

Multivariate Analysis of COVID-19 on Stock, Commodity & Purchase Manager Indices: A Global Perspective

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Abstract

The whole world is going through an unprecedented outbreak of COVID-19 leading to huge economy disruption across the globe. Moreover, the alarming pace of COVID-19 is quite upsetting to the leading financial stakeholders as it has resulted in the fleeing away of the customers, investors, and foreign trading partners. Resultantly, global markets succumbed leading to erosion of more than the US \$6 trillion within just one week in February 2020. During the same week, alone S&P 500 index also experienced a loss of more than \$5 trillion value in the US. This manuscript attempts to perform multivariate analysis of the global economy during the COVID-19 period. An empirical evaluation of the effect of containment policies on financial activity, stock market indices, purchasing manager index and commodity prices are also carried out. The obtained results reveal that the number of lockdown days, overseas travel ban and fiscal stimulus significantly influence the economic activity.

Introduction

During this challenging and unprecedented time of COVID-19, the prime concern for each nation is the maintenance of population health. However, it has another significant and prolonged impact on the national economy which is currently being overlooked. Hence, during this pandemic, each country is facing two major challenges: a healthcare challenge and an economic challenge. The unmatched spread of COVID-19 has triggered concerns for a severe and extended global recession. IMF (International Monetary Fund) has forecasted a negative per capita GDP growth for more than 170 countries in 2020 due to this pandemic, the most severe since 1930s [1].

The planet has experienced a variety of epidemics, including 1918 Spanish Flu, HIV/AIDS outbreak, SARS, MERS, and Ebola. However, COVID-19 potentially turns out to be the biggest emergency ever recorded in our history. Owing to its sharp spread, the outbreak was declared an international public health emergency on 30th January 2020. The outbreak of COVID-19 has triggered global concern, with 3,181,642 cases and 2,24,301 deaths affecting 215 countries and territories as of 1st May 2020[2]. The graph shown in Fig.1 represents a constantly rising trend for active COVID-19 cases. The US has highest no. of 1.128 million active cases, the country wise statistics as depicted in Fig.2.

To curtail the progression of the virus, restrictions on the transportation of raw materials and finished goods across states are imposed. The Governments also declared nationwide lockdown that projected a significant harm to the economy. There are millions of jobs and livelihoods on the stake. Such an uncertain scenario disturbed the supply and distribution chains in almost all sectors. The extent of this financial impact is still unpredictable and would depend on the nature and severity of the health crisis, the length of the lockdown and the way the situation unfolds over time.

The cause & effect of previous economic recessions is comprehensively documented by various authors[3][4][5][6][7][8][9]. For example, the 1997 Asian debt crisis was triggered by drop of the Thai baht,

leading to a regional financial crisis and recession in Asia [10]. The global recession of 2008 was triggered by low inflation [11]. The most recent 2010 recession in Greece was provoked by the effects of the global financial crisis, systemic flaws in the Greek micro and macro economy [12]. Yet, the coronavirus pandemic could trigger a new kind of recession, for several reasons. First, most of the past recessions affected only the single side of the supply-demand chain but this COVID-19 has impacted both the chains equally. Secondly, the effect of past recessions was limited to a particular area only, but this has a widespread impact across the globe.

This manuscript demonstrates how the coronavirus outbreak led to severe consequences in significant sectors of the global economy. The empirical evaluation performed in the paper examines the effect of containment & Closure policies, economic policies, and healthcare policies on the containment of COVID-19. The global impact of the outbreak on various sectors of the economy is also presented. An analysis of the effect of the growing number of reported cases of coronavirus on the manufacturing sector Considering Purchasing Manager Index (PMI) is made. Further, an evaluation of the correlation of commodity prices with respect to COVID-19 cases is also presented.

The manuscript has been organized as follows. Section 1 gives a brief introduction of the COVID-19 and its association with the global economy. The impact of similar pandemics on economy is discussed in section 2. A section is dedicated to the related work and the proposed empirical model is presented in section 4. Results and discussion are explained in section 5 and finally, the conclusion is given in section 6.

II. IMPACT OF PREVIOUS PANDEMICS ON ECONOMY

Human history starting from pre-historic to the modern era is replete with deadly infectious disease outbreaks. However, over the last two centuries, pandemics are becoming more regular events than ever. Degradation of natural ecosystems changed land use patterns combined with high population density, faster global travel, economic integration helps in spreading these highly contagious disease outbreaks to newer countries/regions [13][14]. Resulting in a negative impact on economies will be higher when the pandemic is highly infectious, even if it has lower virulence [15]. Negative impact on socio-economic activities results due to direct and indirect damages wherein indirect damages are attributed to fear-driven behavioral changes in the public.

Spanish Flu (1918), Asian Influenza (1957), Hong Kong Influenza (1968) are recognized as the major Influenza outbreaks of the 20th century [16]. There has been macroeconomic analysis about the impact of these outbreaks on the availability of labor force, manufacturing output, supply, and demand channels. In the study titled "Global Macroeconomic Consequences of Pandemic Influenza Analysis," by Lowy Institute for International Policy, Sydney, Australia suggests that Spanish Flu caused GDP loss of 3 percent in Australia, 15 percent in Canada, 17 percent in the United Kingdom, 11 percent in the United States [17]. According to another study based on the mortality rate of different regions, authors have predicted that 1918 Spanish Flu Pandemic led to an 18% drop in state manufacturing output in the US

[18]. Similarly, the 1957 Flu pandemic led to a GDP loss of 3 percent in Canada, Japan, UK, and the United States.

During the first two decades of the 21st century, outbreaks of SARS in 2003, Swine flu in 2009 and MERS of 2012 had a global impact. Economic impact analysis of SARS suggests that countries that were at the epicenter of the outbreak like Hong Kong, China, Singapore lost billions of dollars of their GDP owing to a downward turn in FDI, Export, Tourism etc. [20]. In Swine flu influenza A H1N1 pandemic in 2009, South Korea had 3,082,113 cases, which represents 6.6% of the country's population, reported a direct and indirect socioeconomic loss of US\$1.09 billion [21]. MERS epidemic of 2012 which started in the Middle East went on to spread into 22 countries. In 2015 MERS reached South Korea, where the study on the economic impact shows altered consumer spending behavior post-outbreak [22] and tourism industry was reported a loss of US \$2.6 billion [23].

II. RELATED STUDIES

The evolution and spread of COVID-19 have badly disrupted the economy of each country across the globe. The global risk factors have increased substantially in response to this pandemic leading to a highly unpredictable and volatile market. Moreover, the spread of this virus is highly uncertain and quite complex to anticipate. Resultantly, various researchers have suggested different approaches in order to evaluate the effect of COVID-19 on finance by exploring different aspects.

Authors in [24] use a technique to understand the evolution of COVID-19 by exploring seven scenarios. The scenario presented here claims that even a controlled outbreak hugely impacts the global economy in minimum time. Additionally, this study concludes that the government of any county plays a crucial role during this critical time. The government must devise short term, and long-term plans to sustain this economic slowdown. Apart from financial policies, the government also needs to devise economic and effective health-related policies. It helps to minimize the extent of contagion and thus reduces social and economic costs.

During COVID-19, authors in [25] analyzes its effect on the stock price. It notices an exponential rise in the telecom and healthcare industries, while entertainment, energy, and transportation industry experience an unprecedented collapse. Additionally, authors in [26] demonstrate that this has led to unprecedented and significant losses in a very short span. It also claims that it may has substantial long-term impacts as well ranging from bulk unemployment to business collapse across the globe. This belief is further strengthened by the work of authors in [27].

The spending and household consumption in response to this epidemic virus are also explored by authors in [27][28]. According to the authors, the economic impact of COVID-19 is quite underrated due to its comparison with similar crisis. Authors in [27] claim that this uncertain and unpredictable trend due to COVID-19 might lead to a great recession in the history of the global economy.

Materials And Methods

EMPIRICAL EVALUATION

This section presents the empirical evaluation of the influence of social distance policies on economic activities. Several cases are presented to demonstrate the impact of COVID-19 and social distancing policy on the global economy. Stock Market Indices, Purchasing Manager Index, and Commodity Market values are evaluated with respect to rising COVID-19 cases. Further, a novel stringency index (SI) proposed by Oxford University Research team that combines various measures of government responses is evaluated to find the correlation with fresh COVID-19 cases[30]. A detailed description of the methodology followed is given below:

A. Data Collection

The stock market data of five countries i.e., The USA (S&P 500), UK (FTSE 100), Italy (FTSE-MIB), China (Shanghai), and India (BSE-Sensex) is collected from Jan 2020 to April 2020. The thin sample period enables us to explore the direct (and immediate) effect of social distancing policies on the stock market and level of general market/business activity at the onset of the coronavirus crisis. The indices data, Coronavirus incidences and SI are downloaded from the yahoo finance web portal, worldometer.com and Oxford Government Response Tracker respectively.

B. Evaluation Variables

Evaluation variables are classified as response variables and input variables. The input variable is the number of COVID-19 confirmed cases and the SI. Response variables i.e., the output variables impacted by the COVID-19 spread evaluated are stock market index, PMI, and Commodity Market Index. PMI is a prominent index based on the monthly survey of purchasing managers of enterprises. It reflects the confidence of people in the market and covers almost every link of enterprises, comprising purchasing, logistics, manufacturing, and so on. The threshold of PMI is 50 units, any value lesser than that reflects recession; higher the value, stronger is the economy. Table I shows the PMI values of the countries since the COVID-19 outbreak.

TABLE I. PMI VALUE OF COUNTRIES SINCE COVID-19 OUTBREAK

Country	First Case	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20
USA	Jan 21, 2020	47.8	50.9	50.1	49.1	41.5
UK	Jan 29, 2020	47.4	49.8	51.9	48	32.9
Italy	Jan 31, 2020	46.2	48.9	48.7	40.3	30
China	Nov 17, 2020	50.2	50	35.7	52	50.8
India	Jan 30, 2020	52.7	55.6	57.5	49.3	42

Further, a team of researchers at Oxford University introduced a novel index called SI, providing a methodical way to track the stringency of various policy decisions of government across various countries. The index evaluates 17 indicators of government decisions, representing closure policies, economic policies, health-related policies. Eight of the indicators represent the policy decisions(C1-C8) on containment and closure, e.g., lockdown, social distancing, the closing of schools, and educational institutions.

TABLE II. FACTORS FOR THE CALCULATION OF SI

Sr. No.	Name	Type	Sectoral /Geographical
1.	Closing of Schools	Containment	Geographical
2.	Closure of Workplaces	Containment	Geographical
3.	Public Events Cancellation	Containment	Geographical
4.	Social Distancing	Containment	Geographical
5.	Closing of Public Transport	Containment	Geographical
6.	Lock down in Home	Containment	Geographical
7.	Inter State Movement Restrictions	Containment	Geographical
8.	International Travel Restrictions	Containment	Geographical
9.	Income Support	Economic	Sectoral
10.	Debt Relief	Economic	Sectoral
11.	Fiscal Incentives	Economic	Sectoral
12.	International Funds	Economic	Sectoral
13.	Public information campaign	Health	Geographical
14.	Testing Policy	Health	Geographical
15.	Contact Tracing	Health	Geographical
16.	Emergency Investment in Healthcare	Health	Geographical
17.	Investment in COVID-19 Vaccines	Health	Geographical

Four economic policy indicators (E1-E4) track record of financial policies, such as foreign aid, no deduction in salary, or income support, and five health indicators (H1-H5), consider health care policies, for instance, testing of COVID-19 cases or healthcare investments, etc. The index records the number and severity of government policies and does not represent the 'scoring' based on the efficacy of a country's response. Table II shows the details of the factors used in the calculation of the SI [31].

Results And Discussion

This section presents the results of the empirical model in terms of correlation. The impact of COVID-19 on a stock market index, PMI, commodity market, and SI are presented in the following subsection:

A. Correlation of COVID-19 with Stock Market Indices

The value of the correlation coefficient represents the intensity of association among variables. In this analysis, correlation matrices of S&P 500, FTSE 100, FTSE-MIB, Shanghai, and BSE-Sensex with respect to COVID-19 cases are demonstrated in Fig. 3, respectively. Blue color demonstrates the correlation index. The darker blue color represents a higher correlation while lighter color demonstrates a weaker correlation. As can be seen from the graphs, Shanghai has the maximum correlation while the USA demonstrates the minimum value of correlation coefficient.

Further, Table III demonstrates the value of the correlation coefficient; negative values represent the negative association between variables, while positive values represent the positive impact of variables on each other. The highest negative value is for the Shanghai index, representing major negative impact on stock markets, whereas value of the correlation coefficient is minimum for USA markets indicating the least impact by COVID-19 spread.

TABLE III. CORRELATION COEFFICIENT OF COVID-19 W.R.T STOCK MARKET INDEX

Country	Correlation Coefficient Value
Shanghai	-0.682671
Italy	-0.501843
UK	-0.409044
India	-0.38986
USA	-0.274079

B. Correlation of COVID-19 with PMI

After stringent policies like Nationwide lockdown, business activities were put to a halt, further impacting the industrial sector to an all-time low. The worst-hit pandemic has taken a toll on all industries. Correlation matrices of PMIs of the countries with respect to COVID-19 cases are demonstrated in Fig. 4, respectively. The USA has shown the darkest value i.e., the highest correlation, while China shows the lightest value explaining the lower correlation between the values. The lowest value of China is explained by the fact that the economy of China is on the path of recovery after the fiasco of COVID-19. Table IV represents the value of the correlation coefficient.

The PMI index for the selected countries dropped down to below 50; the value for UK and Italy tumbled to ~30. Table IV shows the impact of restrictions imposed by the virus with respect to PMIs. The results show that the highest value of the correlation coefficient is for the USA points to the sharpest pace of contraction. Further, for China, the coefficient value came out to be positive and reflects the lower value of the correlation indicating that the economy is on the way of growth, which can be seen from the PMI value of above 50 for China.

TABLE IV. CORRELATION COEFFICIENT OF COVID-19 CASES WRT. PMI

Country	Correlation Coefficient wrt PMI
USA	-0.991274
UK	-0.98903
Italy	-0.972218
India	-0.893224
China	0.123632

C. Correlation of COVID-19 with Commodity Markets

Table V represents the value of the correlation coefficient of the commodity index with COVID-19 cases. Here, we consider the value of Gold, Copper, Silver, Zinc, and Natural Gas. The COVID-19 outbreak affects the gold market dramatically, causing substantial price fluctuations as investors adjust to new pandemic-related developments. A more significant value of the correlation coefficient shows the higher impact of the epidemic. With the stagnation of the biggest economies in the world, global supply plummeting, workplaces shut down, the negative correlation of red metal with COVID-19 cases is apparent. Natural gas is not much impacted by the pandemic, revealed by an extremely low value of the correlation coefficient. Similarly, zinc and Silver have also shown a negative value of correlation coefficient attributing to the shutting down of industries and international trade.

TABLE V. CORRELATION COEFFICIENT OF COVID-19 CASES WRT. COMMODITY PRICES

Country	Correlation Coefficient wrt PMI
Gold	0.694834
Copper	-0.355289
Natural Gas	-0.089533
Zinc	-0.279833
Silver	-0.209542

D. Correlation of COVID-19 with SI

SI can be taken as a measure to track the impact of enforcement of policy measures by the Government on the spread of COVID-19. The response of the Government of different countries has shown a wide variation concerning policy enforcement; some governments quickly intensify initiatives as soon as the epidemic spreads, while in other countries, the rise in intervention rigor tends to lag growth in new cases. Throughout the outbreak period, more stringent policy responses have generally been imposed. The pace at which these initiatives are taken, however, plays a critical role in mitigating the spread. As can be seen from Fig. 5, the SI shows an upward trend with the increased no. of cases, demonstrating that more restrictions were imposed with the spread.

Table VI shows the correlation coefficient values to ascertain the correlation of SI with respect to no. of COVID-19 cases. A negative value means that the higher the stringency, the lower is the number of cases. India has shown the maximum negative correlation coefficient, meaning the stringency measures can curb the infection.

TABLE VI. CORRELATION COEFFICIENT OF COVID-19 CASES WRT. SI

Country	Correlation Coefficient wrt SI
India	-0.899095
Italy	-0.885342
USA	-0.861599
UK	-0.686107
China	-0.521357

At the same time, China has shown the minimum correlation coefficient value; it can be attributed to the fact from mid-Feb, the cases in China started to decline, and hence the policy measures were less stringent. Hence, the impact of stringency measures was not much on the COVID-19 cases in March as the country was on recovery mode.

Conclusion

The novel coronavirus outbreak is probably the most important black swan of 2020. Disruption to industrial manufacturing and foreign trade flows and international logistics networks may be beyond estimations because of the drag caused by extended shutdowns in production. Overall, market sentiment is weak, and financial volatility is on the peak because the outbreak has adversely affected the prospects for financial recovery. It is far too early and moreover, by its very uncertain nature, it becomes tedious to determine the ultimate impact of COVID-19 on economic activity and commercial revenue. Here, the

authors present an empirical model to understand the effect of COVID-19 on the global economy. For the same, the authors evaluate the correlation coefficient of COVID-19 with stock market index, PMI, commodity market, and SI. The obtained correlation coefficient presents the intensity and severity of its impact on the global economy. Also, elongated lockdown is further wrecking its condition. Hence, it is evident that for the quick recovery of the economy, this epidemic should stop at the earliest. Furthermore, economic recovery and prospering also necessitates effective policy implementation by the government. For now, COVID-19 has resulted in declined demand, decreased costs, and disrupted supply chains around the world and thus all industries are currently struggling. However, it should be reflected that our current situation is just that: a brief nightmare that one day will pass.

- Dec**• The data that support the findings of this study related to COVID 19 are openly available at <https://www.worldometers.info/coronavirus>.
- Fun**• The data that support the findings of this study related to stock market indices are openly available at <https://www.moneycontrol.com/markets/global-indices>
- Con**• The data that support the findings of this study related to stringency indices values are openly available in Oxford University Repository at : <https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker>
- A**• The data that support the findings of this study related to PMI values are openly available in Oxford University

Declarations

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Availability of data and material:

- The data that support the findings of this study related to COVID 19 are openly available at <https://www.worldometers.info/coronavirus>.
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- The data that support the findings of this study related to PMI values are openly available in Oxford University Repository at : <https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker>

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Figures

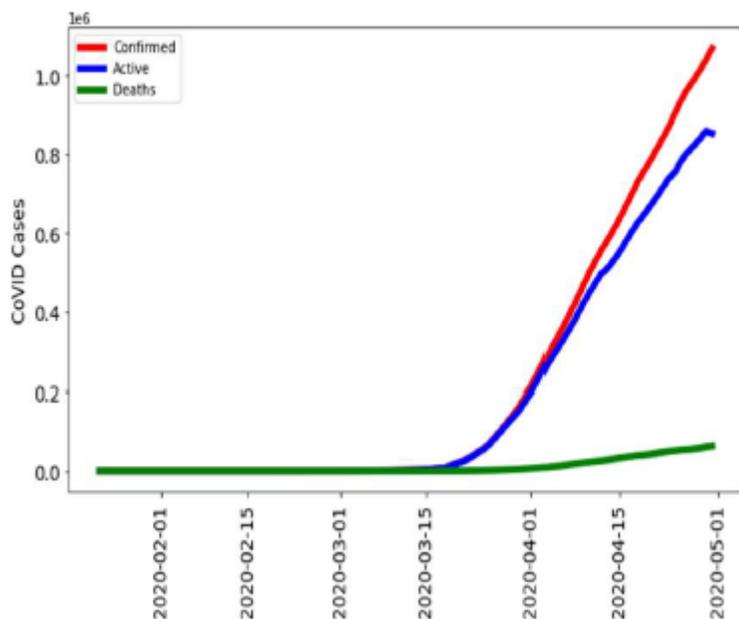


Figure 1

Trend of COVID-19 Cases

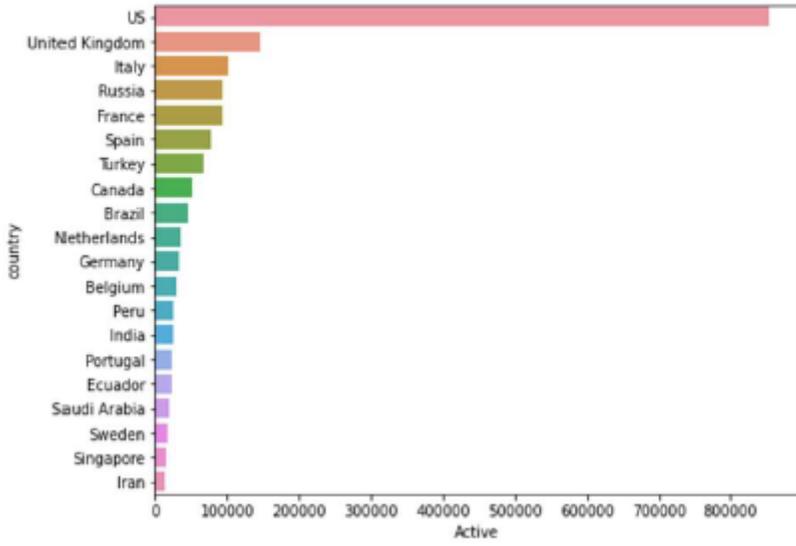


Figure 2

Country Wise Statistics of COVID-19

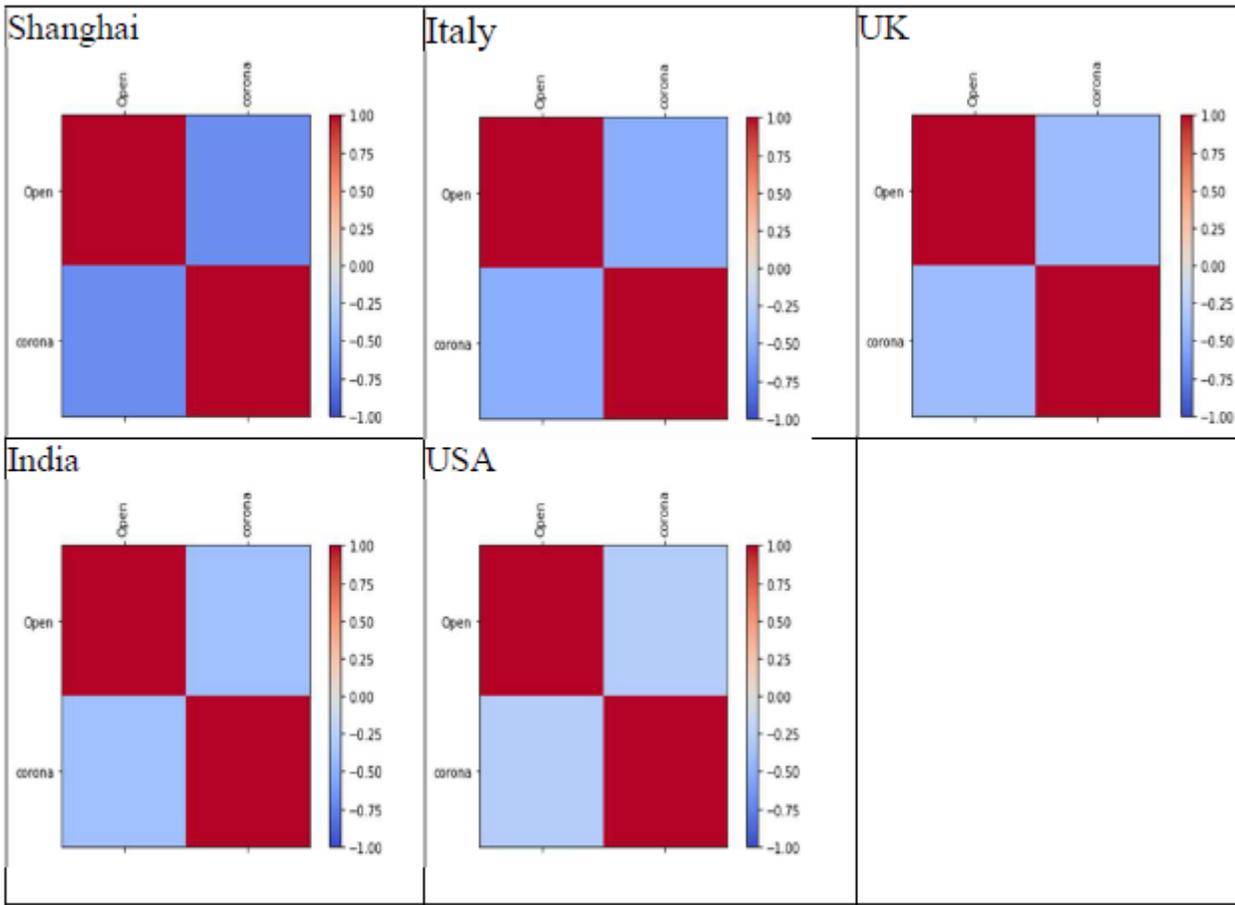


Figure 3

Correlation Matrices of Stock Market Indices with respect to COVID-19 cases

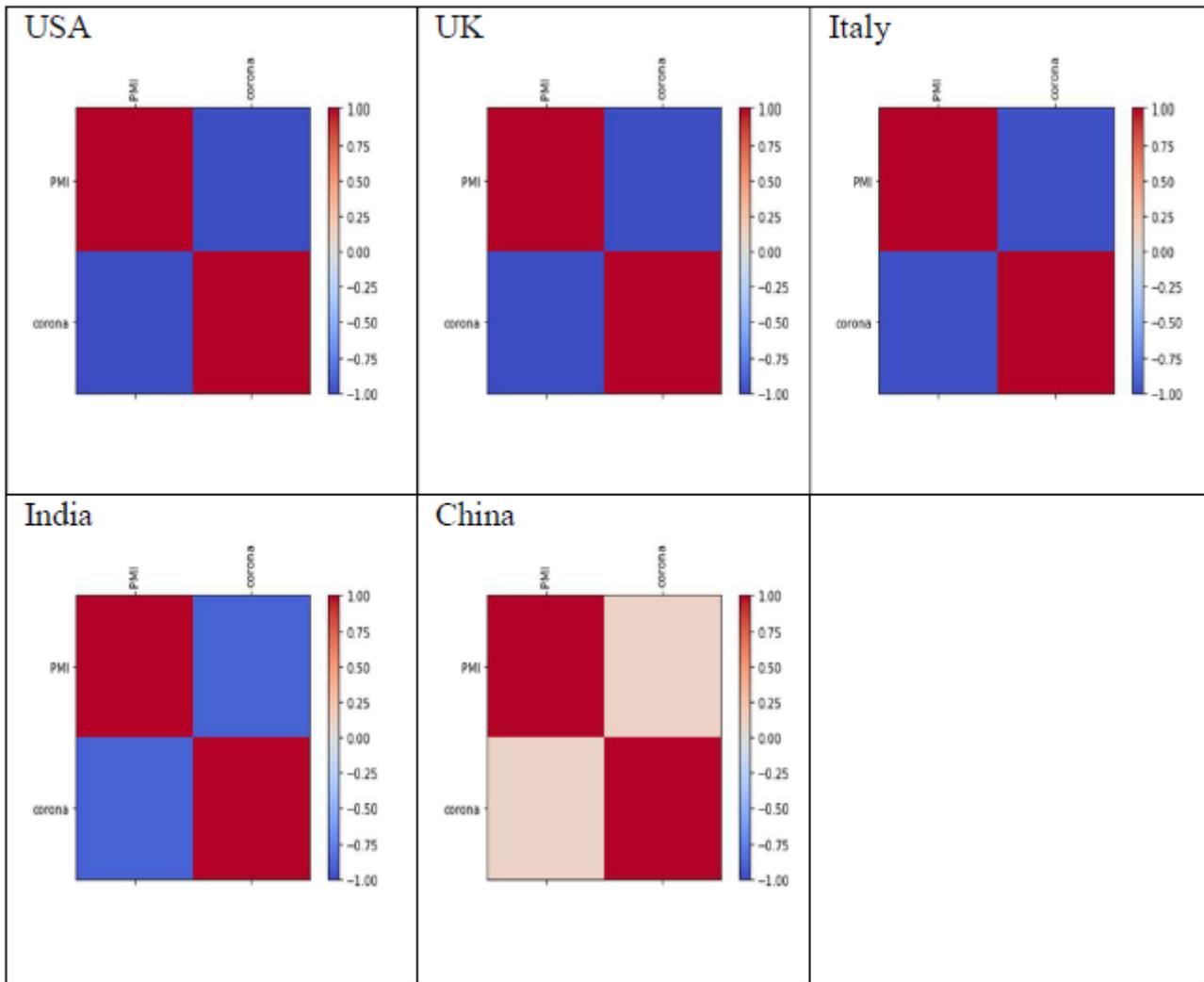


Figure 4
Correlation Matrices of PMI with respect to COVID-19 cases

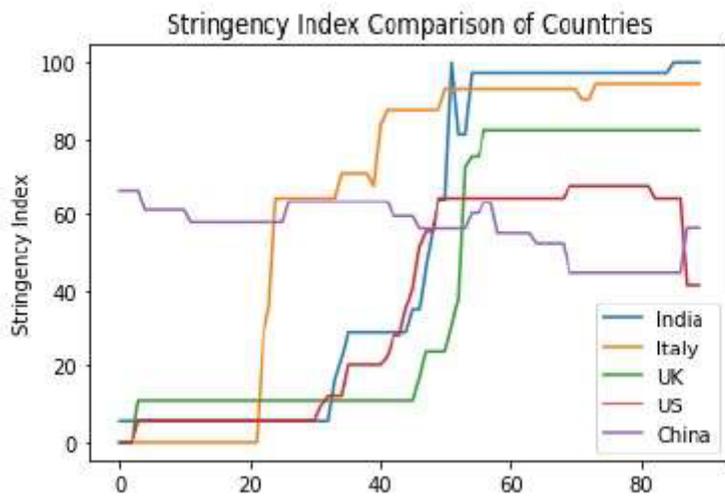


Figure 5

