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IMPACT OF COVID-19 ON THE RETURN CONNECTEDNESS AMONG BRICS

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ABSTRACT

The present study tries to examine and compare the connectedness among the BRICS during the Covid19 period with Pre-Covid19 period. It starts with observing the similarities and dissimilarities in the pattern of stock market indexes of BRICS as well the number of newly infected cases from January 2020 to December 2020. After that the study proceeds towards analysing the change in the return connectedness among BRICS by employing Diebold-Yilmaz Spillover Index during the time when the pandemic is still prevailing compared to the Pre Covid19 period. The empirical findings suggest that in the times of crisis, international markets tend to be more correlated, hence offering lower scope for diversification as compared to the tranquil period.

Keywords: *BRICS, Covid-19, Stock Market,* Financial Crisis.

Introduction

The studies related to connectedness among the financial markets of the countries have received considerable attention in the past. Studies by Bekaert and Harvey (1995), Phylaktis and Ravazzolo (2002) and Carrieri, Errunza, and Hogan (2007) have shown that increased financial integration as a result of financial liberalisation has made the financial markets over the world more sensitive to external events. Events like terrorist attack, collapse of any major institution, outbreak of any virus and others have time and now created financial turbulences in the markets over the world (Ahmed and Farooq, 2008). For instance, the volcanic eruption in the year 2010 in Iceland affected the markets of UK and Finland as well since the global supply chains were disrupted (Ellertsdottir,2014). This attracts the attention of researchers over the world to examine how these events influence the return offered by the global financial markets as well as how it propagates from one market to another market. An extensive amount of literature exists on how shocks transmit across the markets internationally. Empirical studies like Choudhry (2004), Li (2007), Tasdemir & Yalama (2014) have shown the unidirectional as well as bidirectional spillover between the financial markets of the world. The proliferation in the number of financial crisis around the world has led to an increased number of studies on identification of propagation mechanisms between developed and emerging economies (Bekaert, Harvey and Ng, 2005). Lin et al (1994) observed that the markets tend to show uniformity in times of financial crisis and thus a higher degree of co-movement can be noticed as compared to the tranquil periods. Diebold and Yilmaz (2009) also observed the phenomenon of contagion in the times of financial turbulences. This transmission of return and variance has been referred to as Return and Volatility Spillover in studies. In the context of any event or crisis, if an increased transmission is observed, the phenomenon is referred to as Contagion which has been further classified into fundamentals-based contagion and shift contagion (Forbes and Rigobon,1998). The present study is an effort in this direction to examine the impact of the prevailing covid19 crisis on the stock markets of emerging economies specifically BRICS. The study contributes to the existing literature in various ways. First of all, it utilises the contemporary method of Diebold and Yilmaz (2012) spillover index to ascertain and compare the connectedness among the emerging markets during this prevailing pandemic, the studies on which are still in the nascent stage. Secondly limited literature is available on the connectedness among BRICS especially during this covid19 crisis. Thus, it is going to help the policymakers and investors to plan diversification strategies in the times of financial crisis accordingly.

Objectives of the Study

- To observe the similarities in the pattern of movement of newly infected cases and BRICS stock market index during Covid19 pandemic.

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- To compare the connectedness among BRICS during Covid19 period from the period before Covid19 hit the world.

Data and Methodology

For the present study, the data pertaining to the closing prices of representative stock market index of BRICS has been taken from Yahoo Finance and the data related to Number of newly infected cases has been obtained from World Health Organisation. The data of stock market indexes has been divided into two halvesfor the purpose of comparing the connectedness. The first half of the data is from January 2019 to December 2019 i.e., Pre Covid-19 period and the other half starts from January 2020 to December 2020 i.e., when the pandemic is still ongoing. Before the analysis it is necessary to observe the movements in the newly infected cases and the stock market indexes. Line graph has been utilised for this purpose in which Vertical Axis represents the number of newly infected cases registered daily from January 2020 to December 2020 and the secondary vertical axis displays the closing prices of the stock market index. The Horizontal axis represents the time period from January 2020 to December 2020.

For the purpose of analysing and comparing the connectedness among market index of BRICS in the pre-Covid19 period and during the time when it is still prevailing, Diebold Yilmaz (2012) methodology has been employed. The first and foremost requirement in the time series data relates to the stationarity. So, first of all stationarity test has been applied on data to check whether the data is stationary or not and if not, it has been converted into stationary form. After the conversion, the Diebold Yilmaz methodology has been applied described as follows:

Diebold and Yilmaz (2012) have suggested the spillover index which is based on the generalised forecast error variance decomposition. Generalised VAR is an improvement over the Cholesky decomposition as here the computation of variance decomposition does not require orthogonalized shocks which are dependent on the way variables are ordered. Hence the results are invariant to the ordering of variables. As it is already known that the error term in the regression equation represents the information or shocks to the system. The notion behind introduction of the spillover index is that the forecast of variance in the error term of a variable can be divided into two parts. The first part can be attributed to the shocks specific to that variable and the other part contains the shocks from some other variables. In this way the spillover index was calculated by dividing the total of variance caused by the shocks in the other markets to the total variance caused by shocks in the other market as well as by its own.

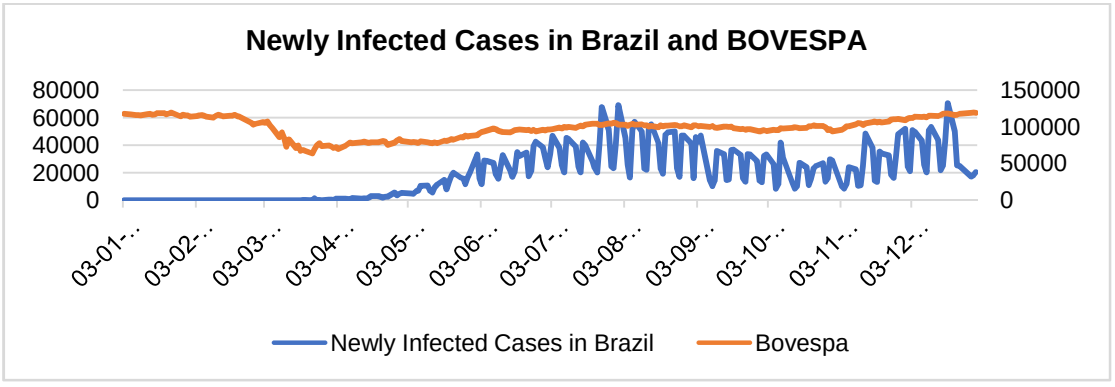
Data Analysis and Presentation

Before proceeding to the analysis part, a graphical presentation of the newly infected cases in BRICS with their corresponding representative market index has been done in order to observe the similarities or dissimilarities between them. The representative stock market index taken for each of the country is presented in the following table:

Table 1: Country and their stock market indices

Country	Stock Market Index
Brazil	BOVESPA
Russia	MOEX
India	SENSEX
China	SSE Composite (SSEC)
South Africa	FTSE/JSE All Share Index (JALSH)

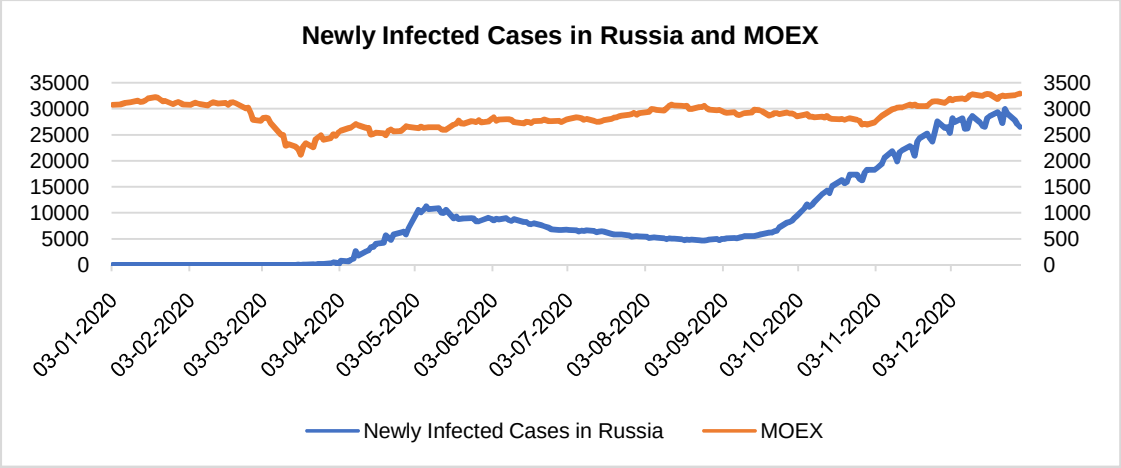
Figure1: Newly Infected Cases in Brazil and BOVESPA



Source: Author's own compilation

In the above graph the newly infected cases are shown in the left side of the y axis whereas the closing prices of BOVESPA are presented in the right side of y axis. From the above graph it is evident that BOVESPA started declining from the mid of February even before there was surge in the newly infected cases. This may have occurred due to the information transmission related to the disease from other countries. Hence BOVESPA experienced decline even before the surge in the covid19 cases in Brazil. From mid-2020, fluctuations were observed in the daily registered newly infected cases while the stock market index didn't experience any major decline.

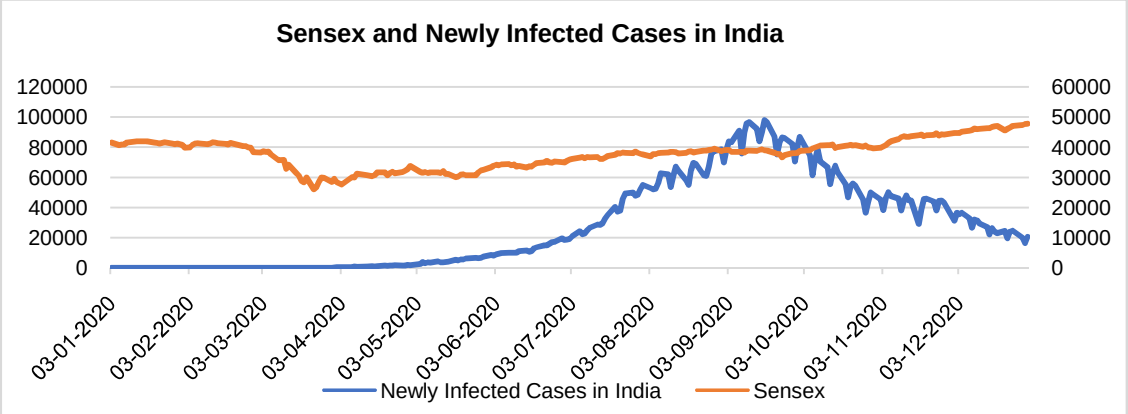
Figure 2: Newly Infected Cases in Russia and MOEX



Source: Author's own compilation

Initially the same phenomenon is observed in the above graph as observed in case of Brazil i.e. MOEX experienced a decline even before the detection of any covid-19 cases in Russia. The reason being quite obvious that lies in the efficient market hypothesis. Covid-19 cases saw a little rise in the newly infected cases being discovered during the month of may and June but after that the growth in the newly infected cases was more or less constant until October after which the daily newly infected cases started rising quickly. Surprisingly this increase didn't affect the stock market index of Brazil much. This may be due to the fact that the news related to development of vaccine started floating at that time.

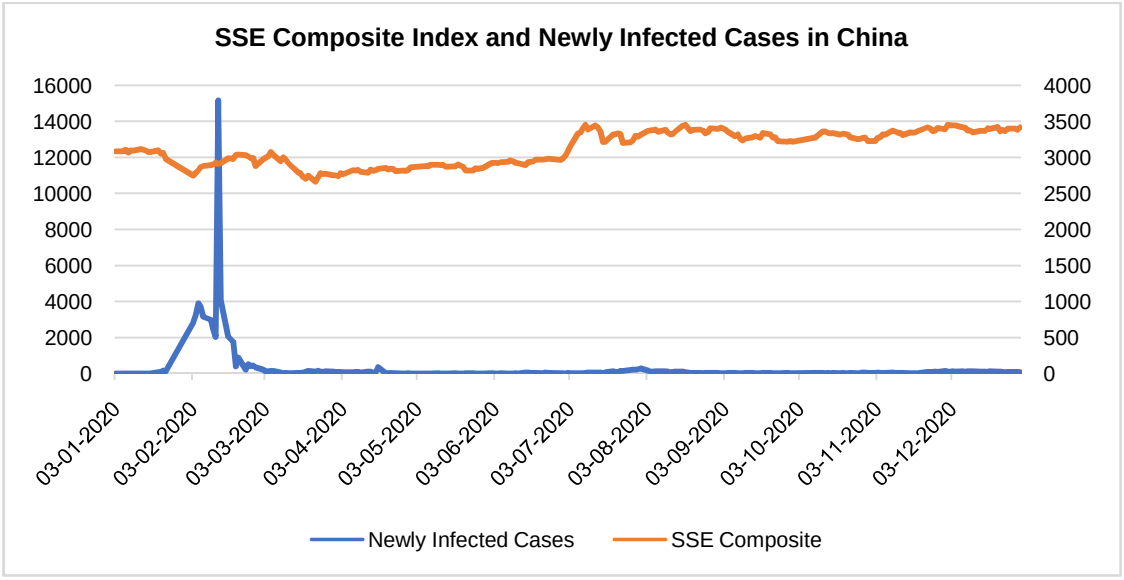
Figure 3: Newly Infected Cases in India and Sensex



Source: Author's own compilation

In the above graph it can be seen that Sensex started experiencing decline from the mid of March just during the time when WHO declared Covid-19 as Global Pandemic on 11th March and it reached its lowest on 23rd March 2020 when it hit the circuit breaker and the trading was halted for 45 minutes. The number of newly infected cases registered increased till mid of September 2020 and reached its peak after which the growth in the newly infected cases gradually declined. Sensex during this time didn't experience any major fluctuation.

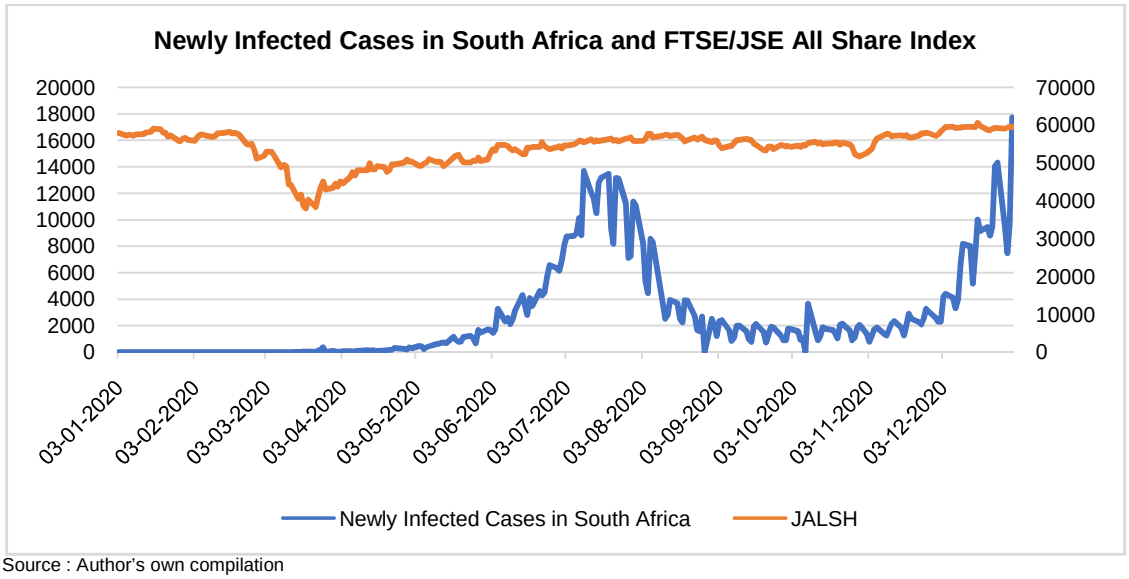
Figure 4: Newly Infected Cases in China and SSE Composite



Source: Author's own compilation

China being the epicentre of this disease reached its peak earlier than any other country in the month of February after which it imposed complete lockdown and had great control over the growth in number of newly infected cases. The Shanghai Composite index of China saw fall in the month of February but after that it started recovering. This may be because of the complete control that China had over the number of newly infected cases.

Fig. 5: Newly Infected Cases in South Africa and FTSE/JSE All Share Index (JALSH)



Source : Author's own compilation

South Africa experienced a fall in its stock market index in the month of March before the rise in the number of Covid-19 newly infected cases. This again may be because of the information transmission as observed in earlier cases. The Covid-19 newly infected cases started shooting up from month of June and saw its peak in the month of July after which the growth gradually started decreasing. JALSH was more or less constant during this time. South Africa had control over the newly infected cases in the month of September but the number of cases started increasing again in the month of December. This may be because of the second wave of Corona Virus hitting the countries.

Empirical Results

- **Test of Stationarity:** The first and foremost requirement before applying Diebold-Yilmaz technique is to ensure that the variables taken are stationary. Time series data pertaining to the stock markets is usually time varying i.e., the mean and variance of such data is not constant. The same was the case with the closing prices of the data taken into account. Thus, the prices were converted into return form by taking logarithmic difference. The returns were again tested for stationarity using Augmented Dickey Fuller (ADF) testand Phillips- Perron (PP) test and the following results were obtained:
- Stationarity test for the return form of the closing prices taken for Pre- Covid19 Period

Table 2: Stationarity Test in the Pre Covid19 Period

Variables	BOVESPA Returns	MOEX Returns	SENSEX Returns	SSEC Returns	JALSH Returns
ADF t-statistic	-14.52556**	-13.79561**	-13.19805**	-13.30314**	-12.95454**
PP t-statistic	-15.20457**	-13.80610**	-13.24032**	-13.30037**	-12.98960**

** indicates the rejection of null hypothesis at 5% significance level

- Stationarity test for the return form of the closing prices taken for During Covid19

Table 3: Stationary test during Covid19 Period

Variables	BOVESPA Returns	MOEX Returns	SENSEX Returns	SSEC Returns	JALSH Returns
ADF t-statistic	-16.47700**	-12.20461**	-15.99344**	-13.11081**	-8.448990**
PP t-statistic	-16.36898**	-12.18855**	-15.92428**	-13.04319**	-13.81454**

** indicates the rejection of null hypothesis at 5% significance level

The null hypothesis in both ADF as well as PP test supports the presence of unit root in the data which was rejected by both the tests for both the data parts taken into account. Hence the variables in the return form achieved stationarity.

Descriptive Statistics of the Data

Table 4: Descriptive Statistics of the Returns in the Pre Covid19 Period

	BOVESPA Returns	MOEX Returns	SENSEX Returns	SSEC Returns	JALSH Returns
Mean	0.001187	0.001249	0.000790	0.001055	0.000555
Median	0.002237	0.000956	0.000965	0.000468	0.000463
Maximum	0.038338	0.023948	0.051859	0.056921	0.034455
Minimum	-0.044914	-0.020177	-0.021486	-0.060070	-0.023346
Std. Dev.	0.012160	0.007510	0.009242	0.012374	0.008446
Skewness	-0.630130	-0.018021	1.079838	0.352441	0.106629
Kurtosis	4.532839	3.240923	7.925843	8.684434	3.927809
Jarque-Bera	32.65133*	0.492053	239.8624*	272.0467*	7.514813*
Probability	0.000000	0.781901	0.000000	0.000000	0.023344

From the above table it is evident that in the pre-covid19 period, highest mean returns were offered by stock market of Russia followed by Brazil and then China. South African Market offered the lowest average return. The Jarque-Bera test statistic was significant in all the cases except Russian stock market indicating that all the returnseries except the one that belong to Russian stock market (MOEX) were not normally distributed. The deviations in the returns were highest in case of Brazil and China.

Table 5: Descriptive Statistics of the Returns during Covid-19

	BOVESPA Returns	MOEX Returns	SENSEX Returns	SSEC Returns	JALSH Returns
Mean	5.17E-05	0.000312	0.000659	0.000476	0.000145
Median	0.001293	0.001850	0.002601	0.001085	0.000904
Maximum	0.130228	0.074349	0.085947	0.055543	0.072615
Minimum	-0.159938	-0.087013	-0.141017	-0.080391	-0.102268
Std. Dev.	0.030526	0.017874	0.022517	0.013737	0.020078
Skewness	-1.278412	-0.830425	-1.397926	-0.933674	-0.931794
Kurtosis	12.56621	9.709105	12.44203	9.673863	9.126064
Jarque-Bera	874.2762	425.9537	864.6382	428.2446	365.5978
Probability	0.000000	0.000000	0.000000	0.000000	0.000000

As shown in the above table, the highest average returns were offered by Indian SENSEX followed by the Chinese SSE Composite. The highest deviations were offered by Brazil followed by Indian stock market. The Jarque-Bera test statistic was significant in all the cases indicating towards the non-normal distribution in all the cases.

Figure 6: Return Plots in the Pre Covid19 period

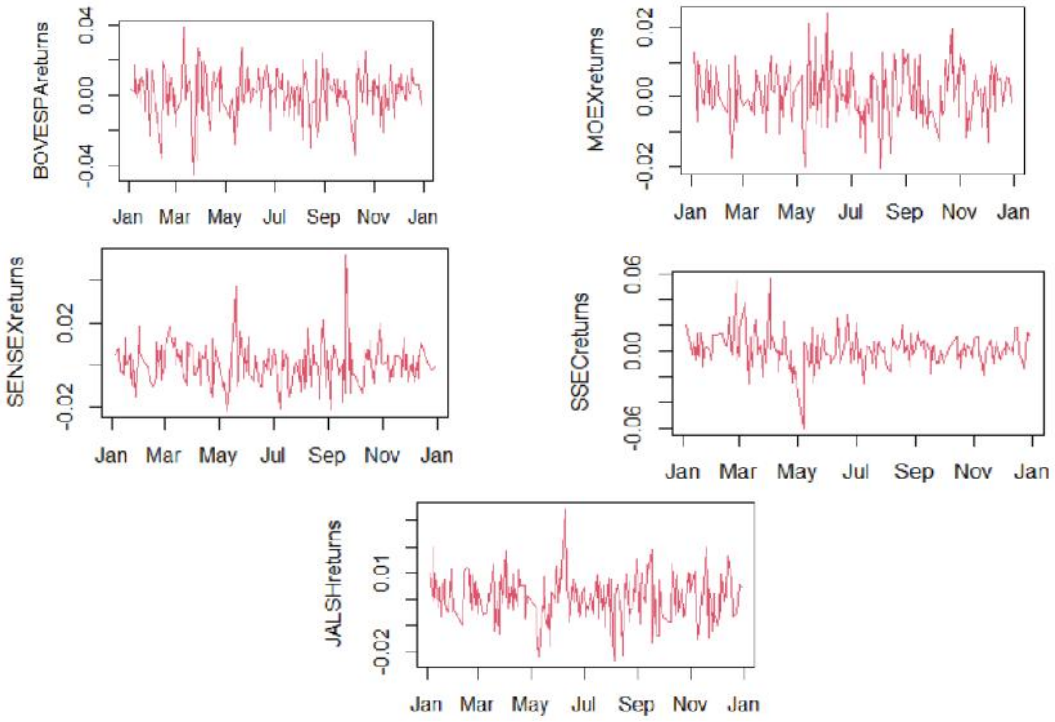
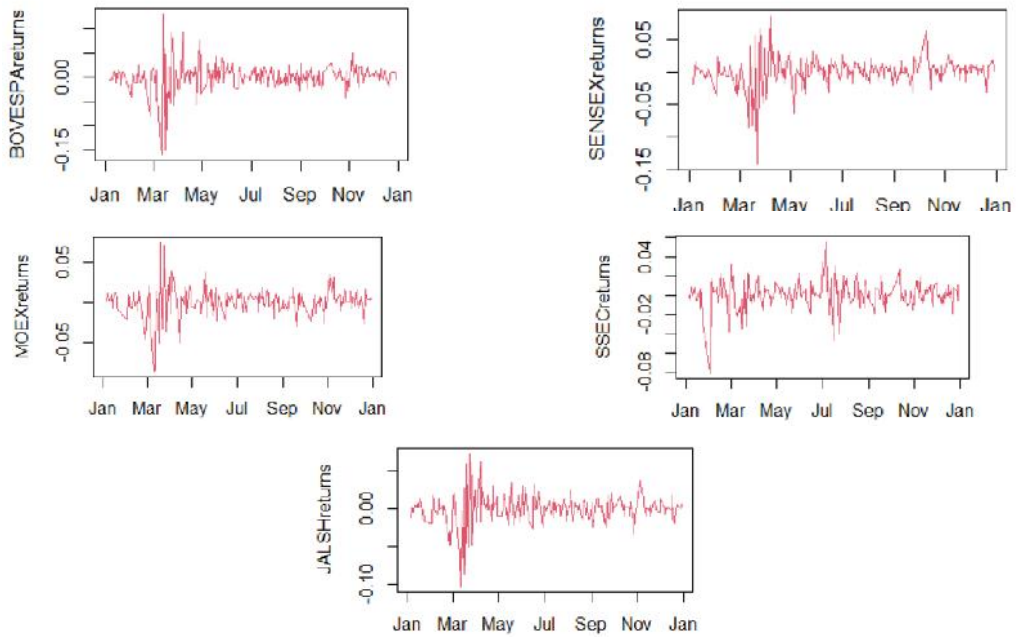


Figure 7: Returns during Covid-19 Period



Diebold Yilmaz Results

Table 6: Overall Connectedness in the Pre Covid 19 Period

	BOVESPA	MOEX	SENSEX	SSEC	JALSH	From Others
BOVESPA	83.02	8.73	1.71	0.23	6.31	16.98
MOEX	7.06	72.66	1.64	1.06	17.58	27.34
SENSEX	1.34	2.15	93.13	2.10	1.28	6.87
SSEC	3.99	1.61	1.91	84.60	7.89	15.40
JALSH	4.96	17.33	1.11	5.84	70.76	29.24
Contribution to Others	17.35	29.81	6.37	9.24	33.05	95.82
Contribution including own	100.37	102.47	99.51	93.84	103.81	TCI 19.16
Net Directional Connectedness	0.37	2.47	-0.49	-6.16	3.81	-

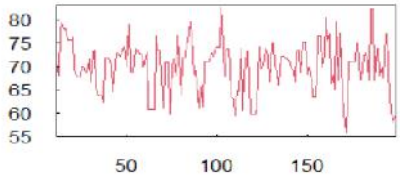
Table 7: Overall Connectedness during Covid19 Period

	BOVESPA	MOEX	SENSEX	SSEC	JALSH	From Others
BOVESPA	43.66	16.03	16.06	3.93	20.32	56.34
MOEX	17.70	48.80	9.33	3.39	20.78	51.20
SENSEX	18.19	12.65	44.43	6.72	18.01	55.57
SSEC	6.34	6.25	9.97	66.46	10.97	33.54
JALSH	18.36	21.85	15.62	6.07	38.09	61.91
Contribution to Others	60.59	56.77	50.99	20.12	70.08	258.55
Contribution including own	104.26	105.58	95.41	86.58	108.17	TCI 51.71
Net Directional Connectedness	4.26	5.58	-4.59	-13.42	8.17	-

Table 6 and Table 7 above display the overall return connectedness among BRICS stock markets in the Pre-Covid19 period and during Covid19 period respectively.The return spillover has been estimated using Diebold-Yilmaz Spillover Index (Diebold &Yimaz, 2012, 2014) with a VAR model of order 1 with 10 days forecast horizon and 10 days rolling window as the sample taken was relatively small.It is evident from the above tables that the total returnspillover in the pre covid19 period was 19.16% which increased to 51.71% during the covid19 period supporting the fact that the rate of information transmission increases during the crisis period. As far as the directional spillover is concerned in both the periods, surprisingly India and China were the receivers of shocks in the returns whereas Brazil, Russia and South Africa were the net transmitters. However, the rate has significantly increased during the covid19 period. This may be due to the fact that China had recovered from covid19 earlier and faster than any other country so the information was transmitted by the countries severely affected from the pandemic. It indicates significant implication for policymakers of BRICS to safeguard their economy during crisis periods.

Overall, Directional and Pairwise Spillover Plots:

Return Spillover Plot in the Pre Covid-19



Return Spillover Plot during Covid-19

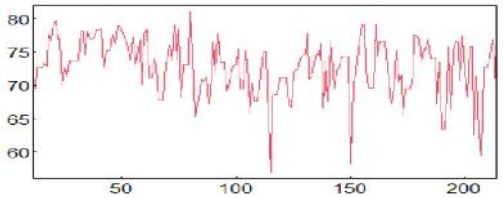


Figure 8: Return Spillover Plots

While observing at the above spillover plots, one can identify that the return spillover during the pandemic has been higher than the return spillover in the pre-covid19 period

Directional Spillover in the Pre-Covid-19 Directional Spillover during Covid-19

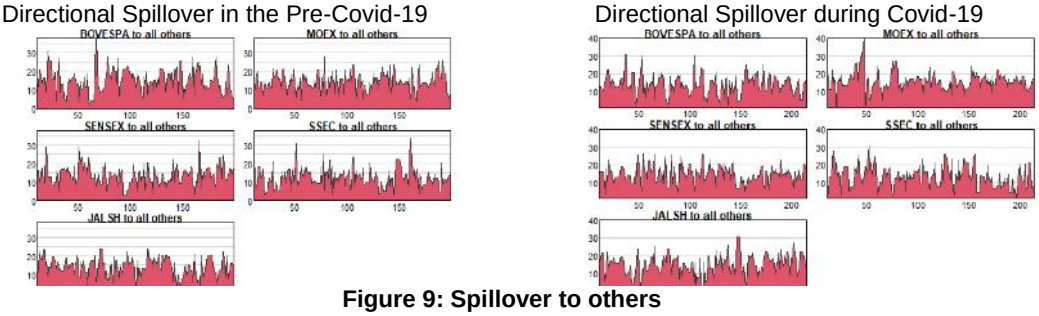


Figure 9: Spillover to others

From the above graph it can be seen that the spillovers by Brazil, Russia and South Africa are higher than the spillovers by China and India to other countries. This may be due to the fact that these nations were badly hit by the pandemic. Hence these played an important role in information transmission.

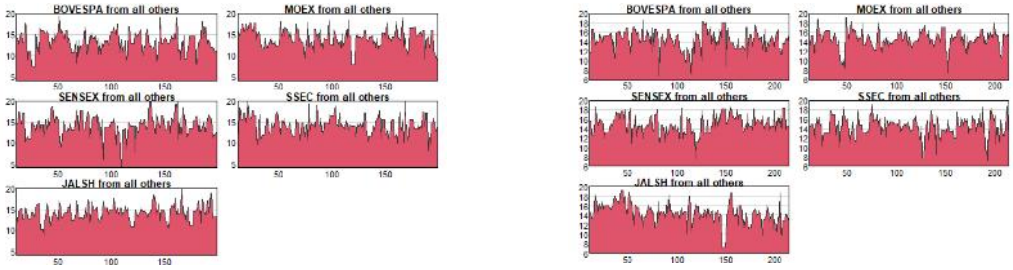


Figure10: Spillover from others

The above graph displays that China and India have received more information as compared to the information transmitted by them. Hence, they have been the receivers of volatility in both the periods. Though the magnitude in the crisis period has increased.

Net Spillovers in the Pre Covid-19 Net Spillovers during Covid-19

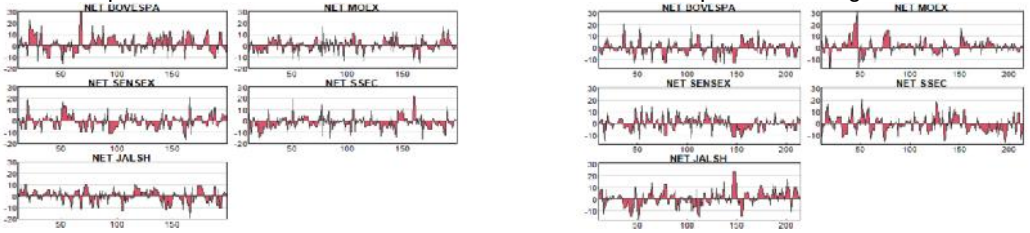


Figure 11: Net Spillovers

After deducting the FROM Spillover from TO Spillovers, it can be observed that China and India were the receivers of shocks in the return whereas Brazil, Russia and South Africa have transmitted the shocks.

Pairwise Connectedness in the Pre Covid-19 Pairwise Connectedness during Covid-19

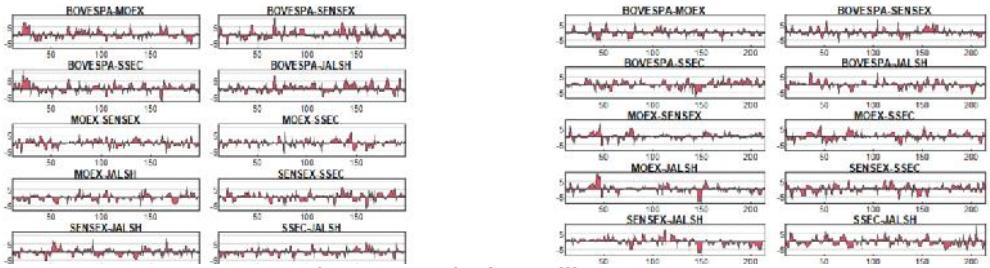


Figure 12: Pairwise Spillovers

Conclusions

The results from the present study indicate that return spillover has increased considerably during the covid19 period as compared to the period before it and there was a significant increase in the information transmission to China during Covid19 period. This may be because of the fact that China recovered fast and hence rather than information getting transmitted from China, it was the receiver of information from the countries which were severely affected from the pandemic. The results are in conjunction with the results obtained by D Wang, P Li, L Huang. The study has taken into account 5 countries. Further research can be done taking more countries into account. Also, the time period taken is short since it has been only one year of pandemic entangling the world in its web. The study was restricted to return spillover and did not extend to volatility spillovers as the ARCH (Autoregressive Conditional Heteroscedasticity) effects were missing on account of the short sample taken for the study. The results from the study may help investors in achieving an optimal portfolio by planning diversification strategies accordingly.

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