Asia-Pacific Financial Markets
https://doi.org/10.1007/s10690-022-09359-7

ORIGINAL RESEARCH

Short Term Stress of Covid-19 on World Major Stock Indices

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Accepted: 29 January 2022

Abstract

The main objective of this study is to check the short-term stress of COVID-19 pandemic on the American, European, Asian, and Pacific stock market indices and furthermore the correlation between all the stock markets during the pandemic. Secondary data of 41 stock exchange from 32 countries have been collected from investing.com website from 1st July 2019 to 14th May 2020 for the stock market and the COVID-19 data has been collected according to the first cases reported in the country, stocks market are classified either developed or emerging economy, further divided according to the subcontinent i.e. America, Europe, and Pacific/Asia, the main focus in the data is the report of first COVID-19 cases. The study reveals that there is volatility in the all the 41 stock market (American, Europe, Asia, and Pacific) after reporting of the first case and volatility increase with the increase of COVID-19 cases, moreover, there is a significant negative relationship between the number of COVID-19 cases and 41 major stock indices of American, Europe, Asia and Pacific, European subcontinent market found more effected from the COVID-19 than another subcontinent, there is Clustering effect of COVID-19 on all the stock market except American's stock market due to smart capital investing.

Keywords COVID-19 · SARS · Pandemic · Financial market · World stock exchange

JEL Classification G1 · G15 · G17

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Published online: 07 March 2022

1 Introduction

In 2019, novel coronavirus known as COVID-19 affected the province of Wuhan, China causing economic crisis in Hubei China. COVID-19 eventually became a cause of global pandemic as it spread throughout the world. The entire world faced volatility in the stock market and a significant decline in the equity market. This is the biggest volatility level seen in the United State stock market after October 1987 and December 2008. (Baker et al., 2020).

The WHO (World Health Organization) officially declared a global pandemic to the COVID-19 outbreak on 11th March 2020. According to the WHO the number of confirmed cases reached up to 4,307,287 on 14th May 2020 and continued to increase on daily basis. As per WHO, a total of 216 countries have been affected by this pandemic and the highest number of confirmed cases has been reported in the USA with 1,361,522 confirmed. Overall, COVID-19 pandemic has had significant effect on the world economy in short term as well as in the long-term basis. The short-term consequence is limited economic activity due to strict lockdown, whereas the longer-term impact of the COVID-19 has been closure of many small businesses with resultant increase in unemployment and the direct effect of travel restrictions on it related industries i.e. tourism, airlines and hotels (Zhang et al., 2020).

The question of this research addresses the predominant importance of global pandemic equally for the market policymaker, institutional investors, and individual investors. 12% decrease has been recorded in the Dow Jones Industrial Average index which was the 2nd highest decline in the market history in the last 124 years on 16th of March 2020, although US government has taken many actions intended to improve the market which includes economic relief program and fiscal stimulus package yet the market did not improve (Gormsen & Koijen, 2020).

This paper aims to study the short-term stress of COVID-19 pandemic on the performance of major stock indices of 32 countries. In this research we aim to recognize the systemic risk pattern in the stock market by answering the following questions through available data, how will we react to the stock market during this pandemic? Does systemic risk escalate all over the world? Do the clustering effect exist in the stock market return?

According to a thorough review of previous literature on the financial implications of COVID-19, the approach chosen for this study has three distinct advantages. A CAPM-based asset pricing model was previously used to calculate the expected normal rate of return for firms prior to COVID-19 (Sharpe, 1964). In the presence of disaster risk, these models can produce incorrectly estimated abnormal returns as the true values may be inferred (Bai et al., 2019). Other benefits include the ability to measure exposure at the firm level without having to identify the firms' channels and without having to assign cumulative returns to COVID 19. This benefit has proved significant because of the COVID-19 pandemic's unpredictable and uncertain nature. Additionally, this approach is superior in terms of providing updated/fresh information on pandemic period returns in that it uses the difference between lag-day $(t-1)$ of the market closing and the market opening on day t to calculate projected returns. When one takes this approach, it is easier to demonstrate the ups

and downs of the market. The conclusion of this paper advocate that investors may rely on daily case forecasts to summarize the scale and eventual economic impact of the epidemic, as Knight (1921) and Keynes (1937) both observed.

By explaining the COVID-19 infection curve, this paper adds to a large body of literature on public health that has already been published. Contrary to the results of 9S, we examine the expected parameters and forecast changes of these models in real-time to observe the effects on financial outcomes. Pandemics, we believe, do not follow a pure exponential or logistic growth path. To better understand how these models can provide adequate information about financial conditions, we are more interested in exploring their relationship with financial markets.

It will also help fill a gap in the existing knowledge about how COVID-19 impacts economic outcomes and add to the existing literature on the pandemic. Important studies like Baker et al. (2020) demonstrate the correlation between daily market movement and press releases about COVID-19, while Barro et al. (2020) demonstrate the link between changes in economic activity and COVID-19 and the "Spanish Flu". The results of this study align with the results of Gormsen and Koijen (2020) and Baker et al. 2020), which demonstrate that financial markets react to the occurrence of the COVID-19 pandemic in line with the nation's GDP growth. Following their studies, this study also uses the equity market. Furthermore, this study correlates to the Cajner et al. (2020) and Coibion et al. (2020), as they explore the employment trends in the labour market during COVID-19 and to Humphries et al. (2020) and Bartik et al. (2020) studies who analyze the labour market interactions during COVID-19. Rather than relying on these efforts, we link labour markets outcomes and exogenous variation in investor expectations about the pandemic's curve to describe cumulative and firm-level exposure.

The structure of this paper is as follows. Section 2 consists of a literature review. Section 3 methodology. Section 4 results and financings, Sect. 5 discussion and conclusion.

2 Literature Review

After the outbreak of the COVID-19 so far various research papers have been published about the impact of COVID-19 on the stock market and the world economy. Before this pandemic there is literature available on the Asian flu 1957 and SARS 2003 which shows that the negative impact on the stock market all over the world.

Schell et al. (2020), conducted research regarding the impact pandemic on stock market they collected data from 26 stock market and tested abnormal returns during the pandemic like COVID-19 declared by Public Health Risk Emergency of International Concern (PHEIC), the results suggested the only COVID-19 has significant and negative impact on 26 stock market within the 30 days after announcement of pandemic.

Goodell et al. (2020) conducted research regarding abnormal returns during the COVID-19 and they include 15 industries listed in US market, they identify in their results that positive abnormal returns in medical and pharmaceutical industries and

negative returns in the hotels, restaurants along with service and utilities related industries.

Barro et al. (2020) compared the Spanish Flu losses with COVID-19 and predict the consequences of COVID-19 on the world economy, furthermore they mention that COVID-19 has caused market crashes, volatility, decline in the interest rate and decrease in the economic activities. The research used forecasting model to identify future dividend and its growth. Results reveal that there has been significant decrease in the dividend growth of 16% and 23% in the USA and Europe respectively. Another research predicted decline in the growth of GDP to 3.6% and 5% in the USA and Europe respectively till 12th of May, 2020 with expected dividend growth within the two years of period to be −29% and −38% in the USA and Europe respectively (Gormsen et al. 2020).

Cajner et al. (2020) researched the developments of the labor market during COVID-19 showing that 13 million people lost their jobs in just two weeks from 14 to 28 March 2020 in the USA in comparison to 9 million people who lost their jobs in the Great Recession in the USA. The most affected sector in the COVID-19 pandemic is hospitality with a 30% decline in the employment which equals to loss of almost 4 million jobs. Humphries et al. (2020) surveyed eight thousand small business owners in USA. Their research showed three main points: the first one is that the 60% of the business owners had already fired one worker from the job whilst being unaware of with the CARES Act by USA government which is also 2nd finding of the research, and the third one is that 46% of the business owners expect the COVID-19 negative impact on their business to remain for next two years.

Bartik et al. (2020) survey of 5,800 owners of USA based small business and revealed that 43% of the businesses stopped their activities which means they closed their business temporarily and that 40% decreased was seen in the employment rate, the numbers of business has been disabled financially and numbers of business are awaited for the Government aids.

Alfaro et al. (2020) researched the change in the market return due to COVID-19 and research shows that 4% to 11% significantly decline has been seen in the total market value and furthermore report that the increase in the number of cases causes a decrease in the volatility of the market returns.

Zhang et al. (2020) research about the impact of COVID-19 on world financial markets argues that COVID-19 record level of risk increase in the market affected the investors in very limited time. Onali (2020) investigation of the COVID-19 effect in term of the number of cases and deaths on US and Europe stock markets reveals that there is no impact of COVID-19 on the market returns of US Stock market, however, there has been a negative relationship between COVID-19 cases and market returns of Italy and France stock exchange. Nozawa et al. (2020) investigated the market reaction of the corporate bonds during the COVID-19 and found that the Central bank promised to support cut down the default risk for loan borrowers which showed mixed evidence about the market reactions caused by the market segments and liquidity channels.

Ortmann et al. (2020) report the impact of COVID-19 outbreak on retail investors showing a significant increase has been seen in the stock trading while increase in the cases specifically older age and male investors. The stock index was affected

by 13.9% increase in a week in trading in stock increased and 9.99% decline as recorded in Dow 30 on 12th March 2020.

Liu et al. (2020) investigated the impact of COVID-19 on 21 major stock indices in short term. The results show that the word major stock markets have been directly affected due to COVID-19 and significantly decreased after the COVID-19 outbreak. Moreover, their results show that Asian countries are more affected than the other regions. Further, regression analyses reveal that there is a negative relationship between the increase in the number of cases and stock indices return.

Çıtak et al. (2020) report the effect of COVID-19 on the stock market as a significant and negative impact of COVID-19 on the stock markets of all the countries. Heyden et al. (2020) investigated what was the impact on the stock market of USA and European after the report of first COVID-19 case in the country. The result showed that a negative relationship between the report of the first case and the stock market, further they identify that the fiscal policy also negatively impacted on the stock market returns. Improvement in the stock market was recorded after the announcement of monetary policy.

3 Data and Method

3.1 Research Strategy

Well-articulated research methodology leads to reliable research, consequently methodology is considered as the heart of the research. Therefore, well systematic structure and intensive caring in analysis are always the responsibility of the authors. In accordance with the aforementioned argument, we have synchronized our methodology with Saunders et al. (2011) research procedure appended below in Fig. 1. However, we have serialized our methodology as research philosophy, research design research technique and so on.

The articles based on the logical facts and realistic phenomena; therefore, the research fall in positivism research approach. Consequently, we have tested already developed hypothesis but in clustering style, such as testing hypothesis in different continents and different countries and then making comparison, so we can infer that the research is a deductive research.

3.2 Research Data

We have used secondary data collected from official websites of each of respective stock exchange. Total indices are 41 from 32 countries from 1st July 2019 to 14th May 2020 on daily basis, and for Covid-19 cases data were collected from official database of Oxford Martin School, which is an open access database and reliable source for covid-19 patient data in real time. Covid-19 data is collected from the period of first reported case of COVID19 according to the country till 14th May 2020and for comparison analysis, we have classified market as per the standards of Morgan Stanley Classification Index (MSCI) as appended below in Table 1.

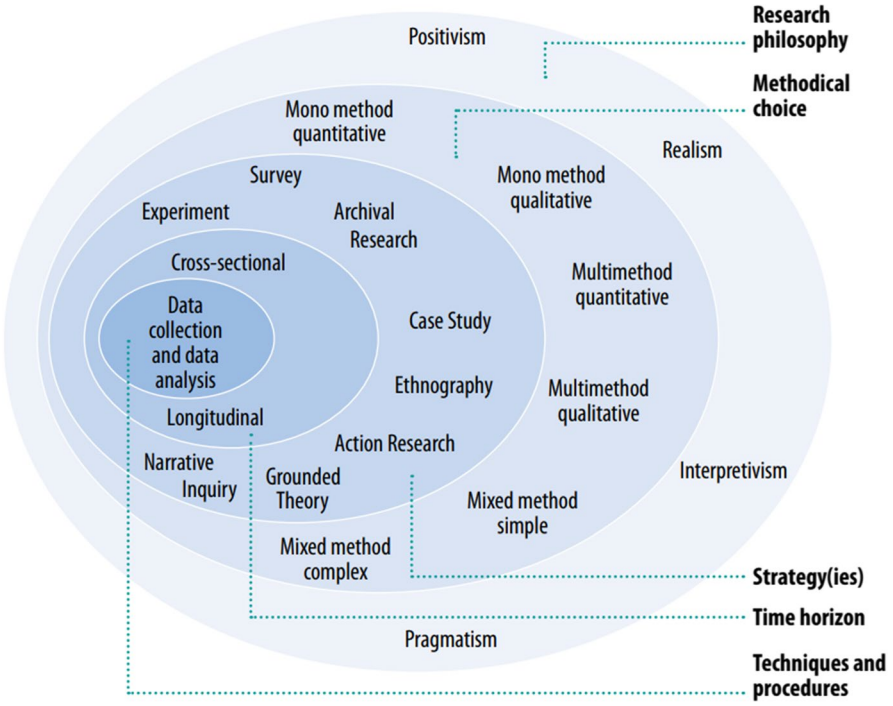


Fig. 1 Research procedure:

3.3 Method

The article is based on the testing the sensitivity of confirmed Covid-19 cases and stock indices. Making it simple, we are interested to test volatility in the daily returns of stock indices due to reported Covid-19 cases around the globe. Engle (1982) propose Autoregressive Conditional Heteroscedasticity (ARCH) model to test the time series data that describes the variance of the current error term or innovation as a function of the actual sizes of the previous time periods' error terms, often the variance is related to the squares of the previous innovations. The ARCH model is appropriate when the error variance in a time series follows an autoregressive (AR) model; if an autoregressive moving average (ARMA) model is assumed for the error variance, the model is a generalized autoregressive conditional heteroscedasticity (GARCH) model which was proposed by Bollerslev (1986). Nevertheless, there are so many ARCH family models which are specifically used to test volatility such as The exponential generalized autoregressive conditional heteroskedastic (EGARCH) model by Nelson and Cao (1992) is another form of the GARCH model. Formally, an EGARCH (p, q). The Threshold GARCH (TGARCH) model by Zakoian (1994) is similar to GJR GARCH. The specification is one on conditional standard deviation instead of conditional variance:

The reason behind using ARCH family model because ARCH family model are considerably finest model to witness volatility as mentioned in details above. Hence,

Table 1 Detail of indexes

S.no	Codes	Index Name	Country Name	MSCI	Continent
1	A	Dow 30	American	Developed	American
2	B	S&P 500	American	Developed	American
3	C	Nasdaq	American	Developed	American
4	D	SmallCap 2000	American	Developed	American
5	E	S&P 500 VIX	American	Developed	American
6	G	DAX	Germany	Developed	Europe
7	H	FTSE 100	UK	Developed	Europe
8	I	CAC 40	France	Developed	Europe
9	J	AEX	Netherland	Developed	Europe
10	K	IBEX 35	Spain	Developed	Europe
11	L	FTSE MIB	Italy	Developed	Europe
12	M	SMI	Switzerland	Developed	Europe
13	N	PSI 20	Portugal	Developed	Europe
14	O	BEL 20	Belgium	Developed	Europe
15	P	ATX	Austria	Developed	Europe
16	Q	OMXS30	Sweden	Developed	Europe
17	R	OMXC25	Denmark	Developed	Europe
18	S	Nikkei 225	Japan	Developed	Pacific
19	T	S&P/ASX 200	Australia	Developed	Pacific
20	U	DJ New Zealand	New Zealand	Developed	Pacific
21	W	STI Index	Singapore	Developed	Pacific
22	X	TA 35	Israel	Developed	Europe
23	Y	Bovespa	Brazil	Emerging	American
24	Z	S&P/BMV IPC	Mexico	Emerging	American
25	AA	MOEX	Russia	Emerging	Europe
26	AB	RTSI	Russia	Emerging	Europe
27	AC	WIG20	Poland	Emerging	Europe
28	AD	Budapest SE	Hungary	Emerging	Europe
29	AE	BIST 100	Turkey	Emerging	Europe
30	AF	Tadawul All Share	Saudi Arab	Emerging	Middle East
31	AG	Shanghai	China	Emerging	Asia
32	AH	SZSE Component	China	Emerging	Asia
33	AI	China A50	China	Emerging	Asia
34	AJ	DJ Shanghai	China	Emerging	Asia
35	AK	Taiwan Weighted	Taiwan	Emerging	Asia
36	AL	SET	Thailand	Emerging	Asia
37	AM	IDX Composite	Indonesia	Emerging	Asia
38	AN	Nifty 50	India	Emerging	Asia
39	AO	BSE Sensex	India	Emerging	Asia
40	AP	PSEi Composite	Philippine	Emerging	Asia
41	AQ	Karachi 100	Pakistan	Emerging	Asia

The table above, exhibiting Indices Name, Alphabetical Codes, Country, Market, and Regional Classification, we have categorized markets and regions according to Morgan Stanley Capital International (MSCI) classification index

we have employed ARCH, GARCH, TARCH, and EGARCH models. Therefore we did not find ARCH and TARCH as suitable for this study thus we dropped these model, then from GARCH and EGRACH we selected EGARCH model according to the Information Criterion Tests (AIC, HIC, and HQC) as suggested by Hannan et al. (1979); Akaike (1973); Schwarz (1978). The method is to choose the best test as the least value of for above mentioned criterions will be the best mode that will be, we have adopted EGARCH model similarly like Bajaj et al. (2019). In the last, in every EGARCH model, we use ARCH-LM test to diagnose the ARCH type of effect in the model.

We have a thorough process of statistical modelling, initially we have tested data stationarity by using Dickey and Wayne Fuller (1979); and Durlauf and Phillips (1988) tests, which are common test of data stationary, the proposed null hypothesis are stated as Ho: There is presence of unit root in the data, and alternative refers as H1: There is no presence of unit root in the data, hence unit root in the data is a serious problem which may have effect on the research modeling and estimation. Interestingly, we have not detected any unit root problem in the data.

In second process, we classified 4 panels on the basis of geographical distribution of each country. Panel-1 for America. Panel-2 for Asia, Panel-3 for Europe and Panel-4 Asia Pacific indices.

In third we established descriptive statistics for each of the panels and identify the market shift by analyzing median values. In the fourth step, we generated correlation matrix of all indices where we analyzed the correlation of each market indices before the pandemic and after the first case reported in each country. In the fifth step, we used the same panels and generate regression tables where we identify impact of Covid-19 on each country individually. In the sixth step, we have extracted coefficient values from each regression model and placed them in a single table, the purpose of doing this exercise is to create a tabulated presentation so that we can understand the highest effect country by rise in the Covid-19 in term of stock market fluctuation.

In seventh step, we have divided all indices in two as Developed and Emerging Market classified by MSCI, then we average out the returns all country in their respective indexes of MSCI. We have also established a table of cumulative cases % change of Covid-19 on last terminal day of our data for every single country.

In the eight step, we have developed EGARCH models for every single index such like regression table, and report our results of EGARCH for every single index accounted in this research, we used EGARCH model as suggested by the information criterion as mentioned above, it is also noticeable that we already segregated the indices according to MSCI classification criteria which we used in the next step. In ninth step, we connect our step number seven where have done an exercise of averaging out returns of all indices and used them in EGARCH, we have used a comparison table of EGARCH model where we place results of developed and emerging markets so a reasonable comparison to identify Covid-19 cases effect on capital market. In tenth and our final step, we redo the same exercise as in step nine but this time we establish EGARCH model table for comparing the results of all four continents, as we have 4 panels or 4 continents in these results, in this results we have gone through a detailed recursive statistical models which starts from the

individual indices and end up with collective comparison market wise and continent wise. Below are the further description of independent and dependent variable with EGARCH model derivation.

3.4 Dependent Variables

Daily market average returns are used as dependent variable in the regression and individual EGARCH models, and in the classification wise models, we have averaged out indices daily market return concerning their region and market classification and then create a single index such as Index of Developed Market, Emerging Market, American, European, Asian and Pacific and Gulf markets.

3.5 Independent Variable

Covid-19 confirm cases are used as an independent variable, the session begins when the first case is lodged in any of targeted country, in this research we have used two series a one with confirm cases reported, and a two a year daily data when there was no Covid-19 or global pandemic. So we have split up data in two streams to check the effect of covid-19 case on the markets, and for that we use dummy variable such as when cases are reported onwards to the last observation we used 1 and before the pandemic when market was normal there were no case, we used 0.

We have also used cumulative cases as an independent variable but we could not find any of effect of covid-19 cases on the market returns, so we dropped this method and decided to use before after effect technique by using dummy variable, and for EGARCH Model we have established below mentioned hypothesis.

H_0 There is no presence of clustering effects in the returns and volatility of each selected index, Developed Markets, Emerging Markets, and Continental Markets during the Coronavirus Pandemic.
H_1 There is a presence of clustering effects in the returns and volatility of each selected index, Developed Markets, Emerging Markets, and Continental Markets during the Coronavirus Pandemic.

Moreover, it should also be noted that for ARCH models we used dummy variable treatment but for regression results we used cumulative cases as independent variable because we found more realistic results in this way. we used % change of Covid-19 cases daily in each of the countries then regressed these % changes of Covid-19 cases to the daily indexes returns. Below is the hypothesis for regression models for individual indices.

H_0 There is no significant impact on the returns on each selected index by the Coronavirus Pandemic.
H_1 There is a significant impact on each return on selected indices by the Coronavirus Pandemic.

3.6 Exponential Generalized Autoregressive Conditional Heteroskedasticity *(EGARCH)*

$$Log\left(\sigma_t^2\right) = W + \beta_{\log} + \left(\sigma_{t-1}^2\right) + \alpha\frac{Et-1}{\sigma t-1} + \gamma\frac{Et-1}{\sigma t-1}$$

The equation above denotes the constant of the variance equation; w is the $\beta_{\log}+(\sigma t-1)$ GARCH term which evaluates the size of the group effect in the restricted volatility of the selected indices returns. $\alpha\lfloor(\mathrm{Et}-1)/(\sigma t-1)\rfloor$ is the ARCH term which measures the closeness and scope of ARCH influence in the measured conditional fluctuation. Is the asymmetric γ $(\mathrm{Et}-1)/(\sigma-1)$ expression which evaluates the vastness of asymmetric effect. Asymmetric term measures the size of the uneven effect in the restricted variations of the selected indices return. Adverse innovation, normally principals for the greatest part stimulates higher next period volatility distinguished with positive development. This component is known as Asymmetric impact (Ding et al., 1993) (Table 2).

4 Results and Findings

The purpose of keeping above mentioned statistic was to analyze the median shift in the returns of each index, therefore not only we reported the shift in the median as well as encountered the risk associated with the return in term of standard deviation, it has been measure, shift of median showcased that since Novel Covid-19 has not been declared as pandemic, the indexes above exhibiting the strong stability with steady risk associated. On 11 March Novel Covid-19 declared as pandemic by the World Health Organization (WHO), then stock market aggressively exhibited abnormal change and huge shift in the average returns. The virus largely effected the world's biggest economy like America and Europe. We have developed statistics to measure the hit of Novel virus on these markets. We have total of 11 observations bases of monthly frequencies with descriptive statistics, as mentioned above we have observed monthly shift of returns and risk of each index comes under American region, we found massive change into each American indexes, the best ranked index become eventually the worsen such as Dow 30, S&P 500, Nasdaq, SmallCap 2000 and S&P 500 VIX ranked 39, 42, 30, 36 and 43 in Mar20 (Jul-19, 17, 5, 3, 15 and 13) on basis of monthly median returns respectively.

We have also ranked the indexes on the basis of standard deviation, the one with highest value of standard deviation is considered highly risky index, as we have seen on the basis of standard deviation American Indexes rank on the top in overall 40 plus indexes, meaning, these indexes are highly risky in the peak time of pandemic. The information also claims, when Covid-19 cases shown significant increment in America effect strongly on the American index as the panic index is always remained higher in the America at the time of pandemic. Therefore, the American stock market was classified as the highest vulnerable stock market around the globe. Not only there is a significant shift into the rank but also the aggressive shift has

Table 2 Descriptive statistics for panel 1 (America)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
Dow 30	Median of returns	0.04%	0.18%	0.14%	0.09%	0.11%	0.11%	0.11%	−0.43%	−1.41%	0.17%	−0.17%
	Stdv of returns	0.491%	1.381%	0.578%	0.798%	0.405%	0.529%	0.788%	1.624%	6.327%	2.661%	1.577%
	Ranks on returns	17	6	17	25	18	21	10	40	39	37	31
	Ranks on Stdv	41	10	32	27	40	38	30	18	4	8	19
	No. of cases	–	–	–	–	–	–	6	60	164,620	1,039,909	1,390,746
S&P 500	Median of returns	0.18%	0.07%	0.02%	0.28%	0.12%	0.09%	0.11%	−0.16%	−1.66%	0.58%	0.22%
	Stdv of Returns	0.53%	1.43%	0.56%	0.82%	0.36%	0.48%	0.75%	1.56%	5.88%	2.60%	1.55%
	Ranks on returns	5	16	26	9	16	24	10	22	42	22	7
	Ranks on Stdv	38	7	35	24	42	40	34	23	7	11	20
	No. of cases	–	–	–	–	–	–	6	60	164,620	1,039,909	1,390,746
Nasdaq	Median of returns	0.20%	−0.11%	−0.09%	0.33%	0.17%	0.20%	0.14%	0.11%	−0.70%	0.77%	0.85%
	Stdv of returns	0.69%	1.63%	0.85%	0.93%	0.48%	0.54%	0.87%	1.74%	5.73%	2.62%	1.69%
	Ranks on returns	3	31	40	8	9	12	8	9	30	11	1
	Ranks on Stdv	23	3	12	16	35	37	24	13	8	10	16
	No. of cases	–	–	–	–	–	–	6	60	164,620	1,039,909	1,390,746

Table 2 (continued)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
SmallCap 2000	Median of Returns	0.05%	−0.19%	−0.07%	0.13%	0.14%	0.13%	−0.09%	−0.24%	−1.23%	1.26%	−0.18%
	Stdv of returns	0.74%	1.59%	1.03%	0.89%	0.70%	0.50%	0.77%	1.55%	6.79%	3.73%	2.41%
	Ranks on returns	15	35	37	23	14	17	33	27	36	3	32
	Ranks on Stdv	19	4	8	18	16	39	31	24	3	2	2
	No. of cases	–	–	–	–	–	–	6	60	164,620	1,039,909	1,390,746
S&P 500 VIX	Median of returns	0.08%	−2.11%	−2.12%	−1.75%	0.63%	−0.16%	0.16%	0.93%	−2.24%	−3.33%	−2.38%
	Stdv of returns	6.51%	14.41%	6.33%	7.43%	4.29%	7.45%	9.13%	15.18%	17.94%	7.28%	9.53%
	Ranks on returns	13	43	43	43	2	43	3	1	43	43	43
	Ranks on Stdv	1	1	1	1	1	1	1	1	1	1	1
	No. of cases	–	–	–	–	–	–	6	60	164,620	1,039,909	1,390,746
Bovespa	Median of returns	0.12%	0.43%	0.21%	0.35%	−0.16%	0.33%	−0.26%	−0.50%	−1.44%	1.37%	−0.32%
	Stdv of returns	0.79%	1.54%	0.66%	1.12%	0.90%	0.62%	1.35%	1.99%	7.69%	2.95%	1.52%
	Ranks on returns	10	1	13	2	40	3	39	41	40	1	36
	Ranks on Stdv	15	5	25	3	8	27	4	8	2	4	21
	No. of cases	–	–	–	–	–	–	–	1	4,579	78,162	188,974

Table 2 (continued)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
S&P/BMV IPC	Median of returns	−0.16%	0.27%	−0.09%	−0.08%	0.01%	−0.09%	−0.07%	−0.28%	−1.33%	0.13%	−0.13%
	Stdv of returns	0.84%	1.20%	0.67%	0.85%	0.68%	0.94%	1.07%	1.13%	3.16%	1.74%	1.40%
	Ranks on returns	42	2	41	37	28	42	30	31	38	38	29
	Ranks on Stdv	12	16	24	21	19	4	13	38	34	30	24
	No. of cases	–	–	–	–	–	–	–	–	1094	17,799	40,186

been observed into the American stock market within 5 months such as in the month of March-2020 after declaration as a pandemic (Table 3).

This is being exhibited by the above-mentioned table, all the Asian indexes exhibited least riskiness and stable returns after pandemic, but Chinese stock market showcases massive median shift in the month of February-2020 in each Chinese indexes, it is very interesting, before pandemic the Chinese market was more vulnerable and later reported the significant stability in term of Monthly Average Returns, Standard Deviation, Median and Standard Deviation ranks. The number indicates that when there is a massive change in the number of Covid-19 reported cases in January and February then the market lost its stability. Coming towards rest of the stock market into Asia, Indian stock market showed healthy improvement in term of average monthly returns and stable rank shift, not only Indian Stock market but also Pakistani stock market showed stability in the global pandemic because these are the countries which adopted smart lockdown policy and intended to run stock market as usual plus immunity system of these masses is slightly stronger than Americans and Europeans and also the large % of population is based on the youth which also gives an edge to these countries over the America and Europe (Table 4).

The table above comprised on the European Stock Market, hence the Worlddometer shows the daily real time data, and the number indicates the destructions of the virus into Europe. This makes it the second largest market after America which succumbed to the pandemic. On May-15-2020, Russia, Spain, United Kingdom, Italy, France, Germany and Turkey ranked in the top ten effected countries by Covid-19 according to worlddometere. Median and Standard Deviation shift for these indexes are classified as MOEX −0.32% and 4.03% on Mar-20 (Jul-19 −0.01 and 0.66), RTSI −0.66% and 5.90% on Mar-20 (Jul-19 −0.08% and 0.68%), IBEX 35 −0.07% and 4.91% on Mar-20 (Jul-19 −0.12% and 0.80%), FTSE-100 0.86% and 4.33% on Mar-20 (Jul-19 −0.05% and 0.66%), FTSE MIB 0.32% and 5.42% on Mar-20 (Jul-19 0.06% and 0.95%), CAC-40 0.42% and 4.75% on Mar-20 (Jul-19 −0.03% and 0.57%), DAX 0.31% and 4.66% on Mar-20 (Jul-19 0.01% and 0.81%) and BIST-100 −0.32% and 3.34% on Mar-20 (Jul-19 0.38% and 1.374%). The information concluded that rapid increase in the Covid-19 cases reflected into European stock market. Italy and Spain are quantified the highest vulnerable indexes in Europe due to peak of Covid-19 cases and complete lock down for many days (Table 5).

Panel 4 consists of Pacific and Gulf indexes. Gulf region countries are least victim countries. Business activities are impacted heavily due to coronavirus pandemic in the Pacific region and the shift of above-mentioned factors support the statement with major shift into the factors seen in Nikkei 225 (Japan) and STI Index (Singapore) in March. Nikkei 225 reports median average return −1.13% in Mar-20 (Jul-19 0.03%) and Median rank 35 in Mar-20 (Jul-19 20), however, STI Index exhibited monthly average return at -0.95% in Mar-20 (Jul-19 −0.07%) with ranking as 33 in Mar-20 (Jul-19 31), in term of ranks STI is not hit as much higher as Japan. The most considerable thing in the pandemic, according to survey Covid-19 attacks quickly on people who are above 40 years, hence a noticeable thing that Japan inherent skewed population in terms of age group, there are more aged people compared to teenage or young adults. Further, people in an age of 30 to 35 years are in the

Table 3 Descriptive statistics for panel 2 (Asia)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
Shanghai	Median of returns	0.03%	−0.11%	0.23%	−0.35%	−0.07%	0.24%	−0.52%	0.31%	−0.47%	0.25%	0.19%
	Stdv of returns	0.93%	0.97%	0.75%	0.64%	0.69%	0.68%	0.94%	2.17%	1.85%	0.87%	0.51%
	Ranks on returns	21	29	10	40	33	8	42	4	22	35	9
	Ranks on Stdv	9	33	16	35	18	24	19	5	43	43	43
	No. of cases	–	–	–	–	–	27	9,714	78,927	82,241	83,944	84,024
SZSE Component	Median of returns	0.15%	−0.11%	0.30%	−0.31%	−0.06%	0.40%	−0.17%	0.58%	−0.47%	0.28%	0.48%
	Stdv of returns	1.26%	1.20%	1.07%	0.83%	0.98%	0.88%	1.31%	2.80%	2.42%	1.21%	0.74%
	Ranks on returns	6	32	5	39	32	2	37	3	21	34	4
	Ranks on Stdv	3	17	6	23	4	8	5	2	40	39	37
	No. of cases	–	–	–	–	–	27	9,714	78,927	82,241	83,944	84,024
China A50	Median of returns	−0.09%	−0.01%	−0.01%	0.07%	−0.12%	0.15%	−0.55%	−0.04%	−0.49%	0.06%	0.02%
	Stdv of returns	1.00%	1.09%	0.74%	0.62%	0.86%	0.70%	0.99%	2.08%	2.11%	0.87%	0.55%
	Ranks on returns	36	23	32	27	38	14	43	16	23	40	20
	Ranks on Stdv	4	24	17	37	9	22	16	6	41	42	41
	No. of cases	–	–	–	–	–	27	9,714	78,927	82,241	83,944	84,024

Table 3 (continued)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
DJ Shanghai	Median of returns	−0.01%	−0.11%	0.13%	0.00%	−0.11%	0.24%	0.00%	0.25%	−0.40%	0.30%	0.00%
	Stdv of returns	0.96%	1.03%	0.77%	0.63%	0.74%	0.70%	0.92%	2.22%	1.97%	0.89%	0.52%
	Ranks on returns	26	29	20	32	37	8	23	5	19	33	21
	Ranks on Stdv	6	28	14	36	14	21	21	4	42	41	42
	No. of cases	–	–	–	–	–	27	9,714	78,927	82,241	83,944	84,024
Taiwan Weighted	Median of returns	−0.07%	0.04%	0.07%	0.17%	0.08%	0.13%	0.00%	−0.29%	−0.86%	0.46%	0.52%
	Stdv of returns	0.57%	0.86%	0.45%	0.60%	0.67%	0.57%	1.40%	0.95%	3.02%	1.27%	1.21%
	Ranks on returns	31	18	23	19	21	17	25	32	32	26	2
	Ranks on Stdv	32	38	39	40	20	33	2	41	38	38	26
	No. of cases	–	–	–	–	–	–	9	34	306	429	440
SET	Median of returns	−0.02%	−0.28%	0.04%	−0.08%	−0.18%	−0.07%	−0.04%	−0.42%	0.49%	0.69%	0.38%
	Stdv of returns	0.48%	0.91%	0.54%	0.60%	0.69%	0.60%	1.02%	1.87%	4.51%	2.06%	1.16%
	Ranks on returns	28	37	24	37	41	39	29	39	5	17	5
	Ranks on Stdv	42	36	37	38	17	28	14	10	21	25	28
	No. of cases	–	–	–	–	–	–	14	40	1,651	2,954	3,017

Table 3 (continued)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
IDX Composite	Median of returns	0.02%	0.02%	−0.05%	0.19%	−0.31%	0.21%	−0.08%	−0.34%	−1.49%	0.38%	−0.36%
	Stdv of returns	0.54%	0.86%	0.70%	0.72%	0.62%	0.58%	0.73%	0.94%	4.01%	2.08%	0.98%
	Ranks on returns	23	20	36	14	43	11	31	36	41	32	37
	Ranks on Stdv	36	39	21	34	26	31	35	42	25	24	35
	No. of cases	–	–	–	–	–	–	–	–	1,414	9,771	15,438
Nifty 50	Median of returns	−0.15%	0.17%	0.00%	0.14%	0.08%	0.08%	−0.03%	−0.27%	−0.54%	0.76%	−0.30%
	Stdv of returns	0.74%	1.02%	1.63%	0.75%	0.52%	0.56%	0.77%	1.26%	4.84%	2.81%	2.21%
	Ranks on returns	41	8	29	21	21	26	28	29	27	12	33
	Ranks on Stdv	20	30	2	33	32	35	32	33	13	6	5
	No. of cases	–	–	–	–	–	–	1	3	1,251	33,050	78,003
BSE Sensex	Median of returns	−0.09%	0.20%	−0.04%	0.19%	0.07%	0.02%	0.03%	−0.26%	−0.50%	0.73%	−0.43%
	Stdv of returns	0.70%	1.01%	1.63%	0.82%	0.52%	0.57%	0.75%	1.23%	4.96%	2.90%	2.28%
	Ranks on returns	36	5	35	14	26	32	19	28	24	14	39
	Ranks on Stdv	22	31	3	25	33	34	33	34	11	5	4
	No. of cases	–	–	–	–	–	–	1	3	1,251	33,050	78,003

Table 3 (continued)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
PSEi Composite	Median of returns	0.03%	0.11%	−0.03%	0.19%	−0.14%	0.04%	−0.15%	−0.05%	0.05%	0.46%	−0.02%
	Stdv of returns	0.93%	1.18%	0.57%	0.85%	0.95%	0.97%	1.07%	1.52%	4.84%	2.66%	1.07%
	Ranks on returns	22	12	34	14	39	29	36	18	12	26	25
	Ranks on Stdv	8	18	34	22	5	3	12	26	14	9	31
	No. of cases	–	–	–	–	–	–	1	3	2,084	8,212	11,618
Karachi 100	Median of returns	0.04%	−1.44%	−0.01%	0.35%	0.69%	0.22%	−0.13%	−0.52%	−0.53%	0.74%	0.14%
	Stdv of returns	0.97%	1.72%	1.05%	0.95%	1.27%	1.16%	1.21%	1.28%	3.31%	2.27%	0.69%
	Ranks on returns	18	42	31	2	1	10	35	42	26	13	13
	Ranks on Stdv	5	2	7	12	2	2	9	32	33	17	40
	No. of cases	–	–	–	–	–	–	–	2	1625	15,759	35,788

Table 4 Descriptive Statistics for Panel 3 (Europe)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
DAX	Median of returns	0.01%	0.11%	0.32%	0.34%	0.10%	−0.07%	−0.02%	−0.03%	−0.31%	0.95%	−0.39%
	Stdv of returns	0.81%	1.26%	0.55%	1.04%	0.51%	0.78%	1.00%	1.48%	4.66%	2.57%	1.97%
	Ranks on returns	24	11	4	5	19	39	26	15	16	8	38
	Ranks on stdv	13	13	36	4	34	15	15	29	19	12	9
	No. of cases	–	–	–	–	–	–	5	47	61,913	159,119	172,239
FTSE 100	Median of returns	−0.05%	−0.07%	−0.02%	0.09%	0.13%	0.11%	0.01%	−0.27%	0.86%	0.55%	−0.05%
	Stdv of returns	0.66%	1.03%	0.52%	0.91%	0.61%	0.85%	0.83%	1.48%	4.33%	2.26%	1.51%
	Ranks on returns	30	27	33	25	15	21	21	29	1	23	27
	Ranks on Stdv	26	27	38	17	27	11	28	30	22	19	22
	No. of cases	–	–	–	–	–	–	2	16	22,141	165,221	229,705
CAC 40	Median of returns	−0.03%	0.16%	0.23%	0.17%	0.08%	0.13%	−0.02%	−0.19%	0.42%	0.65%	−0.75%
	Stdv of Returns	0.57%	1.42%	0.62%	1.02%	0.38%	0.78%	0.89%	1.59%	4.75%	2.36%	2.02%
	Ranks on returns	29	9	8	19	21	17	26	23	6	19	41
	Ranks on Stdv	35	8	29	6	41	14	23	19	16	14	7
	No. of cases	–	–	–	–	–	–	6	38	44,550	128,442	140,734
AEX	Median of returns	0.14%	0.13%	0.20%	−0.02%	0.15%	−0.01%	0.07%	0.01%	0.35%	1.23%	−0.02%
	Stdv of returns	0.53%	1.23%	0.44%	0.94%	0.47%	0.79%	0.92%	1.74%	4.23%	2.04%	1.90%
	Ranks on returns	8	10	15	34	13	35	14	13	7	4	24
	Ranks on Stdv	39	15	41	14	36	13	22	14	23	26	11
	No. of cases	–	–	–	–	–	–	–	1	11,750	38,802	43,211
IBEX 35	Median of returns	−0.12%	0.21%	0.29%	0.03%	−0.05%	0.02%	−0.17%	0.05%	−0.07%	0.40%	−0.30%
	Stdv of Returns	0.807%	1.023%	0.629%	0.973%	0.573%	0.866%	0.822%	1.700%	4.917%	2.096%	1.656%
	Ranks on returns	39	4	6	30	31	32	37	11	14	30	34
	Ranks on Stdv	14	29	28	9	31	9	29	17	12	23	18
	No. of cases	–	–	–	–	–	–	–	35	104,267	215,183	228,691

Table 4 (continued)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
FTSE MIB	Median of returns	0.06%	−0.22%	0.15%	0.21%	0.07%	0.14%	0.02%	0.12%	0.32%	0.95%	0.09%
	Stdv of returns	0.95%	1.48%	0.69%	0.95%	0.66%	0.86%	1.18%	1.90%	5.42%	2.33%	1.81%
	Ranks on returns	14	36	16	13	25	16	20	8	8	9	16
	Ranks on Stdv	7	6	23	13	22	10	10	9	10	15	13
	No. of cases	–	–	–	–	–	–	3	650	101,739	203,591	222,104
SMI	Median of returns	0.09%	−0.12%	0.01%	0.25%	0.19%	0.17%	0.10%	0.03%	0.58%	0.40%	0.35%
	Stdv of Returns	0.62%	0.97%	0.58%	0.77%	0.45%	0.68%	0.71%	1.57%	3.78%	1.42%	1.20%
	Ranks on returns	12	33	28	12	8	13	13	12	3	31	6
	Ranks on Stdv	28	34	33	30	37	23	36	22	28	34	27
	No. of cases	–	–	–	–	–	–	–	8	15,412	29,324	30,330
PSI 20	Median of returns	−0.28%	0.01%	0.22%	0.19%	−0.08%	0.01%	0.04%	−0.15%	0.18%	0.59%	−0.77%
	Stdv of returns	0.68%	1.10%	0.75%	0.60%	0.61%	0.62%	0.68%	1.49%	4.01%	1.49%	1.37%
	Ranks on returns	43	21	11	14	34	34	18	21	10	21	42
	Ranks on Stdv	25	23	15	39	28	26	38	27	26	33	25
	No. of cases	–	–	–	–	–	–	–	–	6,408	24,692	28,132
BEL 20	Median of Returns	0.14%	−0.04%	0.38%	0.10%	0.17%	0.10%	−0.08%	−0.04%	0.21%	1.21%	0.12%
	Stdv of returns	0.76%	1.25%	0.60%	1.00%	0.45%	0.58%	0.87%	2.02%	4.72%	2.47%	2.15%
	Ranks on returns	7	25	3	24	11	23	31	16	9	5	14
	Ranks on Stdv	16	14	31	8	38	32	25	7	17	13	6
	No. of cases	–	–	–	–	–	–	–	1	11,899	47,859	53,981

Table 4 (continued)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
ATX	Median of returns	−0.15%	−0.32%	0.21%	0.27%	0.08%	0.11%	−0.12%	−0.35%	−0.61%	1.00%	−0.74%
	Stdv of Returns	0.73%	1.00%	0.70%	0.93%	0.78%	0.59%	0.71%	1.55%	5.55%	2.75%	1.94%
	Ranks on returns	40	40	12	10	21	20	34	37	28	7	40
	Ranks on Stdv	21	32	22	15	13	30	37	25	9	7	10
	No. of cases	–	–	–	–	–	–	–	5	9,618	15,364	15,964
OMXS30	Median of returns	−0.09%	0.00%	0.45%	0.35%	−0.10%	0.06%	0.07%	−0.02%	0.01%	0.43%	0.02%
	Stdv of returns	0.91%	1.29%	0.71%	0.96%	0.65%	0.75%	0.95%	1.70%	3.87%	2.30%	2.29%
	Ranks on returns	36	22	2	2	36	28	14	14	13	28	19
	Ranks on Stdv	10	12	20	11	23	18	18	16	27	16	3
	No. of cases	–	–	–	–	–	–	–	7	4,028	20,302	27,909
OMXC25	Median of returns	0.05%	0.03%	0.03%	0.14%	0.24%	0.08%	0.22%	−0.19%	0.69%	0.72%	0.17%
	Stdv of returns	0.75%	1.15%	0.72%	0.96%	0.85%	0.64%	0.92%	1.58%	3.03%	1.13%	1.12%
	Ranks on returns	15	19	25	21	4	27	2	23	2	15	10
	Ranks on Stdv	17	20	19	10	10	25	20	21	37	40	30
	No. of cases	–	–	–	–	–	–	–	1	2,577	9,008	10,667
TA 35	Median of returns	−0.08%	0.26%	0.28%	−0.02%	−0.01%	−0.07%	0.11%	0.61%	−1.10%	0.47%	−0.08%
	Stdv of returns	0.61%	1.12%	0.45%	0.53%	0.42%	0.37%	0.55%	1.49%	3.58%	1.84%	1.85%
	Ranks on returns	35	3	7	34	29	38	10	2	34	25	28
	Ranks on Stdv	29	22	40	42	39	41	41	28	30	29	12
	No. of cases	–	–	–	–	–	–	–	3	4,473	15,834	16,548

Table 4 (continued)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
MOEX	Median of returns	−0.01%	−0.03%	−0.19%	0.19%	0.19%	0.25%	0.16%	−0.29%	−0.32%	0.64%	−0.02%
	Stdv of returns	0.66%	0.90%	0.64%	0.80%	0.64%	0.56%	0.85%	1.59%	4.03%	1.88%	0.74%
	Ranks on returns	27	24	42	14	7	7	3	32	18	20	26
	Ranks on Stdv	27	37	26	28	25	36	26	20	24	28	38
	No. of cases											
RTSI	Median of returns	−0.08%	0.09%	0.01%	0.45%	−0.02%	0.28%	0.23%	−0.56%	−0.66%	1.35%	0.15%
	Stdv of returns	0.68%	1.38%	0.87%	0.79%	0.82%	0.76%	1.31%	2.40%	5.90%	3.21%	1.74%
	Ranks on returns	34	15	27	1	30	5	1	43	29	2	12
	Ranks on Stdv	24	11	10	29	11	16	6	3	6	3	15
	No. of cases	–	–	–	–	–	–	–	2	1,836	99,399	242,271
WIG20	Median of returns	−0.07%	−0.31%	0.13%	0.05%	−0.31%	0.09%	0.01%	−0.36%	−0.86%	0.89%	−0.31%
	Stdv of returns	0.57%	1.42%	0.98%	1.03%	0.91%	0.90%	1.23%	1.79%	4.71%	2.22%	1.67%
	Ranks on returns	31	39	18	29	42	24	21	38	31	10	35
	Ranks on Stdv	34	9	9	5	7	7	8	12	18	20	17
	No. of cases	–	–	–	–	–	–	–	–	2,055	12,640	17,204
Budapest SE	Median of returns	0.11%	−0.30%	0.23%	0.27%	0.07%	0.27%	−0.38%	0.25%	−0.10%	0.71%	0.12%
	Stdv of returns	0.57%	0.81%	0.74%	1.01%	0.78%	0.91%	0.98%	1.81%	4.55%	2.20%	1.00%
	Ranks on returns	11	38	9	10	27	6	41	5	15	16	14
	Ranks on Stdv	33	40	18	7	12	5	17	11	20	21	34
	No. of cases	–	–	–	–	–	–	–	–	492	2,775	3,380

Table 4 (continued)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
BIST 100	Median of returns	0.38%	−0.09%	0.49%	−0.35%	0.23%	0.29%	0.05%	−0.32%	−0.32%	0.49%	−0.14%
	Stdv of returns	1.374%	1.084%	1.122%	1.637%	0.912%	0.704%	1.385%	1.735%	3.348%	1.379%	1.069%
	Ranks on returns	1	28	1	40	5	4	17	34	17	24	30
	Ranks on Stdv	2	25	5	2	6	20	3	15	32	35	32
	No. of cases	–	–	–	–	–	–	–	–	10,827	117,589	143,114

Table 5 Descriptive Statistics for Panel 4 (Pacific & Gulf)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
Nikkei 225	Median of returns	0.03%	0.06%	0.20%	0.34%	0.17%	−0.08%	0.07%	−0.23%	−1.13%	−0.04%	0.06%
	Stdv of returns	0.90%	0.96%	0.63%	0.76%	0.65%	0.76%	1.14%	1.47%	3.56%	2.18%	1.46%
	Ranks on returns	20	17	14	5	11	41	14	26	35	42	18
	Ranks on Stdv	11	35	27	31	24	17	11	31	31	22	23
	No. of cases	–	–	–	–	–	–	14	210	1,953	14,088	16,079
S&P/ASX 200	Median of returns	0.32%	0.18%	0.13%	0.07%	0.21%	−0.04%	0.13%	−0.14%	−1.24%	0.00%	−0.02%
	Stdv of returns	0.51%	1.12%	0.41%	0.81%	0.67%	0.90%	0.62%	1.18%	4.83%	1.96%	1.98%
	Ranks on returns	2	6	18	27	6	36	9	20	37	41	23
	Ranks on Stdv	40	21	42	26	21	6	40	37	15	27	8
	No. of cases	–	–	–	–	–	–	7	23	4,557	6,746	6,975
DJ New Zealand	Median of returns	0.18%	−0.05%	−0.07%	−0.03%	0.30%	−0.04%	0.16%	−0.07%	−0.50%	0.19%	0.50%
	Stdv of returns	0.598%	1.042%	0.858%	0.877%	0.605%	0.595%	0.537%	1.023%	3.116%	1.573%	0.696%
	Ranks on returns	4	26	37	36	3	36	3	19	25	36	3
	Ranks on Stdv	31	26	11	20	29	29	42	40	36	32	39
	No. of cases	–	–	–	–	–	–	–	1	647	1,129	1,147

Table 5 (continued)

Indexes	Descriptive	31-Jul-19	30-Aug-19	30-Sep-19	31-Oct-19	29-Nov-19	31-Dec-19	31-Jan-20	28-Feb-20	31-Mar-20	30-Apr-20	14-May-20
STI Index	Median of returns	−0.07%	−0.36%	−0.01%	0.34%	−0.09%	0.04%	0.00%	−0.19%	−0.95%	0.09%	0.00%
	Stdv of returns	0.60%	0.69%	0.60%	0.59%	0.60%	0.37%	0.64%	1.18%	3.63%	1.70%	1.05%
	Ranks on returns	31	41	30	5	35	29	23	23	33	39	21
	Ranks on Stdv	30	43	30	41	30	42	39	36	29	31	33
	No. of cases	–	–	–	–	–	–	13	96	844	15,641	25,346
Tadawul All Share	Median of returns	0.13%	0.09%	0.07%	−0.42%	0.17%	0.44%	0.15%	−0.32%	0.15%	0.69%	0.16%
	Stdv of returns	0.54%	0.76%	0.84%	0.89%	0.72%	0.72%	0.84%	0.89%	3.13%	1.34%	0.92%
	Ranks on returns	9	13	22	42	10	1	7	34	11	17	11
	Ranks on Stdv	37	42	13	19	15	19	27	43	35	36	36
	No. of cases	–	–	–	–	–	–	–	–	1453	21,402	44,830

Table 6 Correlation matrix before Coronavirus

Indices	A	B	CI	DI	E	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
A	1.00																																								
B	0.96	1.00																																							
CI	0.91	0.97	1.00																																						
DI	0.83	0.87	0.88	1.00																																					
E	-0.86	-0.89	-0.86	-0.72	1.00																																				
G	0.00	-0.02	-0.01	0.03	-0.08	1.00																																			
H	0.59	0.59	0.56	0.46	-0.50	0.09	1.00																																		
I	0.69	0.72	0.70	0.57	-0.62	-0.01	0.76	1.00																																	
J	0.68	0.71	0.70	0.58	-0.60	0.05	0.80	0.92	1.00																																
K	0.60	0.62	0.58	0.50	-0.53	0.02	0.64	0.83	0.80	1.00																															
L	0.62	0.67	0.65	0.54	-0.56	-0.02	0.58	0.84	0.78	0.80	1.00																														
M	0.61	0.65	0.63	0.51	-0.55	0.05	0.71	0.81	0.81	0.68	0.69	1.00																													
N	0.59	0.59	0.57	0.50	-0.44	0.07	0.61	0.75	0.74	0.73	0.68	0.61	1.00																												
O	0.61	0.64	0.63	0.55	-0.50	0.00	0.72	0.87	0.86	0.81	0.76	0.70	0.74	1.00																											
P	0.58	0.57	0.53	0.55	-0.49	0.16	0.62	0.69	0.65	0.68	0.67	0.58	0.70	0.68	1.00																										
Q	0.54	0.57	0.55	0.50	-0.46	0.04	0.72	0.82	0.79	0.75	0.69	0.65	0.71	0.80	0.69	1.00																									
R	0.53	0.56	0.55	0.42	-0.51	0.07	0.61	0.67	0.69	0.57	0.58	0.68	0.57	0.65	0.53	0.58	1.00																								
S	0.07	0.04	0.07	0.09	-0.05	0.42	0.25	0.19	0.27	0.18	0.04	0.11	0.24	0.27	0.29	0.33	0.17	1.00																							
T	0.08	0.05	0.06	0.08	0.01	0.46	0.35	0.18	0.27	0.23	0.08	0.23	0.22	0.21	0.27	0.22	0.22	0.56	1.00																						
U	0.05	0.02	0.03	-0.02	-0.03	0.31	0.07	0.08	0.10	0.10	0.10	0.11	0.12	0.07	0.07	0.08	0.20	0.54	1.00																						
W	0.24	0.20	0.20	0.18	-0.21	0.43	0.39	0.31	0.39	0.28	0.22	0.28	0.38	0.35	0.36	0.38	0.30	0.59	0.47	0.26	1.00																				
X	0.41	0.46	0.44	0.46	-0.41	0.19	0.32	0.44	0.37	0.38	0.44	0.39	0.31	0.38	0.48	0.46	0.31	0.17	0.21	-0.01	0.15	1.00																			
Y	0.61	0.62	0.59	0.52	-0.56	0.03	0.41	0.46	0.40	0.40	0.43	0.44	0.37	0.39	0.47	0.33	0.40	0.01	0.06	0.10	0.19	0.30	1.00																		
Z	0.46	0.45	0.42	0.37	-0.40	0.06	0.42	0.43	0.40	0.42	0.33	0.32	0.40	0.42	0.36	0.39	0.32	0.23	0.19	0.06	0.24	0.20	0.49	1.00																	
AA	0.35	0.37	0.35	0.36	-0.28	0.09	0.50	0.44	0.44	0.30	0.31	0.38	0.35	0.38	0.37	0.46	0.28	0.27	0.19	0.01	0.40	0.39	0.31	0.35	1.00																
AB	0.45	0.47	0.44	0.46	-0.36	0.00	0.52	0.54	0.52	0.41	0.43	0.42	0.48	0.47	0.49	0.53	0.36	0.23	0.14	-0.01	0.33	0.41	0.38	0.38	0.85	1.00															
AC	0.44	0.40	0.36	0.38	-0.30	0.08	0.42	0.47	0.45	0.39	0.43	0.44	0.51	0.50	0.64	0.53	0.36	0.20	0.22	0.10	0.31	0.38	0.34	0.27	0.32	0.40	1.00													
AD	0.31	0.29	0.24	0.26	-0.25	-0.04	0.38	0.36	0.40	0.30	0.25	0.35	0.37	0.42	0.40	0.38	0.27	0.14	0.09	0.04	0.41	0.14	0.30	0.30	0.39	0.39	0.52	1.00											
AE	0.08	0.09	0.05	0.10	-0.01	-0.05	0.24	0.13	0.20	0.11	0.09	0.20	0.18	0.17	0.21	0.12	0.12	0.18	0.15	-0.10	0.20	0.15	0.04	-0.03	0.20	0.25	0.27	0.26	1.00										
AF	-0.01	-0.01	0.01	-0.05	0.00	0.08	0.08	0.09	0.09	0.02	0.05	0.06	0.14	0.04	0.06	0.02	0.07	0.03	0.09	0.12	0.12	-0.08	-0.02	-0.04	0.02	0.04	0.10	0.22	0.03	1.00									
AG	0.10	0.12	0.15	0.06	-0.08	0.28	0.25	0.23	0.27	0.24	0.18	0.16	0.22	0.27	0.27	0.32	0.18	0.49	0.33	0.07	0.40	0.09	-0.01	0.15	0.15	0.19	0.20	0.16	0.05	0.17	1.00								
AH	0.07	0.09	0.12	0.13	-0.05	0.27	0.19	0.19	0.22	0.20	0.16	0.12	0.19	0.23	0.25	0.27	0.16	0.38	0.28	0.10	0.30	0.06	-0.04	0.11	0.11	0.17	0.15	0.09	0.08	0.16	0.94	1.00							
AI	0.09	0.10	0.12	0.11	-0.09	0.23	0.20	0.18	0.25	0.17	0.11	0.15	0.16	0.24	0.22	0.27	0.19	0.52	0.30	0.10	0.40	0.07	-0.01	0.13	0.16	0.19	0.21	0.18	0.08	0.10	0.88	0.78	1.00						
AJ	0.09	0.11	0.15	0.15	-0.07	0.26	0.22	0.21	0.25	0.22	0.16	0.15	0.20	0.25	0.24	0.30	0.17	0.47	0.32	0.08	0.40	0.07	-0.04	0.14	0.14	0.19	0.19	0.14	0.04	0.13	0.98	0.92	0.90	1.00					
AK	0.08	0.09	0.11	0.10	-0.08	0.33	0.27	0.19	0.27	0.15	0.11	0.19	0.32	0.26	0.30	0.32	0.26	0.61	0.41	0.23	0.53	0.07	0.08	0.29	0.35	0.35	0.31	0.29	0.16	0.17	0.43	0.35	0.52	0.44	1.00				
AL	0.19	0.17	0.16	0.22	-0.14	0.06	0.29	0.29	0.29	0.27	0.28	0.25	0.38	0.37	0.36	0.35	0.29	0.28	0.12	0.11	0.40	0.13	0.29	0.31	0.26	0.21	0.42	0.48	0.19	0.03	0.21	0.10	0.28	0.21	0.44	1.00			
AM	0.11	0.12	0.13	0.10	-0.11	0.20	0.25	0.17	0.26	0.09	0.03	0.20	0.09	0.28	0.09	0.21	0.18	0.43	0.29	0.17	0.32	0.03	0.18	0.23	0.15	0.05	0.16	0.21	0.04	0.16	0.25	0.16	0.28	0.23	0.35	0.18	1.00		
AN	0.06	0.07	0.05	0.11	-0.07	0.02	0.07	0.10	0.06	0.13	0.06	0.16	0.09	0.13	0.07	0.04	0.09	0.09	0.03	-0.09	0.07	0.14	0.02	0.12	0.12	0.11	0.12	0.21	0.06	0.13	0.15	0.08	0.16	0.12	0.15	0.10	0.10	1.00	
AO	0.06	0.07	0.04	0.11	-0.06	0.02	0.07	0.09	0.05	0.11	0.04	0.15	0.08	0.11	0.06	0.03	0.08	0.09	0.03	-0.09	0.06	0.13	0.01	0.12	0.12	0.11	0.11	0.20	0.06	0.12	0.15	0.09	0.17	0.12	0.14	0.08	0.10	0.99	1.00
AP	0.20	0.14	0.14	0.12	-0.13	0.18	0.23	0.13	0.16	0.15	0.08	0.08	0.25	0.22	0.22	0.17	0.12	0.36	0.30	0.28	0.38	0.07	0.18	0.24	0.11	0.10	0.24	0.26	0.01	0.16	0.26	0.21	0.27	0.26	0.34	0.29	0.49	0.06	0.07	1.00
AQ	0.11	0.08	0.08	0.06	-0.06	0.20	0.16	0.15	0.15	0.15	0.17	0.14	0.21	0.14	0.24	0.15	0.13	0.24	0.25	0.00	0.27	0.18	0.04	0.09	0.17	0.21	0.16	-0.01	0.12	0.00	0.18	0.15	0.12	0.20	0.10	0.08	-0.02	-0.15	-0.15	0.01	1.00

Table 7 Correlation matrix after Coronavirus

Indices	A	B	CI	DI	E	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
A	1.00																																								
B	0.99	1.00																																							
CI	0.97	0.98	1.00																																						
DI	0.94	0.94	0.92	1.00																																					
E	-0.70	-0.72	-0.76	-0.65	1.00																																				
G	-0.16	-0.17	-0.19	-0.10	0.04	1.00																																			
H	0.76	0.75	0.72	0.78	-0.56	0.14	1.00																																		
I	0.73	0.72	0.69	0.77	-0.57	0.15	0.94	1.00																																	
J	0.69	0.67	0.66	0.74	-0.56	0.13	0.93	0.96	1.00																																
K	0.74	0.74	0.72	0.77	-0.60	0.08	0.91	0.91	0.90	1.00																															
L	0.70	0.70	0.69	0.72	-0.61	0.06	0.88	0.91	0.90	0.93	1.00																														
M	0.68	0.68	0.65	0.71	-0.51	0.01	0.89	0.86	0.91	0.85	0.83	1.00																													
N	0.71	0.71	0.68	0.73	-0.58	0.12	0.90	0.91	0.90	0.91	0.86	0.82	1.00																												
O	0.63	0.63	0.61	0.65	-0.59	0.18	0.87	0.91	0.90	0.88	0.90	0.82	0.83	1.00																											
P	0.62	0.61	0.60	0.69	-0.57	0.11	0.80	0.89	0.86	0.82	0.82	0.68	0.83	0.86	1.00																										
Q	0.71	0.71	0.68	0.74	-0.53	0.11	0.90	0.91	0.92	0.90	0.87	0.91	0.85	0.86	0.74	1.00																									
R	0.62	0.62	0.59	0.62	-0.56	0.18	0.84	0.84	0.83	0.78	0.86	0.84	0.80	0.73	0.84	1.00																									
S	0.39	0.37	0.33	0.41	-0.21	0.44	0.47	0.48	0.48	0.43	0.39	0.42	0.49	0.40	0.38	0.49	0.44	1.00																							
T	0.71	0.71	0.68	0.67	-0.45	-0.01	0.66	0.63	0.57	0.62	0.56	0.56	0.66	0.50	0.54	0.58	0.64	0.37	1.00																						
U	0.40	0.39	0.31	0.37	-0.20	0.26	0.55	0.52	0.52	0.48	0.42	0.57	0.58	0.53	0.42	0.51	0.65	0.37	0.55	1.00																					
W	0.41	0.39	0.32	0.37	-0.23	0.31	0.56	0.60	0.53	0.55	0.50	0.47	0.59	0.60	0.55	0.56	0.55	0.57	0.51	0.53	1.00																				
X	0.55	0.53	0.53	0.65	-0.38	0.11	0.64	0.68	0.71	0.65	0.58	0.63	0.70	0.57	0.67	0.67	0.65	0.53	0.45	0.48	0.44	1.00																			
Y	0.86	0.84	0.81	0.83	-0.57	0.13	0.74	0.74	0.73	0.75	0.71	0.66	0.69	0.64	0.65	0.71	0.62	0.34	0.70	0.38	0.48	0.48	1.00																		
Z	0.73	0.72	0.68	0.71	-0.55	0.05	0.78	0.73	0.71	0.68	0.70	0.69	0.70	0.68	0.61	0.76	0.63	0.38	0.55	0.41	0.50	0.46	0.74	1.00																	
AA	0.45	0.43	0.41	0.56	-0.34	0.13	0.70	0.73	0.77	0.69	0.68	0.71	0.63	0.69	0.70	0.70	0.65	0.28	0.32	0.39	0.30	0.55	0.43	0.52	1.00																
AB	0.45	0.44	0.42	0.56	-0.34	0.16	0.70	0.72	0.76	0.68	0.66	0.68	0.65	0.67	0.70	0.69	0.65	0.25	0.32	0.37	0.30	0.57	0.42	0.54	0.97	1.00															
AC	0.63	0.64	0.64	0.66	-0.55	-0.04	0.78	0.79	0.79	0.84	0.79	0.80	0.79	0.77	0.72	0.82	0.82	0.30	0.54	0.39	0.42	0.61	0.64	0.60	0.63	0.64	1.00													
AD	0.66	0.66	0.64	0.68	-0.57	0.08	0.77	0.85	0.76	0.77	0.79	0.67	0.81	0.77	0.83	0.71	0.73	0.36	0.57	0.40	0.52	0.53	0.66	0.71	0.64	0.67	0.75	1.00											
AE	0.63	0.62	0.60	0.62	-0.53	0.07	0.73	0.74	0.74	0.75	0.75	0.67	0.73	0.78	0.71	0.69	0.71	0.37	0.56	0.53	0.53	0.55	0.58	0.61	0.62	0.63	0.68	0.76	1.00										
AF	0.53	0.53	0.51	0.50	-0.47	-0.08	0.49	0.48	0.48	0.51	0.46	0.49	0.55	0.51	0.51	0.49	0.48	0.35	0.50	0.40	0.51	0.50	0.53	0.43	0.21	0.17	0.58	0.50	0.49	1.00									
AG	0.34	0.32	0.27	0.30	-0.20	0.14	0.40	0.40	0.39	0.35	0.29	0.36	0.43	0.38	0.40	0.39	0.42	0.46	0.42	0.42	0.63	0.26	0.34	0.36	0.26	0.24	0.33	0.40	0.39	0.45	1.00								
AH	0.35	0.33	0.29	0.32	-0.19	0.13	0.40	0.39	0.39	0.36	0.30	0.36	0.39	0.40	0.39	0.39	0.41	0.45	0.44	0.40	0.65	0.27	0.41	0.37	0.26	0.24	0.35	0.39	0.41	0.48	0.96	1.00							
AI	0.35	0.33	0.28	0.31	-0.24	0.23	0.45	0.45	0.44	0.38	0.33	0.36	0.48	0.43	0.45	0.43	0.46	0.51	0.47	0.48	0.67	0.27	0.36	0.41	0.27	0.26	0.31	0.44	0.43	0.44	0.94	0.88	1.00						
AJ	0.36	0.34	0.29	0.32	-0.20	0.14	0.41	0.42	0.41	0.37	0.31	0.37	0.46	0.40	0.42	0.41	0.43	0.49	0.44	0.42	0.64	0.27	0.35	0.37	0.27	0.24	0.34	0.42	0.40	0.46	0.98	0.95	0.94	1.00					
AK	0.32	0.30	0.25	0.28	-0.22	0.36	0.49	0.58	0.50	0.46	0.44	0.36	0.55	0.56	0.58	0.45	0.55	0.51	0.47	0.60	0.77	0.41	0.37	0.43	0.32	0.33	0.34	0.51	0.54	0.36	0.53	0.50	0.64	0.52	1.00				
AL	0.39	0.39	0.34	0.39	-0.38	0.21	0.58	0.63	0.56	0.60	0.60	0.54	0.58	0.68	0.63	0.57	0.65	0.35	0.50	0.51	0.73	0.34	0.53	0.46	0.40	0.35	0.61	0.61	0.57	0.59	0.56	0.60	0.57	0.56	0.61	1.00			
AM	0.35	0.37	0.32	0.32	-0.31	0.14	0.35	0.42	0.35	0.37	0.37	0.32	0.44	0.45	0.47	0.35	0.50	0.18	0.32	0.40	0.52	0.39	0.34	0.39	0.24	0.28	0.45	0.51	0.47	0.47	0.33	0.32	0.37	0.33	0.54	0.55	1.00		
AN	0.41	0.40	0.34	0.43	-0.26	0.18	0.60	0.65	0.56	0.62	0.57	0.52	0.61	0.62	0.61	0.61	0.63	0.31	0.48	0.50	0.79	0.41	0.53	0.49	0.48	0.50	0.55	0.60	0.60	0.39	0.50	0.53	0.52	0.51	0.68	0.78	0.56	1.00	
AO	0.42	0.41	0.35	0.44	-0.26	0.18	0.61	0.66	0.57	0.62	0.57	0.53	0.61	0.63	0.61	0.62	0.63	0.30	0.48	0.49	0.78	0.41	0.54	0.50	0.48	0.51	0.55	0.60	0.60	0.39	0.49	0.53	0.51	0.51	0.67	0.77	0.56	1.00	1.00
AP	0.41	0.40	0.36	0.32	-0.30	0.29	0.46	0.51	0.39	0.51	0.46	0.31	0.54	0.49	0.46	0.41	0.50	0.31	0.57	0.53	0.59	0.29	0.48	0.42	0.14	0.19	0.37	0.51	0.49	0.37	0.35	0.36	0.44	0.35	0.65	0.59	0.67	0.56	0.55	1.00
AQ	0.16	0.18	0.18	0.18	-0.32	-0.07	0.16	0.20	0.18	0.19	0.18	0.13	0.25	0.23	0.36	0.16	0.29	0.05	0.21	0.17	0.25	0.17	0.19	0.19	0.18	0.24	0.30	0.40	0.35	0.33	0.40	0.40	0.41	0.41	0.31	0.46	0.50	0.47	0.45	0.32	1.00

established phase and they are potential investors, therefore it can be perceived that Japan's market was hit due to withdrawal of potential aged investors (Table 6).

We have taken the date before and after the pandemic, hence above mentioned correlation matrix are before Coronavirus cases, there are few indexes which have strongly significant correlation such as American and European indexes, therefore the purpose was to see the movement of the global indexes to each other, hence in the second correlation matrix, we found very different results (Table 7).

The European region is considered the most effective countries by Covid-19, above matrix, was constructed after the very first case of Covid-19 till 14 of May 2020, therefore it is being witnessed that before pandemic the market was stable and have very least correlation but after the Coronavirus pandemic entire European stock markets started to move in the same direction highlighted as in red. As per the theory of Forbes and Rigobon (2002) the domino effect of one market to another one, if one market crashed in the same region then there is much probability that it will affect some other market, and this what is seen in the correlation matrix after

the very first case of Covid-19 to the current date, the correlation markets indicates market to market impact in American and European regions, and these are the regions which are badly affected by the virus (Table 8).

By using linear regression model, we quantified the relation of % change in Coronavirus cases to index returns. Panel-1 consists on American indices, the indices from A to DI witnessed negative significant relationship between % change in cases to the index returns, as higher the percentage, the more decline will be into the stock market returns. Hence America is the highest affected region by Novel coronavirus and due to complete lockdown in the entire states of American stock markets showcased significant decline, many businesses closure and shortage in the basics necessities products put the entire American economy in difficult time.

Panel-2 comprised on Asian region stock indexes, due to rapid increase in Covid-19 cases in China, Thailand and Philippine impacted heavily on the economy of these countries including the stock markets, the outbreak began in Wuhan (China Mainland) which spread from China to the entire world due to giant trade nexus of China around the globe, therefore table above showing the significant relationship with major indices of Chinese capital market, increment in Covid-19 cases reflects into Chinese capital market. Not only China which has had massive cases and its effect on the market, but Thailand and Philippines also showed the impact of percentage change into Covid-19 cases with stock market downfall.

Panel-3 categorized one European based indexes, interestingly RTSI (Russia) and Budapest SE (Hungary) did not have any significant impact on the % change in Covid-19 cases with stock market returns. It may be assumed that these countries had some smart policy to deal with the global pandemic, but rest of the entire European stock markets are badly damaged by the pandemic, and this is what we analyzed in the above-mentioned segment in the correlation matrix. We have further examined the effected indexes by assigning them ranks according to their "Coefficients Values" driven from linear regression model as below (Table 9).

Panel-4 is based on Pacific and Gulf-based indexes, S&P/ASX 200, STI Index and Tadawul All Share exhibited a significant negative relationship between coronavirus cases and stock market returns, the coefficient of the equations are very low that means there is a very minor type of effect on the indexes by the increment in the Covid-19 cases within the country, therefore the relationship still exists and can't be ignored at all (Table 10).

Not only did we detect the effect and intensity of the Covid-19 on stock indices but we also encountered clustering effects into each index classified as Developed and Emerging markets, to measure volatility in the stock indices. We have used ordinary least square (OLS), GARCH, TARCH, and EGARCH models, as per the information criterions (AIC, HIC, and HQC) the least valuable one model is the best. We have selected to used EGARCH model in both of the panels, we have tested every single index to find the clustering effect in the markets by using dummy in place of reported cases on daily basis. Below is the list of cumulative cases on the last terminal day of this research (Table 11).

As discussed previously, America was found to be the highest affected country around the globe with around 1.3 m cases reported in USA and New Zealand as the least cases around the world. Anyhow, according to above mentioned EGARCH

Table 8 Regression Model for each index

Regression Panel-1	A	B	CI	DI	E	Y	Z
Coefficient	−0.0153	−0.015	−0.014	−0.016	0.066	−0.0492	−0.0140
t-Statistic	−2.008**	−2.095**	−2.014**	−1.828*	1.549	−3.3967	−1.5033
Adjusted R-squared	0.0361	0.040	0.036	0.028	0.017	0.1584	0.0232
Cases in Start	1	1	1	1	1	1	5
Cases in End	1,390,746	1,390,746	1,390,746	1,390,746	1,390,746	188,974	40,186

Regression Panel-2	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
Coefficient	−0.0049	−0.0053	−0.0057	−0.0040	−0.0031	−0.0295	−0.0218	−0.0117	−0.0122	−0.0191	−0.0041
t-Statistic	−1.906**	−1.5506	−2.129**	−1.4981	−0.6476	−3.574*	−3.098*	−1.4801	−1.5109	−2.433**	−0.8310
Adjusted R-squared	0.0272	0.0147	0.0363	0.0131	−0.0072	0.1205	0.1396	0.0163	0.0175	0.0624	−0.0057
Cases in start	27	27	27	27	1	1	2	1	1	1	2
Cases in end	84,024	84,024	84,024	84,024	440	3,017	15,438	78,003	78,003	11,618	35,788

Regression Panel-3	G	H	I	J	K	L	M	N	O	P	Q
Coefficient	−0.009	−0.021	−0.019	−0.001	−0.015	−0.001	−0.008	−0.027	−0.013	−0.0330	−0.0206
t-Statistic	−1.186	−2.008**	−2.183**	−0.352	−2.058**	−1.633*	−2.318**	−3.602*	−1.929**	−2.599***	−2.925***
Adjusted R-squared	0.005	0.040	0.047	−0.016	0.044	0.022	0.072	0.187	0.037	0.0932	0.0950
Cases in Start	1	2	3	1	1	3	1	2	1	2	1
Cases in End	172,239	229,705	140,734	43,211	228,691	222,104	30,330	28,132	53,981	15,964	27,909

Regression Panel-3	AA	AB	AC	AD	AE	R	X
Coefficient	−0.0160	−0.0203	−0.0083	−0.0240	−0.0097	−0.0104	−0.0191
t-Statistic	−1.763*	−1.4585	−2.514*	−2.6204	−3.990***	−1.944**	−2.403**
Adjusted R-squared	0.0285	0.0154	0.0945	0.1050	0.2490	0.0482	0.0761

Table 8 (continued)

Regression Panel-3	AA	AB	AC	AD	AE	R	X
Cases in Start	2	2	1	2	1	1	2
Cases in End	242,271	242,271	17,204	3,380	143,114	10,667	16,548
Regression Panel-4	S	T	U	W	AF		
Coefficient	−0.0120	−0.0417	−0.0037	−0.0322	−0.0102		
t-Statistic	−1.0107	−2.813***	−0.7262	−1.720*	−2.063**		
Adjusted R-squared	0.0003	0.0824	−0.0088	0.0245	0.0590		
Cases in Start	1	4	1	3	1		
Cases in End	16,079	6975	1147	25,346	44,830		

*p-value > 0.05 but < 0.10 or > 5% and < 10%

**p-value > 0.01 but < 0.05 or > 1% and < 5%

***p-value < 0.01 or < 1%

Table 9 Country wise coefficients

Indices code	Country	Coefficients	Ranks
P	Austria	−3.30%	1
N	Portugal	−2.72%	2
H	UK	−2.11%	3
Q	Sweden	−2.06%	4
I	France	−1.94%	5
X	Israel	−1.91%	6
AA	Russia	−1.60%	7
K	Spain	−1.49%	8
O	Belgium	−1.31%	9
R	Denmark	−1.04%	10
AE	Turkey	−0.97%	11
G	Germany	−0.90%	12
AC	Poland	−0.83%	13
M	Switzerland	−0.76%	14
L	Italy	−0.13%	15
J	Netherland	−0.09%	16

We have excluded Russian RTSI (Russia) and Budapest SE (Hungary) from the rankings because Covid-19 has no impact on these indexes. We assigned ranks on the basis of "Coefficient Values" which are derived by linear regression model

equation witnessed the smart policies of Portugal and Australia because the PSI 20 & S&P/ASX 200 asymmetry term is insignificant, which indicates that in both of the indexes there is no instable fluctuation which harms market decorum, therefore it is also noticeable that these markets are saved from markets shocks generated by the bad news. Coming towards the rest of the indices, almost every index reported the clustering effects because p-value of the EGARCH Term is under accepted regions, meaning we cannot reject the alternative hypothesis. There are clustering effect in the model, meaning period of low volatility is followed by period of low volatility for prolonged period and period of high volatility is followed by period of high volatility. If one day return is negative then there are possibilities that next will be negative too and this pattern remains same with a certain time, and that has been seen in the rest of the indexes in developed market. It is also noticeable that most of the indexes categorized into the developed market are from America or Europe and that is the red zone area of Covid-19 (Table 12).

In the emerging market, most of the countries are from Asian and Pacific regions, apart from China, which was declared red zone in the pandemic. In above table, 4th and 5th column is the mean equation in the EGARCH model and rest of the columns for the EGARCH. Result from the emerging market are far different from the developed market such as the biggest index of China and India. DJ Shanghai and BSE Sensex had no clustering effect on pandemic even PSEi Composite does not have any clustering effect because p-value of Asymmetry term (EGARCH Model) is more than 0.10% which means negative news or

Table 10 EGARCH model for each index in developed market classified by MSCI

EGARCH model—Each index for developed markets							
Code	Indices	MSCI	Coefficient	t-statistics	ARCH Term	Asymmetry term	GARCH Term
A	Dow 30	Developed	0.000	0.152	0.204**	−0.368***	0.958***
B	S&P 500	Developed	0.001	0.001	0.283**	−0.394***	0.957***
CI	Nasdaq	Developed	0.002	1.067	0.270**	−0.316***	0.957***
DI	SmallCap 2000	Developed	−0.001	−0.492	0.214**	−0.250***	0.978***
E	S&P 500 VIX	Developed	−0.02	−3.151***	−0.066	0.413***	0.878***
G	DAX	Developed	0.006	3.814***	−0.150**	−0.242***	0.965***
H	FTSE 100	Developed	0.000	0.091	0.497***	−0.138*	0.948***
I	CAC 40	Developed	−0.006	−3.529***	0.317***	−0.151***	0.955***
J	AEX	Developed	−0.003	−1.042	0.689***	−0.190*	0.920***
K	IBEX 35	Developed	0.003	4.433***	−0.151***	−0.283***	0.959***
L	FTSE MIB	Developed	0.006	6.165***	−0.248***	−0.369***	0.937***
M	SMI	Developed	0.005	4.109***	1.0317***	−0.478***	0.119*
N	PSI 20	Developed	−0.003	−1.818*	0.728***	−0.10619	0.884***
O	BEL 20	Developed	0.002	1.257	0.158***	−0.277***	0.959***
P	ATX	Developed	−0.002	−0.600	0.156**	−0.185***	0.984***
Q	OMXS30	Developed	0.006	3.609***	−0.150**	−0.231***	0.962***
R	OMXC25	Developed	0.002	1.358	0.232***	−0.222***	0.897***
S	Nikkei 225	Developed	−0.000	−0.39	0.066	−0.216***	0.974***
T	S&P/ASX 200	Developed	−0.003	−2.606**	0.381***	−0.081	0.957***
U	DJ New Zealand	Developed	0.001	0.605	0.169**	−0.127***	0.965***
W	STI Index	Developed	−0.000	−0.352	0.202**	−0.190***	0.958***
X	TA 35	Developed	−0.001	−0.824	0.369***	−0.123**	0.975***

* p-value > 0.05 but < 0.10 or > 5% and < 10%

** p-value > 0.01 but < 0.05 or > 1% and < 5%

*** p-value < 0.01 or < 1%

shock does not impact the market equilibrium. Hence, smart policies and initiative to retain the capital taken by the Indian, Chinese and Philippine looks fruitful to stabilize the market equilibrium. EGARCH refers to two broad criteria such as it measures the volatility into the stock market as well as the role of information meaning negative and positive shocks into the market.

Before moving forward we would like to mention the table which indicates cumulative cases in Emerging Markets (Table 13).

Russia, Brazil, and Turkey have shown the highest reported cases as per above table. In the indexes of Russia, Brazil and Turkey, strong clustering effect has been detected by EGARCH model, whereas in the rest of the Chinese indices aggressive

Table 11 Cumulative cases in developed markets country wise

S.no	ISO3 codes	Country	Market	Cumulative cases	% of cumulative cases
1	USA	American	Developed	1,390,746	52.27%
2	GBR	UK	Developed	229,705	8.63%
3	ESP	Spain	Developed	228,691	8.60%
4	ITA	Italy	Developed	222,104	8.35%
5	DEU	Germany	Developed	172,239	6.47%
6	FRA	France	Developed	140,734	5.29%
7	BEL	Belgium	Developed	53,981	2.03%
8	NLD	Netherland	Developed	43,211	1.62%
9	CHE	Switzerland	Developed	30,330	1.14%
10	PRT	Portugal	Developed	28,132	1.06%
11	SWE	Sweden	Developed	27,909	1.05%
12	SGP	Singapore	Developed	25,346	0.95%
13	ISR	Israel	Developed	16,548	0.62%
14	JPN	Japan	Developed	16,079	0.60%
15	AUT	Austria	Developed	15,964	0.60%
16	DNK	Denmark	Developed	10,667	0.40%
17	AUS	Australia	Developed	6,975	0.26%
18	NZL	New Zealand	Developed	1147	0.04%
Total	Total			2,660,508	100.00%

clustering effect has been detected apart from Shanghai index. We have used dummy variable for every reported case to developed EGARCH equation, hence almost every index individually effect by the Covid-19 is reported by the regression model above and there are few indexes which have Covid-19 impact as per the regression but not clustering effect means no abnormal volatility. Furthermore, in the above-mentioned table, the emerging market indicates that there is a clustering effect in each index apart from the Shanghai, BSE Sensex, and PSEi Composite (Table 14).

In every model of this research, we found European market is the most affected market by the Covid-19 and most of the indexes are classified in the developed market. Therefore, we needed to hypothesize the Covid-19 clustering effect on Developed and Emerging Market collectively. Before this segment we analyze the market on an individual basis by using regression and EGARCH Model, but in this segment, we have averaged out the daily return of each index and plugged this into the respective category and created single indexes for developed and emerging markets.

Initially, we tested the ARCH effect in the both constructed equation and found ARCH effect because p-value of AR (1) is less than 0.05 or 5% which allows us to use ARCH family model, therefore we use Ordinary Least Square, GARCH,

Table 12 EGARCH Model for each index in emerging market classified by MSCI

EGARCH model – each index for developed markets							
Code	Indices	MSCI	Coefficient	t-statistics	ARCH Term	Asymmetry term	GARCH Term
Y	Bovespa	Emerging	−0.002	−0.756	0.254***	−0.255***	0.945***
Z	S&P/BMV IPC	Emerging	0.001	2.410***	−0.142***	−0.250***	0.958***
AA	MOEX	Emerging	0.000	0.146	0.201***	−0.128***	0.967***
AB	RTSI	Emerging	0.000	0.227	0.179	−0.140***	0.971***
AC	WIG20	Emerging	0.003	2.368**	−0.122***	−0.250***	0.962***
AD	Budapest SE	Emerging	−0.001	−0.277	0.178**	−0.127***	0.970***
AE	BIST 100	Emerging	0.001	0.938	0.000	−0.239***	0.930***
AF	Tadawul All Share	Emerging	0.007	3.824***	0.072	−0.265***	0.896***
AG	Shanghai	Emerging	−0.001	−1.551	1.076***	−0.136*	−0.158
AH	SZSE Component	Emerging	0.003	1.976**	0.111	−0.226***	0.889***
AI	China A50	Emerging	0.000	0.948	0.037	−0.264***	0.906***
AJ	DJ Shanghai	Emerging	−0.002	−1.339	0.797	−0.149	−0.205
AK	Taiwan Weighted	Emerging	0.005	3.324	0.034	−0.207***	0.935***
AL	SET	Emerging	0.002	2.921**	−0.146***	−0.298***	0.961***
AM	IDX Composite	Emerging	−0.001	−0.443	0.107	−0.197***	0.965***
AN	Nifty 50	Emerging	0.002	2.168**	0.041	−0.226***	0.980***
AO	BSE Sensex	Emerging	0.002	2.144**	0.022	−0.233	0.98
AP	PSEi Composite	Emerging	−0.012	−9.487***	1.138***	0.057	−0.203***
AQ	Karachi 100	Emerging	0.000	0.277	0.168**	−0.106**	0.942***

*p-value > 0.05 but < 0.10 or > 5% and < 10%

**p-value > 0.01 but < 0.05 or > 1% and < 5%

***p-value < 0.01 or < 1%

TARCH, and EGARCH model, we selected EGARCH model on the basis of information criterion such as AIC, SIC, and HQC.

Interestingly, both of the Developed and Emerging Markets exhibited positive returns in these 11 months on the average basis shown by the mean driven equation the first part of the model, and second part is variance equation. It has been witnessed that developed and emerging markets have strong clustering effect because p-value of Asymmetry term is negative and less than 0.05 or 5% which further claims that the negative shock within the market effect more rather than the positive shocks, which means huge increment in cumulative cases make significant persistent volatility for long period, further coefficients of the mean and variance equation are higher in the Developed Market compare to the Emerging Market, meaning

Table 13 Cumulative cases in emerging markets with respect to country

S. no.	ISO3 codes	Country	Market	Cumulative cases	% of cumulative cases
1	RUS	Russia	Emerging	242,271	26.67%
2	BRA	Brazil	Emerging	188,974	20.81%
3	TUR	Turkey	Emerging	143,114	15.76%
4	CHN	China	Emerging	84,024	9.25%
5	IND	India	Emerging	78,003	8.59%
6	SAU	Saudi Arab	Emerging	44,830	4.94%
7	MEX	Mexico	Emerging	40,186	4.42%
8	PAK	Pakistan	Emerging	35,788	3.94%
9	POL	Poland	Emerging	17,204	1.89%
10	IDN	Indonesia	Emerging	15,438	1.70%
11	PHL	Philippine	Emerging	11,618	1.28%
12	HUN	Hungary	Emerging	3380	0.37%
13	THA	Thailand	Emerging	3017	0.33%
14	TAI	Taiwan	Emerging	440	0.05%
Total	Total			908,287	100.00%

Table 14 Market wise classification of EGARCH model

Developed—Emerging market							
EGARCH model							
	Developed market				Emerging market		
	Coeff	z-stat	Prob		Coeff	z-stat	Prob
Mean equation				Mean equation			
C	0.00032	1.025625	0.3051	C	0.000154	0.350885	0.7257
Developed market	0.002213	3.31E + 00	0.0009	Emerging markets	0.001389	2.14E + 00	0.0321
AR (1)	0.177919	2.669502	0.0082	AR (1)	0.187777	2.822439	0.0052
Variance equation				Variance equation			
C	− 0.26665	− 3.06681	0.002	C	− 0.82169	− 3.43228	0.0006
ARCH term	− 0.03495	− 0.6348	0.526	ARCH term	0.393685	4.363591	0.0000
Asymmetry term	− 0.26024	− 7.62018	0.000	Asymmetry term	− 0.14025	− 2.61873	0.0088
GARCH term	0.972621	138.7587	0.000	GARCH term	0.948585	42.9176	0.0000
ARCH LM test				ARCH LM test			
		t-Statistic	Prob			t-Statistic	Prob
		0.108679	0.9136			− 0.23796	0.8121

Developed Market is more volatile and have persistent clustering effect. We also use diagnostic test such as ARCH-LM test which indicates that equations do not have

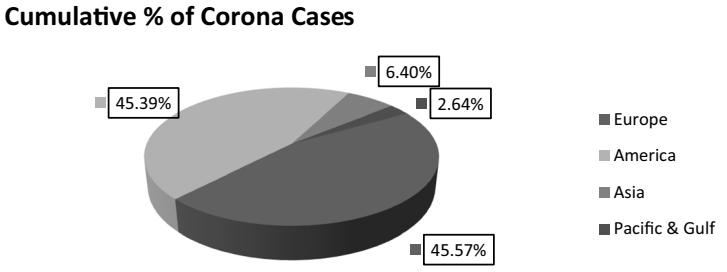
Table 15 Continent wise classification of EGARCH model

Continent classification							
EGARCH model							
	American market				Asian market		
	Coeff	z-stat	Prob		Coeff	z-stat	Prob
Mean equation				Mean equation			
C	0.00095	0.480074	0.6312	C	−0.000181	−0.405055	0.6854
American market	0.0000438	1.91E−02	0.9847	Asian market	−0.004955	−1.92E+00	0.0549
AR (1)	0.303847	4.70879	0.000	AR (1)	0.201858	3.043132	0.0026
Variance equation				Variance equation			
C	−8.618946	−0.54581	0.585	C	−0.521984	−3.676844	0.0002
ARCH term	0.01	0.182267	0.855	ARCH term	0.200308	3.192093	0.0014
Asymmetry term	0.01	0.357303	0.721	Asymmetry term	−0.150435	−4.340833	0.000
GARCH term	0.01	0.00551	0.996	GARCH term	0.961391	78.37841	0.000
ARCH LM test				ARCH LM test			
		t-Statistic	Prob			t-Statistic	Prob
		4.604761	0.000			−0.938532	0.349
	European market				Pacific and Gulf market		
	Coeff	z-stat	Prob		Coeff	z-stat	Prob
Mean equation				Mean equation			
C	0.000279	0.522072	0.6016	C	−0.0000134	−0.031752	0.9747
Europeon market	−0.097015	−9.49E−01	0.3428	Pacific and Gulf market	0.000786	8.76E−01	0.3809
AR (1)	0.268005	4.098165	0.0001	AR (1)	0.390356	6.260474	0.000
Variance equation				Variance equation			
C	−0.35313	−3.264434	0.001	C	−0.464996	−3.427611	0.0006
ARCH term	0.142783	2.415525	0.016	ARCH term	0.138435	1.815372	0.0695
Asymmetry term	−0.2156	−6.277141	0.000	Asymmetry term	−0.2078	−5.46053	0.000
GARCH term	0.973524	99.29631	0.000	GARCH term	0.964017	84.55819	0.000
ARCH LM test				ARCH LM test			
		t-Statistic	Prob			t-Statistic	Prob
		0.096569	0.9232			1.335432	0.1831

the ARCH type of effect; therefore, p-value of ARCH-LM test in both markets is more than 0.05 or 5% which proclaims that both equations do not have the ARCH type of effect (Table 15).

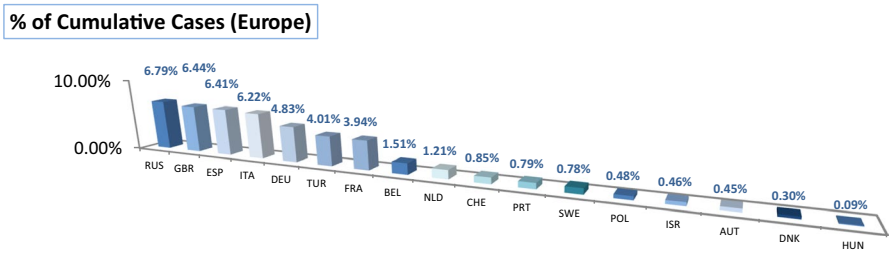
As per the Morgan Stanley Capital International (MSCI) region classification guideline, we have further divided our model continent wise; the above table has the segments, (1) Mean Equation and (2) Variance Equation. We can understand the Covid-19 cases globally by the below-mentioned table and pie chart.

Continents	Cumulative Cases	%
Europe	1,626,184	45.57%
America	1,619,906	45.39%
Asia	228,328	6.40%
Pacific & Gulf	94,377	2.64%
Total	3,568,795	100.00%



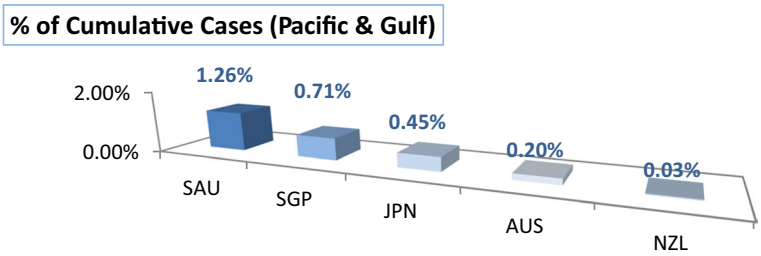
The table above shows the cumulative cases and percentage of the Covid-19 cases on the last terminal day of this research as of May 15, 2020. Europe stood on rank 1 by having around 45.57% cases in the continental ranking, while testing the Covid-19 Effect in correlation and regression model we found the heavy intervention of pandemic to shock the European markets, but in this segment, we have to test the volatility or clustering effect in each of the continents, we have averaged out the returns of all indices which come under European region and use a single index as European index then we regressed this on the cumulative cases in the European region, in mean equation AR(1) show p-value less than 0.05 or 5% which allow us to use the ARCH family model, as per the Information criterion AIC, SIC, and HQC we selected EGARCH model as most suitable model. *p*-value of Asymmetry term in European Market Model is less than 0.05 or 5% with a negative coefficient, which supports the negative shocks impact more rather than the positive one, Covid-19 is one of the kinds of a negative shock to the stock market and the value of the coefficient of European Market Model remains at the highest amongst all of other markets, that further indicates the presence of stock market anomalies with market clustering in European indices.

Below is the bar chart of countries in the European region with cumulative percentages Covid-19 Cases on last terminal day of this research.



By using the same methodology as above, we have averaged out all index and constructed the single index as Pacific and Gulf, hence again AR(1) test signal us to use ARCH family model, therefore by using EGARCH Model we have driven mean and variance equation and came to the findings by defining the clustering effect into the region, in the last segment we employed diagnostic test as ARCH-LM test and the p-value is more than 0.05 or 5% which means there is no ARCH type of effect in the model and model is fit to predict results. Pacific and Gulf markets are considered the second least affected regions by the Covid-19 but it has the second-highest clustering effect, because the countries under this region started lockdown earlier then Asia and the region has more reported Covid-19 cases compare to Asia, which became the cause of clustering effect into the Pacific and Gulf region. However, market exhibits the instability in term of daily volatility witnessed by the negative coefficient and p-value (<0.05 or $<5\%$) of Asymmetry term. Therefore rapid increment in Covid-19 on daily basis created significant negative news/shocks and that is noticeable sign for the clustering effect into the Pacific and Gulf region. In the last segment, we employed a diagnostic test as ARCH-LM test and the p-value is more than 0.05 or 5% which means there is no ARCH type of effect in the model and the model is fit to predict results.

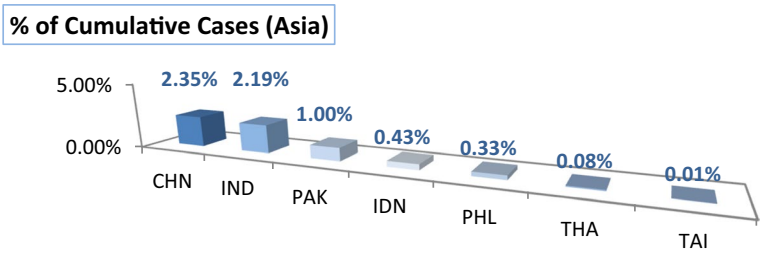
Below-mentioned graph illustrates country name along with % of cumulative Covid-19 cases in the Pacific and Gulf region.



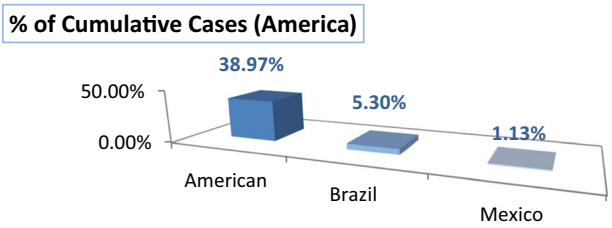
To drive result for Asian Stock market we use the same pattern of calculating index and regressed it for EGARCH model as above, initially we applied the ARCH test to see whether long term volatility is followed by another period of long term volatility or in easy words can ARCH family models be used to witness

clustering effect into the region. Hence the test allowed us to use ARCH family models but we found EGARCH model is the best-suited model. Asian markets reported the negative abnormal returns, meaning as Covid-19 cases increase, the market will fall down. Going forward, it has also been noticed that market has strong clustering effect in the pandemic period. According to worlddometer and rest of the other authentic sources, Asia is the least affected region by Covid-19 (Apart from China), two factors became the cause of cushion or savior for Market from the virus effect, (1) Smart lockdown in the Market and (2) Rapid Recoveries from the Virus. Furthermore, we can't ignore the role of cumulative cases in Asia which is still less than rest of the other regions, and we found the least volatility into these stock market as mentioned in the above table. We employed the ARCH-LM test to check model fitness and the p-value is less than more than 0.05 or 5% which further indicates there is no ARCH type of effect in the model and model is fit to use for prediction.

Below is the graph which illustrates % of Covid-19 cases in the pandemic in the Asia.



America is considered second highest affected region by Covid-19 Interestingly we could not find clustering effect into American stock market, by using the same methodology as above. We employed the EGARCH model and found indeed there is a significant relationship between individual American Index and Covid-19 cases, but there is no clustering effect as illustrated by the value of the Asymmetry term and market is not effect by the negative shock or news in the pandemic. In the light of the above numbers, we can claim that America uses good Standard Operating Procedure (SOPs) to stabilize the capital market in America. ARCH-LM test defines the model fitness because p-value is more than 0.05 or 5%, further below is the graph of % of Covid-19 cases in the American Countries.



In term of stock volatility against confirmed and reported Covid-19 case in the United States, we have seen no such volatility because when we average out all indices so indices which stable volatility cancel out the abnormal or instable stock markets of American states in term of volatility. Due to these nullifications we could not quantify any of clustering or volatility effect in single index of America as made by the researcher. It should be considered as the justification of these EGARCH results.

5 Discussions and Conclusion

5.1 Discussion

The purpose of this study is to encounter Covid-19 impact on global indices; hence we have selected the best performing indices around the globe classified by the investing.com. We have used umbrella approach to see market movement before and after pandemic by using different models. In the first phase of the research, we used descriptive statistics by classifying it region-wise as per the methodology of MSCI, in which we see the median shift, standard deviation shift and relative rank shifts before and after the pandemic and also tried to relate the cumulative cases with these shifts into each sampled index. In the second phase, we have seen the correlation matrix where is used to see the joint movement of entire sampled indexes to each other before and after the pandemic. In the third phase we tested linear regression model for each index by categorizing them region-wise as per the MCSI classification to see the impact of % change into Covid-19 with single individual index. We also encountered the clustering effect-Volatility in each index by using EGARCH model in this is classified as Developed and Emerging Market as per the methodology of MSCI this is in phase four. With the same method by dividing markets into two broad segments as Developed and Emerging Market, we collectively tested clustering effect by using EGARCH model in phase five and in the last phase six we classified the indexes into four broad categories as America, Asia, Europe, and Pacific and Gulf by assigning them a single index and constructed variance equation by using EGARCH model.

5.2 Conclusion

As per international reports, articles and other authentic source, region Europe found the highest affected region around the globe. Hence our research found the European Markets are much vulnerable and risky, shifts in descriptive statics show the trend how European market goes from good to worse in these 11 months. Shifts indicates not only returns are affected by the Covid-19 in European capital market but also ranking with peer group became worse and the correlation matrix illustrated after the rapid increase in the Novel Coronavirus cases of the entire European market exhibited highly correlated market, meaning almost all big indexes in Europe move closely to each other. The linear regression model supported this movement by illustrating the significant impact on the Market Returns. Moreover, in MSCI index classification most indexes in Developed Market are from European countries, due to this Developed ARCH model reported clustering effect in the developed markets. Finally in the last model we have found European Market has the highest volatility in relation to Covid-19.

As the rapid increase of Covid-19 cases in America affected American indexes, we found that American indexes exhibited significant shifts in term of average monthly returns, standard deviation, and relative rankings before and after the announcement of the pandemic by World Health Organization (WHO). We found American Indices as stable because of intellectual and smart investment policies for capital markets, indeed there is a significant and strong impact of Covid-19 on indices returns but no evidence found for clustering effect/volatility in American indices.

Pacific and Gulf region countries reported the third highest Covid-19 cases, therefore we found great shift in medians, standard deviation and relatives ranking in Pacific and Gulf indices. We also detected Covid-19 impacts on indexes daily returns, classifying the Pacific and Gulf indexes as the second highest volatile market having strong clustering effect in contrast to Covid-19 cases.

Due to less cases reported in the Asian region and smart lockdown policy, we found that Asian stock markets have less Covid-19 impact with least clustering effect compared to Europe and Pacific & Gulf, median shift indicated that after the declaration of pandemic on 11-March-2020, market reported a significant change in each index on Asian Capital Market. Therefore we can conclude Asian Capital Markets have the least effected market in comparison to other continents with least volatility against confirmed Covid-19 cases.

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