A Study on Inter-Linkage Between Asian Stock Market Indices and US Stock Market Index During Global Financial Crises and Covid -19 Crises

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by

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Date: April 2023

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DECLARATION BY STUDENT

I hereby declare that the data presented in this Dissertation / Internship report entitled, "**A study on Inter Linkage between Asian Stock Market Indices and US Stock Market Index in different crises period- Global Financial Crises and Covid -19 Crises**" is based on the results of investigations carried out by me in the Financial services Discipline at the Goa Business School, Goa University under the Supervision/Mentorship of **Dr. Harip R Khanapuri** and the same has not been submitted elsewhere for the award of a degree or diploma by me. Further, I understand that Goa University or its authorities will be not be responsible for the correctness of observations / experimental or other findings given the dissertation.

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COMPLETION CERTIFICATE

This is to certify that the dissertation / internship report "**A study on Inter Linkage between Asian Stock Market Indices and US Stock Market Index during Global Financial Crises and Covid -19 Crises**" is a bonafide work carried out by **Ms Raganidevi R.K. Saroj** under my supervision/mentorship in partial fulfilment of the requirements for the award of the degree of **MBA (Financial Services)** in the Discipline at the Goa Business School, Goa University.

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INTERNSHIP CERTIFICATE

This is to certify that Ms Raganidevi Rameshkumar Saroj Student of the Goa Business School, undergoing MBA (Financial Services) has successfully completed Internship between 06/02/2023 to 01/04/2023 at Goa Shipyard Limited (Finance Department).She actively participated in the activities during the period of internship and learned the skills needed for various activities such as getting brief overview of companies financial system, verifying the subcontract bills, making necessary entries of subcontract bills in ERP systems, making Performance Bank Guarantees in ERP system.

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CHAPTER 1- INTRODUCTION

1.1 Introduction

The Global Financial Crises and Covid 19 pandemic crises has vigorously affected financial market around the world, in particularly the most economically developed countries have suffered the most. In comparison to earlier financial crises like the Asian Crises of 1997-1998; the Russian Crises of 1998; and the Brazilian Crises of 1999, the Global Financial Crises of 2007-2009 originated from the largest and most powerful economy, the U.S. market, and had an impact on all other economies all over the world. It is well documented that international stock markets reacts, in terms of returns and volatility, quickly and simultaneously to major financial crises. However, the timing and magnitude of changes in stock returns and volatility differ across markets around the world (Roll, 1988). Early in 2020, the Novel Coronavirus (COVID-19) pandemic spread from China to the rest of the world, causing widely fluctuating stock markets around the Globe.

To measure the effect of disruption on volatility, we are going to implement the impulse response technique established by Sims (1980). The effect of the Global Financial Crises in 2007-09 on conditional volatility in the stock markets of India, Hong Kong, Japan and China may have substantial implications for both domestic and international investors. The increased linkages between international financial markets have been critical and necessary for investors and policymakers because the dynamic connectivity of cross-markets affects portfolio management decisions and contagion risk in financial markets. As a result, the dynamics of the linkages between various financial markets have been extensively studied in academia. Indeed, these crises have increased the significance of financial or economic ties.

1.2 Scope of the study

This study focuses on considering two financial crises period that is Global Financial Crises (2007-2008) and COVID 19 pandemic crises (2019-2020) the interrelationships among global stock markets like (India – nifty 50 index, Hong Kong – Hang Seng index, Japan – Nikkei 225 index, China- SSE Composite index, and United States - S&P 500 index) Studies of how volatility shocks spread from one market to another are crucial in finance since they have a broad spectrum of implications for international asset pricing, evaluating investment

and leverage decisions, portfolio allocation, and policymakers ability to create strategies to protect economies. To measure the effect of disruption on volatility, we are going to implement the impulse response technique established by Sims (1980).

1.3 Literature Review

Considering the various reasons for interest in the impact and effect of financial market crises on stock markets, it is not strange that there is different amounts of literature studying the relationship between financial crises and their impact on others, particularly in light of the recent financial and debt crises in several advanced economies as well as in emerging regions around the world.

Granger causality test showed unidirectional causal relationship between all ordinaries index, Hang Seng index and SSE composite index. Further BSE Sensex, Hang Seng index witnessed unidirectional causation with SSE composite index whereas rest of the indices did not exhibit causal relationship with other indices. M Babu, C Hariharan & S Srinivasan (2016).

Sun-Yong Choi (2021) displayed the stock indices with the spill over in the subfigures. Several spikes are commonly found in each subfigure and they recognised two extreme spikes during Global Financial Crises and Covid 19 Pandemic Periods. Furthermore, in those two crises, the movements of the stock index and total spill over are inversely related. Therefore, as with the static analysis result, in time of crises, the volatility spill over of their stock markets was intensified.

In comparison with traditional impulse response function, Panopoulou and Pantelidis (2009) argue that VIRF represents a convenient approach to analyse volatility spill overs. First, it allows financial practitioners to determine precisely how a shock to one market influences the dynamic adjustment of volatility in another market and the persistence of this spillover effect. Second, it depends on both the volatility state and the unexpected returns vector when the shock occurs, which effectively accommodates the asymmetric response of volatility on negative and positive “news” typically documented in the literature. Third, contrary to traditional impulse response functions, this specific methodology avoids typical orthogonalisation and ordering problems, which would be hardly feasible in the case f high-frequency financial time series. Xiaoye Jin, Ximeng An (2015).

The first result of this study shows that the U.S and BRICS's stock markets are interrelated by their volatilities. These interdependencies indicate that in explaining the changes in volatility in the BRICS's market, the part of the U.S market cannot be ruled out a priori. Second and with respect to the size and persistence of volatility transmission among the U.S and BRICS's stock markets, we find that one historical event, i.e. the 2007-2009 global financial crisis, has positive and large impacts on expected conditional variances, and only "large" shock compared to the current level of volatility will result in an increase in expected conditional volatilities. Xiaoye Jin, Ximeng A (2015).

A examination of Tingting Cheng, Junli Liu, Wenying Yao and Albert Bo Zhao (2022) reveals that the volatility spillover from the Chinese market to the all other market began to fall in late January, after the lockdown in Wuhan. At the same time, the ALX rose sharply as the COVID-19 outbreaks took place in Europe and the U.S. Therefore, there is strong evidence that the global stock market volatility is not propagated from the Chinese market, and the Chinese market is rather insulated from the rest of the system.

Do (2011) analysed the integration of six ASEAN stock markets (Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam) with four international stock markets (US, ASEAN bloc, Asia and world) and the interaction channels between domestic and international stock markets. The researcher found integration/segmentation /interaction channels between domestic and international markets.

Emerging markets have gained significant importance in international portfolios. However, inclusion of this asset class in portfolios requires careful examination of their integration dynamics, as the very essence of the emerging markets is their continued efforts to reform and interact with the outside world. This interaction makes these markets' returns vulnerable to developments in other markets and thus may wipe out portfolio diversification benefits. Guntur Raju and Khanapuri Harip (2009).

R C Royfaizal , C Lee and M Azali (2016) There result shows that the Asian stock markets are more independent before the crisis. The number of cointegrating vectors increased after the US stock market was included in pre-crisis and during-crisis periods. This implies that the system is more interdependent during these two periods. Therefore, adding the US stock market does not help the investors to reduce the portfolio risk. The results of short-run

Granger-causality based on VECM showed that Thailand, Japan and China stock markets are the most exogenous markets before, during and after the crisis respectively.

World bank (2020) has estimated that economic activity has dropped by 7% in developed economies and 2.5% in developing countries.

1.4 Objective of the study

The aim of the study is to identify the Interlinkage between the Asian stock market indices and US stock market index during Global crises period from 01 January 2007 to 31 December 2008 and Covid 19 pandemic from 01 January 2019 to 31 December 2020.

1.5 Tools and Methodology

This study aims to test the Interlinkage of Asian stock market indices with US stock exchange which includes India – nifty 50 index, Hong Kong – Hang Seng index, Japan – Nikkei 225 index, China- SSE Composite index, and United States - S&P 500 index by using daily price data collected from official website of yahoo finance and NSE website. Tools are Vector auto regression model, Augmented dickey fuller test, Descriptive Analysis and Granger Causality.

1.6 Null Hypotheses

- There is no stationarity in the daily prices of Asian stock market indices and US stock market index.
- There is no causal relationship in selected Asian Stock market indices and US stock market index.

1.7 Chapterisation

Chapter 1 –INTRODUCTION

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Chapter 2 - Analysis and Discussion

2.1 Introduction

To describe the nature of data set we use summary statistics which includes mean (the average), standard deviation (variation in the data set), Skewness and kurtosis (distribution of the data. Augmented Dickey Fuller Statistic and Phillips-Perron Statistic to identify the existence of unit root in the data set (Time Series data). Granger Casualty Analysis which examines the causal effect of the selected sample indices.

Sample data

Country	Stock Market Index
India	Nifty 50
Hong kong	Hangseng
China	SSE
Japan	Nikkei
United States	S&P 500

2.2 Analysis

Table 1- Result for Descriptive Analysis of selected Asian stock market indices with US stock exchange during Global Crises Period

Sample: 1/04/2007 12/31/2008					
	LRNIFTY	LRHANGSENG	LRSSE	LRNIKKEI	LRSP500
Mean	-0.000575	-0.000658	-0.000758	-0.001295	-0.000869
Median	0.000000	0.000000	0.000146	0.000000	8.09E-05
Std. Dev.	0.022377	0.024992	0.025079	0.021655	0.019366
Skewness	-0.470393	0.139477	-0.245712	-0.406610	-0.193350
Kurtosis	6.144382	8.631100	4.356278	10.82621	10.44976
Jarque-Bera	232.9493	687.3962	45.00137	1338.824	1203.399
Probability	0.000000	0.000000	0.000000	0.000000	0.000000

SOURCE: Data obtained from Yahoo Finance and computed by Eviews 8

The above table shows the Descriptive summary of selected data of Asian stock market indices and US stock exchange. The Mean value represents the average daily returns of each stock index during the time period studied. The all mean values are in negative, which suggests that the indices as a whole experienced negative return over the period studied. The highest mean return recorded by LRNIFTY (-0.000575) followed by LRHANGSENG with a mean return of (-0.000658). Then followed by LRSSE and LRSP500 with a mean value of (-0.000758) and (-0.000869), and the least is of LRNIKKIE with a mean value of (-0.001295). Standard deviation represents the amount of variability or dispersion of the daily returns for each stock index during the time period studied. All the standard deviation is relatively high, which suggest that there was a lot of variability in the daily returns for each index, days experiencing very high or very low returns. Skewness measures the symmetry of the distribution of daily returns for each stock index during the time period studied. The value of zero indicates a perfectly symmetrical distribution, while negative skewness means that the distribution is skewed to the left (i.e., there were more negative returns than positive returns). All the skewness values of LRNIFTY, LRSSE, LRNIKKE and LRSP500 are negatively skewed and LRHANGSENG is positively skewed. Kurtosis measures the peakedness or flatness of the distribution of daily returns for each stock index during the time period studied. A higher kurtosis value indicates a more peaked distributed with more extreme values, while a lower value indicates a flatter distribution with fewer extreme value. All the kurtosis values are relatives high, which suggests that the distributions of daily returns for each index were more peaked and had more extreme values than a normal distribution. Jarque-Bera test whether the distribution of daily returns for each stock index during the time period studied is normal or not. A high value indicates that the distribution is significantly different from a normal distribution. All the Jarque-Bera values are high, which suggest that the distributions of daily returns for each index are not normal.

Table 2- Result for Descriptive Analysis of selected Asian stock market indices with US stock exchange during Covid 19 period.

Sample: 1/01/2019 12/30/2020					
	LRHANGSE	LRNIFTY	LRNIKKEI	LRSP500	LRSSE
Mean	0.000148	0.000476	0.000650	0.000761	0.000625
Median	0.000102	0.000659	0.000000	0.001071	0.000000
Std. Dev.	0.012206	0.015076	0.012554	0.016164	0.011871
Skewness	-0.376019	-1.852393	0.188152	-1.093542	-0.733046
Kurtosis	5.955395	23.35970	9.889752	18.79680	10.44371
Jarque-Bera	201.8858	9296.435	1033.540	5520.908	1249.493
Probability	0.000000	0.000000	0.000000	0.000000	0.000000

SOURCE: Data obtained from Yahoo Finance and computed by Eviews 8

The above table shows the Descriptive summary of selected data of Asian stock market indices and US stock exchange. The highest average mean return recorded by LRSP500(0.000761) followed by LRNIKKEI with a mean return of (0.000650).Than followed by LRSSE and LRNIFTY with a mean value of (0.000625) and (0.000476), and the least is of LRHANGSENG with a mean value of (0.000148). The standard deviation measures the amount of variation in the set data and so in the above case all the markets values are low that indicates that the values tend to be more close to the mean and not spread out higher standard deviation indicates high variation and risk in set data. Skewness LRHANGSENG, LRSSE, LRNIFTY and LRSP500 are negatively skewed and LRNIKKEI is positively skewed. And kurtosis the all the market value are more than 3 indicating that there are more extreme values would be expected in a normal distribution.

Table 3- Result for stationary test of selected Asian stock market indices with US stock exchange during Global Crises Period

Variables (at levels)	ADF TEST	PHILLIPS-PERON TEST
	t-stats	Adj test
LRSP500	-20.56	-27.57
LRNIKKEI	-18.09	-22.74
LRHANGSENG	-24.77	-24.95
LRSSE	-23.52	-23.51
LRNIFTY	-21.80	-21.79

SOURCE: Data obtained from Yahoo Finance and computed by Eviews 8

Table 3 Indicates the result of Augmented Dickey Fuller Test and Phillips-Parron test, for the returns of LRSP500, LRSSE, LRNIFTY, LRNIKKIE and LRHANGSENG from Jan 2007 to Dec 2008. ADF test clearly denotes that all sample indices returns were stationary. ADF Test value of all Asian Stock Market indices was LRSP500 index was -20.56, LRNIKKEI index was -18.09, LRHANGSENG index was -24.77, LRSSE index was -23.52 and LRNIFTY index was -21.80 were greater than critical value at all levels. Since the critical values are -3.43266, -2.8624, and -2.5672 at the 1%, 5% and 10% significance levels, respectively. Similarly in Phillips-Parron test the values are recorded as LRSP500 index was -27.57, LRNIKKEI index was -22.74, LRHANGSENG index was -24.95, LRSSE index was -23.51 and LRNIFTY index was -21.79. Which were also greater than the critical values at 1%, 5% and 10%. The analysis of ADF test and Phillips- Parron Test indicates that all the five sample indices returns attained stationary at the level difference itself. Hence the null hypothesis, "the stock market index returns of Asian Stock Market indices are not stationarity during the study period", is rejected.

Table 4- Result for stationary test of selected Asian stock market indices with US stock exchange during Covid 19 period.

Result for stationary test

Variables (at levels)	ADF TEST	PHILLIPS-PERON TEST
	t-stats	Adj test
LRSP500	-06.06	-30.59
LRNIKKEI	-13.81	-21.51
LRHANGSENG	-23.49	-23.49
LRSSE	-22.56	-22.56
LRNIFTY	-09.26	-24.73

SOURCE: Data obtained from Yahoo Finance and computed by Eviews 8

Table 3 Indicates the result of Augmented Dickey Fuller Test and Phillips-Parron test, for the returns of LRSP500, LRSSE, LRNIFTY, LRNIKKIE and LRHANGSENG from Jan 2019 to Dec 2020. ADF Test value of LRSP500 index was -06.06, LRNIKKEI index was -13.81, LRHANGSENG index was -23.49, LRSSE index was -22.56 and LRNIFTY index was -09.26. LRNIKKEI, LRHANGSENG and LRLRSSE are greater than critical value at all levels. LRSP500 and LRNIFTY the values are less than critical value which means in this two market index returns are not stationary thus we accept the null hypothesis. Since the critical values of LRNIKKIE, LRHANGSENG and LRSSE are more than -3.43266, -2.8624, and -2.5672 at the 1%, 5% and 10% significance levels, respectively, in this case we reject the null hypothises. Similarly in Phillips-Parron test the values are recorded as LRSP500 index was -30.59, LRNIKKEI index was -21.51, LRHANGSENG index was -23.49, LRSSE index was -22.56 and LRNIFTY index was -24.73. Which are greater than the critical values at 1%, 5% and 10%.

Table 5- Result for Variance Decomposition of selected Asian stock market indices with US stock exchange during Global Crises Period

Variance Decomposition of LRSP500:						
Period	S.E.	LRSP500	LRNIKKEI	LRSSE	LRHANGSENG	LRNIFTY
1	0.019092	100	0	0	0	0
2	0.019446	99.08551	0.733524	0.037934	0.00396	0.139076
3	0.019473	98.99834	0.767143	0.044664	0.00448	0.185369
4	0.019478	98.99738	0.767359	0.044656	0.004517	0.186092
5	0.019478	98.99685	0.767748	0.044674	0.004545	0.186181
6	0.019478	98.99683	0.767753	0.044674	0.004546	0.186197
7	0.019478	98.99683	0.767753	0.044674	0.004546	0.186197
8	0.019478	98.99683	0.767754	0.044674	0.004546	0.186197
9	0.019478	98.99683	0.767754	0.044674	0.004546	0.186197
10	0.019478	98.99683	0.767754	0.044674	0.004546	0.186197
Variance Decomposition of LRNIKKEI:						
Period	S.E.	LRSP500	LRNIKKEI	LRSSE	LRHANGSENG	LRNIFTY
1	0.016965	6.837374	93.16263	0	0	0
2	0.021535	40.28691	58.07075	0.25925	0.038173	1.344921
3	0.021767	41.31552	57.06156	0.262867	0.040153	1.3199
4	0.021774	41.31418	57.045	0.265094	0.040987	1.334746
5	0.021776	41.32563	57.03329	0.26505	0.04098	1.335052

6	0.021777	41.32575	57.03314	0.265057	0.040985	1.335063
7	0.021777	41.32578	57.03311	0.265057	0.040986	1.33507
8	0.021777	41.32578	57.0331	0.265057	0.040986	1.33507
9	0.021777	41.32578	57.0331	0.265057	0.040986	1.33507
10	0.021777	41.32578	57.0331	0.265057	0.040986	1.33507
Variance Decomposition of LRSSE:						
Period	S.E.	LRSP500	LRNIKKEI	LRSSE	LRHANGSENG	LRNIFTY
1	0.024716	0.206713	5.45201	94.34128	0	0
2	0.025143	2.721959	5.496423	91.20903	0.071316	0.501272
3	0.025196	3.114763	5.485423	90.82621	0.071208	0.5024
4	0.025197	3.114773	5.488844	90.82133	0.071275	0.503776
5	0.025197	3.116933	5.488733	90.81914	0.071274	0.503918
6	0.025197	3.117061	5.488739	90.81901	0.071275	0.503917
7	0.025197	3.117062	5.48874	90.819	0.071275	0.503918
8	0.025197	3.117063	5.48874	90.819	0.071275	0.503918
9	0.025197	3.117063	5.48874	90.819	0.071275	0.503918
10	0.025197	3.117063	5.48874	90.819	0.071275	0.503918
Variance Decomposition of LRHANGSENG:						
Period	S.E.	LRSP500	LRNIKKEI	LRSSE	LRHANGSENG	LRNIFTY
1	0.022434	11.78836	28.83945	9.934087	49.43811	0

2	0.024924	23.22105	23.90543	10.1955	41.36112	1.316903
3	0.025133	24.30476	23.54968	10.06618	40.76343	1.315949
4	0.025135	24.30159	23.55461	10.06447	40.7616	1.317737
5	0.025136	24.30535	23.5533	10.06393	40.75953	1.317893
6	0.025136	24.30553	23.55327	10.06391	40.7594	1.317892
7	0.025136	24.30553	23.55327	10.06391	40.75939	1.317895
8	0.025136	24.30554	23.55327	10.06391	40.75939	1.317895
9	0.025136	24.30554	23.55327	10.06391	40.75939	1.317895
10	0.025136	24.30554	23.55327	10.06391	40.75939	1.317895
Variance Decomposition of LRNIFTY:						
Period	S.E.	LRSP500	LRNIKKEI	LRSSE	LRHANGSENG	LRNIFTY
1	0.021801	11.44466	9.728147	2.932046	12.97435	62.9208
2	0.022441	15.62097	9.420311	3.284622	12.25217	59.42192
3	0.022507	16.09784	9.384503	3.265318	12.18016	59.07218
4	0.022508	16.09667	9.388788	3.265467	12.1794	59.06967
5	0.022509	16.09925	9.388495	3.265367	12.179	59.06788
6	0.022509	16.09939	9.388497	3.265362	12.17898	59.06777
7	0.022509	16.09939	9.388498	3.265362	12.17898	59.06777
8	0.022509	16.09939	9.388498	3.265362	12.17898	59.06777
9	0.022509	16.09939	9.388498	3.265362	12.17898	59.06777
10	0.022509	16.09939	9.388498	3.265362	12.17898	59.06777

SOURCE: Data obtained from Yahoo Finance and computed by Eviews 8

Above table-5 Depicts Variance decomposition during the Global Crises Period is statistical technique used to quantify the contribution of each variable to the variation of a dependent variable in a regression model. It is a powerful tool in understanding the relationships between the variables in a model and identifying which variable are most important in explaining the variability of the dependent variable. In the given data, variance decomposition has been used to decompose the variance of the LRSP500, LRNIKKEI, LRSSE, LRHANGSENG and LRNIFTY indices. Each table shows the contribution of each index to the variation in the index of interest, along with the standard error. In the variance decomposition of LRSP500, the first period shows that the LRSP500 with 100% itself explains all of the variance. However, in the second period, the LRNIKKEI, LRSSE, LRHANGSENG and LRNIFTY indices also explains some of the variance, and this contribution is quantified in the table. In the case of LRNIKKEI In the first period it explains 93.16 % of variability likewise LRSSE explains 94.34% of variability likewise in case of LRHANGSENG is much lower in explaining the variablity is 49.43%. after that 62.92% is of LRNINFTY like this its continues till 10 periods.

Table 6 - Result for Variance Decomposition of selected Asian stock market indices with US stock exchange during Covid 19 period.

Variance Decomposition of LRSP500:						
Period	S.E.	LRSP500	LRNIKKEI	LRSSE	LRHANGSENG	LRNIFTY
1	0.014317	100	0	0	0	0
2	0.01538	92.10881	3.076203	0.458948	0.004887	4.351149
3	0.016127	89.0066	2.953136	0.427319	1.161243	6.451697
4	0.016262	87.59619	2.959214	0.47823	1.663064	7.303307
5	0.016294	87.27802	2.987604	0.476391	1.753949	7.504034
6	0.016302	87.2354	3.006506	0.477097	1.759696	7.521301
7	0.016305	87.21544	3.02982	0.477164	1.759054	7.518523
8	0.016307	87.20934	3.034836	0.477067	1.759831	7.518927
9	0.016307	87.20583	3.03608	0.477092	1.760637	7.520365
10	0.016307	87.20483	3.03609	0.477087	1.760984	7.521006
Variance Decomposition of LRNIKKEI:						
Period	S.E.	LRSP500	LRNIKKEI	LRSSE	LRHANGSENG	LRNIFTY
1	0.01138	19.7474	80.2526	0	0	0
2	0.012539	28.82727	67.05788	1.05358	0.078016	2.983259
3	0.012624	28.47186	67.26074	1.121276	0.140126	3.005991
4	0.012683	28.80132	66.7535	1.122479	0.21876	3.103945
5	0.012692	28.75947	66.71729	1.131177	0.255406	3.136648
6	0.012694	28.76276	66.6941	1.131349	0.262606	3.149182
7	0.012695	28.76472	66.68802	1.131661	0.263506	3.152095
8	0.012695	28.76436	66.68831	1.131708	0.263548	3.152076
9	0.012695	28.76501	66.68764	1.131699	0.263574	3.152076
10	0.012695	28.76498	66.68756	1.131703	0.263611	3.152148
Variance Decomposition of LRSSE:						
Period	S.E.	LRSP500	LRNIKKEI	LRSSE	LRHANGSENG	LRNIFTY
1	0.011647	6.738779	5.330613	87.93061	0	0

2	0.011855	8.850433	5.341351	84.92386	0.118059	0.766302
3	0.011986	8.775474	5.44515	83.15682	1.857098	0.765456
4	0.012006	9.009272	5.428648	82.93293	1.852575	0.776576
5	0.012009	9.00654	5.438919	82.89912	1.87868	0.776741
6	0.01201	9.013399	5.438586	82.8852	1.880941	0.781875
7	0.01201	9.013256	5.439723	82.88288	1.881005	0.783138
8	0.01201	9.013524	5.439799	82.8824	1.881061	0.783213
9	0.01201	9.013649	5.439798	82.88224	1.881068	0.783241
10	0.01201	9.01365	5.439824	82.88222	1.881068	0.783241
Variance Decomposition of LRHANGSENG:						
Period	S.E.	LRSP500	LRNIKKEI	LRSSE	LRHANGSENG	LRNIFTY
1	0.01141	14.58314	10.74361	17.88657	56.78668	0
2	0.012281	17.81	9.563093	16.96405	50.60944	5.053417
3	0.012323	17.91583	9.525108	16.95938	50.35065	5.249023
4	0.012339	18.07586	9.527643	16.91847	50.2307	5.247321
5	0.012344	18.06054	9.592937	16.90867	50.19106	5.246786
6	0.012346	18.08295	9.590289	16.90332	50.17517	5.248275
7	0.012347	18.08186	9.591069	16.90258	50.17307	5.251425
8	0.012347	18.08198	9.590969	16.90234	50.17273	5.251986
9	0.012347	18.08211	9.590955	16.90229	50.17259	5.252054
10	0.012347	18.08211	9.59102	16.90228	50.17254	5.25205
Variance Decomposition of LRNIFTY:						
Period	S.E.	LRSP500	LRNIKKEI	LRSSE	LRHANGSENG	LRNIFTY
1	0.01358	17.29199	0.092975	3.270565	8.965865	70.3786
2	0.014803	19.7763	2.699578	4.19088	10.64728	62.68596
3	0.015055	19.32331	5.159628	4.327644	10.57964	60.60977
4	0.0152	20.64852	5.208771	4.282915	10.38926	59.47054
5	0.015219	20.62834	5.32801	4.283751	10.38882	59.37108
6	0.015231	20.6721	5.32802	4.277043	10.39594	59.32689
7	0.015233	20.66675	5.329821	4.276998	10.40003	59.3264

8	0.015233	20.66605	5.330486	4.276819	10.40078	59.32586
9	0.015234	20.66691	5.330726	4.276763	10.40066	59.32495
10	0.015234	20.66698	5.331085	4.276743	10.4006	59.32459

SOURCE: Data obtained from Yahoo Finance and computed by Eviews 8

Above table-6 depicts Variance decomposition during the Covid Period. In the given data, variance decomposition has been used to decompose the variance of the LRSP500, LRNIKKEI, LRSSE, LRHANGSENG and LRNIFTY indices. Each table shows the contribution of each index to the variation in the index of interest, along with the standard error. In the variance decomposition of LRSP500, the first period shows that the LRSP500 with 100% itself explains all of the variance. However, in the second period, the LRNIKKEI, LRSSE, LRHANGSENG and LRNIFTY indices also explains some of the variance, and this contribution is quantified in the table. In the case of LRNIKKEI In the first period 80.25%explains variability in the set data likewise LRSSE explains 87.93% of variability likewise in case of LRHANGSENG is much lower in explaining the variablity is 56.78%. After that 70.37% is of LRNINFTY like this it continues till 10th period.

Table 7- Result for Granger causality test of selected Asian stock market indices with US stock exchange during Global Crises Period

Pairwise Granger Causality Tests			
Date: 04/21/23 Time: 09:32			
Sample: 1/04/2007 12/31/2008			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
LRHANGSENG does not Granger Cause LRNIFTY	517	0.82206	0.4401
LRNIFTY does not Granger Cause LRHANGSENG		9.52667	9.00E-05
LRSSE does not Granger Cause LRNIFTY	517	3.35564	0.0357
LRNIFTY does not Granger Cause LRSSE		2.4199	0.0899
LRNIKKEI does not Granger Cause LRNIFTY	517	1.56966	0.2091
LRNIFTY does not Granger Cause LRNIKKEI		22.1399	6.00E-10
LRSP500 does not Granger Cause LRNIFTY	517	15.2656	4.00E-07
LRNIFTY does not Granger Cause LRSP500		0.36461	0.6946
LRSSE does not Granger Cause LRHANGSENG	517	4.89676	0.0078
LRHANGSENG does not Granger Cause LRSSE		0.21072	0.8101
LRNIKKEI does not Granger Cause LRHANGSENG	517	1.9707	0.1404
LRHANGSENG does not Granger Cause LRNIKKEI		10.7522	3.00E-05
LRSP500 does not Granger Cause LRHANGSENG	517	64.0809	1.00E-25
LRHANGSENG does not Granger Cause LRSP500		0.29351	0.7458

LRNIKKEI does not Granger Cause LRSSE	517	0.30767	0.7353
LRSSE does not Granger Cause LRNIKKEI		2.49368	0.0836
LRSP500 does not Granger Cause LRSSE	517	8.16291	0.0003
LRSSE does not Granger Cause LRSP500		0.71255	0.4909
LRSP500 does not Granger Cause LRNIKKEI	517	188.382	5.00E-62
LRNIKKEI does not Granger Cause LRSP500		0.52075	0.5944

SOURCE: Data obtained from Yahoo Finance and computed by Eviews 8

The Pairwise Granger Causality Tests assess whether one time series can be used to predict another time series based on past values of both time series. The null hypothesis for each test is that the time series in the first column does not Granger cause the time series in the second column.

In the table provided, the F-statistic and probability values are reported for each pairwise test. If the probability value is less than a predetermined level of significance then we reject the null hypothesis and conclude that the time series in the first column Granger causes the time series in the second column. If the probability values is greatest then the significance level, then we fail to reject the null hypothesis and conclude that there is no evidence that the time series in the first column Granger causes the time series in the second column.

Based on the results in the table, we can make the following conclusions.

1. LRHANGSENG does not Granger cause LRNIFTY:

• The F-statistic of 0.82206 and a probability value of 0.4401 indicate that the past values of LRHANGSENG do not have a statistically significant impact on predicting the current values of LRNIFTY. In other words, the historical performance of LRHANGSENG does not provide useful information for forecasting LRNIFTY.

2. LRNIFTY does not Granger cause LRHANGSENG:

• The F-statistic of 9.52667 and a very low probability value of 9.00E-05 suggest that the past values of LRNIFTY have a statistically significant impact on predicting the current

values of LRHANGSENG. This means that the historical performance of LRNIFTY can be used to forecast LRHANGSENG.

3. LRSSE does not Granger cause LRNIFTY:

• The F-statistic of 3.35564 and a probability value of 0.0357 indicate that the past values of LRSSE do not have a statistically significant impact on predicting the current values of LRNIFTY. The historical performance of LRSSE does not provide meaningful information for forecasting LRNIFTY.

4. LRNIFTY does not Granger cause LRSSE:

• The F-statistic of 2.4199 and a probability value of 0.0899 suggest that the past values of LRNIFTY do not have a statistically significant impact on predicting the current values of LRSSE. Therefore, the historical performance of LRNIFTY is not a reliable predictor of LRSSE.

5. LRNIKKEI does not Granger cause LRNIFTY:

• The F-statistic of 1.56966 and a probability value of 0.2091 indicate that the past values of LRNIKKEI do not have a statistically significant impact on predicting the current values of LRNIFTY. The historical performance of LRNIKKEI does not provide useful information for forecasting LRNIFTY.

6. LRNIFTY does not Granger cause LRNIKKEI:

• The F-statistic of 22.1399 and an extremely low probability value of 6.00E-10 suggest that the past values of LRNIFTY have a statistically significant impact on predicting the current values of LRNIKKEI. This means that the historical performance of LRNIFTY can be used to forecast LRNIKKEI.

7. LRSP500 does not Granger cause LRNIFTY:

• The F-statistic of 15.2656 and a very low probability value of 4.00E-07 indicate that the past values of LRSP500 have a statistically significant impact on predicting the current values of LRNIFTY. In other words, the historical performance of LRSP500 can be used to forecast LRNIFTY.

8. LRNIFTY does not Granger cause LRSP500:

• The F-statistic of 0.36461 and a probability value of 0.6946 suggest that the past values of LRNIFTY do not have a statistically significant impact on predicting the current values of LRSP500. Therefore, the historical performance of LRNIFTY is not a reliable predictor of LRSP500.

9. LRSSE does not Granger cause LRHANGSENG:

• The F-statistic of 4.89676 and a probability value of 0.007These results suggest that there are some causal relationships between the stock market indices LRNIFTY, LRHANGSENG, LRNIKKEI, LRSP500, and LRSSE, but the causal relationships are not uniform across all pairs of time series. For example, while LRNIKKEI Granger causes LRNIFTY, LRNIKKEI does not Granger cause LRSSE. These results can be used to inform investment decision and risk management strategies.

Table 8 - Result for Granger causality test of selected Asian stock market indices with US stock exchange during Covid 19 Period

Pairwise Granger Causality Tests			
Date: 04/21/23 Time: 11:01			
Sample: 1/01/2019 12/30/2020			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
LRNIFTY does not Granger Cause LRHANGSENG	519	5.50201	0.0043
LRHANGSENG does not Granger Cause LRNIFTY		2.88248	0.0569
LRNIKKEI does not Granger Cause LRHANGSENG	519	9.99491	6.00E-05
LRHANGSENG does not Granger Cause LRNIKKEI		0.1145	0.8918
LRSP500 does not Granger Cause LRHANGSENG	519	19.1365	1.00E-08
LRHANGSENG does not Granger Cause LRSP500		3.66687	0.0262
LRSSE does not Granger Cause LRHANGSENG	519	0.44988	0.638
LRHANGSENG does not Granger Cause LRSSE		6.12158	0.0024

LRNIKKEI does not Granger Cause LRNIFTY	519	34.0522	1.00E-14
LRNIFTY does not Granger Cause LRNIKKEI		1.07944	0.3406
LRSP500 does not Granger Cause LRNIFTY	519	35.8943	3.00E-15
LRNIFTY does not Granger Cause LRSP500		19.9443	5.00E-09
LRSSE does not Granger Cause LRNIFTY	519	0.07449	0.9282
LRNIFTY does not Granger Cause LRSSE		1.73848	0.1768
LRSP500 does not Granger Cause LRNIKKEI	519	41.2059	3.00E-17
LRNIKKEI does not Granger Cause LRSP500		9.15401	0.0001
LRSSE does not Granger Cause LRNIKKEI	519	0.84266	0.4312
LRNIKKEI does not Granger Cause LRSSE		1.86049	0.1566
LRSSE does not Granger Cause LRSP500	519	0.31276	0.7316
LRSP500 does not Granger Cause LRSSE		7.19588	0.0008

SOURCE: Data obtained from Yahoo Finance and computed by Eviews 8

Based on the results of the pairwise Granger causality tests, we can draw he following conclusions:

1. LRNIFTY Granger causes LRHANGSENG with a statistically significant F-statistic of 5.50201 and a probability value of 0.0043. This suggests that the past values of LRNIFTY can help predict the current values of LRHANGSENG.

   LRHANGSENG does not Granger cause LRNIFTY, as the F-statistic of 2.88248 is not statistically significant at the 5% level.
2. LRNIKKEI Granger causes LRHANGSENG with a statistically significant F-statistic of 9.99491 and a probability value of 6.00E-05.

   LRHANGSENG does not Granger cause LRNIKKEI, as the F-statistic of 0.1145 is not statistically significant at the 5% level.
3. LRSP500 Granger causes LRHANGSENG with a statistically significant F-statistic of 19.1365 and a probability value of 1.00E-08.

   LRHANGSENG does not Granger cause LRSP500, as the F-statistic of 3.66687 is statistically at the 5% level.

4. LRSSE does not Ganger case RHANGENG, as the F-statistic of 0.44988 is not statistically at the 5% level.

   LRHANGSENG Granger causes LRSSE with a statistically significant F-statistic of 6.12158 and a probability values of 0.0024.
5. LRNIKKEI Granger causes LRNIFTY with a statistically significant of 34.0522 and probability values of 1.00E-14.

   LRNIFTY does not Granger cause LRNIKKEI, as the F-statistic of 1.07944 is not statistically significant at the 5% level.
6. LRSP500 Granger causes LRNIFTY with a statistically significant F-statistic of 35.8943 and a probability value of 3.00E-15.

   LRNIFTY does not Granger cause LRSP500, as the F-statistic of 19.9443 is statistically significant at the 5% level.
7. LRSSE does not Granger cause LRNIFTY, as the F-statistic of 0.07449 is not statistically significant at the 5% level.

   LRNIFTY does not Granger cause LRSSE, as the F-statistic of 1.773848 is not statistically significant at the 5% level.
8. LRSP500 Granger causes LRNIKKEI with a statistically significant F-statistic of 41.2059 and a probability value of 3.00E-17.

   LRNIKKEI does not Granger cause LRNIKKEI, as the F-statistic of 9.15401 is statistically significant at the 5% level.
9. LRSSE does not Granger cause LRNIKKEI, as the F-statistic of 0.84266 is not statistically significant at the 5% level.

   LRNIKKEI does not Granger cause LRSSE, as the F-statistic of 1.86049 is not statistically significant at the 5% level.
10. LRSSE does not Granger cause LRSP500, as the F-statistic of 0.31276 is not statistically significant at the 5% level.

CHAPTER 3 –Findings and Conclusion

3.1 Findings

As per the study's findings, there is a significant interlinkage between the Asian Stock Market Indices and the US Stock Market Index during both crises periods, i.e., Global Financial Crisis and Covid-19 pandemic. The result suggests that the US stock market index has a significant impact on the Asian Stock Market Indices. Additionally, the study found that the daily returns of the Asian Stock Market Indices and the US Stock Market index are normally distributed, and there is stationarity in their daily prices. The study also identified a significant causal relationship between the selected Asian Stock Market Indices and the US Stock Market index during both crises periods.

3.2 Conclusion

Therefore, the study concludes that during Global Crises Periods, the interlinkage between the Asian Stock Market Indices and the US Stock Market index is significant and that there is a causal relationship between them. This study's findings have several other implications. First, the study's results suggest that investors in Asian Stock market should pay close attention to the US stock markets movements, as it has a significant impact on the Asian Markets. Second, policymakers should be aware of the potential spillover effects of global crises, such as global Financial Crises and the Covid-19 pandemic, and take appropriate measures to mitigate systematic risks.

Overall, this study results have significant implications for investors, policymakers, and other stakeholders in the global financial system. By understanding the interlinkages between the Asian Stock Market indices and the US stock market index during crises periods, stakeholders can better navigate the complex and rapidly changing global financial landscape.

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