




# “Impact of COVID-19 on financial integration: Study on BRICS”

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# IMPACT OF COVID-19 ON FINANCIAL INTEGRATION: STUDY ON BRICS

## Abstract

The paper examines the shift in stock indices' behavior in BRICS nations, prior to and following the outbreak of the COVID-19 pandemic, using daily data of relevant stock indices from April 2019 to March 2021. The study seeks to ascertain the influence of COVID-19 on stock markets of BRICS countries. The descriptive analysis and graphical presentation established that the pandemic period was extremely variable, with high average returns. Furthermore, the findings reveal that, with the exception of China and South Africa, the BRICS nations' stock indices were not cointegrated prior to the epidemic. Interdependence has increased throughout the epidemic, as three BRICS nation pairings, particularly Brazil and China, China and South Africa, and Russia and South Africa, are all cointegrated. This demonstrates that the COVID-19 problem strengthened the BRICS countries' cointegration or relatedness. As a result, portfolio diversification opportunities have dwindled. Additionally, given the relatively high average stock indices, investors may generate significant returns by investing in indices rather than individual firms, especially during the pandemic crisis time.

## Keywords

COVID-19, BRICS, pandemic, cointegration

## JEL Classification

F30, F60, G00

## INTRODUCTION

With the emergence of the unique coronavirus known as "COVID-19," the globe is dealing with pandemic calamity, as major cities throughout the world have shut down and the businesses around the world get affected by the pandemic. This has also resulted in the stock market crash. The Black Death of 1347–1351 and the Spanish Flu of 1918–1919 are almost identical historical events. Recent events appeared to have obvious, significant, broad, and serious short-term financial disruptions, as well as medium-term economic growth and development implications.

WHO has implemented several social distancing measures to prevent the outbreak of contagious disease. Also, there was widespread labor mobility and travel restrictions that took effect immediately after entering into the new year 2020 by most of the countries. The coordinated closure of plant production lines resulted in considerable cost reductions and a significant reduction in manufacturing, both of which had significant economic consequences. COVID-19's financial market impact has been felt in the first half of 2020 specially.

The spread of COVID-19 in March 2020 caused most global financial markets to overreact, resulting in a very unexpected trajectory. As a result of panic selling and falling stock index prices, the markets experienced trade halts and frequent circuit breaks in March and April 2020. In most stock markets around the world, aggressive and worrisome reactions persisted.

The primary area of concern is determining and measuring impact of COVID-19 outbreak on global financial markets. The BRICS countries were no exception when it comes to being impacted by the global COVID-19 epidemic in many socioeconomic dimensions, and they have been the focus of current research efforts to assess those repercussions.

BRIC was founded in 2008 in Yekaterinburg, Russia, with the four fastest growing emerging countries – Brazil, Russia, India, and China – for its first summit, the word having been in use since the millennium began. In 2010, South Africa joined, and BRICS was created. As of 2019, the BRICS accounted for 41.42 percent of global population and generated 24.10 percent of global GDP, with a 16.25 percent share of global exports (BRICS Policy Center, 2019). BRICS is unique in that it is a successful multinational organization comprised of emerging economies from around the globe. Between 2010 and 2019, the BRICS member nations' population growth rate fell by 3.20 percent, but their GDP as a proportion of GDP climbed by 34.04 percent, with an average yearly increase of 3.80 percent (The World Bank, 2021).

It is therefore important to analyze the current state of financial integration between markets, as it is noted in the literature that financial integration benefits in good times. High financial integration, on the other hand, elevates the danger of contagion in times of crisis due to the strong connection between financial markets caused by proximity to markets.

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## 1. LITERATURE REVIEW

In numerous countries around the world, viruses have wreaked havoc on the economy, resulting in substantial human casualties. Zika was identified in 2016, and it was followed by the discovery of Measles and Ebola in 2014, MERS in 2013, Cholera in 2010, Swine Flu in 2009, Dengue Fever and Avian Flu in 2006, and SARS in 2003, among other diseases. A novel coronavirus disease, popularly known as 'COVID 19' has occurred in the year 2019. Because of its prevalence among animal species, this virus has turned into a huge threat to human lives as well as the global financial markets. This fatal virus has invaded virtually all 199 countries on the planet, and it is still spreading. The next sections of this section discuss some of the basic concepts that are explored in relevant studies.

SARS was one of the viruses that was extensively examined by a large number of researchers. SARS had a detrimental impact on the Hong Kong economy, and there were significant negative ramifications on the demand side, which affect the economy adversely (Siu & Wong, 2004). The performance of Taiwan's hotel stock, on the other hand, has been reported negatively by Chen et al. (2007). According to Wang et al. (2013), Taiwanese biotechnology stocks did experience swings as a result of infectious diseases, however these variations were not always negative. Del and Paltrinieri

(2017) conducted an evaluation to study the impact of the Arab Spring and Ebola on 78 equity mutual funds specialized in African countries from 2006 to 2015, and they reported a fall in the mutual fund market as a result of a loss of investor confidence in them.

Many scholars are also concerned about the impact of macroeconomic variables, policy changes, the financial crisis, and other factors such as these. Karnizova and Li (2014), investigate the efficacy of economic policy uncertainty indices in predicting future recessions in the United States. Onan et al. (2014) investigated the implied volatility of S&P 500 index options resulted from the macroeconomic developments and found that macroeconomic news had an impact on the VIX but not on the slope of the option premium. Hartwell (2018) further demonstrates that institutional changes were the most important sources of financial volatility throughout the transition period in question. Instead of equity market volatility trackers, Zen et al. (2019) found that the Volatility Index (VIX) has significant in-sample impact on volatility in the stock market of the United States.

With the outbreak of coronavirus in Wuhan in 2019 and its subsequent declaration as a pandemic by the World Health Organization (WHO) in January 2020, the impact of the virus on society, the stock market, the economy, and other pol-

icies has become a source of concern for policymakers and researchers. Alfaro et al. (2020) suggested that, even as infections continue to increase, stock markets may begin to recover if the disease's trajectory becomes less serious than initially expected. While Goodell (2020) underlined massive societal and economic impact of pandemic catastrophe in studies that either predicted large-scale occurrence and its economic ramifications, or investigated the consequences of existing pandemics. Some of them examined the fall and volatility of global financial markets in response to the change of epicenter of Coronavirus from Chinese to European nations and then the US and their impact on stock indices of various countries including US, ASEAN member countries, and further emerging stock markets. There has been a negative impact on stock and index performance, which has been accompanied by significant volatility. Researchers have also discovered that unfavorable returns will disappear as soon as the infectious sickness is weakened, according to their findings (Ali et al., 2020; Azmili, 2020; Cao et al., 2020; Liu et al., 2020; Lyocsa & Molnar, 2020; Mishra & Mishra, 2020; Phan & Narayan, 2020; Ramelli & Wanger, 2020; Rizvi et al., 2020; Ruiz Estrada, 2020; Singh et al., 2020; Topcu & Gulal, 2020; Zeren & Hizarci, 2020; Gao et al., 2021; Haldar & Sethi, 2021; Narayan et al., 2021; Okorie & Lin, 2021). Gormsen and Kojen (2020) looked at how investors' expectations for economic growth altered over time after the discovery of a new coronavirus (COVID-19) and subsequent government actions, up to July 2020. According to Saadat et al. (2020), millions of people have been quarantined in their homes to prevent the virus from spreading, and businesses have shuttered, resulting in lost revenue and substantial unemployment. Mishra et al. (2020) compared the impact of COVID-19 on the Indian banking industry to the effects of two institutional changes namely, demonetization and the introduction of the Goods and Services Tax (GST). They discovered that returns of all indices were affected adversely during the COVID-19 pandemic by examining daily stock returns, exchange rates, and net foreign institutional investment throughout the pandemic period. Managers routinely overestimated pandemic risk when computing SEC-mandated risk variables, according to the analysis, and the vast ma-

jority of enterprises suffered a loss of value when the virus struck, the report found (Schoenfeld, 2020). Zhang et al. (2020) investigated and evaluated the impact of policy measures related to the COVID-19 pandemic in the United States, as well as the impact on economic uncertainty. David et al. (2021) investigated financial and economic repercussions of COVID-19 outbreaks, as well as the dynamic link between pandemics such as EBOLA, MERS, and SARS, using an event-study approach.

Through event study approach, Sachdeva and Sivakumar (2020) evaluated the impact of COVID-19 on BRICS countries' indices. They reported that stock market start recovering after a span of 60 days. While Kumar et al. (2021) made comparison between financial crisis impact and COVID-19's impact on BRICS nations stock indices. Ledwani et al. (2021) compared COVID-19's impact on G-7 and BRICS nations and reported that the stock behavior was different between these two groups of nations.

After a comprehensive analysis of the results of the literature cited above, it is obvious that viruses and pandemics have an impact on the economies and financial interdependence of countries. Few research has centered on examining the shift in interdependence between pandemic and pre-pandemic periods; in addition, the vast majority of studies were based on stock returns rather than indices as their primary data source. Furthermore, studies pertaining to the study of pandemic and pre-pandemic periods for BRICS countries are deficient in this area. As a result, this paper attempts to bridge a portion of the gap by examining the shift in financial interdependence of BRICS members in the setting of a pandemic.

Thus, this paper tries to achieve the following research goals:

- Comparing the average return and variability in returns and prices of BRICS' nations indices in the pre-pandemic and pandemic periods.
- Comparing the level of financial integration among BRICS nations in the pre-pandemic and pandemic periods.

## 2. METHODS

The sample under consideration contains stock indices from five countries: South Africa, China, India, Russia, and Brazil, which collectively make up the BRICS region. The indices of the member countries of this regional integration that are the most liquid and heavily traded are employed for the purpose of the study. Time series data of daily closing prices of stock indices in the individual nations were collected for the period beginning in April 2019 and ending in March 31, 2021, with the most recent data being used. The study period is divided into two sub parts: pre-pandemic (from April 1, 2019 to January 31, 2020) and pandemic (from February 1, 2020 to March 31, 2021).

It is necessary to eliminate heteroscedasticity in data by using the natural logarithm of the daily closing indices. In addition, to examine the overall behavior of individual indices over the course of the study period, the graphical representation of indices and their returns series are employed. The use of E-Views tools to evaluate descriptive statistics and graphical analysis is carried out both before and during the outbreak of a pandemic. Finally, the tests are applied on the data that has been segmented in order to investigate the behavior of cointegration.

The Johansen cointegration test was used to examine long-run cointegration and causal inter-linkages among the member countries of the BRICS nations of most emerging economies. Because, according to a review of the literature, this model was judged to be the best appropriate model for studying long-run

and causal links between the variables, this test is applied. Non-stationarity of data at the level and stationarity of data at the level of the first difference are both required before conducting the Johansen co-integration test. ADF and PP tests were used to evaluate the results, and both provided a positive result, indicating that further testing should be carried out to evaluate the level of cointegration of indices under consideration. The Johansen test also necessitates the determination of a suitable lag length, which in the current investigation was determined using the Akaike information criterion (AIC).

Johansen cointegration test has been carried out upon completion of all of the preconditions for carrying out the experiment. The Trace-statistics and the Maximum Eigenvalue are two alternative test statistics that are provided for the aforementioned test. If the approach discovers co-integrating vectors between the variables under investigation, it is presumed that long-run interlinkages exist between the variables under investigation.

## 3. RESULTS

First and foremost, descriptive statistics of the data related to stock indices have been calculated to better understand the distinctive essence of various price series throughout time. These findings are summarized in Table 1 for the pre-pandemic period and Table 2 for the pandemic period.

Graphical representation of the same series during all the above-mentioned cycles is prepared in

**Table 1.** Descriptive statistics during the pre-pandemic period

Source: Compiled by the authors.

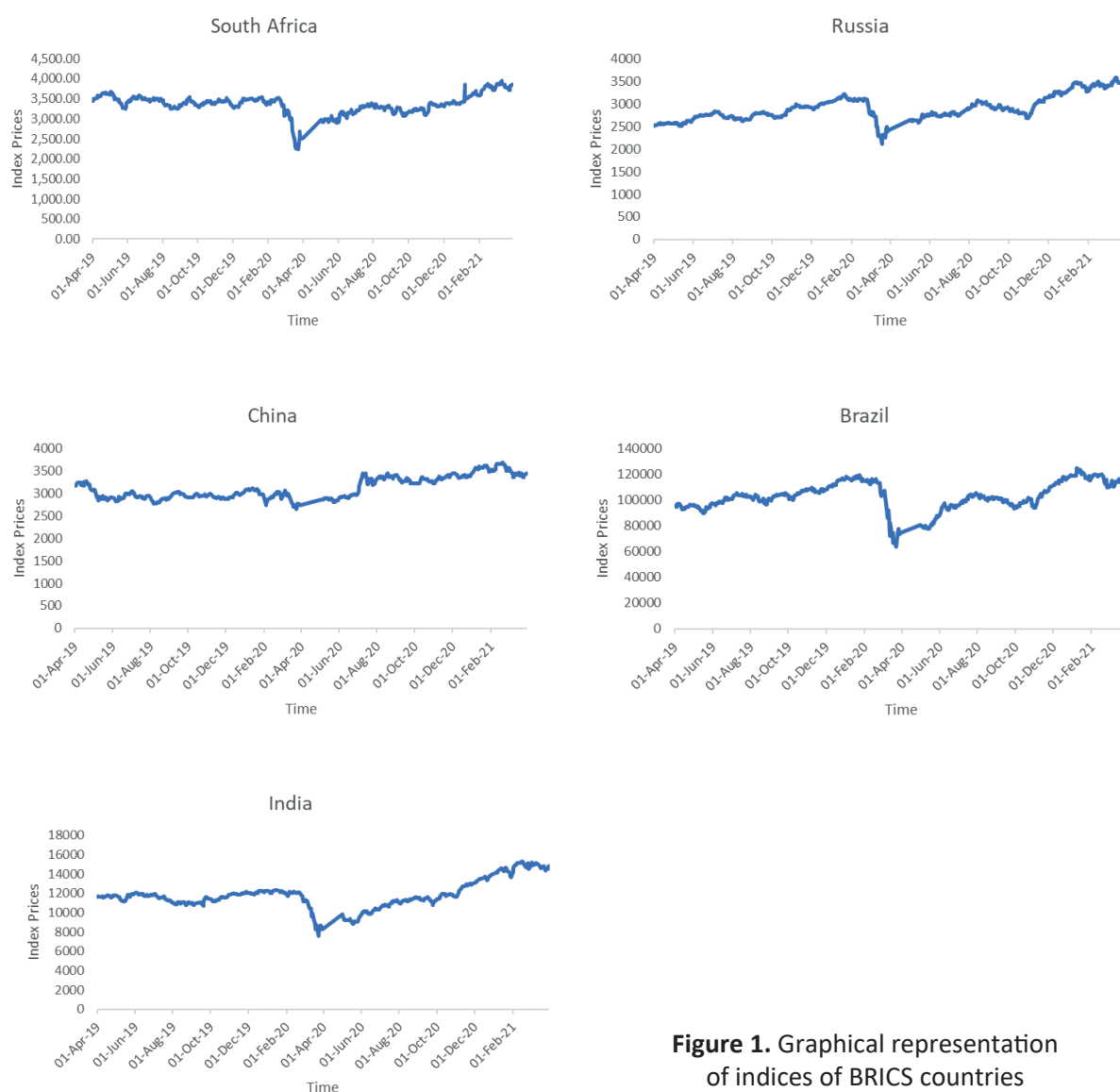
| Countries<br>Variables | BRAZIL      | CHINA    | INDIA    | RUSSIA   | SOUTH AFRICA |
|------------------------|-------------|----------|----------|----------|--------------|
| Mean                   | 103802.1    | 2969.765 | 11641.2  | 2792.562 | 3439.38      |
| Median                 | 103491.9    | 2941.315 | 11695.58 | 2759.705 | 3450.505     |
| Maximum                | 119527.6    | 3270.8   | 12362.3  | 3219.92  | 3671.1       |
| Minimum                | 89992.73    | 2768.68  | 10704.8  | 2508.87  | 3240.24      |
| Std. Dev.              | 7135.937    | 104.4949 | 419.1233 | 175.3515 | 95.99056     |
| Skewness               | 0.405015    | 1.023639 | -0.38138 | 0.4859   | -0.02257     |
| Kurtosis               | 2.422149    | 3.872911 | 2.154014 | 2.400644 | 2.552355     |
| Jarque-Bera            | 8.745524    | 43.7543  | 11.4612  | 11.51533 | 1.788069     |
| Probability            | 0.012616    | 0        | 0.003245 | 0.003158 | 0.049002     |
| Sum                    | 22006054    | 629590.3 | 2467935  | 592023.2 | 729148.7     |
| Sum Sq. Dev.           | 10700000000 | 2303946  | 37065184 | 6487858  | 1944194      |
| Observations           | 212         | 212      | 212      | 212      | 212          |

**Table 2.** Descriptive statistics during the pandemic period

Source: Compiled by the authors.

| Countries    | BRAZIL      | CHINA    | INDIA      | RUSSIA   | SOUTH AFRICA |
|--------------|-------------|----------|------------|----------|--------------|
| Mean         | 101660.7    | 3215.614 | 11839.82   | 2965.822 | 3268.4       |
| Median       | 102117.8    | 3312.5   | 11535      | 2927.17  | 3284.42      |
| Maximum      | 125076.6    | 3696.17  | 15314.7    | 3589.83  | 3941.02      |
| Minimum      | 63569.62    | 2660.17  | 7610.25    | 2112.64  | 2235.49      |
| Std. Dev.    | 14242.84    | 268.5202 | 1969.314   | 331.8423 | 349.5897     |
| Skewness     | -0.68035    | -0.31792 | 0.078143   | -0.14597 | -0.6324      |
| Kurtosis     | 2.81708     | 1.876798 | 2.150462   | 2.527034 | 3.918124     |
| Jarque-Bera  | 23.01253    | 20.33738 | 9.109121   | 3.771507 | 29.8209      |
| Probability  | 0.00001     | 0.000038 | 0.010519   | 0.015171 | 0            |
| Sum          | 29786581    | 942174.9 | 3469066    | 868986   | 957641.3     |
| Sum Sq. Dev. | 59200000000 | 21054106 | 1130000000 | 32154844 | 35686182     |
| Observations | 293         | 293      | 293        | 293      | 293          |

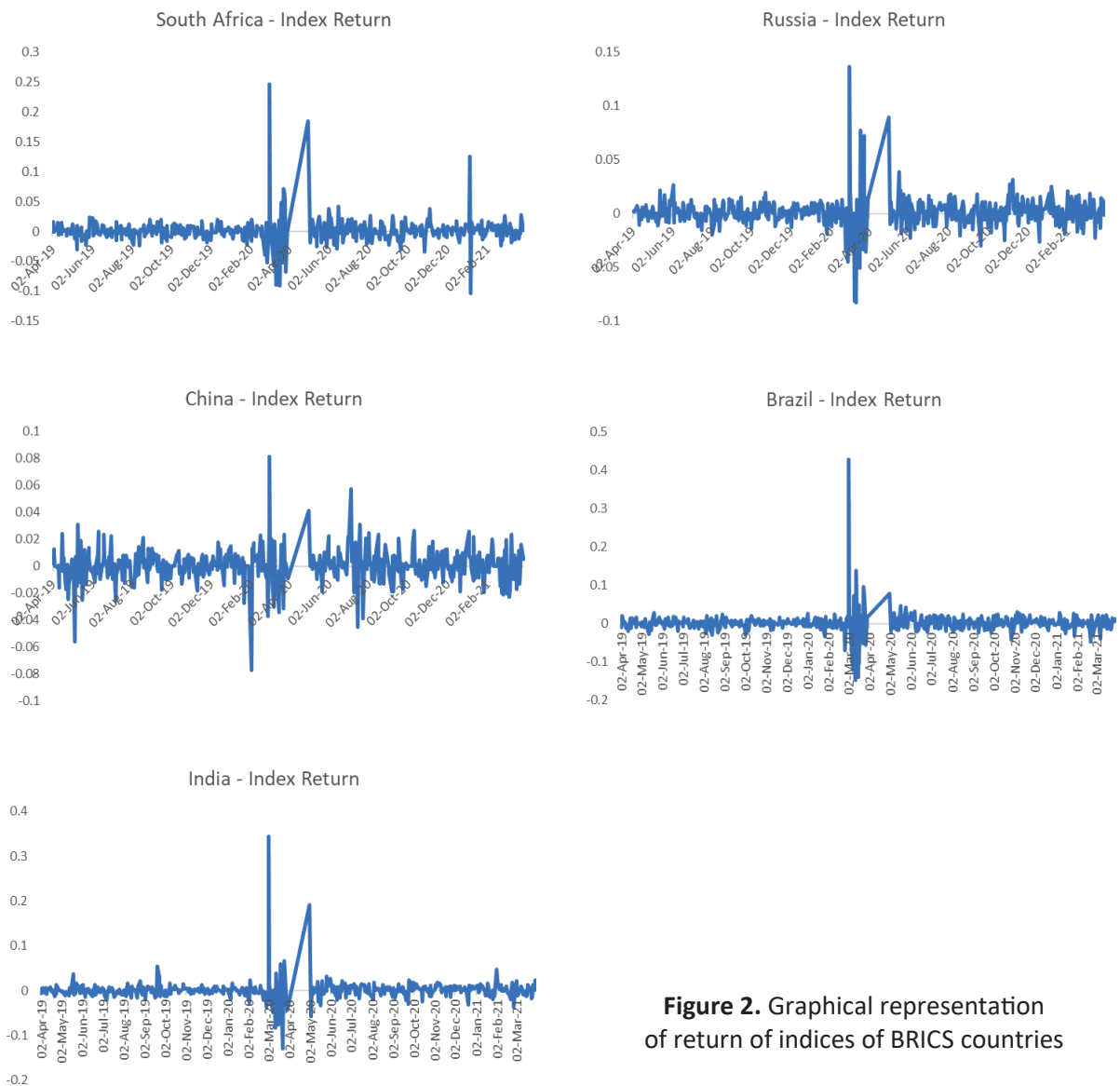
Source: Compiled by the authors.



**Figure 1.** Graphical representation of indices of BRICS countries



Source: Compiled by the authors.



**Figure 2.** Graphical representation of return of indices of BRICS countries

order to explain and analyze the shifts in index prices more effectively. Figure 1 and Figure 2 represent the pictorial representation of index series and their corresponding returns, respectively.

Now, the Johansen co-integration test will be conducted to examine the behavior of BRICS countries' stock indices from a different perspective than that of the previous study. To begin, the ADF test is used to ensure that data stationarity is maintained, which is necessary for co-integration. According to the ADF test, the null hypothesis is that neither non-stationarity nor unit root would be seen. The same indices were also subjected to the stationarity test developed by Phillips and Perron (1988) at the same time. When looking at

the findings at the level, they are negative, but they are positive for first order integration, showing that the indices are non-stationary and that the returns of the indices are stationary. The results are shown in Table 3.

At a 5% significance level, the data series of stock indices of all the countries under examination are found to be non-stationary at level 1 and stationary at level 1.

Now that both of the tests in Table 3 have proved that the data is not stationary, we can move to the next stage of computing the co-integration of the data. If the stock indices of the BRICS countries have stable and long-term links, the co-integration

**Table 3.** Stationarity results

Source: Compiled by the authors.

| Part 1 – During Pre-Pandemic Period |              |         |               |         |                 |         |               |         |
|-------------------------------------|--------------|---------|---------------|---------|-----------------|---------|---------------|---------|
| Countries                           | ADF Test     |         |               |         | Phillips-Perron |         |               |         |
|                                     | Price Series |         | Return Series |         | Price Series    |         | Return Series |         |
|                                     | t-stats      | p-value | t-stats       | p-value | t-stats         | p-value | t-stats       | p-value |
| Brazil                              | -0.60        | 0.87    | -12.08        | 0.00    | -0.59           | 0.87    | -15.43        | 0.00    |
| Russia                              | -0.57        | 0.88    | -0.13         | 0.00    | -0.66           | 0.85    | -13.42        | 0.00    |
| India                               | -1.63        | 0.46    | -9.36         | 0.00    | -1.70           | 0.43    | -13.41        | 0.00    |
| China                               | -2.51        | 0.12    | -14.54        | 0.00    | -2.51           | 0.11    | -14.54        | 0.00    |
| South Africa                        | -2.89        | 0.06    | -8.87         | 0.00    | -2.77           | 0.06    | -14.20        | 0.00    |

| Part 2 – During Pandemic Period |              |         |               |         |                 |         |               |         |
|---------------------------------|--------------|---------|---------------|---------|-----------------|---------|---------------|---------|
| Countries                       | ADF Test     |         |               |         | Phillips-Perron |         |               |         |
|                                 | Price Series |         | Return Series |         | Price Series    |         | Return Series |         |
|                                 | t-stats      | p-value | t-stats       | p-value | t-stats         | p-value | t-stats       | p-value |
| Brazil                          | -1.32        | 0.62    | -6.45         | 0.00    | -2.07           | 0.25    | -20.10        | 0.00    |
| Russia                          | -1.17        | 0.69    | -6.73         | 0.00    | -1.18           | 0.68    | -17.35        | 0.00    |
| India                           | 0.19         | 0.97    | -6.15         | 0.00    | -0.81           | 0.82    | -19.01        | 0.00    |
| China                           | -1.32        | 0.62    | -6.44         | 0.00    | -1.85           | 0.36    | -16.69        | 0.00    |
| South Africa                    | -1.08        | 0.72    | -7.87         | 0.00    | -1.86           | 0.34    | -18.23        | 0.00    |

test can be employed to determine this. Because of the nature of the test, it is necessary to determine an appropriate lag length before applying it; otherwise, over or under parameterization may occur. The selection of an adequate lag time ensures that the residuals do not show any evidence of serial cor-

relation with one another. To this end, the Akaike Information Criterion (AIC) was used to identify the appropriate lag duration for the purposes of this study, and then that optimal lag length was used to make future calculations. As shown in Table 4, the results of the co-integration were obtained.

**Table 4.** Johansen's co-integration results

Source: Compiled by the authors.

| Combination of Countries | Lag Length (AIC) | Hypothesized No. of CE(s) | Eigen Value | Trace Test                                   |        | Maximum Eigenvalue Test |               |
|--------------------------|------------------|---------------------------|-------------|--|--------|-------------------------|---------------|
|                          |                  |                           |             | Trace Statistics                             | Prob.  | Max Eigen Statistics    | Prob.         |
|                          |                  |                           |             | Part 1 – Pre-Pandemic Co-integration Results |        |                         |               |
| Brazil<br>China          | 1                | None                      | 0.0325      | 7.4745                                       | 0.5232 | 6.9416                  | 0.4961        |
|                          |                  | At most 1                 | 0.0025      | 0.5329                                       | 0.4654 | 0.5329                  | 0.4654        |
| Brazil<br>India          | 1                | None                      | 0.3172      | 7.3251                                       | 0.5401 | 6.7686                  | 0.5169        |
|                          |                  | At most 1                 | 0.0027      | 0.5564                                       | 0.4557 | 0.5564                  | 0.4557        |
| Brazil<br>Russia         | 1                | None                      | 0.0594      | 13.2463                                      | 0.1061 | 12.8668                 | 0.0821        |
|                          |                  | At most 1                 | 0.0018      | 0.3796                                       | 0.5378 | 0.3796                  | 0.5378        |
| Brazil<br>South Africa   | 1                | None                      | 0.0316      | 7.1151                                       | 0.5643 | 6.7374                  | 0.5207        |
|                          |                  | At most 1                 | 0.0018      | 0.3777                                       | 0.5388 | 0.3777                  | 0.5388        |
| China<br>India           | 1                | None                      | 0.0330      | 10.4781                                      | 0.2457 | 7.0459                  | 0.4837        |
|                          |                  | At most 1                 | 0.0162      | 3.4321                                       | 0.0639 | 3.4321                  | 0.0639        |
| China<br>Russia          | 1                | None                      | 0.0358      | 8.0483                                       | 0.4603 | 7.6616                  | 0.4141        |
|                          |                  | At most 1                 | 0.0018      | 0.3867                                       | 0.5340 | 0.3867                  | 0.5340        |
| China<br>South Africa    | 1                | None                      | 0.0701      | 24.9206                                      | 0.0014 | 15.2556                 | <b>0.0348</b> |
|                          |                  | At most 1                 | 0.0450      | 9.6650                                       | 0.0019 | 9.6650                  | <b>0.0019</b> |
| India<br>Russia          | 1                | None                      | 0.0362      | 7.9742                                       | 0.4682 | 7.7379                  | 0.4060        |
|                          |                  | At most 1                 | 0.0011      | 0.2363                                       | 0.6209 | 0.2363                  | 0.6209        |
| India<br>South Africa    | 1                | None                      | 0.0371      | 11.5213                                      | 0.1814 | 7.9428                  | 0.3845        |
|                          |                  | At most 1                 | 0.0169      | 3.5785                                       | 0.0585 | 3.5785                  | 0.0585        |
| Russia<br>South Africa   | 1                | None                      | 0.0323      | 7.1124                                       | 0.5646 | 6.9108                  | 0.4997        |
|                          |                  | At most 1                 | 0.0010      | 0.2016                                       | 0.6534 | 0.2016                  | 0.6534        |



**Table 4 (cont.).** Johansen's co-integration results

| Combination of Countries                               | Lag Length (AIC) | Hypothesized No. of CE(s) | Eigen Value | Trace Test       |               | Maximum Eigenvalue Test |               |
|--|------------------|---------------------------|-------------|------------------|---------------|-------------------------|---------------|
|  |                  |                           |             | Trace Statistics | Prob.         | Max Eigen Statistics    | Prob.         |
| <b>Part 2 – During Pandemic Co-integration Results</b> |                  |                           |             |                  |               |                         |               |
| Brazil<br>China  | 1                | None                      | 0.0602      | 19.9104          | 0.0101        | 18.0314                 | <b>0.0121</b> |
|  |                  | At most 1                 | 0.0065      | 1.8790           | 0.1704        | 1.8790                  | 0.1704        |
| Brazil<br>India  | 1                | None                      | 0.0322      | 9.4021           | 0.3295        | 9.3054                  | 0.2616        |
|  |                  | At most 1                 | 0.0003      | 0.0967           | 0.7559        | 0.0967                  | 0.7559        |
| Brazil<br>Russia                                       | 1                | None                      | 0.0287      | 8.6223           | 0.4015        | 8.2767                  | 0.3513        |
|  |                  | At most 1                 | 0.0012      | 0.3456           | 0.5566        | 0.3456                  | 0.5566        |
| Brazil<br>South Africa                                 | 1                | None                      | 0.0197      | 9.8714           | 0.2908        | 5.6886                  | 0.6535        |
|  |                  | At most 1                 | 0.0145      | 4.1828           | 0.0408        | 4.1827                  | 0.0408        |
| China<br>India   | 1                | None                      | 0.0361      | 11.8406          | 0.1647        | 10.4996                 | 0.1811        |
|  |                  | At most 1                 | 0.0047      | 1.3410           | 0.2469        | 1.3410                  | 0.2469        |
| China<br>Russia  | 1                | None                      | 0.0367      | 12.4068          | 0.1384        | 14.2646                 | 0.1722        |
|  |                  | At most 1                 | 0.0061      | 1.7482           | 0.1861        | 1.7482                  | 0.1861        |
| China<br>South Africa                                  | 1                | None                      | 0.0467      | 15.6792          | <b>0.0469</b> | 13.9113                 | 0.0568        |
|  |                  | At most 1                 | 0.0061      | 1.7679           | 0.1836        | 1.7679                  | 0.1836        |
| India<br>Russia  | 1                | None                      | 0.0489      | 15.3907          | 0.0518        | 14.5937                 | 0.0444        |
|  |                  | At most 1                 | 0.0027      | 0.7969           | 0.3720        | 0.7969                  | 0.3720        |
| India<br>South Africa                                  | 1                | None                      | 0.0278      | 8.0119           | 0.4641        | 7.9935                  | 0.3794        |
|  |                  | At most 1                 | 0.0000      | 0.0184           | 0.8920        | 0.0184                  | 0.8920        |
| Russia<br>South Africa                                 | 1                | None                      | 0.0590      | 18.2758          | 0.0186        | 17.3228                 | <b>0.0159</b> |
|  |                  | At most 1                 | 0.0033      | 0.9531           | 0.3289        | 0.9531                  | 0.3289        |

## 4. DISCUSSION

Tables 1 and 2 show the averages along with the degree of variations in the indices of Brazil, Russia, India, China and South Africa. It was revealed that average index prices have increased, during the pandemic period in comparison to the pre-pandemic period, in case of all BRICS countries except Brazil. While the degree of variation, as denoted by standard deviation, has increased manifold in all countries in the pandemic period. It shows higher returns (except Brazil) coupled with high variability existing during the pandemic. To conclude, it can be said that a high degree of uncertainty during the pandemic imposes high degree of risk, thereby increasing returns of indices with high degree of variability. Ali et al. (2020), Ruiz Estrada (2020) and Singh et al. (2020) draw similar results with many countries, some of which are common to the sample.

From Figures 1 and 2, the high degree of uncertainty in index prices during the pandemic period can be easily traced, which is explained earlier with the descriptive performance. In general, the decline began in February 2020, shortly after the WHO declared COVID-19 a pandemic on January

31, 2020, and improved in April 2020. The period of uncertainty was almost similar in all countries of BRICS; however, the degree of variability differs from one country to another depending on the severity of the pandemic in that particular country. Thereafter, this study analyzes the degree of heterogeneity in the return series of those indices. As seen in Figure 2, i.e., the return's graph, the variance in the return of stock index of China was high in comparison to other countries. Over the study period, except during February 2020 to March 2020, the returns of all countries except China showed a steady pattern, implying constant returns.

From the above analysis, one can summarize that although the effect of a pandemic is visible in the economy of all countries, the stock indices of the countries have to capacity to recover faster than the economy. This implies that during the period of uncertainty, it is advisable to invest in stock indices, rather than invest in an individual stock.

Table 4 indicates that at the 5% significance level in the pre-pandemic period, the stock indices of only China and South Africa are found to be

cointegrated using the Johansen cointegration test. If you look at cointegration during the pandemic, you can see that it has increased as stock indices from Brazil and China, China and South Africa, and Russia and South Africa are all co-integrated. In case of China and South Africa during the pandemic period, indices are cointegrated as

per t-statistic while not integrated based on maximum Eigen value. Based on literature, if these two methods give contradictory results, then it is necessary to follow the results given by t-statistics. Thus, cointegration is found to exist between China and South Africa in the pandemic period.

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## CONCLUSION

The globe is dealing with the pandemic, as major cities throughout the world got shut down in response to the increasing cases of coronavirus known as “ COVID-19.” The general consensus among economists is that the global economic shutdown due to the pandemic is the main factor of stock market uncertainty, which has resulted in the market crash, is seen as a key factor of stock market uncertainty. The main worry is determining and quantifying the impact of the COVID-19 outbreak on global stock markets. The BRICS countries were no exception when it comes to being impacted by the global COVID-19 epidemic in many socioeconomic dimensions, and they have been the focus of current research efforts to assess those repercussions.

In the perspective of the global pandemic, this essay examines financial integration during COVID-19 among Brazil, China, India, Russia, and South Africa, which are the five countries that make up the BRICS region, and they make up the sample under investigation. The most liquid and heavily traded indices of the regional integration's member countries have been used. Time series data of daily closing prices of indices of the respective countries were taken for the period starting from April 2019 and ending on March 2020. For the purpose of the study, the time period is further divided into Pre-Pandemic Period (i.e., from April 1<sup>st</sup>, 2019 to January 31<sup>st</sup>, 2020) and Pandemic Period (i.e., from February 1<sup>st</sup>, 2020 to March 31<sup>st</sup>, 2021).

Descriptive analysis and graphical representations show higher returns (except Brazil) coupled with high variability existing in the pandemic. Before moving further to calculate Johansen Cointegration, the non-stationarity of data was first checked through the ADF and PP test, and the optimum lag length through AIC was calculated, which is the pre-requisites of cointegration test. In the pre-pandemic period, the stock indices of only China and South Africa are found to be cointegrated using Johansen cointegration test. When you look at cointegration during the pandemic, you can see that it has increased as stock indices from Brazil and China, China and South Africa, and Russia and South Africa are all co-integrated.

One may summarize that although the effect of the pandemic is visible in the economy of all countries, the stock indices of the countries have the capacity to recover faster than the economy. This implies that in the period of uncertainty, it is advisable to invest in stock indices, rather than invest in individual stock. While the level of cointegration has increased in the pandemic period as three combination of BRICS nations, namely Brazil and China, China and South Africa and Russia and South Africa, showed positive results. This implies that the COVID-19 crisis has increased the degree of cointegration or relatedness between BRICS nations. BRICS nations include the major developing countries of the world, mainly China and India. However, the study indicates that during the pandemic the indices follow more cointegrated direction. From the investors' point of view, one can conclude that diversification during the pandemic period cannot be achieved by investing in BRICS nations only, the investor should look for more diversifying options specially in pandemic situations.

Further studies may be conducted in this regard to ascertain the effect of volatility spillover to check the degree of risk transfer across BRICS nations. Before constructing portfolio, it is also necessary to check whether risk transfer is possible among markets or not. So future research may strive to incorporate that.

## AUTHOR CONTRIBUTIONS

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 Investigation: Sufiya.  
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