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Integration Between South East Asian Stock Markets Before and During the Occurrence of Covid-19

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Abstract - The paper aims to study the dynamics of the long run and short run cointegration between important indexes of South East Asian countries for the period before to the occurrence of the pandemic, COVID-19 (01.04.2019-29.11.2019) and during the pandemic (02.12.2019-3231.07.2020). The data collected is the daily closing prices of the indexes. The countries under study are – Hong Kong, South Korea, Japan, Thailand, China, Singapore and Taiwan. Johansen's Cointegration test shows the existence of a long-run association before and during the crisis. Although, VECM Granger causality shows the altered causation over the occurrence of pandemic and changed economic environment which is unidirectional as well as bidirectional in nature. Detailed country by country analysis is given. Results show that the short term cointegration has changed but is not evident in the current scenario. The finding of the study could be beneficial for international investors, policymakers and academicians.

Keywords: International Economics, Stock Market Integration, Econometrics and Statistical Models, Time Series, Cointegration, Global Crisis

I. INTRODUCTION

Investment requires diversification of risk to mitigate the losses. A lower correlation among the countries provide opportunities for investors to invest in different markets and manage the risk. Investing across countries decrease the correlations while when only in the domestic market will have relatively increased correlations. The benefits are because of the differences in the nature of economies (Gupta & Guidi, 2012). Based on the citation, (Eun & Shim, 1989)contributes that thecorrelations of movements of share prices is lesser seen among countries than within a country.(Longin & Solink, 1995) showed that international correlations between the markets has increased over the past 30 yrs. Increasing liberalisation, international trade, FPIs and faster reach of international news is slowly interconnecting the markets in the long run. While the association of countries against a common natural enemy and other crisis connects the market for a shorter period. Many studies have shown the bigger integration of stocks amid times of crisis such as - financial crisis of Asia, 1997-1999. The paper aims to study stock market integration before the occurrence of the pandemic and during the same. An integrated market according to (Billio, Donadelli, Paradiso, & Riedel, 2017)will have its advantages and disadvantages- high correlation will increase risk-sharing by insuring larger insurance benefits and also long and short-run welfare benefits. Also, portfolio diversification will decrease. Asia is a cluster of emerging markets. Investment in emerging market should provide a process through which the investor could make a diversified portfolio to attain higher risk-adjusted returns (Gupta, 2006). The stock markets of ASEAN-5 are integrating but the integration seems to be segmented at this point of time (Click & Plummer, 2005). A regional integration could lead to currency unification. Arbitrage opportunities for the long run in emerging stock market is very less but local investors can diversify their portfolio and gain arbitrage profits form diversified portfolios (Nasser & Hajilee, 2012).(Dhal, 2009) found that India is only integrated with regional and world markets in terms of US dollars, but when it comes to local currency, the integration to same extent is not found. Which is because of the foreign investor's stronger role as compared to local investor and thus, the process of segregation of Indian stock market with regional and world markets is incomplete. (Panda & Nanda, 2017) suggests the linkage of stock markets is supported by two types, diversification type theory and - integration type theory. Integration theory – common risk factors determines the market returns. Diversification theory - risk-averse agents would want to minimize portfolio risk and maximize portfolio return by building their portfolios with low assets having low correlations.

The increased COVID-19 cases have affected productivity and the business heavily because of global lockdown. Debt, liquidity crunches and economic downturn is inevitable. Global lockdown along with other cross-boundary tensions and speculations of world war III has affected the stock market. The fall in the market is the product of fear generated among investors worldwide. (Engelhardt, Krause, Neukirchen, & Posch, 2020) implies that investors should give focus to news rather than making a rational decision at times of financial crisis.

II. LITERATURE REVIEW

A huge number of studies has been done to study the integration of indices in developed countries. The emerging markets of Asian subcontinent have become new avenues of investments. Thus, it becomes evident to study the pattern of evolution of the stock market to assist both policymakers and investors in taking the lessons from the studies and making the right decisions and choices. (Gupta & Guidi, 2012) conducted Engle and Granger cointegration tests and found non- existence of correlation among Asian stock markets. Using different methods such as- Diebold and Yilmaz methodology and Copula GARCH models (Sehgal, Pandey, & Deisting, 2018) confirms there is low or no level of integration among south Asian countries. (Billio, Donadelli, Paradiso, & Riedel, 2017) conducted study on different groups of stock markets- developed markets, emerging markets and both. All measures show an increase in a very similar long-run integration pattern. .There are few papers cited (Furstenberg & Jeon, 1989), (Arshanapalli , Doukas , & Lang, 1995), (Mash & Masih, 1997), (Yang, Kolari, & Min, 2002), (Dhal, 2009), (Panda P. K., 2015) (Srivastava, Bhatia, & Gupta, 2015) which try to study the t markets for pre and post crisis scenarios, such as – Asian stock market crash (October 1997), Black Monday crash (October 1987) and the stock market crash during the subprime mortgage crash to analyse the market integration. This study aims to analyse the dynamics at the times of corona crash.

(Yang, Kolari, & Min, 2002) gave special attention to the Asian financial crisis and conducted Error correction method for long-run relationship and generalized impulse response functions to conclude that developed country's stock markets and Asian country's emerging stock markets have short-term integration between them. The study has shown that post the Asian crisis, Asian stock markets and developed markets were more cointegrated. (Srivastava, Bhatia, & Gupta, 2015)applied cointegration test and causality test on sample countries (India, Hong Kong, Japan and USA) to report the short and long run integration by dividing the time frame into three- before Asian crisis, before subprime mortgage crisis period and after mortgage subprime crisis. It showed an insignificant causality in the before Asian crisis period. On the other hand, throughout the before subprime mortgage crisis period, there is a considerable causal effect on Japan and on India from US, at the same time, Hong Kong had causal effect by the USA and impingement is significant from Japan on India in the after-subprime mortgage crisis period. (Furstenberg & Jeon, 1989) also confirmed increased interdependence of stock market after 1987 crash and which has contributed to internationalisation. (Dhal, 2009) the study is engaged in the integration of global and major regional stock markets with India's stock market prior to and post the global crisis. It showed that the USA and UK had a greater long-run impact on the Indian market than Singapore and Hong Kong while Japan had very little effect on the Indian stock market. Using the vector error correction model (VECM) it found that regional integration was not short-lived. To check if the global crisis has caused structural breaks in the co-movement of stocks, they applied Quandt-Andrew unknown breakpoint test but it didn't show any change in the market's short-run variation on the long-run path because of the global crisis phase. Asian stock market's interlinkage with other stock markets is also shown in (Panda P. K., 2015) by using Johansen- Juselius bivariate cointegration and Johansen- Juselius multivariate cointegration test. Also, in pre-crisis period, there was a cointegration found between Indian and Hong Kong stock markets which breaks after crisis. While, with China, a cointegrating relationship is found after Crisis. For other sample stock markets, the existence of any cointegrating relationship was rejected. While equity markets of Asia were lesser integrated with equity market of Japan than with the U.S. market (Arshanapalli , Doukas , & Lang, 1995).

Cointegration of stock market returns in different time frames indicate that cointegration is a time variant phenomenon for stock markets (Bracker, Docking, & Koch, 1999), (Hussain & Saeed, 2016), which is confirmed by studying the crisis specific studies by (Arshanapalli , Doukas , & Lang, 1995), (Yang, Kolari, & Min, 2002), (Srivastava, Bhatia, & Gupta, 2015), (Panda P. K., 2015). Two stock markets can have short-term cointegrations between them but do not have long-term cointegrations, and vice versa (Hussain & Saeed, 2016). (Mash & Masih, 1997), (Arshanapalli , Doukas , & Lang, 1995)found that the crash has

brought about a storngerr correlations in the markets, with a larger role of fluctuations in explaining shocks across markets. Countries closer in terms of geography displays greater co-movementthan countries geographically far away (Bracker, Docking, & Koch, 1999). The return distributions within the regional markets shows the presence of a long-term equilibrium connections (Panda & Nanda, 2017). (Chen & Zhang, 1997) finds that international trade within the region measures the economic segregation of the country with the region and upto what level the cashflows are intertwined between the two economies. Countries with greater economic tie ups will have higher stock market return correlations. The larger and the more dominant market will have greater influence on the relatively smaller stock market (Janakiramanan & Lamba, 1998). (Eun & Shim, 1989) mentions the US has a controlling position in the world, thus, brands the economy the largest fabricator of information, moving the other stock markets. (Janakiramanan & Lamba, 1998) also referred that when one stock is listed on multiple stock exchanges. The shock of one market travels to the other through the single security causing a minimal effect. But if there is bigger number of multi- listed companies then shock of one market travels to the other.

(Samadder & Bhunia, 2018) find the existence of short-term international portfolio diversification while long term diversification is restricted. Thus, short term portfolio diversification benefit could be realised by studying the short-term correlation pattern. (Longin & Solink, 1995) concluded that correlation increases when the volatility in markets is large.(Engelhardt, Krause, Neukirchen, & Posch, 2020) studied samples of 64 stock markets exchanges i.e. 94% of world GDP to determine if corona crash 2020 is news-driven or rational outlook about the pandemic's impingement on economy. It says, increase in news attention of 1 standard deviation will decrease the market returns of 0.27 standard deviations. While increase in rational expectation variables of 1 standard deviation will decrease market returns of 0.131 standard deviations(Mukherjee & Mishra, 2007) reports an instantaneous flow of information which leads to greater market efficiency in the international scenarios by conducting contemporaneous Geweke measures on the stock market of India and 22 other foreign indices.

Research Questions

There are very few papers on regional financial integration of South East Asian countries. Based on this the present study puts forward the following research questions:

I. Is there an integration between South East Asian markets?
II. Where is the price discover is taking place if the market is integrated?

Data

Daily closing prices of seven indexes from the South East Asian market- Singapore, South Korea, Taiwan, China, Thailand, Hong Kong and Japan and has taken into account for the period prior to the occurrence of the pandemic (01.04.2019-29.11.2019) and during the pandemic (02.12.2019-31.07.2020). The choices of the country's stock market are guided by the consideration of studying the global regional integration before and during the period of COVID-19. The data has been taken from Bloomberg.

III. METHODOLOGY

Augmented Dicky-Fuller Unit Root Test: Time series econometrics has been employed to analyse long and short cointegration pattern among the indices. A unit root test has to be performed as a pre-essential, to study the stationarity of series. To check the stationarity of series ADF test (Dickey & Fuller, 1979) has been employed. A time-series is considered stationary when the statistical properties are constant over the time and tends to return to same path aftershock. ADF unit root test holds the H0 that unit root is present in time series. If the value calculated is lesser than the value -critical, the Ha is accepted and H0 is rejected. The bigger the negative value, the stronger is the support for the rejection of the hypothesis.

Johansen's Cointegration Test: (Johansen, 1988) is used to analyse the indices for the long-run integration. Two types of test are applied- Trace test and another one is max eigenvalue test. The test is used to study cointegration among three or more time-series. The max eigenvalue test confirms the trace test. The H0 of **trace test is** the rank(π) = r0.On the other hand, the Ha of test is r0< rank(π) <n, where n is the maximal potential cointegration. If the H0 is rejected, the test proceeds with new H0, i.e. rank(π) =

r0 +1 and Ha, r0 + 1 < rank(π) < n. The H0 of **max eigenvalue test** examines the that rank(π) = 0 and the Ha is rank(π)= 1. There is no cointegration and the H0 is accepted if the rank is 0. If the rank is non zero, then-largest eigen value, λ1 is at least 1 and there could be more cointegrating vectors. Similarly, a series of tests are conducted for the null hypothesis, (π) = 1,2,3…. and alternative hypothesis, (π) =2,3,4…….

VECM and VECM Granger Causality: (Granger, 1969) is employed to study the short-term causative association among all the time series. The Granger causality employed to examine if a time series may be used to use for forecasting another. The test has been performed to test if X carries any statistical information about variable Y if it does then "X Granger-cause Y" otherwise "X does not Granger-cause Y". Granger causality is performed using VECM model to check the causality relationship and direction determining the direction of causation between time series.

IV. EMPIRICAL RESULTS

In the first step, the data was examined for stationarity by the ADF test. Stationarity test's outcomes are presented in **table 1** and **table 2.** These results envisage that the market returns of all the stock exchanges are stationary at levels for both the periods- before the corona crisis and during the corona crisis.

Table 1: Results of ADF Test in Pre-Crisis

Series	Without Constant	With Constant	With Constant and Trend
Hang Seng	-9.840716 (0.0000)	-9.853528 (0.0000)	-9.828015 (0.0000)
SSEC	-10.81413 (0.0000)	-10.81610 (0.0000)	-10.80716 (0.0000)
Nikkei 225	-12.03855 (0.0000)	-12.05480 (0.0000)	-12.11074 (0.0000)
KOSPI	-9.121026 (0.0000)	-9.094320 (0.0000)	-9.107582 (0.0000)
Taiwan Weighted	-10.71915 (0.0000)	-10.74074 (0.0000)	-10.75708 (0.0000)
SET	-11.11167 (0.0000)	-11.08369 (0.0000)	-11.11388 (0.0000)
Strait Times	-9.443786 (0.0000)	-9.413087 (0.0000)	-9.375432 (0.0000)

Table 2: Results of ADF Test During Crisis

Series	Without Constant	With Constant	With Constant and Trend
Hang Seng	-11.41769 (0.0000)	-11.37594 (0.0000)	-11.32999 (0.0000)
SSEC	-10.25302 (0.0000)	-10.25867 (0.0000)	-10.25815 (0.0000)
Nikkei 225	-10.29500 (0.0000)	-10.25387 (0.0000)	-10.26494 (0.0000)
KOSPI	-9.833923 (0.0000)	-9.809382 (0.0000)	-9.822108 (0.0000)
Taiwan Weighted	-8.496531 (0.0000)	-8.486367 (0.0000)	-8.578995 (0.0000)
SET	-4.441940 (0.0000)	-4.446471 (0.0004)	-4.439665 (0.0028)
Strait Times	-10.13164 (0.0000)	-10.16769 (0.0000)	-10.12833 (0.0000)

Since the series were found to be stationary at levels, they were further tested for cointegration with the Johansen's Cointegration test. Outcomes for test - Max Eigen Value test & Trace test for returns before Corona crisis, presented in **table 3** and **table 4**, shows the existence of the long run dynamics among all

the market exchanges of South East Asia namely Singapore South Korea, China, Thailand, Hong Kong, Japan and Taiwan.

Table 3: Results of Johansen Cointegration (Trace Test) Pre-Crisis

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Prob.**
None *	0.4372	315.8314	0.0000
At most 1 *	0.3685	243.3983	0.0000
At most 2 *	0.3454	185.4892	0.0000
At most 3 *	0.3000	132.1049	0.0000
At most 4 *	0.2669	87.1605	0.0000
At most 5 *	0.1837	48.0446	0.0000
At most 6 *	0.1633	22.4692	0.0000
Trace test indicates 7 cointegrating eqn(s) at the 0.05 level			

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 4: Results of Johansen Cointegration (Max Eigen Value Test) Pre-Crisis

Hypothesized No. of CE(s)	Eigenvalue	Max Eigen Statistic	Prob.**
None *	0.4372	72.4331	0.0000
At most 1 *	0.3685	57.9090	0.0002
At most 2 *	0.3454	53.3842	0.0001
At most 3 *	0.3000	44.9445	0.0001
At most 4 *	0.2669	39.1159	0.0001
At most 5 *	0.1837	25.5754	0.0006
At most 6 *	0.1633	22.4692	0.0000
Max Eigen Value test indicates 7 cointegrating eqn(s) at the 0.05 level			

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5 and **table 6** reports the outcome of Johansen's Cointegration Test for the stock exchanges of Singapore South Korea, China, Thailand, Hong Kong, Japan and Taiwan. The two tests of cointegration indicates the existence of 3 equations of cointegration, implying the existence of a long-run dynamics among these markets.

Table 5: Results of Johansen Cointegration (Trace Test) During Crisis

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Prob.**
None *	0.6386	266.9890	0.0000
At most 1 *	0.4408	151.9918	0.0000
At most 2 *	0.2886	86.3103	0.0014
At most 3	0.1901	47.8371	0.0502
At most 4	0.1385	24.0185	0.1997
At most 5	0.0610	7.1761	0.5573
At most 6	0.0007	0.0680	0.7943
Trace test indicates 3 cointegrating eqn(s) at the 0.05 level			

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 6: Results of Johansen Cointegration (Max Eigen Value Test) During Crisis

Hypothesized No. of CE(s)	Eigenvalue	Max Eigen Statistic	Prob.**
None *	0.6386	114.9972	0.0000
At most 1 *	0.4408	65.6815	0.0000
At most 2 *	0.2886	38.4731	0.0132
At most 3	0.1901	23.8187	0.1412
At most 4	0.1385	16.8424	0.1796
At most 5	0.0601	7.1081	0.4765
At most 6	0.0006	0.0680	0.7943
Trace test indicates 3 cointegrating eqn(s) at the 0.05 level			

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Since the series were Cointegrated of the same order, VECM and VEC Granger Causality/Block Exogeneity test was used for estimating the causality (short run) between these stock markets.

Table 7 and **table 8** show that before the Corona period, returns of Nikkei 225 (Japan), stock exchange of Thailand (SET) and China (SSEC) were found to granger cause the returns of the Hang Seng stock exchange, but there is no statistical evidence of this causative association during the Corona crisis. This implies a change in the way markets in Hong Kong react to the changes in the markets of Japan, Thailand and China i.e. the price discovery process has changed during the crisis.

Table 7: Results of Granger Causality Test for Hang Seng (Pre-Crisis)

Dependent variable: D(R_HS)		
Excluded	**Chi-sq**	**Prob.**
D(R_K)	3.215330	0.2004
D(R_N)	**12.74728**	**0.0017**
D(R_SET)	**7.472515**	**0.0238**
D(R_SSEC)	**14.58814**	**0.0007**
D(R_ST)	3.652562	0.1610
D(R_TW)	5.843530	0.0538
All	29.68500	0.0031

Table 8: Results of Granger Causality Test for Hang Seng (During Crisis)

Dependent variable: D(R_HS)		
Excluded	**Chi-sq**	**Prob.**
D(R_K)	2.859142	0.9965
D(R_N)	6.274835	0.9016
D(R_SET)	11.94597	0.4500
D(R_SSEC)	9.327798	0.6747
D(R_ST)	4.489773	0.9729
D(R_TW)	7.474470	0.8247
All	50.39680	0.9752

Granger causality result before Corona crisis and during the crisis for South Korean stock exchange are shown in **table 9** and **table 10** respectively. While table 9 puts forward lagged returns of Shanghai stock exchange were granger causing the returns of South Korean stock markets before the crisis, , the same didn't hold during the crisis, as evident from table 10. That is to say, the price discovery process in South Korean stock markets is altered while in the crisis period.

Table 9: Results of Granger Causality Test for KOSPI (Pre-Crisis)

Dependent variable: D(R_K)		
Excluded	**Chi-sq**	**Prob.**
D(R_HS)	2.240441	0.3262
D(R_N)	0.052298	0.9742

D(R_SET)	0.137784	0.9334
D(R_SSEC)	**6.627520**	**0.0364**
D(R_ST)	1.421871	0.4912
D(R_TW)	0.089398	0.9563
All	12.94613	0.3730

Table 10: Results of Granger Causality Test for KOSPI (During Crisis)

Dependent variable: D(R_K)		
Excluded	**Chi-sq**	**Prob.**
D(R_HS)	4.061704	0.9823
D(R_N)	10.43160	0.5782
D(R_SET)	9.748603	0.6380
D(R_SSEC)	4.216303	0.9792
D(R_ST)	3.606617	0.9895
D(R_TW)	7.115931	0.8499
All	75.49345	0.3662

Before the Corona period, Chinese markets were found to granger cause the returns of Nikkei 225 which is the stock exchange for Japan **(table 11)** but here also, we do not have any statistical evidence in favour of any of the markets under study to Granger cause the returns in Nikkei 225 during the Corona period (**table 12**).

Table 11: Results of Granger Causality Test for Nikkei 225 (Pre-Crisis)

Dependent variable: D(R_N)		
Excluded	**Chi-sq**	**Prob.**
D(R_HS)	4.360068	0.1130
D(R_K)	0.283829	0.8677
D(R_SET)	2.342747	0.3099
D(R_SSEC)	**9.128428**	**0.0104**
D(R_ST)	0.042741	0.9789
D(R_TW)	2.495827	0.2871
All	21.33016	0.0457

Table 12: Results of Granger Causality Test for Nikkei 225 (During Crisis)

Dependent variable: D(R_N)		
Excluded	**Chi-sq**	**Prob.**
D(R_HS)	9.349260	0.6728
D(R_K)	10.64675	0.5594
D(R_SET)	15.43077	0.2187
D(R_SSEC)	10.38480	0.5822
D(R_ST)	13.36586	0.3430
D(R_TW)	20.90666	0.0518
All	112.9005	0.0015

Before the onset of the pandemic, lagged returns of stock exchanges of Hong Kong, South Korea, Japan, China and Singapore were found to granger cause the returns in the Stock exchange of Thailand (**table 13**) but the short-term causality changed from Taiwan to Thailand during the pandemic (**table 14**).

Table 13: Results of Granger Causality Test for SET (Pre-Crisis)

Dependent variable: D(R_SET)		
Excluded	**Chi-sq**	**Prob.**
D(R_HS)	**9.525562**	**0.0085**
D(R_K)	**8.117930**	**0.0173**
D(R_N)	**25.63949**	**0.0000**
D(R_SSEC)	**20.28298**	**0.0000**
D(R_ST)	**7.627977**	**0.0221**

D(R_TW)	2.382217	0.3039
All	40.56235	0.0001

Table 14: Results of Granger Causality Test for SET (During Crisis)

Dependent variable: D(R_SET)		
Excluded	**Chi-sq**	**Prob.**
D(R_HS)	14.42314	0.2745
D(R_K)	12.29664	0.4222
D(R_N)	15.85375	0.1980
D(R_SSEC)	14.16403	0.2904
D(R_ST)	20.77511	0.0538
D(R_TW)	**22.52776**	**0.0320**
All	82.58948	0.1847

Tables 15 to 18 show that there is no change in the price discovery procedure in the stock exchanges of Shanghai (SSEC) and Singapore (Strait Times). None of the markets were ganger causing the returns in these two markets before the crisis and the same holds for the pandemic period as well.

Table 15: Results of Granger Causality Test for SSEC (Pre-Crisis)

Dependent variable: D(R_SSEC)		
Excluded	**Chi-sq**	**Prob.**
D(R_HS)	1.217652	0.5440
D(R_K)	1.138876	0.5658
D(R_N)	2.227802	0.3283
D(R_SET)	1.471817	0.4791
D(R_ST)	0.802815	0.6694
D(R_TW)	1.327237	0.5150
All	10.95614	0.5327

Table 16: Results of Granger Causality Test for SSEC (During Crisis)

Dependent variable: D(R_SSEC)		
Excluded	**Chi-sq**	**Prob.**
D(R_HS)	6.670590	0.8786
D(R_K)	5.447364	0.9413
D(R_N)	9.579502	0.6528
D(R_SET)	8.341954	0.7579
D(R_ST)	6.949450	0.8609
D(R_TW)	10.48447	0.5735
All	38.95573	0.9995

Table 17: Results of Granger Causality Test for Strait Times (Pre-Crisis)

Dependent variable: D(R_ST)		
Excluded	**Chi-sq**	**Prob.**
D(R_HS)	0.992210	0.6089
D(R_K)	0.005038	0.9975
D(R_N)	0.134157	0.9351
D(R_SET)	1.732176	0.4206
D(R_SSEC)	3.474314	0.1760
D(R_TW)	1.276062	0.5283
All	8.586145	0.7378

Table 18: Results of Granger Causality Test for Strait Times (During Crisis)

Dependent variable: D(R_ST)		
Excluded	**Chi-sq**	**Prob.**
D(R_HS)	7.052563	0.8541
D(R_K)	8.278169	0.7630

D(R_N)	10.59949	0.5635
D(R_SET)	15.96770	0.1927
D(R_SSEC)	10.18861	0.5994
D(R_TW)	12.10466	0.4373
All	92.48664	0.0524

Similarly, for Taiwan also, the short run causality dynamics have changed during the pandemic. In the period before the crisis, stock returns in Shanghai and Hong Kong stock exchange were found to granger cause the returns of Taiwan stock exchange (**table 19)**, whereas during the crisis period (**table 20)**, none of the stock exchanges are leading the changes in the returns of Taiwan Composite.

Table 19: Results of Granger Causality Test for Taiwan Composite (Pre-Crisis)

Dependent variable: D(R_TW)		
Excluded	**Chi-sq**	**Prob.**
D(R_HS)	**10.24987**	**0.0059**
D(R_K)	0.785782	0.6751
D(R_N)	1.349210	0.5094
D(R_SET)	4.381909	0.1118
D(R_SSEC)	**8.171645**	**0.0168**
D(R_ST)	0.293315	0.8636
All	18.50500	0.1012

Table 20: Results of Granger Causality Test for Taiwan Composite (During Crisis)

Dependent variable: D(R_TW)		
Excluded	**Chi-sq**	**Prob.**
D(R_HS)	6.166243	0.9075
D(R_K)	6.589029	0.8835
D(R_N)	11.01325	0.5278
D(R_SET)	16.03240	0.1898
D(R_SSEC)	8.191926	0.7700
D(R_ST)	8.295567	0.7616
All	57.29471	0.8969

V. CONCLUSION

The paper is an attempt to study integration of the South East Asia stock markets and how the price discovery process in these markets is altered due to the ongoing pandemic. Applying the ADF test, Johansen's Cointegration and VECM, we concluded that though these markets exhibit a long-run association before and during the ongoing pandemic, the nature and direction of short-run causality has changed during the current economic scene. While we found unidirectional as well as the bidirectional causative association between most of these stock exchanges, this causative association was not evident during the ongoing crisis which has hit the world markets severely since January 2020.

` The paper will contribute to the literature of market integration at the times of crisis. It will also be beneficial for policy makers in drafting policies as there is growing regional cointegration. A well-co-ordinated development process and management of risk sharing at the times of global crisis among the regions can be prepared as the dynamics tends to alter in short run. Study also aims to give insight of the current market correlations to international investors for portfolio diversifications. The further study can be done by including after crisis correlations between the regional markets.

Since this region is a huge emerging market, thus a cointegration can be studied using market price in terms of dollars, to study the foreign investor's role in the stock market as compared to the domestic investors. Also, it would be beneficial in studying possible currency unification in the region. This is still too early to predict but might play a beginning role in the foray of this study.

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