Bhaskar Bagchi
Susmita Chatterjee
Raktim Ghosh
Dhrubaranjan Dandapat

Coronavirus Outbreak and the Great Lockdown

Impact on Oil Prices and Major Stock Markets Across the Globe

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Bhaskar Bagchi
Department of Commerce
University of Gour Banga
Malda, West Bengal, India

Susmita Chatterjee
Department of Economics
Maharaja Manindra Chandra College
Kolkata, West Bengal, India

Raktim Ghosh
Department of Commerce
University of Gour Banga
Malda, West Bengal, India

Dhrubaranjan Dandapat
Department of Commerce
University of Calcutta
Kolkata, West Bengal, India

To The Feet of
Lord Venkateswara Swamy

In Loving Memory of
Late Smt. Nihar Bagchi
(April 26, 1941–July 30, 2020)
Mother of Dr. Bhaskar Bagchi

&
All the COVID-19 Warriors World over

Acknowledgements

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About the Authors

Dr. Bhaskar Bagchi works as an Associate Professor in the Department of Commerce, University of Gour Banga, Malda, West Bengal, India. He has teaching and research experience of more than eighteen years and is an active reviewer of many reputed international journals. He has published books on finance and has several publications in some of the leading finance journals of the world. His areas of interests include corporate finance, capital markets and financial econometrics.

Dr. Susmita Chatterjee is currently an Assistant Professor of Economics in the Department at the Maharaja Manindra Chandra College, Kolkata (affiliated to the University of Calcutta) and a Visiting Professor at the Department of Commerce of the university for supervising doctoral students. She graduated from Lady Brabourne College and completed her M.Sc. in Economics at Calcutta University through Presidency College, and later received her M.Phil. from Calcutta University, from where she also obtained her PhD. Before joining the university, she was pursuing postdoctoral research at the Indian Institute of Management Calcutta. She has published a number of papers, book chapters and a books with leading publishers such as Springer, Emerald, Sage, and Palgrave Macmillan. Her research interest is in industrial organisation, applied microeconomics, applied development economics.

Raktim Ghosh is presently pursuing his PhD research in the Department of Commerce, University of Gour Banga. He is also serving as a guest faculty in the Department of Commerce, Maharaja Srischandra College. He graduated from Heramba Chandra College and completed his M.com from the Department of Commerce, University of Calcutta. He also pursued M.Phil in Commerce from the University of Calcutta. His research interest area includes capital market, mutual funds, stress, macro economic developments and other contemporary issues in the subject.

Dr. Dhrubaranjan Dandapat is a Professor in the Department of Commerce, University of Calcutta and the Honorary Secretary of Indian Accounting Association Research Foundation (IAARF). Formerly he was Dean of the Faculty of Commerce, Social Welfare and Business Management, University of Calcutta and also the Director of Calcutta University – Calcutta Stock Exchange Centre for Excellence in Financial Markets (CU-CSE, CEFM). He has successfully supervised many PhD scholars. Being a teacher and researcher of international repute he has several international publications and has attended and chaired sessions in numerous conferences in India and abroad.

Abbreviations

AIDS	Acquired immune deficiency syndrome
ARCH	Autoregressive conditional heteroscedasticity
ASR	Adult survival rates
BOLT	BSE online trading
BSE SENSEX	Bombay Stock Exchange Sensitive Index
CAC 40	CotationAssistee en Continu
CDC	Centre for Disease Control and Prevention
COVID-19	Coronavirus disease
DAX 30	Deutscher Aktien *Index* 30
EGARCH	Exponential generalized autoregressive conditional heteroscedasticity
ETF	Exchange-traded fund
FTSE 100	Financial Time Stock Exchange 100
GARCH	Generalized autoregressive conditional heteroscedasticity
GDP	Gross domestic product
GJR	Glosten, Jagannathan and Runkle
HIV	Human immunodeficiency virus
IEA	International Energy Agency
IMF	International Monetary Fund
IT	Information Technology
JIT	Just-in-time
JSE	Johannesburg Stock Exchange
KOSPI	Korea Composite Stock Price Index
MERS	Middle East respiratory syndrome
NASDAQ	National Association of Securities Dealers Automated Quotations
NSE	National Stock Exchange
NYMEX	New York Mercantile Exchange
NYSE	New York Stock Exchange
OECD	Organization for Economic Cooperation and Development
OTCEI	Over-The-Counter Exchange of India

OPEC	Organization of the Petroleum Exporting Countries
S&P	Standard and Poor
SARS	Severe acute respiratory syndrome
SEBI	Securities and Exchange Board of India
SSE	Shanghai Stock Exchange
TARCH	Threshold autoregressive conditional heteroscedasticity
TSE	Taiwan Stock Exchange
TSX	Toronto Stock Exchange
UNCTAD	United Nations Conference on Trade and Development
USD	United States Dollar
WHO	World Health Organization
WTI	West Texas Intermediate

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Chapter 1
Introduction

Coronavirus is creating a dangerous time for markets, panic is just starting. This disease is contagious even before it shows obvious symptoms. So, it's going to be harder to quarantine people in this epidemic. That's the narrative, and we haven't gotten very far into it yet. So, the potential for market disruption because of a scary narrative is quite high.

—*Robert James Shriller,*

Nobel Memorial Prize Winner in Economic Sciences, 2013

The outbreak of novel Coronavirus (henceforth termed as COVID-19 in this study) has changed the world dramatically within a span of just 4–5 months, and the human beings are now confronted with a harsh reality of their survival like never before. More than twenty three million people across the globe have already been infected with the disease with casualties of more than eight lakhs and still sharply increasing each and every day, where exponential growth of contamination means 100 infected individuals with COVID-19 create another 10,000 within a span of just few days.

The International Monetary Fund (IMF) has termed this crisis as unique and unprecedented like never before. The aftermath of this crisis is enormous and hefty with loss associated with this health crisis, and correlated inhibition procedures possibly dwarfs the damages that triggered the global financial crisis mainly because of the severity and the uncertainty about the duration of this crisis. Moreover, in present situation, it is quite difficult for the policymakers to suggest and implement economic policy because of the volume of the crisis thus making implementation of containment measures and stimulating activity further challenging particularly for the sectors like food and beverages, fashion and entertainment, travel and tourism, automobiles and technology or even iron ore and other base metals that have been most affected.

In January 2020, the outbreak of COVID-19 forced the Chinese government to issue the largest quarantine order in human history, affecting an estimated 45 million people. To arrest the pandemic, United States, Canada, France, Italy, Spain, United Kingdom, Germany, Iran, India and several other nations follow the same path. Now, within just a few months, global cases of the COVID-19 confirmed patients (as of
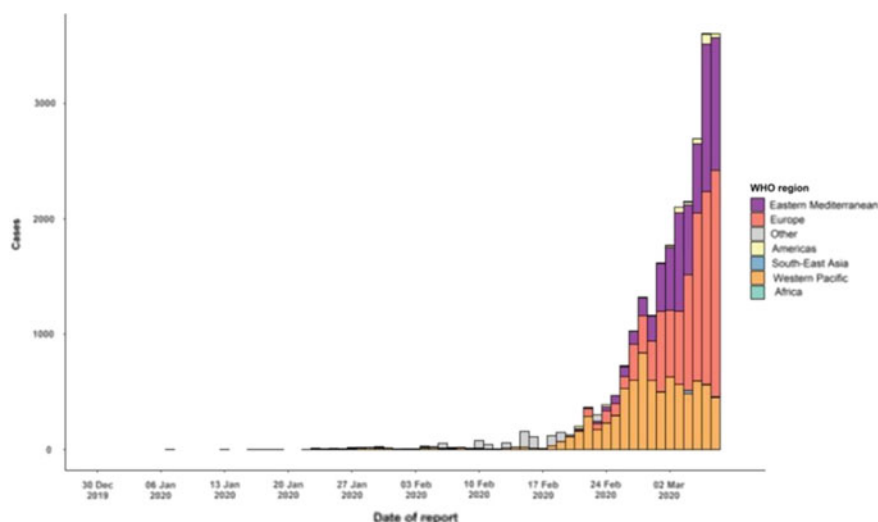
Exhibit 1.1 Epidemic curve of COVID-19 outside China (as on 8 March 2020). *Image* World Health Organization

June 12) have reached 7,390,702 with 417,731 deaths (World Health Organization) spreading across 189 nations. Number of countries has closed schools, institutions, offices, shopping malls including theatres, clubs, restaurants and pubs and cancelled mass gatherings in order to arrest the transmission. Operations of international flights in several countries have also been temporarily suspended. Markets have plunged on account of uncertainties and qualms of another great recession driven by COVID-19. Restrictions on travels and isolations/quarantines are touching more than hundreds of millions of people, disturbing just-in-time (JIT) supply chains and causing trans- actions warnings across technology, automotive, consumer goods, pharmaceutical and other industries throughout the world (Exhibit 1.1).

The report published by World Economic Forum in 2020 cited estimations of different economists' that the present COVID-19 outbreak would be a reason for average yearly economic losses of about 0.7% of global GDP in the impending years, which is regarded as a risk analogous in gauge to that of climate change. The possible monetary losses from communicable virus outbreaks are enormous, as recommended by current proceedings. Globalization has motivated incredible development in both advanced and emerging countries, and the better liberty of migration of workforce and wealth has shaped more and more codependent economies. Although this arrange- ment may be advantageous for growth and expansion, but simultaneously, it has also augmented the dangers postured by communicable virus outbreaks, with undulations and waves far-flung spreading (World Economic Forum 2020).

Latest World Bank assessment recommends that merely 39% of the financial damages from epidemics are related with impact on sick persons. Reasonably, the majority of the expenses are the outcome from the change of behaviour and conduct
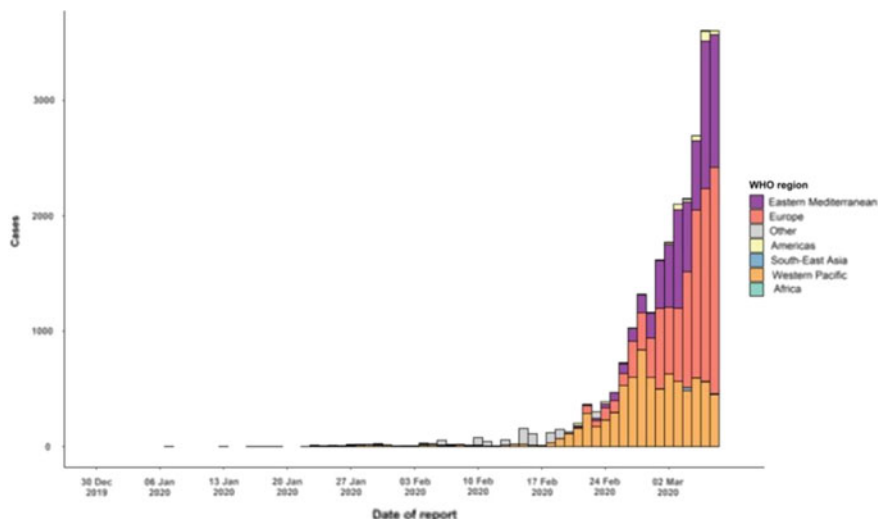
Exhibit 1.1 (continued)

of the healthy people, because these people wish to escape contamination. In 2015, the outbreak of MERS in South Korea results in infections of approximately 200 individuals and 38 fatalities, although, almost 17,000 individuals remained isolated at projected cost of USD 8.5 billion. In present economic situation, comparatively slight quantities of contaminations may possibly have immense economic impact which can spread far-off further than the actual origin of the outbreak (World Economic Forum 2020).

The danger we confront with COVID-19 is that after eruptions remain no longer in the news headings, pandemic willingness is often expatriate on financial plans and advanced programmes in support of additional instantaneous and noticeable urgencies, the world may face a new threat of sheer hunger and famine. Nonetheless, fresh outbreaks of diseases are definite to happen, and devoid of continuous care and financing, they are probably to incite panic yet again. A first-hand public–private agenda is required to comprehend and interconnect the impact of pandemics (World Economic Forum 2020).

Industries are preferably positioned to donate for preparations and responses to pandemic, thus possibly avoiding damages to their bottom lines and inhabitants in general. With the capability to convince their workers' attitude, along with through their refined communications organization and capability to foyer with governments, companies can be significant contributors in answering to the risk of occurrences of pandemics (World Economic Forum 2020).

The outbreak of COVID-19 is at present challenging universal collaboration amongst governments, global societies and the commercial organizations which ultimately prompted the establishment of the World Economic Forum's COVID Action

Platform. The international stage, the archetype, purposes to organize the corporate organizations for combined action, defend people's occupations and expedite commercial endurance and activate sustenance for the COVID-19 reaction. It has been generated with the funding of the World Health Organization and is exposed to all companies and manufacturing clusters, in addition to other interested parties, with a motto towards assimilating and apprising mutual action (World Economic Forum 2020).

We can recognize that the infection is scattering rapidly. The novel Coronavirus that began in Wuhan, China in December, 2019 has been rapidly dispersed all over the globe and there are now 23,518,343 confirmed cases of COVID-19 worldwide, with deaths of about 810,492 people (as on 25 August, 2020) (3.49 pm CEST). About 189 countries across six continents across the globe are being affected by COVID-19 making it an international felonious that urgently seeks global reaction. But, still we may further more expect that COVID-19 will be finally wiped out at the end of the day, but how fast it will materialize is beyond our speculation.

According to reports published by International Monetary Fund (IMF), nonetheless, this COVID-19 shockwave is to some extent uncommon as it disturbs important fundamentals of demand and demand equally. IMF is of the estimation that, supply may be interrupted owing to illness and death, nevertheless, also the repression determinations that confine movement and advanced charges of doing commercial occupations because of controlled resource chains and narrowing limits of credit. Demand will also plunge owing to escalation in security cost, repression struggles, and growing economic charges that decrease the capacity to spend more and all these things will tumble over through boundaries. Beneath any situation, inclusive development in 2020 will fall beneath previous year's growth rate. But, how long is very difficult to forecast and depends upon the spread of epidemic, nevertheless, too on the appropriateness and efficiency of our activities. This is predominantly perplexing for countries with fragile health infrastructures and reaction capability—that calls for worldwide synchronization device that can quicken the retrieval of demand and supply (https://blogs.imf.org/2020/03/04/potential-impact-of-the-coronavirus-epidemic-what-we-know-and-what-we-can-do/).

Reference

World Economic Forum (2020) https://www.weforum.org/events/world-economic-forum-annual-meeting-2020. Retrieved on 15th April, 2020

Chapter 2
Pandemics and Economic Crisis

The spread of the COVID-19 is causing worldwide downturn in economic activity and creating crisis in spheres of life. World has witnessed several crisis situations due to outbreak of epidemic, world wars and financial insurgency. The coronavirus outbreak has already had massive negative implications for the global economies with supply chain disruptions and disintegration across the globe. The positivity of globalization, enjoyed by all the nations, is now disappearing with restrain in movements of both people and product. The consumption of goods and services including energy is plunging throughout the globe.

Market volatility in the recent times can be well explained by factors like, rapid and easy information dissemination, interconnected economic system, government policy reactions. According to Baldwin (2020), "COVID-19 and the containment policies have directly and massively reduced the flow of labour to businesses. The result has been a sudden and massive reduction in the output of goods and services". The true facts are not censored as past so that information diffusion plays a potent role in stock market volatility. In Western countries, many services are predominantly based on face-to-face interactions. The adaptation of social distancing, voluntarily or by compulsion, brings down the demand for these services.

The COVID-19 pandemic has the potential to jeopardize macroeconomic conditions in both developed and developing economies. The effect will be heterogeneous across different sectors of the economy and people engaged therein. It is argued that redistribution from least vulnerable sectors to the most vulnerable ones can be done by developed economies and the impact will be mitigated (Heathcote et al. 2020). However, such redistributive policies may not be applicable to the developing counterparts and balancing act between live and livelihood will be more pronounced.

Emerging economies must get a route to combat the effect of this pandemic, with shrinking exports, remittances from West and Arabian countries and tight international credit environment. The governments of these economies cannot rely upon issuing debt as fiscal expansion will cause taxation pressure in the future.

5

Particularly developed countries can get cushioning effect through fiscal expansions without any considerations of fiscal deficit situations. Emerging countries like India has to care about the fiscal situations. Administrative expenses are shooting up with regard to tracing and tracking virus affected population at the time of lockdown situation and will remain high enough after the period of lockdown as well. The expenses will be high enough to smooth the supply chain within the country in a federal system. Revival of the small- and medium-sized enterprises will be also challenging. The pain of the market will be experienced by all the sectors, and it will be wise to give financial assistance to the enterprises with good profitability records that can revive on their own in future. The obvious role of the governments will be to identify very small and micro-entrepreneurs and support them with livelihood support may be with only provisioning of food for sustenance.

Box 1 The World may see another Great Depression

In the 2008 global financial crisis and the great depression, we have seen collapse of stock markets by more than 50%. The credit markets were also interrupted with massive bankruptcies and unemployment rates surged up. These consequences were taken place in phased manner. With the outbreak of this pandemic the economies, developed or emerging, all are experiencing all the awful macroeconomic and financial consequences within a month or less.

The major cause behind great depression was deficient demand. The present world is witnessing severe fall in all the constituents of aggregate demand-consumption, investment, exports. The economies are facing contraction which is like a vertical line, only sharp fall in both real and financial sectors.

In the great depression period, economic activities were halted as it is now in most of the countries with reduction in cumulative global output. Nonetheless, we can hope that the present pandemic situation across the globe will improve and also economic activities will recover and regain its pace from the last quarter of the year. The persistent depression and financial market distortions can be avoided with containment of the pandemic with proper health policies and research to combat the virus, sufficient fiscal and monetary responses and stopping of geopolitical turmoil.

Box 2 Financial Crises Faced by the World

Looking into the history, we can see that our mother earth had suffered from several financial crises situations, the first one was way back in eighteenth century, named as Credit Crisis of 1772. Originating in London, this crisis quickly extended to the rest of Europe. The over optimism of the British Empire and British banks had caused rapid credit expansion. The propaganda came to a sudden end on 8 June 1772, when Alexander Fordyce—one of the partners

of the British banking house Neal, James, Fordyce and Down—left for France to escape his debt repayments. The spread of the news had triggered a banking panic in England. The demand for instant cash withdrawals surged up. As a consequence of this crisis, Scotland, the Netherlands, other parts of Europe and the British American colonies were hardly affected. The economic repercussions of this crisis were also seen as a major contributing factor of the American Revolution.

The worst financial and economic disaster of the twentieth century was well known as the great depression. It was triggered by the crash of American stock market in 1929. The impact of the depression lasted almost 10 years with huge loss in income and output with record unemployment rates.

The Organization of the Petroleum Exporting Countries (OPEC) oil price shock began when member countries—primarily consisting of Arab nations—retaliated against the United States with respect to its arm support policies favouring to Israel during the Fourth Arab–Israeli War. OPEC countries declared an oil embargo, abruptly stopping oil exports to the United States and its allies. This caused price hike of oil. The world faced economic stagnation as well high inflation. This era of "stagflation" persisted for several years.

The Asian crisis originated in Thailand in 1997 and had contagion effect to the rest of East Asia and its trading partners. The massive inflow of capital from developed countries to the East Asian economies of Thailand, Indonesia, Malaysia, Singapore, Hong Kong and South Korea (known then as the "Asian tigers") had triggered lenient investment policies and overextension of credit with debt accumulation in those economies. In July 1997, the Thai government was compelled to abandon its fixed exchange rate against the U.S. dollar and float the Thai Baht. That started a wave of panic across Asian financial markets and quickly led to the outflow of dollars from the region. The panic devastated the markets and investors lost their faith on East Asian governments, and a worldwide financial meltdown began to spread. The International Monetary Fund stepped in with bailout packages.

The Great Recession of 2008 was the most severe financial crisis since the great depression, and it caused severe volatility in financial markets around the world. The housing bubble in the U.S. was the origin of the crisis, with collapse of Lehman Brothers (one of the biggest investment banks in the world). The crisis affected financial institutions and businesses, rescue was done through government bailouts with millions of job loss and economic downturn.

2.1 Brief History of Pandemics

Illness and diseases have crushed down human civilization ever since the most primitive days and shifting from agricultural societies to industrialized one further augmented the rapid spread of the epidemics with diseases like, malaria, tuberculosis, leprosy, influenza, smallpox and others which mainly broke out during the initial years of our human civilization. Now, we present here a timeline of some of the epidemics of our world that took place over time (Table 2.1).

Table 2.1 Timeline of historical pandemics

Epidemics	Year	Type	Fatalities
Antonine Plague	165–180	Either smallpox or measles	5 million
Japanese smallpox epidemic	735–737	Variola major virus	1 million
Plague of Justinian	541–542	Yersinia pestis bacteria	30–50 million
Black Death	1347–1351	Yersinia pestis bacteria	200 million
New World Smallpox Outbreak	1520–onwards	Variola major virus	56 million
Great Plague of London	1665	Yersinia pestis bacteria	100,000
Italian Plague	1629–1631	Yersinia pestis bacteria	1 million
Cholera Pandemics 1–6	1817–1923	V. Cholerae bacteria	1 million+
Third Plague	1885	Yersinia pestis bacteria	12 million (China and India)
Yellow Fever	Late 1800	Virus/mosquitoes	100,000–150,000 (US)
Russian Flu	1889–1890	H_2N_2 (avian origin)	1 million
Spanish Flu	1918–1919	H_1N_1 virus	40–50 million
Asian Flu	1957–1958	H_2N_2 virus	1,1 million
Hong Kong Flu	1968–1970	H_3N_2 virus	1 million
HIV/AIDS	1881–present	Virus/Chimpanzees	25–35 million
Swine Flu	2009–2010	H_1N_1 virus/pigs	200,000
SARS	2002–2003	Coronavirus/Bats, Civets	770
Ebola	2014–2016	Ebolavirus/Wild animals	11,000
MERS	2015–present	Coronavirus/Bats, Camels	850
COVID-19	2019–present	Coronavirus—unknown	417,731 (as on June, 12, 2020)

Sources https://www.weforum.org/agenda/2020/03/a-visual-history-of-pandemics/
https://www.visualcapitalist.com/history-of-pandemics-deadliest/

Box 3 Epidemics and Pandemics in World

The Plague of Galen or the Antonine Plague was an ancient pandemic started in 165 AD, affected Asia Minor, Egypt, Greece and Italy and is thought to have been either smallpox or measles, though the true cause is still unknown. The disease was expanded to Rome by soldiers returning from Mesopotamia unknowingly, they had spread a disease which would end up killing over 5 million people and devastating the Roman army.

The outbreak of the Plague ravaged Europe, Africa and Asia, between 1346 and 1353 with an estimated death toll between 75 and 200 million people. Originated in Asia, the Plague most likely entered other continents via the fleas living on the rats those lived aboard merchant ships. Ports were the perfect breeding ground for the rats and fleas, and thus, the dangerous bacterium flourished, devastating three continents in its wake.

The third major outbreak of Cholera in the nineteenth century lasted from 1852 to 1860. The Third Cholera Pandemic originated in India, spreading from the Ganges River Delta expanded through Asia, Europe, North America and Africa and ended with taking lives of over a million people.

The Sixth Cholera Pandemic originated in India where it killed over 800,000, before spreading to the Middle East, North Africa, Eastern Europe and Russia. The Sixth Cholera Pandemic was also the source of the last American outbreak of Cholera (1910–1911).

Between 1918 and 1920, a disturbingly deadly outbreak of influenza known as Spanish Flu broke across South Seas to North Pole, infecting over a third of the world's population. Of the 500 million people infected in the 1918 pandemic, the mortality rate was estimated at 10–20%, with up to 25 million deaths in the first 25 weeks alone. The flu's spread and lethality was triggered by the cramped conditions of soldiers and lack of immunity due to poor wartime nutrition because of the World War I.

Asian Flu was a pandemic outbreak of Influenza A of the H_2N_2 subtype that originated in China in 1956 and lasted until 1958. In its two-year spree, Asian Flu travelled from the Chinese province of Guizhou to Singapore, Hong Kong and the United States. Estimates for the death toll of the Asian Flu vary depending on the source, but the World Health Organization places the final tally at approximately 2 million deaths, 69,800 of those in the US alone.

First identified in Democratic Republic of the Congo in 1976, HIV/AIDS has truly proven itself as a global pandemic, killing more than 36 million people since 1981. Currently, there are between 31 and 35 million people living with HIV, the vast majority of those are in sub-Saharan Africa, where 5% of the population is infected, roughly 21 million people.

The 2009 swine flu pandemic was caused by a new strain of H_1N_1 that originated in Mexico in the spring of 2009 before spreading to the rest of the world. In one year, the virus infected as many as 1.4 billion people across the

globe and killed between 151,700 and 575,400 people, according to the Centre for Disease Control and Prevention (CDC).

The 2009 flu pandemic primarily affected children and young adults, and 80% of the deaths were in people younger than 65, the CDC reported. That was unusual, considering that most strains of flu viruses, including those that cause seasonal flu, cause the highest percentage of deaths in people ages 65 and older.

Ebola ravaged West Africa between 2014 and 2016, with 28,600 reported cases and 11,325 deaths. The first case to be reported was in Guinea in December 2013 and then the disease quickly spread to Liberia and Sierra Leone. The recent Zika epidemic in South America and Central America is still a threat to humanity.

Source Information gathered from Centre for Disease Control and Prevention Britanica Encyclopedia

Shelter-in-place policies reduce social contact and risks of interpersonal COVID-19 transmission. Though the economic consequences of these policies are substantial, local non-compliance creates public health risks and may cause regional spread. Understanding the drivers of what enhance or mitigate compliance is a first order public policy concern.

Clarifying these mechanisms provides actionable insights for policymakers and public health officials responding to the COVID-19 pandemic (Tables 2.2 and 2.3).

The new Bull Case assumes that China's draconian efforts continue to demonstrate their effectiveness, thereby allowing them to restart production and get their economy—at least the manufacturing part thereof—moving. Other countries manage to control, or significantly slow, the non-China case increases (currently 20% per day) and slows the spread of the disease. Global growth is negatively impacted by 0.5–0.75%—slightly more than SARS. Anxiety outside China increases, slowing global economies by a 0.75–1.25% annual rate, and both Europe and the U.S. enter mild recessions as consumer spending drops significantly and unemployment rises modestly. The equity markets are also struggling and likely to enter a bearish mode with the widening of credit spreads, lower interest rates and diminishing fed rate. Fiscal stimulus totals close to USD 3 trillion in US with rates, ramped up QE, and expanded lending facilities are announced to boost up the economy. An unparalleled contraction in Q2 has been noticed. The economy should rebound with all stimulus effects, but prolonged outbreak of pandemic and election-related uncertainty may have an adverse impact in the process of recovery. The South Korean economy appears to be under siege in Q2. Business sentiment is pessimistic and GDP contracting throughout the year. Although the virus seems to be largely under control domestically, a feeble global trading environment will increase the trade deficit. In United Kingdom, conditions have worsened in Q2, after the economy shrank in Q1. In April, retail sales contracted at a record-sharp pace and benefits claims skyrocketed. The risk of second wave and uncertainty over Brexit are key

challenges to economic growth. In Russia, the economic backdrop worsened severely in Q2, after growth slowed to 1.6% in Q1. Economic activity reportedly contracted by a quarter in April, amid restrained consumer demand, rising unemployment and plunging industrial output projection has been done about a sharp recession from Q2 2020 onwards as lockdown measures and low oil prices bang the economy. In Japan, the government doubled the size of its fiscal package to over USD 2 trillion, while the BOJ has announced a USD 280 billion business lending program and pledged unlimited asset purchases. Economic conditions were dire in Q2 as exports dived and consumer confidence sank. COVID-19 is set to hinder domestic activity

Table 2.2   Impact of pandemic on labour market and economic growth

Name of the pandemic	Impact on labour market	Impact on economic growth
1918 Influenza pandemic	A decrease in the supply of manufacturing workers that resulted from influenza mortalities would have had the initial effect of reducing manufacturing labour supply, increasing the marginal product of labour and capital per worker, and thus increasing real wages. In the short term, labour immobility across cities and states is likely to have prevented wage equalization across the states, no substitution from relatively more expensive labour to capital	Rise in per capita income due to mortalities
Asian Flu 1957–1958	Fall in supply of labour due to sickness and prophylactic absenteeism	The 1958 Eisenhower Recession and The 1957 Bear Market
Severe Acute Respiratory Syndrome (SARS) outbreak in 2002–03	Temporary unemployment in specific regions and services and retail sectors due to labour market institutions	Demand shock in service-related activities in specific regions and GDP loss and capital outflow from most affected countries
H_1N_1 2009	Decline in labour supply in Taiwan, Philippines (specific areas and particularly in poultry sector)	Decline in GDP in affected countries and global GDP as well
AIDS in Southern African Countries	Loss of workers and workdays Increase in gender inequality in workforce as women are more vulnerable than men Influx of child labour due to rise in number of orphans	Negative effects on per capita income growth and decline in human capital (Haacker 2002)

(continued)

Table 2.2 (continued)

Name of the pandemic	Impact on labour market	Impact on economic growth
COVID-19	International Labour Organization (ILO) estimated 10.5% job deterioration for the second quarter of 2020 due to COVID-19, meaning loss of 309 million full-time jobs. The previous quarterly estimate was 195 million, and the estimated unemployment rose by almost 60% by the mid of April 2020 ILO: International Labour Organization Monitor: COVID-19 and the world of work. Third edition https://www.ilo.org/wcmsp5/groups/public/—dgreports/—dcomm/documents/briefingnote/wcms_743146.pdf (2020) Accessed 30 May 2020	32% reduction in expenditures for retailing and services (China Wuhan District) per capita income is expected to downsize by 4.2% on average, with the most severe declination in the advanced economies by 6.5%. (IMF. World Economic Outlook, Chap. 1: The great lockdown. https://www.imf.org/en/Publications/WEO/Issues/2020/04/14/weo-April-2020 (2020) Accessed 27 may 2020)

Table 2.3 Economic growth (GDP, annual variation, in %)

Years	2020				2021			
Quarters	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Brazil	−1	−9.5	−6	−3.7	−0.9	8.3	4	2.7
China	−6.8	0.5	4.1	5.7	15.2	9	5.4	3.7
France	−5.4	−15.3	−8.8	−5.9	0.8	14	6.6	3.9
Germany	−1.9	−11.9	−7.3	−4.4	−0.9	11.5	6.6	4.8
India	2.5	−7.8	−2.9	0.5	3.2	14.4	8.7	6.6
Japan	−2.1	−8.4	−6.7	−3.6	−1.8	5.6	4.4	3.5
Mexico	−1.4	−12.9	−9.3	−6.3	−3.6	8.1	4.8	2.9
Russia	1.6	−8.1	−5.6	−3.4	−1.3	6.5	5.2	3.9
South Korea	1.3	−2.5	−1.6	−1.4	1	4.5	4.1	4
UK	−1.6	−15.4	−8.7	−5.6	−1.6	15.9	7.5	4.8
US	0.3	−10.6	−7	−5.1	−2.1	10.6	7.1	5.3

Source Focus Economics Corona Virus weekly update accessed on 7 June 2020

and hammer demand for Japanese exports this year, although fiscal and monetary policy stimulus should have cushioning effect. In India, total stimulus is around 10% of GDP according to the government, though direct fiscal support is limited, the economy will see sharper contraction this year. A recovery is projected from Q4 and beyond. The outlook in Germany appears bleak in Q2, after the economy shrank at a

decade-high pace in Q1, with continued deterioration in business conditions, while consumer sentiment remains negative. The economy witnessed a heavy contraction in Q2, with a recovery set to begin in end of the year. The country is in perpetual state of uncertainty while reopening. Roughly EUR 300 billion in government loan guarantees and EUR 110 billion in additional aid, including the deferral of tax and payroll charges, are used as stimulus in France. The scenario remains dim in Q2 of 2020 with sinking business and consumer demand. The output and employment levels continued to contract markedly. The Mexican government promises higher health and social spending but prioritizes austerity. Banxico cut its policy rate to 5.50% in mid-May. After contracting slightly in Q1, the economy is performing far worse in Q2 of 2020: In April, the manufacturing sector contracted sharply and exports plummeted. Projection of contraction through Q1 2021 has been done with the presence of domestic containment measures and recession in the U.S. (Focus Economics Corona Virus Weekly Surveys (www.focus-economics.com).

Box 4 Immediate Economic Impacts of 1918 Influenza Pandemic

The economic effects of pandemic are studied with intense importance as probability of future pandemic is positive. The greatest disadvantage of studying the economic effects of the pandemics is the lack of economic data. There are some academic studies that have looked at the economic effects of the pandemic using available data, and these studies are reviewed later. Given the general lack of economic data, however, a remaining source for information on (some) economic effects of the pandemic is print media. For example, Newspaper in the Eighth Federal Reserve District cities of Little Rock and Memphis were printed in the fall of 1918 was researched for information on the effects of the influenza pandemic in these cities.

- Industrial plants are running under a great handicap;
- Out of a total of about 400 men used in the transportation department of the Memphis Street Railway, 124 men were incapacitated;
- The Cumberland Telephone Co. reported more than a hundred operators absent from their posts. The telephone company asked that unnecessary calls be eliminated. "Tennessee Mines May Shut Down". The Commercial Appeal, Oct. 18, 1918, page 12;
- 50% decrease in production reported by coal mine operators;
- Mines throughout east Tennessee and southern Kentucky are on the verge of closing down owing to the epidemic that is raging through the mining camps.

Source Sidebar: Headlines from 1918.1918 Influenza Pandemic in Eighth District Newspapers Little Rock, Ark."How Influenza Affects Business." The Arkansas Gazette, Oct. 19, 1918, Page 4 http://www.nber.org/papers/w26866.pdf.

Reference

Baldwin R (2020) COVID, remobilisation and the 'stringency possibility corridor': Creating wealth while protecting health. VoxEU.org, 10 April

Chapter 3
Impact of COVID-19 on Global Economy

As the whole domain of our world struggles to encounter the COVID-19 pandemic, its effect on the global economy is increasing—with the OECD cautioning, the present pandemic poses the biggest threat to the international economy after great recession in 2008–2009. UNCTAD, the United Nation's Trade and Development Agency, already cautioned of a depression of global growth rate to below 2% in 2020, which may eventually rub out USD 1 trillion off the total worth of the global economy (https://news.un.org/en/story/2020/03/1059011). Richard Kozul–Wright, Director, Division on Globalization and Development Strategies, UNCTAD, commented— *"We envisage a slowdown in the global economy to under two per cent for this year, and that will probably cost in the order of USD 1 trillion, compared with what people were forecasting back in September 2019"*. On account of rising uncertainty regarding production and prices of crude oil, and by the way, the major stock indices collapsed above apprehensions regarding supply-chain disruptions that begun from China, Mr. Kozul–Wright also informed that some countries may likely to be left unharmed by the COVID-19 outbreak (https://news.un.org/en/story/2020/03/1059011) (Exhibit 3.1).

A recent poll conducted by the London School of Economics amongst the economists shows that about 51% assumed that the world is going to experience another major depression, even though the ongoing pandemic creates no further deaths. Merely 5% of the surveyed economists do not agree with this statement (http://blogs.lse.ac.uk/businessreview/2020/03/13). Most of the businesses the world over are operating with loss of revenue and interrupted supply line because of shutdown of factories in China. In order to arrest the pandemic, China enforced travel constraints and put the country under total lockdown. In order to arrest the rapid outspread of COVID-19, similar measures are being adopted by US, UK, European Union, India,
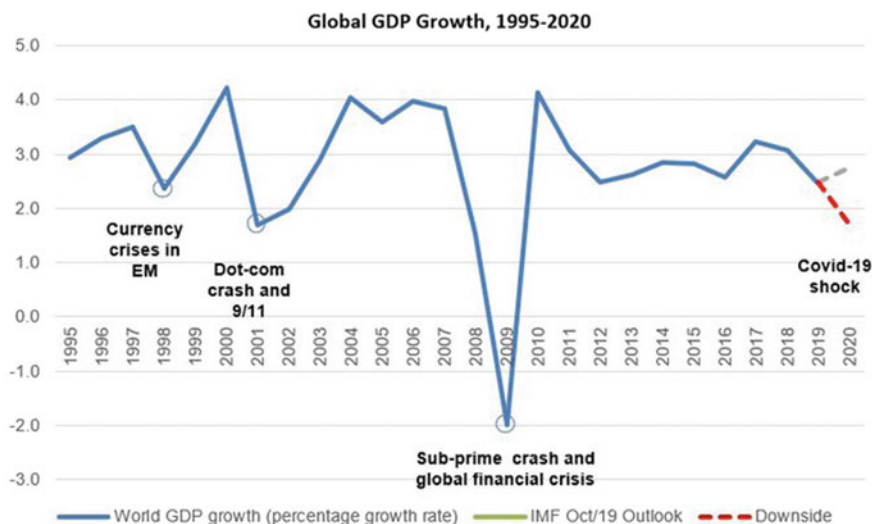
Exhibit 3.1   Global GDP growth, 1995–2020. *Sources* UNCTAD, March, 2020

including many other countries across the world (https://www.weforum.org/agenda/
2020/02/coronavirus-economic-effects-global-economy-trade-travel).

China being the world's second largest economy with GDP growth rate of more
than 6% in 2019 (National Bureau of Statistics, http://www.cnbc.com) suffered
a lot due to COVID-19 outbreak that massively hampers country's economic
growth which in turn also threatens global GDP growth rate for 2020. A group
of economists surveyed by Reuters during 3–5 March opines that this COVID-19
pandemic most likely to reduce China's GDP growth rate by 50% during the first
quarter of 2020 (http://de.reuters.com/article/china-economy-poll/). Rob Carnell,
Head, Asia-Pacific Research, ING clearly states that *"If you're in a city which
has been basically closed down or put (under) virtual house arrest, you're not
going to go out to the streets, you can't go to the cinema, the restaurants…with
all those sorts of things, economic activity will be substantially negatively affected".*
It is estimated that the economy of China is going to be further affected by the
decreased global demand for its different manufacturing products on account of
this pandemic that spreads around the world. A recent statistics (as on 16 March
2020) shows that during the month of January–February, 2020, the production in
factories in China plummetted sharply, which is the fastest during the last three
decades, which might be an indication of bigger economic recession in near future
(http://news.trust.org/item/20200316071843-1rb9t/). According to Zhang Yi, Chief
Economist, Zhonghai Shengrong Capital Management, the recent depressing data
regarding economic activities of China after the outbreak of COVID-19 suggests

severe global recession in near future which may be even greater than that of 2008 recession. He further described the present situation as *"Doomsday scenario"*, which may eventually affect the world economy with an estimated loss of USD 1 trillion, with sharp decline in crude oil prices acting as a catalyst. Moreover, it is too difficult to forecast the impact of COVID-19 pandemic on the world markets, as the investors are being gripped with a high sense of anxiety and fear which is as also as scary as the pandemic (https://www.weforum.org/agenda/2020/02/coronavirus-economic-effects-global-economy-trade-travel).

As per the report published by the International Monetary Fund (IMF) in World Economic Outlook in April 2020, the global economy in this year is going to confront with its horrible economic downturn ever since the "great depression" in 2008–2009 and likely to exceed even that extent which was experienced in 2008–2009. Most of the nations, whether advanced or emerging or less developed, have resorted to lock down their countries completely, which is even called as "The Great Lockdown" in order to combat COVID-19 pandemic is expected to intensely diminish the global growth rate. Although, IMF is optimistic about fractional recovery of the economy in the year 2021, but GDP level will probably persist beneath the previrus development, with substantial insecurity regarding the strength of the reverberation, and moreover, considerable shoddier outcomes may even be possible. If emerging and developing economies are even more rigorously affected, the pandemic and control procedures become lengthier, if pervasive damaging effects arise because of shutdown of firms and prolonged joblessness along with constricted economic situations continue, then the worst economic outcome can be a harsh reality (World Economic Outlook, April, 2020).

The COVID-19 pandemic is perpetrating extraordinary and increasing human budgets throughout the world for saving human lives and permitting healthcare arrangements to handle necessary quarantine, lockdowns and extensive closures in order to curb the spread of the disease. Therefore, health crisis is experiencing an austere effect on financial activities. Due to the outbreak of COVID-19 pandemic, the global economy is estimated to shrink harshly by (negative)—3% in 2020, which is quite shoddier than that of global meltdown in 2008–2009. In a standard situation, which undertakes that if the pandemic may disappear in the latter half of 2020 and inhibition pains can be slowly relaxed, then the international economy is estimated to rise by 5.8% in 2021 with the normalization of the worldwide economic activity (World Economic Outlook, April, 2020).

There is sheer ambiguity regarding the speculations of global growth. The economic outcome be determined by the issues that intermingle in techniques that are tough to forecast, comprising the path of the COVID-19 contagion, the strength and effectiveness of control struggles, the degree of disruptions in supply, the consequences of the histrionic compression of international financial markets, changes in

Coronavirus impact on global stock markets since the start of the outbreak. *Sources* International monetary fund blog-bloomberg, Chicago board options exchange and IMF staff calculations
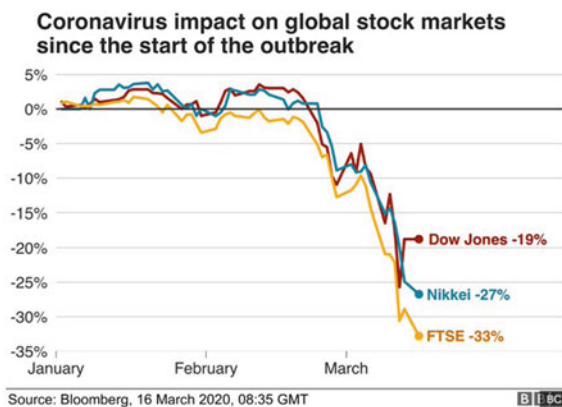
expenditure behaviours, communicative variations like people escaping large market-places and avoiding civic conveyances), assurance effects and unpredictable product costs. Numerous countries are being confronted with multi-layered disaster encompassing a health shock, national economic disturbances, plunging outward demand, funds flow setbacks and a downfall in product prices thus intensifying the threats of worst economic outcome (World Economic Outlook, April, 2020).

The COVID-19 pandemic varies distinctly in terms of its nature of the shock from earlier causes of recessions. Contaminations decrease supply of labour. Isolations, provincial lockdowns and social separation—that are indispensable to arrest spread of the disease (Ferguson et al. 2020)—restrain movement, with predominantly severe impacts on segments that depend on societal communications (like, entertainment, hospitality, travel and tourism). Closures of office and other workplaces interrupt supply chains and poorer efficiency. Dismissals, downsizings, reduction in salary, anxiety of contamination and sharp insecurity compel people to expend a lesser amount of, generating additional commercial cessations and loss of job. There is an effective shutdown of a noteworthy share of the economy. Expenditures in health care inevitably increases steeply far beyond the expectation. These national interruptions tumble above to swapping companions by means of business and international value chain relationships, accumulating to the total macroeconomic effects (World Economic Outlook, April, 2020) (Exhibit 3.2).

As a move to fight against this economic slowdown with simultaneous decline in oil prices, on 15 March 2020, central banks in Japan, Australia and New Zealand and US Federal Reserve reduce its significant interest rates to almost zero which is first time ever since 2008 global recession. Nevertheless, this coordinated effort remains unsuccessful to boost up the sentiments of the investors, when oil prices on 16 March further plunge below USD 25 per barrel (http://www.reuters.com/article/us-global-oil/). It is to be noted that China stands to be world's second largest oil importer only

Spike of uncertainty
A spike in option-implied volatility in equity
markets signals higher uncertainty about the
future.

(Equity volatility, standardized, since 2015)
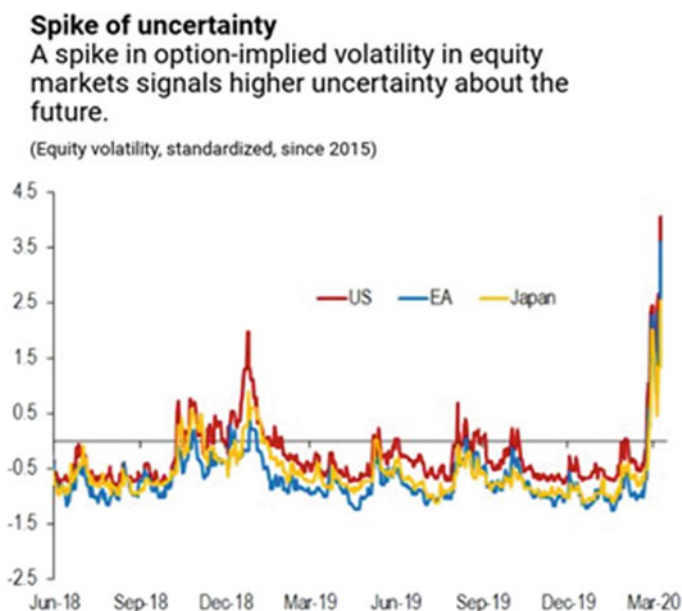
Exhibit 3.3   Spike of uncertainty. *Sources* International monetary fund blog-bloomberg, Chicago board options exchange and IMF staff calculations

next to United States according to International Energy Agency (IEA), which also forecast gloomy oil prices ahead, due to massive effect of COVID-19 pandemic on manufacturing and travel industries (https://www.weforum.org/agenda/2020/02/coronavirus-economic-effects-global-economy-trade-travel).

Various events related to uncertainty of global economy like stock market instability augmented in a large scale in various major economies round the globe. Major equity markets in countries like United States, UK, Japan, China, India and other countries that belong to G-20 including other emerging economies experienced sharp downslides, as the trade and businesses in most parts of the world came to standstill due to COVID-19 pandemic (https://blogs.imf.org/2020/03/11/monetary-and-financial-stability-during-the-coronavirus-outbreak/) (Exhibit 3.3).

Spread of credit has widened due to high-pitched uncertainty, generally through the markets as depositors are in a process of rearranging their assets from comparatively precarious to more secure ones. Emerging-market and high-return bonds are mainly affected due to these reallocation of assets, which in turn has sharply widened the spreads of emerging and frontier-market bonds denominated in U.S. dollars (https://blogs.imf.org/2020/03/11/monetary-and-financial-stability-during-the-coronavirus-outbreak/) (Exhibit 3.4).

Capital flight

Spreads of emerging- and frontier-market bonds have widened, indicating investors' declining appetite for riskier investments.

(US dollar bond spreads, basis points)

Exhibit 3.4 Capital flight. *Sources* International monetary fund blog-bloomberg, JP morgan chase, ICE bank of America and IMF staff calculations

Economic situation around the world is constricted particularly during last few weeks implying that enterprises are being confronted with greater capital costs, while they knock bond and equity markets. This unexpected harsh tightening of fiscal settings acts as a hindrance to the economy, as companies delay venture choices in addition to delay in individual consumption due to increasing financial insecurity (https://blogs.imf.org/2020/03/11/monetary-and-financial-stability-during-the-coronavirus-outbreak/) (Exhibit 3.5).

The severe shrinking of economic situations, alongside with opportunities of squat price rises, implies that financial course of action does play a vital character at this present occasion. The central banks in various countries may turn up fast in order to support for easiness of the tight financial conditions by means of cutting interest rates and liquidity, therefore avoiding a likely crisis in credit. Indeed, markets have been antedating antagonistic implification by central banks, which are shown by the severe drop in sovereign bond yields across different countries round the globe (https://blogs.imf.org/2020/03/11/monetary-and-financial-stability-during-the-coronavirus-outbreak/) (Exhibit 3.6).

Tightening underway
Financial conditions have tightened, spelling
problems for future economic growth.

(Financial conditions indices, standard deviations from mean)
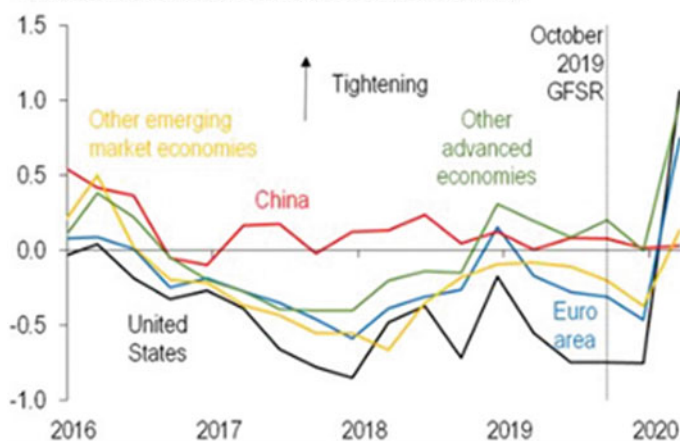
Exhibit 3.5   Tightening underway. *Sources* International monetary fund blog-bloomberg and IMF
staff calculations

Flight to safety
Government bond yields have dropped
sharply as investors readjust rate
expectations.

(Government bond yields)

Exhibit 3.6   Flight to safety. *Sources* International monetary fund blog-bloomberg and IMF staff
calculations

Falling prices
The sharp repricing of bank share prices
indicates investor worries about profitability.

(Bank equity prices, indexed to Jan 1)

Exhibit 3.7 Falling prices. *Sources* International monetary fund blog-bloomberg and IMF staff calculations

The harsh reduction in interest rates, along with mounting nervousness regarding the future of global economy furthermore increases anxiety amongst the stakeholders regarding banks' impending prospects. The stock prices of different banks experienced sharp decline, including their bond prices antici-pating substantial losses (https://blogs.imf.org/2020/03/11/monetary-and-financial-stability-during-the-coronavirus-outbreak/) (Exhibit 3.7).

Due to the advent of COVID-19, the financial condition of the globe is at stake leading to the spectacular corrosion from the economic viewpoint which caused one year ahead distribution of global expansion extraordinarily to the left. This has high-lighted the noteworthy hike in downside risks in growth and constancy in financial situation. There is now 5% likelihood (an event that happens once every 20 years) that global growth will drop below—7.4% in comparison with the threshold which was above 2.6% in October 2019 (Exhibit 3.8).

However, budding markets have experienced the sharpest portfolio flow reversal on record—about $100 billion or 0.4% of their GDP posturing severe challenges to more vulnerable countries (Exhibit 3.9).

The global outbreak of COVID-19 may require the imposition of tougher and long lasting control measures—actions that may lead to a further tightening of worldwide economic conditions should they result in a more stern and long-standing down-swing. Such a tightening may, in turn, disclose financial vulnerabilities that have built in current years in the environment of tremendously low interest rates. This

Sharp tightening of financial conditions
The speed at which global financial
conditions have tightened is unprecedented.
(standard deviations from mean)
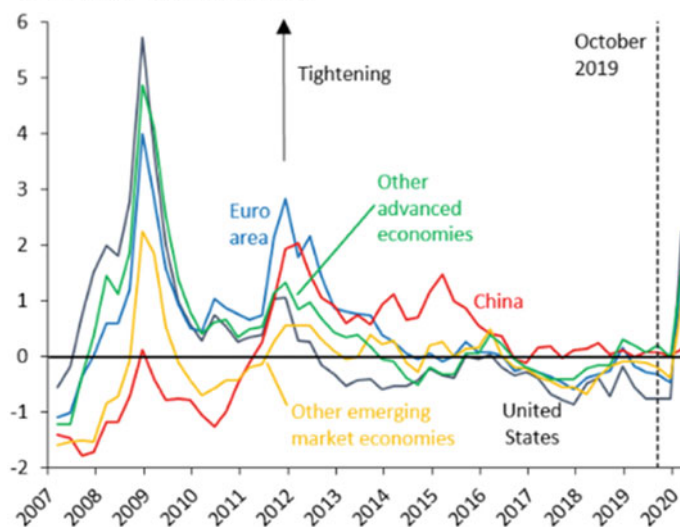
Sources: Bank for International Settlements; Bloomberg Finance L.P.; Haver Analytics; IMF,
International Financial Statistics database; and IMF staff calculations.
Note: "Other advanced economies" comprises Australia, Canada, Denmark, Hong Kong SAR,
Japan, Korea, Norway, Singapore, Sweden, Switzerland, and the United Kingdom. "Other
emerging market economies" comprises Brazil, India, Mexico, Poland, Russia, and Turkey.

Exhibit 3.8 Sharp tightening of financial conditions. *Sources* International monetary fund blog-
bloomberg and IMF staff calculations

would further worsen the COVID-19 shock. For example, asset managers facing
large outflows may be forced to sell into declining markets—thus intensifying down-
ward price moves. In addition, levered investors may face further margin calls and
may be forced to relax their portfolios; such financial deleveraging may aggravate
selling pressures (Exhibit 3.10).

Banks have more capital and liquidity than in the past, and they have been subject
to stress tests and superior supervisory scrutiny in recent years, putting them in a better
position than at the commencement of the worldwide economic crisis. In addition to
it, considerable and harmonized action by central banks to provide liquidity to banks
in many economies should also help improve possible liquidity strains (Exhibit 3.11).

Global growth is at risk
The odds of global growth exceeding zero
this year are now negligible.
(probability density)

Source: IMF staff calculations.
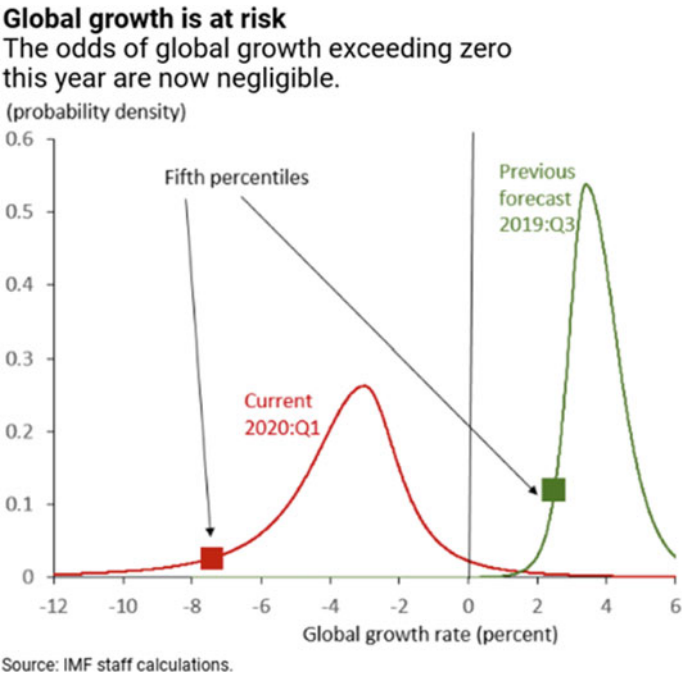
Exhibit 3.9 Global growth is at risk. *Sources* International monetary fund blog-bloomberg and IMF staff calculations

Indeed, the large downfall in bank equity prices since mid-January suggests that investors are worried about profitability and prospects for the banking sector. For example, measures of bank capitalization based on market prices are now not as good as than during the 2008 global financial crisis in many countries. The concern is that banks and other financial intermediaries may act as an amplifier should the crisis intensify further (Exhibit 3.12).

Unprecedented outflows
Emerging markets saw unprecedented portfolio outflows in terms of both size and speed.
(cumulative total non-resident portfolio flows as percent of GDP)

Global financial crisis (2008)
Taper tantrum (2013)
China's currency devaluation (2015)
Emerging market sell-off (2018)
COVID-19 (2020)

Days after start of event (t = 0)
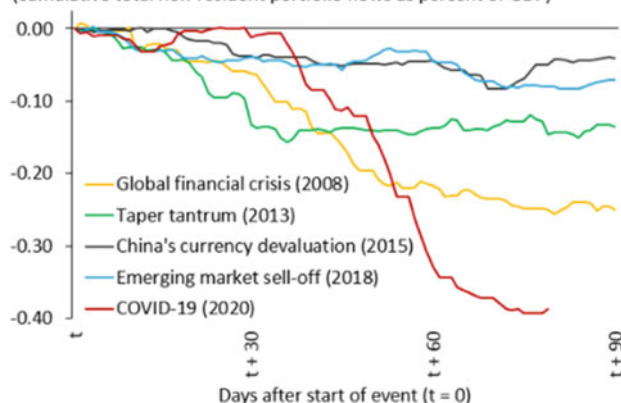
Sources: Bloomberg Finance L.P.; EPFR Global; Haver Analytics; Institute of International Finance; and IMF staff calculations.

Exhibit 3.10 Unprecedented outflows. *Sources* International monetary fund blog-bloomberg and IMF staff calculations

Skyrocketing spreads
In the segment of markets where borrowers have lower credit ratings, borrowing costs have risen sharply.
(basis points)

US high yield
Air travel sector
Energy sector
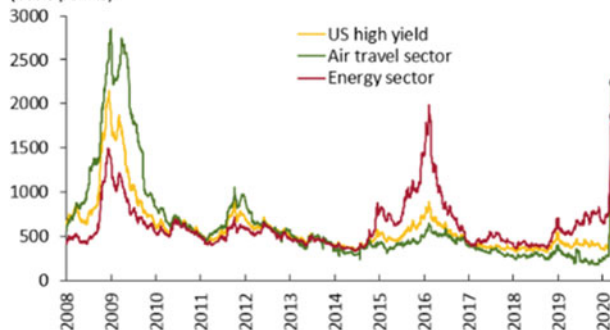
Sources: Bank of America, Bloomberg Finance LP, and IMF staff calculations.
Note: US high yield refers to spreads of high yield-rated bonds (BB+ rating and below).

Exhibit 3.11 Skyrocketing spreads. *Sources* International monetary fund blog-bloomberg and IMF staff calculations

Lower bank capitalization
Measures of bank capitalization—capital
relative to assets—based on equity market
valuations have worsened significantly.
(percent)
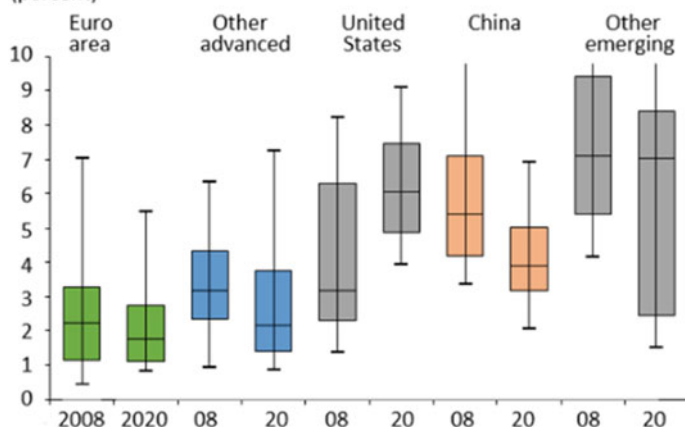
Source: Bloomberg Finance L.P.; and IMF staff calculations.
Note: Other advanced = Australia, Canada, Denmark, Japan, Korea, Norway, Singapore,
Sweden, Switzerland and the United Kingdom. Other emerging = Brazil, India, Mexico,
Poland, Russia, South Africa, and Turkey.

Exhibit 3.12   Lower bank capitalization. *Sources* International monetary fund blog-bloomberg and
IMF staff calculations

Reference

World Economic Outlook (2020) International Monetary Fund, April, 2020

Chapter 4
Plummeting Oil Prices and Oil Demand

International demand of crude oil is likely to drop in the current year due to imme-
diate shock that has been created because of COVID-19 outbreak around the globe
covering 183 countries. According to the International Energy Agency's (IEA) **recent
forecast on oil market, the present** COVID-19 **pandemic has restricted travel and
other financial activities throughout the world.** The economic state of condition is
very much volatile, thereby generating an unusual degree of insecurity amongst the
investors, as because the total after effect of this pandemic is still unknown. Demand
for crude oil in IEA's central **base case** has been dropped for the current year for
the first time since 2009, mainly due to huge fall in consumption of oil in China, the
second largest importer of crude oil (https://www.iea.org/news/global-oil-demand-
to-decline-in-2020-as-coronavirus-weighs-heavily-on-markets).

According to Dr. Fatih Birol, Executive Director at IEA, the outbreak of coron-
avirus disaster is somewhat distressing the broad range of global energy markets—
comprising all types of fossil fuel like renewable, gas and coal, nonetheless its effect
on crude oil markets is mainly harsh as it has stopped movement of people and
merchandises from moving around, thus causing a severe setback for demand of
crude oil. All the major oil importers, mainly China and India, have reduced their
import volume due to less consumption of crude oil in their respective domestic
markets. The aftermath of COVID-19 that began in China has now covered the
entire world with grim of uncertainty (https://www.iea.org/news/global-oil-demand-
to-decline-in-2020-as-coronavirus-weighs-heavily-on-markets).

On 9 March 2020, crude oil prices have suffered a loss of almost one-third of its
value, which is considered to be the largest collapse in daily prices since 1991 Gulf
war. The production war between OPEC and Russia also contributed significantly
to this plunging oil prices. These two oil producers have terminated their three-year
supply pact and decided to increase their production more oil in order to capture
world markets. Margaret Yang, Market Analyst, CMC Markets, Singapore, is of
the opinion that declaration of COVID-19 outbreak as pandemic by World Health
Organization and restriction of traffic movement across the globe as well as intensified

oil price war between OPEC and Russia has distressed the global energy demand outlook (https://www.weforum.org/agenda/2020/02/coronavirus-economic-effects-global-economy-trade-travel).

The overall international demand of crude oil may come down to 99.9 million barrels per day in the present year which is around less than 90,000 barrels per day in 2019, as forecasted by IEA, which is in contrast with its earlier forecast of increasing global oil demand by 825,000 barrels per day in 2020. At present times, the interim forecast for oil demand will now eventually be determined by the factor of quick government decisions to stop the COVID-19 pandemic and its success in particular countries. Moreover, it also depends on both short-term and long-term effects of worldwide health disaster on economic activity. Now, keeping in view, the severe uncertainty relating to global oil demand, IEA has now forecasted two situations of energy markets that may evolve in 2020, based on pessimistic theory and optimistic theory. According to pessimistic theory, the global oil demand may drop by 730,000 barrels per day and according to optimistic **view**, the global oil demand may increase by 480,000 barrels per day, provided that the affected countries will be successful in restricting the COVID-19 pandemic and will return to their normal economic and financial activities quickly (https://www.iea.org/news/global-oil-demand-to-dec line-in-2020-as-coronavirus-weighs-heavily-on-markets).

The IEA has furthermore circulated its mid-term forecast up to 2025, scrutinizing the significant concerns that may affect global supply, demand and trade. As per the IEA report, *Oil 2020,* after reduction in oil demand in 2020, it may rebound sharply in 2021, although average annual growth in oil demand may be sluggish. In between 2019 and 2025, global oil demand is projected to increase at an average yearly rate of slightly less than 1 million barrels per day. And taking this period altogether, the overall global oil demand may increase by a total of 5.7 million barrels per day, by way of India and China contributing for almost 50% of this growth. Moreover, during this period, global crude oil production is estimated to be increased by 5.9 million barrels per day, with in excess of 75% contribution are from Russia, Brazil and other non-OPEC countries. But, at the same time, it is also expected that, after 2022, the production growth in the USA and other non-OPEC producers may fail to maintain the impetus thereby permitting OPEC producers to capture their market share once more (https://www.iea.org/news/global-oil-demand-to-decline-in-2020-as-coronavirus-weighs-heavily-on-markets).

Oil 2020, the mid-term publication, furthermore reflects the effect of fresh energy changeovers on oil market movements. Growth of demand for diesel and gasoline between 2019 and 2025 is estimated to be decline as various countries across the globe execute strategies for increasing efficacy and reduce emissions of carbon dioxide by enhanced manufacturing of electric vehicles. The effect of transitions of energy business on crude oil production is still undecided, with numerous firms highlighting on short-term ventures as their future planning. Moreover, the COVID-19 outbreak is further enhancing the impending worries faced by the crude oil producers as it may affect innovative investments and corporate policies. According to Dr. Faith Birol, the burdens on firms are now shifting, and these firms are required to

display that they can produce not only crude oil, but they can also play a significant role in reduction of carbon emission as a part of policies on tackling climate change (https://www.iea.org/news/global-oil-demand-to-decline-in-2020-as-corona virus-weighs-heavily-on-markets).

It is quite bizarre to find that the prices of crude oil fall below zero for the first time in the world history on 20 April 2020. The circumstances are quite bleak. The May futures of crude oil (WTI) fell to $(-)$37.63/barrel. That's right; sellers are actually paying buyers to take the stuff off their hands. This has been found when the world is under lockdown and practically the demand of crude oil is too less. Due to the current oil market, CME's advisory predicts that few NYMEX futures can be traded at zero or negative. The US commodity funds that manage USO of $3.9 billion will shift to later date in future. In spite of disappearance of May futures, there are few contracts outstanding. It is also felt that the absolute collapse of WTI prices is primary owing to the expiry of May WTI contracts, along with the significant demand destruction due to lockdowns. One must note that while US crude prices worn out, ICE's Brent crude was still trading around $25 a barrel level. The sharp discrepancy was seen as WTI needs to be delivered physically at Cushing, Oklahoma (US), whereas for Brent contracts, deliveries can be done offshore at several locations. The storage constraints at Cushing, Oklahoma, led to the clearance and unwinding of May contracts with other market participants moving to June contracts. Following the crash on 20 April 2020, US crude for May delivery was trading at $1.10 a barrel on Tuesday morning. OPEC and its associates newly broadcasted a record production cut of 9.7 mnbopd starting May, but the declaration has failed to enthuse the oil market. Since the beginning of 2020, oil prices have plunged after the compounding bang of COVID-19 and a collapse in the original OPEC+ agreement. With no end in sight, and producers around the world continuing to pump, that's causing a fire-sale amongst traders who do not have access to storage. Despite the flaw in headline prices, retail investors are continuing to cultivate money back into oil futures. The U.S. Oil Fund ETF saw a record $552 million comes in on Friday, taking total inflows last week to $1.6 billion.

Scott Sheffield, Chief Executive of Pioneer Natural Resources, told the commission at a inquiry last week that if the oil price stayed around $20 a barrel for a while, 80% of the hundreds of sovereign oil companies in the state would be enforced into bankruptcy and 250,000 workers would lose their jobs (https://economictimes.ind iatimes.com/markets/commodities/news/what-led-crude-oil-prices-fall-below-0-a-barrel/articleshow/75264813.cms?from=mdr)   (https://m.economictimes.com/mar kets/commodities/news/too-much-oil-how-a-barrel-came-to-be-worth-less-than-nothing/amp_articleshow/75262652.cms).

4.1   Impact of Plunging Oil Prices on Economy

It is most expected that reduction in oil prices will lower transport costs and costs of fuel for firms, and this benefit of lower costs will be passed over to the consumers, as reduced oil prices will ultimately help in enhancement of their disposable earnings and allow them to use this savings in purchasing other goods. Since crude oil is the greatest merchandized product and plays an important role in determining international transportation costs, so it can lead to inflation and also pave the way towards greater economic growth. Nevertheless, occasionally crude oil prices plunge in anticipation of occurrence of economic recession. However, in the present crisis, declining crude oil prices are insufficient to accelerate the economic growth as because the COVID-19 pandemic restricted all economic activities throughout the world that are essential for growth. Moreover, if crude oil prices decline substantially, it may be the reason for several oil-producing companies to shut down because of increasing bad debts due to loss of business. The effect of declining oil prices will vary from country to country. Major oil-importing nations like China, India, Germany, Japan and others may reap the advantages of declining oil prices, but, oil-exporting nations like, Russia, Brazil may experience significant loss of revenue from exports (https://www.economicshelp.org/blog/11738/oil/impact-of-falling-oil-prices/).

The graph (Exhibit 4.1) demonstrates nominal prices and has not been adjusted
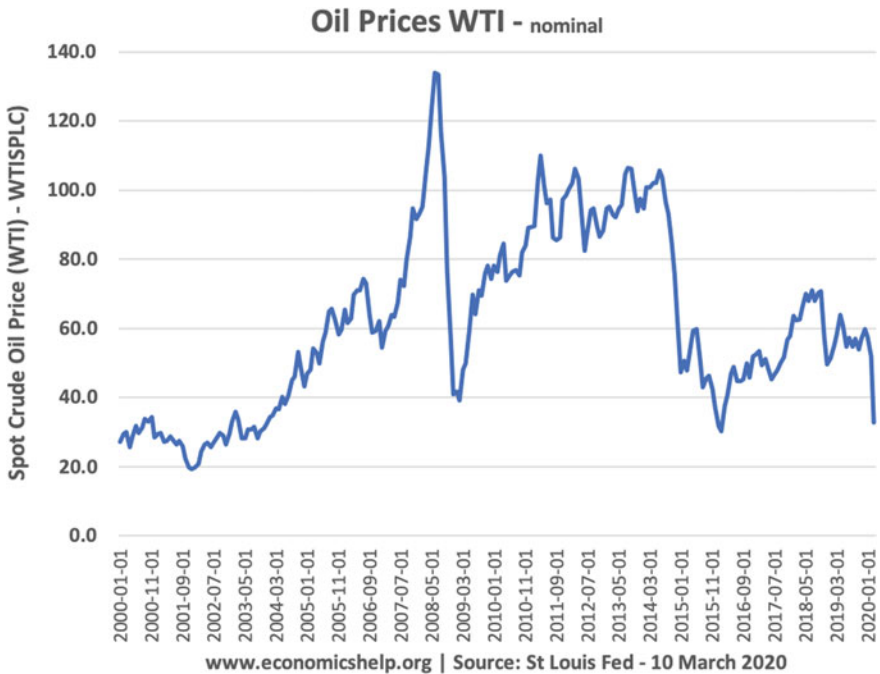
Exhibit 4.1   Oil prices WTI

for inflation. Sharp plunge in oil prices in March 2020 has driven crude oil to its lower most values ever after several years. Generally, reduction in oil prices is welcomed by users and firms because of lesser costs. However, this drop is because of confined business activity worldwide, harsh reduction in movement of transport and anticipated economic recession because of COVID-19 pandemic. As a result, it is quite unlikely that reduced oil prices will ensure progressive economic effect. If public shrink their movements, lower fuel costs do not create considerable difference. It may only act as compensation, if there is a reduction in income of common people because of limited business activities, provided that the benefit of lower oil prices is being passed on to the consumers by the government. It is expected that in oil-importing economies, general consumables will become cheaper because of reduced costs of transportation (https://www.economicshelp.org/blog/11738/oil/impact-of-falling-oil-prices/).

It is imperative to remark that oil-importing nations will now have to spend less for importing the same quantity of oil as before, which in turn will help in reducing current account deficit of oil-importing nations. This is significant for a nation like India that relies on 75% oil imports of its total oil consumption as well as presently has a bulky current account deficit. On the other hand, the oil-producing nations will face reduction in value of their export commodities, creating lower trade surplus. Again, countries like UK, that import only small fragment of oil of its total consumption, will experience narrow effect on its current account. Several oil-producing nations count on tax revenue from in order to fund its government expenditure. As for instance, Russia achieves 70% of its total tax incomes from exporting crude oil and gasoline. Deteriorating oil prices may create government budget deficit and will need either escalated tax rate or shrinkage in government expenditure. Oil exporters like Saudi Arabia and UAE can afford temporary fall in oil prices because they have been able to create enormous foreign currency reserves with which they can offset their temporary losses. Other small oil-exporting countries like Venezuela depend on incomes from exporting oil to finance its substantial societal expenditure, so decline in oil prices may lead to a substantial budget deficit and societal difficulties (https://www.economicshelp.org/blog/11738/oil/impact-of-falling-oil-prices/). Dr. Charles Donovan, Executive Director, Centre for Climate Finance and Investment, London's Imperial College Business School, opines that *"We've been like the frog in a pan of water that's slowing warming up: the fire has just been turned up several notches, and the only thing we can do now is jump out of the pan."* He further added that, *"I think we're entering a whole new phase of volatility. These are the unfortunate repercussions of a global market that's exposed to the volatility of the oil markets, and suffers when unforeseeable events like coronavirus arise at the worst time"* (https://www.forbes.com/sites/davidrvetter/2020/03/13/how-coronavirus-makes-the-case-for-renewable-energy/amp/).

Now, with this backdrop, an attempt has been made in this study to analyse and investigate the impact of COVID-19 outbreak on crude oil prices and major stock markets across the globe, like, Dow Jones (USA); FTSE 100 (UK); FTSE MIB (Italy); MOEX (Russia); Bovespa (Brazil); Nikkei 225 (Japan); KOSPI (South Korea); Shanghai composite (China); and BSE SENSEX (India) and some more. The study tries to capture the dynamic relationship between COVID-19 pandemic, crude

oil prices and major stock indices as well as the crude oil prices and stock market volatility that have been caused due to outbreak of COVID-19 pandemic. The study can be considered to be an exceptional one and first of its kind in the literature that can be used by the economists and policymakers at both government and private levels, keeping in view the present state of economy throughout the world. Here lies the unique contribution of the study.

Chapter 5
Major Stock Markets of the World: An Overview

This chapter provides a brief summary on the major stock markets across the globe which is considered to be the mirror of the global economy. In our study, we have considered Shanghai Composite Index for China, KOSPI for South Korea, BSE Sensex for India, FTSE 100 for United Kingdom, NASDAQ 100 for United States of America, MOEX for Russia, BOVESPA for Brazil, FTSE MIB for Italy, Nikkei 225 for Japan, CAC 40 for France, DAX for Germany, S&P TSX for Canada and FTSE for South Africa. Now, we will have some theoretical insight to these stock markets across the globe.

5.1 Shanghai Composite

Shanghai is referred to as the first city to witness the appearance of stock and its trading which started in 1860. The Shanghai Share Brokers Association was established in 1891 in the form of stock exchange to continue the function of share trading. In 1920, due to the advent of Shanghai Securities Goods Exchange and the Shanghai Chinese Securities Exchange, Shanghai emerged to be the financial hub of the Far East. The Shanghai Stock Exchange was established on 26 November 1990 (http://english.sse.com.cn/aboutsse/overview/).

The Shanghai Stock Exchange started its function on 19 December 1990 with the following functions:

- Facilities and services for centralized trading of securities.
- Revising of business convention.
- Listing and trading of securities, postponement of securities and termination of listing.
- Making necessary arrangements for relocate of non-public offering securities.
- Executing modernization in trading appliances and trading mechanisms.

- Other such functions as predetermined by law from time to time.

There are also other functionaries to be performed from time to time. (http://english.sse.com.cn/aboutsse/overview/). The Shanghai Stock Exchange has undergone modifications for twenty-nine years continuously, and it has emerged into a widespread, open and service centric exchange. The Shanghai Stock Exchange provides diverse products of stocks, bonds, funds and derivatives, has world class trading systems and communications infrastructure which can sustain the competent and steady operation of the Shanghai securities market (http://english.sse.com.cn/aboutsse/overview/).

The Shanghai Stock Exchange Composite Index of China was launched on 15 July 1991 and includes all types of funds. Indices are all calculated using a Paasche weighted composite price index formula. The base day for SSE Composite Index is 19 December 1990, and the base period is the total market capitalization of all stocks of that day with base value 100. It follows the performance of all *A*-shares and *B*-shares listed on the Shanghai Stock Exchange. It operates independently and is one out of the three stock exchanges in China. Shanghai Stock Exchange is still not completely open to foreign investors due to rigid capital account controls exercised by the Chinese mainland authorities (https://www.bloomberg.com/quote/Shcomp:Ind).

The impact of COVID-19 on Shanghai Stock Exchange has also been witnessed in our study. Shanghai Composite reached at a highest point of 3040.02 on 30 December 2019 and reached at a lowest point of 2660.17 on 23 March 2020 after the outbreak of COVID-19 with a decline of 12.49%. During the study period, Shanghai Composite has increased by 8.22% easing out the negativity of COVID-19 and reached at 2898.58 on 19 May 2020. Now, as on 12 April 2020, the following companies are listed in Shanghai Composite Index that tracks 50 (fifty) companies (Table 5.1).

5.2   Korea Composite Stock Price Index (KOSPI)

In South Korea, Korea exchange is the exclusive exchange operating for trading stocks with headquarters in Busan. It was formed through the amalgamation of Korea Stock Exchange, Korea Futures Exchange and KOSDAQ Stock Market under the Korea Stock and Futures Exchange Act. Commencing January 2015, Korea exchange had 2030 (two thousand and thirty) listed companies with a collective market capitalization of $1.2 trillion. Since its inception, the stock exchange is functioning autonomously. In addition to launching electronic trading, some of the exchange's milestones consist of establishing a stock index futures and options Market in 1996–97; trading warrants in 2000, and equity options and exchange-traded funds (ETFs) in 2002 (https://www.investopedia.com/terms/k/koreastockexchange.asp).

The South Korea Government has authorized its stock exchange to drive its economy to an international standard with an aim to expand its financial base (Thompson, S. F., The Korea Stock Exchange: From Development to Internationalization). The Korea Composite Stock Price Index (KOSPI) was launched in the

Table 5.1 Companies enlisted in Shanghai Composite

Companies	Industry
Shanghai Pudong Development Bank	Banking
China Minsheng Bank	Banking
Sinopec	Oil & gas
China Southern Airlines	Airline
CITIC Securities	Financial services
China Merchants Bank	Banking
Poly Real Estate	Real estate
China United Network Communications	Telecommunication
Tsinghua Tongfang	Engineering
SAIC Motor	Automotive
China Northern Rare Earth	Mining
China Fortune Land Development	Real estate
Xinwei Group	Telecommunications
Kangmei Pharmaceutical	Pharmaceutical
Kweichow Moutai	Beverages
Shandong Gold Mining	Mining
Greenland Holdings	Real estate
Haitong Securities	Financial services
Yili Group	Dairy
Bank of Jiangsu	Banking
Orient Securities	Financial services
China Merchants Securities	Financial services
Daqin Railway	Rail transport
China Shenhua Energy	Energy
Industrial Bank	Banking
Bank of Beijing	Banking
China Railway Construction	Construction
Dongxing Securities	Financial services
GuotaiJunan Securities	Financial services
Bank of Shanghai	Banking
Agricultural Bank of China	Banking
Ping An Insurance	Insurance
Bank of Communications	Banking
New China Life Insurance	Insurance
China Railway [Engineering]	Construction
Industrial and Commercial Bank of China	Banking

Table 5.1 (continued)

Companies	Industry
China Pacific Insurance	Insurance
China Life Insurance	Insurance
China State Construction Engineering	Construction
Huatai Securities	Financial services
CRRC	Rolling stock
Everbright Securities	Financial services
China Communications Construction	Construction
China Everbright Bank	Banking
PetroChina	Oil & gas
China Galaxy Securities	Financial services
Founder Securities	Financial services
China National Nuclear Power	Energy
Bank of China	Banking
China Shipbuilding Industry	Shipbuilding

Source https://www.english.sse.com.cn

year 1983 with a base value of 100 as on 4 January 1980 which is considered to be the major index of the market of South Korea. The index characterizes all common stocks traded on the Korea Exchange which is calculated based on the market capitalization method. KOSPI moved below 1000 points for more than a few years. The index crossed 1000 points for the first time in April 1989. KOSPI evidenced its largest one-day percentage increase of 8.50% on 17 June 1998 and largest one-day percentage fall of 12.02% on 12 September 2001. KOSPI reached one more landmark of breaking 2000 level for the first time on 24 July 2007 (https://www.moneycontrol.com/live-index/kospi).

In our study period, KOSPI reached at a highest point of 2204.21 on 27 December 2019 and reached at a lowest point of 1457.64 on 19 March 2020 after the outbreak of COVID-19 with a decline of 33.87%. During the study period, KOSPI increased by 27.05% easing out the negativity of COVID-19 and reached at 1998.31 on 21 May 2020. As on 14 April 2020, eight hundred and ninety-one (891) companies are listed in KOSPI. As the list is very exhaustive, so we have given list of some of the major companies that comprise the index here under (Table 5.2).

5.3 Bombay Stock Exchange Sensitivity Index (BSE Sensex)

In India, stocks, shares and other long-term commitments or outlay are purchased and sold in stock markets. The Securities Contracts (Regulation) Act of 1956 defines

Table 5.2 Companies
enlisted in KOSPI

Companies	Ticker code	Industries
Hynix	XXL, KR	Semiconductors
SK Telecom	XXL, KR	Wireless Telecommunication
KT	XXL, KR	Integrated Telecommunication
LG Electronics	XXL, KR	Consumer Electronics
Hana Financial	XL, KR	Diversified Banks
GS	XXL, KR	Oil & Gas Refining
Industrial Bank of Korea	XL, KR	Diversified Banks
Hyundai Motor	XXL, KR	Automobile Manufacturers
POSCO	XXL, KR	Steel
CJ	XXL, KR	Industrial Conglomerates
NH Investment & Securities	XL, KR	Investment Banking and Brokerage
Ncsoft	L, KR	Home Entertainment Software
Lotte Chemical	XXL, KR	Commodity Chemicals
Samsung SDS	XL, KR	IT Consulting & oth. Services
Hanwha	XXL, KR	Industrial Conglomerates
Hankook Tire	XL, KR	Tires & Rubber
Hyundai Mobis	XXL, KR	Auto Parts & Equipment
Hyundai Heavy Industries	XL, KR	Farm & Heavy Machinery
NAVER	XL, KR	Internet Software & Services
KT & G	XL, KR	Tobacco

Source https://www.obermatt.com/en/index/korea-composite-stock-price-index-kospi-

a stock exchange as "an association, organization or body of individuals, whether incorporated or not, established for the purpose of assisting, regulating and controlling, business in buying, selling and dealing in securities" (http://www.yourarticlelibrary.com/stock-exchange/history-of-stock-exchange-in-india/23488). Security trading in India started to function on the eighteenth century when the East India Company began trading in loan securities (https://medium.com/@askteek/the-history-of-stock-exchanges-in-india-c97f1ec6f1c1).

The organized stock exchange in India started in 1875 at Bombay which is considered to be the oldest in Asia. Later in 1894, Ahmedabad Stock Exchange was established to address the dealings of textile mills. In 1908, the Calcutta Stock Exchange was started to deal with plantation and jute mills. Presently, there are twenty-four stock exchanges functioning in India. The National Stock Exchange (NSE) and Over-the-Counter Exchange of India (OICEI) have authorization to perform across India. Out of these twenty-four markets, twenty-one are regional. They are positioned at Ahmedabad, Vadodara, Bangalore, Bhubaneswar, Mumbai, Kolkata, Kochi, Coimbatore, Delhi, Guwahati, Hyderabad, Indore, Jaipur, Kanpur, Ludhiana, Chennai Mangalore, Meerut, Patna, Pune and Rajkot (http://www.yourarticlelibrary.com/stock-exchange/history-of-stock-exchange-in-india/23488).

During the period after independence, the Bombay Stock Exchange (BSE) dictated the capacity of trading. On the other hand, the low level of simplicity and undependable clearing and settlement systems distant from other macrofactors augmented the need of a financial market supervisor, and the SEBI was incorporated in 1988 as a non-statutory body which was later made a statutory body in 1992. As an aftermath of infamous Harshad Mehta scam, the National Stock Exchange (NSE) was incorporated in 1992 which began its trading from 1994 onwards. It is also considered to be the first stock market where the trading took place in electronic mode. Later, in 1995, the Bombay Stock Exchange (BSE) also incepted digital form of trading through a mechanism known as BSE Online Trading (BOLT) (https://medium.com/@askteek/the-history-of-stock-exchanges-in-india-c97f1ec6f1c1).

Nowadays, trading at both the exchanges (BSE and NSE) takes place through an open electronic limit order book. The order matching is done by the trading computer. There are no market makers, and the whole method is order-driven, which means that market orders placed by investors are routinely matched with the best limit orders. As a result, buyers and sellers remain unknown. The benefit is that it brings more transparency by displaying all buy and sell orders in the trading structure. However, in the non-existence of market makers, there is no assurance that orders will be implemented. Orders need to be placed through brokers (https://www.investopedia.com/articles/stocks/09/indian-stock-market.asp).

Today, the BSE is regarded to be the world's 11th largest stock exchange, and the market capitalization is expected to be around $1.7 trillion. The market capitalization of the NSE is expected to be over $1.65 trillion (https://enrichbroking.in/indian-share-market-history). Over 5000 companies are listed on the BSE and 1500 on the NSE. In terms of share trading volumes, equally the exchanges are on equivalence. These days' people are able to carry out online trading sitting in the comfort of their home (https://enrichbroking.in/indian-share-market-history). The exchanges are being monitored by their governing boards and executive chiefs. Guidelines relating to their rule and control are laid down by the Ministry of Finance. Government also set up Securities and Exchange Board of India (SEBI) in April 1988 for methodical expansion and regulation of securities industry and stock exchanges (http://www.yourarticlelibrary.com/stock-exchange/history-of-stock-exchange-in-india/23488).

The term BSE Sensex was advocated by Deepak Mohoni in 1989 who is an analyst of stock is a measure of stock of thirty well-known companies that are listed in the

Bombay Stock Exchange. It is a free float market weighted index. These companies represent different sectors in India and are regarded as blue chip companies. The base value is 100 considered on 1 April 1979 with base year of 1978–79 (https://en.wikipedia.org/wiki/BSE_SENSEX).

On 25 July 1990 the BSE Sensex reached the four-digit figure for the first time and closed at 1001 points in the stir of a good monsoon and exceptional corporate outcome. Again on 15 January 1992, BSE Sensex crossed 2000 mark and closed at 2020 points due to the liberalization of Indian economy. The BSE Sensex crossed record 24,000 levels for the first time, on 13 May 2014 and reached its peak of 24,067.11 due to constant capital inflows by foreign funds at the domestic bourses and extensive buying by retail investors (https://en.wikipedia.org/wiki/BSE_SENSEX). Since its inception, BSE Sensex has passed though lots of ups and downs with a major crash in January 2008 due to the advent of the subprime crisis with acceleration in March 2008. Again, in the beginning of 2009, it suffered a big jolt due to the Satyam scam that shook the entire corporate world and particularly the information technology (IT) sector in India.

In our study period, BSE Sensex reached at a highest point of 41,681.54 on 20 December 2019 and reached at a lowest point of 25,981.24 on 23 March 2020 after the outbreak of COVID-19 with a decline of 37.66%. During the study period, BSE Sensex increased by 22.94% easing out the negativity of COVID-19 and reached at 33,717.62 on 30 April 2020. As on January 2020, the following companies are included in BSE Sensex representing different sectors (Table 5.3).

5.4 Financial Time Stock Exchange 100 (FTSE 100)

The London Stock Exchange was founded on 23 Jan 1571 in England and is considered to be the oldest stock exchange in the world. The London Stock Exchange began its functioning at the coffee house in the year 1698 and gradually developed as time passed. In 1801, it took a formal birth with survivals from world wars and the bombing of IRA. In 2007, it purchased the Bursa Italiana thus allowing it to perform as a fully owned subsidiary of the London Stock Exchange itself (https://www.tradecrowd.com/learn-to-trade/stocks/history-of-london-stock-exchange/#.XruPzP8zZ0w). The London Stock Exchange consists of 2938 (two thousand nine hundred and thirty-eight) companies out of which 1151 (one thousand one hundred and fifty-one) companies belong to Alternative Investment Market, 44 (forty-four) from Professional Security market and 10 (ten) from Special Fund market (https://www.tradecrowd.com/learn-to-trade/stocks/history-of-london-stock-exchange/#.XruPzP8zZ0w).

The exchange provides MTS Bond Vision, MTS Cash, MTS Credit, MTS Data, MTS Indices and MTS Repo. Secondary markets include common stock, bonds, derivatives, ETFs, debt securities, exchange-traded commodities, structured products, global depository receipts and many more. The Financial Time Stock Exchange (FTSE) 100 Index is the major stock index of the 100 most highly capitalized UK companies listed on the market with the highest market capitalization. The value is

Table 5.3 Companies enlisted in BSE Sensex

Companies	Industries
Asian Paints	Chemical
Axis Bank	Banking
Bajaj Auto	Automobile
Bajaj Finance	Automobile
BhartiAirtel	Telecommunications
HCL Technologies Ltd.	Information Technology
HDFC Bank	Banking
Hero Motocorp	Automobile
Hindustan Unilever	Fast Moving Consumer Goods, i.e. FMCG
HDFC	Banking and Financial Services
ICICI Bank	Banking
Indusind Bank	Banking
Infosys	Information Technology
ITC	Hotels and FMCG
Kotak Mahindra Bank	Banking
Larsen & Toubro	Heavy instrumentation and Engineering
Mahindra & Mahindra	Automobile
Maruti Suzuki	Automobile
Nestle India Ltd.	Fast Moving Consumer Goods, i.e. FMCG
National Thermal Power Corporation (NTPC)	Power
Power Grid Corporation of India	Power
Reliance Industries Limited	Integrated Oil and Gas
State Bank of India	Banking
Sun Pharmaceutical	Pharmaceuticals
Tata Consultancy Services	Information Technology
Tata Steel	Iron and Steel
Tech Mahindra Ltd.	Information Technology
Titan Company Ltd.	Electronics
UltraTech Cement Ltd.	Cement

Source https://www.bseindia.com

calculated by multiplying share price and total number of shares, and these companies comprise 81% of the total market. The index started on 3 January 1984 at the base level of 1000, and it has attained the highest closing value of 7877.45 on 22 May 2018. The highest intra-day value of 7903.50 has been reached on 22 May 2018 (https://en.wikipedia.org/wiki/FTSE_100_Index).

In our study period, FTSE 100 reached at a highest point of 7644.90 on 27 December 2019 and touched the lowest point of 4993.89 on 23 March 2020 after the outbreak of COVID-19 with a decline of 34.67%. During the study period, FTSE 100 increased by 18.33% easing out the negativity of COVID-19 and reached at 6115.25 on 29 April 2020. As on 28 April 2020, the following companies are listed in FTSE 100 which is mentioned hereunder (Table 5.4).

5.5 National Association of Securities Dealers Automated Quotations (NASDAQ) Composite Index

The New York Stock Exchange (NYSE) is considered to be the world's largest stock exchange situated at the Wall Street, New York, with a market capitalization of 16 trillion US dollars. The exchange is also known as "The Big Board" with 1900 companies listed in it. Out of these, 1500 companies belong to New York itself (https://www.fxcm.com/uk/insights/new-york-stock-exchange-nyse/). The New York Stock Exchange (NYSE) was founded on 17 May 1792 with 24 stock brokers signing the Buttonwood Agreement. The agreement set a commission for trading, and the headquarters was established at Tontine Coffee House with focus on trading with government bonds. After twenty-five years of the inception, the organization was recognized as the official exchange. The eighteenth century marked the trading of the exchange ahead of government bonds and bank stocks. The advancement in telephonic communication and technology marked the advancement in trading through telephonic mode which helped in enhancing the memberships in the exchange and in 1878, and the market is completely open to give the access to brokers. The crash of the stock market in 23 October 1929 led to stringent formation of rules and regulations. The NYSE consequently registered with the United States Securities and Exchange Commission. In 19 October 1987, the Dow Jones Industrial Average slumped 508 points, the biggest crash since 1929.

Since the founding of the circuit breaker market protection mechanism, the NYSE has witnessed challenges on more than a few occasions which are listed below:

- In October 1989, NYSE witnessed a collapse of 6.9% with a fall in the junk bond market;
- In October 1997, the Dow Jones knocks down by 7.2%, in reaction to the outburst of the Asian Financial Crisis;
- In September 2001, due to the terrorist attack on New York World Trade Centre, four trading sessions were closed;
- In May 2010, The Dow Jones Industrial Average fell about 10%.

Table 5.4 Companies enlisted in FTSE 100

Ticker code	Companies
ULVR.L	Unilever Plc.
AZN.L	AstraZeneca Plc.
RDSB.L	Royal Dutch Shell Plc.
RDSA.L	Royal Dutch Shell Plc.
GSK.L	GlaxoSmithKline Plc.
BHP.L	BHP Group Plc.
HSBA.L	HSBC Holdings Plc.
BATS.L	British American Tobacco Plc.
RIO.L	Rio Tinto Plc.
DGE.L	Diageo Plc.
BP.L	BP Plc.
RB.L	Reckitt Benckiser Group Plc.
REL.L	Relax Plc.
VOD.L	Vodafone Group Plc.
NG.L	National Grid Plc.
LSE.L	London Stock Exchange Group
PRU.L	Prudential Plc.
EXPN.L	Experian Plc.
AAL.L	Anglo American Plc.
TSCO.L	Tesco Plc.
CPG.L	Compass Group Plc.
LLOY.L	Lloyds Banking Group Plc.
CRH.L	CRH Plc.
BARC.L	Barclays Plc.
GLEN.L	Glencore Plc.
BA.L	BAE Systems Plc.
OCDO.L	Ocado Group Plc.
FLTR.L	Flutter Entertainment Plc.
ABF.L	Associated British Foods Plc.
SN.L	Smith & Nephew Plc.
FERG.L	Ferguson Plc.
IMB.L	Imperial Brands Plc.
RBS.L	Royal Bank of Scotland Group
SSE.L	SSE Plc.
LGEN.L	Legal & General Group Plc.
STAN.L	Standard Chartered Plc.
BT-A.L	BT Group Plc.

Table 5.4   (continued)

Ticker code	Companies
AHT.L	Ashtead Group Plc
SMT.L	Scottish Mortgage Investment
AV.L	Aviva Plc.
SDR.L	Schroder's Plc.
SGRO.L	Segro Plc.
RTO.L	Rentokil Initial Plc.
ITRK.L	Intertek Group Plc.
HLMA.L	Halma Plc.
HL.L	Hargreaves Lansdown Plc.
ANTO.L	Antofagasta Plc.
III.L	3i Group Plc
SGE.L	Sage Group Plc.
CCL.L	Carnival Plc.
WPP.L	WPP Plc.
CCH.L	Coca-Cola HBC Ag
MNDI.L	Mondi Plc.
PSN.L	Persimmon Plc.
IHG.L	Intercontinental Hotels Group
ADM.L	Admiral Group Plc.
INF.L	Informa Plc.
CRDA.L	Croda International Plc.
DCC.L	DCC Plc.
NXT.L	Next Plc.
BNZL.L	Bunzl Plc.
SKG.L	Smurfit Kappa Group Plc.
UU.L	United Utilities Group Plc.
HIK.L	Hikma Pharmaceuticals Plc.
BRBY.L	Burberry Group Plc.
SLA.L	Standard Life Aberdeen Plc.
JE.L	Just Eat Plc.
SVT.L	Severn Trent Plc.
FRES.L	Fresnillo Plc.
MRO.L	Melrose Industries Plc.
AUTO.L	Auto Trader Group Plc.
RR.L	Rolls-Royce Holdings Plc.
SMIN.L	Smiths Group Plc.
BKG.L	Berkeley Group Holdings

Table 5.4 (continued)

Ticker code	Companies
RMV.L	Rightmove Plc.
WTB.L	Whitbread Plc.
BDEV.L	Barratt Developments Plc.
STJ.L	St. Jamess Place Plc.
TW.L	Taylor Wimpey Plc.
SMDS.L	Smith (Ds) Plc.
IAG.L	International Consolidated
LAND.L	Land Securities Group Plc.
MRW.L	Morrison (Wm) Supermarkets
PHNX.L	Phoenix Group Holdings Plc.
SBRY.L	Sainsbury (J) Plc.
EVR.L	Evraz Plc.
KGF.L	Kingfisher Plc.
JMAT.L	Johnson Matthey Plc.
RSA.L	RSA Insurance Group Plc.
BLND.L	British Land Company Plc.
DLG.L	Direct Line Insurance Group
PSON.L	Pearson Plc.
ITV.L	ITV Plc.
EZJ.L	Easyjet Plc.
TUI.L	TUI Ag.
HSX.L	Hiscox Ltd.
CNA.L	Centrica Plc.
MKS.L	Marks And Spencer Group Plc.
MCRO.L	Micro Focus International Plc.
NMC.L	NMC Health Plc.

Source http://www.lsemarketcap.com

- In October 2012, Hurricane Sandy induced closure of trading for two days;
- In July 2015, cyber-attack led to closure of trading for almost 48 h.

In 2015, licences for floor trading were available for US $50,000 and a licence for bond trading is available for US $1000. Unlike seats, licences cannot be resold, but they can be transferred throughout the change of possession of a company that holds them (https://www.fxcm.com/uk/insights/new-york-stock-exchange-nyse/).

The NASDAQ 100 is a yardstick to measure performance of more than 100 non-financial companies listed in the exchange that is determined by weighted market capitalization system which is computed as (Market capitalization = Stock price * No. of shares outstanding). This method is quite relevant because of its change due to change in any component. The index represents different companies from different

sectors in United States. It is also known as US tech 100 (https://www.dailyfx.com/nas-100/what-is-nas-100.html).

The base price of NASDAQ 100 started with 250 points since its inception in 1985 and rose to 8000 points in 2019 due to increase in tech equities in the market. The dot com boom also made the index to witness a significant rise in its value. The NASDAQ 100 is well recognized for huge price volatility and liquidity in the market. It also features long trading hours which are also unique (https://www.dailyfx.com/nas-100/what-is-nas-100.html). The NASDAQ 100 plays a vital and significant role in predicting the market condition as the leading companies in the market from different sectors are included here. It performs as the source of employment to lot of people directly and indirectly across the globe.

In our study period, NASDAQ 100 reached at a highest point of 8778.31 on 26 December 2019 and reached at a lowest point of 7006.92 on 23 March 2020 after the outbreak of COVID-19 with a decline of 20.17%. During the study period, NASDAQ 100 increased by 26.12% easing out the negativity of COVID-19 and reached at 9485.02 on 20 May 2020. As on 30 April 2020, the following companies are listed in NASDAQ 100 index (Table 5.5).

5.6 MOEX Russia Index (Formerly MICEX)

The Russian securities market was established in the year 1992. The market reached at the zenith in 2008 with a market capitalization of 1.5 trillion USD. This market is considered to be the largest and leading market in eastern and central parts of Europe (https://publishup.uni-potsdam.de/opus4-ubp/frontdoor/deliver/index/docId/6640/file/EFC_Rubtsov_105_118.pdf). The Russian securities market is volatile in nature with a set of financial instruments which performs in eight time zones with innumerable professionals and investors participating in the trading system (http://www.mirkin.ru/_docs/speech11_07_03.pdf).

The Russian securities market features the following:

- Non-diversified ownership structure;
- Traditional attitude of individual investors;
- Risk averse nature of the public;
- Command of debt financing;
- Small-sized home financial institutions;
- Reliance on financial markets;
- Volatility of the market.

The following macroeconomic events cater to the development of Russian securities market:

- Privatization of Vouchers in 1992–94;
- Deficit financing of federal and local budgets in 1993–98;
- Issuing securities and substitute by new commercial institutions in 1993–94;

Table 5.5 Companies enlisted in NASDAQ 100

Companies	Ticker code
Activision Blizzard	ATVI
Adobe Inc.	ADBE
Advanced Micro Devices	AMD
Alexion Pharmaceuticals	ALXN
Align Technology, Inc.	ALGN
Alphabet Inc. (Class A)	GOOGL
Alphabet Inc. (Class C)	GOOG
Amazon.com	AMZN
Amgen Inc.	AMGN
Analog Devices	ADI
ANSYS	ANSS
Apple Inc.	AAPL
Applied Materials, Inc.	AMAT
ASML Holding	ASML
Autodesk, Inc.	ADSK
Automatic Data Processing, Inc.	ADP
Baidu.com, Inc.	BIDU
Biogen, Inc	BIIB
BioMarin Pharmaceutical, Inc.	BMRN
Booking Holdings	BKNG
Broadcom Inc.	AVGO
Cadence Design Systems	CDNS
CDW	CDW
Cerner Corporation	CERN
Charter Communications, Inc.	CHTR
Check Point Software Technologies Ltd.	CHKP
Cintas Corporation	CTAS
Cisco Systems	CSCO
Citrix Systems	CTXS
Cognizant Technology Solutions Corporation	CTSH
Comcast Corporation	CMCSA
Copart	CPRT
CoStar Group	CSGP
Costco Wholesale Corporation	COST
CSX Corporation	CSX
Dexcom	DXCM
Dollar Tree, Inc.	DLTR

Table 5.5 (continued)

Companies	Ticker code
eBay Inc.	EBAY
Electronic Arts	EA
Exelon Corporation	EXC
Expedia Group	EXPE
Facebook, Inc.	FB
Fastenal Company	FAST
Fiserv, Inc.	FISV
Fox Corporation (Class A)	FOXA
Fox Corporation (Class B)	FOX
Gilead Sciences, Inc.	GILD
IDEXX Laboratories	IDXX
Illumina, Inc.	ILMN
Incyte Corporation	INCY
Intel Corporation	INTC
Intuit	INTU
Intuitive Surgical	ISRG
JD.com	JD
KLA Corporation	KLAC
Kraft Heinz	KHC
Lam Research	LRCX
Liberty Global (Class A)	LBTYA
Liberty Global (Class C)	LBTYK
LululemonAthletica	LULU
Marriott International	MAR
Maxim Integrated Products	MXIM
Mercado Libre	MELI
Microchip Technology	MCHP
Micron Technology, Inc.	MU
Microsoft Corporation	MSFT
Mondelēz International	MDLZ
Monster Beverage Corporation	MNST
NetApp	NTAP
NetEase, Inc.	NTES
Netflix	NFLX
NVIDIA Corporation	NVDA
NXP Semiconductors N.V.	NXPI
O'Reilly Automotive, Inc.	ORLY

Table 5.5 (continued)

Companies	Ticker code
PACCAR Inc.	PCAR
Paychex, Inc.	PAYX
PayPal Holdings, Inc.	PYPL
PepsiCo, Inc.	PEP
QUALCOMM Incorporated	QCOM
Regeneron Pharmaceuticals	REGN
Ross Stores Inc.	ROST
Seattle Genetics	SGEN
Sirius XM Radio, Inc.	SIRI
Skyworks Solutions, Inc.	SWKS
Splunk	SPLK
Starbucks Corporation	SBUX
Synopsys, Inc.	SNPS
T-Mobile US	TMUS
Take-Two Interactive, Inc.	TTWO
Tesla, Inc.	TSLA
Texas Instruments, Inc.	TXN
Trip.com Group	TCOM
Ulta Beauty	ULTA
United Airlines Holdings	UAL
VeriSign	VRSN
Verisk Analytics	VRSK
Vertex Pharmaceuticals	VRTX
Walgreen Boots Alliance, Inc.	WBA
Workday, Inc.	WDAY
Western Digital	WDC
Xcel Energy, Inc.	XEL
Xilinx, Inc.	XLNX
Zoom Video Communications	ZM

Source http://www.nasdaq.com

- Crisis of non-payment in 1992–98;
- Loans for auctioning of share in 1995–96;
- The crisis of August 1998.

(https://pdfs.semanticscholar.org/b236/232859525671cdd5b4f991df0090ee391e07.pdf).

The MOEX Russia Index is a measure for Russia stock market which was renamed from MICEX. It is a weighted capitalized index launched in the year 1997 with base value of 100 (https://www.bloomberg.com/quote/IMOEX:IND).

In our study period, MOEX reached at a highest point of 3050.47 on 27 December 2019 and reached at a lowest point of 2112.64 on 18 March 2020 after the outbreak of COVID-19 with a decline of 30.74%. During the study period, MOEX increased by 74.64% easing out the negativity of COVID-19 and reached at 8332.74 on 13 April 2020. The top market participants in the equities and funds category as on April 2020 are given (Table 5.6).

5.7 BOVESPA (Indice Bovespa)

The Brazil stock market was established in the year 1890, and till mid 1960, it was a state-owned company. In 2000, 11 stock exchanges in Brazil were amalgamated. In the year 2007, the exchange was demutualised (http://www.trade.education/dictio nary/brazil-stock-exchange/).

The legislations in Brazil made greater significance to stock market. It established the monetary adjustment through the formation of the Brazilian Readjustable National Treasury Bonds. There were many changes that flow into the stock market due to the legislations (https://www.researchgate.net/publication/290950599_The_ Brazilian_stock_market_development_A_critical_analysis_of_progress_and_pro spects_during_the_past_50_years).

BOVESPA has been considered as an index to measure the performance of Brazil in regard to stock market. In our study period, BOVESPA reached at a highest point of 117,203.20 on 26 December 2019 and reached at a lowest point of 63,569.62 on 23 March 2020 after the outbreak of COVID-19 with a decline of 45.76%. During the study period, BOVESPA increased by 23.56% easing out the negativity of COVID-19 and reached at 83,170.80 on 29 April 2020. In order to simplify the assessment and appraisal of movements in the equity marketplace and the economy of Brazil, the stocks of about 60 of the widely traded Brazilian corporate houses and industries that comprise the leading corporations in Brazil are being accumulated in the BOVESPA Index, which is commonly called as IBOVESPA (Indice Bovespa) which is considered the benchmark stock index of Brazil. Below is the list of the thirty most traded companies on the B3 stock exchange during the last financial year 2019–2020 (Table 5.7).

5.8 FTSE MIB (Milano Indice di Borsa)

The Italian Stock Exchange was established in the year 1808 in the name of Milan Merchandise Exchange. A regulation was set up in 1810. Till the year 1998, it functioned under public ownership, and after that, it was privatized, and from 1991,

Table 5.6 Companies
enlisted in MOEX

Rank	Companies
1	BCS Financial Group
2	VTB
3	Sberbank
4	Renaissance Broker Limited
5	Banking Group "FC Otkritie"
6	FINAM
7	Group "REGION"
8	AO "ALFA-BANK"
9	OOO Merrill Lynch Securities
10	Tinkoff Bank
11	JSC "Invest. Company ITinvest"
12	LLC "Credit Suisse Securities (Moscow)"
13	Bank GPB (JSC)
14	IC "Zerich Capital Management" JSC
15	LLC "ATON"
16	RICOM-TRUST Inv. comp Limited
17	OOO UBS Bank
18	"ALOR Plus Corporation"
19	Promsvyazbank PJSC
20	AO Citibank
21	"Alfa-Capital Management Company LLC"
22	IFC "Solid"
23	AO Raiffeisenbank
24	INTRAST Financial Company
25	"RONIN"
26	"IC VELES Capital" LLC
27	PJSC "Sovcombank"
28	KIT Finance (JSC)
29	LLC "URALSIB Broker"
30	CentroCredit Bank
31	PJSC "Best Efforts Bank"
32	PJSC "BANK URALSIB"
33	IC Freedom Finance LLC
34	JSC BANK SNGB
35	SKB-BANK
36	UNIVER CAPITAL LLC
37	IQG Asset Management JSC

Table 5.6 (continued)

Rank	Companies
38	AO Octan-Broker
39	Banking Group AK BARS
40	JSC Rosselkhozbank
41	CB "J.P. Morgan Bank International" (LLC)
42	OOO GS Bank
43	LLC "Moscow City Securities"
44	GPB–AM
45	Profit House
46	IC Indeavour Finance LLC.
47	Spectr Invest, LLC.
48	Aktiv (JSC)
49	PFC
50	LLC IC "Iceberg Finance"

Source http://www.moex.com

the online trading platform was started which enhanced electronic mode of trading. Throughout decades, it has remained an important edifice to the economic performance of Italy. Before it has established itself in the international domain, it had to face a prolonged period of struggle which was marked by transformation from public to private, moving into crisis from growth, performance from local to national markets and many more (https://www.historytour.it/?changelin=ENG).

The FTSE MIB is the index to measure the performance of Italian stock market consisting highly liquid companies in Italy. It quantifies the performance of 40 top scrips listed on Borsa Italiana and looks for reproducing the broad sector weights of the Italian stock market. It enables the investors to trade with options and futures and for large stocks (https://research.ftserussell.com/products/downloads/FTSE_MIB_Index__English_.pdf).

The FTSE MIB was monitored by Standard and Poor's from its inception till June 2009, but subsequently, it was monitored by FTSE group. The components of the FTSE MIB Index are limited at 15% at the time of the quarterly reviews. Capping methods are run on the Monday following the second Friday of March, June, September and December. They are based on Friday closing prices, and they are executed after the close of trading of the third Friday of March, June, September and December. Any components whose weights are greater than 15% are capped at 15%. The weights of all lower ranking components are augmented likewise. The weights of lower ranking components are then confirmed, and if they surpass 15%, they are also capped at 15%. This procedure is repeated until no component weight exceeds 15% (https://research.ftserussell.com/products/downloads/FTSE_MIB_Index__English_pdf).

FTSE MIB has been considered as an index to measure the performance of Italy in regard to stock market. In our study period, FTSE MIB reached at a highest point

Table 5.7 Companies enlisted in BOVESPA

Rank	Companies	Sector
1	Petrobras	Oil and Gas
2	Itaú Unibanco	Financials
3	Banco Bradesco	Financials
4	AmBev	Beverages
5	Vale	Mining
6	Santander Brasil	Financials
7	Banco do Brasil	Financials
8	Itaúsa	Holding
9	TelefônicaBrasil	Telecommunications
10	B3	Securities
11	JBS	Food
12	Eletrobras	Energy
13	WEG Industries	Engineering
14	ENGIE Brasil	Energy
15	Lojas Renner	Retail
16	CPFL Energia	Energy
17	Sabesp	Utilities
18	Rumo	Logistics
19	Localiza	Car Rental
20	CCR	Transport
21	Braskem	Petrochemicals
22	TIM Brasil	Telecommunications
23	BRF	Food
24	Lojas Americanas	Retail
25	GPA	Retail
26	Gerdau	Metallurgy
27	Natura & Co	Cosmetics
28	CEMIG	Energy
29	Companhia Siderurgica Nacional	Metallurgy
30	Ultra	Conglomerate

Source http://www.b3.com.br

of 24,003.64 on 20 December 2019 and reached at a lowest point of 14,894.44 on 12 March 2020 after the outbreak of COVID-19 with a decline of 37.94%. During the study period, FTSE MIB increased by 17.56% easing out the negativity of COVID-19 and reached at 18,067.29 on 29 April 2020. The complete list of components of the Italy FTSE MIB Index as of 1 January 2020 is given here (Table 5.8).

Table 5.8 Companies enlisted in FTSE MIB

Company Name	Industries
A2a	Electricity
Amplifon	Electronics
Atlantia	Industrial Transportation
Azimut Holding	Financial Services
Banca Generali	Financial Services
Banco Bpm	Banks
Bper Banca	Banks
Buzzi Unicem	Construction & Materials
Campari	Beverages
Cnh Industrial	Industrial Goods & Services
Diasorin	Electricity
Enel	Electricity
Eni	Oil & Gas Producers
Exor	Financial Services
Ferrari	Automobiles & Parts
Fiat Chrysler Automobiles	Automobiles & Parts
Finecobank	Banks
Generali	Nonlife Insurance
Hera	Heavy Engineering
IntesaSanpaolo	Banks
Italgas	Oil & Gas
Juventus Football Club	Sports
Leonardo	Aerospace & Defence
Mediobanca	Banks
Moncler	Personal Goods
Nexi	
Pirelli & C	Automobiles & Parts
Poste Italiane	Nonlife Insurance
Prysmian	Electronic & Electrical Equipment
Recordati	Pharmaceuticals & Biotechnology
Saipem	Oil Equipment Services & Distribution
Salvatore Ferragamo	Personal Goods
Snam	Gas Water & Multiutilities
Stmicroelectronics	Technology Hardware & Equipment

(continued)

Table 5.8   (continued)

Company Name	Industries
Telecom Italia	Fixed Line Telecommunications
Tenaris	Industrial Metals & Mining
Terna-Rete Elettrica Nazionale	Electricity
UbiBanca	Banks
Unicredit	Banks
Unipol	Nonlife Insurance

Source www.borsaitaliana.it›borsa›azioniftse-mib›lista

5.9   NIKKEI225 (the NIKKEI Index)

The Tokyo Stock Exchange was established in the year 1878 and is the fourth largest equity trading exchange in the world, although it is being considered as the second largest in the world in terms of market capitalization (https://www.investopedia.com/terms/n/nikkei.asp). The total share turnover was $2.676 trillion in September 2009, and the market value was at $3.479 trillion (http://marketswiki.com/wiki/Tokyo_Stock_Exchange_Inc). It has passed through lots of ups and downs especially in the World War II. The exchange was integrated with other five exchanges which was closed in August 1945 and reopened on 1949 keeping in view the new securities exchange act (https://www.investopedia.com/terms/n/nikkei.asp).

The Nikkei 225 is an index of the Tokyo Stock Exchange of Japan portraying the 225 companies listed at the exchange. Nikkei marks the industrialization and remaking of Japan during the post-world war II scenario. The Nikkei index was previously monitored by the Tokyo Stock Exchange, but now, it is monitored by the Nikkei financial newspaper from 1970 onwards. The index measures the performance of some giant players in the markets like Toyota, Honda, Sony, Panasonic, Mitsubishi and many more. The prices of Nikkei 225 are influenced by the following factors:

- Prices of currency;
- Financial data;
- Calamities;
- Banking policies.

(https://www.dailyfx.com/nikkei-225/what-is-nikkei-225.html).

The Nikkei 225 serves with the benefit of liquidity and volatility in the market. The index is calculated based on market capitalization method. Nikkei 225 has been considered as an index to measure the performance of Japan in regard to stock market. In our study period, Nikkei 225 reached at a highest point of 24,066.12 on 17 December 2019 and reached at a lowest point of 16,552.83 on 19 March 2020 after the outbreak of COVID-19 with a decline of 31.21%. During the study period, Nikkei 225 increased by 19.62% easing out the negativity of COVID-19 and reached

at 20,595.15 on 20 Ma, 2020. Below is a list of some of the major companies that are being traded in NIKKEI 225 in order of their market capitalization (Table 5.9).

5.10 CAC 40 (Cotation Assistée en Continu)

The Paris Stock Exchange is known as the Paris Bourse or the Bourse de Paris is recognized as the largest exchange in France and is now famous as the NYSE Euro next. It is one of the five combined exchanges which is a part of the pan-European Euro next market place (https://www.fxcm.com/markets/insights/paris-stock-exchange/). Equities, bonds, commodities and derivatives are the financial instruments that are dynamically traded in this exchange. Near about 1300 companies are registered here with an electronic trading system which marked a landmark reform to the trading process in 1980s. It was converted into online trading in 1998. The exchange includes 40 largest equities on the basis of liquidity and market capitalization. Investment and trading operations are regulated by France's Ministry of Economics (CECEI), the banking commission and the (AMF). It performs with a market capitalization of $3.5 trillion (https://www.fxcm.com/markets/insights/paris-stock-exchange/).

The CAC 40 is the index to measure the stock performance of 40 largest stocks in France which was founded on 31 December 1987 with a base value of 1000. It enables us to determine the movement of prices of stocks in Euro next Paris, which is the largest stock exchange in France earlier known as the Paris Bourse in terms of liquidity (https://www.investopedia.com/terms/c/cac40.asp).

The dot com boom during the year 2000 made the CAC 40 reached at 7000 points, but as a result of 2011 crisis, it falls to 3000 points. Investors across the globe participate in the buying and selling process of different stocks in the exchange. The index changed the valuation process from December 2003 to free float market capitalization system. Presently, it has a market capitalization of €1.832 trillion (https://www.topratedforexbrokers.com/education-and-guides/cac-40-index/).

The CAC 40 has been considered as an index to measure the economic performance of France in regard to stock market. In our study period, CAC 40 reached at a highest point of 6037.39 on 27 December 2019 and reached at a lowest point of 3754.84 on 18 March 2020 after the outbreak of COVID-19 with a decline of 37.80%. During the study period, CAC 40 increased by 19.61% easing out the negativity of COVID-19 and reached at 4671.11 on 29 April 2020. The list below displays the major stocks that are being traded in CAC 40 (Table 5.10).

5.11 DAX 30 (Deutscher Aktien IndeX 30)

The Frankfurt Stock Exchange of Germany was established in the year 1585 which is controlled by Deutsche Borse AG and Borse Frankfurt Zertifikate AG. The post-world war II scenario marked the establishment of Frankfurt Stock Exchange as the

Table 5.9 Companies enlisted in NIKKEI 225

Rank	Ticker code	Company
1	7203	Toyota Motor Corporation
2	9437	NTT Docomo, Inc.
3	9984	Soft Bank Group Corporation
4	6861	Keyence Corporation
5	6758	Sony Corporation
6	9433	KDDI Corporation
7	4519	Chugai Pharmaceutical Co. Ltd.
8	9434	Soft Bank Corporation
9	9432	Nippon Telegraph And Telephone Corporation
10	4502	Takeda Pharmaceutical Company Limited
11	8306	Mitsubishi UFJ Financial Group Inc.
12	7974	Nintendo Co. Ltd.
13	9983	Fast Retailing Co. Ltd.
14	6098	Recruit Holdings Co. Ltd.
15	4568	Daiichi Sankyo Co. Limited
16	4063	Shin-Etsu Chemical Co. Ltd.
17	4661	Oriental Land Co. Ltd.
18	7267	Honda Motor Co. Ltd.
19	7182	Japan Post Bank Co. Ltd.
20	6367	Daikin Industries Ltd.
21	6981	Murata Manufacturing Co. Ltd.
22	4452	Kao Corporation
23	8316	Sumitomo Mitsui Financial Group Inc.
24	6594	Nidec Corporation
25	7741	Hoya Corporation
26	8058	Mitsubishi Corporation
27	6954	Fanuc Corporation
28	8035	Tokyo Electron Limited
29	8766	Tokio Marine Holdings Inc.
30	9022	Central Japan Railway Company
31	8001	Itochu Corporation
32	4503	Astellas Pharma Inc.
33	6273	SMC Corporation
34	8411	Mizuho Financial Group Inc.
35	3382	Seven & I Holdings Co. Ltd.
36	6501	Hitachi Ltd.

(continued)

Table 5.9   (continued)

Rank	Ticker code	Company
37	7751	Canon Inc.
38	6902	Denso Corporation
39	9020	East Japan Railway Company
40	6503	Mitsubishi Electric Corporation
41	4543	Terumo Corporation
42	2914	Japan Tobacco Inc.
43	4901	Fujifilm Holdings Corporation
44	2413	M3Inc.
45	8031	Mitsui & Co. Ltd.
46	4911	Shiseido Co. Limited
47	8113	Unicharm Corporation
48	8802	Mitsubishi Estate Co. Limited
49	5108	Bridgestone Corporation
50	4578	Otsuka Holdings Co. Ltd.

Source   https://www.jpx.co.jp/english/markets/statistics-equities/misc/b5b4pj000003fs9x-att/202
004-e.pdf

leading stock exchange in Germany. It is now performing at par with other leading stock exchanges in the world (http://www.marketswiki.com/wiki/Frankfurt_Stock_Exchange). The DAX represents the 30 major German companies performing on the Frankfurt Stock Exchange. It was introduced in the year 30 December 1987 with a base value of 1000. Online trading system provides real-time data of the index (https://www.moneycontrol.com/live-index/dax).

The DAX has been considered as an index to measure the financial performance of Germany with regard to stock market. In our study period, DAX reached at a highest point of 13,407.66 on 16 December 2019 and reached at a lowest point of 8441.71 on 18 March 2020 after the outbreak of COVID-19 with a decline of 37.04%. During the study period, DAX increased by 24.79% easing out the negativity of COVID-19 and reached at 11,223.71 on 20 May 2020. The components of DAX are given (Table 5.11).

5.12   S&P/TSX Composite Index

The Toronto Stock Exchange (TSX) was established on 25 October 1861 on account of a resolution passed by 24 men meeting at the Masonic Hall in Toronto with the purpose of instituting a structure to make possible the exchange of financial instruments. At that time, trading was restricted to daily half-hour sessions during which a limited number of transactions took place. By the year 1901, the listed

Table 5.10 Companies
enlisted in CAC 40

Companies	Industry
Accor	Hotels
Air Liquide	Commodity and Chemicals
Airbus	Aerospace
ArcelorMittal	Steel
Atos	IT Services
AXA	Full Line Insurance
BNP Paribas	Banking
Bouygues	Heavy Construction
Capgemini	IT Services
Carrefour	Food Retailers and Wholesalers
Credit Agricole	Banking
Danone	Food Products
Dassault Systemes	Software
Engie	Gas and Electric Utility
Essilor	Medical Supplies
Hermes	Clothing and Accessories
Kering	Retail Business
Loreal	Personal Products
Legrand	Electrical Components and Equipment
LVMH	Clothing and Accessories
Michelin	Tyres
Orange	Telecommunications
PernodRicard	Distillers and Vintners
PSA	Automobiles
Publicis	Media Agencies
Renault	Automobiles
Safran	Aerospace and Defence
Saint-Gobain	Building Materials and Fixtures
Sanofi	Pharmaceuticals
Schneider Electric	Electrical Components and Equipment
Societe Generale	Banks
Sodexo	Food Services and Facilities Management
STMicroelectronics	Semiconductors

Table 5.10 (continued)

Companies	Industry
Thales	Defence
Total	Integrated Oil and Gas
Unibail-Rodamco-Westfield	Real Estate Investment Trusts
Veolia	Water, Waste, Transport, Energy
Vinci	Heavy Construction
Vivendi	Broadcasting and Entertainment
Worldline (fr)	IT Services

Source https://www.live.euronext.com

companies increased to 100 with a growth in quantity of trading. In the year 1914, the trading was stopped in the market due to temporary closure of the exchange on account of World War I, and it again reopened after three months. After that, it experienced a boom period starting from 1920, but, again due to the great depression in 1930s, it started to move into a bearish mode (https://www.investopedia.com/articles/stocks/08/history-of-toronto-stock-exchange.asp).

The S&P/TSX Composite Index is used to measure the performance of the companies listed at the Canadian Toronto Stock Exchange, and it is the only trading exchange in Canada. It is calculated by weighted capitalization method. There are 1501 companies listed in TSX and 1653 companies listed in TSXV. In the recent years, the performance of the index has remained magnificent with a highest index value in September 2019 (https://www.investopedia.com/terms/s/sp-tsx-composite-index.asp).

The S&P/TSX Composite has been considered as an index to measure the performance of Canada in regard to stock market. In our study period, S&P/TSX Composite Index reached at a highest point of 17,180.15 on 24 December 2019 and reached at a lowest point of 11,228.49 on 23 March 2020 after the outbreak of COVID-19 with a decline of 34.64%. During the study period, S&P/TSX Composite Index increased by 26.26% easing out the negativity of COVID-19 and reached at 15,228.11 on 29 April 2020. The list below displays some of the major companies that are being listed in TSX (Table 5.12).

5.13 FTSEJSE (Johannesburg Stock Exchange)

The Johannesburg Stock Exchange (JSE) was established in the year 1887 during the advent of South Africa gold rush. During 1990, it went through a rigorous upgradation process and migrated to online trading system. They provide trading in primary and secondary markets with a range of securities to trade in. The JSE is presently ranked the 19th largest stock exchange in the world on the basis of market capitalization

Table 5.11 Companies
enlisted in DAX 30

Companies	Industry
Adidas	Clothing
Allianz	Insurance
BASF	Chemicals
Bayer	Pharmaceuticals and Chemicals
Beiersdorf	Consumer goods and Chemicals
BMW	Manufacturing
Continental	Manufacturing
Covestro	Chemicals
Daimler	Manufacturing
Deutsche Bank	Banking
Deutsche Telekom	Communications
EON	Energy
Fresenius	Medical
Fresenius Medical Care	Medical
HeidelbergCement	Building
Henkel	Consumer goods and Chemicals
Infineon Technologies	Semiconductors
Linde	Industrial gases
Merck	Pharmaceuticals
MTU Aero Engines	Aerospace
Deutsche Borse	Securities
Deutsche Lufthansa	Transport Aviation
Deutsche Post	Logistics
Volkswagen Group	Manufacturing
Vonovia	Real estate
Munich Re	Insurance
RWE	Energy
SAP	Software
Siemens	Industrial, Electronics
Wirecard	Financial Technology

Source http://www.bloomberg.com

and also considered as the largest exchange in the African continent (https://www. jse.co.za/about/history-company-overview).

The Financial Times Stock Exchange (FTSE) Johannesburg Stock Exchange (JSE) has been considered as the index to measure the performance of capital market in South Africa. It is a capitalization weighted index including 40 largest companies on the basis of market capitalization representing different sectors in South Africa.

Table 5.12 Companies enlisted in S&P/TSX

Companies	Industries
Aecon Group Inc.	Industrials
Cogeco Communications Inc.	Communication Services
AltaGas Ltd.	Energy
Dollarama Inc.	Consumer Defensive
Badger Daylighting Ltd.	Industrials
Canadian Tire Corporation Limited	Consumer Cyclical
Bombardier Inc.	Industrials
Cenovus Energy Inc.	Energy
Ag Growth International Inc.	Industrials
Colliers International Group Inc.	Real Estate
Altus Group Limited	Real Estate
Dream Global Real Estate Investment Trust	Real Estate
Ballard Power Systems Inc.	Industrials
Canadian Utilities Limited	Utilities
Boralex Inc	Utilities
Cominar Real Estate Investment Trust	Real Estate
Agnico Eagle Mines Limited	Basic Materials
Dream Industrial Real Estate Investment Trust	Real Estate
Aphria Inc	Health care
Canadian Western Bank	Financial Services
Bank of Montreal	Financial Services
CGI Inc.	Technology
Boyd Group Income Fund	Consumer Cyclical
Constellation Software Inc.	Technology
Air Canada	Industrials
Dream Office Real Estate Investment Trust	Real Estate
ARC Resources Ltd.	Energy
ECN Capital Corp	Financial Services
Bank of Nova Scotia	Financial Services
Element Fleet Management Corp.	Financial Services
Brookfield Asset Management Inc.	Financial Services
Equitable Group Inc.	Financial Services
Alacer Gold Corp.	Basic Materials

(continued)

Table 5.12 (continued)

Companies	Industries
Eldorado Gold Corporation	Basic Materials
Aritzia Inc.	Consumer Cyclical
Enghouse Systems Limited	Technology
Barrick Gold Corporation	Basic Materials
FirstService Corporation	Real Estate
Brookfield Business Partners L.P	Industrials
Granite Real Estate Investment Trust	Real Estate
Alamos Gold Inc.	Basic Materials
Fortis Inc.	Utilities
Artis Real Estate Investment Trust	Real Estate
Great Canadian Gaming Corporation	Consumer Cyclical
Bausch Health Companies Inc.	Health care
Ero Copper Corp.	Basic Materials
Brookfield Infrastructure Partners L.P.	Utilities
Franco-Nevada Corporation	Basic Materials
Alaris Royalty Corp.	Financial Services
Great-West Lifeco Inc	Financial Services
ATCO Ltd.	Utilities
Emera Incorporated	Utilities
Baytex Energy Corp.	Energy
Exchange Income Corporation	Industrials
Brookfield Property Partners L.P.	Real Estate
Freehold Royalties Ltd.	Energy
Algonquin Power & Utilities Corp.	Utilities
H&R Real Estate Investment Trust	Real Estate
ATS Automation Tooling Systems Inc.	Industrials
Empire Company	Consumer Defensive
BCE Inc.	Communication Services
Extendicare Inc.	Health care
Brookfield Renewable Partners L.P.	Utilities
Frontera Energy Corporation	Energy
Alimentation Couche-Tard Inc.	Consumer Defensive
HEXO Corp.	Health care

Table 5.12 (continued)

Companies	Industries
Aurora Cannabis Inc.	Health care
Enbridge Inc.	Energy
BlackBerry Limited	Technology
Fairfax Financial Holdings Limited	Financial Services
BRP Inc.	Consumer Cyclical
Genworth MI Canada Inc.	Financial Services
Allied Properties Real Estate Investment Trust	Real Estate
Home Capital Group Inc.	Financial Services
B2Gold Corp	Basic Materials
Encana Corporation	Energy
Boardwalk Real Estate Investment Trust	Real Estate
Finning International Inc.	Industrials
CAE Inc.	Industrials
George Weston Limited	Consumer Defensive
Cameco Corporation	Basic Materials
Hudbay Minerals Inc	Basic Materials
Canfor Corporation	Basic Materials
Endeavour Mining Corporation	Basic Materials
Chemtrade Logistics Income Fund	Basic Materials
First Capital Realty Inc.	Real Estate
Detour Gold Corporation	Basic Materials
Gibson Energy Inc.	Energy
Centerra Gold Inc.	Basic Materials
Hudson's Bay Company	Consumer Cyclical
Chartwell Retirement Residences	Real Estate
Enerflex Ltd.	Energy
Cott Corporation	Consumer Defensive
First Majestic Silver Corp.	Basic Materials
Canada Goose Holdings Inc.	Consumer Cyclical
Gildan Activewear Inc	Consumer Cyclical
Canopy Growth Corporation	Health care
Husky Energy Inc.	Energy
Crescent Point Energy Corp.	Energy
Enerplus Corporation	Energy

Table 5.12 (continued)

Companies	Industries
Canadian Apartment Properties Real Estate Investment Trust	Real Estate
First Quantum Minerals Ltd.	Basic Materials
Capital Power Corporation	Utilities
Gran Tierra Energy Inc.	Energy
Choice Properties Real Estate Investment Trust	Real Estate
Hydro One Limited	Utilities
Crombie Real Estate Investment Trust	Real Estate
iA Financial Corporation Inc.	
Canadian Imperial Bank of Commerce	Financial Services
Linamar Corporation	
Cargojet Inc.	Industrials
Metro Inc.	
Chorus Aviation Inc.	Industrials
Ivanhoe Mines Ltd.	Basic Materials
Canadian National Railway Company	Industrials
Keyera Corp.	
Cronos Group Inc.	Health care
Loblaw Companies Limited	
Cascades Inc.	Basic Materials
Iamgold Corporation	Basic Materials
CI Financial Corp.	Financial Services
Morneau Shepell Inc.	Industrials
Descartes Systems Group Inc.	Technology
IGM Financial Inc.	Financial Services
Canadian Natural Resources Limited	Energy
Killam Apartment Real Estate Investment Trust	Real Estate
CCL Industries Inc.	Consumer Cyclical
Lundin Mining Corporation	Basic Materials
Cineplex Inc.	Consumer Cyclical
MTY Food Group Inc.	Consumer Cyclical
Canadian Pacific Railway Limited	Industrials
Imperial Oil Limited	Energy

Table 5.12   (continued)

Companies	Industries
Celestica Inc.	Technology
Kinaxis Inc.	Technology
MAG Silver Corp.	Basic Materials
Mullen Group Ltd.	Energy
Innergex Renewable Energy Inc.	Utilities
Kinross Gold Corporation	Basic Materials
Labrador Iron Ore Royalty Corporation	Basic Materials
Interfor Corporation	Basic Materials
Kirkland Lake Gold Ltd.	Basic Materials
Norbord Inc	Basic Materials
Methanex Corporation	Basic Materials
Magna International Inc.	Consumer Cyclical
National Bank of Canada	Financial Services
Intact Financial Corporation	Financial Services
Manulife Financial Corporation	Financial Services
Laurentian Bank of Canada	Financial Services
Intertape Polymer Group Inc.	Consumer Cyclical
NorthWest Healthcare Properties Real Estate Investment Trust	Real Estate
Northview Apartment Real Estate Investment Trust	Real Estate
InterRent Real Estate Investment Trust	Real Estate
Knight Therapeutics Inc.	Health care
NFI Group Inc.	Consumer Cyclical
Inter Pipeline Ltd.	Energy
Maple Leaf Foods Inc.	Consumer Defensive
Martinrea International Inc.	Consumer Cyclical
Northland Power Inc	Utilities
MEG Energy Corp.	Energy
Lightspeed	Technology
NovaGold Resources Inc.	Basic Materials
Nutrien Ltd.	Basic Materials
OceanaGold Corporation	Basic Materials
Sandstorm Gold Ltd.	Basic Materials
Osisko Gold Royalties Ltd.	Basic Materials
Pretium Resources Inc.	Basic Materials

Table 5.12 (continued)

Companies	Industries
Pan American Silver Corp.	Basic Materials
Seabridge Gold Inc.	Basic Materials
Semafo Inc.	Basic Materials
Parkland Fuel Corporation	
Premium Brands Holdings Corporation	
Pembina Pipeline Corporation	Energy
ShawCor Ltd.	Energy
PrairieSky Royalty Ltd.	Energy
Secure Energy Services Inc.	Energy
Parex Resources Inc	Energy
Richelieu Hardware Ltd.	Consumer Cyclical
Spin Master Corp	Consumer Cyclical
Restaurant Brands International Inc.	Consumer Cyclical
Sleep Country Canada Holdings Inc.	Consumer Cyclical
Ritchie Bros. Auctioneers Incorporated	Industrials
SNC-Lavalin Group Inc.	Industrials
Quebecor Inc.	Communication Services
Smart Centres Real Estate Investment Trust	Real Estate
Shaw Communications Inc.	Communication Services
Power Corporation of Canada	Financial Services
Rogers Communications Inc.	Communication Services
Power Financial Corporation	Financial Services
Royal Bank of Canada	Financial Services
Shopify Inc.	Technology
Onex Corporation	Financial Services
Russel Metals Inc.	Industrials
Open Text Corporation	Technology
Sienna Senior Living Inc.	Health care
Silvercorp Metals Inc.	Basic Materials
Saputo Inc.	Consumer Defensive
Wheaton Precious Metals Corp	Basic Materials
Westshore Terminals Investment Corporation	Basic Materials
Teck Resources Limited	Basic Materials

(continued)

Table 5.12   (continued)

Companies	Industries
Wesdome Gold Mines Ltd.	Basic Materials
Stella-Jones Inc.	Basic Materials
Yamana Gold Inc.	Basic Materials
Torex Gold Resources Inc.	Basic Materials
West Fraser Timber Co. Ltd.	Basic Materials
SSR Mining Inc.	Basic Materials
TransAlta Renewables Inc.	Utilities
Superior Plus Corp	Utilities
Turquoise Hill Resources Ltd.	Basic Materials
Sun Life Financial Inc.	Financial Services
Suncor Energy Inc.	
Stantec Inc.	Industrials
WSP Global Inc.	Industrials
TFI International Inc.	Industrials
TransAlta Corporation	Utilities
RioCan Real Estate Investment Trust	Real Estate
Tricon Capital Group Inc.	Real Estate
Summit Industrial Income REIT	Real Estate
WestJet Airlines Ltd.	Industrials
Tourmaline Oil Corp.	Energy
TC Energy Corporation	Energy
Seven Generations Energy Ltd.	Energy
Pason Systems Inc.	Energy
Whitecap Resources Inc.	Energy
The North West Company Inc.	Consumer Defensive
Transcontinental Inc.	Consumer Cyclical
The Stars Group Inc.	Technology
Winpak Ltd.	Consumer Cyclical
Thomson Reuters Corporation	Financial Services
TMX Group Limited	Financial Services
Vermilion Energy Inc.	Energy
Waste Connections Inc.	Industrials
Toromont Industries Ltd.	Industrials
Toronto-Dominion Bank	Financial Services
Telus Corporation	Communication Services

Source   https://www.tsx.com/listings/listing-with-us/listed-company-directory

The index was developed with a base value of 10,399.53 as of 21 June 2002 (https://www.sashares.co.za/jse-all-share-index/#gs.7mt4ex).

The FTS/JSE has been considered as an index to measure the performance of South Africa in regard to stock market. In our study period, FTSE/JSE Index reached at a highest point of 3513.21 on 20 November 2019 and reached at a lowest point of 2235.49 on 23 March 2020 after the outbreak of COVID-19 with a decline of 36.37%. Again, during our study period, FTSE/JSE index has increased by 27.09% easing out the negativity of COVID-19 and reached at 3066.22 on 20 May 2020. The companies listed in FTSE JSE are given here (Table 5.13).

Now, for better understanding of the impact of COVID-19 on the stock markets and oil price at a glance, the line-plots of the trend of the crude oil prices as well as that of the major stock markets that have been selected in our study during the period from 1 October 2019 to 22 May 2020 are showcased in Exhibits 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13 and 5.14.

Trend of Crude Oil prices (WTI) and that of the stock markets of China (Shanghai Composite), South Korea (KOSPI), India (BSE Sensex), United Kingdom (FTSE 100), United States (NASDAQ 100), Russia (MOEX), Brazil (BOVESPA), Italy (FTSE MIB), Japan (NIKKEI 225), France (CAC 40), Germany (DAX 30), Canada (S&P/TSX) and South Africa (FTSE JSE) before and after the outbreak of COVID-19 (1 October 2019–22 May 2020).

Table 5.13 Companies enlisted in FTSE JSE

Companies
AL Noor
Discovery Holdings Ltd
Mondi Ltd
Remgro Ltd
Anglo American PLC
FirstRand Ltd
Mondi PLC
RMB Holdings Ltd
AngloGold Ashanti Ltd
Fortress Income Fund Ltd
MR PRICE
Sanlam Ltd

(continued)

Table 5.13   (continued)

Companies
Aspen Pharmacare Holdings Ltd
Fortress Income Fund Ltd
MTN Group Ltd
Sappi Ltd
B-AFRICA
Gold Fields Ltd
Naspers Ltd
Sasol Ltd
Bhp Billiton PLC
Growthpoint Properties Ltd
Nedbank Group Ltd
Shoprite Holdings Ltd
BIDCORP
INTUPROP
Netcare Ltd
Standard Bank Group Ltd
British American Tobacco PLC
Investec Ltd
Old Mutual PLC
STEIN NV
Capitec Bank Holdings Ltd
Investec PLC
Redefine Properties Ltd
The Bidvest Group Ltd
Compagnie Financiere Richemont SA
Life Healthcare Group Holdings Ltd
Reinet Investments SCA
Tiger Brands Ltd
Truworths International Ltd
Vodacom Group Ltd
Woolworths Holdings Ltd

Source   https://topforeignstocks.com/indices/the-components-of-the-south-africa-ftse-jse-top-40-index/
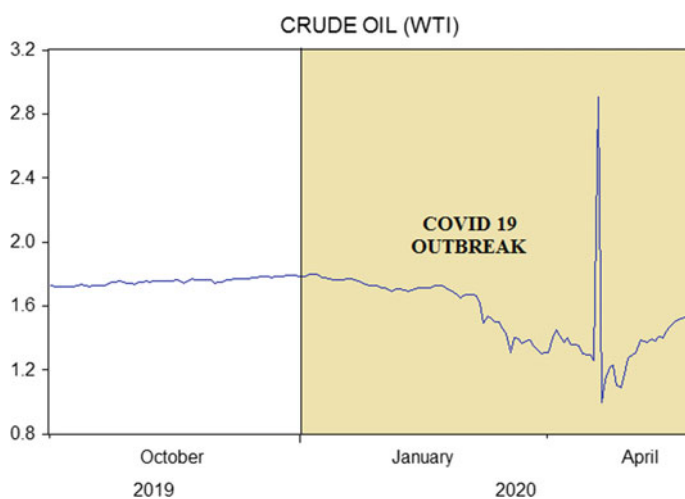
Exhibit 5.1   Trend of crude oil (WTI)
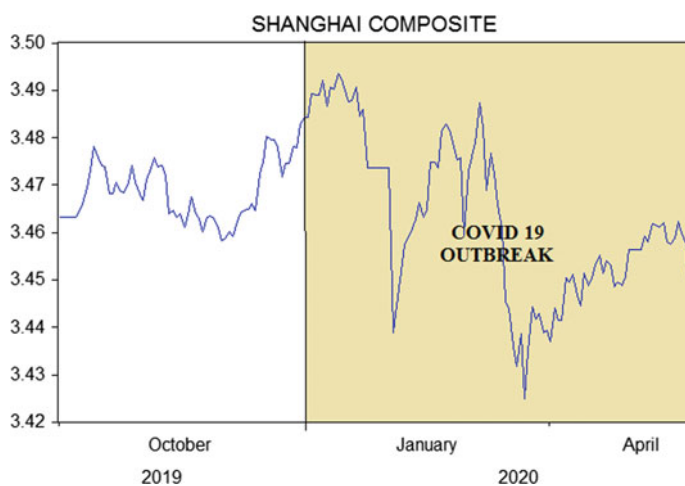
Exhibit 5.2   Trend of Shanghai composite
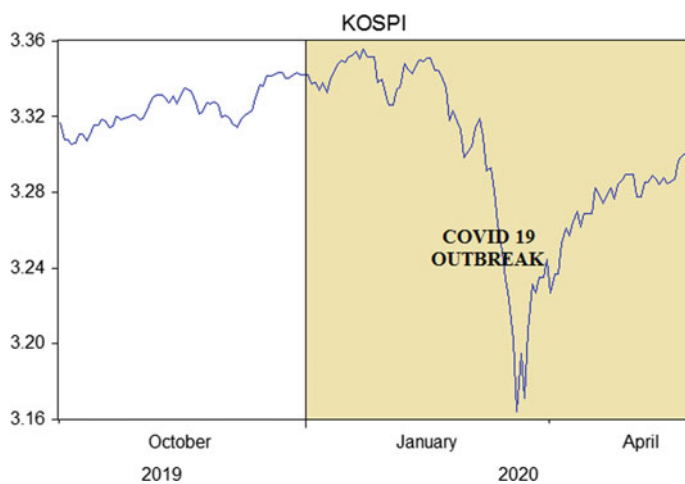
Exhibit 5.3 Trend of KOSPI
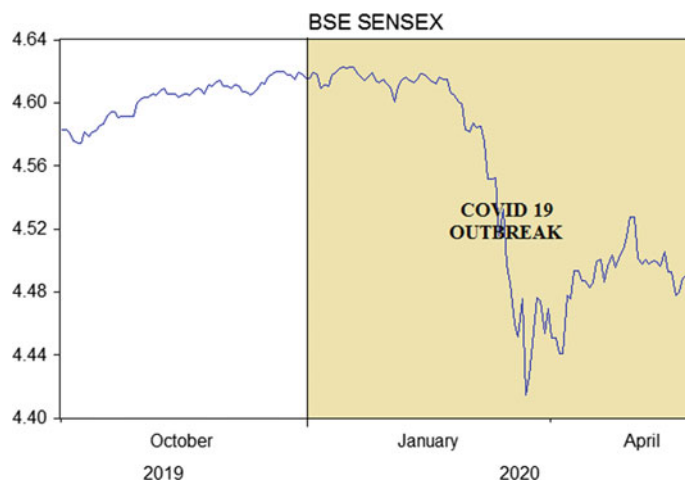
Exhibit 5.4 Trend of BSE SENSEX
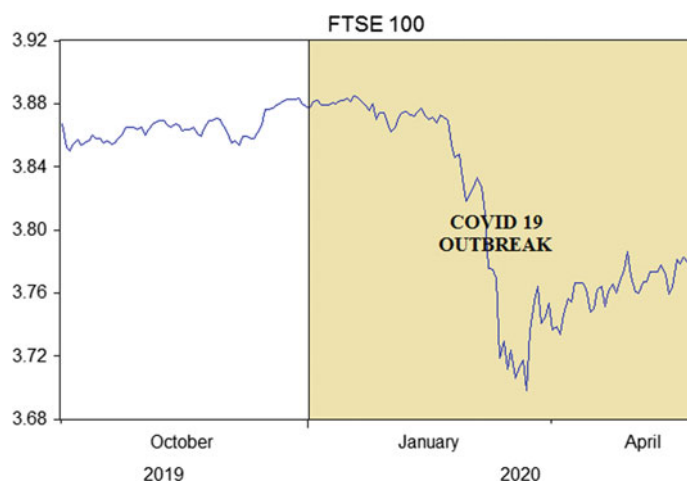
Exhibit 5.5 Trend of FTSE 100
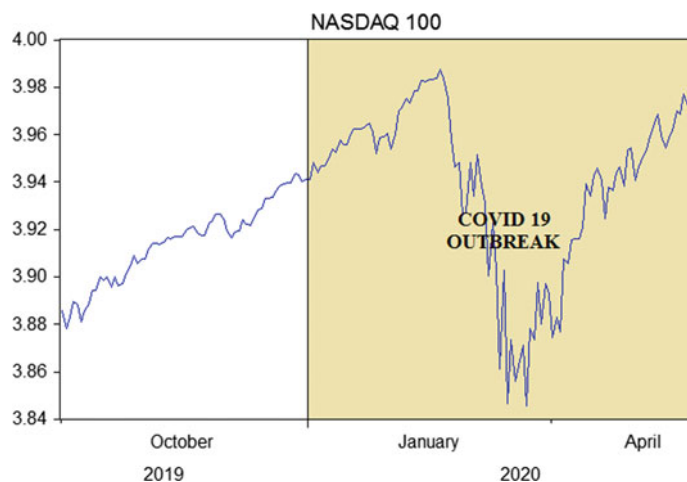
Exhibit 5.6 Trend of NASDAQ 100
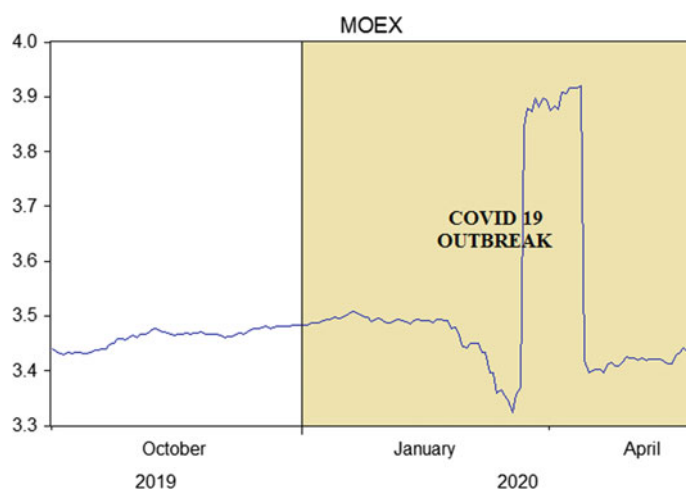
Exhibit 5.7 Trend of MOEX
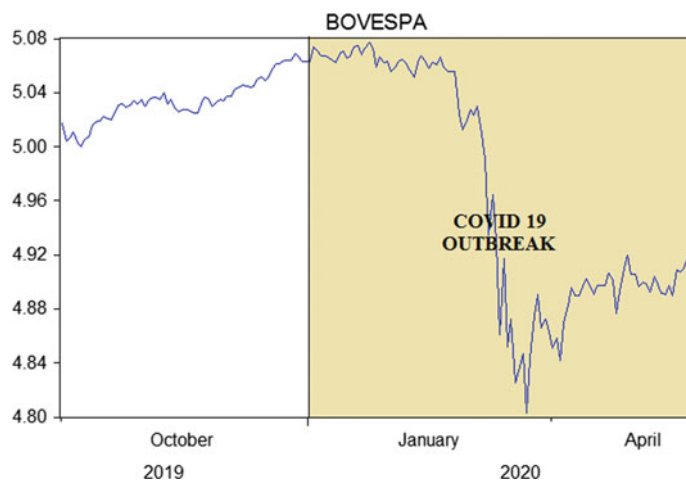
Exhibit 5.8 Trend of BOVESPA
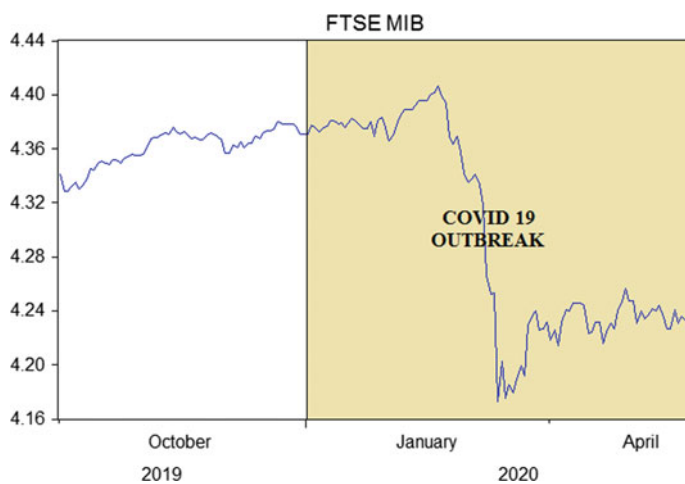
Exhibit 5.9 Trend of FTSE MIB
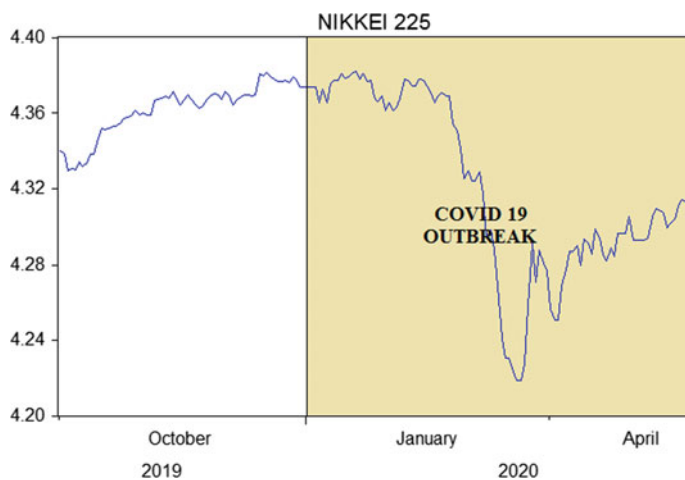
Exhibit 5.10 Trend of NIKKEI 225
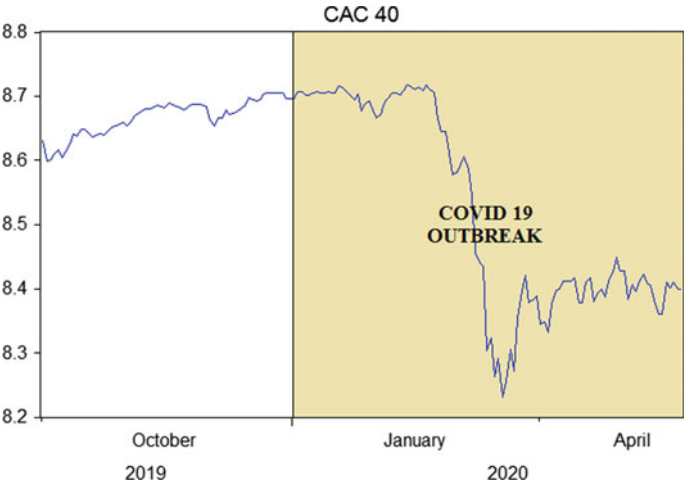
Exhibit 5.11 Trend of CAC 40
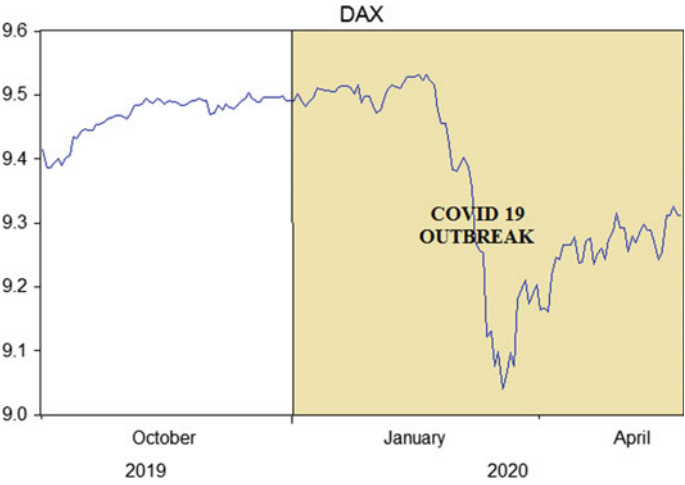
Exhibit 5.12 Trend of DAX 30
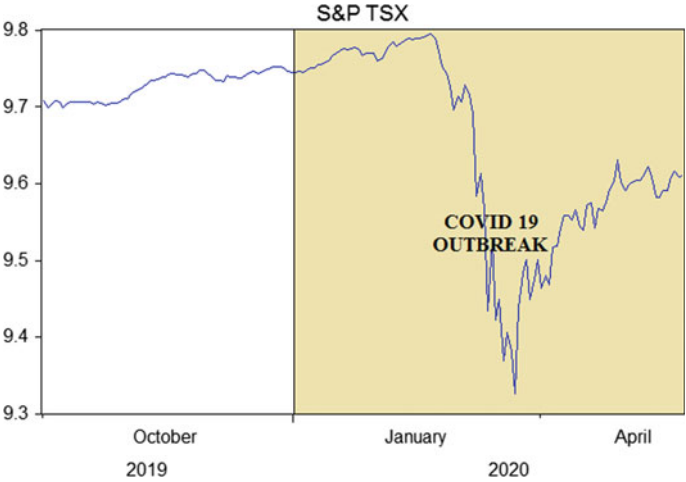
Exhibit 5.13 Trend of S&P TSX
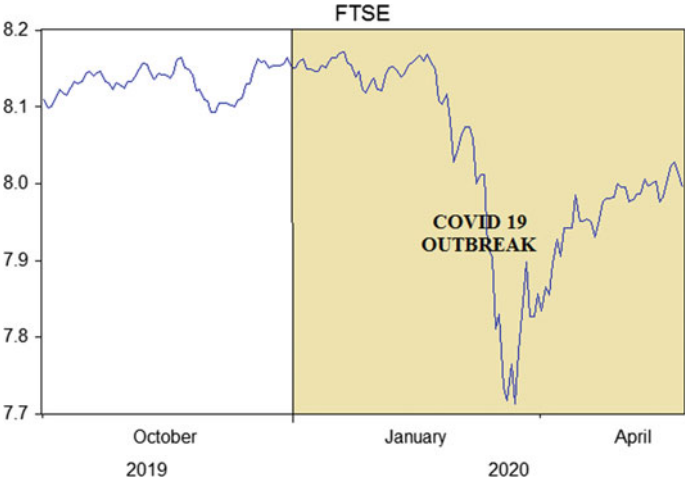
Exhibit 5.14 Trend of FTSE

Chapter 6
Literature Review

In recent times, Chen et al. (2020) investigate the effect of the outbreak of the COVID-19 pandemic upon the daily consumption by the common people using day-to-day transaction data in 214 cities in China. The results reveal that the daily spending on services and goods have been affected harshly. Again, Al-Awadhi et al. (2020) study the impact of COVID-19 on stock market returns of Chinese companies. The authors have applied correlation analysis and panel data regression model, and the study results show that the blowout of the pandemic has considerably affect the returns of the Chinese companies in a negative way in all the sectors. But, as a whole, due to scarcity of literature regarding the impact of COVID-19 outbreak on economy, crude oil prices and stock markets, we have decided to examine research works that analysed the impact of earlier epidemics on the economy of different countries. Thus, several studies relating to the effect of epidemics (like, Spanish flu, avian influenza, HIV/AIDS, etc.) on economy have been surveyed, the summary of which are given here under.

Brainerd and Siegler (2003) analysed the effect of 1918–19 influenza epidemic on US economy by using data set on US economic growth during the period 1919–1930. They have taken variables like urbanization, density, initial income, climate, human capital, geography, sectoral composition of output and the legacy of slavery as controlling output. The study result shows that there was a huge and vigorous positive impact of the influenza epidemic on growth of per capita income across states during the 1920s. Philipson (2000) studied various researches on economic epidemiology. Particularly, the study assesses the incidence of infectious illnesses and the impact of community health intermediations aimed to control the disease. He has highlighted variances in the estimates about short-term and long-term syndrome rate between balanced and epidemiological epidemics, the unusual impact of interferences while epidemics are normal, and the interest and chance of eradication of infectious diseases

Bloom and Mahal (1997) analyses the prerogative that AIDS epidemic will sluggish the rate of economic development. They have exhaustively scrutinized the relationship between occurrence of AIDS and the GDP growth rate per capita in 51

developed and emerging economies using engrained empirical growth equations to regulate number of issues that are probably associated with AIDS predominance and GDP growth. The study results reveal that there is insubstantial relationship between AIDS epidemic and GDP growth rate per capita income. Brainerd (2001) examined the extent of suicide epidemic due to economic instability in 22 nations like Russia, Belarus, Ukraine and the Baltic countries in the early 1990s using fixed-effect regression model. The results show that the male suicide rates are highly correlated with economic situation of the state along with "feedback" effect of male mortality crisis on suicide rates. On the contrary, female suicide rates are highly associated with consumption of alcohol rather than macroeconomic condition of the state.

McDonald and Robert (2005) examine the impact of AIDS and HIV epidemic on economic growth in Africa using econometric models. The study results reveal that the minimal effect on income per capita due to 1% rise in AIDS/HIV incidence rate is minus 0.59%, which is very much significant. Further, countries having low level of HIV prevalence rates, the marginal effects are considerable. Kalemli-Ozcan (2012) explores the outcome of AIDS/HIV outbreak on productiveness in Africa for the period 1985–2000 by applying country-level as well as regional-level data set. Amid approximations that abuse cross-sectional dissimilarity propose a constructive important effect of AIDS/HIV on fertility, while inside estimations which are recognized as off time series variation, reveal equally optimistic and undesirable consequences subject to variables used.

The impact of SARS epidemic is quite significant on the economy considering the source was China which has been the epicentre of foreign investment in Asia. During the year, this disease had a chain reaction across the economies (Lee and McKibbin 2004). The rapid stretch of SARS to innumerable nations, namely Vietnam, Singapore and Canada bring about global awareness to the fact that it was a fatal disease and was rapidly increasing (Siu and Wong 2004), although Siu and Wong (2004) could not found sketchy confirmation to point out that SARS epidemic had pessimistic impact on either domestic or global investment.

Karlsson and Nilsson (2014) examine the effect of the 1918 Spanish flu epidemic on economic activities in the short run and medium run in Sweden. The Spanish flu epidemic is considered to be one of the most severe and fatal epidemic in the history of human beings, although it received very little consideration from financial researchers. To estimate the impact of the epidemic, the authors try to achieve apparently explanatory deviation in occurrence rates of the epidemic amongst different regions in Sweden. The study results reveal an unparalleled labour supply shock and substantial rise in poorhouse rates, along with an indication of negative impact of the epidemic on capital returns, though; there are no sign of distinct effect on earnings. Cuddington and Hancock (1994) analyse the effect of HIV/AIDS on the growth path of Malawian economy including production capacity and other main macroeconomic variables by applying a modified Solow growth model. The findings show that annual average actual GDP growth during 1985–2010 is lower by 0.2–0.3% (1.2–1.5%) in the medium case. Consequently, the economic expansion during 2010 decreased since a real GDP of 5.03 billion Kwacha to 4.81–4.77 (3.80–3.46) billion Kwacha.

Acemoglu and Johnson (2007) try to analyse the impact of life expectation on financial activities from 1940s by examining scenario of improvement in global health care. They developed expected death applying preintervention death rates due to various diseases along with dates of worldwide involvements. Expected deaths do have huge effect on deviations in life expectancy that begin in 1940, although no impact has been found prior to 1940. By applying anticipated rates of transience, the study results reveal that due to 1% rise in life expectancy, the population increases by 1.7–2%, although the effect on total GDP is negligible. Moreover, the results do not show any effect of increase in life expectancy on per capita income.

Bhargava et al. (2001) examine the effect of adult survival rates (ASR) which is taken as an indicator of health on GDP growth rates at an interval of five years in different countries by taking into account GDP series panel data, on buying control alterations and exchange rates of domestic currency. They have analysed relationship between life expectancy and income, relationship between ASR and lagged GDP level along with issues pertaining to that of reverse causality and endogeneity. Bloom et al. (2005) try to investigate the economic impact of avian flu outbreak in the case of Asia applying various suppositions regarding the length and virulence of the outbreak of the disease. The avian flu outbreak in the latter half of 2003 caused severe destruction to the poultry farms in various countries. Having learnt from SARS epidemic in early 2003, the government was quite conscious in taking early preventive measures to arrest the epidemic by destroying the poultry farms, yet the relapse of the disease in 2005 reveal that the action was insufficient to arrest the pandemic and save human lives. The present investigation focuses on comparatively minor eruption, on the basis of past knowledge of earlier flu and SARS epidemics. The study examines the effect of avian flu epidemic on cumulative economic growth in the short run. Again, in the long run, it has been found that the prospective economic growth will be worsening thereby increasing poverty. It is found that the epidemic is expected to slow down the economic growth in Asia leading to a substantial decline in business and services.

MckKibbin and Sidorenko (2006) examine the effect of influenza epidemic on global economic growth over a variety of circumstances like, mild, moderate, severe and ultra during the twentieth century. The results show that even a slightest epidemic can substantially affect global economic output and is estimated to cause 1.4 million deaths and loss of 0.8% of GDP (USD 330 billion) in terms of economic output. And if the severity of the epidemic increases, the economic loss also rises. In ultra-scenario, an enormous economic recession occurs worldwide with more than 142.2 million casualties and USD 4.4 trillion loss of GDP. This configuration of the recession varies abruptly through the nations by means of a main change of universal resources from the worst affected nations to the lesser ones in continents like North America and Europe. Peckham (2013) analyses the correlation ship between the outbreak of H1N1 epidemic in 2009 and economic and financial crisis in an intra-financial system using "contagion" as a model for assessing the dynamics of both episodes. The findings reveal that the outbreak of the epidemic helped to figure out a model of economic infection, relative to economic disasters in developing markets in Southeast Asia.

Jorda et al. (2020) are of the view that noteworthy macroeconomic post effects of the contagion remains for about 40 years with real rate of return considerably low. However, real wages increase to certain extent after pandemic. A pandemic encourages dearth in labour and/or swing to savings made as a part of precaution. Cauchemez et al. (2009) in their study found out that amalgamation of school closure with other intervention might still be cost efficient from a community outlook.

Again Pike et al. (2010) concluded that worldwide harmonized epidemic prevention strategies need to be applied urgently to be optimally helpful and that strategies to diminish pandemics by reducing the shock of their fundamental drivers that are likely to be more successful than trade as usual. Smith et al. (2011) state that pandemic influenza would diminish gross domestic product (GDP). Another researcher, Barua (2020) states that COVID-19 is endangering the economies irrespective of developed, developing or underdeveloped economy. Moreover, financial structures are likely to be exposed to shocks to both the home and the host economic system (Beck et al. 2020; Cecchetti & Schoenholtz 2020).

The IMF head predicts that the contagion could damage worldwide economic growth this year, followed by a speedy economic recovery (Bangkok Post 2020). The COVID-19 impact on GDP is likely to through a difficult interaction of numerous factors discussed so far and so explaining the impact with standard macroeconomic models could be complex and incomplete (Baldwin and di Mauro 2020). Jonung and Roeger (2006) say that even though a pandemic would take a huge charge in human suffering, it would most likely not be a brutal hazard to the European macroeconomy.

Fan et al. (2016) state reasonably strict pandemics about 40% of inclusive cost outcomes from loss in income. For brutal pandemics, this fraction declines to 12%: the intrinsic cost of increased mortality becomes entirely dominant. Dietrich et al. (2020) state that the financial impact of the pandemic depends on whether monetary policy provides the reduction of natural interest rates or not across a short-run time horizon. Verikios et al. (2011) state province wealth is affected not only directly by the epidemic within their own province, but also indirectly by way of trade effects with other provinces affected by the pandemic at different stages of the event's universal spread. The mass of the decrease in global tourism of any pandemic will decide the size of the global effects.

Again, a good number of literatures on the effect of SARS on global economy have been reviewed in our study. A work conducted by Nippani and Washer (2004) pertaining to the field exhibits the application of Mann–Whitney nonparametric tests to inspect the shock of the SARS contagion on the stock markets of Canada, China, Hong Kong, Indonesia, the Philippines, Singapore, Thailand and Vietnam and found that SARS contagion had no pessimistic blow on the affected countries' stock markets with the exception of China and Vietnam. Nonetheless, the outcome generated from their research may not be adequate to completely address the impact of SARS contagion on stock markets as they neither integrate the process of the time varying co integration relation in their model specification nor including the control group in their empirical examination. Hence, this study pertains to the STVC model together DID model in order to explain the effect of the SARS contagion on the stock markets,

and the results provide a vital reference for the investors who look forward to spread their portfolios for risk management during a harsh contagion occurrence.

The results acquired by Chen et al. (2013) detail that the returns from the stock from the basic material industry in Hong Kong and from the service sector in the Philippines were influenced by local market emotion due to the SARS occurrence. The facts generated by these empirical studies substantiate that the investors would reply to the SARS occurrence through the modification of stock prices in several Asian countries' stock markets. Therefore, the monetary combination impact of the SARS occurrence could help to treat the probable effects on the economy and administering the other contagious disease occurrences. From the assumption that epidemics like SARS can occur in the near future, there should be a widespread representation about the possible effect of such epidemic on the economic combination. Again, Ali Md Nassir et al. (2010) illustrate that the investors over-responded to the SARS outbreak in terms of theatrical stock price decline in the Malaysian stock market. Hsieh (2013) unearths that the stock prices are more unpredictable in the trading days during some crisis periods (such as the SARS occurrence, 2002 antiterrorist war phase and the time of corporate governance arriving from the Enron scandal) than those during non-crisis phase.

From time to time, economists have tried to monitor the responses from the community in regard to the risk associated with well-being that has the propensity to be severe and fluctuating (Viscusi 1989, 1990), and an apparent transformation in the risk appetite of the investors could be found in the study by (Wong 2008). Chou et al. (2003) and Siu and Wong (2004) exhibit the results of the monetary effects of the SARS epidemic on different countries like China, Hong Kong and Taiwan. The untoward scenario due to the advent of SARS gives us the occasion to study the effects of a frightful disease on the economies of the victim nations (Nippani and Washer 2004).

In the healthcare sector, not only the individual reply was noted but, also the reactions in the economic market have been examined by Bennett et al. (2015). Existing researches give an insight into the association between SARS occurrences and the return from the stock markets. Chen et al. (2009) specify that the SARS calamity had some pessimistic blow on stock prices involving to the tourism, wholesale and retail sectors, but it affected stock prices linked with the biotechnology sector in a positive way. Chen et al. (2007) verify that the tourism sector witnessed the most severe dent in regard to stock price reduction in the Taiwan Stock Exchange (TSE) during the SARS occurrence phase.

Koo and Fu (2003) inform that in spite of the mental disturbance created by SARS epidemic, it could be estimated that negligible economic blow in the different countries. This induces that impact on financial activities could not be concluded now. Previous studies highlighted that economic costs relate to medical costs and cost relating to human life impact. A global perspective induces the possibility that a transmittable illness found in one country will transmit to another country and occurrence of more grave illness could cause terrible impact on the global economy (Smith 2006). Due to the advent of SARS, it got transmitted to the other countries by way of globalization and the impact can be found on the human community not

because of community transmission but due to the impact on one economy and its spillover effect on the other economies (Lee and McKibbin 2004).

References

Acemoglu D, Johnson S (2007) Disease and development: the effect of life expectancy on economic growth. J Polit Econ 115(6):925–985

Al-Awadhi AM, Al-Saifi K, Al-Awadhi A, Alhamadi S (2020) Death and contagious infectious diseases: impact of the COVID-19 virus on stock market returns. J Behav Exp Finan 100326

Barua S (2020) Understanding coronanomics: the economic implications of the coronavirus (COVID-19) pandemic. SSRN Electron J https://doi.org/10.1016/ggq92n

Beck BR, Shin B, Choi Y, Park S, Kang K (2020) Predicting commercially available antiviral drugs that may act on the novel coronavirus (SARS-CoV-2) through a drug-target interaction deep learning model. Comput Struct Biotechnol J

Bhargava A, Jamison TD, Lau LJ, Murray CJ (2001) Modelling the effects of health on economic growth. J Health Econ 20(3):423–440

Bloom D, Mahal AS (1997) Does the AIDS epidemic threaten economic growth? J Econ 77(1):105–124

Bloom E, Vincent W, Mary J, Carangal-San J (2005) Potential economic impact of an avian flu pandemic on Asia. Asian Development Bank. http://hdl.handle.net/11540/2165. ISSN 1655-5260. Accessed on 18 Mar 2020

Brainerd E (2001) Economic reform and mortality in the former Soviet Union: a study of the suicide epidemic in the 1990s. Eur Econ Rev 45(4–6):1007–1019

Brainerd E, Siegler M (2003) The economic effects of the 1918 influenza epidemic. CEPR Discussion Paper No. 3791. Available at SSRN https://ssrn.com/abstract=394606. Accessed on 18 Mar 2020

Cauchemez S, Donnelly CA, Reed C, Ghani AC, Fraser C, Kent CK, Finelli L, Ferguson NM (2009). Household transmission of 2009 pandemic influenza A (H1N1) virus in the United States. New England J Med 361(27):2619–2627

Cecchetti SG, Schoenholtz KL (2020) Contagion: bank runs and COVID-19. Economics in the Time of COVID-19 77

Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, Qiu Y, Wang J, Liu Y, Wei Y, Xia J Yu T, Zhang X, Zhang L(2020) Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 395:507–323

Cuddington JT, Hancock JD (1994) Assessing the impact of AIDS on the growth path of the Malawian economy. J Dev Econ 43(2):363–368

Jordà Ò, Singh SR, Taylor AM (2020) Longer-run economic consequences of pandemics (No. w26934). National Bureau of Economic Research

Kalemli-Ozcan S (2012) AIDS, "reversal" of the demographic transition and economic development: evidence from Africa. J Popul Econ 25:871–897

Karlsson M, Nilsson S (2014) The impact of the 1918 Spanish flu epidemic on economic performance in Sweden: an investigation into the consequences of an extraordinary mortality shock. J Health Econ 36:1–19

Lee JW, McKibbin WJ (2004) Estimating the global economic costs of SARS. InLearning from SARS: preparing for the next disease outbreak: workshop summary (pp. 92–109). Washington, DC: National Academies Press

McDonald S, Robert S (2005) AIDS and economic growth: a human capital approach. J Dev Econ 54(2):265–289

MckKibbin WJ, Sidorenko AA (2006) Global macroeconomic consequences of pandemic influenza. Centre for Applied Macroeconomic Analysis, Crawford School of Public Policy, The Australian National University

McKibbin WJ, Sidorenko A (2006) Global macroeconomic consequences of pandemic influenza (p. 79). Sydney, Australia: Lowy Institute for International Policy

Peckham R (2013) Economies of contagion: financial crisis and pandemic. Economy and Soc 42(2):226–248. https://doi.org/10.1080/03085147.2012.718626. Accessed on 18 Mar 2020

Philipson T (2000) Economic epidemiology and infectious diseases. In Handbook of Health Economics, Vol. I, AJ Cuyler and JP Newhouse (eds) Amsterdam: North Holland

Pike A, Dawley S, Tomaney J (2010). Resilience, adaptation and adaptability. Cambridge J Reg Econ Soc 3(1):59–70 https://doi.org/10.1093/cjres/rsq001

Chapter 7
Objectives and Methodology of the Study

7.1 Objectives

In the wake of the COVID-19 pandemic that has created a shockwave throughout the world, in terms of both death and insurmountable economic loss, the present study aims to examine the impact of the outbreak of the disease on the world economy in general and more specifically:

- To find out the broad impact of COVID-19 pandemic on the stock markets of China, South Korea, India, UK, USA, Russia, Brazil, Italy, Japan, France, Germany, Canada and South Africa;
- To examine the impact of COVID-19 pandemic on crude oil prices;
- To analyse the dynamic relationship between COVID-19 pandemic, crude oil prices and stock markets in China, South Korea, India, UK, USA, Russia, Brazil, Italy, Japan, France, Germany, Canada and South Africa.
- To identify the presence of short-run causality (if any) between COVID-19 pandemic and the stock markets of China, South Korea, India, UK, USA, Russia, Brazil, Italy, Japan, France, Germany, Canada and South Africa;
- To examine the existence of short-run causality between COVID-19 pandemic and crude oil prices;
- To investigate the impact of COVID-19 pandemic on crude oil price volatility and
- To assess the impact of the outbreak of COVID-19 pandemic on the volatility of the stock markets of China, South Korea, India, UK, USA, Russia, Brazil, Italy, Japan, France, Germany, Canada and South Africa.

7.2 Methodology

7.2.1 Data Set and Econometric Tools

This study is based on daily data of the closing indices of West Texas Intermediate (WTI) crude oil prices. In our study, we have considered Shanghai composite (stock index of China), KOSPI (stock index of South Korea), BSE SENSEX (stock index of India), FTSE 100 (stock index of UK), NASDAQ 100 (stock index of USA), MOEX (stock index of Russia), BOVESPA (stock index of Brazil), FTSE MIB (stock index of Italy), Nikkei 225 (stock index of Japan), CAC 40 (stock index of France), DAX 30 (stock index of Germany), S&P TSX (stock index of Canada) and FTSE/JSE (stock index of South Africa). The outbreak of COVID-19 pandemic is represented by dummy variables. We have also created COVID-19 dummy variable which indicates the outbreak period of the disease. The period of the outbreak of COVID-19 pandemic is represented by dummy variable with "1" implying that the period from 1 January 2020 and "0" otherwise. For better analysis, all the raw values have been converted into corresponding log values.

The COVID-19 disease first erupted on 31 December 2019, in Wuhan, the sprawling capital of Central China's Hubei province. In order to measure the impact of the disease, we have decided to begin the study period three months earlier of the outbreak, i.e. from 01 October 2019 and continued up to 22 May 2020. For examining the stationarity of the data set, Phillips–Perron (PP) unit root test has been applied apart from using descriptive statistics. Subsequently, Johansen cointegration test has been applied to check out the relationship between the variables used in the study. To measure the short-run causality amongst the variables, Wald test for Granger causality is also applied. To measure the effect on crude oil price and stock market volatility, GARCH-dummy variable models like GARCH (1, 1), EGARCH and TARCH by including dummy variables have been used. Finally, we have also applied Bai–Perron test to identify structural breaks during our study period.

7.2.2 The GARCH-Dummy Variable Models

Due to the uncomplicatedness and improved approximation in several studies, GARCH-type models as recommended by Bollerslev (1986) are commonly accepted in various event studies for identification of structural breaks that may occur because of some particular events, whether economic or some other. Again, researchers like Campbell et al. (1997) advocated for applying event studies for identification of any particular event that may be the reason for substantial anomalous returns on fundamental securities. According to Binder (1998), the best prevalent event study approach is to apply event dummy variables into various regression models. Nikkinen et al. (2006) is of the opinion that implications for impact of the events occurred depend on estimation for coefficients of the dummy variables (Lu and Chen 2011).

In the case of volatility, Engle's (1982) approaching was to put the conditional values of a series of errors, ε_t's, as a function of lagged errors, time (t), factors and fixed variables as, where $z_t \sim$ i.i.d with $E(z_t) = 0$, $E(z_t) = 1$ and ε_t is not serially correlated and has zero mean. Nevertheless, the conditional variance of ε_t conditioned on the entire existing information at time $t-1$ as:

$$\sigma_t^2 = \omega + \sum \sigma_i \varepsilon_{t-1}^2 (i = 1 \ldots p), \tag{7.1}$$

where ω and α_i's are positive constants sequentially in support of σ_t^2 is positive. This model $\sigma_t^2 = \omega + \sum \sigma_i \varepsilon_{t-1}^2 (i = 1 \ldots p)$ is prepared to portray volatility as the clustering of large influences to the dependent variable. Bollerslev (1986) extended the ARCH model into the GARCH model in the midst of signifying a higher-order ARCH and authorizing the past conditional variances. The GARCH (p, q) can be symbolized as:

$$\sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2, \tag{7.2}$$

where σ_t^2 is a function of lagged values of ε_t^2 and ω, $\{\sigma_i\}$, $i = 1 \ldots p$ and $\{\beta_j\}$, $j = 1 \ldots q$ are positive constants. Both Bera and Higgins (1991) and Bollerslev, Chou and Kroner (1992) described GARCH as:

$$\varepsilon_t^2 = \omega + \sum_{i=1}^{p} (\alpha_i + \beta_i)\varepsilon_{t-i}^2 - \sum_{j=1}^{p} \beta_i \left[\varepsilon_{t-j}^2 - \sigma_{t-j}^2 \right] + \left[\varepsilon_t^2 - \sigma_{t-j}^2 \right] \tag{7.3}$$

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 = (\omega/1 - \beta) + \sigma \Sigma \beta^i \varepsilon_{t-i-j}^2 (i = 0 \ldots \text{infinity}) \tag{7.4}$$

Nelson (1991), the first researcher of leverage effects model, introduced exponential GARCH model in the case of excess conditional kurtosis using a generalized exponential distribution. He confirmed that the downward movements are more powerful for forecasting volatility than the rising movements. This can be symbolized as:

$$\log \sigma_t^2 = \omega + \sum_{i=1}^{p} \beta_i \log \sigma_{t-i}^2 + \sum_{j=1}^{p} \sigma_i \left\{ (|\varepsilon_{t-i}|)/\sigma_{j-i} \right\} + \sum_{i=1}^{p} \gamma_i \left(\varepsilon_{t-i}/\sigma_{t-j} \right) \tag{7.5}$$

This model (7.5) tolerates positive and negative values of ε_t to have unlike shocks on volatility. The EGARCH model is asymmetric for the reason that the level $|\varepsilon_{t-i}|/\sigma_{j-i}$ is integrated with coefficient γ_i. As this coefficient is usually negative, positive impacts make less volatility than negative impacts and all other things being equal. Glosten et al. (1993) established the threshold GARCH after adding up the negative shock of leverage in the conditional variance and the design for the conditional variance is specified as:

$$\varepsilon_t^2 = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \gamma \varepsilon_{t-1}^2 d_{t-1} + \sum_{i=1}^{p} \beta_i \sigma_{t-i}^2 \qquad (7.6)$$

where $d_t = 1$ if $\varepsilon_t < 0$, and 0 or else. In TARCH or GJR model, positive information when $\varepsilon_t > 0$ and negative information when $\varepsilon_t < 0$, this has discrepancy impacts on the conditional variance. Positive information has a shock of α, whereas negative information has an impact of $(\alpha + \gamma)$. If $\gamma > 0$, we state that the leverage impact subsists and if $\gamma \neq 0$, the information impact is asymmetric. Therefore, it can be seen that markets are more volatile once there is negative information.

In this study, we adopt GARCH models by using dummy variables as formulated by Lu and Chen (2011). Although this model has limitations for short event window, the model of GARCH-dummy methodology as applied by Lu and Chen (2011) provides useful advises and statistical inferences.

The works of Engle (1982) and Bollerslev (1986) show that several commercial and financial time series data possess provisionally endogenous volatility structure. Bollerslev (1986) suggests a GARCH model that uses the stuff of provisionally endogenous volatility and delivers further precise predictions in comparison to conventional regression models. Contrasting to CLRM that assumes volatility as constant and time invariant, GARCH models consider that one-step-ahead restricted variance be dependent on existing accessible evidence (Lu and Chen 2011). Now, the mean structure model as proposed by Lu and Chen (2011) is given below:

$$X_t = \beta_0 + \sum_{i=1}^{k} \beta i \, Y it + \mu \, t, \, \mu \, t|_{It-1} \sim M(0, ht) \qquad (7.7)$$

where Y's are lagged endogenous and/or exogenous variables; I_{t-1} is the information accumulated up to time $t - 1$. Then, the GARCH (q, p) regression model further specifies a conditional variance regression model which is as follows:

$$N_t = \gamma_0 + \sum_{j=1}^{q} \gamma_i \mu_{t-j}^2 + \sum_{k=1}^{p} \delta_k N_{t-k} \qquad (7.8)$$

In Eq. 7.8, γ_i and δ_k are subject to the constraints: $\sum_{j=1}^{q} \gamma i + \sum_{k=1}^{p} \delta k < 1$ and $\gamma_i \delta_k > 0$. French et al. (1987), Franses and Van Dijk (1996) and Chong et al. (1999) have already proved the efficacy of GARCH (1, 1) model in analysing economic time series data. In tune with these studies, Lu and Chen (2011) have also applied this model in analysing business and economic time series data. Researchers like Edison and Reinhart (2001), Bologna and Cavallo (2002), Mazouz and Bowe (2009) and Lu and Chen (2011) used dummy variable methodology in their event studies. In our present study, we adopt a GARCH-dummy model as proposed by Lu and Chen (2011):

$$X_t = \lambda_0 + \sum_{i=1}^{l} \lambda i\, Yi + \mu\, t, \mu\, t|\, \mathrm{I}_{t-1} \sim M(0, ht) \qquad (7.9)$$

$$N_t = \gamma_0 + \sum_{j=1}^{p} \gamma_i \mu_{t-j}^2 + \sum_{k=1}^{q} \delta_k N_{t-k} + \beta d_t \qquad (7.10)$$

where d_t is defined as the dummy variable for a particular event window $\{s_1, s_2\}$ ($d_t = 1$, if $s_1 \le t \le s_2$; $= 0$ otherwise).

References

Binder J (1998) The event study methodology since 1969. Rev Quant Financ Acc 11(2):111–137

Bollerslev T (1986) Generalized autoregressive conditional heteroskedasticity. J Econ 31(3):307–327

Bologna P, Cavallo L (2002) Does the introduction of stock index futures effectively reduce stock market volatility? Is the 'futures effect' immediate? Evidence from the Italian stock exchange using GARCH. Appl Financ Econ 12(3):183–192

Campbell J, Lo A, Mackinlay A (1997) The econometrics of financial market. Princeton University Press, Princeton

Chong CC, Ahmad MI, Abdullah MY (1999) Performance of GARCH models in forecasting stock market volatility. J Forecast 18(5):333–443

Edison H, Reinhart CM (2001) Stopping hot money. J Dev Econ 66(2):533–553

Franses PH, Van Dijk D (1996) Forecasting stock market volatility using (non-linear) GARCH models. J Forecast 15(3):229–235

French K, Schwert G, Stambaugh R (1987) Expected stock returns and volatility. J Financ Econ 19:3–30

Glosten RT, Jagannathan R, Runkle D (1993) On the relation between the expected value and the volatility of the nominal excess return on stocks. J Finance 48:1779–1801

Lu Y, Chen W (2011) Unreliable inference for business and economic event studies based onvariance dummy variable in a GARCH regression model. J Appl Bus Econ 12(5):45–53

Mazouz K, Bowe M (2009) Does options listing impact on the time-varying risk characteristics of the underlying stocks? Evidence from NYSE stocks listed on the CBOE. Appl Financ Econ 19(3):203–212

Nikkinen J, Nikkinen S, Sahlstrom P, Vahamaa V (2006) Implied volatility linkages among major European currencies. J Int Financ Markets Inst Money 16:87–103

Chapter 8
Analysis and Findings

8.1 Descriptive Statistics

Tables 8.1 and 8.2 show the descriptive statistics of all the variables. Probability value suggests that all the variables are normal except Shanghai composite and NASDAQ 100 due to *p* value more than 0.05. The variables have 169 samples during the study period. During the study period, prices of crude oil rose to 2.9052 and came down to 1.0004 with a mean price of 1.6285. The Shanghai composite rose to 3.4935 and came down to 3.4249 with a mean point of 3.4652. The KOSPI rose to 3.3554 and came down to 3.1636 with a mean point of 3.308. The BSE SENSEX rose to 4.6227 and came down to 4.4146 with a mean point of 4.5677. The FTSE 100 rose to 3.885 and came down to 3.6984 with a mean point of 3.8299. The NASDAQ 100 rose to 3.9876 and came down to 3.8455 with a mean point of 3.9296. The MOEX rose to 3.9207 and came down to 3.3248 with a mean point of 3.4965. BOVESPA rose to 5.0774 and came down to 4.8032 with a mean point of 4.9932. FTSE MIB rose to 4.4061 and came down to 4.173 with a mean point of 4.3221. NIKKEI 225 rose to 4.3817 and came down to 4.2188 with a mean point of 4.3367. CAC 40 rose to 8.7178 and came down to 8.2308 with a mean point of 8.5784. DAX 30 rose to 9.5316 and came down to 9.0409 with a mean point of 9.3966. S&P TSX rose to 9.795 and came down to 9.3262 with a mean point of 9.6761. FTSE/JSE rose to 8.1711 and came down to 7.7122 with a mean point of 8.0667. The variables like crude oil KOSPI and MOEX possess "fat tails", and all the select variables are normally distributed.

8.2 Unit Root Test

Table 8.3 portrays the unit root test as stated by Phillips–Perron (1988). The Phillips–Perron test identifies the presence of unit root in a time series data. The results show that *p* value is more than 1% at level, but it is less than 1% at first difference indicating

Table 8.1 Descriptive statistics

	Crude oil (WTI)	Shanghai composite	KOSPI	BSE SENSEX	FTSE 100	NASDAQ 100	MOEX	BOVESPA
Mean	1.6285	3.4652	3.308	4.5677	3.8299	3.9296	3.4965	4.9932
Median	1.7227	3.4645	3.3189	4.6008	3.8593	3.9329	3.4676	5.0293
Maximum	2.9052	3.4935	3.3554	4.6227	3.885	3.9876	3.9207	5.0774
Minimum	1.0004	3.4249	3.1636	4.4146	3.6984	3.8455	3.3248	4.8032
Std. Dev.	0.2151	0.0141	0.0382	0.0582	0.0542	0.0315	0.1331	0.0768
Skewness	0.3809	−0.2384	−1.3255	−0.8817	−0.7878	−0.3466	2.4169	−0.7405
Kurtosis	9.4231	2.6896	4.6685	2.233	2.0497	2.5571	7.6824	1.9755
Jarque–Bera	294.5993	2.2802	69.0932	26.043	23.8425	4.7649	318.9264	22.8365
Probability	0	0.3197	0	0	0	0.0923	0	0
Sum	275.2321	585.6272	559.056	771.9416	647.261	664.116	590.9248	843.865
Sum Sq. Dev.	7.7796	0.0337	0.24461	0.5707	0.495	0.1668	2.9802	0.9919
Observations	169	169	169	169	169	169	169	169

Table 8.2 Descriptive statistics

	FTSE MIB	Nikkei 225	CAC 40	DAX 30	S&P TSX	FTSE/JSE	COVID-19
Mean	4.3221	4.3367	8.5784	9.3966	9.6761	8.0667	0.6153
Median	4.3565	4.3589	8.6534	9.4657	9.7213	8.1216	1
Maximum	4.4061	4.3817	8.7178	9.5316	9.795	8.1711	1
Minimum	4.173	4.2188	8.2308	9.0409	9.3262	7.7122	0
Std. Dev.	0.0674	0.0429	0.1427	0.1267	0.1061	0.1094	0.4879
Skewness	−0.7107	−0.922	−0.7617	−0.9466	−1.1581	−1.3049	−0.4743
Kurtosis	1.8568	2.8029	1.9668	2.7177	3.4458	3.8963	1.225
Jarque–Bera	23.4316	24.2218	23.8591	25.8033	39.1772	53.6207	28.5231
Probability	0	0	0	0	0	0	0
Sum	730.4479	732.9158	1449.754	1588.038	1635.273	1363.288	104
Sum Sq. Dev.	0.7635	0.31	3.4251	2.6985	1.8932	2.0133	40
Observations	169	169	169	169	169	169	169

Table 8.3 Phillips–Perron unit root test

Phillips–Perron test						
At level (intercept only)				At first difference (intercept only)		
Variables	t-statistics	p-values		Variables	t-statistics	p-values
Crude oil (WTI)	−1.7334	0.41		Crude oil (WTI)	−10.5862	0
Shanghai composite (China)	−2.2601	0.19		Shanghai composite (China)	−14.0988	0
KOSPI (South Korea)	−1.9437	0.31		KOSPI (South Korea)	−5.3943	0
BSE SENSEX (India)	−1.1448	0.7		BSE SENSEX (India)	−2.9253	0.04
FTSE 100 (UK)	−1.096	0.72		FTSE 100 (UK)	−3.6028	0.01
NASDAQ 100 (USA)	−2.21	0.2		NASDAQ 100 (USA)	−3.8585	0
MOEX (Russia)	−2.6618	0.08		MOEX (Russia)	−12.1097	0
BOVESPA (Brazil)	−1.1088	0.71		BOVESPA (Brazil)	−3.8625	0
FTSE MIB (Italy)	−1.0983	0.72		FTSE MIB (Italy)	−4.7377	0
Nikkei 225 (Japan)	−1.365	0.6		Nikkei 225 (Japan)	−7.3443	0
CAC 40 (France)	−0.9168	0.78		CAC 40 (France)	−4.1892	0
DAX 30 (Germany)	−1.6256	0.47		DAX 30 (Germany)	−3.5897	0.01
S&P TSX (Canada)	−1.7229	0.42		S&P TSX (Canada)	−3.7359	0
FTSE/JSE (South Africa)	−1.3345	0.61		FTSE/JSE (South Africa)	−4.6691	0
COVID-19	−1.261	0.65		COVID-19	−12.9228	0

that the data is non-stationary at level and stationary at first difference. This means there is unit root at level, but there is no unit root at first difference for all the share markets along with crude oil prices and the dummy variable COVID-19.

8.3 Johansen Cointegration Test

A cointegration test is run to identify whether there is long-run relationship between two or more variables as proposed by Johansen in the year 1991 despite the fact that the series are trending either upward or downward. Tables 8.4, 8.5, 8.6, 8.7, 8.8, 8.9, 8.10, 8.11, 8.12, 8.13, 8.14, 8.15, 8.16 and 8.17 show the co integration amongst the variables as proposed by Johansen. A significant p value suggests that only crude oil price moves in same direction along with COVID-19 across a long time horizon as they have a long-run relationship. Crude oil has a p value of 0.0254 indicating presence of one cointegrating factor. Due to an insignificant p value (0.642) from cointegration test, we can conclude that Shanghai composite do not have long-run relationship with COVID-19. KOSPI has an insignificant p value of 0.751 indicating no long-run relationship. BSE SENSEX has a p value of 0.211, FTSE 100 has a p value of 0.846, NASDAQ 100 has a p value of 0.947, MOEX has a p value of 0.704, BOVESPA has a p value of 0.255, FTSE MIB has a p value of 0.915, Nikkei 225 has a p value of 0.492, CAC 40 has a p value of 0.83, DAX 30 has a p value of 0.81, S&P TSX has a p value of 0.85 and FTSE/JSE has a p value of 0.77 which indicates that they do not possess any long-run relationship with COVID-19 or do not move in same direction across a long-run time horizon.

Table 8.4 Johansen cointegration test for crude oil and COVID-19

Crude oil and COVID-19							
No. of cointegration equations	Eigen value	Trace statistics	0.05 critical value	p-value	Max-eigenvalue	0.05 critical value	p-value
None*	0.127528	16.09886	15.49471	0.0405	16.09807	14.2646	0.0254
At most 1	6.66E−06	0.000786	3.841466	0.9783	0.000786	3.841466	0.9783
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level							

Table 8.5 Johansen cointegration test for Shanghai composite and COVID-19

Shanghai composite and COVID-19							
No. of cointegration equations	Eigenvalue	Trace statistics	0.05 critical value	p-value	Max-eigenvalue	0.05 critical value	p-value
None	0.047745	7.27278	15.49471	0.5461	5.772839	14.2646	0.6425
At most 1	0.012631	1.499941	3.841466	0.2207	1.499941	3.841466	0.2207

Table 8.6 Johansen cointegration test for KOSPI and COVID-19

KOSPI and COVID-19							
No. of cointegration equations	Eigenvalue	Trace statistics	0.05 critical value	*p*-value	Max-eigenvalue	0.05 critical value	*p*-value
None	0.040878	5.315045	15.49471	0.7745	4.924917	14.2646	0.7513
At most 1	0.003301	0.390128	3.841466	0.5322	0.390128	3.841466	0.5322

Table 8.7 Johansen cointegration test for BSE SENSEX and COVID-19

BSE SENSEX and COVID-19							
No. of cointegration equations	Eigenvalue	Trace statistics	0.05 critical value	*p*-value	Max-eigenvalue	0.05 critical value	*p*-value
None	0.081263	10.05407	15.49471	0.2766	10.0012	14.2646	0.2118
At most 1	0.000448	0.05287	3.841466	0.8181	0.05287	3.841466	0.8181

Table 8.8 Johansen cointegration test for FTSE 100 and COVID-19

FTSE 100 and COVID-19							
No. of cointegration equations	Eigenvalue	Trace statistics	0.05 critical value	*p*-value	Max-eigenvalue	0.05 critical value	*p*-value
None	0.034323	4.568602	15.49471	0.8528	4.121244	14.2646	0.8463
At most 1	0.003784	0.447358	3.841466	0.5036	0.447358	3.841466	0.5036

Table 8.9 Johansen cointegration test for NASDAQ 100 and COVID-19

NASDAQ and COVID-19							
No. of cointegration equations	Eigenvalue	Trace statistics	0.05 critical value	*p*-value	Max-eigenvalue	0.05 critical value	*p*-value
None	0.02507	5.00208	15.49471	0.8086	2.995932	14.2646	0.947
At most 1	0.016858	2.006149	3.841466	0.1567	2.006149	3.841466	0.1567

Table 8.10 Johansen cointegration test for MOEX and COVID-19

MOEX and COVID-19							
No. of cointegration equations	Eigenvalue	Trace statistics	0.05 critical value	*p*-value	Max-eigenvalue	0.05 critical value	*p*-value
None	0.043891	6.824373	15.49471	0.5982	5.296279	14.2646	0.7041
At most 1	0.012866	1.528093	3.841466	0.2164	1.528093	3.841466	0.2164

Table 8.11 Johansen cointegration test for BOVESPA and COVID-19

BOVESPA and COVID-19							
No. of cointegration equations	Eigenvalue	Trace statistics	0.05 critical Value	*p*-value	Max-Eigen value	0.05 critical value	*p*-value
None	0.076455	9.519987	15.49471	0.3195	9.385227	14.2646	0.2555
At most 1	0.001141	0.13476	3.841466	0.7135	0.13476	3.841466	0.7135

Table 8.12 Johansen cointegration test for FTSE MIB and COVID-19

FTSE MIB and COVID-19							
No. of cointegration equations	Eigenvalue	Trace statistics	0.05 critical value	*p*-value	Max-eigenvalue	0.05 critical value	*p*-value
None	0.028549	4.970676	15.49471	0.8119	3.417804	14.2646	0.9151
At most 1	0.013074	1.552871	3.841466	0.2127	1.552871	3.841466	0.2127

Table 8.13 Johansen cointegration test for Nikkei225 and COVID-19

Nikkei and COVID-19							
No. of cointegration equations	Eigenvalue	Trace statistics	0.05 critical value	*p*-value	Max-eigenvalue	0.05 critical value	*p*-value
None	0.057349	7.139682	15.49471	0.5615	6.968965	14.2646	0.4928
At most 1	0.001446	0.170717	3.841466	0.6795	0.170717	3.841466	0.6795

Table 8.14 Johansen cointegration test for CAC 40 and COVID-19

CAC 40 and COVID-19							
No. of cointegration equations	Eigenvalue	Trace statistics	0.05 critical value	*p*-value	Max-eigenvalue	0.05 critical value	*p*-value
None	0.0259	5.9181	15.4947	0.71	4.31	14.2646	0.83
At most 1	0.0097	1.6081	3.8414	0.2	1.6081	3.8414	0.2

Table 8.15 Johansen cointegration test for DAX 30 and COVID-19

DAX and COVID-19							
No. of cointegration equations	Eigenvalue	Trace statistics	0.05 critical value	*p*-value	Max-eigenvalue	0.05 critical value	*p*-value
None	0.0267	6.1216	15.4947	0.68	4.4396	14.2646	0.81
At most 1	0.0102	1.6819	3.8414	0.19	1.6819	3.8414	0.19

Table 8.16 Johansen cointegration test for S&P TSX and COVID-19

S&P TSX and COVID-19							
No. of cointegration equations	Eigenvalue	Trace statistics	0.05 critical value	*p*-value	Max-eigenvalue	0.05 critical value	*p*-value
None	0.0243	5.7856	15.4947	0.72	4.0406	14.2646	0.85
At most 1	0.0105	1.745	3.8414	0.19	1.745	3.8414	0.19

Table 8.17 Johansen cointegration test for FTSE/JSE and COVID-19

FTSE/JSE and COVID-19							
No. of cointegration equations	Eigenvalue	Trace statistics	0.05 critical value	*p*-value	Max-eigenvalue	0.05 critical value	*p*-value
None	0.0286	6.5009	15.4947	0.64	4.7755	14.2646	0.77
At most 1	0.0104	1.7253	3.8414	0.19	1.7253	3.8414	0.19

The results are quite expected as the pandemic first out broke on 31 December 2019, in Wuhan in China which gradually spread across the countries in Europe with the first patient diagnosed with the disease in Italy and UK on 31 January 2020, and during the first week of February in India and also in USA. Japan, Russia, South Korea and Brazil also reported their first confirmed COVID-19 patient later in February, and numbers of infection were also quite low in these countries. It is pertinent to note that the period of our study spans up to 14 April 2020, i.e. we have collected our data set up to this date. Moreover, at the beginning, the stock markets also remain unaffected by the outbreak of COVID-19 and that is why we do not find any long-term relationship till 14 April 2020.

As per the reports published by the economic times on 11 April 2020, vast swaths of American businesses are being shut down for an indefinite period and the ongoing economic quarter will probably experience the worst fall in economic activities since the global recession of 2008–2009. But, still the closing value of S&P 500 on 9 April 2020, increased by 25 per cent from its recent low on 23 March 2020. Moreover, in the year 2020, it is down by only 14 per cent and is up from its levels of just eleven months back. According to the experts, two dominant powers are pushing in opposite directions. Trade and businesses are being disrupted to a seemingly worst degree. But, on the other hand, American stock investors are betting that powerful intervention programme with an estimated lending package of USD 2.3 trillion, from the Federal Reserve will be sufficient for the major companies to continue their operations with feeble loss to their long term profitability. Big business corporations that are the key constituents of the major US stock indices tend to have reliable access to capital, specifically after the announcement made by Federal Reserve to boost up corporate lending (http://m.economictimes.com/markets/stocks/news/everything-is-awful-so-why-is-the-stock-market-booming/amp/_articleshow/75094889/).

8.4 Bai–Perron Test

The Bai–Perron test was developed by Bai and Perron (1998) to identify the multiple structural changes occurring at unknown dates in a time series data. This test provides us the benefit of selecting structural breaks endogenously. This test can be applied with a large sample size of at least more than 100. The Bai–Perron test can be represented through an equation in the following way:

$$y_t = x_t' \beta + z_t' \partial_j + u_t \tag{8.1}$$

The Tables 8.18 and 8.19 show the results of Bai-Perron test (1998) applied to check the structural breaks in a time series data. Results show that during the study period, change point occurs from 5 March 2020 to 20 March 2020, in all the variables except COVID-19. Crude oil price has a break point on 9 March 2020. Shanghai composite has a break point on 13 March, 2020, KOSPI has a break point on 9 March, 2020, BSE SENSEX has a break point on 12 March 2020, FTSE 100 has a break point on 6 March 2020, NASDAQ 100 has break point on 22 November 2019, MOEX has a break point on 20 March 2020, BOVESPA has a break point on 6 March 2020, FTSE MIB has a break point on 6 March 2020, Nikkei 225 has a break point on 5 March 2020, CAC 40 has a break point on 6 March 2020, DAX 30 has a break point on 5 March 2020, S&P TSX has a break point on 6 March 2020, FTSE/JSE has a break point on 6 March 2020 and the dummy variable COVID-19 has a break point on 31 December 2019. The change/break point in a time series data structure indicates a change in the nature of a data due to any shock from the universal scenario, and we anticipate that it might be COVID-19 in this case.

Table 8.18 Bai-Perron test

Crude oil (WTI)	Shanghai composite (China)	KOSPI (South Korea)	BSE SENSEX (India)	FTSE 100 (UK)	NASDAQ 100 (USA)	MOEX (Russia)	BOVESPA (Brazil)
9 March 2020	13 March 2020	9 March 2020	12 March 2020	6 March 2020	12 March 2020	20 March 2020	6 March 2020

Table 8.19 Bai-Perron test

FTSE MIB (Italy)	NIKKEI 225 (Japan)	CAC 40 (France)	DAX 30 (Germany)	S&P TSX (Canada)	FTSE/JSE (South Africa)	COVID-19
6 March 2020	5 March 2020	6 March 2020	5 March 2020	6 March 2020	6 March 2020	31 December 2019

8.5 Wald Test

Table 8.20 displays the results of Wald test which predicts the short-run causality between the variables. In this study, our independent variable is COVID-19 and dependent variables are crude oil, Shanghai composite, KOSPI, BSE SENSEX, FTSE 100, NASDAQ 100, MOEX, BOVESPA, FTSE MIB, Nikkei 225, CAC 40, DAX 30, S&P TSX and FTSE/JSE. Our null hypothesis is $C(1) = 0$. We see that crude oil and COVID-19 have a p value of 0, which is less than 1% with f statistic 203.5472, t statistic 14.267 and chi square 203.5472 indicating a significant model. Shanghai composite and COVID-19 has a p value of 0, which is less than 1% with f statistic 267.9476, t statistic 16.3691 and chi square 267.9476 indicating a significant model. So, we may conclude that both Shanghai composite and COVID-19 have short-run causality or both the variables moves together across a short-run time horizon. We see that KOSPI and COVID-19 have a p value of 0, which is less than 1% with f statistic 264.379, t statistic 16.2597 and chi square 264.379 indicating a significant model. Thus, it may be concluded that both KOSPI and COVID-19 have short-run causality or both the variables move together across a short-run time horizon. We see that BSE SENSEX and COVID-19 have a p value of 0, which is less than 1% with f statistic 262.1822, t statistic 16.192 and chi square 262.1822 indicating a significant model. So, we may conclude that both BSE SENSEX and COVID-19 have short-run causality or both the variables moves together across a short run time horizon. We see that FTSE 100 and COVID-19 has a p value of 0, which is less than 1% with f statistic 260.8829, t statistic 16.1518 and chi square 260.8829 indicating

Table 8.20 Wald test

Null hypothesis: $C(1) = 0$					
Dependent variable	Independent variable	f-statistic	t-statistic	Chi square	Probability
Crude oil	COVID-19	203.5472	14.267	203.5472	0
Shanghai composite		267.9476	16.3691	267.9476	0
KOSPI		264.379	16.2597	264.379	0
BSE SENSEX		262.1822	16.192	262.1822	0
FTSE 100		260.8829	16.1518	260.8829	0
NASDAQ 100		272.2124	16.4988	272.2124	0
MOEX		276.6981	16.6342	276.6981	0
BOVESPA		261.592	16.1738	261.592	0
FTSE MIB		260.9667	16.1544	260.9667	0
Nikkei 225		263.7742	16.2411	263.7742	0
CAC 40		259.8572	16.12	259.8572	0
DAX 30		262.0643	16.1884	262.0643	0
S&P TSX		264.1376	16.2523	264.1376	0
FTSE/JSE		261.7019	16.1772	261.7019	0

a significant model. So, we may conclude that both FTSE 100 and COVID-19 have short-run causality or both the variables moves together across a short-run time horizon. We see that NASDAQ 100 and COVID-19 have a p value of 0, which is less than 1% with f statistic 272.2124, t statistic 16.4988 and chi square 272.2124 indicating a significant model. So, we may conclude that both NASDAQ 100 and COVID-19 have short-run causality or both the variables move together across a short-run time horizon. We see that MOEX and COVID-19 have a p value of 0, which is less than 1% with f statistic 276.6981, t statistic 16.6342 and chi square 276.6981 indicating a significant model. So, we may conclude that both MOEX and COVID-19 have short-run causality or both the variables move together across a short-run time horizon. We see that BOVESPA and COVID-19 has a p value of 0, which is less than 1% with f statistic 261.592, t statistic 16.1738 and chi square 261.592 indicating a significant model. So, we may conclude that both BOVESPA and COVID-19 have short-run causality or both the variables move together across a short-run time horizon. We see that FTSE MIB and COVID-19 have a p value of 0, which is less than 1% with f statistic 260.9667, t statistic 16.1544 and chi square 260.9667 indicating a significant model. So, we may conclude that both FTSE MIB and COVID-19 have short-run causality or both the variables move together across a short-run time horizon. We see that Nikkei 225 and COVID-19 have a p value of 0, which is less than 1% with f statistic 263.7742, t statistic 16.2411 and chi square 263.7742 indicating a significant model. So, we may conclude that both Nikkei 225 and COVID-19 have short-run causality or both the variables move together across a short-run time horizon. We see that CAC 40 and COVID-19 have a p value of 0, which is less than 1% with f statistic 259.8572, t statistic 16.12 and chi square 259.8572 indicating a significant model. So, we may conclude that both CAC 40 and COVID-19 have short-run causality or both the variables move together across a short-run time horizon. It may be observed that DAX 30 and COVID-19 have a p value of 0, which is less than 1% with f statistic 262.0643, t statistic 16.1884 and chi square 262.0643 indicating a significant model. So, we may conclude that both DAX and COVID 19 have short-run causality or both the variables move together across a short-run time horizon. We see that S&P TSX and COVID 19 have a p value of 0, which is less than 1% with f statistic 264.1376, t statistic 16.2523 and chi square 264.1376 indicating a significant model. So, we may conclude that both S&P TSX and COVID 19 have short-run causality or both the variables move together across a short-run time horizon. It is shown that FTSE/JSE and COVID-19 have a p value of 0, which is less than 1% with f statistic 261.7019, t statistic 16.1772 and chi square 261.7019 indicating a significant model. So, we may conclude that both FTSE/JSE and COVID-19 have short-run causality or both the variables move together across a short-run time horizon.

Table 8.21 GARCH with volatility breaks

Variables	Dummy coefficient (time dummy taken from 31 December 2019)	Dummy coefficient (time dummy taken as per structural break point)
BSE SENSEX	1.92	2.02
KOSPI	0.93	0.50
Shanghai composite	0.73	−0.64
NASDAQ 100	2.47	1.62
NIKKEI 225	1.10	0.93
FTSE 100	2.4	2.44
BOVESPA	0.864	0.45
FTSE MIB	1.81	2.06
CAC 40	2.9	2.77
DAX 30	–	2.76
S&P TSX	2.47	3.7
FTSE/JSE	2.44	2.31

*All coefficients are significant at 1% level

8.6   GARCH with Volatility Breaks (with Time Dummy)

GARCH models can provide a formal test to verify whether there is change of volatility after a certain break. In this study, at first, we claim that 31 December 2019 is a break point after which the volatility in the stock markets increases. The dummy coefficients of estimated models for all the markets except China are positive and statistically significant. The results supported the claim; markets became significantly volatile after 31 December 2019. We reinstated the claim of higher market volatility by taking into account different structural breakpoints in accordance to Bai–Perron test (Tables 8.18 and 8.19) (Table 8.21).

8.7   EGARCH

EGARCH (1, 1) model is applied to examine the asymmetric effect of information on volatility and the leverage effect; this study applies EGARCH (1, 1) model. It is expected that values of gamma (γ) in EGARCH (1, 1) model to be negative and significant. The asymmetric effect confined by the parameter (γ) in EGARCH model is negative, and statistically significant values indicate the existence of leverage effect to divulge positive impacts which have less influence on the conditional variance while contrasted to the negative impacts. Tables 8.22 and 8.23 point out that the determination in volatility, as calculated by the sum of α and β in the GARCH (1, 1) model, ranging from 3.427 to 1.232 with an average of 1.629, is more than one, signifying a stronger presence of ARCH and GARCH influences on volatility. The

Table 8.22 EGARCH (1, 1)

	Crude oil (WTI)	Shanghai composite	KOSPI	BSE SENSEX	FTSE 100	NASDAQ 100	MOEX	BOVESPA	FTSE MIB	Nikkei 225
$\bar{\omega}$ (constant)	−2.448	1.221	−2.999	1.537	1.412	0.615	1.209	0.198	1.635	2.213
p value	0.003*	0.000*	0.000*	0.002*	0.004*	0.049**	0.005	0.025**	0.000*	0.000*
α (ARCH effect)	2.487	0.481	1.886	0.996	0.624	0.889	1.099	1.238	1.134	1.279
p value	0.006*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.00*	0.000*	0.000*
β (GARCH effect)	0.940	1.280	0.912	0.538	0.963	0.477	0.133	0.323	0.122	0.027
p value	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
$\alpha + \beta$	3.427	1.761	2.798	1.534	1.587	1.366	1.232	1.561	1.256	1.306
γ (leverage effect)	−0.145	−1.303	−0.084	−1.951	−0.670	−1.803	−1.372	−1.685	−0.220	−0.470
p value	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*

*Denotes significant at the 1%
**Denotes significant at 5% level

Table 8.23 EGARCH (1, 1)

	CAC 40	DAX 30	S&P TSX	FTSE/JSE
ω (constant)	2.825	3.184	3.238	2.591
p value	0.002**	0.000*	0.001*	0.003**
α (ARCH effect)	1.226	0.597	0.596	1.225
p value	0.002*	0.000*	0.000*	0.003*
β (GARCH effect)	0.105	1.084	0.983	0.979
p value	0.002*	0.002*	0.000*	0.008**
$\alpha + \beta$	1.331	1.681	1.579	2.204
γ (leverage effect)	−1.104	−0.695	−0.677	−1.595
p value	0.000*	0.000*	0.000*	0.000*

*Denotes significant at the 1%
**Denotes significant at 5% level

test results of EGARCH (1, 1) furthermore confirm that the sum of ARCH (α) and GARCH coefficients (β) are more than one in the case of select stock markets and crude oil, which designate that the conditional variance is volatile and the coefficients of ARCH and GARCH are statistically significant at 1% level. As regards the gamma parameter (γ), which is regarded as the indicator for asymmetric volatility, it is negative and significant at 1% level for all the stock markets as well as for crude oil which implies that leverage effect in select stock markets and crude oil is observed. Moreover, this signifies that positive returns impact to the select stock markets and crude oil creates lower volatility than a negative returns impact, as proposed by Bala and Premaratne (2003).

8.8 TARCH

In an attempt to identify the asymmetric or leverage effect and also to confine the availability of asymmetric performance and the continued existence of leverage effect, we have furthermore applied TARCH (1, 1) model. Tables 8.24 and 8.25 point out that the determination in volatility, as calculated by the sum of α and β in the TARCH (1, 1) model, ranging from 0.956 to 3.798 with an average of 1.897, which is greater than one, therefore, indicating a stronger existence of ARCH and GARCH influences on volatility. The coefficient of ARCH is found to be statistically significant at both 1% and 5% levels. It has also been observed that the gamma parameter (γ) is positive and greater than zero, which is significant at 1% level implying that leverage effects in stock markets and crude oil are observed. The extent of the differential shock on conditional variance can be established from the values of α (arch effect) and γ (leverage effect).

Table 8.24 TARCH (1, 1)

	Crude oil (WTI)	Shanghai composite	KOSPI	BSE SENSEX	FTSE 100	NASDAQ	MOEX	BOVESPA	FTSE MIB	Nikkei 225
ϖ (constant)	0.457	0.853	1.064	3.205	2.225	0.816	1.010	4.171	4.416	3.827
p value	0.000*	0.008**	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
α (ARCH effect)	2.487	0.481	2.886	0.596	0.624	0.389	0.899	0.238	0.834	0.279
p value	0.006*	0.002**	0.000*	0.001*	0.000*	0.000*	0.002*	0.000*	0.000*	0.000*
β (GARCH effect)	0.940	1.280	0.912	0.438	0.363	0.977	0.133	0.723	0.122	1.027
p value	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
$\alpha + \beta$	3.427	1.763	3.798	1.034	0.987	1.366	1.032	0.961	0.956	1.306
γ (leverage effect)	0.145	1.303	0.084	1.951	0.670	1.803	1.372	1.685	1.220	0.470
p value	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*

*Denotes significant at the 1%
**Denotes significant at 5% level

Table 8.25 TARCH (1, 1)

	CAC 40	DAX 30	S&P TSX	FTSE/JSE
ω (constant)	2.825	3.184	3.238	2.591
p value	0.002*	0.000*	0.001*	0.007**
α (ARCH effect)	1.226	0.597	0.596	0.325
p value	0.000*	0.006*	0.007*	0.000*
β (GARCH effect)	0.1058	0.848	0.833	0.799
p value	0.000*	0.000*	0.000*	0.000*
$\alpha + \beta$	1.331	1.445	1.429	1.124
γ (leverage effect)	1.104	0.695	0.677	1.595**
p value	0.000*	0.000*	0.000*	0.009**

*Denotes significant at the 1%
**Denotes significant at 5% level

It has been observed that KOSPI reveals higher α (arch effect) values than the stock markets, which indicate that the consequences of impacts in previous periods have a tendency to remain more or less for a longer time relative to other select stock markets and crude oil. Thus, it can be said that KOSPI has less market efficiency in comparison to the other select stock markets in our study as because the magnitudes of effect receive a longer time drive out. The β (GARCH effect) values confine long-term effects on market volatility. Again, the value of γ (leverage effect), in BSE SENSEX, is found to be higher than the other stock markets, which indicates that the leverage effect is higher in the BSE SENSEX against that experienced in crude oil, Shanghai composite, KOSPI, FTSE 100, NASDAQ 100, MOEX, BOVEPSA, FTSE MIB, Nikkei 225 and others. Hence, it can be said that BSE SENSEX is the most and extremely vulnerable to outlying volatility movements that may be due to the outbreak of COVID-19.

Reference

Bala L, Premaratne G (2003) Volatility spillovers and co-movement: some new evidence from Singapore. Retrieved from https://pdfs.semanticscholar.org/a681/9ced6f699ec74b615875f98dad3ef72839e8.pdf

Chapter 9
Conclusion

The outbreak of COVID-19 pandemic throughout the world is nonetheless a human tragedy unfolding across the world, since the outbreak of Spanish flu in 1918–19. Due to significant uncertainty about the economic outlook and the associated downside risks, it is quite difficult to quantify the economic impact, and an unforeseen upsurge in vagueness can put both economic growth and financial stability at risk. The economists at International Monetary Fund (IMF) suggests that besides targeted economic policies and fiscal measures, the appropriate monetary and financial stability policies of the countries are very much necessary in order to strengthen the global economy.

It is anticipated that the major effect of COVID-19 pandemic will be on the demand side, because consumption and the demand for services will be reduced, although the outbreak of the disease will also have adverse impact on the supply side due to huge casualties across many countries. In this way, due to destruction of human and physical capital, long-run economic growth potential of emerging economies will be reduced. Several emerging economies including BRICS nations are considered to be an integral part of the international economy and a foremost exporter and importer of goods and services.

COVID-19 has smashed the entire world with striking wildness, and at this point of time, although we do not know for how long this catastrophe will pertain, it is almost certain that the economic impact will be severe. In most of the countries around the globe, non-emergency services have been shut down by the government that accounts for almost one-third of total production.

Johansen cointegration test reveals that only crude oil has long-term relationship with the outbreak of COVID-19. However, the other stock markets do not show any such long-term relationship with the outbreak of the disease. Conversely, the Wald test results show the existence of short-run causality that flows from COVID-19 to all the stock indices and also crude oil prices, and therefore, it proves that the stock indices in our study have been affected by the outbreak of the disease.

Any change in the structure of time series data implies a change in the nature of the dataset which may be due to some external universal shock. Crude oil price has a break point on 9 March 2020. Shanghai Composite has a break point on 13 March 2020, KOSPI has a break point on 9 March 2020, BSE SENSEX has a break point on 12 March 2020, FTSE 100 has a break point on 6 March 2020, NASDAQ 100 has break point on 22 November 2019, MOEX has a break point on 20 March 2020, BOVESPA has a break point on 6 March 2020, FTSE MIB has a break point on 6 March 2020, Nikkei 225 has a break point on 5 March 2020, CAC 40 has a break point on 6 March 2020, DAX 30 has a break point on 5 March 2020, S&P TSX has a break point on 6 March 2020, FTSE/JSE has a break point on 6 March 2020, and the dummy variable COVID-19 has a break point on 31 December 2019. The change/break point in a time series data structure indicates a change in the nature of a data due to any shock from the universal scenario, and we anticipate that it might be COVID-19 in this case.

EGARCH results reveal the existence of ARCH and GARCH that have an impact on the volatility of stock markets and crude oil. Moreover, the value of γ is negative and significant at 1% level implying the presence of leverage effect in all the stock markets as well as in crude oil. Analysis of TARCH results shows that KOSPI has less market efficiency in comparison to the other select stock markets. Again, the value of γ (leverage effect), in BSE SENSEX, is found to be higher in comparison to other stock markets, thus implying greater vulnerability and volatility of the index to some external shocks that may be due to the outbreak of COVID-19 pandemic.

In countries like China, Japan and in major economies across Europe and North America, the existence of resilient social welfare schemes and social market model will enable the distribution of direct aid to companies and families, yet the task is quite complex, keeping in view the whole magnitude of the demand that they are now facing. In this situation, countries are reacting in inventive and unacquainted methods, and they can acquire new techniques from each other the strategies that work best. The methods of crisis-handling that is suitable for advanced countries may not deem fit for emerging and undeveloped economies and vice versa. So, the countries confronting the pandemic should step up with their own course of action depending upon the volume and nature of its economy.

In this moment of crisis, the first and foremost duty of the governments is to protect their people from the adverse economic effect of COVID-19 pandemic. Governments should take care of its people primarily those who belong to the unorganized sector and other unprivileged people of the society because they will be the worst sufferer.

As suggested by IMF, governments should expend money to check, identify, regulate, treat and restrict the spread of the disease and then to deliver rudimentary facilities to the quarantined people and to the small business owners. It is to be noted that providing appropriate and short-term relief, both cash and in-kind to the targeted vulnerable groups are the most vital until the lockdown period ends and everything becomes normal.

With a view to arrest the pandemic from spreading further, most of the affected countries have gone for "lockdown", of the entire nation which has a harsh effect on the economy owing to reduction in capacity utilization. Disturbances in trades and

industries have reduced productions, thus generating supply shock and also due to high mortality rates, there may be direct reduction in supply of labour.

Economists are also anticipating that the sharp reduction in income, anxiety of contamination and increased uncertainty about the future will bind people to spend less and in various sectors, like, transportation, tourism and hospitality, there may be lay-off of workers.

Whereas the global economy is completely lockdown, it is necessary that the policymakers confirm that publics are capable to encounter their requirements and that trades can pick up when the severe stages of the pandemic pass. This involves considerable directed financial, measures to sustain the financial links amongst employees and organizations and investors and debtors, keeping unharmed the financial and economic set-up of the humanity. As for instance, to deliver targeted support, new digital technologies may be applied in emerging and less emerging countries. In several countries, policymakers have already adopted some broad range of fiscal measures to confront with this unprecedented challenge. Long-term stimulus package and provision of liquidity facilities for reducing systematic stress could enhance self-confidence and avert more abysmal shrinking in demand (World Economic Outlook 2020).

Developed markets with robust governance capability, well-resourced healthcare infrastructure, as well as the honour of delivering reserve currencies are comparatively superior positioned to face this critical situation. Nonetheless, some emerging markets and developing economies deprived of analogous resources and challenging concurrent health, economic and financial disasters will need assistance and support from developed nations, mutual creditors and global monetary organizations (World Economic Outlook 2020).

While the global economy was confronted with a catastrophe in 1930s of this magnitude, the absence of bilateral and multidimensional monetary agency worldwide compelled the affected countries to struggle for global liquidity, accepting ineffective business strategies in that pursuit, which furthermore deteriorated the global recession. In contrast to the crisis of 1930s, at present we have a much robust international financial safety net—with the IMF functioning as the nucleus that vigorously providing assistance to the affected countries in this hour of crisis (World Economic Outlook 2020).

Resilient multifaceted collaboration is indispensible in order to overcome the adverse impact of the pandemic, including providing assistance to financially weaker countries that are confronting health as well as depressing economic shock, and also for directing assistance to countries with feeble healthcare infrastructure. All the nations throughout the globe immediately need to work collectively in order to combat the blowout of the disease additionally inventing and developing a vaccine and treatments to fight with the deadly pandemic and until and unless such medical inventions come out, no country is safe from the pandemic (World Economic Outlook 2020).

Reference

World Economic Outlook (2020) International Monetary Fund, April, 2020

Bibliography

Bollerslev T (1990). Modeling the coherence in short-run nominal exchange rates: a multivariate generalized ARCH model. Rev Econom Stat 72(2):498–505

Engle R, Ng V (1993) Measuring and testing the impact of news on volatility. J Finan 48:1749–1778

Glover A, Heathcote J, Krueger D, Rios Rull V (2020) Health versus wealth: on the distributional effects of controlling a pandemic. In: COVID, economics vetted and real-time papers vol 6, 17 April

Philipson T (1999) Economic epidemiology and infectious diseases. In: NBER Working Paper No. 7037. Accessed on March 18, 2020

Websites

http://www.weforum.org

https://blogs.imf.org/2020/03/04/potential-impact-of-the-coronavirus-epidemic-what-we-know-and-what-we-can-do/

https://news.un.org/en/story/2020/03/1059011

http://blogs.lse.ac.uk/businessreview/2020/03/13

http://www.cnbc.com

http://de.reuters.com/article/china-economy-poll/

http://news.trust.org/item/20200316071843-1rb9t/

http://www.reuters.com/article/us-global-oil/

https://blogs.imf.org/2020/03/11/monetary-and-financial-stability-during-the-coronavirus-out break/

https://www.iea.org/news/global-oil-demand-to-decline-in-2020-as-coronavirus-weighs-heavily-on-markets

https://www.weforum.org/agenda/2020/02/coronavirus-economic-effects-global-economy-trade-travel

https://www.economicshelp.org/blog/11738/oil/impact-of-falling-oil-prices/

https://www.forbes.com/sites/davidrvetter/2020/03/13/how-coronavirus-makes-the-case-for-ren ewable-energy/amp/

https://www.weforum.org/agenda/2020/03/a-visual-history-of-pandemics/

https://www.visualcapitalist.com/history-of-pandemics-deadliest/

http://m.economictimes.com/markets/stocks/news/everything-is-awful-so-why-is-the-stock-mar
ket-booming/amp/_articleshow/75094889/

https://economictimes.indiatimes.com/markets/commodities/news/what-led-crude-oil-prices-fall-
below-0-a-barrel/articleshow/75264813.cms?from=mdr

https://m.economictimes.com/markets/commodities/news/too-much-oil-how-a-barrel-came-to-be-
worth-less-than-nothing/amp_articleshow/75262652.cms

https://www.focus-economics.com/economic-indicator/gdp