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A STUDY ON DYNAMIC LINKAGES BETWEEN GLOBAL STOCK MARKETS DURING COVID-19 PANDEMIC

Mr. S.Hariprasath*
Dr. D.Susana**

ABSTRACT

Globalization and financial integration across the globe have increased degree of global stock market integration. The linkages among global stock markets have been studied by researchers. The COVID-19 pandemic has caused uncertainties in the global arena. While previous literature has documented the dominance of the U.S. in the international markets during the global crisis period and pre-crisis period, this paper investigates the influence of the U.S. market during the pandemic period and the dynamic linkages among different global stock markets namely the US, UK, India, China, Hong Kong, Japan and Australia Vector Autoregressive framework (VAR) is employed to observe the transmission across the implied volatility indices. The U.S. was found to be the leading source of shock transmission across all the select global markets.

KEYWORDS: *Market Linkages, Vector Auto Regressive Framework, COVID-19.*

JEL Classification: *G150, C320, I120.*

Introduction

Globalization had augmented the nexus across the global financial markets. The economic integration by means of trade and financial linkages across the globe has led to the increased degree of global stock market integration, which in turn has led to enhanced correlations of equity returns among the stock markets (Bekaert and Harvey, 2017). Moreover, the technological developments and financial deregulations has made the stock markets increasingly globalized and integrated.

A stock market crash results with unexpected massive decline of stock prices across a major cross-section of a stock market, resulting in significant losses, panic selling. The COVID-19 pandemic has caused major economic disruption on a global scale. As the count of the virus spread continues every day, it has led to uncertainty across several sectors across the globe. The impact of COVID-19 pandemic on stock markets was evinced by the global stock market decline that began on 20 February 20, 2020. From February 25 to 28, 2020, the stock markets worldwide reported their largest one-week declines since the 2008 financial crisis. The global markets during early March 2020 showed extreme volatile conditions with large swings on upside and downside trends. On March, 9 2020 the major global markets reported severe contractions, mainly in response to the COVID-19 pandemic. The COVID-19 pandemic has also caused Stock Market crashes and the markets moved to bull trends. The US stock market was forced to stop trading during March 10, 2020 and subsequently on March 21, 2020. The Indian stock markets were halted twice during March 13, 2020 and March 23, 2020 after a period of 12 years (Livemint report, March, 23, 2020).

* 2nd Year MBA Student.
** Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India.

The studies on linkages across global stock marketindices reveal that US market was a leading source of transmission of shocks across different global markets (Aboura,2003; Nikkinen and Sahlström,2004) To the best of our knowledge, only very minimal studies have examined the presence of international stock market integration during the pandemic period. However, it is imperative to investigate whether the U.S. is still the leading source of uncertainty in its own market and in the other markets. In this context this study has chosen the U.S. and the key markets from America, Europe, Asia and Australia in the pandemic period to examine the global market linkages and the proportion of shocks from the own and external markets. The global market linkages across the select markets are examined using techniques such as Granger causality, Impulse response function and Variance decomposition of the Vector Autoregressive (VAR) framework.

Review of Literature

The following literature review discusses the various studies carried out in the year 2020 in the context of COVID-19 pandemic and its impact on stock markets.

Liu (2020) investigated the immediate effect of COVID-19 on the stock markets of the major affected countries which included the USA, the UK, Japan, Korea, Singapore, USA, Germany and Italy using event study method and panel regression methods. The findings revealed the Asian markets experienced abnormal negative returns than the other affected countries.

Thapa (2020) compared the international stock markets Shanghai (China), London stock exchange (Australia), NASDAQ (USA), and DJIA (USA) with BSE to know the impact of stock market with global pandemic of COVID-19 where the data was split into various global events that took place during the COVID-19 period. It was found that Indian stock exchanges were influenced by other international stock exchanges and price movement changes in the international market affected the price movements in Indian markets in the pandemic time.

Yalova (2020) investigated the relationship between Covid-19 daily total death and Covid-19 daily total cases with stock markets in China (SSE), South Korea(KOSPI), Italy(FTSE MIB) , France(CAC40) , Germany (DAX30) and Spain (IBEX35) where Covid-19 is widely seen during the initial outbreak in Europe. The daily data between January 23, 2020 and March 13, 2020 of these countries were analyzed using co-integration test. It was found that all stock markets examined with total death acted together in the long run and the total cases having cointegration relationship of SSE, KOSPI and IBEX35.The co-integration relationship between FTSE MIB, CAC40,DAX30 was not found in the study.

Sansa (2020) investigated the impact of the COVID-19 on the financial markets from 1st March 2020 to 25th march 2020 in China (Shanghai Stock exchange) and USA (New York Dow Jones) and the findings revealed that there is a positive significant relationship between the COVID - 19 confirmed cases and select Financial markets of China and USA. Mzoughi et al. (2020) examined the e□ects of COVID-19 pandemic on energy market, economic activities and the stock markets,using data on oil prices, CO2 emissions and the stock market. Unrestricted VAR analysis were used in the study to explain the e□ects of the current COVID-19 infections on the energy market, economic activities and the stock markets. The results of the study revealed the significant impulse responses of crude oil prices, CO2 emissions and stock market volatility to a standard deviation shock on COVID-19 infection during the period January 22, 2020 to March 30,2020.

Yan (2020) studied the COVID-19 Outbreak in a window of fifty trading days, from January 20,2020 to April 7, 2020 in the Chinese stock market.The study found that coronavirus lead to big moves in stock prices. The Stock returns reverse was found in every ten trading days throughout the window period, and firm size was a key factor resisting the return reversals.

Izzeldin et al. (2020) examined the impact of COVID-19 on G7 stock markets volatility using a ST-HAR model The findings revealed a non-linear transition to a crisis regime for all countries and the selected sectors (Consumer Goods, Consumer Services, Financials, Healthcare, Industrials, Materials, Oil & Gas, Technology, Telecommunications and Utilities) in the analysis. However,the intensity differed and the Health Care and Consumer Services sectors were found to be severely affected, and the Telecommunications and Technology least affected.

Fernandez-Perez et al. (2020) investigate the response of stock market to COVID-19 Pandemic using theMorgan Stanley Capital International (MSCI) total return indices of 63 countries and event study methodology. The study found that countries with high uncertainty avoidance tendencies, low individualistic behavior, and high exposure to disease-causing pathogens reacted more negatively and with greater volatility than the countries with low uncertainty avoidance, high individualism, and low disease prevalence. Ruiz Estrada (2020) examined the impact of COVID-19 on various global stock markets namely the S&P 500, TWSE, Shanghai Stock Exchange, Nikkei 225, DAX, Hang Seng, U.K.-FTSE, KRX, SGX, and Malaysia FTSE. The study the stock market simulator to make different simulations under different levels of growth rates of the pandemic contagious disease and the stock markets growth rates simultaneously and found impact of COVID-19 pandemic on the stock markets.

Ozili(2020) studied whether the coronavirus outbreak led to spillovers into major sectors of the global economy, and how fast policy response by several governments either triggered and prolonged the recession and the responsibility in trying to save the lives of citizens. The study showed that many countries moved towards recession and a 30-day lockdown restriction had impact on the economy by a reduction in the level of general economic activities and through its negative effect on stock prices.

The review of the studies on COVD-19 pandemic had examined its impact on the global market stock returns (Liu,2020; Yan,2020) , different sectors (Izzeldin et al. ,2020), impact on policies (Ozili, 2020), relationship of cases of COVID-19 and stock markets (Yalova ,2020). However the dynamic linkages among different Global stock markets during this COVID-19 pandemic were not examined. Hence, this study aims to fill the gap by using Vector Auto-Regressive frame work to examine the dynamic linkages among the key global stock markets.

Methodology

Data Description

The study adopts descriptive research design to evaluate the dynamic linkages between different global stock markets during COVID-19 without disturbing the variables in the study. The data used for the study are daily closing prices of the selected stock market indices during the study period. The selected stock market indices are Nifty 50 (India), S&P 500(US), FTSE 100(UK), S&P/ASX 200(Australia), Hang Seng (Hong Kong), NIKKEI 225 (Japan),Shanghai Index (China).The daily closing prices of the indices are collected for a period of 6 months from December 1, 2019 to May 31, 2020 and the total observations in the study are 131.The variables selected are the leading stock exchanges of the American, Asian, European and Australian continent. The data are collected from secondary sources from the official websites of the respective stock exchanges as shown in the Table.1.

Table 1: Details of Global Indices and their Official Stock Exchanges

Country	Indices variables	Sourced from
India	Nifty 50	National stock exchange
China	Shanghai Index	Shanghai stock exchange
Japan	Nikkei 225	Nikkei index
Hong Kong	Hang Seng	Hang Seng Index
Australia	S&P /ASX 200	Australian Securities Exchange
US	S&P 500	S&P Global
UK	FTSE 100	London stock exchange

Statistical Tools used for Analysis

Descriptive Statistics

The characteristics of the selected indices are examined using the tests of time series plots, normality and stationarity. The study uses the Jarque-Bera normality test to examine the normality for this series under the following hypothesis,

H_1: The IVIX series is normally distributed

The normality will be determined by the insignificance of the p value of Jarque Bera test.

The study uses the Augmented Dickey Fuller (ADF) test and the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test to check the stationarity of the returns. The hypothesis for ADF test for stationarity is

H_2: The IVIX series is stationary

The KPSS test examines the null hypothesis that a time series is stationary versus an alternative hypothesis that the series is a unit root process.

H_3: The IVIX series are not stationary.

Vector Autoregressive Framework (VAR)

The dynamic linkages between different stock exchanges are examined using Vector Autoregressive (VAR) framework, a simultaneous equations system with all endogenous variables developed by Sims (1980) is used in this study. In this model, the value of a variable is expressed as a linear function of the past or lagged values of that variables and all other variables included in the model. A time series data is characterized as stationary if the mean, variance and auto-covariance remain constant over the sample time period and unit root tests are applied to determine the stationarity of the data series. Vector autoregressive modeling is applied to ascertain the causal dynamics of the implied volatilities. In the vector auto regressive framework, the order of the VAR is determined based on the standard lag length criteria. Granger causality tests are used to identify potential lead-lag relationships between the implied volatilities and the direction of causalities. Impulse response analysis to describe the evolution of a model's variables in reaction to a shock in one or more variables is also used in the study. Variance decomposition is used to detect fraction of the variation in one variable explained by a variation in another variable and hence it can investigated how important other markets are in explaining uncertainty changes in another markets.

Analysis and Interpretation

Figure 1 shows the time-series plots of the daily closing prices of the select seven global indices for the sample period December 1, 2019 to May 31, 2020.It can be observed from Figure 1 the closing price of the all the select indices had fall in the prices during the last fortnight of March 2020. However, the indices of India, Hong Kong, Japan had steep fall in prices when compared to the other indices.

Figure1: Time Series Plots of Daily Closing Prices of Select Stock Indices

Table 2 presents the descriptive statistics of the level and first differences of the seven global indices. It can be noted that the standard deviations or the fluctuations from the mean for the Indices of India, Japan and Hong King were higher when compared to the other indices. Hence the COVID -19 impact seemed to affect these indices during the last two weeks of March 2020. From the measures of skewness and kurtosis it can be observed that the indices are not normal in nature. The results of JarqueBera statistics also corroborate the non-normality of the data and the Null Hypothesis is not rejected.

Table 2: Descriptive Statistics of Closing Prices of Select Indices

Details	Hong Kong	Japan	India	US	China	UK	Australia
Mean	25805.80	21516.97	10662.36	3011.574	2913.385	6640.483	6163.240
Median	26284.82	21916.31	11303.30	3090.230	2898.580	6815.590	6441.200
Maximum	29056.42	24083.51	12362.30	3386.150	3115.570	7674.560	7162.500
Minimum	21696.13	16552.83	7610.250	2237.400	2660.170	4993.890	4546.000
Std. Dev.	2005.602	2239.226	1544.896	284.2627	106.9046	873.6265	800.6141
Skewness	-0.092496	-0.441824	-0.297057	-0.671463	0.026710	-0.213506	-0.228930
Kurtosis	1.627127	1.884375	1.376925	2.551297	2.105413	1.393263	1.407519
Jarque-Bera	10.47456	11.05560	16.30593	10.94279	4.383802	15.08653	14.98656
Probability	0.005315	0.003975	0.000288	0.004205	0.111704	0.000530	0.000557
Observations	131	131	131	131	131	131	131

Table 3 presents the descriptive statistics of the returns of the indices. The stationarity of the results are verified using JarqueBera statistics and the insignificance of the results indicate the normality of the returns of the indices and Alternate hypothesis is accepted.

Table 3: Descriptive statistics of Returns of select Indices

Details	Hong Kong	Japan	India	US	China	UK	Australia
Mean	0.9997	0.9988	0.9985	0.9993	0.9992	0.9986	0.9995
Median	1.0011	0.9987	0.9993	1.0001	1.0009	1.0007	1.0013
Maximum	1.0505	1.0804	1.0950	1.1123	1.0539	1.0905	1.0700
Minimum	0.9444	0.9392	0.8702	0.8392	0.9228	0.8913	0.9030
Std. Dev.	0.0174	0.0205	0.0287	0.0360	0.0153	0.0225	0.0237
Skewness	-0.3161	0.4361	-0.6802	-0.9646	-0.9582	-0.7279	-0.7907
Kurtosis	4.5268	5.4935	7.9150	7.9342	7.9688	8.4288	6.3275
Jarque-Bera	14.7924	37.7982	140.8753	152.0338	153.6263	171.1204	73.5187
Probability	0.069	0.071	0.059	0.063	0.091	0.121	0.231

The unit root tests, the augmented Dickey-Fuller (ADF) and Kwiatkowski–Phillips–Schmidt–Shin tests are applied to determine the stationarity of the seven global stock markets. The returns of the series were non- stationary at level and was found to be stationary at first difference and the results are provided in Tables 4 and 5.

Table 4: ADF Results (1st Difference)

Details	Hong Kong	Japan	India	US	China	UK	Australia
Test statistic	-11.223	-11.152	-9.5623	-9.8138	-11.123	-8.5996	-9.5541
P. Value	0	0	0	0	0	0	0
Critical value at 1% significant level	-2.5833	-2.5833	-2.5834	-2.5834	-2.5833	-2.5837	-2.5834
Critical value at 5% significant level	-1.9434	-1.9434	-1.9434	-1.9434	-1.9434	-1.9434	-1.9434
Critical value at 10% significant level	-1.6151	-1.6151	-1.615	-1.615	-1.6151	-1.615	-1.615
Hypothesis	H0 is rejected	H0 is rejected	H0 is rejected	H0 is rejected	H0 is rejected	H0 is rejected	H0 is rejected

The ADF and PP test statistic values of the return series at first difference are found to be to be lesser than the critical values at 1% and hence H0 is rejected and the return series are found to be stationary. The KPSS test statistic value are lesser than the critical value 0.739 at 1% level and hence H0 was accepted and the return series were found to be stationary at first difference.

Table 5: KPSS Results (1st difference)

Details	Hong Kong	Japan	India	US	China	UK	Australia
Test statistic	0.500	0.5000	0.500	0.393	0.500	0.344	0.339
Critical value at 1% significant level	0.739	0.739	0.739	0.739	0.739	0.739	0.739
Critical value at 5% significant level	0.463	0.463	0.46	0.463	0.463	0.463	0.463
Critical value at 10% significant level	0.347	0.347	0.347	0.347	0.347	0.347	0.347
Hypothesis	H0 is accepted	H0 is accepted	H0 is accepted	H0 is accepted	H0 is accepted	H0 is accepted	H0 is accepted

Table 6 presents the correlation among the select indices and it can be observed that highest positive correlation was between Hong Kong and India and the lowest negative correlation was between Hong Kong and US.

Table 6: Correlation of First Difference of Returns of Indices

	India	China	Australia	UK	Hong Kong	Japan	US
India	1 (0.000)						
China	0.346 (0.000)	1 (0.000)					
Australia	0.305 (0.000)	0.324 (0.000)	1 (0.000)				
UK	0.169 (0.000)	0.111 (0.000)	-0.018 (0.000)	1 (0.000)			
Hong kong	0.594 (0.000)	0.473 (0.000)	0.453 (0.000)	0.104 (0.000)	1 (0.000)		
Japan	0.156 (0.000)	0.335 (0.000)	0.326 (0.000)	0.3160 (0.000)	0.424 (0.000)	1 (0.000)	
US	-0.145 (0.000)	-0.109 (0.000)	0.149 (0.000)	-0.156 (0.000)	-0.001 (0.000)	-0.071 (0.000)	1 (0.000)

Vector Auto Regressive (VAR) Analysis

Vector autoregressive modelling is applied to ascertain the causal dynamics of the implied volatilities. In the vector auto regressive framework, the order of the VAR is determined based on the standard lag length criteria. The lag length is ascertained using four different criteria, FPE (Final prediction error), AIC (Akaike information criterion), SC (Schwarz information criterion) and HQ (Hannan-Quinn information criterion) and the results are reported in Table.7. Lag length of four is selected on the basis of HQ criteria for the study.

Table 7: Lag Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1754.38	NA	6.75E-22	-28.8822	-28.7205	-28.8165
1	2006.64	471.173	2.35E-23	-32.242	-30.9481	-31.7165
2	2133.81	222.813	6.50E-24	-33.5341	-31.10798*	-32.5488
3	2204.31	115.365	4.65E-24	-33.8895	-30.3312	-32.4443
4	2294.65	137.379	2.44E-24	-34.5728	-29.8823	-32.66782*
5	2362.67	95.554	1.90E-24	-34.887	-29.0644	-32.5223
6	2441.8	102.023	1.27E-24	-35.3851	-28.4303	-32.5605
7	2494.75	62.1438	1.37E-24	-35.4505	-27.3635	-32.166
8	2574.75	84.62704*	9.99e-25*	-35.96284*	-26.7437	-32.2186

* indicates lag order selected by the criterion

Granger causality tests are used to identify potential lead-lag relationships between the dynamic linkages of global stock markets. The results of Granger causality are presented in Table 8. It can be observed that,

- Japan Granger causes Australia, Hong Kong, India, US, UK,
- Australia granger causes India,
- US granger causes Australia, UK
- UK granger Australia US, Hong Kong, India
- Australia granger causes UK,
- India granger causes Hong Kong and UK
- Hong Kong granger causes US and UK
- China granger causes UK

It can be inferred that the since China granger causes only UK, the initial spread on the Corona virus during December 2019 in China did not cause much impact on the other global indices. However, the other Asian, American and European indices granger causes each other and hence the virus spread in these countries during March 2020 reflected in the fall in stock prices in March 2020.

Table 8: Granger Causality Results

Null Hypothesis	F-Statistic	Prob.
HONG_KONG does not Granger Cause AUSTRALIA	0.26345	0.7688
AUSTRALIA does not Granger Cause HONG_KONG	1.84464	0.1624
JAPAN does not Granger Cause AUSTRALIA	18.3306	0.0000
AUSTRALIA does not Granger Cause JAPAN	0.02783	0.9726
INDIA does not Granger Cause AUSTRALIA	2.43426	0.0919
AUSTRALIA does not Granger Cause INDIA	8.41099	0.0004
CHINA does not Granger Cause AUSTRALIA	0.66476	0.5162
AUSTRALIA does not Granger Causes CHINA	0.02748	0.9729
US does not Granger Cause AUSTRALIA	3.56277	0.0313
AUSTRALIA does not Granger Cause US	1.25713	0.2881
UK does not Granger Cause AUSTRALIA	3.07091	0.0500
AUSTRALIA does not Granger Cause UK	33.7745	0.0000
JAPAN does not Granger Cause HONG_KONG	4.58330	0.0120
HONG_KONG does not Granger Cause JAPAN	0.30114	0.7405
INDIA does not Granger Cause HONG_KONG	3.86173	0.0236
HONG_KONG does not Granger Cause INDIA	1.23872	0.2933
CHINA does not Granger Cause HONG_KONG	0.27732	0.7583
HONG_KONG does not Granger Cause CHINA	0.13572	0.8732
US does not Granger Cause HONG_KONG	0.72317	0.4873
HONG_KONG does not Granger Cause US	3.43887	0.0352
UK does not Granger Cause HONG_KONG	4.05040	0.0198
HONG_KONG does not Granger Cause UK	21.1700	0.0000
INDIA does not Granger Cause JAPAN	1.22633	0.2969
JAPAN does not Granger Cause INDIA	20.3804	0.0000
CHINA does not Granger Cause JAPAN	2.08960	0.1281
JAPAN does not Granger Cause CHINA	1.31507	0.2722
US does not Granger Cause JAPAN	1.29864	0.2766
JAPAN does not Granger Cause US	5.66261	0.0044
UK does not Granger Cause JAPAN	1.91531	0.1517
JAPAN does not Granger Cause UK	20.2916	0.0000
CHINA does not Granger Cause INDIA	0.57136	0.5662
INDIA does not Granger Cause CHINA	0.46634	0.6284
US does not Granger Cause INDIA	2.73201	0.0690
INDIA does not Granger Cause US	1.24329	0.2920
UK does not Granger Cause INDIA	10.4211	0.0005
INDIA does not Granger Cause UK	15.6667	0.0000
US does not Granger Cause CHINA	1.01004	0.3672
CHINA does not Granger Cause US	1.44197	0.2404
UK does not Granger Cause CHINA	1.26844	0.2849
CHINA does not Granger Cause UK	4.85609	0.0093
UK does not Granger Cause US	10.1431	0.0000
US does not Granger Cause UK	4.62264	0.0116

The VAR system is used to ascertain possible lead-lag relationships between the indices, to examine the dynamic linkages between different stock markets. The VAR results are summarized in Table 9. The significance of the VAR (4) model is established by the F statistics results, the adequacy of lag selection is established by the absence of residual serial correlation using the Ljung-Box statistic for 8 lags.

Table 9: Results of VAR Framework

	India	Australia	Hong Kong	Japan	China	UK	US
Adj. R-squared	0.65311	0.75754	0.62244	0.40497	0.5520	0.76788	0.74015
F-statistic	9.33795	14.8365	8.30095	4.01399	6.45721	15.6505	13.6142
P Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Q(8)	8.345	7.458	10.311	9.9787	6.1754	13.96	13.323
P Value	0.401	0.488	0.244	0.267	0.628	0.083	0.101

The residual correlations of the seven global indices are presented in Table 10. It can be seen that all residual correlations are positive and statistically significant except for the US with other global indices. The highest residual correlation was found between the Hong Kong and India with the correlation coefficient of 0.59435 and lowest correlation was between Hong Kong and UK residuals correlation coefficient being 0.10463. The residual correlations results show positive correlation among the Asian indices and negative correlation of Asian Indices with the US.

Table 10: Residual Correlation

	D(India)	D(Australia)	D(Hong Kong)	D(Japan)	D(China)	D(UK)	D(US)
D(India)	1 (0.000)						
D(Australia)	0.3052 (0.000)	1 (0.000)					
D(Hong Kong)	0.5943 (0.000)	0.4532 (0.000)	1 (0.000)				
D(Japan)	0.1562 (0.000)	0.3267 (0.000)	0.4245 (0.000)	1			
D(China)	0.3468 (0.000)	0.3247 (0.000)	0.4731 (0.000)	0.3359 (0.000)	1		
D(UK)	0.1691 (0.000)	-0.0181 (0.000)	0.1046 (0.000)	0.3160 (0.000)	0.1110 (0.000)	1 (0.000)	
D(US)	-0.1459 (0.000)	0.1494 (0.000)	-0.001 (0.000)	-0.0729 (0.000)	-0.1090 (0.000)	-0.156 (0.000)	1 (0.000)

The results of Impulse response are provided in Figure 2. It can be seen that the shock of the US market has impact on all the other markets and persists for a longer duration. The shock in Hong Kong market has impact in the India market, shock in UK market had impact on Australia, India and Japan

Figure 2: Impulse Response of Select Stock Indices

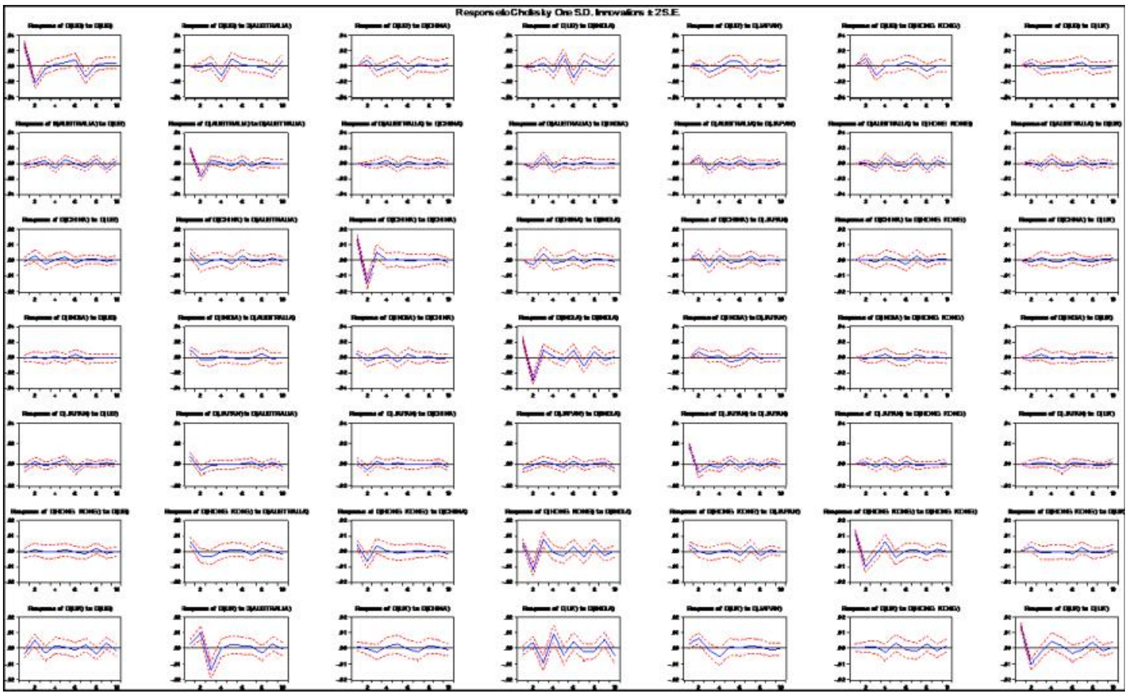

Table 11 presents the Variance Decomposition analysis of the select indices.It can be observed that the forecast variance of the U.S. index is primarily caused by innovations in itself. It can also be observed that the forecast variance in all markets is caused by its own innovations, from the U.S.

Table 11: Variance Decomposition of the Select Indices

Period	S.E.	D(US)	D(Australia)	D(China)	D(India)	D(Japan)	D(Hong Kong)	D(UK)
Variance Decomposition of D(US)								
1	0.0288	100.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0393	87.4080	0.1763	3.7641	0.1537	0.2947	7.1825	1.0208
3	0.0428	74.2253	1.1334	5.0767	0.9816	3.6350	13.1883	1.7597
4	0.0454	66.1474	8.5919	4.5121	3.9739	3.3942	11.7293	1.6513
5	0.0496	56.3989	11.1537	4.8981	11.6798	4.5599	9.8445	1.4651
6	0.0534	51.0436	9.6724	5.6620	17.6358	5.0426	9.5589	1.3848
7	0.0566	51.9714	8.6024	5.2476	17.2324	6.4048	8.6313	1.9102
8	0.0572	51.0619	8.4990	5.1517	16.9085	6.3390	9.8603	2.1796
9	0.0580	50.0116	9.8309	5.0416	17.0448	6.2551	9.5730	2.2430
10	0.0596	47.6852	10.7980	5.0891	19.2009	6.0368	9.0641	2.1259
Variance Decomposition of D(Australia)								
Period	S.E.	D(US)	D(Australia)	D(China)	D(India)	D(Japan)	D(Hong Kong)	D(UK)
1	0.0189	1.9318	98.0683	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0269	1.0436	87.8515	0.1898	3.0905	7.6233	0.1043	0.0970
3	0.0309	2.3627	68.5395	0.1686	10.9792	13.5512	2.9146	1.4842
4	0.0339	5.8362	56.8621	1.5474	12.0916	11.7693	7.0952	4.7983
5	0.0352	7.7615	53.5673	3.2600	11.4185	11.2226	7.4298	5.3403
6	0.0362	7.3661	52.2802	3.6809	11.0279	11.9710	7.9751	5.6988
7	0.0379	8.2917	48.7677	3.3678	10.2646	11.2989	11.3601	6.6493
8	0.0393	10.4662	45.5591	3.2530	9.5383	10.4940	14.1352	6.5541
9	0.0402	12.5547	43.6038	3.4258	9.1297	10.1776	14.7469	6.3614
10	0.0406	13.5457	42.6444	3.5032	8.9603	10.4873	14.5404	6.3188
Variance Decomposition of D(China)								
Period	S.E.	D(US)	D(Australia)	D(China)	D(India)	D(Japan)	D(Hong Kong)	D(UK)
1	0.0156	0.5032	9.2124	90.2843	0.0000	0.0000	0.0000	0.0000
2	0.0225	1.8943	6.4734	86.3982	1.8737	2.9959	0.0205	0.3441
3	0.0241	2.8246	5.7104	80.1040	4.5331	5.6819	0.3898	0.7563
4	0.0245	2.7560	5.6274	77.6335	5.1242	6.9417	1.0688	0.8484
5	0.0247	3.2648	6.3122	76.0429	5.1282	7.2192	1.0801	0.9525
6	0.0253	3.5920	7.1645	72.7411	5.6774	7.1265	2.3065	1.3921
7	0.0256	3.5303	7.0533	70.8900	5.9910	7.7882	3.3533	1.3940
8	0.0257	3.5473	7.0898	70.1969	6.0055	7.8723	3.6723	1.6159
9	0.0258	3.6950	7.2264	69.8913	5.9815	7.8608	3.6802	1.6649
10	0.0260	3.6783	7.2783	69.4309	6.1152	7.9206	3.7238	1.8528
Variance Decomposition of D(India)								
Period	S.E.	D(US)	D(Australia)	D(China)	D(India)	D(Japan)	D(Hong Kong)	D(UK)
1	0.0261	0.2682	13.2940	2.7273	83.7105	0.0000	0.0000	0.0000
2	0.0402	0.1446	5.9934	2.3901	88.1672	3.1400	0.1477	0.0171
3	0.0417	0.3229	6.2816	2.2321	87.1133	2.9317	0.1576	0.9606
4	0.0423	0.5114	6.2167	3.1778	84.6634	3.1021	1.2582	1.0704
5	0.0435	0.6728	5.9041	4.9592	81.1221	4.7736	1.5217	1.0465
6	0.0454	1.4304	5.6428	5.4632	79.1419	4.9455	2.0727	1.3036
7	0.0474	1.4124	5.2272	5.0646	78.3600	6.2553	2.4561	1.2243
8	0.0483	1.4067	6.0654	4.9588	77.9326	6.0752	2.3626	1.1988
9	0.0486	1.4305	6.1098	5.0791	77.7825	6.0339	2.3482	1.2161
10	0.0486	1.4565	6.1035	5.0814	77.5997	6.0208	2.4516	1.2864
Variance Decomposition of D(Japan)								
Period	S.E.	D(US)	D(Australia)	D(China)	D(India)	D(Japan)	D(Hong Kong)	D(UK)
1	0.020753	2.675875	12.84225	2.546986	4.523337	77.41156	0	0
2	0.024006	3.471122	15.34653	7.624835	3.497208	69.09304	0.953075	0.014191
3	0.024652	3.793396	14.74151	8.270699	4.8663	65.63302	1.891792	0.803284
4	0.025034	3.93081	14.32383	8.090377	4.732314	65.37253	2.730198	0.81994
5	0.026618	6.126426	12.72624	7.502879	5.759633	60.21833	4.066728	3.599757
6	0.027863	9.793599	11.6458	6.869755	6.5988	56.22319	5.049694	3.819165
7	0.028183	9.734711	11.95162	6.768727	6.89815	55.64362	5.178212	3.824959
8	0.028377	9.609491	12.42914	6.688028	6.851799	55.49043	5.126146	3.804966
9	0.028787	9.620301	12.69872	6.854076	7.174982	54.7002	4.986103	3.965615
10	0.029502	9.159647	12.74305	7.280346	9.094179	52.14875	5.111568	4.46246

Variance Decomposition of D(Hong_Kong)								
Period	**S.E.**	**D(US)**	**D(Australia)**	**D(China)**	**D(India)**	**D(Japan)**	**D(Hong Kong)**	**D(UK)**
1	0.0166	0.3829	15.4885	7.7462	12.8432	5.9217	57.6176	0.0000
2	0.0238	0.4505	8.9936	10.8362	29.8926	2.8706	45.1672	1.7894
3	0.0258	0.4012	9.6805	11.1694	35.0583	2.9205	39.0627	1.7075
4	0.0266	0.3799	9.0939	10.5360	33.0435	2.7446	42.5549	1.6473
5	0.0272	0.5467	8.9201	10.3018	32.9474	2.7612	42.9358	1.5872
6	0.0275	0.5511	8.8000	10.0380	33.3493	3.6377	41.8248	1.7992
7	0.0282	0.7927	8.9203	9.5840	33.1554	5.1508	39.9385	2.4583
8	0.0289	1.1983	8.9518	9.1601	33.7925	5.7724	38.6582	2.4667
9	0.0291	1.4018	8.8168	9.0652	34.0450	5.8203	38.3334	2.5175
10	0.0293	1.3871	9.0206	9.3654	33.6897	5.8007	37.9334	2.8032
Variance Decomposition of D(UK)								
Period	**S.E.**	**D(US)**	**D(Australia)**	**D(China)**	**D(India)**	**D(Japan)**	**D(Hong Kong)**	**D(UK)**
1	0.0158	5.2715	2.7213	0.4883	1.0156	2.3831	0.0000	88.1202
2	0.0231	7.3835	19.9487	0.2808	3.0209	8.5300	0.0489	60.7872
3	0.0291	6.1213	35.2702	1.0895	12.6639	5.6145	0.0630	39.1776
4	0.0315	5.5543	30.0995	1.0545	18.9671	7.9947	0.8613	35.4688
5	0.0322	5.3412	29.2278	1.6131	20.3537	7.6927	1.8248	33.9465
6	0.0327	5.3532	28.4814	1.6060	21.2785	7.4451	1.8361	33.9996
7	0.0331	5.6229	27.9043	2.0661	21.3952	7.5030	2.1931	33.3154
8	0.0340	6.5759	27.5858	2.1885	20.7504	7.2037	2.6817	33.0140
9	0.0348	7.0987	26.8999	2.1337	22.3051	6.9917	2.8169	31.7540
10	0.0353	7.1790	26.1819	2.1904	23.7054	6.8091	3.0564	30.8776

Conclusion

The advent of globalization and financial liberalization has led to the interconnectedness of financial markets across the globe. The uncertainty or turmoil in one market is reflected in other markets in short span of time and the pandemic crisis stands as an exemplar for this. Several studies has documented that the U.S. financial market is the dominant market and influences the other markets during the pre-crisis and crisis period. Seven key American, European, Australian and Asian markets were chosen for the study and transmission of market uncertainty from the U.S. and among these markets were analyzed. The impact of shock from Chinese market to other markets were not evident in the analysis of this study. The findings from the study reveal that the U.S. is the leading source of uncertainty among the global markets in the pandemic period, similar to the findings of the previous studies conducted during the pre-crisis and crisis period.

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