

**DIGITAL TRANSFORMATION,
STRATEGIC RESILIENCE,
CYBER SECURITY AND RISK
MANAGEMENT**

CONTEMPORARY STUDIES IN ECONOMICS AND FINANCIAL ANALYSIS

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MANAGEMENT**

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FOREWORD



Digital transformation represents a topical subject nowadays due to its notable societal impact. As digitalisation disrupts society ever more profoundly, concerns are growing about how it is affecting issues such as skills, jobs, wages, inequality, resource efficiency and security. Therefore, resilient and risk management strategies are considered by policy-makers, economists and industry leaders that render global the keen need to address the digitalisation challenges and emerging opportunities.

Digital Transformation, Strategic Resilience, Cyber Security and Risk Management brings together the right mix of approaches and scientific studies to provide a coordinated response to the societal challenges arising from digitalisation, considering its wide-ranging impact on individuals, labour market, and the business environment.

In this complex framework, the edited book is a notable scientific research output, well configured, structured and designed, being devoted to a highly relevant and complex topic, with profound economic, social and political consequences.

The book offers valuable insights about artificial intelligence technology and its role in future performance management, as well as about digital transformation in finance and insurance and the impact of digitalisation on the competitive assessment of research and development agreements while also mapping the research on blockchain in education. Later in the text, the role of central bank digital currency for achieving the sustainable development goals is examined. Another interesting perspective presents the effective implementation of climate-smart intervention that is meant to provide sustainable benefits to both men and women. Furthermore, the impact of digitalisation on human capital and business strategies is entailed next through several in-depth studies focussed on managing human resources in digital marketing, developing resilient organisations through strategic human resources, and reviewing the technology impact on customer relationship management. Business intelligence and its impact on decision

making and decision support systems are presented at the end, with a focus on data-driven companies and organisations with sophisticated and strong information technology supporting the business intelligence systems. On these lines, the specific ways in which innovations in the digital technologies support the business use cases with the help of real-time data are also examined.

I am confident the readers will benefit from an insightful reading experience of this book that stands out through its scientific merit and practical value, the quality of argumentation, and accuracy of analyses, bringing notable value to the literature in this scientific field.

Prof Dr Grațiela Georgiana NOJA
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PREFACE

The book creatively advances a number of cutting-edge studies conducted to offer precise answers to the persistent global challenges that have thrust digital transformation, cyber security, and risk management into a raging discussion and at the centre of comprehensive resilience strategies.

Global challenges currently being confronted have sparked a heated discussion about digital transformation, cyber security, and risk management. Both scientists and the general public have recognised the urgent need for strategic resilience through new innovative measures and coordinated risk management approaches. As a result of the current COVID-19 pandemic's impact on the world economy, digitalisation is now even more crucial to overcoming these obstacles and advancing sustainable economic growth. The global economy is being significantly shaped by digitalisation, which has broader effects on people, businesses, industries, labour markets, educational systems, and governments. On the one hand, technological advancement and digital transformations are changing the competencies required of people to participate effectively in the online work environment, in the modern economy, and, particularly, in the post-pandemic period. The proposal book offers a comprehensive analysis of the world's intricate digital transformation processes, including both the underlying causes and the significant impacts of the transformations and digitisation of social and economic life. The book plan addresses digital transformation, strategic resilience, cyber security, and risk management.

The following are some unique qualities that make this work stand out to readers:

1. Illustrates the function of resource and performance management being widely used across various organisations.
2. Implementation of artificial intelligence and sophisticated analytics in the creation of performance management strategies.
3. Offers novel study modalities, including the use of algorithms for performance evaluation, real-time evaluation, statistical forecasting for performance management, Digital Ledger Technology (DLT), etc.
4. Using a clever analytics-based compass to monitor and navigate success factors like Key Result Areas (KRAs) and Key Performance Indicators (KPIs).
5. Examine data security and privacy concerns in light of the General Data Protection Rules (GDPR), the Digital Operations Resilience Act (DORA), and other relevant laws.
6. Describes ethical and sustainable performance indicators for ensuring company expansion and continuity.
7. Describes to viewers the multilateral initiatives used to combat money laundering and terrorist financing for improved economic performance and sustainability of a nation.

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CHAPTER 1

A STUDY ON THE IMPACT OF COVID-19 ON THE STOCK MARKET IN BRIC COUNTRIES

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ABSTRACT

The COVID-19 pandemic has recently had an impact on the stock market all over the globe. A thorough review of the literature that included the most cited articles and articles from well-known databases revealed that earlier research in the field had not specifically addressed how the BRIC stock markets responded to the COVID-19 pandemic. The data regarding COVID-19 were collected from the World Health Organization (WHO) website, and the stock market data were collected from Yahoo Finance and the respective country's stock exchange. A random forest regression algorithm takes the closing price of respective stock indices as target variables and COVID-19 variables as input variables. Using this algorithm, a model is fit to the data and is visualised using line plots. This study's findings highlight a relationship between the COVID-19 variables and stock market indices. In addition, the stock market of BRIC countries showed a high correlation, especially with the Shanghai Composite Stock Index with a correlation value of 0.7 and above. Brazil took the worst hit

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in the studied duration by declining approximately 45.99%, followed by India by 37.76%. Finally, the data set's model fit, which employed the random forest machine learning method, produced R^2 values of 0.972, 0.005, 0.997, and 0.983 and mean percentage errors of 1.4, 0.8, 0.9, and 0.8 for Brazil, Russia, India, and China (BRIC), respectively. Even now, two years after the coronavirus pandemic started, the Brazilian stock index has not yet returned to its pre-pandemic level.

Keywords: COVID-19; BRIC; stock market indices; cumulative cases; cumulative deaths; random forest regression; correlation; decision tree;

JEL Classification: G10

1. INTRODUCTION

The development of a country and its economy is assessed by the performance of stock markets. The stock market is used as an economic barometer to measure how well a nation is doing. Instances from the past had impacted the stock market, like the great depression of 1929 and the economic recession of 2008. Globalisation has magnified the impact of international fluctuations on individual economies across the globe. Since the contemporary international financial crisis, the stock market has been subjected to some unprecedented fluctuations. The uncertainty and risk in the stock market increase with volatility. This makes it important for the accurate measurement of stock market volatility. Stock markets are institutions of global importance; hence, their beneficial development has become the focus. Thus, knowledge of the theoretical and literary significance of volatility is needed to measure the volatility of stock index returns (Bhowmik & Wang, 2020). To assess the volatility, assessing the stock market performance becomes important. The stock market's performance depends not only on the company's financials but also on various other factors. A series of economic factors like monetary policy, government regulation, capital flows, and other economic factors affect the stock market's performance, but the significance of these factors is different in pre-COVID and post-COVID scenarios (Dong, Song, & Yoon, 2021). So, depending on the previous analysis, one cannot make an informed decision based on the stock market performance. This research aims to study the impact of unprecedented COVID-19 on the stock market returns in BRIC. Moreover, this study tries to examine the extent to which the COVID-19 pandemic has impacted the stock market's returns.

2. LITERATURE REVIEW

The materials collected for this study for the literature review were previously published research articles related to the study of stock markets. The research articles taken up for literature review were from prominent and verified journals

like Science Direct, Research Gate, Emerald, *Journal of Risk and Financial Management*, *Journal of Behavioral and Experimental Finance*, *Journal of Asian Finance, Economics, and Business*, and WHO research database. In addition, popular articles which had been extensively cited in other works were also taken up from the research paper repository, Google Scholar. The COVID-19 pandemic has left no sector unaffected. The impact of COVID-19 on the stock market has been previously studied empirically. Moreover, there are many studies that tried to ascertain the reaction of the stock markets to the COVID-19 pandemic. Existing literature found diverse results in these regards. Two major pandemics have been experienced in the twenty-first century. One being H1N1 (11 June 2009) and the other being COVID-19 (11 March 2020). The impact of the announcement of the pandemic on the daily returns of stock markets of BRIC countries in 2020 was relatively better compared to 2011, as investors had learned a lesson and were not as paranoid as they were during H1N1 (Velásquez, Griñen, & Henríquez, 2021). However, the fear of people on COVID-19 strongly impacts the returns. This effect is visible for a significant time and does not subside in a short time (Subramaniam & Chakraborty, 2021). Investors' culture and their response to uncertainties highly affect the returns of the stock market. Hence, countries with high volatility and low individual behaviour react negatively to the returns of the stock market (Fernandez-Perez, Gilbert, Indriawan, & Nguyen, 2021). The stock market returns were negative in the COVID period; however, in the second quarter, the stock market returns gradually moved upward, but the volatility of the stock markets remained higher than normal scenarios (Chaudhary, Bakhshi, & Gupta, 2020). For stock market returns, the average buys and holds abnormal returns in the stock markets reflected negative figures for both G7 and BRICS nations (Ledwani, Chakraborty, & Shenoy, 2021). The negative impact of the pandemic lasted for about 30 days in Brazil, Russia, and China, while it lasted for about 60 days in India and South Africa. Upon intervention from the government to reduce the impact on the economy, the financial markets indicated a positive impact and growth (Chavali, Al Samman, & Jamil, 2021). The financial sector, being the backbone of the economy, faced an adverse impact rather than the other sectors of the Indian market like pharma, consumer goods, and information technology. Hence, the pandemic has increased the risk of investing in stock markets. COVID-19 has affected stock prices and volatility. The weighted average of the pre-COVID-19 normal returns constitutes the new normal returns for the COVID-19 period (Khanthavit, 2021). The COVID-19 cases and deaths have a significant negative impact on the stock market returns across all companies in China (Al-Awadhi, Alsaifi, Al-Awadhi, & Alhammad, 2020). We have noticed a negative impact on stock returns, and COVID-19 confirmed cases and lockdowns, but this is evident even in emerging and advanced economies. Whereas deaths have a positive impact on emerging economies and a negative impact on advanced economies, which is evident in the emerging economies in the long run (Khilar, Singh, Dash, & Sethi, 2022). However, an analysis done in African countries shows that the number of confirmed cases rather than the number of deaths is responsible for negative returns in the African stock markets (Udeaja & Isah,

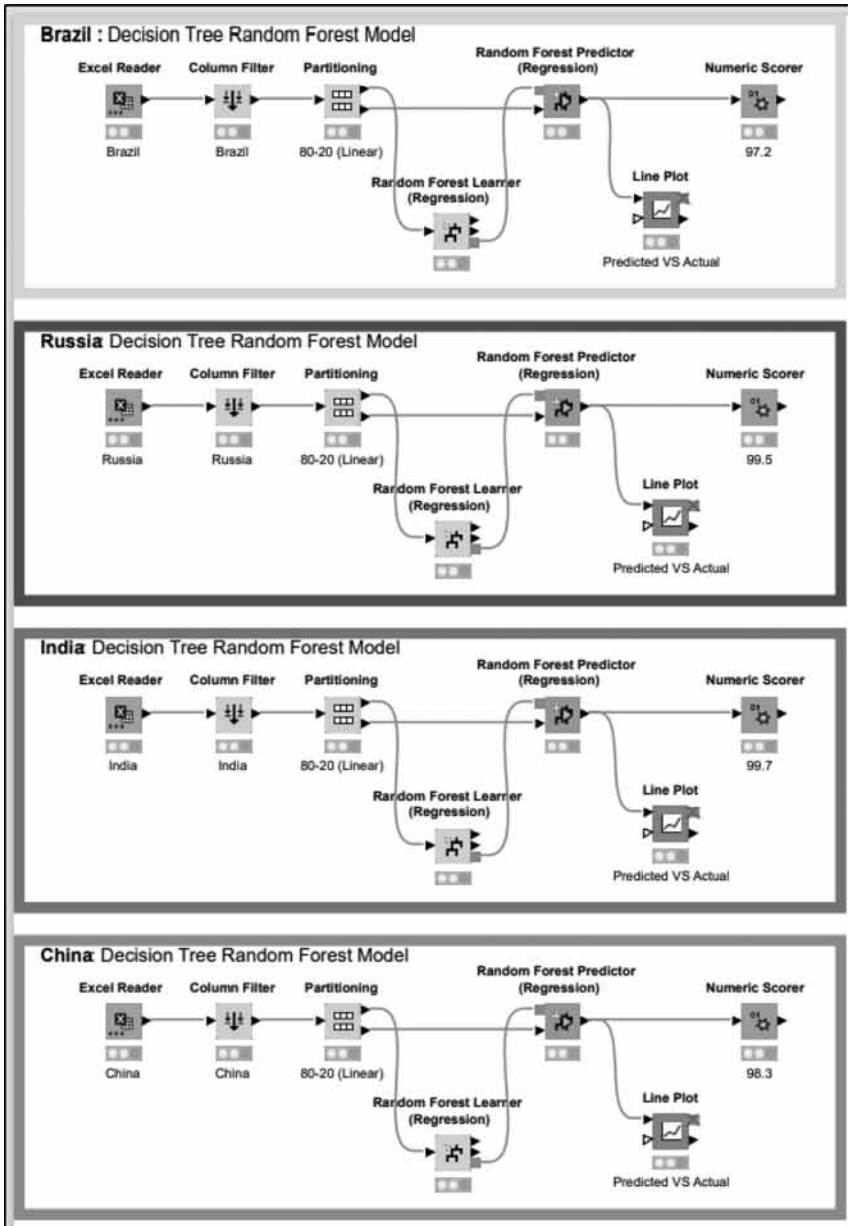


Fig. 1. KNIME Workflow of BRIC.¹

2022). The COVID-19 pandemic has left no sector unaffected, and the stock market return compared to the pre-COVID situation was significantly negative. However, the stock market returns gradually moved upward when there was an

announcement regarding the lockdown relaxation policy (Bora & Basistha, 2021). On the contrary, only for a specified period, there were strong positive changes in stock prices due to the announcement of lockdown due to the notion that lockdown would benefit the country in the long run by containing the spread of coronavirus (Alam, Alam, Md, & Chavali, 2020). The coronavirus outbreak has affected the markets and the economies of countries worldwide, which led to its underperformance. But with the steady adaptation to the new normal, the markets started improving steadily (Sachdeva & Sivakumar, 2020). The effect of the COVID-19 pandemic is not restricted only to the returns and volatilities of the stock markets, but it has a short-term contagion effect that disappears in the long term (Okorie & Lin, 2021). However, the significant changes in stock market returns cannot be simply explained by the lethality of the coronavirus, but the early changes in stock market returns were closely attributed to the negative news related to increasing the cases and deaths due to COVID-19. In addition, travel restrictions, business closures, and social distancing mandate policies bring great economic damage (Baker et al., 2020). However, the stock market returns are not only based on the local confirmed cases and deaths but also on the global situation. Hence, stock market returns are dependent on the changes around the globe (Yücel, FiKiRli, & ŞahiN, 2021). From the past studies, it is also observed that there are certain determinants like return on equity, book value per share, earnings per share, dividend per share, dividend yield, and price to earnings that influence the stock prices. The coefficients for return on equity, book value, dividend per share, and price to earnings had a positive effect on the stock prices. However, the dividend yield showed a negative effect on the stock prices. It was also observed that there had been a strong positive correlation between the market price per share and book value per share. In addition, during the pandemic, there had been a decline in stock market returns and GDP rates in countries that had been moderate-to-heavily affected by the pandemic. For every 1% increase in the COVID-19 cases, the stock market returns declined by 0.8% in the respective country and GDP declined by 0.56% in the respective country. There was an increase in the volumes due to enhanced liquidity in mid-2020 because of COVID-19. Hence, spike in COVID-19 hurts stock market growth (Latif et al., 2021). Moreover, a study conducted concerning Romania made it evident that, in addition to the determinants of stock prices mentioned in the existing literature, there had been other variables like pandemic variables (new cases and new deaths), measures adopted by authorities in containing the virus (internal movement restrictions, international travel control, monetary interest rates), variables related to the international economic context (crude oil prices and purchasing managers index) that influenced the stock market index (Hatmanu & Cautisanu, 2021). The presence of volatility spillover among oil prices, natural gas prices, and the BRICS stock market implies that oil market information (natural gas market information) enhances the volatility forecast in stock markets (Sadraoui, Regaieg, Abdelghani, Moussa, & Mgdmi, 2021). There had been a negative effect of pandemic variables on the Romanian stock index. Conversely, there was an inverse relationship between the monetary policy and the Romanian stock index. However, crude oil prices tend to show a strong positive effect in the first

sub-period and a negative effect in the second sub-period. To conclude, there had been a significant long-run relationship between the studied variables and the Romanian stock index (Hatmanu & Cautisanu, 2021). A study conducted in Malaysia showed that other factors such as responses taken by the government in terms of restrictions placed such as staying at home, shut down of workplace, debt relief, or household relief had a significant effect on the economic activity and stock market performance. The purchasing manager index (PMI), which measured the economic activity and closing stock prices (CLOSE), had a negative relationship with all the variables that were taken up for the study, namely restrictions on gatherings (ROG), international travel control (IT), workplace closures (WPC), the number of confirmed cases (LCC), stay at home requirements (SAHR), debt or contract relief for households (DCR), and income support (IS). The number of confirmed cases had a negative impact on the closing price of the stock index in Malaysia. Workplace closures impacted the economic activity and the stock markets negatively in the country. Contrary to this, the international travel control, income support for households (IS), and debt or contract relief for households (DCR) showed a positive effect on the closing price of the stock market index, however, the same had a negative impact on economic activity (Guan Keh & Teng Tan, 2021). In response to uncertain situations, the government must be proactive and take measures to reduce its impact (Varma, Venkataramani, Kayal, & Maiti, 2021). The two most important policy actions taken by the government to tackle COVID-19 are the nationwide lockdown and the interest rate cut policy. These policies have a positive impact on the stock market and the interest rate cuts have a higher impact on the stock market (Deng, Xu, & Lee, 2021). All these factors and variables become very important to policymakers to make informed decisions while formulating policies for the benefit of mankind, as all this information is relevant for policymakers and investors about regional development policies and portfolio diversification strategies in BRIC's financial markets (Heliodoro et al., 2020). The stock markets had been volatile during the pandemic. When it comes to stock market volatility, the global fear index is a better indicator of market volatility when compared with other conventional measures as established in the study (Salisu & Akanni, 2021). It is suggested that the BRIC countries' stock indices have exhibited volatility spillover due to the COVID-19 pandemic (Malik, Sharma, & Kaur, 2021). Moreover, during the 2019 (COVID-19) pandemic, bad volatility spillovers are more pronounced and dominated by good volatility spillovers, indicating contagion effects (Mensi, Vinh Vo, & Hoon Kang, 2021). To add to that discussion, a study on the Turkish stock exchange showed that positive and negative shocks, which are a result of news, had the same effect on the volatility of the financial index. However, in the industrial index, the positive and negative news had different effects on volatility as negative shocks caused more volatility in the industrial index than positive shocks (Aydm, Alpagut, Polat, & Lögün, 2021). Assuming that movement in the stock market index of one of the BRIC countries is independent of movements in stock market indices of other BRIC countries, would be unrealistic. The stock market of BRIC countries has become dependent on each other as the time and the frequency of impact of fluctuations in one index on others was established in the

study (Shi, 2021). It is worth noting that the interdependence of stock markets is not the same for a few BRIC nations, the results show that lagged Russia's stock exchange performance during the pandemic period can predict or cause the performance of India's stock exchange during the COVID-19 pandemic period (with a p -value of 0.0220), but this relationship is not vice versa (Ngwakwe, 2020). Moreover, a study on COVID-19 and the stock market and exchange rate established that there is a dynamic association between pandemic growth and stock market indices in the context of BRIC nations. Using impulse response analyses, the COVID-19 shock to the growth of the exchange rate was seen to persist for around 10 + days, and that for stock exchange was seen to be around 15 days (Bhattacharyya, Rama, Kumar, & Banerjee, 2021). This research study tries to ascertain the stock market returns by taking the return of indices that constitute the top 50 companies as a proxy to measure stock market returns with reference to BRIC countries.

3. PROBLEM STATEMENT

The stock market is viewed to be one of the economic barometers of a country. Given its importance, many participants invest their hard-earned money in expectation of a positive return. So, it is necessary to understand the market dynamics. The pandemic had a drastic effect on all sectors, and stock markets were no exception. The volatility and the performance of stock markets were disturbed, creating turbulence. From the last few months, it is evident that the stock markets have reacted adversely to COVID-19. This is mainly due to investors' beliefs, government policies, the shutdown of companies, and the imposed restrictions. This built interest to understand the magnitude of impact on the stock market in emerging economic use, especially the BRIC nations. But the studies reviewed have not examined the effect of COVID-19 on the stock markets of BRIC countries. Furthermore, the studies have also not discussed the magnitude of the effect of COVID-19 on the stock market at different waves. The studies have considered the impact of COVID-19 for a specified short period, whose results differ in the long run. This study develops a model to ascertain the impact of COVID-19 on stock market indices and forecast the effect of such unforeseen events in the future. This study aims at striking a relationship between COVID-19 positivity and death rate and the stock market indices. So that future researchers can use this as a foundation for further exploration.

4. RESEARCH QUESTIONS

1. What is the investor's perception of the increasing number of COVID-19 cases and deaths?
2. How has the COVID-19 pandemic positivity rate and death rate affected the stock markets?

3. Whether the effect of the pandemic on stock markets is uniform across the BRIC nations?
4. How did the stock markets of developed countries, China and Russia, react when compared to the developing countries, Brazil and India?
5. Is there any relationship between the COVID-19 variables and stock market variables during the pandemic?
6. Which country among BRIC has been affected badly due to active cases and the death counts due to COVID-19?
7. Is there any correlation in the movement of stock market indices amongst BRIC countries during uncertain times?
8. Which country's stock market had a strong recovery, and to what extent?

5. RESEARCH GAP

Existing literature in this field had analysed the impact of COVID-19 on the stock market from the short-term perspective, but the same might not hold in the long run. In addition, some uncertainties affect the stock market, and the COVID-19 pandemic is one such uncertainty. Presently, there is no such model that helps to predict the value of the stock market index based on the COVID-19 variables. The articles mainly focussed on the impact of the pandemic on a particular economy which doesn't give conclusive evidence of the other emerging economies. BRIC has a significant share of around 30% in global trade and 25% of world GDP (Dua, Chancellor, & Ghate, 2021), which makes it essential to analyse the impact of COVID-19 on the BRIC stock markets to get a wider and more holistic view. Existing studies speak about the impact of COVID-19 on individual economies but ignore how changes in the indices of one of the BRIC nations impacted that of the others. For example, fluctuations in the SSE Composite Index impacted the NSE Index.

6. MATERIALS AND METHODS

The materials collected for this study were previously published research articles related to the study of stock markets. The research articles taken up for literature review were from prominent and verified databases and journals like Science Direct, Research Gate, Emerald, *Journal of Risk and Financial Management*, *Journal of Behavioral and Experimental Finance*, *Journal of Asian Finance, Economics, and Business*, and WHO research database. In addition, popular articles, which had been extensively cited in other works, were also taken up from the research paper repository, Google Scholar. The variables taken up for the study are classified into two categories: COVID-19 variables and stock market metrics variables. Moreover, COVID-19 cases and deaths fall under the COVID-19 variables, and the closing price of the respective index falls under the stock market metric variable. Data relating to the COVID-19 variables were collected from the