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Financial Market Volatility and Risk Analysis during COVID 19 Pandemic. Applied Research in Social Sciences,

Abstract: Spread of COVID-19 pandemic had a considerable impact on the stock markets throughout the world. The disease has generated peerless risk level in almost all the stock markets at some point of time during the pandemic. This expansion in number of COVID 19 cases and mortality has caused the investors to bear great losses during pandemic. The study analyzes how the stock markets retaliated to COVID-19 peaks which ultimately increased in the volatility in stock markets. The core objective of research is to analyze the increase in country specific risk of stock markets as well as the systematic risk in international financial markets as the confirmed cases of infection increases. The study also aims to find the market integration among the countries during the pandemic of COVID-19.

Note: The views expressed herein are those of the author and do not necessarily reflect those of

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1.0 Introduction

The pandemic of COVID-19 has profound effects on the world. The outburst of infection and attempts to control it through quarantine policies have significant effects on social, political, and economic aspects globally. COVID-19 has drastic effects on the global financial markets. The spread of COVID-19 has set off panic that caused an imminent financial crisis across the globe. This crisis has caused great decrease in returns of stock markets and increased volatility increasing the systematic and country specific risk (Nicola et al., 2020). Dow Jones stock index had a decline of 1191 points in the second week of March causing overall decrease of 28.6% (Schoenfeld, 2020). At that level standard deviation of returns have expanded from 0.0071 to 0.0196 (Zhang et al., 2020). In a statement recorded by ADB, the COVID-19 pandemic may cost Pakistan the economic loss of $16.38M to $4.95B, which is almost 1.57% of total GDP (Waheed et al., 2020). The stock exchange of Japan has relinquished about 20% in March. The stock market of Spain, Hong Kong, and China also relinquished to 25.1%, 14.75, and 12.1% the returns in the month of March from 8th March to 18th March 2020 (Bora & Basistha, 2021). The pandemic has increased the country specific risk in the stock markets as well as the systematic risk the global financial markets. The risk level of the stocks has increased parallel to the confirmed cases of COVID-19 causing huge loss to the investors due to negative returns (Zhang et al., 2020).

Latest studies based on COVID-19 and stock markets suggest that the volatility of all the stock markets has increased drastically in the month of March 2020 (Gormsen & Koijen, 2020b). Later the risk level has somehow been slowed down due to government interventions trough their supporting economic policies (Elgin et al., 2020). On March 11th WHO announced COVID-19 as global pandemic with 118000 confirmed cases and 4292 deaths. Pandemic at that level has reached in 110 countries (Baker et al., 2020). This pandemic has directly affected the global economy as the trade activities between the countries and within the countries were stopped due to strict quarantine policies to stop the spread which directly affected the stock markets and the increase in risk in stock markets was expected (Zhang et al., 2020). U.S and European countries along with Iran were highly attacked by the virus due to which the returns in stock markets were highly decreased (Ali et al., 2020).

The upshot of COVID-19 has direct and significant impacts on the stock markets across the world. The study shows that the indices of stock markets that are adversely affected by the pandemic and has caused a crash in the stock markets of these countries. The studies found that Asian markets were more negatively affected that the European stock markets (Liu et al., 2020). Another study shows that as the confirmed patients of COVID-19 increases, there is unusual pattern of stock returns due to defeatist sentiments and future uncertainties that are caused mostly by news shared on electronic or social media. Another study shows that there is direct negative impact of pandemic on the stock market's volatility of emerging markets than already developed markets. More specifically the emerging markets in the region of Asia had more negative impact of COVID-19 confirmed cases than those in European regions (Topcu & Gulal, 2020). Systematic risk in the global financial markets have also increased that increased the market integration between the European countries. The Asian countries were not correlated before the announcement of pandemic but as it was announced the markets changed their patterns and became highly integrated showing increase in systematic risk (Akhtaruzzaman et al., 2021).

Government policies to cope with the financial crisis caused by COVID-19 also effected the global financial markets (Baker et al., 2020). Such as the policy of government of United States of unlimited quantitative easing has decreased the risk level in the market (Fernandes, 2020). Such policies were made by almost all the countries to decrease the panic in the markets (Schoenfeld, 2020). In this crisis situations, countries take measures to mitigate the country specific risks, like in US FED has reduced interest rate to 0% or adopted policy of quantitative easing. These policies, however, have decreased the current risk level but the future uncertainties may still exist as the threat of the pandemic is still prevailing (Zhang et al., 2020). The central banks of all the countries have also taken measure to decrease the country specific risks such as FED reduced to interest rate to 0%. Other countries also decreased their interest rates to cope up with the challenges such as Pakistan whose central bank decreased the interest rate from 13.25% to 7% in 100 days. When IMF and loan provider nations extend dates to pay back loan and IMF approved $1.4B aid for Pakistan to manage pandemic. The grant from the world bank also helped indirectly to recover the stock market and business activities in the country (Waheed et al., 2020). These policies however has decreased the current risk level, but the future uncertainties still exists as the pandemic is still out of control (Gormsen & Koijen, 2020a).

Risk in stock markets was higher in initial stages of corona but later when the pandemic was on its peak the risk level was very less frequent due to better understanding of policies and economy during the disastrous situations (Topcu & Gulal, 2020). COVID-19 is considered as difficult to contain as the SARS in terms of its spread as well as its impact on global financial institutions (Smith, 2006). Also, a significant contagion effect is likely to hit the global stock markets (Okorie & Lin, 2021). As long as the coronavirus is contagious and communicable, this virus is capable of affecting many economies of the world and their stock markets simultaneously (Biswas et al., 2020).

This paper has several interlinked sections. Facts about Covid-19 are shown in section 2 while the third section shed light on the background of the problem. Section 4 includes empirical methods while section 5 includes results and interpretation. The last section includes concluding remarks.

2.0 Fundamental facts about COVID-19

The first case of COVID-19 was reported in China on 17th November in Hubei City. In November total 9 cases of infectious disease were reported. In January the disease started to spread in other countries too and at the end of the month of January the total cases reported globally were 9976 in 21 countries along with United States. On January 23rd, a strict lockdown was imposed in Wuhan, the city of China when the total number of cases were 1988. In the very next week World Health Organization announced a PHEIC status in China. In that week the total number of cases have reached 7628 in China (Timeline, n.d.). The world except China had 83 total confirmed cases at that specific point. After China the most affected country was Iran and then South Korea. On the same time the pandemic was spreading in other European countries especially in Italy and United States.

China due to its strict quarantine policies was able to control the disease spread in the country. On March 11th WHO announced COVID-19 as a global pandemic. The infectious disease started to

spread quickly in all the regions of world and have started to affect their economies that was directly reflected in their stock market returns. From March 23rd the pandemic started to spread dramatically with most confirmed cases in United Sates and mortalities in Italy. At the same time the pandemic was on its peak in Spain, Italy, and UK. The spread at time was more towards European region but it was also spreading in Asian region but with low intensity. Later in the 2nd week of April the spread was more towards Asian region with highest cases in Russia, India, Pakistan, Turkey. The spread was so quick that all the countries have to follow strict quarantine policies and have to implement the trade barriers that caused huge loss to economies as the countries were unable to carry out their business activities that was directly reflected through their stock markets (Ashraf, 2020).

In the start of May 2020, the infection started to spread in Brazil and the spread was so quick that the cases dramatically increased from 60000 to 498440 in just a month. In the month of May UK, Russia, US and India had the highest cases at the end of month of May. The infection was spreading more quickly in these countries and at the end of June countries have been through the highest confirmed cases of COVID-19 US having the highest confirmed cases 2255119. At that point Brazil was the 2nd most affected country with total confirmed cases of 1067579. Russia had 3rd highest confirmed cases at that point of time having 576952 cases.
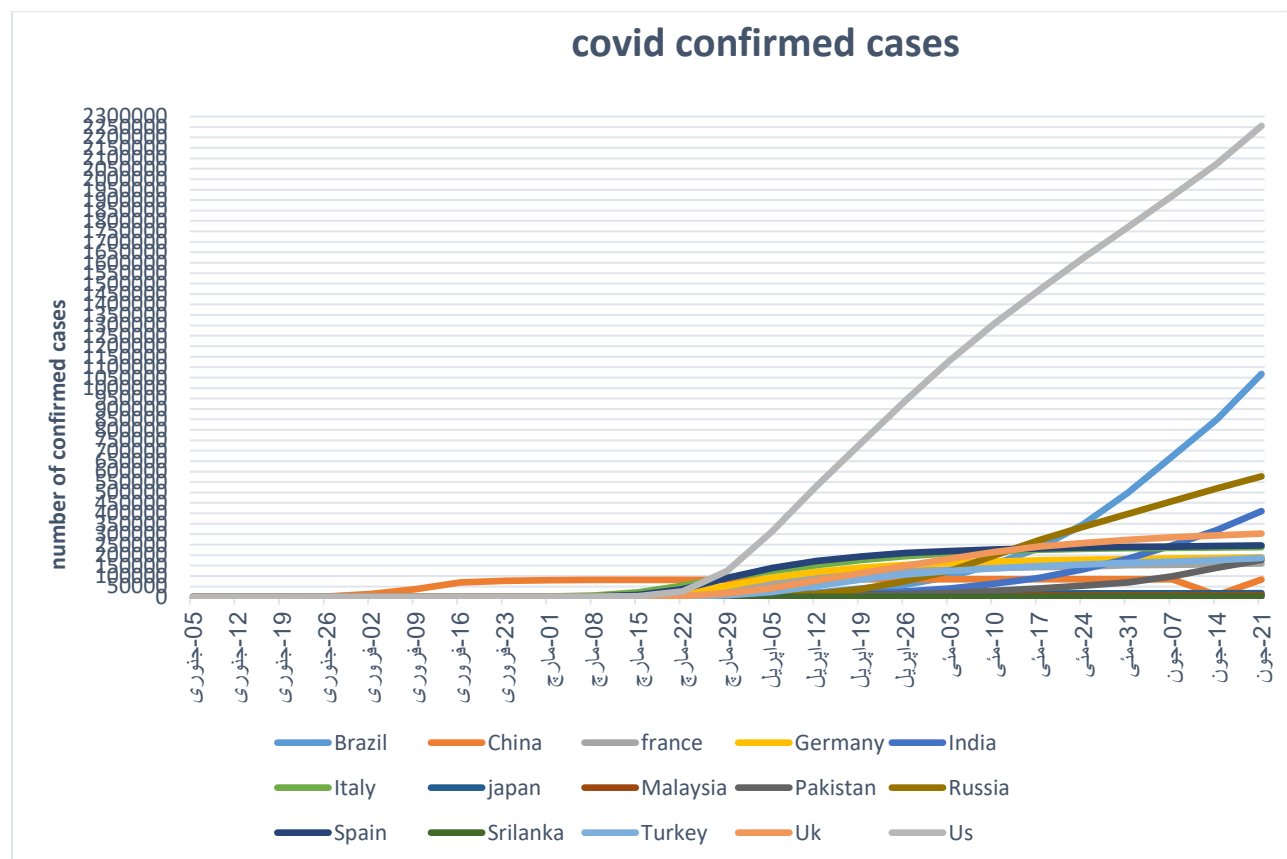

Fig. 1. Number of COVID-19 confirmed cases

Followed by Russia, India had 2nd highest confirmed cases in Asian region with total confirmed cases reaching 410461 and Pakistan at that time had 3rd highest number of COVID-19 patients in the region of Asia with total number of confirmed cases reaching 176617. The total impact of COVID-19 can't be measured still, as the pandemic is still not gone, and world is going through the second wave of the pandemic. And until the world gets a proper cure of disease. Fig 1 explains the movement of disease across the time period in selected countries.

In 2003, the world has faced the SARS which was estimated to cost the world between 30 -100 billion USD. The SARS mainly prevailed in China, but the COVID-19 pandemic has become a global crisis, behaving like "the once-in-a-century pathogen". A detrimental impact of this COVID-19 pandemic is expected on the global economy. It is also expected that it may increase risks in the global financial markets especially in the stock markets which utterly need scholarly attention (Smith, 2006).

3.0 Background of the problem

The pandemic of COVID-19 has directly affected the world economies. All the countries across the globe with developed and developing economies got effected by COVID-19 which ultimately had clear negative impact on their financial markets (Goodell, 2020). The economic conditions of a country are directly reflected by its stock markets which are negatively impacted by the pandemic and show its impact on the economies (Wójcik & Ioannou, 2020). The pandemic of great influenza back 1918 to 1920 caused huge financial crisis in the century. 2% of the total world's population died due to that pandemic and caused around 6% to 8% of the economic loss including GDP and realized returns in stock markets (Barro et al., 2020). In 2003 SARS infection caused the loss of 3 trillion to world with total 1000 deaths (Smith, 2006). The total impact of pandemic of COVID-19 are still not clear but it has direct impact on the global economy. All the economies have been directly affected by pandemic which is reviewed in their stock markets with negative realized returns, increased volatility, and uncertainty (Zhang et al., 2020).

4.0 Methods

This study is conducted on stock markets of the top 15 countries (United States, France, Germany, UK, Brazil, China, Italy, Spain, Russia, Pakistan, India, Malaysia, Turkey, Japan and Sri Lanka) that are severely affected by COVID-19 pandemic. Daily data from January 2020 to July 2020 is used to conduct volatility analysis and weekly data to conduct correlation analysis and check market integration. Data is gathered through stock market indices available on investing.com. COVID-19 data is gathered from WHO official website1 and John Hopkins Coronavirus Resource Centre2. Volatility analysis is conducted to check the market risk in the stock markets. Based on daily data, standard deviation is calculated for each stock market. The countries are ranked according to the increase in risk on monthly basis. Correlation analysis is performed to check systematic risk in the global stock markets. Weekly data of returns are taken and are correlated 28

observations for each country. Heat maps are used to see correlation between pair of countries to show market integration.

5.0 Results and Discussion

5.1 Volatility Analysis

The core objective is to demonstrate the association among the risks in stock markets and the spread of coronavirus confirmed cases. The top effected countries from Europe and Asia region have been selected to see the impact of COVID-19 on financial markets. Together these countries had 6185679 cases on 21 June as demonstrated in Table 1. Most of these countries have well developed stock markets excluding some of the Asian countries like Pakistan, Sri Lanka and Malaysia. Country specific risk in the markets have been calculated by standard deviation of stock market returns. Using the daily returns of stock markets, the standard deviation of all these markets have been determined which shows the country specific risk of that specific market.

The statistic of standard deviation shows that the risk level have increased subsequently from 0.1447 to 0.2282 as the virus was spreading in all the countries after China and WHO has also declared PHIEC status in China in the month of February which ultimately increased risk level in the stock markets. in March the standard deviation calculated was 0.6437 which shows the highest risk level in stock markets as the virus was announced as a pandemic by WHO and the disease has spread to 172 countries of the world. The sudden increase in the risk level has been due to the strict quarantine policies adopted by countries and unlimited trade barriers which made it difficult for countries to carry out their economic activities that caused huge loss to the economies which is ultimately reflected in their stock markets (Ashraf, 2020). The increase in stock markets risk is due probably due to the fact that investor sentiments play vital role (Gormsen & Koijen, 2020b) and these responses are rapidly magnified through media that in turn brace the investment activities which subsequently stimulate acute price activity and volatility in stock markets (Zhang & Broadstock, 2020). The risk level later have decreased subsequently from 0.3222 in April to 0.2352 in May and 0.2241 in June. This decrease was due to government and central banks of all the countries interventions through their policies such as unlimited quantitative easing program by FED (Zhang et al., 2020).

COVID-19 started from China and spread throughout the world and effected the world developed and developing economies which effected their stock markets directly. China had the maximum risk in the February and in March Brazil, United States and Italy had the highest risk level due to high confirmed cases and mortality rate in these countries. In April and may India have the highest risk level and Germany in June. Market risk of all the countries has increased in both the Asian and European region in correlation to the spread of infection. According to analysis the top effected stock markets based on the increase in market risk are BOVESPA, Dow Jones, and DAX in European region and BSE, SSE and PSX in Asian group.

Table 1. Volatility Analysis

Countries	S.D Jan	Cases Jan	Rank	S.D Feb	Cases Feb	Rank	S.D Mar	Cases Mar	Rank	S.D Apr	Cases Apr	Rank	S.D May	Cases May	Rank	S.D June	Cases June	Rank
Brazil	0.013	0	2	0.021	1	2	0.077	4579	1	0.030	78162	2	0.0201	498440	4	0.016	1145906	8
China	0.01	9714	7	0.022	79355	1	0.019	82241	15	0.009	83944	15	0.0069	84128	14	0.0074	84653	13
France	0.009	6	9	0.016	57	9	0.047	44550	6	0.024	128442	5	0.021	151496	3	0.0203	161267	4
Germany	0.01	5	6	0.017	61	6	0.046	61913	7	0.026	159119	4	0.0211	181482	2	0.0227	191449	1
India	0.007	1	14	0.013	3	12	0.051	1251	4	0.030	33050	1	0.0212	182143	1	0.0135	456183	9
Italy	0.011	3	5	0.019	888	3	0.052	101739	3	0.022	203591	7	0.0167	232664	8	0.0196	238833	5
Japan	0.012	14	4	0.015	230	10	0.036	1953	10	0.022	14088	10	0.0143	16851	10	0.0173	18027	7
Malaysia	0.006	8	15	0.009	25	14	0.027	2626	13	0.011	5945	14	0.0096	7762	13	0.0126	8590	10
Pakistan	0.012	0	3	0.013	2	13	0.034	1625	11	0.022	15759	7	0.0066	69496	15	0.0093	188926	12
Russia	0.009	0	8	0.016	5	8	0.041	1836	9	0.019	99399	12	0.0142	396575	11	0.0109	599705	11
Spain	0.008	0	11	0.017	54	5	0.049	104267	5	0.021	215183	11	0.0201	239429	4	0.0218	246752	3
Sri Lanka	0.008	1	13	0.006	1	15	0.025	120	14	0.022	649	7	0.0193	1620	6	0.0063	1991	15
Turkey	0.014	0	1	0.017	0	4	0.033	10827	12	0.014	117589	13	0.0106	163103	12	0.0069	190165	14
UK	0.008	0	10	0.015	18	11	0.043	22141	8	0.023	165221	6	0.017	272826	7	0.0176	306210	6
US	0.008	6	12	0.016	66	7	0.063	164620	2	0.027	1039909	3	0.0165	1770384	9	0.0219	2347022	2
Average SD	0.144			0.228			0.644			0.322			0.235			0.224		

Note: The top effected countries by COV ID-19 have been selected based on number of confirmed cases. SD January, SD February, SD March, SD April, SD May and SD June are shown in the figure which shows the country specific risk in the stock markets calculated through daily returns of stock markets. Rank shows the ranking of the countries based on the results of Standard Deviation.

5.2 Correlation analysis

As COVID-19 has been announced as a global pandemic, it would ultimately cause increase in systematic risk in the international stock markets. In this study correlation is calculated to demonstrate the relation between number of confirmed cases of COVID-19 and weekly stock market returns. Fig.2 lay out the weekly return correlation of the selected 15 countries. These correlations are calculated busing weekly returns of stock markets from January to June with total 25 observations.
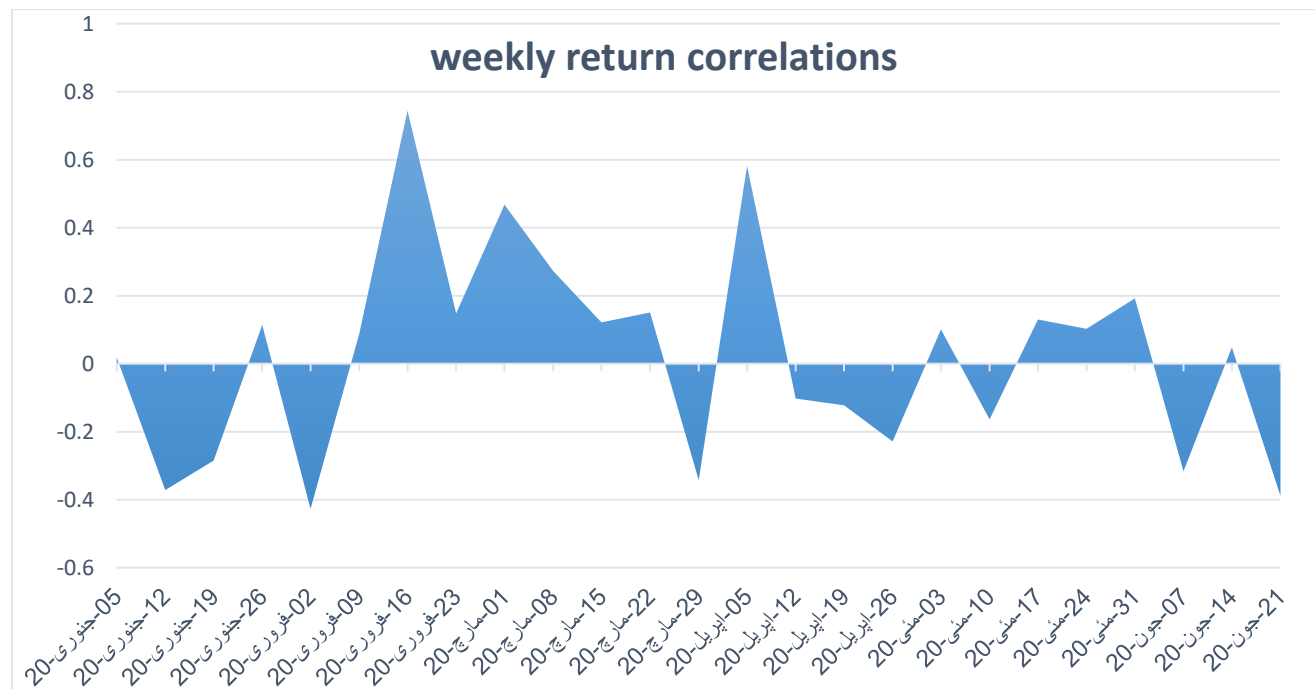
Fig. 2. Weekly return correlations

The correlations are negative and very low in January but as the number of COVID-19 patients increases and disease started to spread in all other countries in February the correlations ultimately increase subsequently in the month of February. High positive correlations are shown in February and in 2nd week of February highest correlation has been shows as the spread was increasing and PHIEC status was implemented in China due to which China has to stop its cross-border trade with all other countries and all countries have to adopt strict quarantine policies to stop the spread of disease. In March again high-risk level is seen as the disease was declared as a pandemic by WHO but as the spread was not in all the selected countries so here correlations are relatively lower than February.

As the spread was more towards European countries and mostly in United States, the government of US took precautionary measure to balance the economy such as 0% interest and unlimited quantitative easing program so the correlation is measured negative in the last two week of March. In April again a high increase was shows in the first week as the pandemic started to spread in Asian countries too and high cases and mortality rate effected the stock markets increasing the risk level. From the 2nd month of April to 2nd month of May the risk level have been decreased as of government interventions but as the pandemic started to spread in Brazil and increased cases in Russia, India, US, UK the risk level was increasing again in May. Later the risk level was again decreased as the countries became aware of the disease and started taking measures to stabilize the economy. There is a global rally of stock markets hereafter, yet the total impacts of pandemic can't be measured as pandemic is till spreading.

Here we are using heat maps to demonstrate the pairwise correlation and market integration before the announcement of pandemic and after the announcement of pandemic shown in Fig.3. High positive and negative correlations have been seen before the announcement of pandemic. European stock markets were positively correlated before the pandemic and after the pandemic too while India and Pakistan are having the most negative correlations before the announcement of pandemic and after the announcement too showing high risk level and no market integration too. China has shown quite different behavior as it shows high negative correlation before the announcement of pandemic but after the announcement it is showing neutral correlations and integration. European markets have shown high positive correlations and integration in both cases but after the pandemic has been announced the correlations have decreased and a bit than before the announcement of pandemic and so was the market integration.
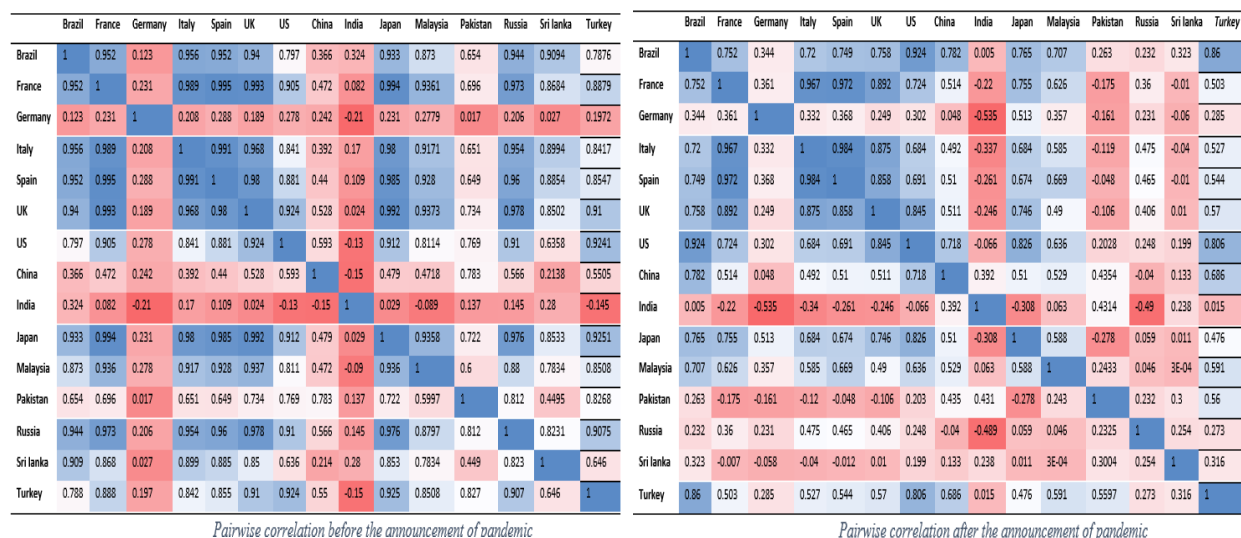
	Brazil	France	Germany	Italy	Spain	UK	US	China	India	Japan	Malaysia	Pakistan	Russia	Sri lanka	Turkey
Brazil	1	0.952	0.123	0.956	0.952	0.94	0.797	0.366	0.324	0.933	0.873	0.654	0.944	0.9094	0.7876
France	0.952	1	0.231	0.989	0.995	0.993	0.905	0.472	0.082	0.994	0.9361	0.696	0.973	0.8684	0.8879
Germany	0.123	0.231	1	0.208	0.288	0.189	0.278	0.242	-0.21	0.231	0.2779	0.017	0.206	0.027	0.1972
Italy	0.956	0.989	0.208	1	0.991	0.968	0.841	0.392	0.17	0.98	0.9171	0.651	0.954	0.8994	0.8417
Spain	0.952	0.995	0.288	0.991	1	0.98	0.881	0.44	0.109	0.985	0.928	0.649	0.96	0.8854	0.8547
UK	0.94	0.993	0.189	0.968	0.98	1	0.924	0.528	0.024	0.992	0.9373	0.734	0.978	0.8502	0.91
US	0.797	0.905	0.278	0.841	0.881	0.924	1	0.593	-0.13	0.912	0.8114	0.769	0.91	0.6358	0.9241
China	0.366	0.472	0.242	0.392	0.44	0.528	0.593	1	-0.15	0.479	0.4718	0.783	0.566	0.2138	0.5505
India	0.324	0.082	-0.21	0.17	0.109	0.024	-0.13	-0.15	1	0.029	-0.089	0.137	0.145	0.28	-0.145
Japan	0.933	0.994	0.231	0.98	0.985	0.992	0.912	0.479	0.029	1	0.9358	0.722	0.976	0.8533	0.9251
Malaysia	0.873	0.936	0.278	0.917	0.928	0.937	0.811	0.472	-0.09	0.936	1	0.6	0.88	0.7834	0.8508
Pakistan	0.654	0.696	0.017	0.651	0.649	0.734	0.769	0.783	0.137	0.722	0.5997	1	0.812	0.4495	0.8268
Russia	0.944	0.973	0.206	0.954	0.96	0.978	0.91	0.566	0.145	0.976	0.8797	0.812	1	0.8231	0.9075
Sri lanka	0.909	0.868	0.027	0.899	0.885	0.85	0.636	0.214	0.28	0.853	0.7834	0.449	0.823	1	0.646
Turkey	0.788	0.888	0.197	0.842	0.855	0.91	0.924	0.55	-0.15	0.925	0.8508	0.827	0.907	0.646	1

Pairwise correlation before the announcement of pandemic

	Brazil	France	Germany	Italy	Spain	UK	US	China	India	Japan	Malaysia	Pakistan	Russia	Sri lanka	Turkey
Brazil	1	0.752	0.344	0.72	0.749	0.758	0.924	0.782	0.005	0.765	0.707	0.263	0.232	0.323	0.86
France	0.752	1	0.361	0.967	0.972	0.892	0.724	0.514	-0.22	0.755	0.626	-0.175	0.36	-0.01	0.503
Germany	0.344	0.361	1	0.332	0.368	0.249	0.302	0.048	-0.535	0.513	0.357	-0.161	0.231	-0.06	0.285
Italy	0.72	0.967	0.332	1	0.984	0.875	0.684	0.492	-0.337	0.684	0.585	-0.119	0.475	-0.04	0.527
Spain	0.749	0.972	0.368	0.984	1	0.858	0.691	0.51	-0.261	0.674	0.669	-0.048	0.465	-0.01	0.544
UK	0.758	0.892	0.249	0.875	0.858	1	0.845	0.511	-0.246	0.746	0.49	-0.106	0.406	0.01	0.57
US	0.924	0.724	0.302	0.684	0.691	0.845	1	0.718	-0.066	0.826	0.636	0.2028	0.248	0.199	0.806
China	0.782	0.514	0.048	0.492	0.51	0.511	0.718	1	0.392	0.51	0.529	0.4354	-0.04	0.133	0.686
India	0.005	-0.22	-0.535	-0.34	-0.261	-0.246	-0.066	0.392	1	-0.308	0.063	0.4314	-0.49	0.238	0.015
Japan	0.765	0.755	0.513	0.684	0.674	0.746	0.826	0.51	-0.308	1	0.588	-0.278	0.059	0.011	0.476
Malaysia	0.707	0.626	0.357	0.585	0.669	0.49	0.636	0.529	0.063	0.588	1	0.2433	0.046	3E-04	0.591
Pakistan	0.263	-0.175	-0.161	-0.12	-0.048	-0.106	0.203	0.435	0.431	-0.278	0.243	1	0.232	0.3	0.56
Russia	0.232	0.36	0.231	0.475	0.465	0.406	0.248	-0.04	-0.489	0.059	0.046	0.2325	1	0.254	0.273
Sri lanka	0.323	-0.007	-0.058	-0.04	-0.012	0.01	0.199	0.133	0.238	0.011	3E-04	0.3004	0.254	1	0.316
Turkey	0.86	0.503	0.285	0.527	0.544	0.57	0.806	0.686	0.015	0.476	0.591	0.5597	0.273	0.316	1

Pairwise correlation after the announcement of pandemic

Fig.3 Heat map of pairwise correlations before and after the announcement of pandemic

6.0 Conclusion

This paper issue easy and original statistics about the effects of COVID-19 on returns in stock markets globally. The pandemic has affected millions of people till date and has asserted millions of lives globally. World economies has faced huge losses that effected the financial markets of the world that was directly reflected in their stock markets generating spontaneous response to COVID-19. All stock markets have a discrete response to the increase in spread of pandemic. Increase in the uncertainty of disease has increased uncertainty in stock markets increases stock markets volatility and systematic risk in global stock markets.

The present study states that COVID-19 pandemic had profound effects on the global economy that is reflected through the stock markets. All the stock markets of the countries having developed or developing economies, having well established and growing stock markets have been impacted by the virus in one way or another. The study shows that risk level in the individual stock markets as well as the global stock markets have increased during the pandemic increasing synchronized patterns of country specific and systematic risks in the stock markets. volatility in the stock markets have increased substantially as the virus effect the people in the countries and countries have to adopt strict quarantine policies and trade barriers which made it difficult and near to impossible to carry out their business activities which increased the country specific risk in stock markets at different points of pandemic. On the other hand, the global systematic risk have also increased during the times when COVID-19 was on early stages and countries have no ideas to cope up with the pandemic and the times when the confirmed cases of infection were on peak in the countries. The study further analyze that market integration among the countries before the announcement of COVID-19 as a pandemic very strong and has decreased after its announcement as a pandemic. The study shows the direct impact of pandemic on all the stock markets and shows the sensitivity of stock markets towards any disaster situation. This study further supports the current literature review and shows that there is an impact of pandemic on the economies directly reflected through their stock markets and effecting market integration between the countries. Study further shows that policy interventions plays vital role to cope up with such situation and to gear up the economic activities reflecting in their stock markets.

List Of Abbreviations

ADB	Asian Development Bank
GDP	Gross Domestic Product
WHO	World Health Organization
US	United States
USD	US Dollar
UK	United Kingdom
FED	Federal Reserve
IMF	International Monetary Fund
SARS	Severe Acute Respiratory Syndrome
PHEIC	Public Health Emergency of International Concern
BOVESPA	Brazil Stock Market

DAX	Deutscher Aktienindex, or German stock index
BSE	Bombay Stock Exchange
SSE	Shanghai Stock Exchange
PSX	Pakistan Stock Exchange

References

Akhtaruzzaman, M., Boubaker, S., & Sensoy, A. (2021). Financial contagion during COVID–19
crisis. *Finance Research Letters*, *38*, 101604.

Ali, M., Alam, N., & Rizvi, S. A. R. (2020). Coronavirus (COVID-19)—An epidemic or
pandemic for financial markets. *Journal of Behavioral and Experimental Finance*, *27*,
100341.

Ashraf, B. N. (2020). Economic impact of government interventions during the COVID-19
pandemic: International evidence from financial markets. *Journal of Behavioral and
Experimental Finance*, *27*, 100371. https://doi.org/10.1016/j.jbef.2020.100371

Baker, S. R., Bloom, N., Davis, S. J., Kost, K. J., Sammon, M. C., & Viratyosin, T. (2020). *The
unprecedented stock market impact of COVID-19*. National Bureau of Economic
Research.

Barro, R. J., Ursúa, J. F., & Weng, J. (2020). *The coronavirus and the great influenza pandemic:
Lessons from the "spanish flu" for the coronavirus's potential effects on mortality and
economic activity*. National Bureau of Economic Research.

Biswas, S., Sarkar, I., Das, P., Bose, R., & Roy, S. (2020). Examining the effects of pandemics
on stock market trends through sentiment analysis. *Journal of Xidian University*, *14*(6),
1163–1176.

Bora, D., & Basistha, D. (2021). The outbreak of COVID-19 pandemic and its impact on stock

   market volatility: Evidence from a worst-affected economy. *Journal of Public Affairs*,

   e2623.

Elgin, C., Basbug, G., & Yalaman, A. (2020). Economic policy responses to a pandemic:

   Developing the COVID-19 economic stimulus index. *Covid Economics*, *1*(3), 40–53.

Fernandes, N. (2020). Economic effects of coronavirus outbreak (COVID-19) on the world

   economy. *Available at SSRN 3557504*.

Goodell, J. W. (2020). COVID-19 and finance: Agendas for future research. *Finance Research

   Letters*, *35*, 101512.

Gormsen, N. J., & Koijen, R. S. (2020a). Coronavirus: Impact on stock prices and growth

   expectations. *The Review of Asset Pricing Studies*, *10*(4), 574–597.

Gormsen, N. J., & Koijen, R. S. J. (2020b). *Coronavirus: Impact on Stock Prices and Growth

   Expectations* (SSRN Scholarly Paper ID 3555917). Social Science Research Network.

   https://doi.org/10.2139/ssrn.3555917

Liu, H., Manzoor, A., Wang, C., Zhang, L., & Manzoor, Z. (2020). The COVID-19 outbreak and

   affected countries stock markets response. *International Journal of Environmental

   Research and Public Health*, *17*(8), 2800.

Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., Agha, M., & Agha, R.

   (2020). The socio-economic implications of the coronavirus pandemic (COVID-19): A

   review. *International Journal of Surgery*, *78*, 185–193.

Okorie, D. I., & Lin, B. (2021). Stock markets and the COVID-19 fractal contagion effects.

   Finance Research Letters, *38*, 101640.

Schoenfeld, J. (2020). The invisible risk: Pandemics and the financial markets. *Tuck School of Business Working Paper*, *3567249*.

Smith, R. D. (2006). Responding to global infectious disease outbreaks: Lessons from SARS on the role of risk perception, communication and management. *Social Science & Medicine*, *63*(12), 3113–3123. https://doi.org/10.1016/j.socscimed.2006.08.004

Timeline: WHO's COVID-19 response. (n.d.). Retrieved December 16, 2020, from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline

Topcu, M., & Gulal, O. S. (2020). The impact of COVID-19 on emerging stock markets. *Finance Research Letters*, *36*, 101691. https://doi.org/10.1016/j.frl.2020.101691

Waheed, R., Sarwar, S., Sarwar, S., & Khan, M. K. (2020). The impact of COVID-19 on Karachi stock exchange: Quantile-on-quantile approach using secondary and predicted data. *Journal of Public Affairs*, *20*(4), e2290.

Wójcik, D., & Ioannou, S. (2020). COVID-19 and finance: Market developments so far and potential impacts on the financial sector and centres. *Tijdschrift Voor Economische En Sociale Geografie*, *111*(3), 387–400.

Zhang, D., & Broadstock, D. C. (2020). Global financial crisis and rising connectedness in the international commodity markets. *International Review of Financial Analysis*, *68*, 101239. https://doi.org/10.1016/j.irfa.2018.08.003

Zhang, D., Hu, M., & Ji, Q. (2020). Financial markets under the global pandemic of COVID-19. *Finance Research Letters*, *36*, 101528. https://doi.org/10.1016/j.frl.2020.101528