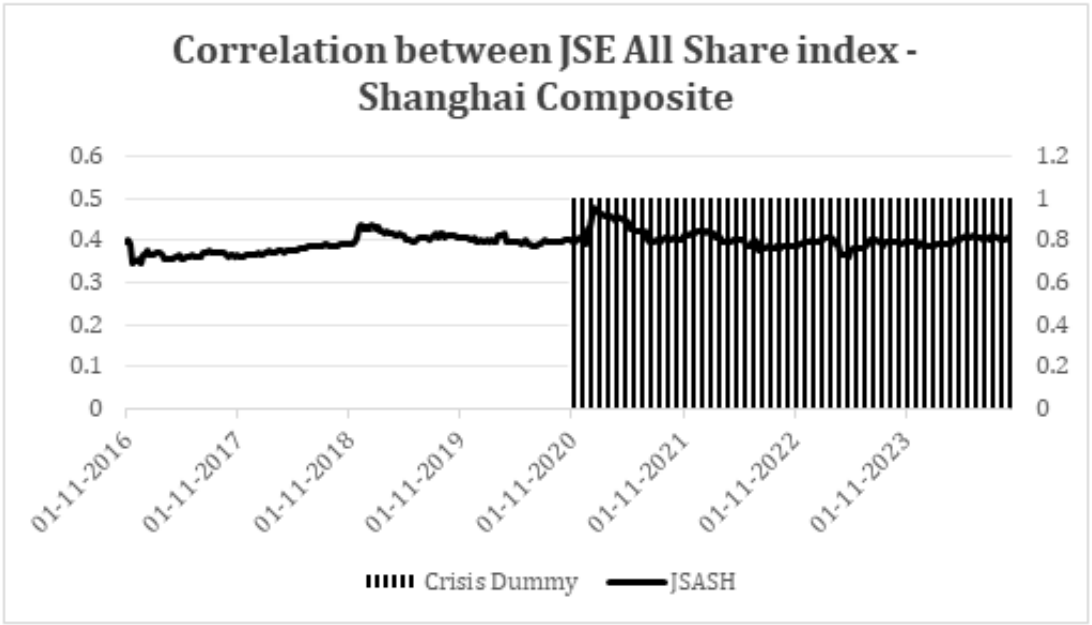

Figure 18. Conditional Correlations Between South Africa's JSE And China's SCI

Source: Authors' own elaboration

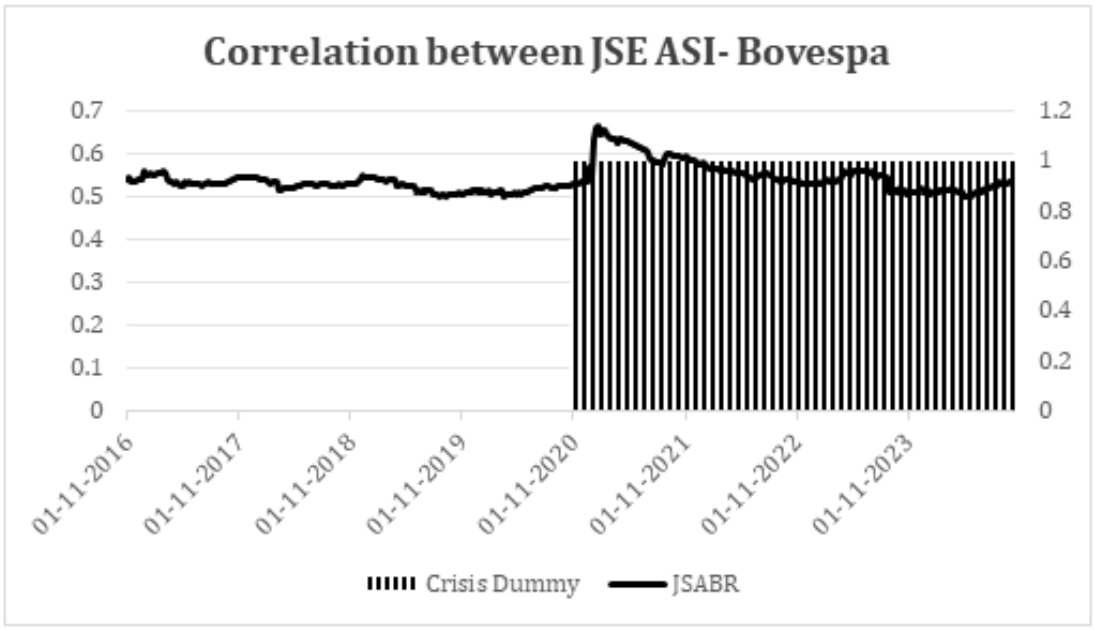

Figure 19. Conditional Correlations Between South Africa's JSE And Brazil's Bovespa

Source: Authors' own elaboration

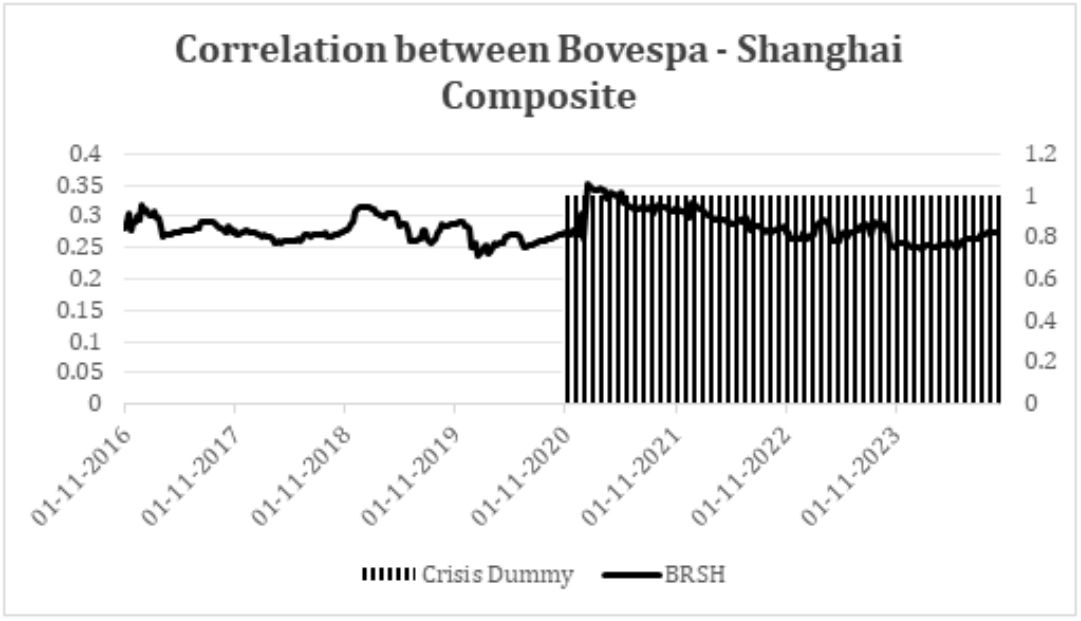

Figure 20. Conditional Correlations Between Brazil's Bovespa And China's SCI

Source: Authors' own elaboration

Table 5. Effect On Conditional Correlations Based On GARCH DCC Among Stock Markets During The Phases Of COVID 19 And Russia-Ukraine War (Using OLS With Robust Standard Errors)

	COVID	WAR	INTERCEPT	INFERENCE
RBSE and RMOEX	0.0174665***	−0.0234719***	0.336934***	COVID: Contagion, WAR: Flight-to-quality except for RJSA and RSHANGHAI
RBSE and RJSA	0.0193259***	−0.0111857***	0.538499***	
RBSE and RBR	0.0391483***	−0.0322144***	0.525893***	
RBSE and RSHANGHAI	0.0229384***	−0.0184092***	0.274380***	
RMOEX and RJSA	0.0287739***	−0.0601139***	0.429796***	
RMOEX and RBR	0.0218547***	−0.0702195***	0.292758***	
RMOEX and RSHANGHAI	0.0168077***	−0.0254029***	0.185836***	
RJSA and RBR	0.0411498***	−0.0289871***	0.529778***	
RJSA and RSHANGHAI	0.0140743***	−0.00515400	0.391237***	
RBR and RSHANGHAI	0.0215893***	−0.0250818***	0.278074***	

Note: RBR represents the SMR of Brazil, RBSE represents the SMR of India(BSE), RJSA represents the SMR of South Africa, RMOEX represents the SMR of Russia and RSHANGHAI represents the SMR of China

*,**, *** indicate 10%, 5% and 1% LoS respectively.

5 Conclusion

This study examines SMI in BRICS countries with particular reference to two crisis periods during the selected study period. We explore the effect of COVID-19 pandemic and the Russia-Ukraine conflict on the TVCCs across the BRICS stock markets. To meet these objectives, we utilize weekly data from 04.01.2016 to 25.12.2023 and multivariate GARCH DCC model. Dummy variables are created to account for the effect of both the crisis on the conditional correlations. The findings of this study indicate existence of comovement in the BRICS countries equity market returns during 2016-2023. We find existence of significant contagion effects among the BRICS SMR during the COVID period. Moreover, our results reveal that post the outset of the war 'flight to quality' effects exist in the stock market yields of BRICS nations. Our analysis has several implications for the portfolio managers who endeavour portfolio diversification in the international markets.

Existence of significant contagion effects during the covid period implies that the benefits of divergence of stocks among BRICS stock markets may not occur. Instead, 'flight to quality' effects found among the stock returns of BRICS countries due to Russia Ukraine war indicate the new opportunities for portfolio diversification in these economies. Moreover, the correlation estimates between BRICS stock market returns found in this study has implications for the optimal portfolio allocation. An interesting inference for the policymakers, regulatory authorities and other stakeholders is about the difference in impact of global and regional/country specific events on BRICS economies. Global pandemic of Covid 19 has affected all markets alike as displayed by the significant contagion effects. Therefore, optimal asset allocation policy within BRICS economies may not be a preferred choice. However, Russia-Ukraine war has impacted as a regional/ country specific event affecting the sample countries differently. This finding makes portfolio diversification within BRICS economies a preferred choice for investment managers.

Lastly, this study may have a useful impact on the international policy decisions of governments of BRICS countries. The governments in these countries can plan strategies to guard their respective countries against global crises as well as regional events.

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