Market Reaction to COVID-19 and the Variants of Concern in BRICS-T Countries

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ABSTRACT

This thesis investigates the market reaction effect of the announcements of the initial surge of COVID-19 and the subsequent variants of concern, namely Delta and Omicron, on the stock market of Brazil, Russia, India, China, South Africa, and Turkey (BRICS-T). To this aim, we employ the event study methodology to measure the abnormal return of the relevant stock market index during the event windows of each variant's first case announcement in each country. The results of this investigation suggest a late market reaction to first case announcement, and in most cases, new variants do not have statistically significant negative market reactions with the exception of South Africa for the case of delta variant, Russia and Turkey for the case of omicron variant.

Keywords: Event-study, COVID-19, Omicron, Delta, BRICS-T.

ÖZ

Bu çalışmada Brezilya, Rusya, Hindistan, Çin, Güney Afrika ve Türkiye (BRICS-T) borsalarının koronavirüs (COVID-19) salgınının ilk ortaya çıkışına ve ardından ortaya çıkan Delta ve Omicron gibi yeni varyantlara karşı piyasa tepkileri araştırılmaktadır. Bu amaçla, her bir ülkede ortaya çıkan yeni varyantların ilk vaka duyurusunun olay pencereleri sırasında ilgili ülkenin borsa endeksinin anormal getirisini ölçmek için olay çalışması yöntemi kullanılmıştır. Olay çalışması sonuçlarına göre ilk vaka duyurusuna piyasa tepkisi geç olmaktadır. Ayrıca, Delta varyantında ortaya çıkan Güney Afrika piyasa tepksi ile Omicron varyantında Rusya ve Türkiye piyasalarının tepkileri haricinde yeni varyantların istatistiksel olarak anlamlı ve negatif bir piyasa tepkisi ile karşılaşılmamıştır.

Anahtar Kelimeler: Olay çalışması, COVID-19, Omicron, Delta, BRICS-T.

To My Mom and Dad

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TABLE OF CONTENTS

ABSTRACT iii

ÖZ iv

DEDICATION v

ACKNOWLEDGEMENT vi

LIST OF TABLES vii

LIST OF FIGURES x

1 INTRODUCTION 1

1.1 Background 1

1.2 Objectives 3

1.3 Data and Methodology 4

1.4 Thesis Structure 5

2 LITERATURE REVIEW 6

2.1 The Pandemic and its Consequences 6

2.2 Global Event Study Results 7

2.3 Other Pertinent and Consequent Effects 15

3 EMPIRICAL RESULTS 20

3.1 Stock Markets 20

3.1.1 Brazil's Stock Market 20

3.1.2 Russia's Stock Market 21

3.1.3 India's Stock Market 21

3.1.4 China's Stock Market 21

3.1.5 South Africa's Stock Market 21

3.1.6 Turkey's Stock Market 22

3.2 Empirical Methodology and Data 22
3.2.1 Methodology: Event Study.....22
3.2.2 The Event Study Periods and Data 23
3.2.3 Estimating the Abnormal Returns and Testing Statistical Significance 24
3.3 Empirical Event Study Results 25
3.3.1 Results from Brazil's Stock Market Index.....34
3.3.2 Results from China's Stock Market Index 34
3.3.3 Results from India's Stock Market Index 35
3.3.4 Results from Russia's Stock Market Index.....35
3.3.5 Results from South Africa's Stock Market Index.....36
3.3.6 Results from Turkey's Stock Market Index 36
4 CONCLUSION 37
REFERENCES.....39

LIST OF TABLES

Table 1. Literature Review Table.....8

Table 2. Respective markets' adjusted mean and standard deviation prior and during the consecutive events 28

Table 3. Abnormal returns on Day 0 and 1.....31

Table 4. Cumulative Abnormal Returns in the event window and the pre-event period 32

LIST OF FIGURES

Figure 1. Event study timeline 24

Chapter 1

INTRODUCTION

1.1 Background

It has been more than two years that the COVID-19 pandemic has been posing a major threat to the global economy and financial markets with each new variant causing more panic and concern (Myers, 2022). Most of the world's stock markets have lost approximately 24 trillion dollars, and international financial institutions are being forced to lower their growth forecasts for 2022 and beyond (Jones, 2022). The effect of the first surge of COVID-19 pandemic is clear as it had nearly stopped economic activity as countries impose strict travel restrictions to stop the virus from spreading (Worldbank.org, 2022) and this has been well documented in the literature in almost all countries (Aristovnik et al., 2020; Maneenop & Kotcharin, 2020; McKibbin & Fernando, 2021; Mishra et al., 2020; Priyadarshini et al., 2020; Uğur & Akbıyık, 2020).

However, the pandemic has not stopped there, and the virus has evolved over time. There have been five variants of concern so far and more sub-variants have mutated from these variants according to the WHO (World Health Organization). We have had more than a dozen "variants of concern" pop up, and such variants are variants that have evolved enough from the original virus such that they are significantly dissimilar. These become variant of concern, rather than a variant of interest, when they have evolved in such a way that has made the virus more dangerous such as being easier to

spread or a higher mortality rate. Some variants are no longer of threat and some such as omicron with its various mutations are still accounting for many lives lost despite the world's improved efforts at more quality healthcare and vaccination efforts since the pandemic (European Centre for Disease Prevention and Control, 2022).

The effects of these variants have not been as closely looked at as the first surge. Some factors might be due to the lack of a market reaction to other variants' announcement dates. For example, we see more literature on Omicron since it was more widespread than Delta or Gamma variants. In a report by J.P. Morgan Center for Commodities (2022), Omicron has been said to have further increased market volatility and has created a downward price gap as well.

Going back to the first surge, while a few companies like Amazon have benefited unintentionally from the COVID "new normal," most enterprises stagnated and had to lay off numerous people; more than a handful collapsed completely and was liquidated. According to a Federal Reserve assessment of U.S. small companies, over 30% had either shut down or were on the verge of shutting down by the end of 2021, putting millions of Americans' jobs in jeopardy. The story was similar in almost every other wealthy country.

Unsurprisingly, no industry of the world economy was more affected by the virus than the hotel and tourism industry, the significance of which cannot be stressed. Based on industry figures, prior to the virus's epidemic, there were at least nineteen million employees in the hospitality industry in the U.S. alone making hospitality the nation's largest industry, significantly higher than employment in healthcare and

manufacturing (Shapoval et al., 2021). Virtually all employees were out of work—for the time being—during the pandemic's deadliest days. Apparently, due to its absolute reliance on money, travel, and in-person communication, hospitable global businesses were not created to thrive in an environment characterized by declining revenues and travel restrictions.

1.2 Objectives

In this study, we will be studying how the markets have reacted to not just the first surge but also the consequent variants of concern such as SARS-CoV-2 Delta variant and SARS-CoV-2 Omicron variant in Brazil, Russia, India, China, South Africa, Turkey which are prominent emerging markets. Since they have all had their fair share of struggles due to COVID-19 and with each variant being deadlier than the previous, despite the increase in our defense against it (Moreira, 2022), we has still witnessed dramatic numbers of victims of the virus (Nolen & Mueller, 2022). These countries share a common characteristic, being developing countries with very high populations that are densely distributed; our choice of countries was due to the BRICS-T countries being developing countries meaning their infrastructure to combat the virus wouldn't be as effective as most developed countries (Singh & Misra, 2020). We also decided that it would be appropriate to add a T for Turkey to the traditionally known as BRICS countries, due to their emerging regional power and with the President of Turkey, Recep Tayyip Erdoğan, attending the 10^{th} summit of BRICS (Ayan, 2022). Therefore, the expected result is that we would see the market reacting more comparatively.

Moreover, many studies have focused on developed countries except for China which has extensive literature in this regard as it is the origin country of the virus. The motivation of this study was to find out if multiple variants of COVID-19 would have

as significant an impact as the first surge has let us understand the mentality of the masses when it comes to multiple variants of the same virus and allowing us to prepare for future variants. Be it another COVID-19 variant or another virus, the results would be applicable. The results will tell us whether people have mentally adapted themselves to virus announcements and thus have a less strong negative reaction when it comes to such announcements. We will also be giving policy recommendations based on the results to suggest ways governments could assist in an already turbulent period in their respective countries.

1.3 Data and Methodology

The data we used in this study is as follows. For instance, we took their market index, IBVOSEVA for Brazil, which is the major indicator of the performance of the stocks that are traded in B3, a stock exchange in Brazil, and consists of the main companies in the capital market of Brazil. It is updated quarterly and accounts for 4 out of 5 trades in the Brazilian capital markets (www.b3.com.br). For Russia, we used MOEX Russia Index, which is the main benchmark for the stocks traded in the Russian market. India's Nifty50 was the market index we chose, as it comprises of companies in the top 50 of the free-floating capital market and is utilized as a benchmark for portfolios and returns of mutual funds. As for China, we went with the Shanghai Stock Exchange Composite which is their main stock market index and tracks the performance of all the A and B shares that a on the STE (Shanghai Stock Exchange). Lastly for Turkey, we use BIST 100, which as the name suggest is the portfolio of the top 100 companies trading in the Borsa Istanbul which is their stock exchange market, and it is similarly a free-float index. Our data was retrieved from Worldbank.org (2022), and is characterized by monthly intervals, ranging from October 10th, 2019, until the 28th of March 2022, and consists of adjusted closed prices of the aforementioned indices that

are accounting for dividends and stock splits.

To measure the market reaction of these indices to the original and the subsequent variants of Covid-19, we use the traditional event study methodology. Specifically, we use the mean-adjusted market reaction to measure the reaction as the data include the indices. Along with testing for statistical significance, we employ abnormal return (AR) and cumulative abnormal return (CAR) analysis in our empirical examination.

1.4 Thesis Structure

This thesis consists of a total of four chapters. In the first chapter, we introduce the issue at hand. In the second chapter, we review the literature done on the first surge of the virus, previous outbreaks that are similar in nature (Black Swan events), and other COVID-19 related studies to get a full grasp of the topic at hand. In the third chapter, we introduce our empirical results mainly in the form of tables and graphs where we then interpret and report them unbiasedly. Lastly, the fourth chapter is our conclusion to the thesis in which we interpret the results and implications and make suggestions accordingly.

Chapter 2

LITERATURE REVIEW

2.1 The Pandemic and its Consequences

Regardless of the virus's obscure origins, there is one certainty that not since the early 90s "Spanish flu" has there been a contagious disease that has dramatically impacted international affairs. Although, as of July 2022, the global toll of the virus (about 547,000,000 illnesses and 6.3 million fatalities) has shown positive signs that the economic situation appeared to be improving (Word Health Organization, 2022). Many studies have tried to find how much covid has affected the world's economic, financial, and industrial state. Although it is undisputed that the coronavirus has significant social, economic, and financial impacts addition to its impact such as illnesses and deaths due to the virus.

All over the world, health scientists have tried to find a cure for the virus. Scientific studies on the effects of COVID-19 continue to be conducted in various branches of science. Considering the current literature in economics and finance, one can see that COVID-19 has had dramatic impacts on economies such as labor supply, country risk premium, output by sector, consumer demand, government spending, and loss of GDP (McKibbin and Fernando, 2020), oil prices, tourism and travel (Arezki and Nguyen, 2020), supply and demand in trade (Baldwin and Tomiura, 2020), banks (Barua & Barua, 2020; Cecchetti and Schoenholtz, 2020), economic anxiety (Fetzer et al., 2020),

monetary policy (Cochrane, 2020), and macroeconomic policies (Sapulette & Santoso, 2021).

Studies examining the impact of COVID-19 on financial markets are rapidly proliferating in the literature. The impact of the virus on the markets of different countries on stock indices and stock returns is analyzed using different methods. The first section of the literature review focuses on the event study results done for different countries whereas the second section focuses on studies pertaining to the other relevant economic effects of the pandemic.

2.2 Global Event Study Results

An event study is a good tool for determining the influence of a specific event on the returns of stocks. According to Binder (1998), when studying events, they must be precisely characterized and their influence must be logically supported. Event studies have become a useful tool for modeling the returns that are abnormal in a regression model as a co-efficient. Furthermore, they contend that the event research approach includes three assumptions one being that the markets are efficient; two is that the occurrence is unforeseen by the markets; and lastly, no other confounding events occur during the event window.

COVID-19 and its variants are projected to have a negative impact on market indices on average in the following studies. Table 1 summarizes a global list of studies done regarding COVID-19 measuring the market reaction. The studies listed in the table use various methodologies. However, majority of studies are comprised of the event study methodology.

Table 1. Literature Review Table

Title	Reference	Study area	Method	Conclusion
"Death and contagious infectious diseases: Impact of the COVID-19 virus on stock market returns"	Al-Awadhi et al. (2020)	China	Panel data analysis	"Stock returns are significantly negatively related to the daily growth in both the total confirmed cases and total cases of death caused by COVID-19."
"The Impact of COVID-19 Pandemic on Global Stock Markets: An Event Study"	Hani et al. (2020)	Global	Event Study	"Significant negative impact on the returns. Moreover, these effects were more substantial following the WHO announcement of COVID19 as a global pandemic on March 11, 2020. Also, underreaction to pandemic reaction as shown by delayed response of stock market in terms of significant cars"
"The Outbreak of COVID-19 and Stock Market Responses: An Event Study and Panel Data Analysis for G-20 Countries"	Singh et al. (2020)	G20	Event Study	"Stock markets all over the world performed badly and experienced negative returns but in the later stages of the event window the stock markets were gradually recovering from the setback of the coronavirus outbreak, as indicated by positive cars"
"The impact of COVID-19 on emerging stock markets"	Topcu, Gulal (2020)	Emerging markets	Driscoll-Kraay estimator	"The negative and statistically significant impact of the coronavirus on emerging stock markets until April 10, with a relatively higher magnitude during March"

“Stock markets' reaction to COVID-19: evidence from the six WHO regions”	Al-Qudah, Houcine (2021)	WHO regions	Event Study	“There is an adverse impact of the daily increasing number of COVID-19 cases on stock returns and stock markets fell quickly in response to the pandemic. The findings also suggest that negative market reaction was strong during the early stage of the outbreak between the 26th and 35th days after the initial confirmed cases”
“Stock markets’ reaction to COVID-19: Cases or fatalities?”	Ashraf (2020)	64 countries	panel data analysis	“Stock market returns decline as the number of confirmed cases increase in a country”
“Financial markets under the global pandemic of COVID-19”	Zhang et al. (2020)	Global	minimum spanning tree	“Global financial market risks have increased substantially in response to the pandemic. Individual stock market reactions are clearly linked to the severity of the outbreak in each country. The great uncertainty of the pandemic and its associated economic losses has caused markets to become highly volatile and unpredictable.”
“COVID-19 and market expectations: Evidence from option-implied densities”	Hanke et al. (2020)	-	risk-neutral density	“Financial markets did not anticipate major economic effects of the COVID-19 pandemic until late February”

“Aggregate And Firm-Level Stock Returns During Pandemics, In Real Time”	Alfaro et al. (2020)	United States	Simulated Logistic Pandemic	“COVID-19-related losses in market value at the firm level rise with capital intensity and leverage and unexpected changes in the trajectory of COVID-19 infections predict US stock returns, in real time”
“The Impact of the COVID-19 on the Financial Markets: Evidence from China and USA”	Sansa (2020)	China, USA	Simple Regression model	“There is a positive significant relationship between the COVID - 19 confirmed cases and all the financial markets (Shanghai stock exchange and New York Dow Jones)”
“Impact of COVID-19 Pandemic on Financial Markets: a Global Perspective”	Ullah (2022)	30 most affected developed and emerging markets	Panel Quantile Regression	“The results confirm that the new COVID-19 daily cases and deaths adversely impact daily market returns around the globe”
“COVID–19’s Impact on Stock Prices Across Different Sectors—An Event Study Based on the Chinese Stock Market”	He et al. (2020)	China	Event Study	“The study found that transportation, mining, electricity & heating, and environment industries have been adversely impacted by the pandemic. However, manufacturing, information technology, education and health-care industries have been resilient to the pandemic. ”
“Impact of COVID-19 pandemic on micro, small, and medium-sized Enterprises operating in Pakistan”	Shafi et al. (2020)	Pakistan	Literature Review	“Due to the COVID-19 outbreak and lockdowns, many msmes have been severely negatively affected”

“The COVID-19 Outbreak and Affected Countries Stock Markets Response”	Liu et al., (2020)	21 leading stock market indices	Event Study	“Results indicate that the stock markets in major affected countries and areas fell quickly after the virus outbreak. Countries in Asia experienced more negative abnormal returns as compared to other countries”
“Short term response of Chinese stock markets to the outbreak of COVID-19”	Liu et al., (2020)	China	Event study	“The Chinese and Asian stock markets had significantly declined, with the cumulative abnormal returns (CAR) remaining negative in all the examined event window periods”
“COVID-19 outbreak and sectoral performance of the Australian stock market: An event study analysis”	Alam et al. (2020)	Australia	Event Study	“Significant Positive AR on food, pharmaceutical and health industries on the announcement day, negative AR on transportation and energy indices”
“Fear of the coronavirus and the stock markets”	Lyócsa et al. (2020)	Global	Google Search Volume	“Fear of the coronavirus – manifested as excess search volume – represents a timely and valuable data source for forecasting stock price variation around the world. ”
“Spillover of COVID-19: Impact on the Global Economy”	Ozili & Arun (2020)	Global	multivariate model	“Rising number of COVID cases and rising death cases led to a significant increase in global inflation rate, global unemployment rate, and global energy commodity index. ”

“Global Financial Crisis, Smart Lockdown Strategies, and the COVID-19 Spillover Impacts: A Global Perspective Implications From Southeast Asia”	wang et al. (2020)	Pakistan	Literature Review	“Covid has hit the Pakistan economy's critical sectors and disrupted social interaction, trade, and economic activities”
“Stock Market Reaction to COVID-19: Evidence in Customer Goods Sector with the Implication for Open Innovation”	Machmuddah et al. (2020)	Indonasia	Event Study	“Daily closing stock price and volume of stock trade were significantly different before and after COVID-19 emergence”
“Stock markets and the COVID-19 fractal contagion effects”	Okorie, Lin (2021)	top 32 countries	DMCA and DCCM	“Significant but short-lived contagion effect in the stock markets as a result of the COVID-19 pandemic”
“The Essential Role of Pandemics: A Fresh Insight into the Oil Market”	Qin et al. (2020)	Global	residual-based bootstrap modified-likelihood ratio statistics	“Pandemics may reduce the oil demand, causing oil prices to decrease, which is inconsistent with the predictions of the intertemporal capital asset pricing model”
“The COVID-19 black swan crisis: Reaction	Yarovaya et al. (2022)	Global	ADF	“Almost all equity indices demonstrate high potential for recovery even in very high periods of shock”

and recovery of various financial markets"				
"Black swan events and COVID-19 outbreak: Sector level evidence from the US, UK, and European stock markets"	Ahmad et al. (2021)	US, UK, EU	Event Study	"Until March 31, 2020, they found that the investors had limited investment opportunities except for a few sectors in the US, UK, and Europe due to black swan events"
"The effect of COVID-19 on the global stock market"	Chatjuthamard et al. (2021)	Global	Regression	"An increase in the growth rate of the number of confirmed cases increases volatility and jumps while reducing return"
"The unprecedented stock market impact of COVID-19"	Baker et al. (2020)	Global	Text-based	"Government restrictions on commercial activity and voluntary social distancing, operating with powerful effects in a service-oriented economy, are the main reasons the U.S. stock market reacted so much more forcefully to COVID-19 than to previous pandemics"
"Relative Stock Market Performance during the Coronavirus Pandemic: Virus vs. Policy Effects in 80 Countries"	Burdekin & Harrison (2020)	80 Countries	Pooled OLS & Panel Regression Analysis	"Increased coronavirus cases exert the expected overall effect of worsening relative stock market performance, but with little consistent impact of rising deaths"

“The impact of the COVID-19 lockdown on stock market performance: evidence from Vietnam”	Anh & Gan (2020)	Vietnam	Panel-data regression models	“The study confirms the adverse impact of the daily increasing number of COVID-19 cases on stock returns in Vietnam & though COVID-19 pre-lockdown had a significant, negative impact on Vietnam's stock returns, the lockdown period had a significant, positive influence on stock performance”
“Feverish Stock Price Reactions to COVID-19”	Ramelli, Wanger (2020)	Global	CAPM	“Anticipated real effects from the health crisis, a rare disaster, were amplified through financial channels”
“The effect of COVID-19 pandemic on global stock markets: Return, volatility, and bad state probability dynamics”	Basuony et al. (2021)	Global	asymmetric exponential generalized autoregressive conditional heteroscedasticity model	“They found unprecedented increases in conditional volatilities and bad state probabilities across all the markets, they also found that the negative affect of deaths is more pronounced, compared to the positive impact of recovered cases”
“Coronavirus: Impact on Stock Prices and Growth Expectations”	Gormsen, Koijen (2020)	US, EU, Japan	Modelling	“Forecast of annual growth show dividends points to a decline of 8% in both the United States and Japan and a 14% decline in the European Union compared to January 1”

2.3 Other Pertinent and Consequent Effects

Zeren and Hızarcı (2020) examine the impact of COVID-19 on stock markets such as China, South Korea, Italy, France, Germany, and Spain where cases are high. The study used the Maki (2012) cointegration test, which used daily data between January 23, 2020, and March 13, 2020. The results showed that the total number of deaths and all stock markets studied cooperate over the long term, and the total number of cases co-integrates with the stock markets of China, South Korea, and Spain. However, the research also finds that the total number of cases does not co-integrate with the stock markets of Italy, France, and Germany. However, they also find that hotels outperformed restaurants, beating casinos during the pandemic. Similarly, Alam et al. (2020) investigate the effect of the virus on eight industries in the continent of Australia. They find that the confidence of investors has changed since the outbreak was announced as a pandemic, and they found that food and health industries had a positive significant abnormal return, and energy and transportation industries took a big hit in terms of indices performances.

In a study done by Baker et al. (2020), it was found that the market has shown an unprecedented reaction to the pandemic, and it is unexplainable when looking at the death rates and comparing it to previous outbreaks. The stock market's unprecedented response to COVID-19 cannot alone be explained by the mortality rate of the virus. Today, the mortality rate caused by COVID-19 is only 4% of that of the Spanish flu. They go on to suggest the reaction could be caused by the strict rules and policies initiated by governments such as social distancing and restrictions on mobility which have huge socio-economic impacts on the service-focused nature of today’s economy.

Heyden & Heyden (2020) find that stock markets respond differently when a country's first case and death (i.e., first surge) are announced. In comparison, there is no notable reaction to the first cases. However, the revelation of the first fatality results in extremely adverse reactions. Moreover, market reactions differ when the initial fiscal and monetary policy measures are published. While fiscal policies may cause investor fear, central bank statements may help to calm markets.

In an intriguing research, Goodell and Huynh (2020) investigate the trading activity in the stock market of United States' congressmen during the beginning of the pandemic. They provide several examples of politicians "trading ahead of the market" by shorting stocks of firms that were projected to benefit (lose) numbers of infected increased, notably by purchasing pharmaceutical stocks furthermore shorting shares of hospitality-related companies.

Popkova et al. (2020) carry out a study of the impact of Corporate Social Responsibility (CSR) investments in five of the industrialized Organization for Economic Co-operation and Development (OECD) countries and developing (BRICS) nations in the framework of a COVID-19 economy. The empirical results indicated the utmost importance of CSR in the corporate environment during the hard times of the pandemic.

It is not just covid announcement dates that affect the market return as shown in a study by Al-Awadhi et al. (2020) where they look at all the reactions in the Hang Seng index and Shanghai Stock Exchange composite index during the pandemic in China. The results show that the pandemic had a negative impact on stock market performance. In particular, the stock market's returns have a significant negative

correlation with both the increase in confirmed daily cases and the increase in total deaths caused by COVID-19.

A study done by Aqeel et al. (2021) on students in Pakistan find that the pandemic could further lead to psychological problems. They find that perceptual disorders are associated with decreased mental health in students. The study finds that disease awareness was associated with lower levels of mental health and that students were associated with higher levels of anxiety during the pandemic. The study also finds that young students exposed to the pandemic were more vulnerable to a predisposition to mental health.

During the pandemic, governments faced a difficult choice of continued economic progress at the cost of rapid spread of the virus or decreasing economic growth to suppress the spread of the virus and in fact, countries have adopted policies that reduce real GDP as a way to limit the spread of the disease, especially in terms of travel and trade. There are complex negotiations for material goods and life and little discussion on how to evaluate and respond to these offers (Barro et al., 2020).

A study on the behavior of global financial markets in response to the virus's outbreak is done by Liu et al. (2020). Investors' faith in the stock market has eroded as a result of the pandemic's high level of market uncertainty. COVID-19, according to Iyke (2020), has considerable and ongoing negative effects on the world economy. Another recent study projected the impact of COVID-19 on the Spanish market index using A.R.I.M.A. (AutoRegressive Integrated Moving Average) and SutteARIMA. (Ahmar & del Val, 2020). Furthermore, Alam et al. (2020) claim that the pandemic has had a significant impact on Australia's stock market from the beginning of 2020. Despite the

fact that certain businesses were put at danger while others thrived, the stock market has shown a negative tendency. The study focused on early volatility and sectoral returns in eight different sectors. They analyzed the data using the event study method and a 10-day window for official COVID-19 incident notifications in Australia.

Several industries performed well on the day of the announcement, according to the statistics. In a study of the stock market reaction for the case of Romania, it is concluded that there is a short and long term significant negative effect on the stock market due to the pandemic in Romania, and the study used an ARDL test (Hatmanu & Cautisanu, 2021).

Jabeen et al. (2022) examines the global effects of covid by reviewing the literature and conclude that the epidemic has severely affected global markets and challenged economists, politicians, heads of state, international financial institutions, regulators and health agencies to address the long-term effects of the eruption. Dray and Schäfer (2020) assess pandemics' effect on work in the sector of aviation and found uncertainty in the future of forecasting CO2 levels due to the virus's disruption of the aviation industry.

Another study on the effect of COVID on the Indonesian stock market found that it is significantly affected Indonesia's economy. Indonesia will have a negative growth of .4%, which is the worst-case scenario. The government's economy has suffered the most in 19 housing sectors. Stock returns in China and the United States have fallen to an all-time low. The global economy has suffered significant delays as a result of the extensive lockdowns imposed by many governments to deal with the countless fatalities and illnesses caused by the coronavirus's ongoing fast spread (Ozili & Arun,

2020). The world economy has experienced a major recession during government repression, and as a result, several companies have suffered severe damage. Many workers were at risk because jobs such as tourism, education, and transportation were completely closed.

Using an event study analysis, Liu et al. (2020) collected a list of nations that were the most impacted by the virus and did an analysis of the impact of the virus on their stock markets, and they found a negative significant reaction. The event study approach is also employed by Sun et al. (2021) to investigate the influence of COVID-19 on the Chinese industry and stock market performance. The virus has had a substantial influence on a variety of businesses such as the environmental and mining ones. Although the repercussions that come with the pandemic have been restricted to various other businesses such as manufacturing and education.

Zhang et al. (2020) assert that the virus has a larger effect on the U.S. market indices than earlier pandemics like the Spanish Flu. Lockdowns and production cuts were the reasons for such increases. According to Ozili and Arun (2020), COVID-19 uncertainty and the fear of losing revenues led to a 6,000,000,000 USD drop in the world stock market on February 24, 2020. Another study also looked at the impact of the virus on the stock markets of ten different countries. It was established that European stock markets were connected throughout the pandemic while U.S. Markets could not play a major role before and after the pandemic (Mishra & Mishra, 2020). Corbet et al. (2020) present intriguing results that even in companies that were not related to the pandemic in terms of their business and business model, the virus still has been shown to have a significant impact on these companies if they had a virus-related name.

Chapter 3

EMPIRICAL RESULTS

3.1 Stock Markets

3.1.1 Brazil's Stock Market

The data we used in this study is as follows, for Brazil we took their market index, IBVOSEVA, which is the major indicator of the performance of the stocks that are traded in B3 and consists of the main companies in the capital market of Brazil. It is updated quarterly and accounts for 4 out of 5 trades in the Brazilian capital markets. (www.b3.com.br). Brazil is currently struggling with an uncertain economic recovery since its growth has mainly stopped or has been on a downward projector since 2012. The pandemic has certainly played a huge role, even though we're looking at initial announcements in this study, as the president of the country President Jair Bolsonaro's low regard for the virus had the country not take the threat of it seriously (Kaye et al., 2021), and the economy paid for it, from 9th of March to 13th of March, Brazil's stock market dropped by more the 15 percentage points. The volatility of Brazil's stock market has also been higher than the average historical rate which goes hand in hand with the volatility of their exchange rate. An even larger increase in volatility is noticed from the beginning until the middle of 2020, however it declines afterwards, although still being higher than pre-pandemic levels.

3.1.2 Russia's Stock Market

For Russia, we used MOEX Russia Index, which is the main benchmark for the stocks traded in the Russian market. Russia's stock market index has been facing some turbulence since the beginning of 2020 due to the unstable political environment, for example, Russia's Ruble sank in November due to the fall in oil prices, and the increasing tensions caused by the U.S. elections, these are additions to Russia's struggle against containing the spread of Covid in 2020, which collectively had caused the drop of investor's confidence in the Russian market (Foy, 2020).

3.1.3 India's Stock Market

India's Nifty50 was the market index we chose, as it is comprised of companies in the top 50 of the free-floating capital market and is utilized as a benchmark for portfolios and returns of mutual funds, the Nifty50 got hit the worst, on March 12th the Indian stock market saw its biggest daily decline in absolute terms, as risk sentiment of investors took a hit after the WHO declared the outbreak of COVID-19 a global pandemic (Sanyal, 2020).

3.1.4 China's Stock Market

As for China, we went with the Shanghai Stock Exchange Composite which is their main stock market index and tracks the performance of all the A and B shares that are on the STE (Shanghai Stock Exchange). The index has undergone many downfalls since the pandemic; however, this is especially true in early 2020 when close to 400 billion dollars' worth was taken out by investors from the benchmark index, this led to the drops in Shanghai-traded commodities as well (Zhou & Sin, 2022).

3.1.5 South Africa's Stock Market

South Africa has the JSE (Johannesburg Stock Exchange) which has around 473 companies included. For this study we used JSE Africa All Shares Index, which is a

market capitalization weighted index. Companies included in this index make up the top 99% of the market capitalization of all listed companies on the Johannesburg Stock Exchange.

3.1.6 Turkey's Stock Market

The index we use for Borsa Istanbul is the BIST-100 which is a free-floating market capitalization-weighted index. We decided to include Turkey in the BIST partly because of the common characteristics it shares with the BRICS, and partly because Turkey is intending on joining the BRICS and their application will be reviewed in the next BRICS summit in 2023 according to Teletrader.com.

3.2 Empirical Methodology and Data

3.2.1 Methodology: Event Study

Event studies are a great tool for estimating how the market responds to each event by calculating how much return the market has above or under the usual or the mean return (expected return). We call this abnormal return from which we can also draw conclusions on the efficiency of that market. If a market is efficient, it will react sharply and adjust itself quickly right after the public announcement of the event is made. If the event is leaked pre-event announcement, we will notice abnormal returns before the announcement. Using other assumptions of efficient market hypothesis, we could deduce whether a market is efficient or not based on the timeliness of the market reaction (Bowman, 1983).

This event research technique is sometimes considered as a technical approach focused mostly on econometrics and statistics. This technique also studies the financial effects of company-related events. Most of the research employing this technique is focused on finance. A key purpose is to assess the economic impact of various events on the

company as well as the shareholders. Furthermore, event studies can assist academics in better understanding the efficiency of financial markets.

3.2.2 The Event Study Periods and Data

In this study we utilized Microsoft Excel to perform the empirical analysis, and our data was retrieved from www.finance.yahoo.com. The data includes the major market indices of the six countries of our study which is the São Paulo Stock Exchange (IBOVESPA) for Brazil, the Moscow Exchange (MOEX) for Russia, and the National Stock Exchange of India which has NIFTY50 as its main index for India. China has the Shanghai Stock Exchange Composite Index (SSE Composite Index) which is on the Shanghai Stock Exchange. For South Africa, it is the Johannesburg Stock Exchange (JSE) which uses the FTSE/JSE Africa All Shares Index as its stock market index. Lastly, Turkey has the Borsa Istanbul stock exchange which has BIST-100 as its main stock market index.

In this study we have an estimation window of 120 trading days, and 40 days for each event window. Following the structure of MacKinlay (1997), our dates vary from country to country depending on when the first case was announced in each country. For example, our data for Brazil starts from 1st of August and for Russia it's 7th of October. Some events may have only 21 trading days considered for their event window; this is due to the previous event being too close to the date of the next event. Figure 1 shows the timeline of our event study, where the axis shows the number of days relevant to each event, the first zero is the initial COVID-19 surge, the next 0 is the delta variant, and the last zero is the omicron variant. The event window is 20 days before and after each event for which we are testing for statistically significant abnormal returns, and the estimation window is our frame of reference for comparing the returns of the event windows to, it can be referred to as "normal" days where our

event should not have influenced the returns in that period therefore providing us an unbiased view.

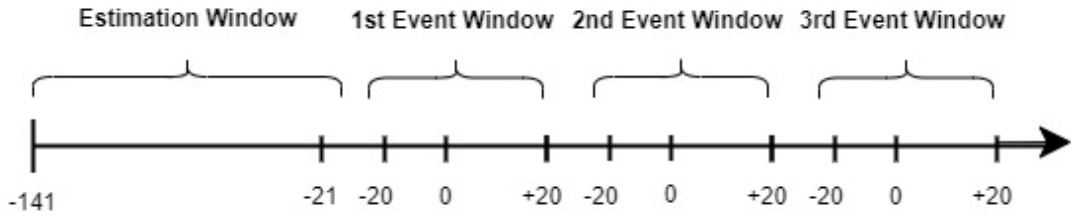

Figure 1: Event study timeline

3.2.3 Estimating the Abnormal Returns and Testing Statistical Significance

To calculate the mean adjusted AR, we utilize the following formula:

$$AR_{i,t} = \left[\frac{P_{i,t}-P_{i,t-1}}{P_{i,t-1}}\right] - \left[\frac{1}{120} \times \sum_{-21}^{-140} R_{i,t}\right] \quad (1)$$

where $AR_{i,t}$ is the mean adjusted abnormal return of the index I on day t; $P_{i,t}$ shows the index adjusted closing price on day t, and consequently $P_{i,t-1}$ shows the adjusted closing price of the previous day. To calculate the mean adjusted model of our estimation window, we use the sum of index returns, represented by $R_{i,t}$, divided by 120, which is the number of trading days during our estimation window.

To derive the statistical significance of our results, we perform a t-statistic test for each AR using the formula suggested by Patell (1976). This is done using the following formula:

$$t - statistic\ for\ AR\ on\ index\ i\ on\ day\ t = \frac{AR_{i,t}}{\hat{\sigma}_{\varepsilon_1}} \quad (2)$$

where $\hat{\sigma}_{\varepsilon_1}$ measures the standard deviation (STD) of our abnormal returns in the period of the estimation window. Our null hypothesis of no abormal return (i.e., no market

reaction) is rejected if the result of our t-test is above the previously set confidence intervals at 90%, 95%, and 99% levels.

Next, the cumulative abnormal return (CAR) is calculated to find the cumulative AR of multiple trading days. This is done through the following equation:

$$CAR_i(t_x, t_y) = \sum_{t=t_x}^{t_y} AR_{i,t_{y-x}} \quad (3)$$

where $CAR_i(t_x, t_y)$ represents the cumulative abnormal return of day t_x until day t_y

Like the t-test for AR, we also perform a t-test for our CARs using the following equation:

$$tt - statistic\ for\ CAR\ from\ day\ t_x\ until\ day\ t_y\ = \frac{AR_{i,t_{y-x}}}{\sqrt{T} \times \hat{\sigma}_{AR_i}} \quad (4)$$

where $\hat{\sigma}_{AR_i}$ represents the STD of the abnormal return in the period of our estimation window, and $\sqrt{T}$ is the length of our event period ($T = t_y - t_x + 1$).

3.3 Event Study Results

In this section, we go over our empirical results. The first announcement of cases in Brazil was on 25th February, although the impact was seen on 26th February as it is the first trading day after the announcement (Melo et al., 2020). Although China had confirmed cases before 20th of January 2020, that was the day that Nanshan, an NHFC employee in China, said in his first interview about the outbreak that the new coronavirus could spread to humans. After the interview, information about the epidemic caught the public's attention and appeared in the print and electronic media around the world. Therefore, in this study, January 20, 2020, was selected as the date on which the news about the virus first appeared in the media in China (Singh et al., 2020). India had their first confirmed case reported on 30th of January (Andrews et al., 2020); Russia had their first two cases confirmed on 31st January (Stepanov &

Komendantova, 2022); South Africa's first case announcement came on 5th of March (Giandhari et al., 2020), and lastly, Turkeys first case announcement was on 11th of March (Zorlu, 2022).

The first announcement for the first case of the Delta variant for Brazil came on 20th March 2021 in the state of Maranhão when six crew members anchored off its coast (Barbosa, 2021). For China, the announcement came on 22nd of June 2021 (Rai, 2021). Russia had their first delta case announced on 21st of October 2021 (Auyezov, 2021). For India, they had their first case of delta traced back to early October of 2020. However, the first announcement comes from WHO which officially announced the variant on May 31st of 2021. For South Africa, the first announcement came on 26th of June 2021 (Winning, 2021). Lastly, Turkey's first announcement on the Delta variant came on June 20th (Archyworldys, 2021).

The first announcement of the Omicron in Brazil came on 30th of November (Fonseca & Eisenhammer, 2021); for Russia, it was on the 6th of December (Choi, 2021); India's first Omicron announcement came on 2nd of December (Mitra & Monnappa, 2021). China had their first case announcement on 13th of December (Hindustan News Hub, 2021), South Africa's came on 25th of November, where it was first detected (Miao, 2022). Lastly, Turkey's first Omicron announcement came on 11th of December (Donmez, 2021).

We can refer to Table 2 to see the days considered for the estimation period and event period of each event and the stock market, and each individual market's mean adjusted

model and standard deviation during their respective estimation period and event period.

Table 2. Respective markets' mean adjusted mean and standard deviation prior and during the consecutive events

Indices (B.R.I.C.T)	No. of Trading Days	Event Group's Mean Adjusted Model (%)	Event Group's Std. Dev. (%)
Part A: Pre-event Period (Estimation Period), 140 days prior to the event			
IBOVESPA	121	0.128%	1.040%
MOEX	121	0.067%	0.726%
Nifty50	121	0.057%	0.956%
SSE Composite Index	121	0.014%	0.791%
JSE	121	0.021%	1.429%
BIST 100	121	0.196%	1.212%
Part B: During the initial Covid event period			
IBOVESPA	21	-1.284%	4.150%
MOEX	21	-0.088%	0.869%
Nifty50	21	-0.568%	5.456%
SSE Composite Index	21	-0.270%	1.988%
JSE	21	0.105%	1.428%
BIST 100	21	-1.128%	3.380%
Part C: During Delta variant event period			
IBOVESPA	21	0.408%	0.945%
MOEX	21	0.032%	1.745%
Nifty50	21	-0.091%	1.378%
SSE Composite Index	21	0.220%	0.766%
JSE	21	-0.310%	1.316%
BIST 100	21	-0.132%	0.891%

Part D: During Omicron variant event period			
IBOVESPA	21	0.031%	1.535%
MOEX	21	-0.410%	2.032%
Nifty50	21	-0.196%	1.167%
SSE Composite Index	21	0.131%	0.507%
JSE	21	0.489%	1.763%
BIST 100	21	0.375%	3.553%

We observe that all BRIC-T countries had their stock market standard deviation increase dramatically, which is a sign of increased panic and higher perception of risk in the markets. Additionally, all the adjusted mean returns turned negative which further suggests that people deemed the markets to be unsafe during the first Covid variant's announcement. The stock markets' standard deviations decreased during the Delta's first case event window suggesting that people had gotten more adapted to the announcement and thus, their perception of market risk not altering as strongly. However, it is still not as low as it was in the pre-covid era. Omicron's first case announcement seemed to again increase the risk perception of Brazil, Russia, and especially Turkish investors' perception of the market risk.

Table 3 shows the day of the event when the news of the first coronavirus patient of each variant was officially announced. Brazil was the hardest hit by the initial Covid virus announcement while Turkey had the worst reaction one day after the event. For Delta variant, South Africa's stock market reacted the worst but it recovered slightly the next day with a positive abnormal return. For Omicron, Russia was the worst affected event though it reacted positively the following day.

Table 3. Abnormal returns on Day 0 and 1

Index	Event day	A day after the event day
Original Covid Variant event		
IBOVESPA	-0.0713***	-0.0271***
MOEX	-0.0109	-0.0026
Nifty50	0.0657***	0.0383***
SSE Composite Index	0.0065	-0.0142*
JSE	0.0033	0.0014
BIST 100	-0.0029	-0.0745***
Delta Variant event		
IBOVESPA	-0.0008	-0.0022
MOEX	-0.0157**	0.0336***
Nifty50	-0.0110	0.0115
SSE Composite Index	-0.0024	0.0039
JSE	-0.0380***	0.0001
BIST 100	0.0102	0.0009
Omicron Variant event		
IBOVESPA	-0.0100	-0.0125
MOEX	-0.0270***	0.0159**
Nifty50	0.0131	-0.0123
SSE Composite Index	0.0018	0.0009
JSE	-0.0081	0.0170
BIST 100	0.0163	-0.0015

*Note:** statistically significant at 10% level; ** statistically significant at 5% level; *** statistically significant at 1% level

Table 4. Cumulative Abnormal Returns in the event window and the pre-event period

Index	CAR (-20,-1)	p-value	Significant?	CAR (-10,-1)	p-value	Significant?	CAR (-5,-1)	p-value	Significant?
Original Covid surge event									
IBOVESPA	0.064	0.169	No	0.013	0.697	No	0.012	0.599	No
MOEX	0.006	0.851	No	0.022	0.345	No	0.014	0.406	No
Nifty50	0.404	0.000***	Yes	0.277	0.000***	Yes	0.129	0.000***	Yes
SSE	0.017	0.636	No	0.004	0.875	No	0.006	0.731	No
BIST 100	0.204	0.000***	Yes	0.139	0.000***	Yes	0.103	0.000***	Yes
	CAR(0,1)	**p-value**	**Significant?**	**CAR(0,10)**	**p-value**	**Significant?**	**CAR(0,20)**	**p-value**	**Significant?**
IBOVESPA	0.098	0.191	No	0.284	0.000***	Yes	0.377	0.000***	Yes
MOEX	0.014	0.191	No	0.011	0.651	No	0.128	0.000***	Yes
Nifty50	0.104	0.000***	Yes	0.146	0.000***	Yes	0.184	0.000***	Yes
SSE	0.008	0.488	No	0.056	0.036**	Yes	0.019	0.601	No
JSE	0.005	0.815	No	0.025	0.605	No	0.005	0.939	No
BIST 100	0.077	0.000***	Yes	0.139	0.001***	Yes	0.112	0.047**	Yes
Delta Variant event									
	CAR (-20,-1)	**p-value**	**Significant?**	**CAR (-10,-1)**	**p-value**	**Significant?**	**CAR (-5,-1)**	**p-value**	**Significant?**
IBOVESPA	0.047	0.077*	Yes	0.039	0.024**	Yes	0.040	0.001***	Yes
MOEX	0.107	0.273	No	0.043	0.045**	Yes	0.042	0.010**	Yes
Nifty50	0.012	0.787	No	0.011	0.729	No	0.005	0.811	No
SSE	0.019	0.553	No	0.014	0.498	No	0.005	0.670	No
JSE	0.075	0.241	No	0.039	0.393	No	0.039	0.220	No
BIST 100	0.067	0.218	No	0.038	0.330	No	0.029	0.286	No
	CAR(0,1)	**p-value**	**Significant?**	**CAR(0,10)**	**p-value**	**Significant?**	**CAR(0,20)**	**p-value**	**Significant?**
IBOVESPA	0.033	0.000***	Yes	0.071	0.353	No	0.003	0.141	No
MOEX	0.018	0.001***	Yes	0.035	0.037*	Yes	0.062	0.021**	Yes
Nifty50	0.000	0.972	No	0.021	0.516	No	0.025	0.574	No
SSE	0.012	0.567	No	0.045	0.417	No	0.044	0.178	No

JSE	-0.038	0.063*	Yes	-0.031	0.516	No	-0.057	0.387	No
BIST 100	0.002	0.907	No	0.037	0.359	No	0.036	0.513	No
Omicron Variant event									
	CAR (-20,-1)	**p-value**	**Significant?**	**CAR (-10,-1)**	**p-value**	**Significant?**	**CAR (-5,-1)**	**p-value**	**Significant?**
IBOVESPA	-0.051	0.272	No	-0.045	0.172	No	0.001	0.960	No
MOEX	-0.076	0.021**	Yes	-0.031	0.180	No	0.023	0.151	No
Nifty50	-0.054	0.210	No	-0.052	0.086*	Yes	-0.017	0.437	No
SSE	0.037	0.357	No	0.031	0.282	No	0.019	0.379	No
JSE	-0.036	0.571	No	0.041	0.363	No	-0.029	0.370	No
BIST 100	0.154	0.005***	Yes	0.091	0.019**	Yes	0.028	0.311	No
	CAR(0,1)	**p-value**	**Significant?**	**CAR(0,10)**	**p-value**	**Significant?**	**CAR(0,20)**	**p-value**	**Significant?**
IBOVESPA	-0.022	0.129	No	0.025	0.475	No	-0.013	0.787	No
MOEX	-0.011	0.282	No	-0.069	0.005***	Yes	-0.021	0.524	No
Nifty50	0.001	0.956	No	-0.001	0.977	No	-0.009	0.843	No
SSE	-0.006	0.888	No	-0.011	0.564	No	-0.022	0.411	No
JSE	0.009	0.660	No	0.057	0.231	No	0.064	0.327	No
BIST 100	-0.024	0.159	No	-0.107	0.009***	Yes	-0.081	0.147	No

0*ote:** statistically significant at 10% level; ** statistically significant at 5% level;
*** statistically significant at 1% level

Table 4 shows multiple CARs before the event and after the event with their t-test and significance. In the following sections, we discuss our findings for each country.

3.3.1 Results from Brazil's Stock Market Index

Referring to Table 4, we see that Brazil was negatively affected by the initial surge of COVID-19 from day -20 to day -1 prior to the event but was not statistically affected from day -10 to -1, and day -5 to -1. During the post event period, we can see that Brazil had negative CARs in every range of periods, escalating as the ranges increased; -0.1 return (not statistically significant) at the event day until the next day, -0.28 statistically significant return from the event day until 10 days later, and CAR of -0.38 statistically significant return from the event day until 20 days later. We can observe from the same table that Brazil had better pre-event CARs for the Delta variant event with all CAR ranges returning statistically significant positive values. Same goes for the post event CAR, Brazil's stock market had statistically significant positive CAR from the event day until the next day (CAR(0,1)). However, for the Omicron variant, we did not find any statistically significant market reaction in any of the CAR ranges; pre and post event.

3.3.2 Results from China's Stock Market Index

China's SSE had no negative statistically significant reaction during the pre-event period of the initial COVID-19 surge. However, it had a statistically significant negative reaction in the post-event window as shown by CAR of the event day until 10 days later (CAR(0,10)). During the Delta variant event, China's SSE had no statistically significant reaction in the pre-event period and in the post-event period. It did not have any statistically significant reaction in the pre-event and post-event period of the Omicron variant event as well.

3.3.3 Results from India's Stock Market Index

For the original covid surge event, India's Nifty50 had statistically significant negative reactions with a CAR of -0.40 from 20 days prior to the event until 1 day prior to the event; 10 days prior to the event until 1 day prior to the event had a CAR of -0.28, and there was a CAR of -0.13 from 5 days until the event to 1 day until the event. For the post-event period from day 0 until day 1, there is a statistically significant CAR of 0.1, and a statistically significant CAR of 0.15 from the event day until 10 days after the event, and a statistically significant CAR of 0.18 from the event day until 20 days after the event. Nifty50 had no statistically significant CARs in the pre-event period and in the post-event periods for both Delta and Omicron variants.

3.3.4 Results from Russia's Stock Market Index

In the case of Russia, referring back to Table 4, during the initial surge of COVID-19, we can see that there is no significant CAR during the pre-event, and the only statistically significant CAR post-event was from the event day until 20 days after the event having a CAR of -0.13. During the Delta variant event, Russia's CAR from -20 to -1 is statistically insignificant, but the rest of the pre-event CARs, namely CAR (-10, -1) and CAR (-5, -1), are statistically significant and negative, both being -0.04. Lastly, during the Omicron variant event, Russia started off with a statistically significant negative CAR from 20 days prior to the event until 1 day prior, 10 and 5 days prior until 1 day prior to the event saw no statistically significant CARs. During the post-event window, we see statistically significant negative CARs from event day until 10 days after the event of -0.07.

3.3.5 Results from South Africa's Stock Market Index

In Table 4, we can see that South Africa did not a statistically significant and negative during any pre-event and post-event window for all three events with the exception of CAR(0,-1) of the delta variant which had a negative CAR of -0.038.

3.3.6 Results from Turkey's Stock Market Index

Turkey's stock market index, BIST 100, had statistically significant and negative reactions during all the CAR ranges in the pre-event window; -0.20 for CAR (-20, -1), -0.14 for CAR (-10, -1), and -0.10 for CAR (-5, -1). During the post-event period, the CARs remain negative and statistically significant throughout all the ranges. CAR (0, 1), CAR (0, 10), and CAR (0, 20) have a cumulative abnormal return of -0.08, - 0.14, and -0.11 respectively.

During the Delta variant event, Turkey's BIST100 had no statistically significant CARs in the pre-event period and in the post-event period. During the Omicron variant event, BIST100 had statistically significant positive reactions in the pre-event window in the following CARs: CAR (-20, -1) and CAR (-10, -1). However, in the post-event window, we saw a statistically significant negative CAR of -0.11 in CAR (0, 10).

Chapter 4

CONCLUSION

In conclusion we investigated the stock market reactions to different variants of concerns and the first case announcement of Covid-19 in BRICS-T countries and found that with the initial covid surge, all countries with the exception of South Africa and India, had statistically significant negative abnormal returns. In the cumulative abnormal return from day 0 to day 20 (CAR(0,20)), we found Brazil, Russia, and Turkey to be significantly negatively affected by the first case announcement.

In the case of the Delta variant, only South Africa's stock index, JSE, showed a statistically significant negative abnormal return, which was in the CAR (0,1). Except for Russia and Turkey, Omicron's first case announcement did not statistically affect the stock markets of these countries. In the case of Russia and Turkey, the effect of the announcement only appeared once for the cumulative abnormal return from day 0 to day 10 (CAR(0,10)) where we found statistically significant negative abnormal returns.

The trend that we see in our results is that the effect of the announcements are not immediate and take a while for the market to react to the announcements. Besides, except for the initial surge, the variants had much less statistically significant negative values meaning announcements of first cases of new variants do not negatively affect

the stock market in the cases of Brazil, Russia, India, China, and Turkey for the case of delta variant, and Brazil, India, China, and South Africa.

We recommend other researchers to test other measures to test the effect on the stock market such as death counts and date of vaccine release in the country, and the correlation between the dependency of the country on tourism and their stock market reaction.

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