ASSESSING THE DYNAMIC STOCK MARKET LINKAGES AMONG RCEP MEMBER COUNTRIES IN TIMES OF COVID-19 CALAMITY: AN EMPIRICAL STUDY UTILIZING A TIME SERIES ANALYSIS METHOD

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Abstract

The COVID-19 calamity has affected every corner of the world economy, including the fifteen countries in the Asia-Pacific region which finally signed the Regional Comprehensive Economic Partnership (RCEP) agreement after several years of negotiations to accelerate post-pandemic economic recovery. After paralyzing the economy, the pandemic undoubtedly had a negative impact on stock market movements in RCEP member countries. This paper aims to investigate the dynamic linkages of stock market prices among RCEP member states with a comparison of current conditions with the 2008-2009 global financial crisis. By performing the Johansen cointegration and Autoregressive Distributed Lag (ARDL) bound tests, this study shows that pandemic has decreased the degree of long-run relationships among the RCEP stock price indices, which implies that domestic factors tend to determine the movement of stock prices leading to long-run co-movements. The Vector Error Correction (VEC) analysis also demonstrates that although the short-run impact of COVID-19 is not as severe as the global financial crisis, the temporal causality among RCEP stock prices is more complex compared to the pre-pandemic period; for example, stock prices in ASEAN developing countries with the exception of Vietnam are deemed as endogenous variables, suggesting that they are affected by the COVID-19 outbreak and required to adjust toward long-run equilibrium relationships. Considering that Vietnam's stock market does not have a strong short-run relationship with other RCEP stock markets in this time frame, portfolio investors may consider to hold Vietnamese stocks in the short run to minimize risks caused by the spread of the novel coronavirus. In addition, the empirical results carried out in this paper also demonstrate that RCEP stock market indices are strongly influenced by the movement of the U.S. and Euro Area stock price indices. As such, policy makers in RCEP member nations should pay attention to policies taken by the United States and Euro Area when formulating their national response policies to overcome the adverse impact of the pandemic. Finally, considering a key takeaway from the analysis that the movements of RCEP stock prices rely to some extent on the Australian and Japanese stock price movements, other signatory members of RCEP, especially developing countries in ASEAN, should work closely with these two countries to develop their stock markets into more sophisticated ones in preparation for the entry into force of the RCEP pact.

Keyword: Regional Comprehensive Economic Partnership (RCEP), Stock Market Linkages, Time Series Analysis Method

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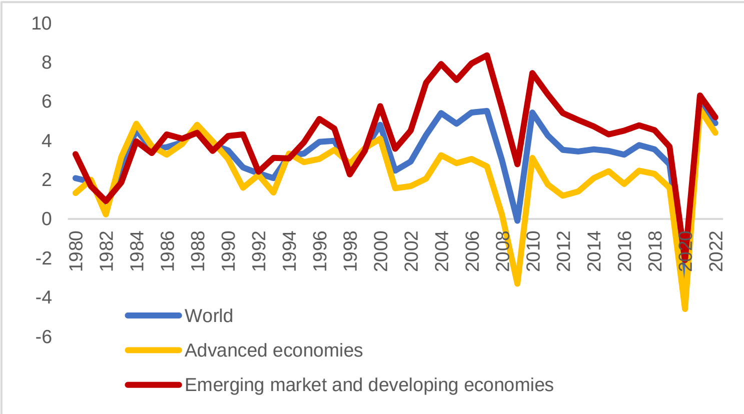
Chapter I

Introduction

1.1 Research Background

The novel coronavirus (SARS-CoV-2), later known as COVID-19, has become a frightening spectre as this new variant of infectious malady has affected 222 countries worldwide and infected more than 200 million people around the globe with an average mortality rate of 2%.[1] The unprecedented impact of the COVID-19 crisis has inevitably brought countries into a state of emergency which ultimately pushed the majority of the economies across the globe into a dire situation. The International Monetary Fund (IMF), in its latest World Economic Outlook (WEO) update of July 2021, estimated that the world economy in 2020 experienced a great recession with a contraction of 3.2%. The decline in world economic growth due to COVID-19 was more severe than the global financial crisis in 2008-2009 (see Figure 1). According to the same IMF estimates, the advanced economies experienced a deep contraction by 4.6%, while the economies of emerging markets and developing countries fell by 2.1% in 2020 due to the COVID-19 calamity. In addition, fiscal constraint, economic vulnerability and severity of the pandemic inexorably made it more difficult for emerging markets and developing economies to return to their pre-pandemic activity levels compared to advanced economies.

Figure 1. Global Economic Growth (%), 1980-2022



Source: Author's compilation based on WEO July 2021

The COVID-19 pandemic has created a turbulent time, yet there are reasons for optimism. This circumstance encourages the crucial role of multilateralism in order to counter protectionism and promote global and regional growth in the post-COVID-19 pandemic era. One of the historical milestones of multilateralism is the signing of the Regional Comprehensive Economic Partnership (RCEP) on November 15, 2020. After eight years of tedious negotiations, fifteen signatories comprising developed and developing countries in the Asia-Pacific region agreed on a free trade deal covering a market of 2.3 billion people or accounting for nearly 30% of the global population with a combined Gross Domestic Product (GDP) of $25.8 trillion or about 29% of the world's GDP and a combined trade value of $12.7 trillion or nearly 25% of global trade in goods and services (Asian Development Bank, 2021).

[1] Information about the COVID-19 cases throughout the world is retrieved from Worldometers website (available at https://www.worldometers.info/coronavirus/, accessed date: August 13, 2021).

Through the RCEP agreement, the ten ASEAN member states[2] and five other partner countries, namely Australia, China, Japan, New Zealand, and the Republic of Korea (ROK), have committed to reject inward-looking policies by accelerating trade and investment during and post-COVID-19 era. A study by Petri and Plummer (2020) estimates that RCEP will increase world real income by $186 billion in 2030 (see Table 1). The trade deal is projected to benefit the RCEP member states by $174 billion or equivalent to 0.4% of their aggregate GDP. China, Japan and the ROK are expected to gain the most, amounting to $85 billion, $48 billion and $23 billion, respectively. Other significant RCEP benefits are projected to accrue to the top five developing countries in ASEAN, namely Thailand ($4 billion), Malaysia ($4 billion), Indonesia ($3 billion), Vietnam ($3 billion), and the Philippines ($2 billion). The Oceanic countries, i.e., Australia and New Zealand, also receive an additional $1 billion each in real income. Moreover, the United Nations Conference on Trade and Development (UNCTAD, 2020) predicts that RCEP's trading arrangements will add member countries' exports by more than 10% by 2025.

Table 1. Additional Real Income in 2030 Induced by the RCEP Agreement (billion USD)

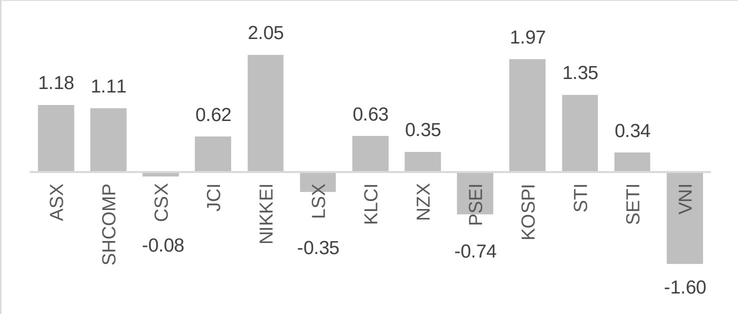
Description	2030 Income	Incremental Change	
		Value	%
RCEP Member Countries	**43,516**	**174**	**0.4**
Australia	2,590	1	0.0
Brunei Darussalam	31	0	0.5
China	27,839	85	0.3
Indonesia	2,192	3	0.1
Japan	4,924	48	1.0
Korea, Republic of	2,243	23	1.0
Malaysia	675	4	0.6
New Zealand	264	1	0.2
Philippines	680	2	0.3
Singapore	485	0	0.0
Thailand	812	4	0.5
Vietnam	497	3	0.5
Others	284	0	0.0
Other Asian Countries (including India and Taiwan)	**9,997**	**-9**	**-0.3**
Americas	**39,569**	**2**	**0.0**
Rest of the World	**40,720**	**19**	**0.0**
World	**133,801**	**186**	**0.1**

Source: Author's compilation based on Petri and Plummer (2020), p. 11-12

[2] The Association of Southeast Asian Nations (ASEAN) consists of Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

With the signing of the RCEP agreement, this ASEAN-centered trade deal may also add a silver lining to financial integration among the fifteen Asia-Pacific nations. From market perspectives, the RCEP agreement also provides optimism in the midst of the pandemic as indicated by hikes in the majority of the RCEP stock price indices after the announcement (see Figure 2). Although the RCEP agreement still has some time before its implementation, it is believed to stimulate not only trade and investment but also financial market integration in the region, which will encourage capital accumulation and thus have a positive impact on economic growth. Financial market integration can ultimately improve macroeconomic discipline, boost the efficiency and stability of the financial system, expand investor opportunities to diversify portfolios, and enable member countries to share risks for smoothing consumption (Agénor, 2001; Boonbandanrit, 2015; Eyraud, Singh, & Sutton, 2017). With the financial integration of RCEP member economies going forward, it is expected that foreign participation in the financial market will be greater due to a reduction in limits on foreign share ownership in the market.

Figure 2. Daily Stock Returns after RCEP Deal Announcement on November 16, 2021 (%)



Notes: ASX represents Australia, CSX represents Cambodia, SHCOMP represents China, JCI represents Indonesia, NIKKEI represents Japan, LSX represents Lao PDR, KLCI represents Malaysia, NZX represents New Zealand, PSEI represents Philippines, KOSPI represents ROK, STI represents Singapore, SETI represents Thailand, and VNI represents Vietnam

Source: Author's calculation based on Bloomberg

In the middle of the ongoing uncertainty due to the COVID-19 turmoil, financial markets including stock markets in RCEP member jurisdictions are inevitably experiencing considerable volatility. Even in an unfavourable situation, the stock market indices of RCEP members, especially developing countries, are still the target of international portfolio investors seeking profits due to the high returns expected. For RCEP member states fighting the epidemic, the dynamic linkages of equity markets in the region are a matter of interest. This paper therefore aims to delve into it and intends to identify whether RCEP stock prices have moved towards greater or lesser co-movements during the COVID-19 crisis. Furthermore, this study will also explore the extent of dynamic linkages between RCEP stock prices and Hong Kong and Taiwan stock prices due to their geographical proximity and mutual financial integration. Additionally, realizing that the COVID-19 calamity also hit the United States (U.S.) and European countries and considering that previous research showed strong impacts of both U.S. and European stock prices on the equity markets of Asia-Pacific countries during the 2008-09 global financial crisis (GFC), this paper also explores the influence of U.S. and Euro Area stock prices on RCEP stock price movements in times of the COVID-19 and GFC periods.

1.2 Research Questions and Hypotheses

Based on the background mentioned above, there are three research questions to address in this study:

1. Has the COVID-19 pandemic caused a change in the degree of linkages among the equity markets of RCEP member jurisdictions?
2. Are there any differences in the short-run and long-run relationships among the stock prices of RCEP member countries during the GFC and the COVID-19 catastrophe?
3. Have the stock price indices of non-RCEP economies (specifically Hong Kong, Taiwan, the United States, and the Euro Area) had a more significant influence on RCEP stock price movements during the turbulent times of COVID-19 than the GFC period?

To tackle these research questions, the paper uses a time series analysis method. In addition, this study also utilizes secondary research to provide policy implications. Previous research outputs and documents reviewed in this paper include academic journals, working papers, and reports published by the ADB, IMF, and other international organizations. The hypotheses of this study are as follows:

1. Because of the COVID-19 headwind, the degree of linkages among RCEP equity markets has decreased.
2. The pandemic has caused changes in the short- and long-run relationships of stock price movements among RCEP member countries.
3. The movement of stock prices in non-RCEP economies has had a strong influence on stock prices in RCEP countries, especially in the COVID-19 era.

The paper provides empirical evidence of cointegration and linkage patterns among RCEP stock markets. In addition, taking into account the possible influence of non-RCEP stock market indices on RCEP equity prices, the study also considers the implications of not only RCEP member states' policy responses to the COVID-19 crisis but also policy measures taken by non-RCEP economies, which likely contributed to reducing stock price volatility in these economies and, thus, in RCEP member countries. The paper is structured as follows. Section 2 presents a literature review. Section 3 explains the nature of data used and discusses the econometric model and method used in this study. Section 4 reports and analyses the empirical results. Section 5 provides the paper's conclusion, policy implications and limitations of the study.

Chapter II
Literature Review

2.1 Theory of Stock Market Integration

As the world economy has grown rapidly and become more integrated in recent decades, international finance is undoubtedly becoming more complex and interconnected which has increased the cross-border allocation of financial assets (Park, 2013 and Lilian Ng, 2020). The neoclassical macroeconomic theory poses capital should flow from capital-rich to capital-poor nations due to free capital mobility. However, in the real-world situation, lower productive capacity and unenforced property rights are considered as reasons why capital flows do not follow the theoretical framework. This phenomenon is also known as the Lucas Paradox which postulates the existence of capital market imperfections (Alfaro, et al., 2003 and Mankiw, 2016). Strong economic fundamentals, political stability, technological sophistication and information disclosure determine where capital flows are channelled.

Previous studies reveal that due to stock market integration, risks posed across stock markets are the same (Korajczyk, 1999). Lessons from past crises have provided clear evidence that increasingly integrated stock markets tend to make countries experience spillover effects in the event of a shock in a particular country's stock market. In this regard, policymakers should be aware of the extent to which their stock markets are linked to other countries' markets. From an investor's point of view, highly integrated stock market indices also make it difficult for investors to reduce portfolio risk. Additionally, asset price theory also posits that stronger co-movement among stock prices lessens investor’s opportunity to benefit from a diversified stock portfolio (Alan, et al., 2012). It means that if a country's stock price index falls, the stock price indices of other countries that have strong relationships also tend to weaken, which in turn causes investors to be unable to avoid losses.

2.2 RCEP Agreement

In the last three decades, ASEAN countries have been actively involved in the activities of free trade agreements (FTAs) as an instrument of trade policy which ultimately leads to the deepening of market-based economic integration (Kawai & Wignaraja, 2011, and Suvannaphakdy, et al., 2014). Benefiting from the FTAs that had been agreed upon, ASEAN led by Indonesia sparked the idea of establishing an RCEP at the 19th ASEAN Summit in 2011. Given the geographical proximity and bilateral cooperation agreements, RCEP carried the concept of consolidating ASEAN’s FTAs with its six trading partners, namely Australia, China, India, Japan, New Zealand, and ROK. At the end of 2019, India decided not to participate in RCEP which led only fifteen countries in Asia Pacific to continue their commitment to finalize negotiations.

The RCEP pact which was signed on November 15, 2020 is expected to come into effect after at least five ASEAN member nations and three non-ASEAN member states complete ratification. As of June 2021, four countries, namely China, Japan, Singapore, and Thailand confirmed the completion of the ratification process in their countries. The RCEP agreement consists of 20 chapters at which provisions of financial services liberalization are listed in Chapter 8. The "Trade in Services" chapter aims to pave the way for greater trade in services through the substantial removal of restrictive and discriminatory measures in the region (ASEAN, 2020). In the agreement's Annex, it is also stated that RCEP intends to strike the right balance between promoting the liberalization of financial services, while providing a strong prudential safeguard to enable financial regulators to apply policy measures to maintain the integrity and stability of the financial system in the region.

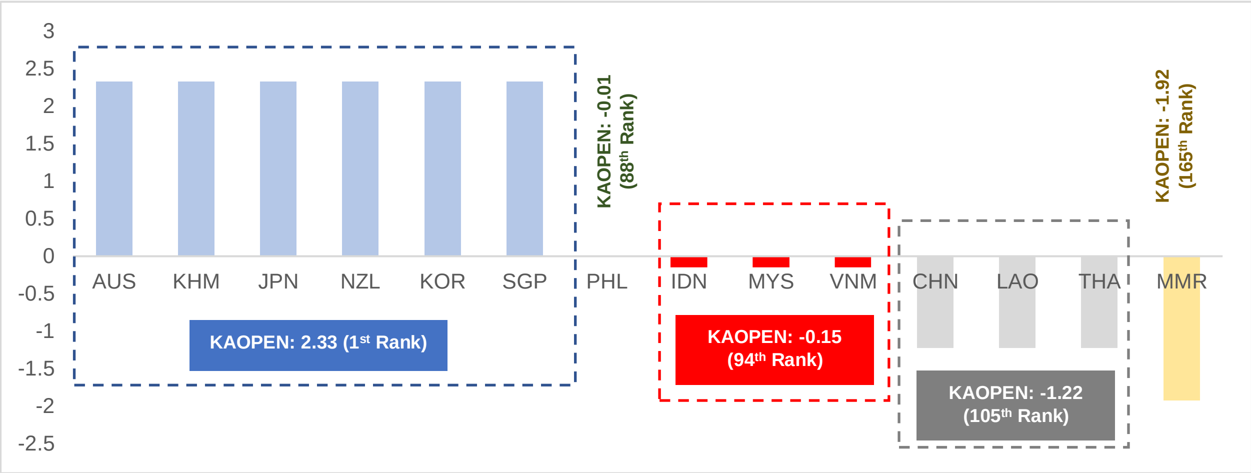
Table 2. OECD FDI Restrictiveness Index for Financial Services, 2019

Countries	Total	Banking	Insurance	Other Finance
Australia	0.133	0.200	0.125	0.075
Brunei Darussalam	0.024	0.000	0.006	0.067
Cambodia	0.060	0.110	0.060	0.010
China	0.226	0.050	0.375	0.253
Indonesia	0.222	0.180	0.255	0.230
Japan	0.000	0.000	0.000	0.000
Korea, Rep. of	0.050	0.000	0.000	0.150
Lao PDR	0.133	0.080	0.080	0.238
Malaysia	0.319	0.358	0.400	0.200
Myanmar	0.276	0.260	0.350	0.217
New Zealand	0.223	0.240	0.240	0.190
Philippines	0.115	0.265	0.040	0.040
Singapore	0.021	0.038	0.013	0.013
Thailand	0.456	0.615	0.615	0.138
Vietnam	0.118	0.270	0.020	0.064

Notes: The value for the index is ranging from 0 (no restriction) to 1 (complete restriction)
Source: Author's compilation based on OECD, https://stats.oecd.org/Index.aspx?datasetcode=FDIINDEX#

To date, although RCEP member countries have liberalized their financial services, the level of readiness to allow foreign participation in their market varies considerably. According to 2019 OECD data as set out in Table 2, the majority of developing countries in the region, such as China, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, and Vietnam still have restrictions on opening up financial markets for foreign services providers. Meanwhile, in the case of Japan, there are no barriers to foreign participation supported by the country's sophisticated system. The degree of capital account liberalization also varies in various ways. Based on the 2018 Chinn-Ito index (or also known as KAOPEN) which measures a country's capital account openness level, Australia, Cambodia, Japan, New Zealand, the ROK, and Singapore adopt open capital accounts, while the rest still maintain some restrictions (see Figure 3).

Figure 3. 2018 Chinn-Ito Financial Openness Normalized Index



Notes: AUS is Australia; KHM is Cambodia; JPN is Japan; NZL is New Zealand; KOR is the Rep. of Korea; SGP is Singapore; PHL is Philippines; IDN is Indonesia; MYS is Malaysia; VNM is Vietnam CHN is China; LAO is Lao PDR; THA is Thailand; and MMR is Myanmar

Source: Author's compilation based on Ito and Chin, 2020, p. 9-10

2.3 Previous Research

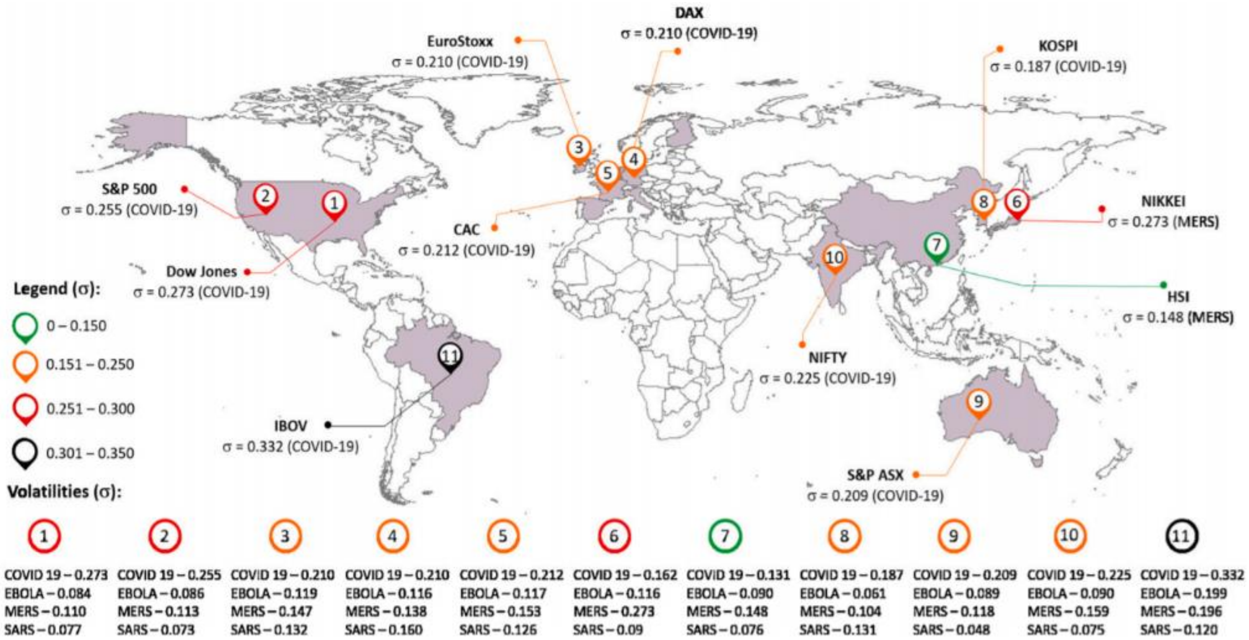
COVID-19 has had a tremendous impact, especially since the outbreak first occurred in China, which is a member of the RCEP. COVID-19 is not the first pandemic; several years earlier, the severe acute respiratory syndrome (SARS) infection quickly spread from China to other Asian countries. A study by Chen et al. (2018) investigated cointegration among Asian stock prices during the SARS epidemic in 2002-03. By utilizing a time-varying cointegration model, they found that the SARS plague had weakened the long-run relationship between the Chinese and other four stock prices in Hong Kong, Japan, Taiwan, and Singapore. Based on their findings, the authors advised shareholders and policymakers to pay more attention to the impact of catastrophic epidemic diseases on the extent of co-movements of stock prices in Asia. David et al. (2020) focused on eleven stock exchanges (Dow Jones, S&P 500, EuroStoxx, DAX, CAC, NIKKEI, HSI, KOSPI, S&P ASX, Nifty, and IBOV[3]) and compared market volatility during the four pandemic episodes of SARS, MERS,[4] EBOLA,[5] and COVID-19. They found that stock price indices experienced sustainable and rapid recovery during the SARS, MERS and EBOLA outbreaks. They also showed higher volatility for all stock market indices during COVID-19 than during other pandemic episodes, and the Brazilian stock price index (IBOV) suffered the highest volatility among all equity price indices examined (see Figure 4).

[3] The abbreviations are as follows: Dow Jones = Dow Jones Industrial Average Index (for the 30 U.S. blue chip companies); S&P 500 = Standard & Poor's 500 Index (for the 500 U.S. companies); EuroStoxx = Stock index of the Euro Area; DAX = Deutscher Aktienindex (representing a stock index of the 30 German blue chip companies); CAC = Cotation Assistée en Continu (representing a stock index of the 40 France blue chip companies); NIKKEI = Stock index of the 225 Japan blue chip companies; HSI = Hang Seng Index (in Hong Kong); KOSPI = Korea Composite Stock Price Index; S&P ASX = Australia stock index; Nifty = National Stock Exchange Fifty (in India); and IBOV = Índice Bovespa (in Brazil).

[4] MERS stands for Middle East Respiratory Syndrome. This infectious disease was first reported in Saudi Arabia in 2012 and infected 27 countries in total.

[5] The Ebola virus disease originated from sub-Saharan Africa and spread during 2014-2016.

Figure 4. Historical Volatility of Eleven Stock Exchange Indices Observed during the Four Outbreaks



Source: David, et.al., 2020, p.14

Aside from catastrophes triggered by virus diseases, the world stock market also underwent a great upheaval when the Asian financial crisis (AFC) took place in 1997-98 and the GFC occurred in 2008-09. Studies conducted by Jang and Sul (2002), Click and Plummer (2003), Royfaizal et al. (2009), Samadder and Bhunia (2018), Haque and Shamsub (2015), Karim and Karim (2012), and Yoshida (2010) examined the extent of stock price co-movement in times of crisis. By performing cointegration and causality tests, Jang and Sul found that before the AFC took place, there was almost no co-movement among stock prices in seven Asian countries, namely Hong Kong, Indonesia, Japan, the ROK, Taiwan, and Thailand. The stock market linkages among these economies became much stronger during and post AFC period. Jang and Sul also demonstrated that after the AFC, Granger causality between the Japanese stock price index and other Asian stock prices was found more pronounced, which implied that the six economies were to some extent dependent on the recovery of the Japanese economy and stock market. Meanwhile, vector autoregressive (VAR) estimation results conducted by Click and Plummer also exhibited that the ASEAN5 (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) stock prices were cointegrated in the post-AFC period. Royfaizal et al. also examined the interlinkages between stock markets in ASEAN5+3 countries (ASEAN5 plus China, Japan, and the ROK), and the United States before, during, and after the AFC. After performing Johansen cointegration and Granger-causality tests based on a vector error correction (VEC) model, they found that the ASEAN5+3 and U.S. stock prices were cointegrated in the mid- and post-AFC periods and that the impact of the U.S. stock price on ASEAN5+3 stock prices was significant only before and during the AFC period.

Shamadder and Bhunia also studied the relationship among several Asian stock markets in the aftermath of the GFC by conducting cointegration and causality tests. They revealed that the Asian stock prices were cointegrated with each other. Haque and Shamsub performed a single equation cointegration test and showed that stock prices in the G20 member countries were less cointegrated with the S&P 500 during the GFC than in the pre-GFC period. Their research findings revealed that as the GFC deepened, the S&P 500 and G20 stock price indices became less cointegrated. They concluded that the GFC caused structural damage to the long-run relationship that might have resulted from policy interventions by the G20 authorities in response to the crisis. By performing an Autoregressive Distributed Lag (ARDL) bound test, Karim and Karim signified that the ASEAN5 stock market indices were integrated in the pre-, mid-, and post-AFC periods as well as in the post-GFC period. Based on their empirical results, they advised that policy coordination among ASEAN5 would be indispensable in coping with market fluctuations as the markets were cointegrated especially during the crisis. Yoshida further studied the degree of cointegration and causality directions between equity prices in the U.S. and selected Asian markets in the AFC and GFC periods. He examined whether the effects of the GFC on 13 Asian economies were similar to those of the AFC. Yoshida found that there was a stark difference in stock price movements between the two crises in that volatility spillovers were more limited during the GFC than during the AFC. He conjectured the reason behind this was that Asia had learned from its past experience by adopting more effective policy measures, such as multilateral currency exchange arrangements under the Chiang Mai Initiative for helping Asian markets, and being better prepared for the latter crisis. He further explained that regional financial integration was strengthened after the financial turmoil of the GFC but not after the AFC.

Recent researchers have also conducted studies on the impact of COVID-19 on stock market indices. By utilizing a VEC method, Kotishwar (2020) found that COVID-19 had a significant negative impact on long-run relationships among stock price indices in six most affected countries, namely the United States, Spain, France, Italy, China and India. Based on his findings, the author also found that portfolio investors considered long-term strategies and benefitted from the weakening stock price indices in those six countries because they were able to have opportunities to buy stocks at low price. Meanwhile, Yiu and Tsang (2021) estimated dynamic panel data models and found that the global COVID-19 infection trend had greater impact on the daily returns of ASEAN5 stock markets than did the local COVID-19 case trend. They also claimed that COVID-19 had severer impact on ASEAN5 stock market returns and volatility than did the 2008-2009 GFC and the 2013 Taper Tantrum. The authors also underlined the important role of domestic monetary policy and exchange rate policy in reducing market volatility and mitigating the adverse impact of external shocks on stock markets in the region. Additionally, U.S. monetary policy measures – the zero-interest rate and quantitative easing – adopted in response to the COVID-19 crisis posed other challenges and created uncertainty as they led to a dramatic stock market surge on an unprecedented scale (Zhang, et al, 2020).

Given that not much previous research has been done to examine the impact of COVID-19 on stock market co-movements particularly in the prospective RCEP member countries, this paper contributes to the literature by filling the gap in the existing literature through a study of the specifics of the equity markets for RCEP member states. Aside from that, this paper also compares the impacts of the current pandemic and the 2008-2009 GFC and explores the effects of the non-RCEP (i.e., Hong Kong, Taiwan, the United States, and the Euro Area) stock price indices in both periods on movements in RCEP stock price indices. Therefore, the empirical findings of this paper are expected to highlight the importance of taking pre-emptive policy measures to be rolled out by policymakers in RCEP member countries to keep their capital markets robust during the epidemic and going forward.

Chapter III
Data and Research Methodology

This section discusses the data and methodology used for addressing the research questions and testing the hypotheses stated in the introductory chapter.

3.1 Data Observation

The data used in this research consist of closing daily stock price indices of RCEP member countries. Additionally, considering that one of the objectives of this paper is to compare the influence of the U.S. stock price index on RCEP countries' stock prices during the GFC and the current worldwide COVID-19 crisis, data series are collected spanning from January 2005 to March 2021. All indices expressed in local currency values are taken from the Bloomberg database. To obtain a homogeneous set (Jang and Sul, 2002), individual country holidays are omitted. Furthermore, before conducting time series analysis tests, all daily observations are transformed into a logarithmic form. As set out in Table 3, Brunei Darussalam and Myanmar are not included in the analysis because the former has yet to establish a stock exchange and the latter's market does not provide data. The Cambodia (CSX) and Lao (LSX) equity indices are also excluded from the analysis because these stock markets are not well developed yet and have only few listed companies.[6] Taking into account the differences in market closing times, adjustments are also made for the U.S. and European stock market indices. For the U.S. stock price index, Standard and Poor's 500 Index (S&P 500) is selected instead of Dow Jones Industrial Average. It is due to the fact that S&P 500 represents the 500 largest companies listed on the exchange and this index uses a float-adjusted market capitalization weighting. Meanwhile, for the Euro Area, the STOXX Europe 600 Index (EUROSTOXX) is used with a note that this index comprises large, medium and small capitalization enterprises among 17 European countries.

The analysis of data in this research is further divided into four sub-periods. First, the period before the GFC (pre-GFC period) spans from 15 September 2005 to 29 June 2007. Second, the GFC period covers data from 2 July 2007 to 31 March 2009. The underlying reason selecting this timeframe for the GFC is based on the 2009 Bank for International Settlements (BIS) Report written by Filardo et al. (2009) who considered the GFC having occurred from the Q3 of 2007 to the Q1 of 2009. Consequently, for the first and second samples, each has a total of 338 observations. The third sample refers to the pre-COVID-19 crisis period lasting from 10 August 2018 to 22 January 2020. The last period representing the time of the COVID-19 crisis includes data from 23 January 2020 to 30 July 2021. The rationale for selecting 23 January 2020 as the starting point of COVID-19 is based on the timing of the Wuhan lockdown in response to the pandemic (Yiu and Tsang, 2021, p. 7). Thus, for the third and fourth samples, each has a total of 262 observations.

[6] Up to the present, there are only 11 companies listed on the Lao Securities Exchange and 7 companies listed on the Cambodian stock exchange (for more details, see Appendix Table 1).

Table 3. List of RCEP and Non-RCEP Stock Market Indices Used in this Study

Country	Index Name	Abbreviation	Data Availability	Model Formed
RCEP Member Countries				
Australia	Australian Securities Exchange Index	ASX	Jan 2005 – July 2021	Included
Brunei Darussalam	n/a	n/a	n/a	Excluded
Cambodia	Cambodia Securities Exchange Index	CSX	Apr 2012 – July 2021	Excluded
China	Shanghai Composite Index	SHCOMP	Jan 2005 – July 2021	Included
Indonesia	Jakarta Composite Index	JCI	Jan 2005 – July 2021	Included
Japan	Japan's Nikkei 225 Stock Average Index	NIKKEI	Jan 2005 – July 2021	Included
Korea, Rep. of	Korea Stock Exchange Index	KOSPI	Jan 2005 – July 2021	Included
Lao PDR	Lao Securities Exchange Composite Index	LSX	Jan 2011 – July 2021	Excluded
Malaysia	Kuala Lumpur Composite Index	KLCI	Jan 2005 – July 2021	Included
Myanmar	Yangon Stock Exchange Index	YSX	n/a	Excluded
New Zealand	New Zealand's Exchange Index	NZX	Jan 2005 – July 2021	Included
Philippines	Philippine Stock Exchange Index	PSEI	Jan 2005 – July 2021	Included
Singapore	Straits Time Index	STI	Jan 2005 – July 2021	Included
Thailand	Stock Exchange Thailand Index	SETI	Jan 2005 – July 2021	Included
Vietnam	Vietnam Stock Index	VNI	Jan 2005 – July 2021	Included
Non-RCEP Economies				
Hong Kong	Hang Seng Index	HSI	Jan 2005 – July 2021	Included
Taiwan	Taiwan Capitalization Weighted Stock Index	TAIEX	Jan 2005 – July 2021	Included
United States	Standard and Poor's 500 Index	S&P 500	Jan 2005 – July 2021	Included
Euro Area	STOXX Europe 600 Index	EUROSTOXX	Jan 2005 – July 2021	Included

Source: Author's compilation using information obtained from Bloomberg

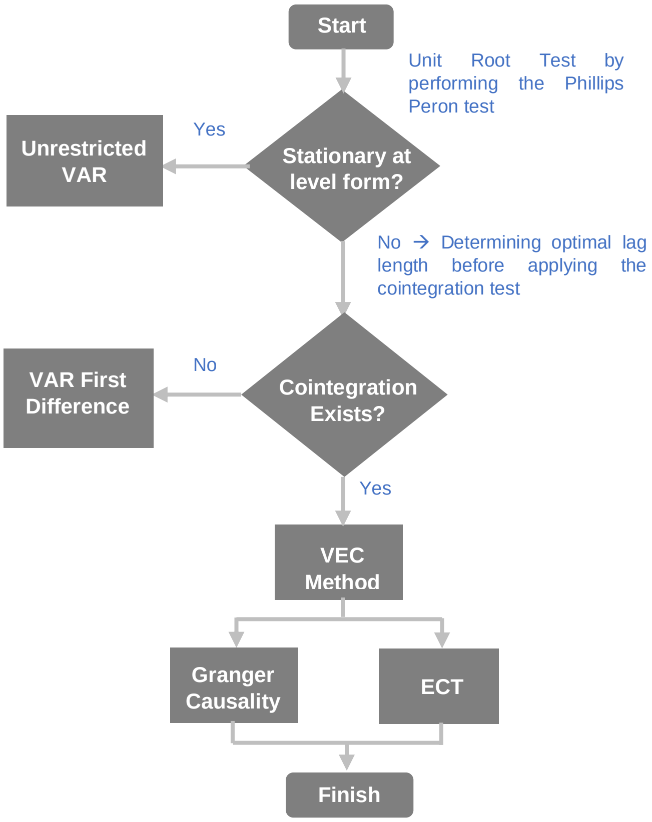
3.2 Research Methodology

This paper uses a multivariate time series approach, which is much more appropriate than a univariate approach, as it analyses relationships among several variables (Suharsono et al., 2017). A vector autoregressive (VAR) model is a widely used form of the multivariate model. Stationarity is one of the important prerequisites in a time series analysis method. If this condition is not met, it may cause spurious regression.[7] However, an unrestricted VAR model cannot be used if the variable under study is not stationary at the level. Therefore, when a linear combination of two or more series is not stationary at level yet cointegrated, a VEC model, which is a restricted version of the VAR model, is utilized. The assumption that must be fulfilled in a VEC analysis is that all variables are stationary in the same order. The advantage of using a VEC model is that all variables are considered endogenous and each variable is treated symmetrically (Enders, 2015, p.285). In addition, the benefit of using a VEC model is that this method is able to measure long-run and short-run relationships between the variables studied by imposing a cointegration restriction into the model specifications.

[7] Spurious regression is a situation in which regression results show significant regression coefficients and a high coefficient of determination but the independent and dependent variables in the time series model are completely non-intercorrelated.

In this study, Eviews-9 statistical package software is harnessed. To perform VEC estimation, the following steps -- stationarity tests, optimal lag length determination, and cointegration tests -- are carried out (shown in Figure 5). After confirming that a VEC model can be employed, the next procedure is performing Granger-causality tests to identify whether a unidirectional or bidirectional causality exists between variables observed. Beside causality tests, an important parameter in VEC estimation which is known as the error correction term (ECT) is also estimated. The size of ECT measures the adjustment speed at which, due to the presence of disequilibrium, a variable's growth adjusts to its long-run equilibrium level (Andrei and Andrei, 2015, p. 572-573). The coefficient of ECT is expected to be negatively significant, which indicates the existence of a long-run causal relationship.

Figure 5. Steps Carried out in Performing Research Methodology



Source: Author's interpretation

- **Stationarity Test**

Considering that the non-stationary regressors invalidate numerous standard empirical results, it is essential to check for stationarity in the first step in order to avoid spurious regression (Chang, and Nieh, 2001, p.383). To observe stationary data, the Augmented Dickey-Fuller (ADF) method is widely used. However, when the time series data are stationary with structural breaks, the conventional ADF test is biased towards the false unit root. Thus, to deal with structural change issue, this study employs ADF with breakpoint tests. Additionally, given that the Phillips-Perron (PP) unit root test has proven to be more reliable than the conventional ADF test (Royfaizal et al., 2009, p. 47), the PP test is also performed in this paper. The null hypothesis that "the variable observed has unit root" is rejected if the t-test is less than critical values or when p-value is smaller than the significance value α.[8] If the null is rejected, the time series variable observed is stationary.

[8] α which is used as a symbol of significance level is the probability of rejecting the null hypothesis when the null is true. In this study, α is set to either 1% (0.01) or 5% (0.05).

- **Determination of the Optimum Lag Length**

When the data are confirmed to be stationary in the same order at the first difference, the next step is to select the optimal lag of the VEC model. Determination of the lag length is crucial because it usually results in trade-offs. On the one hand, if the lag length is too short, it cannot explain the dynamics of the model as a whole. On the other hand, if the number of lags is large, it leads to a reduction in the forecasting performance of the fitted model (Enders, 2015, p. 69), as the degrees of freedom of the sample used are certainly decreased. In this study, a sequential modified Likelihood Ratio (LR) test and Akaike information criterion (AIC) are applied to determine optimal lag length.

- **Cointegration Test**

After verifying the optimal lag order, the subsequent step is to inspect whether dynamic relationships exist among variables. In this study, the Johansen test is used to test for the presence of cointegration that describes long-run relationships among variables. A test for the cointegrating vector rank will be conducted through the trace test (or λ_{trace}). If λ_{trace} exceeds the 5% critical value, the null hypothesis that there is no cointegrating vector is rejected and one or more cointegrating vectors exist (Enders, 2015, p. 391). Aside from performing the Johansen cointegration test, this study also employs the ARDL bound test. The advantages of using the ARDL bound test is that this approach is able to distinguish endogenous variables and exogenous variables in the model. The ARDL technique is also more robust and consistent in dealing with a smaller sample size (Karim & Karim, 2012, and Nkoro, & Uko, 2016). To determine whether there is a long-run relationship between the variables studied, the ARDL bound test uses an F-statistical approach. The null hypothesis is that there is no cointegration. If the F-statistic is less than the lower limit critical value, it signifies that there is insufficient evidence to reject the null. If the F-statistic is greater than the upper limit critical value, then the null is rejected and there exists cointegration among variables observed. However, if the F-statistic is within the range of the lower and upper critical values, the results are inconclusive.

- **Granger Causality Test**

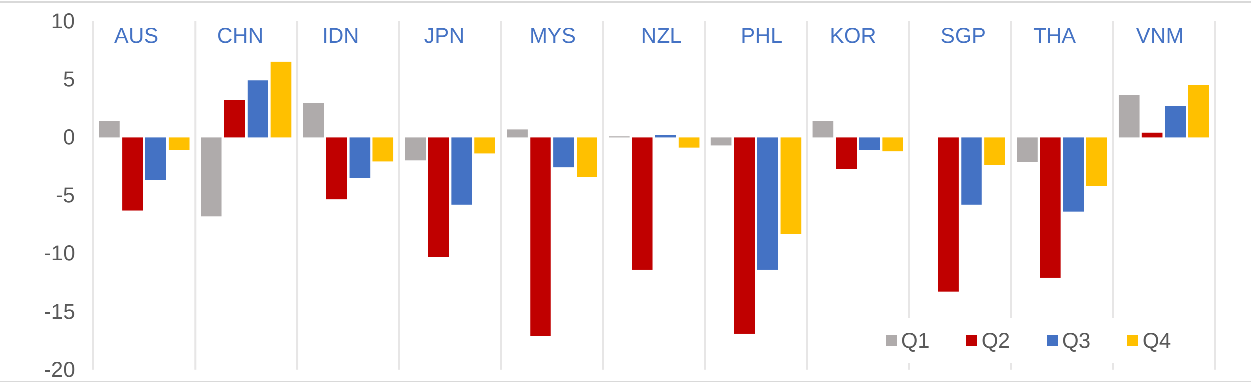
Before concluding the cointegration test, a causality test is conducted given that the results of the cointegration test are sensitive to the inclusion or exclusion of certain countries' stock price indices because different combinations of countries can yield different results (Allen and MacDonald, 1995 in Majid et al., 2009). Furthermore, according to Chang and Nieh (2001), Granger (1988) emphasizes that if there exists a cointegration vector, there must be a causality among variables at least in one direction. The Granger-causality test conducted in this study, which is based on a Chi-squared test, is useful to investigate whether lagged information on Y is able to forecast X in the presence of lagged X (Samadder and Bhunia, 2018). If the null hypothesis that “there is no Granger causality” is rejected, it indicates that there is a causal relationship between variables studied.

Chapter IV
Empirical Results and Analysis

4.1 RCEP Stock Market Indices in Times of the Pandemic

COVID-19 which has severely affected the global economy, including RCEP member countries, has undeniably slumped various economic sectors in these countries. This circumstance is indicated by the economic disruption in which GDP growth experienced a sharp contraction, especially in the second quarter of 2020. In the third and fourth quarters, the majority of member countries were still unable to position their economies into a positive trend, but the economic downturn was not as severe as in the second quarter. According to Figure 6, China and Vietnam are the only RCEP member nations that enjoyed positive economic growth despite holding uncertainties. In particular, China as the source country of the COVID-19 pandemic showed quite strong economic performance, despite the fact that in the first quarter of 2020, the country recorded negative economic growth.

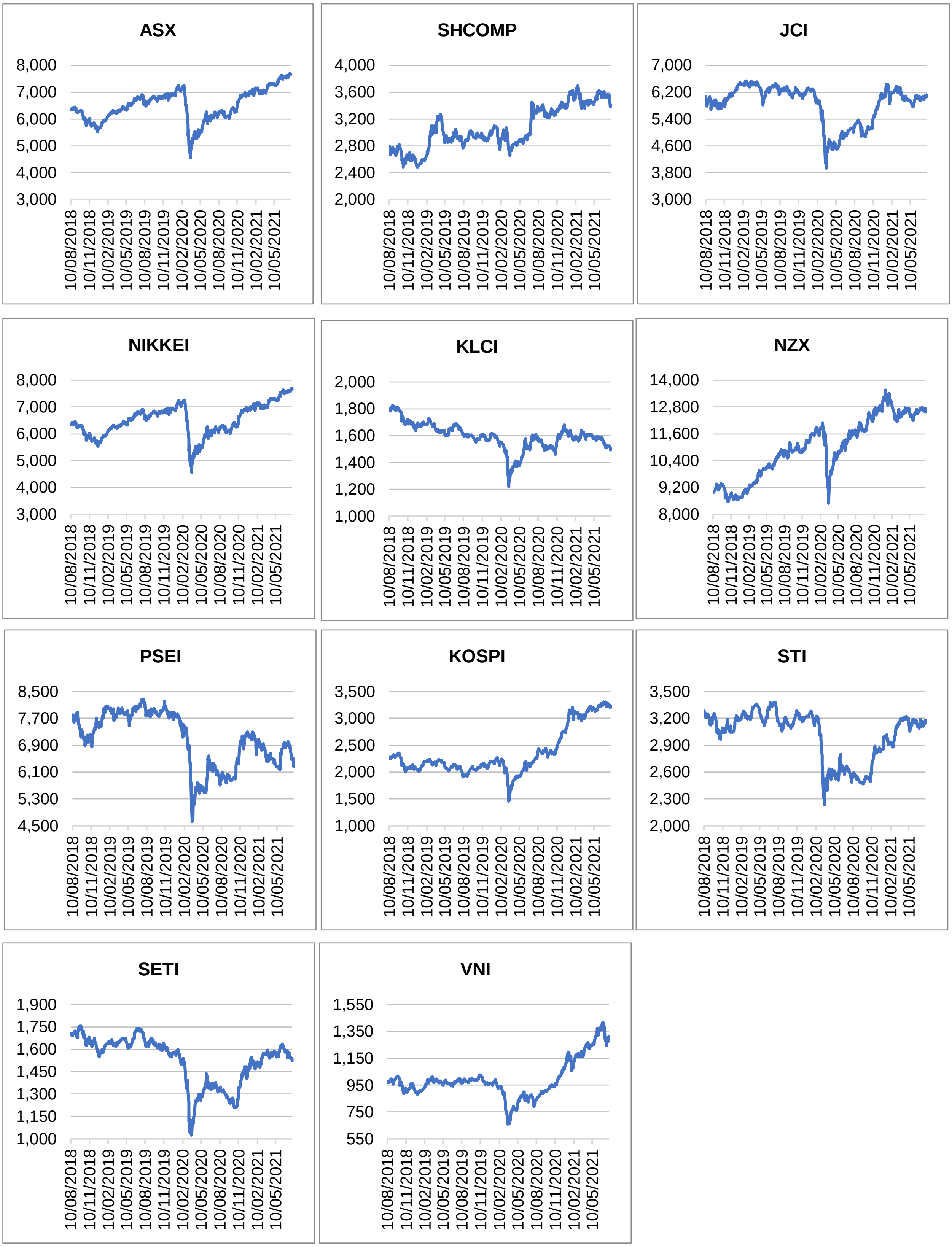
Figure 6. Quarterly GDP Growth, throughout 2020 (% year-on-year)



Notes: AUS is Australia; CHN is China; IDN is Indonesia; JPN is Japan; MYS is Malaysia; NZL is New Zealand; PHL is Philippines; KOR is the Rep. of Korea; SGP is Singapore; THA is Thailand; and VNM is Vietnam
Source: Author's compilation based on Trading Economics data

After successfully paralyzing the economy, COVID-19 hit the RCEP stock markets. As shown in Figure 7 below, the majority of the stock price indices of member countries show a similar pattern where there was a sharp plunge when the outbreak was out of control at the end of the first quarter of 2020. Additionally, stock price indices in the RCEP region were also more volatile during the pandemic. This evidence is supported by a higher standard deviation (see Table 4) compared to the pre-crisis period. This condition was undoubtedly triggered by the high number of confirmed positive cases, which likely reduced investor confidence. Nonetheless, after the first quarter of 2020, it can be seen from Figure 7 that the majority of stock market indices in RCEP member states showed strengthening and even some stock price indices (such as ASX, SHCOMP, NIKKEI, NZX, KOSPI, and VNI) exceeded pre-pandemic levels. This occurrence is certainly supported by the return of investor confidence and the active role of the state in rolling out accommodative policies as well as ensuring that orderly market conditions were maintained.

Figure 7. Stock Price Index Movements of RCEP Member Countries



Source: Author's compilation using data from Bloomberg database

A detailed comparison of stock market performance before and during the pandemic (see Table 4) shows that the average performance of the stock price indices of RCEP member countries varied. ASEAN countries had lower average stock price indices during the epidemic. However, this observation does not apply to VNI whose average stock price index performance passed pre-pandemic levels. This condition is consistent with Vietnam's relatively strong economic performance in the midst of the COVID-19 crisis which is arguably the best compared to other ASEAN member countries. Furthermore, judging from the movement and descriptive statistics of the RCEP stock price indices during the pandemic, only the SHCOMP was relatively robust compared to other stock indices in the region. This is in line with China's economic conditions which gradually improved in the second quarter of 2020 after successfully curbing COVID-19 infection cases in the country. Another reason is that China has limited foreign participation in the stock market, which has been less vulnerable to external shocks.

Table 4. Descriptive Statistics of RCEP Stock Market Indices

Index	262 Days before COVID-19				262 Days during COVID-19			
	Mean	Maximum	Minimum	Standard Deviation	Mean	Maximum	Minimum	Standard Deviation
ASX	6,433.73	7,249.00	5,533.30	402.88	6.614.57	7,704.00	4,564.10	726.34
SHCOMP	2,852.54	3,270.80	2,483.09	181.48	3,277.49	3,696.17	2,660.17	275.27
JCI	6,202.30	6,540.95	5,683.50	208.07	5,543.10	6,435.21	3,937.63	611.98
NIKKEI	21,926.49	24,120.04	19,561.96	1,037.38	25,083.24	30,236.09	16,552.83	3,613.01
KOSPI	2,121.66	2,355.43	1,909.71	89.10	2,589.07	3,305.21	1,457.64	518.28
KLCI	1,655.67	1,826.90	1,551.87	64.01	1,536.83	1,681.41	1,219.72	84.27
NZX	10,023.29	11,889.68	8,568.23	934.92	11,970.14	13,558.19	8,498.70	937.52
PSEI	7,757.92	8,272.18	6,843.83	312.14	6,456.46	7,616.35	4,632.42	599.31
STI	3,195.24	3,381.26	2,966.45	90.29	2,844.27	3,234.56	2,233.48	270.02
SETI	1,646.06	1,756.41	1,548.37	49.17	1,418.68	1,636.56	1,024.46	143.54
VNI	966,70	1,024.91	880.90	31.45	1,026.10	1,420.00	659,21	199.17

Source: Author's calculation based on Bloomberg database

4.2 Dynamic Stock Market Linkages among RCEP Member States

After observing the descriptive statistics of individual RCEP stock market indices, the subsequent analysis investigates whether the COVID-19 outbreak weakened the co-movements among the equity markets of RCEP member jurisdictions. In addition, the analysis compares the RCEP stock index co-movements during the COVID-19 and the GFC period. The time series analysis method explained in the methodology chapter is harnessed.

The unit root test results by performing the Augmented Dickey-Fuller with breakpoint tests and Phillips-Perron tests (as shown from Appendix Table 2 to Appendix Table 5) demonstrate that all observed variables in the logarithmic form are non-stationary in the level because the unit root test failed to reject the null hypothesis of non-stationarity at any significance level. In the form of first differences, the test rejected the null hypothesis, indicating that all stock market indices are stationary. Thus, all the selected stock price indices are stationary in first differences, which implies that they are integrated of order 1, i.e., I(1). Recognizing that all variables are stationary at the first difference, the next step is to ascertain whether a cointegration or long-run relationship exists among the non-stationary variables. However, before proceeding with the Johansen cointegration test, it is also necessary to determine the optimal lag length. By applying the lag order selection criteria, it is found that in the pre- and during the COVID-19 period, the optimal lag length obtained is seven and six, respectively.

Table 5. Trace Test Results in Times of COVID-19 at the 5% Significance Level (*)

Vectors	r = 0	r ≤ 1	r ≤ 2	r ≤ 3	r ≤ 4
262 Days before COVID-19, with the Optimum Lag = 7					
Trace Statistic	374.8276	290.8381	234.4343	185.3971	144.0067
0.05 Critical Value	322.0692	273.1889	228.2979	187.4701	150.5585
P-value	0.0001*	0.0069*	0.0250*	0.0634	0.1103
262 Days during COVID-19, with the Optimum Lag = 6					
Trace Statistic	336.2036	269.8524	223.8691	179.8749	140.4368
0.05 Critical Value	322.0692	273.1889	228.2979	187.4701	150.5585
P-value	0.0122*	0.0687	0.0787	0.1138	0.1613

Source: Author's calculation using Eviews-9 statistical software

Table 5 summarizes the results of the Johansen cointegration test, by performing the trace test, for each sub-sample period observed in this study. For the pre-COVID-19 crisis period, as shown in Table 5, the trace test rejects the null hypothesis of no cointegrating vector. The trace test indicates the presence of three significant cointegrating vectors at the 5% significance level before the crisis period. Meanwhile, during turmoil times due to the novel coronavirus, the trace test demonstrates the presence of only one significant cointegrating vector. Compared to the pre-COVID period, the number of cointegrating vectors decreases from three to one. The same results are also shown by the ARDL bound test where before the COVID-19 period there are three cointegrating relationships while during the pandemic period, only one cointegration is found (see Table 6). As discussed in the methodology chapter, the ARDL bound test has the advantage of identifying endogenous variables which lead to long-run relationships. The stock price indices of China (LSHCOMP), Malaysia (LKLCI), and Singapore (LSTI) are found to be endogenous in the cointegration equation prior to the pandemic, while the LKLCI is the only endogenous stock price found in the equation at the time of COVID-19.

Table 6. ARDL Bound Test Results at the 5% Significance Level (*)

Dependent Variables	F-Statistics (F-stat)	Result	Note
262 Days before COVID-19: 3 Long-run Relationships Exist			
LASX	3.3399	I0 < F-stat < I1	Inconclusive
LSHCOMP	3.6480*	F-stat > I1	Cointegration
LJCI	1.5482	F-stat < I0	No Cointegration
LNIKKEI	1.6918	F-stat < I0	No Cointegration
LKOSPI	2.5447	I0 < F-stat < I1	Inconclusive
LKLCI	3.4706*	F-stat > I1	Cointegration
LNZX	1.9125	F-stat < I0	No Cointegration
LPSEI	2.0527	I0 < F-stat < I1	Inconclusive
LSTI	4.0327*	F-stat > I1	Cointegration
LSETI	2.3422	I0 < F-stat < I1	Inconclusive
LVNI	1.0211	F-stat < I0	No Cointegration
262 Days during COVID-19: 1 Long-run Relationship Exists			
LASX	2.2755	I0 < F-stat < I1	Inconclusive
LSHCOMP	1.6890	F-stat < I0	No Cointegration
LJCI	2.8637	I0 < F-stat < I1	Inconclusive
LNIKKEI	2.0449	F-stat < I0	No Cointegration
LKOSPI	3.2029	I0 < F-stat < I1	Inconclusive
LKLCI	3.6838*	F-stat > I1	Cointegration
LNZX	3.0169	I0 < F-stat < I1	Inconclusive
LPSEI	2.2389	F-stat < I0	No Cointegration
LSTI	1.6650	F-stat < I0	No Cointegration
LSETI	1.9882	F-stat < I0	No Cointegration
LVNI	1.6851	F-stat < I0	No Cointegration

Note: 5% critical value bound (the lower bound (I0) is 2.33, while the upper bound (I1) is 3.46)

Source: Author's calculation using Eviews-9 statistical software

One of the reasons for a decline in the degree of cointegration relationships is that during the crisis, domestic factors tend to determine the movement of stock price indices (Royfaizal et al., 2009). This is due to the efforts taken by all stakeholders, particularly policy makers, in their respective countries who tried to minimize economic turbulence in their own ways so that the long-run linkages among RCEP stock markets are reduced. Thus, country-specific factors tend to be more important than external factors in affecting long-run relationships. Given that each RCEP country has its own specific risks such as currency risk, it may also encourage portfolio investors to be more cautious. Investors may also minimize their portfolio risks in certain RCEP member countries that experience considerable economic volatility which may lead to a decline in the degree of long-run linkages in the region. Additionally, noting that the ARDL bound test results show the LKLCI was an endogenous variable either in the period before or during the pandemic, the political instability factor in Malaysia was also a concern for investors and affected the Malaysian stock market performance.

Table 7. Trace Test Results in Times of the GFC at the 5% Significance Level (*)

Vectors	r = 0	r ≤ 1	r ≤ 2	r ≤ 3	r ≤ 4
338 Days before the GFC, with the Optimum Lag = 5					
Trace Statistic	351.2722	274.7701	210.0059	157.7085	117.5757
0.05 Critical Value	322.0692	273.1889	228.2979	187.4701	150.5585
P-value	0.0020*	0.0428*	0.2530	0.5665	0.7418
338 Days during the GFC, with the Optimum Lag = 2					
Trace Statistic	329.1912	259.1222	197.3293	158.3513	125.2027
0.05 Critical Value	322.0692	273.1889	228.2979	187.4701	150.5585
P-value	0.0254*	0.1681	0.5217	0.5498	0.5300

Source: Author's calculation using Eviews-9 statistical software

Similar to the COVID-19 crisis, the GFC also eroded the long-run relationship, as only one co-movement was found among the RCEP stock indices at the time of the GFC (see Table 7). This finding aligns with the study carried out by Shamadder and Bhunia (2018) who considered the GFC as toxic to pre-existing cointegrating relationships. Previous research as reported in the literature review showed that, only when the AFC occurred, the long-run relationship among stock market indices became stronger compared to the pre-AFC period. It was inevitable that during the AFC, a decrease in one stock market index was followed by the others, thereby strengthening the cointegrating relationship. A decrease in the number of cointegration relationships at the times of both the GFC and COVID-19 suggests that RCEP member states, particularly those affected by the AFC, learned from the past experience that the authorities should take appropriate policy measures and/or even intervene in the equity market so that investor confidence would be maintained and the stock index would not fall sharply in times of economic distress. Additionally, even though the degree of linkage has decreased, there is still one significant cointegration vector during the COVID-19 and GFC. This finding also implies the importance of close cooperation among RCEP member countries to minimize long-run risks in their stock markets.

After examining long-run relationships, the subsequent analysis identifies short-run dynamic interactions among the RCEP stock market indices. Granger causality tests based on a VEC model are conducted. The Granger-causality relationships for the pre-COVID-19 crisis period are abstracted from Appendix Table 6 and summarized in Figure 8.1. Before the COVID-19 period there are three sets of short-run causality relationships as shown in Figure 8.1. The first set is channelled from the Indonesian stock price index (DLJCI) to the Singaporean stock price index (DLSTI). For the second set, there is unidirectional relationship running from the Thailand stock price index (DLSETI) to the Australian stock price index (DLASX), to the New Zealand stock price index (DLNZX) and indirectly to the Malaysia stock price index (DLKLCI). Changes in the DLNZX then has a short-run impact on the Philippines stock price index (DLPSEI) and the temporal risk ultimately spreads to the Japanese stock price index (DLNIKKEI). In terms of the last set of short-run causality relationships during this time period, even though the origin point is the same as the second group, the last set is much more complicated compared to the previous ones. The channel in this set ends with the Singaporean stock price index (DLSTI) and the Chinese stock price index (DLSHCOMP) is also involved. It may explain why the latter channel is complex. In this time frame, China inevitably faced a trade war with the United States which in turn had disrupted its stock market performance and directly affected the Korean stock price index (DLKOSPI) and the DLSTI indirectly through the DLKOSPI.

A different picture can be seen when COVID-19 spread to the prospective RCEP member countries. During the COVID-19 era, as shown in Figure 8.2 which is abstracted from Appendix Table 7, the Granger-causality test shows that although there is only one channel, unidirectional linkages increase considerably and there are two short-run bidirectional causalities found, such as those between the DLNIKKEI and the DLSETI; and between the DLNZX and the DLSETI (in the pre-COVID-19, only one bidirectional causality was found which was between the DLNZX and the DLPSEI). Given the magnitude of the short-run relationship among the stock markets of RCEP countries, this condition needs to be a concern for policy makers in each prospective RCEP member country. This is because the risk easily spreads among countries that have strong short-run linkages with each other. Apart from that, another interesting empirical result for further observation in times of COVID-19 crisis is that the Vietnamese stock price index (DLVNI) does not even have a short-run relationship with any other RCEP stock price index. This is an indication that Vietnam is trying hard to maintain its domestic economic indicators so that the stock market's performance in the short run is not affected by external shocks caused by the pandemic. This is in line with the previous discussion in Chapter 4.1, where Vietnam is the only prospective RCEP member country that enjoys positive economic growth amid the COVID-19 outbreak. Additionally, from the perspective of portfolio investors, this finding suggests that, by holding Vietnamese stocks, they can still reduce potential short-run risks that may occur during the pandemic.

A similar phenomenon is also observed during the GFC. The short-run relationship among the RCEP stock price indices was more complex when the GFC hit. When analysed more deeply, short-run causality is more visible in the GFC period than in the COVID-19 period. Additionally, Figure 8.4, obtained from Appendix Table 9, exhibits that the Thai stock price index (DLSETI) was the most endogenous in the GFC period as it was Granger-caused by almost all other RCEP stock prices. Domestic political turmoil that occurred in the country at the same time as the GFC could be one of the triggers. Meanwhile, the Australian stock price index (DLASX) and the Japanese stock price index (DLNIKKEI) were the most exogenous variables. These empirical results signify that during the GFC, the DLASX and the DLNIKKEI had a considerable influence on the short-run movements of stock prices in countries that are currently members of the RCEP trade deal. The results obtained are also in line with previous research conducted by Jang and Sul (2002) who stressed that the stock market movements of several Asian countries to some extent relied on the recovery of the Japanese economy and stock market.

Figure 8. Short-run Causality Relationships among RCEP Stock Price Indices

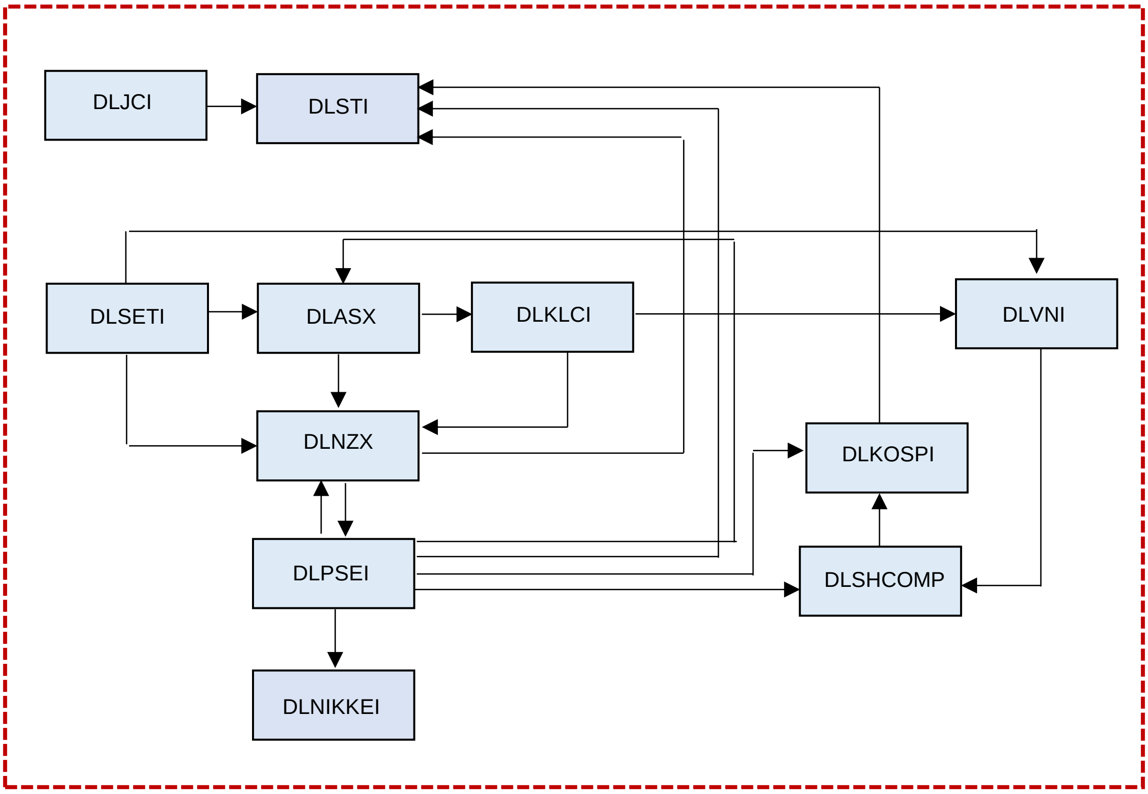


Figure 8.1. 262 Days before COVID-19

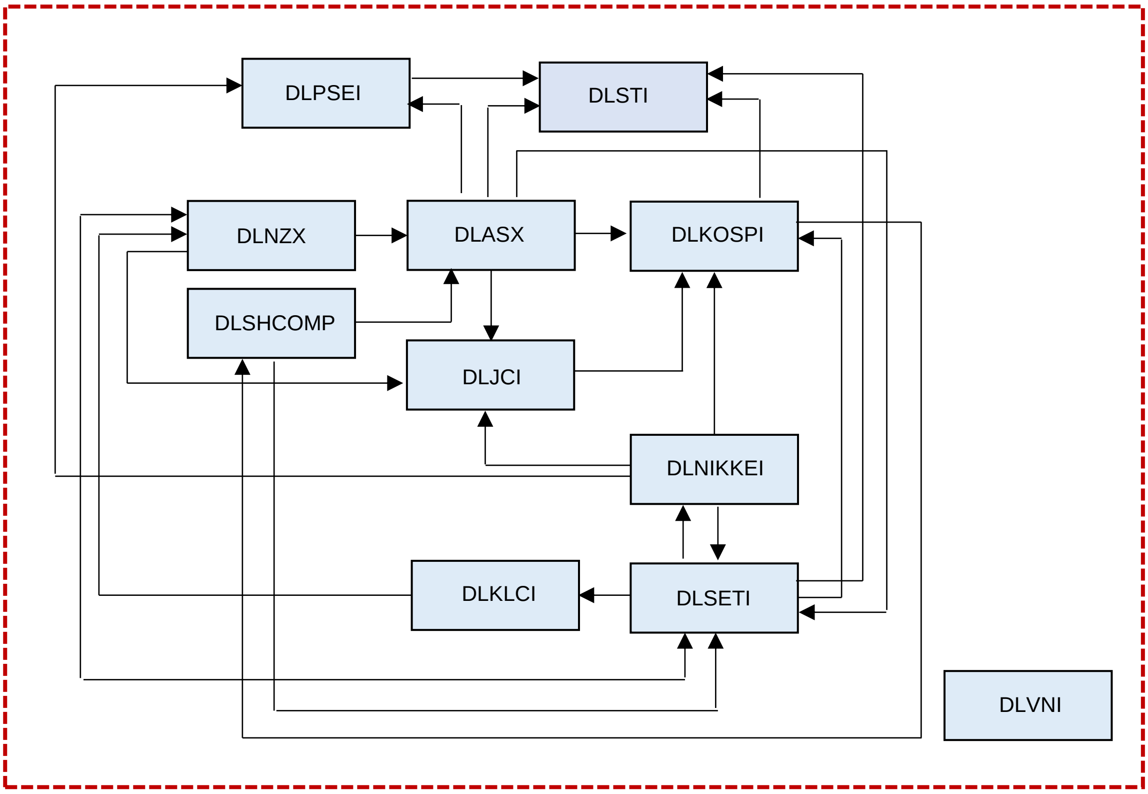


Figure 8.2. 262 Days during COVID-19

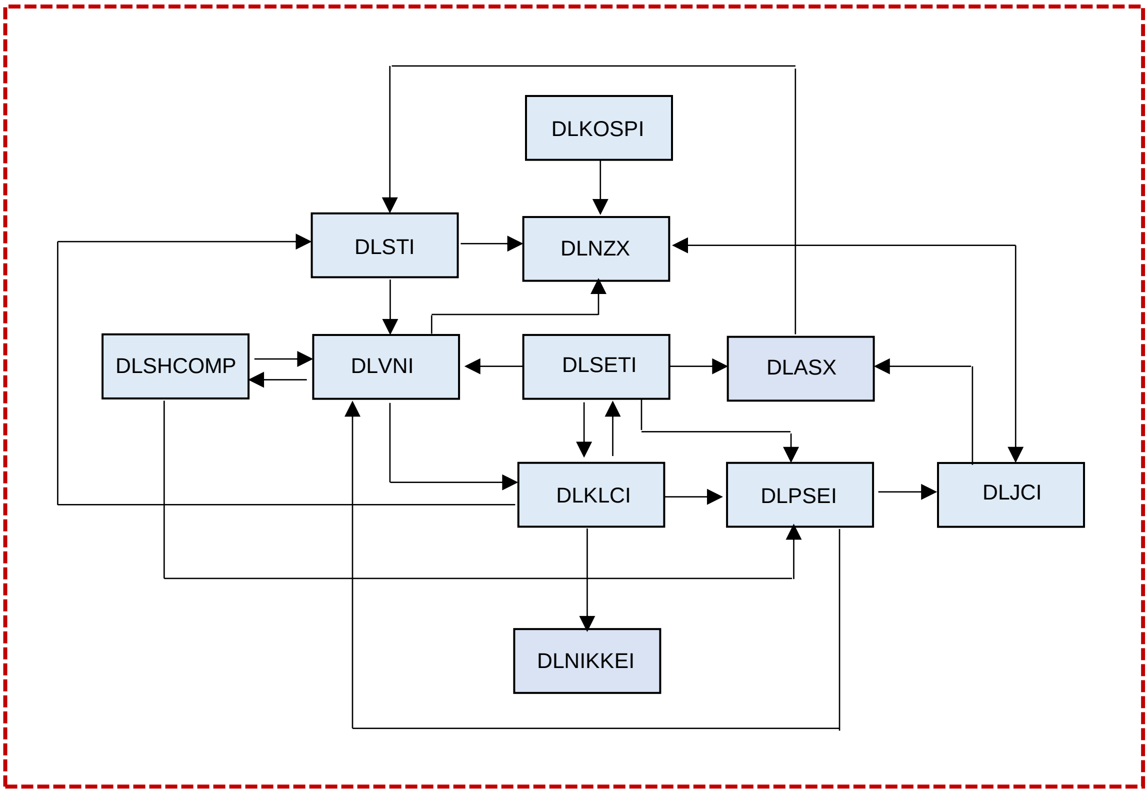


Figure 8.3. 338 Days before the GFC

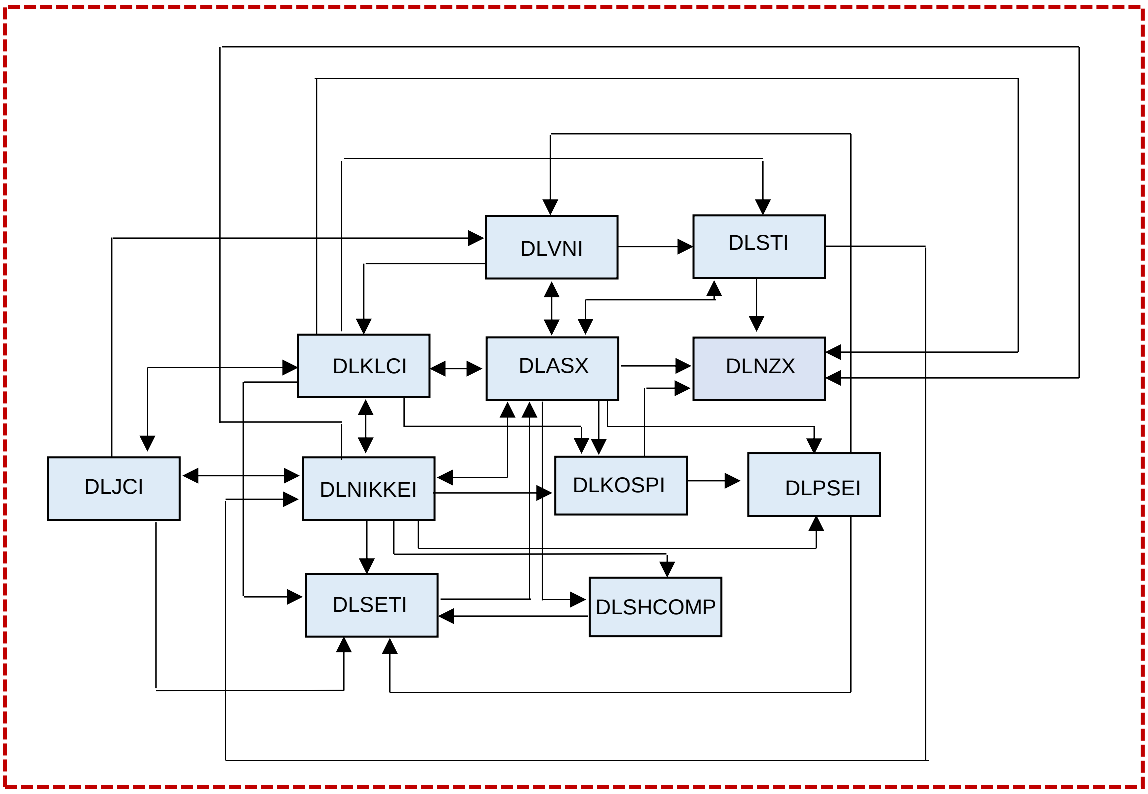


Figure 8.4. 338 Days during the GFC

Source: Author's compilation using regression results based on Granger-causality tests

4.3 Influence of Non-RCEP Stock Markets on RCEP Stock Price Movements

Research related to the effects of the Hong Kong, Taiwan, U.S., and Euro Area stock price indices on the long- and short-run movements of the stock price indices of prospective RCEP member countries has been carried out for a long time. The results of empirical testing conducted in this paper also confirm that in the pre-COVID-19 period, the inclusion of the stock price indices of Hong Kong (LHSI), Taiwan (TAIEX), the United States (LS&P500), and the Euro Area (LEUROSTOXX) in the model increases the degree of linkages among RCEP stock price indices. By adding either the LHSI, the LTAIEX, or the LEUROSTOXX in the model, as reported in Table 8, the trace test results demonstrate three significant cointegrating vectors at 5% significant level (without the LHSI, the LTAIEX, or the LEUROSTOXX in the model, three cointegrating vectors are also detected). Meanwhile, as also portrayed in Table 7, the LS&P500 does have a more significant impact in the sense that its inclusion makes long-run interdependence among RCEP stock price indices much stronger. In this time period, by including the LS&P500 into the model, four long-run equilibrium relationships among the RCEP stock price indices are identified. The possible reason is due to the trade war between the United States and China that has lasted since 2018. Thus, these empirical results can indicate that the long-run linkage between the RCEP and U.S. stock markets has occurred even since the pre-crisis period.

Table 8. Trace Test Results with the Non-RCEP Inclusion at the 5% Significance Level

Trace Test	RCEP Only in the Model	The Inclusion of Non-RCEP Stock Price Index in the Model			
		LHSI	LTAIEX	LS&P500	LEUROSTOXX
262 Days before COVID-19					
Cointegrating vectors	3	3	3	4	3
262 Days during COVID-19					
Cointegrating vectors	1	2	1	3	2
338 Days before the GFC					
Cointegrating vectors	2	2	2	2	2
338 Days during the GFC					
Cointegrating vectors	1	1	1	1	1

Note: Table 8 is abstracted from Appendix Table 10, Appendix Table 11, Appendix Table 12, and Appendix Table 13
Source: Author's calculation using Eviews-9 statistical software

In times of pandemic, by incorporating non-RCEP stock price indices in the model, the number of cointegrating vectors is reduced compared to the pre-crisis period. When the LHSI and the LEUROSTOXX are included, the number of cointegrating vectors is decreased from three in the pre-COVID-19 to two during the COVID-19 crisis. In terms of adding the LTAIEX to the model, the degree of linkages declines from three to one at the 5% significance level. With the LS&P500 included in the model, the number of cointegrating vectors is also reduced from four in the pre-COVID-19 to three during the COVID-19 crisis. In this time frame, the results exhibit that the U.S. stock price index is still an important element influencing the long-run movement of RCEP stock price indices.

Similar results were obtained when investigating long-run relationships during the GFC. As can be seen in Table 7, the number of cointegrating vectors also declined when the GFC occurred. Prior to the GFC, there are two cointegrating vectors, whereas during the GFC, there is one cointegrating vector found at the 5% significance level. Previous studies have also found a decrease in the number of cointegration factors attenuating long-run relationships between the variables studied (Royfaizal et al., 2009, and Majid et al., 2009). Thus, both the pandemic and GFC decreased the degree of long-run linkages among the RCEP stock price indices as indicated by a decline in the number of cointegrating vectors. Another point to underline is that the inclusion of non-RCEP stock price indices in the model does not have a significant effect on the long-run relationship among the RCEP stock prices at the time of the GFC. The trace test results show the same outcomes with or without including non-RCEP stock price indices in the model. However, during the pandemic, the addition of non-RCEP stock price indices with the exception of the LTAIEX significantly affects the number of long-run interdependence. In addition, compared to other non-RCEP stock price indices, U.S. stock price index (LS&P500) is more influential on the movement of RCEP stock price indices during the pandemic. The reason behind this finding may that the confirmed COVID-19 cases in the United States experienced a significant spike and eventually had effects on its own and RCEP stock markets.

In terms of temporal causality effects as summarized in Table 9, the movements in the U.S. (DLS&P500) and Euro Area (DLEUROSTOXX) stock price indices have a significant impact on the stock markets of RCEP member countries during the COVID-19 epidemic. This condition may be due to the significant number of confirmed COVID-19 cases in the United States and European countries after the first case was discovered in China. The stock markets inevitably experienced a second round-effect after the economic slump caused by the novel coronavirus. In this period, as reported in Table 9, the short-run movement of RCEP stock price indices is affected by the movement of the DLSP500 and the DLEUROSTOXX. Nevertheless, in this time span, RCEP stock price indices are not very strongly related to stock prices in Hong Kong (DLHSI) or Taiwan (DLTAIEX). The short-run relationship between the DLHSI/DLTAIEX and RCEP stock price indices is quite visible when the GFC hit. If we look further over the four sample periods, the U.S. stock price (DLSP500) is found to be the only variable that has a significant temporal impact on the movement of RCEP stock prices. In the pre-pandemic period, as discussed earlier, the trade war between the United States and China has undoubtedly caused turmoil in stock markets, including RCEP markets. Furthermore, this evidence also implies that the U.S. stock price (LS&P500) is a volatility transmitter as it significantly affected the movement of RCEP stock price indices both in the short and long run before and during the epidemic era. Since no one knows when the pandemic will end, uncertainty remains. Therefore, this circumstance has important implications for policy makers in the RCEP region who need to pay attention to U.S. policies before rolling out policy measures in the face of adversary shocks.

Table 9. Temporal Causality Effects between Non-RCEP and RCEP Stock Price Indices

Non-RCEP VS RCEP Stock Price Indices		262 Days before COVID-19	262 Days during COVID-19	338 Days before GFC	262 Days during GFC
Hong Kong (DLHSI)	DLASX	X	X	X	<O>
	DLSHCOMP	X	X	O>	X
	DLJCI	X	X	X	X
	DLNIKKEI	X	X	X	<O>
	DLKLCI	X	X	<O	<O
	DLNZX	X	X	X	O>
	DLPSEI	<O	X	X	O>
	DLKOSPI	X	X	X	X
	DLSTI	<O	O>	X	X
	DLSETI	X	<O	X	X
	DLVNI	X	X	X	X
Taiwan (DLTAIEX)	DLASX	X	O>	O>	<O
	DLSHCOMP	<O	X	X	X
	DLJCI	X	X	X	X
	DLNIKKEI	X	X	X	O>
	DLKLCI	X	<O	X	<O>
	DLNZX	X	X	X	<O
	DLPSEI	X	X	X	<O>
	DLKOSPI	X	X	X	X
	DLSTI	X	O>	O>	X
	DLSETI	X	<O	X	<O
	DLVNI	X	X	X	O>
United States (DLS&P500)	DLASX	X	<O	X	<O>
	DLSHCOMP	X	X	<O	X
	DLJCI	X	O>	X	X
	DLNIKKEI	O>	X	X	O>
	DLKLCI	<O	<O>	X	<O
	DLNZX	O>	X	O>	X
	DLPSEI	<O	X	X	O>
	DLKOSPI	O>	O>	X	<O
	DLSTI	<O>	O>	X	X
	DLSETI	X	<O>	X	X
	DLVNI	X	X	X	X
Euro Area (DLEURO-STOXX)	DLASX	X	<O	X	<O
	DLSHCOMP	X	X	<O	X
	DLJCI	X	<O	X	X
	DLNIKKEI	X	<O>	X	X
	DLKLCI	X	X	X	X
	DLNZX	X	<O	X	X
	DLPSEI	X	X	X	X
	DLKOSPI	X	<O	X	X
	DLSTI	<O	<O	<O	X
	DLSETI	X	<O>	X	X
	DLVNI	X	X	X	X

Note: Table 9 is abstracted from Appendix Table 14, Appendix Table 15, Appendix Table 16, and Appendix Table 17. <O indicates unidirectional causality running from non-RCEP to RCEP; O> indicates unidirectional causality running from RCEP to non-RCEP; <O> indicates bidirectional causality; and X indicates no causality

Source: Author's calculation using Eviews-9 statistical software

After acknowledging that the movements of the U.S. and Euro Area stock price indices had a considerable influence on stock prices in RCEP member countries in the pandemic era, the subsequent analysis investigates the error correction term (ECT) mechanism to capture the speed of adjustment from short-run dynamics among the stock prices toward long-run relationships. As portrayed in Table 10, the Malaysian stock price index (DLKLCI) is the only stock price index which showed statistically negative ECTs by either including or excluding the U.S. (S&P500) and Euro Area (Eurostoxx) stock price indices in the model. In other words, in the case of short-run disequilibrium, the DLKLCI adjusts by 8.10% in one day toward equilibrium, indicating that it takes about 12 days[9] to completely eliminate disequilibrium. By adding the U.S. stock price (S&P500) to the model, the required time for the Malaysian stock price index (DLKLCI) adjustment is a bit faster (see ECT_3 in the "with S&P 500" column), correcting by 13.16% in a day or 8 days to restore disequilibrium. However, when the Eurostoxx is included (see ECT_2 in the "with Eurostoxx" column), the time needed for adjustment from short-run to long-run dynamics is around 7 days.

Table 10. Error Correction Term (ECT) Coefficients in 262 Days during COVID-19

Indices (Log Transform)	RCEP Only	With S&P 500			With Eurostoxx	
	ECT	ECT_1	ECT_2	ECT_3	ECT_1	ECT_2
RCEP Stock Price Indices						
DLASX	-0.0990**	-0.0892*	0.0120	-0.1647**	-0.0504	-0.0731
DLSHCOMP	0.0288	-0.0115	0.1163**	0.0745	0.0659*	0.1211**
DLJCI	-0.0746*	-0.0760*	-0.0516	-0.0971	-0.0444	-0.0694
DLNIKKEI	0.0244	-0.0117	0.0779	0.0327	0.0235	0.0362
DLKOSPI	0.0136	-0.0181	-0.0342	-0.0007	0.0171	0.0327
DLKLCI	-0.0807**	-0.0918**	-0.0945**	-0.1316**	-0.0823**	-0.1393**
DLNZX	0.0232	0.0354	-0.0267	0.0100	0.0442	0.0837
DLPSEI	-0.1057**	-0.1881**	-0.0575	-0.1382*	-0.0904*	-0.1515*
DLSTI	-0.0360	-0.0096	-0.0101	-0.0864	0.0097	0.0286
DLSETI	-0.0639*	-0.0370	-0.0506	-0.1281*	-0.0329	-0.0437
DLVNI	-0.0334	0.0110	0.1250*	-0.0523	0.0216	0.0480
Non-RCEP Stock Price Indices						
DLS&P500		-0.0142	0.0888*	0.0424		
DLEUROSTOXX					0.0125	0.0207

Note: Asterisk (**) and (*) indicate significance at the 1% and 5% levels respectively.

Source: Author's calculation using Eviews-9 statistical software

[9] This number is derived by computing (1 / 0.0807 = 12.39), as previously described by Maher, et al. (2017), p. 5

In addition to the DLKLCI, the Philippines stock price index (DLPSEI), the Indonesian stock price index (DLJCI), and the Thai stock price index (DLSETI) also have a negative ECT at the 5% significance level. Without including either the S&P 500 or Eurostoxx in the model, the DLPSEI, DLJCI, and DLSETI adjust by 10.57%, 7.46%, and 6.39% respectively in a day or approximately need 9 days, 13 days, and 16 days respectively to entirely remove the disequilibrium towards long-run equilibrium. From this finding, it is found that the stock market in developing countries in ASEAN with the exception of Vietnam are endogenous, which means that they are affected by the pandemic and need to make adjustments towards long-run equilibria. For this reason, it is critical for policy makers particularly in ASEAN countries to monitor and ensure that the economic indicators remain robust in order to maintain investor confidence. Considering that the current level of readiness of ASEAN developing countries for the upcoming RCEP trade deal, especially in the trade in services part, lags behind other RCEP member states as discussed in Chapter 2, it is also important for these countries to continue to develop their capital markets to be globally competitive. Improved economic indicators, political stability and continuous efforts to overcome the adverse effects of the epidemic must be a concern for them considering that these factors affect the movement of stock price indices.

According to Table 10, it is also found that by including either the U.S. or Euro Area stock price index into the system, the adjustment time required becomes faster. Taking into account these findings, it is indispensable for RCEP member countries to also pay attention to the policies taken by non-RCEP economies, especially the United States and Euro Area in formulating their domestic policies to reduce volatility that may arise due to the pandemic. Additionally, a lesson learned from the 2008-2009 GFC shown in the previous chapter is that the Australian and Japanese stock price indices have considerable influence over the movement of RCEP stock prices during this time period. Realizing that these two countries also have sophisticated stock markets, it is important for other RCEP member countries to coordinate closely with Australia and Japan in developing their capital markets going forward to welcome the entry into force of the RCEP trade deal.

Chapter V
Conclusion and Policy Implications

5.1 Conclusion and Policy Implications

The unprecedented COVID-19 crisis has brought uncertainty to every corner of the world economy. The unfavourable conditions encouraged the fifteen countries in the Asia-Pacific region to sign the RCEP agreement to accelerate post-pandemic economic recovery. The stock markets in RCEP member countries have been negatively impacted by the COVID-19 pandemic particularly at the end of the first quarter of 2020. The results of the Johansen cointegration and ARDL bound tests exhibit that the RCEP stock market indices are cointegrated before and during the COVID-19 crisis. Nevertheless, the degrees of long-run cointegration decreased considerably during the pandemic. Similar observations are also made when the GFC crippled the world economy which ultimately reduced the long-run cointegrating relationship among RCEP stock markets compared to the pre-GFC period. This situation implies that domestic factors tend to determine the movement of the stock market indices leading to limited long-run co-movements in times of crisis vis-à-vis the pre-crisis period.

The empirical results also reveal that the U.S. stock price index (S&P 500) is an essential element in the formation of cointegration vectors among RCEP stock prices given the strong interdependent linkage between the S&P 500 and RCEP stock prices pre- and during pandemics. The possible reason to explain this phenomenon is that before the pandemic, the United States was involved in a trade dispute with China, which ultimately had a negative impact on the RCEP stock markets. Moreover, the VEC Granger causality test results demonstrates that the short-run relationship among RCEP stock price indices is more likely to be tightened during the crisis. During the COVID-19 period, the Vietnamese stock price index (VNI) also does not even have a short-run relationship with the stock prices of other RCEP member countries. From the perspective of market participants, portfolio investors in particular, this finding suggests that by holding VNI stocks, investors can minimize risks caused by the spread of the novel coronavirus. The results of the ECT calculation reveal that stock markets in developing countries in ASEAN with the exception of Vietnam have been severely impacted by the pandemic. The stock markets of Indonesia, Malaysia, the Philippines and Thailand have likely made short-run adjustments to remove the imbalance towards long-run equilibrium. Additionally, the results of the ECT also show that the U.S. and Euro Area stock prices have had strong short-run relationships with RCEP stock prices, which has required faster time adjustment towards long-run equilibrium.

As such, policy makers in RCEP member states need to formulate policies to support their economies by taking into account economic policies adopted by the United States and Euro Area. Learning from the previous crisis where the movements of RCEP stock prices depended to some extent on the Australian and Japanese stock prices, other signatory members of RCEP, especially developing countries in ASEAN, should work closely with these two countries to further develop their stock markets in preparation for the entry into force of the RCEP treaty.

5.2 Research Limitation

The limitation of this study is that the pandemic period has not ended yet. Therefore, when the COVID-19 era is over, future research can better capture the dynamics of stock market indices in RCEP member countries and their relations with stock prices in non-RCEP economies, particularly the United States. Going forward, it is also hoped that a future study will include stock price indices in the RCEP region that are excluded in the current paper so that it can study the dynamics of such stock market prices as the Cambodia and Lao equity price indices. In addition to investigating the dynamic relationships of RCEP stock prices, it is also highly recommended for future research to assess bond market linkages considering that ASEAN's developing countries have been promoting their local-currency bond markets.

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Appendix

Appendix Table 1. Number of Listed Companies on Stock Exchanges in RCEP

Countries	Listed Companies	Information Source
AUS	2,049	https://www2.asx.com.au/markets/trade-our-cash-market/directory
BRN	n/a	n/a
KHM	7	http://csx.com.kh/data/lstcom/listPosts.do?MNCD=50101
CHN	1,924	http://english.sse.com.cn/
IDN	741	https://www.idx.co.id/en-us/listed-companies/company-profiles/
JPN	3,778	https://www.jpx.co.jp/english/listing/co/index.html
KOR	2,450	http://global.krx.co.kr/contents/GLB/03/0308/0308010000/GLB0308010000.jsp
LAO	11	http://www.lsx.com.la/main.do?lang=en
MYS	779	https://www.bursamalaysia.com/trade/trading_resources/listing_directory/main_market
MMR	7	https://ysx-mm.com/main-board/listing/company/
NZL	186	https://www.nzx.com/markets/NZSX
PHL	271	https://www.pse.com.ph/listing-statistics/
SGP	513	https://www.sgx.com/securities/corporate-information?listingBoard=MAINBOARD
THA	825	https://www.set.or.th/en/company/companylist.html
VNM	359	https://hnx.vn/en-gb/cophieu-etfs/chung-khoan-ny.html

Notes: AUS is Australia; BRN is Brunei Darussalam; KHM is Cambodia; CHN is China; IDN is Indonesia; LAO is Lao PDR JPN is Japan; MYS is Malaysia; MMR is Myanmar; NZL is New Zealand; KOR is the Rep. of Korea; PHL is Philippines; SGP is Singapore; THA is Thailand; and VNM is Vietnam

Source: Author's compilation based on aforementioned website

Appendix Table 2. Unit Root Test Results (262 Days before COVID-19)

Indices (Log Transform)	Level				First Difference			
	ADF with breakpoint test		PP test		ADF with breakpoint test		PP test	
	P-value	Notes	P-value	Notes	P-value	Notes	P-value	Notes
LASX	0.8749	Non-stationary	0.9528	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LSHCOMP	0.0596	Non-stationary	0.5086	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LJCI	0.0533	Non-stationary	0.2193	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LNIKKEI	0.6158	Non-stationary	0.5402	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LKLCI	0.6067	Non-stationary	0.2693	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LNZX	0.9836	Non-stationary	0.9785	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LPSEI	0.0526	Non-stationary	0.3150	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LKOSPI	0.3949	Non-stationary	0.1741	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LSTI	0.3310	Non-stationary	0.0870	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LSETI	0.7364	Non-stationary	0.2386	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LVNI	0.4962	Non-stationary	0.1185	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LHSI	0.6470	Non-stationary	0.1605	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LTAIEX	0.8842	Non-stationary	0.6679	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LS&P500	0.9767	Non-stationary	0.9152	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LEUROSTOXX	0.8745	Non-stationary	0.8632	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary

Note: Asterisk (**) denotes significance at the 1% level
Source: Author's calculation using Eviews-9 statistical software

Appendix Table 3. Unit Root Test Results (262 Days during COVID-19)

Indices (Log Transform)	Level				First Difference			
	ADF with breakpoint test		PP test		ADF with breakpoint test		PP test	
	P-value	Notes	P-value	Notes	P-value	Notes	P-value	Notes
LASX	0.4744	Non-stationary	0.7076	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LSHCOMP	0.0507	Non-stationary	0.5520	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LJCI	0.1040	Non-stationary	0.5107	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LNIKKEI	0.7841	Non-stationary	0.7844	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LKLCI	0.1878	Non-stationary	0.2911	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LNZX	0.2300	Non-stationary	0.5026	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LPSEI	0.2434	Non-stationary	0.1121	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LKOSPI	0.6464	Non-stationary	0.8817	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LSTI	0.1927	Non-stationary	0.4874	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LSETI	0.1128	Non-stationary	0.4085	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LVNI	0.8551	Non-stationary	0.9255	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LHSI	0.2152	Non-stationary	0.3789	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LTAIEX	0.5697	Non-stationary	0.7547	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LS&P500	0.9146	Non-stationary	0.8907	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LEUROSTOXX	0.6866	Non-stationary	0.6989	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary

Note: Asterisk (**) denotes significance at the 1% level
Source: Author’s calculation using Eviews-9 statistical software

Appendix Table 4. Unit Root Test Results (338 Days before the GFC)

Indices (Log Transform)	Level				First Difference			
	ADF with breakpoint test		PP test		ADF with breakpoint test		PP test	
	P-value	Notes	P-value	Notes	P-value	Notes	P-value	Notes
LASX	0.8343	Non-stationary	0.9217	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LSHCOMP	> 0.9900	Non-stationary	0.9933	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LJCI	> 0.9900	Non-stationary	0.9536	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LNIKKEI	0.4967	Non-stationary	0.1707	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LKLCI	0.9816	Non-stationary	0.9974	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LNZX	0.6580	Non-stationary	0.9113	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LPSEI	0.8973	Non-stationary	0.9435	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LKOSPI	0.7550	Non-stationary	0.8846	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LSTI	0.9711	Non-stationary	0.9936	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LSETI	0.6176	Non-stationary	0.1381	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LVNI	0.6087	Non-stationary	0.7761	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LHSI	0.9761	Non-stationary	0.9591	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LTAIEX	0.9845	Non-stationary	0.9588	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LS&P500	0.8193	Non-stationary	0.9254	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LEUROSTOXX	0.8705	Non-stationary	0.8150	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary

Note: Asterisk (**) denotes significance at the 1% level
Source: Author's calculation using Eviews-9 statistical software

Appendix Table 5. Unit Root Test Results (338 Days during the GFC)

Indices (Log Transform)	Level				First Difference			
	ADF with breakpoint test		PP test		ADF with breakpoint test		PP test	
	P-value	Notes	P-value	Notes	P-value	Notes	P-value	Notes
LASX	0.3204	Non-stationary	0.8839	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LSHCOMP	0.5975	Non-stationary	0.8774	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LJCI	0.1286	Non-stationary	0.8822	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LNIKKEI	0.2430	Non-stationary	0.8241	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LKLCI	0.9188	Non-stationary	0.9215	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LNZX	0.9524	Non-stationary	0.9007	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LPSEI	0.8427	Non-stationary	0.8042	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LKOSPI	0.5040	Non-stationary	0.7873	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LSTI	0.3943	Non-stationary	0.9327	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LSETI	0.3250	Non-stationary	0.9515	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LVNI	0.8199	Non-stationary	0.8747	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LHSI	0.3646	Non-stationary	0.9139	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LTAIEX	0.5314	Non-stationary	0.8563	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LS&P500	0.0614	Non-stationary	0.9349	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary
LEUROSTOXX	0.8596	Non-stationary	0.9758	Non-stationary	< 0.0100**	Stationary	0.0000**	Stationary

Note: Asterisk (**) denotes significance at the 1% level
Source: Author's calculation using Eviews-9 statistical software

Appendix Table 6. Vector Error Correction (VEC) Granger Causality Test Results (262 Days before COVID-19)

Dependent Variables	Independent Variables										
	DLASX	DLSHCOMP	DLJCI	DLNIKKEI	DLKLCI	DLNZX	DLPSEI	DLKOSPI	DLSTI	DLSETI	DLVNI
DLASX		4.9530 [0.5499]	6.2202 [0.3990]	11.7181 [0.0686]	7.8478 [0.2495]	9.8423 [0.1315]	15.6216* [0.0159]	6.0412 [0.4186]	3.6413 [0.7251]	22.9157** [0.0008]	5.3501 [0.4997]
DLSHCOMP	5.6245 [0.4665]		4.7865 [0.5715]	11.7349 [0.0682]	4.3551 [0.6287]	1.7511 [0.9411]	13.2655* [0.0390]	5.4529 [0.4872]	5.0704 [0.5348]	4.2594 [0.6416]	15.4991* [0.0167]
DLJCI	10.4227 [0.1079]		4.6173 [0.5937]	6.0136 [0.4217]	8.3969 [0.2104]	7.9417 [0.2424]	4.2410 [0.6441]	1.3953 [0.9661]	2.3314 [0.8868]	7.1514 [0.3071]	6.3219 [0.3881]
DLNIKKEI	1.6771 [0.9469]	7.9403 [0.2425]	6.4316 [0.3766]		7.1828 [0.3043]	2.7959 [0.8340]	15.5007* [0.0167]	11.4924 [0.0743]	3.9387 [0.6850]	10.6249 [0.1007]	8.2898 [0.2176]
DLKLCI	14.6632* [0.0230]	7.6407 [0.2656]	5.2521 [0.5119]	2.6730 [0.8486]		6.8222 [0.3376]	11.5038 [0.0740]	7.6812 [0.2624]	7.8646 [0.2482]	6.2603 [0.3947]	1.6491 [0.9490]
DLNZX	12.9820* [0.0433]	11.5400 [0.0731]	12.0415 [0.0611]	7.4365 [0.2823]	14.2029* [0.0275]		28.7431** [0.0001]	4.4523 [0.6157]	10.0953 [0.1207]	43.3074** [0.0000]	6.0525 [0.4173]
DLPSEI	3.8617 [0.6954]	8.3424 [0.2141]	3.6249 [0.7273]	8.0296 [0.2359]	10.4828 [0.1057]	15.3671* [0.0176]		3.1403 [0.7910]	7.2609 [0.2974]	3.4519 [0.7504]	7.3100 [0.2931]
DLKOSPI	8.1855 [0.2248]	15.0505* [0.0199]	10.6858 [0.0986]	1.4454 [0.9630]	11.6109 [0.0712]	9.3220 [0.1563]	18.3983** [0.0053]		7.5053 0.2766	11.2013 [0.0823]	12.0367 [0.0612]
DLSTI	11.6414 [0.0705]	11.9133 [0.0639]	13.7103* [0.0330]	10.4940 [0.1053]	6.9606 [0.3245]	16.2005* [0.0127]	17.0086* [0.0093]	11.3305 [0.0787]		12.4082 [0.0535]	2.9966 [0.8093]
DLSETI	3.2429 [0.7778]	5.9114 [0.4332]	9.3281 [0.1559]	4.0863 [0.6650]	5.1053 [0.5304]	11.9772 [0.0625]	7.7094 [0.2602]	5.3172 [0.5038]	8.8750 [0.1807]		11.4017 [0.0767]
DLVNI	7.3915 [0.2862]	11.0433 [0.0870]	3.3992 [0.7573]	4.4793 [0.6121]	14.4568* [0.0249]	6.2929 [0.3912]	12.4308 [0.0530]	7.6110 [0.2680]	8.7110 [0.1905]	14.9297* [0.0208]	

Note: Asterisk (**) and (*) indicate significance at the 1% and 5% levels, respectively. P-value is presented in the parenthesis [ ]
Source: Author's calculation using Eviews-9 statistical software

Appendix Table 7. Vector Error Correction (VEC) Granger Causality Test Results (262 Days during COVID-19)

Dependent Variables	Independent Variables										
	DLASX	DLSHCOMP	DLJCI	DLNIKKEI	DLKLCI	DLNZX	DLPSEI	DLKOSPI	DLSTI	DLSETI	DLVNI
DLASX		11.7659* [0.0381]	9.0652 [0.1065]	2.4245 [0.7878]	5.9305 [0.3130]	12.3291* [0.0305]	8.1575 [0.1478]	2.1114 [0.8335]	6.7829 [0.2373]	10.7995 [0.0555]	1.5480 [0.9075]
DLSHCOMP	1.1611 [0.9486]		1.4167 [0.9225]	2.0788 [0.8381]	3.2945 [0.6547]	9.8445 [0.0798]	2.5465 [0.7695]	12.5041* [0.0285]	4.8452 [0.4351]	7.5330 [0.1839]	4.4580 [0.4855]
DLJCI	16.0133** [0.0068]	4.5567 [0.4723]		14.4650* [0.0129]	5.4144 [0.3674]	11.6499* [0.0399]	9.5823 [0.0880]	1.9106 [0.8614]	5.2189 [0.3898]	8.1012 [0.1507]	2.2310 [0.8163]
DLNIKKEI	10.5561 [0.0609]	1.7954 [0.8767]	10.3978 [0.0647]		3.2100 [0.6676]	6.7064 [0.2434]	8.5278 [0.1294]	8.1336 [0.1490]	4.6368 [0.4618]	37.6048** [0.0000]	2.9889 [0.7017]
DLKLCI	4.0588 [0.5410]	3.0467 [0.6928]	9.1633 [0.1027]	4.9576 [0.4211]		4.1636 [0.5261]	7.6744 [0.1751]	10.5453 [0.0612]	9.4625 [0.0920]	18.2729** [0.0026]	1.4842 [0.9149]
DLNZX	6.0139 [0.3049]	6.1061 [0.2960]	6.9176 [0.2268]	10.2005 [0.0697]	14.5513* [0.0125]		2.2574 [0.8125]	4.4719 [0.4836]	0.6282 [0.9867]	19.9801** [0.0013]	4.7381 [0.4487]
DLPSEI	11.1005* [0.0494]	6.9263 [0.2262]	6.5239 [0.2585]	13.9091* [0.0162]	2.3004 [0.8062]	2.5207 [0.7734]		0.4174 [0.9948]	9.8547 [0.0795]	3.7905 [0.5800]	1.4102 [0.9232]
DLKOSPI	17.1886** [0.0042]	6.6739 [0.2460]	13.5160* [0.0190]	16.9071** [0.0047]	3.5792 [0.6114]	8.1492 [0.1482]	9.0308 [0.1078]		5.2961 [0.3808]	26.3739** [0.0001]	2.2361 [0.8156]
DLSTI	15.3100** [0.0091]	7.8884 [0.0055]	8.0554 [0.1532]	9.6907 [0.0845]	4.8269 [0.4374]	10.4251 [0.0640]	20.8310** [0.0009]	11.2129* [0.0473]		17.0009** [0.0045]	2.7990 [0.7309]
DLSETI	13.6368* [0.0181]	16.5264** [0.1625]	9.9108 [0.0778]	12.3302* [0.0305]	5.4392 [0.3647]	20.4916** [0.0010]	7.6100 [0.1791]	8.6719 [0.1229]	1.9704 [0.8532]		4.3194 [0.5044]
DLVNI	7.2196 [0.2048]	7.5495 [0.1829]	5.0939 [0.4045]	5.5886 [0.3483]	10.1170 [0.0720]	3.7242 [0.5898]	1.5665 [0.9053]	1.8200 [0.8734]	6.0512 [0.3013]	6.5116 [0.2596]	

Note: Asterisk (**) and (*) indicate significance at the 1% and 5% levels, respectively. P-value is presented in the parenthesis [ ]
Source: Author's calculation using Eviews-9 statistical software

Appendix Table 8. Vector Error Correction (VEC) Granger Causality Test Results (338 Days before the GFC)

Dependent Variables	Independent Variables										
	DLASX	DLSHCOMP	DLJCI	DLNIKKEI	DLKLCI	DLNZX	DLPSEI	DLKOSPI	DLSTI	DLSETI	DLVNI
DLASX		3.4550 [0.4848]	16.3947** [0.0025]	0.7099 [0.9501]	8.6764 [0.0697]	0.3746 [0.9845]	6.5039 [0.1645]	4.7006 [0.3194]	4.3988 [0.3547]	12.2828* [0.0154]	4.9681 [0.2906]
DLSHCOMP	3.4532 [0.4850]		2.5699 [0.6322]	1.2612 [0.8679]	7.5736 [0.1085]	5.4545 [0.2438]	4.0874 [0.3943]	1.9979 [0.7362]	4.7530 [0.3136]	7.1261 [0.1294]	13.9833** [0.0073]
DLJCI	2.9722 [0.5625]		3.2767 [0.5126]	3.7992 [0.4339]	8.8994 [0.0637]	9.7688* [0.0445]	17.8868** [0.0013]	6.6006 [0.1586]	6.0738 [0.1937]	8.1959 [0.0847]	4.2776 [0.3697]
DLNIKKEI	0.5563 [0.9678]	1.0311 [0.9051]	6.3756 [0.1728]		9.5584* [0.0486]	1.7215 [0.7868]	3.0878 [0.5432]	0.9504 [0.9172]	1.2802 [0.8647]	5.9264 [0.2047]	6.0082 [0.1985]
DLKLCI	2.7761 [0.5960]	6.6619 [0.1549]	3.3591 [0.4996]	6.1864 [0.1857]		4.3014 [0.3667]	5.4691 [0.2425]	3.4950 [0.4786]	3.6281 [0.4587]	10.8922* [0.0278]	11.6716* [0.0200]
DLNZX	5.7685 [0.2171]	4.6942 [0.3201]	12.9290* [0.0116]	3.6462 [0.4560]	5.6267 [0.2288]		1.9985 [0.7360]	10.6932* [0.0302]	13.01086* [0.0112]	9.3461 [0.0530]	11.2096* [0.0243]
DLPSEI	2.2901 [0.6826]	10.7091* [0.0300]	7.3805 [0.1171]	1.5291 [0.8215]	11.4383* [0.0221]	5.8087 [0.2139]		1.4670 [0.8325]	0.8922 [0.9257]	22.0068** [0.0002]	4.0519 [0.3990]
DLKOSPI	2.0362 [0.7291]	5.0056 [0.2867]	6.7526 [0.1496]	6.0982 [0.1919]	6.0462 [0.1957]	2.7078 [0.6079]	2.0710 [0.7227]		2.4493 [0.6537]	8.6786 [0.0697]	0.8934 [0.9255]
DLSTI	11.2200* [0.0242]	5.5240 [0.2376]	3.4046 [0.4925]	0.1602 [0.9970]	18.6978** [0.0009]	7.0898 [0.1312]	4.8144 [0.3069]	3.4201 [0.4901]		5.5273 [0.2373]	0.5085 [0.9727]
DLSETI	0.7876 [0.9401]	2.4945 [0.6456]	3.7758 [0.4372]	0.8972 [0.9250]	13.2248* [0.0102]	1.3268 [0.8568]	2.5020 [0.6443]	4.4992 [0.3426]	8.0139 [0.0911]		6.9360 [0.1393]
DLVNI	3.9853 [0.4080]	13.8973** [0.0076]	3.1728 [0.5293]	4.8001 [0.3084]	4.0492 [0.3994]	0.2891 [0.9905]	14.8432** [0.0050]	1.2009 [0.8780]	10.9133* [0.0276]	14.8062** [0.0051]	

Note: Asterisk (**) and (*) indicate significance at the 1% and 5% levels, respectively. P-value is presented in the parenthesis [ ]
Source: Author's calculation using Eviews-9 statistical software

Appendix Table 9. Vector Error Correction (VEC) Granger Causality Test Results (338 Days during the GFC)

Dependent Variables	Independent Variables										
	DLASX	DLSHCOMP	DLJCI	DLNIKKEI	DLKLCI	DLNZX	DLPSEI	DLKOSPI	DLSTI	DLSETI	DLVNI
DLASX		2.3689 [0.1238]	0.1447 [0.7037]	5.2014* [0.0226]	9.8708** [0.0017]	2.4852 [0.1149]	0.9458 [0.3308]	3.2535 [0.0713]	4.6589* [0.0309]	4.0122* [0.0452]	4.0791* [0.0434]
DLSHCOMP	8.7605** [0.0031]		0.0433 [0.8352]	10.6387** [0.0011]	0.6795 [0.4098]	1.0016 [0.3169]	0.4717 [0.4922]	0.0017 [0.9674]	1.9615 [0.1614]	0.0836 [0.7725]	1.4698 [0.2254]
DLJCI	1.3463 [0.2459]	2.7920 [0.0947]		11.1769** [0.0008]	6.6932** [0.0097]	0.3419 [0.5587]	3.1871 [0.0742]	2.4216 [0.1197]	2.1527 [0.1423]	1.6966 [0.1927]	1.4588 [0.2271]
DLNIKKEI	40.1195** [0.0000]	2.8214 [0.0930]	4.7119* [0.0300]		8.2660** [0.0040]	0.3527 [0.5526]	0.6172 [0.4321]	0.6701 [0.4130]	3.9116* [0.0480]	0.0304 [0.8616]	2.2647 [0.1324]
DLKLCI	9.1602** [0.0025]	1.5786 [0.2090]	4.7086* [0.0300]	11.6331** [0.0006]		0.8875 [0.3462]	3.1100 [0.0778]	0.5617 [0.4536]	1.2272 [0.2680]	1.0546 [0.3044]	8.8415** [0.0029]
DLNZX	19.0323** [0.0000]	1.04234 [0.3073]	1.0122 [0.3144]	10.9286** [0.0009]	4.7321* [0.0296]		0.0299 [0.8626]	4.3298* [0.0375]	5.4295* [0.0198]	0.2205 [0.6386]	0.1845 [0.6676]
DLPSEI	10.5955** [0.0011]	3.5486 [0.0596]	0.4426 [0.5059]	8.4056** [0.0037]	2.8340 [0.0923]	0.1277 [0.7209]		10.9239** [0.0009]	2.4962 [0.1141]	0.0907 [0.7633]	0.0277 [0.8679]
DLKOSPI	23.3948** [0.0000]	1.9338 [0.1643]	1.4401 [0.2301]	9.0956** [0.0026]	10.1485** [0.0014]	0.0582 [0.8093]	3.8129 [0.0509]		1.0307 [0.3100]	1.3571 [0.2440]	3.4656 [0.0627]
DLSTI	10.3449** [0.0013]	3.6426 [0.0563]	0.0039 [0.9499]	2.8965 [0.0888]	6.2282* [0.0126]	0.0278 [0.8676]	3.1985 [0.0737]	0.2505 [0.6167]		0.4522 [0.5013]	4.8390* [0.0278]
DLSETI	13.4588 [0.3245]	4.4191* [0.0476]	0.2331** [0.0026]	1.6001** [0.0016]	1.8604** [0.0002]	3.7381 [0.1085]	1.9064* [0.0157]	2.3850 [0.1276]	4.1912* [0.8264]		1.7810 [0.6979]
DLVNI	9.2668** [0.0023]	1.0410 [0.3076]	6.1501* [0.0131]	3.4077 [0.0649]	1.6953 [0.1929]	1.6278 [0.2020]	5.9776* [0.0145]	2.9378 [0.0865]	0.6213 [0.4305]	0.0029 [0.9570]	

Note: Asterisk (**) and (*) indicate significance at the 1% and 5% levels, respectively. P-value is presented in the parenthesis [ ]
Source: Author's calculation using Eviews-9 statistical software

Appendix Table 10. Trace Test Results at the 5% Significance Level (*), with LHSI

Vectors	r = 0	r ≤ 1	r ≤ 2	r ≤ 3	r ≤ 4
262 Days before the COVID-19 Crisis, with the Optimum Lag = 5					
Trace Statistic	386.2054	320.4167	260.1194	203.8143	156.7462
0.05 Critical Value	348.9784	298.1594	251.2650	208.4374	169.5991
P-value	0.0009*	0.0045*	0.0192*	0.0812	0.1932
262 Days during the COVID-19 Crisis, with the Optimum Lag = 6					
Trace Statistic	394.5427	325.2275	267.1750	222.4621	178.9088
0.05 Critical Value	374.9076	322.0692	273.1889	228.2979	187.4701
P-value	0.0076*	0.0374*	0.0875	0.0902	0.1252
338 Days before the GFC, with the Optimum Lag = 5					
Trace Statistic	397.3733	309.9114	238.3441	189.8117	149.6024
0.05 Critical Value	348.9784	298.1594	251.2650	208.4374	169.5991
P-value	0.0002*	0.0152*	0.1592	0.2695	0.3407
338 Days during the GFC, with the Optimum Lag = 3					
Trace Statistic	358.8427	282.4243	216.8715	174.6417	137.4505
0.05 Critical Value	348.9784	298.1594	251.2650	208.4374	169.5991
P-value	0.0202*	0.1785	0.5552	0.6137	0.6582

Source: Author’s calculation using Eviews-9 statistical software

Appendix Table 11. Trace Test Results at the 5% Significance Level (*), with LTAIEX

Vectors	r = 0	r ≤ 1	r ≤ 2	r ≤ 3	r ≤ 4
262 Days before the COVID-19 Crisis, with the Optimum Lag = 7					
Trace Statistic	444.1626	351.9986	282.1949	225.3218	181.0586
0.05 Critical Value	374.9076	322.0692	273.1889	228.2979	187.4701
P-value	0.0000*	0.0018*	0.0195*	0.0681	0.1011
262 Days during the COVID-19 Crisis, with the Optimum Lag = 4					
Trace Statistic	359.2603	265.9860	217.6101	175.7545	136.6397
0.05 Critical Value	348.9784	298.1594	251.2650	208.4374	169.5991
P-value	0.0194*	0.4492	0.5393	0.5873	0.6788
338 Days before the GFC, with the Optimum Lag = 8					
Trace Statistic	384.1543	289.1508	216.1551	158.4277	118.1713
0.05 Critical Value	311.1288	263.2603	219.4016	179.5098	143.6691
P-value	0.0000*	0.0024*	0.0701	0.3500	0.5359
338 Days during the GFC, with the Optimum Lag = 5					
Trace Statistic	374.0350	294.5643	231.9886	178.9311	138.7756
0.05 Critical Value	348.9784	298.1594	251.2650	208.4374	169.5991
P-value	0.0039*	0.0691	0.2509	0.5110	0.6237

Source: Author’s calculation using Eviews-9 statistical software

Appendix Table 12. Trace Test Results at the 5% Significance Level (*), with LS&P500

Vectors	r = 0	r ≤ 1	r ≤ 2	r ≤ 3	r ≤ 4
262 Days before the COVID-19 Crisis, with the Optimum Lag = 7					
Trace Statistic	414.2957	319.4451	256.3163	198.8149	153.0042
0.05 Critical Value	334.9837	285.1425	239.2354	197.3709	159.5297
P-value	0.0000*	0.0008*	0.0067*	0.0423*	0.1071
262 Days during the COVID-19 Crisis, with the Optimum Lag = 6					
Trace Statistic	379.6329	308.3365	253.0539	205.7510	161.2628
0.05 Critical Value	348.9784	298.1594	251.2650	208.4374	169.5991
P-value	0.0020*	0.0180*	0.0416*	0.0667	0.1260
338 Days before the GFC, with the Optimum Lag = 2					
Trace Statistic	407.8283	334.9607	262.4103	208.5199	157.5907
0.05 Critical Value	374.9076	322.0692	273.1889	228.2979	187.4701
P-value	0.0016*	0.0139*	0.1305	0.2800	0.5695
338 Days during the GFC, with the Optimum Lag = 5					
Trace Statistic	361.4995	286.0829	223.3254	181.6785	142.9140
0.05 Critical Value	348.9784	298.1594	251.2650	208.4374	169.5991
P-value	0.0155*	0.1374	0.4158	0.4453	0.5130

Source: Author's calculation using Eviews-9 statistical software

Appendix Table 13. Trace Test Results at the 5% Significance Level (*), with LEUROSTOXX

Vectors	r = 0	r ≤ 1	r ≤ 2	r ≤ 3	r ≤ 4
262 Days before the COVID-19 Crisis, with the Optimum Lag = 7					
Trace Statistic	444.0193	351.8096	287.3932	227.3711	180.1586
0.05 Critical Value	374.9076	322.0692	273.1889	228.2979	187.4701
P-value	0.0000*	0.0019*	0.0106*	0.0552	0.1107
262 Days during the COVID-19 Crisis, with the Optimum Lag = 6					
Trace Statistic	404.3252	318.9171	251.1008	202.8085	164.2717
0.05 Critical Value	348.9784	298.1594	251.2650	208.4374	169.5991
P-value	0.0001*	0.0055*	0.0508	0.0897	0.0921
338 Days before the GFC, with the Optimum Lag = 8					
Trace Statistic	439.0798	325.5588	249.9885	191.2102	151.3924
0.05 Critical Value	348.9784	298.1594	251.2650	208.4374	169.5991
P-value	0.0000*	0.0023*	0.0569	0.2438	0.2993
338 Days during the GFC, with the Optimum Lag = 4					
Trace Statistic	371.4309	296.2252	225.2235	170.1901	133.2136
0.05 Critical Value	348.9784	298.1594	251.2650	208.4374	169.5991
P-value	0.0052*	0.0596	0.3763	0.7144	0.7603

Source: Author's calculation using Eviews-9 statistical software

Appendix Table 14. Short-run Relationships between Hong Kong and RCEP Stock Price Indices (Empirical Results by Performing Vector Error Correction [VEC] Granger Causality Tests)

Country	Causality Direction	262 Days before COVID-19 Crisis	262 Days during COVID-19 Crisis	338 Days before GFC	338 Days during GFC
Australia VS Hong Kong	DLASX →DLHSI	9.1946 [0.0564]	10.9337 [0.0527]	3.0470 [0.5500]	21.0043** [0.0000]
	DLHSI → DLASX	3.5153 [0.4756]	7.9156 [0.1610]	1.8723 [0.7592]	6.4177* [0.0404]
China VS Hong Kong	DLSHCOMP → DLHSI	2.5721 [0.6318]	1.3495 [0.9298]	0.6887 [0.9527]	4.1109 [0.1280]
	DLHSI →DLSHCOMP	1.5221 [0.8227]	7.8535 [0.1645]	18.3711** [0.0010]	2.6254 [0.2691]
Indonesia VS Hong Kong	DLJCI → DLHSI	3.1017 [0.5410]	5.3226 [0.3778]	2.0097 [0.7340]	1.7068 [0.4260]
	DLHSI → DLJCI	2.7297 [0.6040]	7.1400 [0.2104]	2.3395 [0.6736]	5.4023 [0.0671]
Japan VS Hong Kong	DLNIKKEI → DLHSI	2.0453 [0.7274]	8.7638 [0.1189]	3.9984 [0.4062]	9.6648** [0.0080]
	DLHSI → DLNIKKEI	2.5414 [0.6372]	7.6786 [0.1749]	3.0228 [0.5540]	13.6179** [0.0011]
Malaysia VS Hong Kong	DLKLCI → DLHSI	3.2024 [0.5245]	3.9312 [0.5594]	10.5291* [0.0324]	7.4199* [0.0245]
	DLHSI → DLKLCI	2.6053 [0.6259]	2.7544 [0.7378]	3.0383 [0.5514]	4.2816 [0.1176]
New Zealand VS Hong Kong	DLNZX → DLHSI	3.8645 [0.4247]	4.7344 [0.4492]	8.8630 [0.0646]	1.5787 [0.4541]
	DLHSI → DLNZX	7.6442 [0.1055]	4.7693 [0.4447]	5.8969 [0.2070]	19.8656** [0.0000]
Philippines VS Hong Kong	DLPSEI → DLHSI	13.7407** [0.0082]	3.2571 [0.6604]	6.4457 [0.1682]	3.3366 [0.1886]
	DLHSI → DLPSEI	7.3801 [0.1171]	3.3368 [0.6482]	2.3026 [0.6803]	12.5408** [0.0019]
ROK VS Hong Kong	DLKOSPI → DLHSI	6.5517 [0.1616]	6.8746 [0.2301]	3.2149 [0.5225]	0.5028 [0.7777]
	DLHSI → DLKOSPI	0.6877 [0.9528]	3.3134 [0.6518]	3.5374 [0.4722]	4.6791 [0.0964]
Singapore VS Hong Kong	DLSTI → DLHSI	11.8334* [0.0186]	4.1993 [0.5211]	1.5661 [0.8149]	4.9525 [0.0841]
	DLHSI → DLSTI	5.0618 [0.2810]	16.1440** [0.0064]	4.6113 [0.3296]	1.3163 [0.5178]
Thailand VS Hong Kong	DLSETI → DLHSI	3.2114 [0.5231]	12.7238* [0.0261]	2.8711 [0.5796]	4.8084 [0.0903]
	DLHSI → DLSETI	6.5011 [0.1647]	7.6338 [0.1776]	1.3825 [0.8472]	5.6025 [0.0607]
Vietnam VS Hong Kong	DLVNI → DLHSI	1.9731 [0.7407]	5.6464 [0.3422]	3.0470 [0.5500]	0.6384 [0.7267]
	DLHSI → DLVNI	3.5638 [0.4682]	3.4496 [0.6310]	1.9382 [0.7471]	3.5655 [0.1682]

Note: Asterisk (**) and (*) indicate significance at the 1% and 5% levels, respectively. P-value is presented in the parenthesis [ ]

Source: Author's calculation using Eviews-9 statistical software

Appendix Table 15. Short-run Relationships between Taiwan and RCEP Stock Price Indices (Empirical Results by Performing Vector Error Correction [VEC] Granger Causality Tests)

Country	Causality Direction	262 Days before COVID-19 Crisis	262 Days during COVID-19 Crisis	338 Days before GFC	338 Days during GFC
Australia VS Taiwan	DLASX →DLTAIEX	11.3569 [0.0780]	4.1965 [0.2410]	12.6743 [0.0805]	14.6859** [0.0054]
	DLTAIEX → DLASX	2.5226 [0.8659]	9.2778* [0.0258]	19.3217** [0.0072]	2.7052 [0.6083]
China VS Taiwan	DLSHCOMP → DLTAIEX	14.8784* [0.0212]	0.4020 [0.9398]	2.6571 [0.9148]	0.6353 [0.9591]
	DLTAIEX →DLSHCOMP	6.4613 [0.3735]	5.2599 [0.1537]	6.8229 [0.4476]	0.7753 [0.9417]
Indonesia VS Taiwan	DLJCI → DLTAIEX	9.7602 [0.1351]	1.4095 [0.7033]	7.5485 [0.3741]	7.2850 [0.1216]
	DLTAIEX → DLJCI	4.5591 [0.6015]	0.5954 [0.8975]	7.3655 [0.3918]	6.2749 [0.1795]
Japan VS Taiwan	DLNIKKEI → DLTAIEX	5.2176 [0.5162]	0.1378 [0.9869]	6.6040 [0.4712]	8.5385 [0.0737]
	DLTAIEX → DLNIKKEI	4.8512 [0.5630]	5.5393 [0.1363]	4.3143 [0.7429]	10.0753* [0.0392]
Malaysia VS Taiwan	DLKLCI → DLTAIEX	7.6069 [0.2683]	8.2154* [0.0418]	6.2909 [0.5062]	11.5326* [0.0212]
	DLTAIEX → DLKLCI	4.0903 [0.6645]	2.0196 [0.5684]]	9.3233 [0.2303]	10.6296* [0.0311]
New Zealand VS Taiwan	DLNZX → DLTAIEX	11.9332 [0.0635]	3.9831 [0.2633]	11.7354 [0.1096]	10.0542* [0.0395]
	DLTAIEX → DLNZX	4.0472 [0.6703]	5.3975 [0.1449]	5.5030 [0.5988]	5.3389 [0.2543]
Philippines VS Taiwan	DLPSEI → DLTAIEX	10.1056 [0.1203]	5.6857 [0.1279]	1.2417 [0.9899]	10.1669* [0.0377]
	DLTAIEX → DLPSEI	6.2271 [0.3982]	2.4637 [0.4819]	8.7194 [0.2734]	14.3145** [0.0064]
ROK VS Taiwan	DLKOSPI → DLTAIEX	3.5808 [0.7332]	4.5084 [0.2115]	6.9090 [0.4384]	2.1031 [0.7168]
	DLTAIEX → DLKOSPI	2.4355 [0.8756]	3.6762 [0.2986]	7.4486 [0.3837]	2.4331 [0.6567]
Singapore VS Taiwan	DLSTI → DLTAIEX	8.4269 [0.2085]	0.8704 [0.8326]	6.9021 [0.4391]	1.6529 [0.7993]
	DLTAIEX → DLSTI	3.1172 [0.7940]	11.1178* [0.0111]	18.0833* [0.0116]	1.4164 [0.8413]
Thailand VS Taiwan	DLSETI → DLTAIEX	10.0228 [0.1237]	9.6185* [0.0221]	5.6032 [0.5868]	13.4889** [0.0091]
	DLTAIEX → DLSETI	4.8017 [0.5695]	6.0134 [0.1110]	2.5665 [0.9220]	1.0725 [0.8986]
Vietnam VS Taiwan	DLVNI → DLTAIEX	11.7019 [0.0690]	1.3521 [0.7168]	5.1898 [0.6368]	6.0662 [0.1943]
	DLTAIEX → DLVNI	3.0038 [0.8084]	7.5274 [0.0569]	4.1206 [0.7658]	11.9231* [0.0179]

Note: Asterisk (**) and (*) indicate significance at the 1% and 5% levels, respectively. P-value is presented in the parenthesis [ ]
Source: Author's calculation using Eviews-9 statistical software

Appendix Table 16. Short-run Relationships between U.S. and RCEP Stock Price Indices (Empirical Results by Performing Vector Error Correction [VEC] Granger Causality Tests)

Country	Causality Direction	262 Days before COVID-19 Crisis	262 Days during COVID-19 Crisis	338 Days before GFC	338 Days during GFC
Australia VS the U.S.	DLASX →DLS&P500	5.5764 [0.4723]	24.1020** [0.0002]	2.7379 [0.0980]	132.0093** [0.0000]
	DLS&P500 → DLASX	12.2848 [0.0559]	10.3426 [0.0661]	0.8315 [0.3618]	10.1261* [0.0384]
China VS the U.S.	DLSHCOMP → DLS&P500	6.4948 [0.3701]	5.9669 [0.3095]	5.7360* [0.0166]	8.8477 [0.0650]
	DLS&P500 →DLSHCOMP	10.4169 [0.1082]	6.7172 [0.2425]	0.0023 [0.9622]	5.1028 [0.2769]
Indonesia VS the U.S.	DLJCI → DLS&P500	5.1500 [0.5247]	9.7993 [0.0811]	2.9552 [0.0856]	4.6738 [0.3224]
	DLS&P500 → DLJCI	11.9782 [0.0625]	27.9692** [0.0000]	0.3006 [0.5835]	1.2303 [0.8731]
Japan VS the U.S.	DLNIKKEI → DLS&P500	7.7349 [0.2582]	9.4376 [0.0928]	0.6414 [0.4232]	3.3511 [0.5009]
	DLS&P500 → DLNIKKEI	12.8672* [0.0452]	5.5373 [0.3539]	0.4647 [0.4954]	12.9883* [0.0113]
Malaysia VS the U.S.	DLKLCI → DLS&P500	13.7158* [0.0330]	15.3041** [0.0091]	1.2568 [0.2623]	11.6498* [0.0202]
	DLS&P500 → DLKLCI	10.0522 [0.1225]	29.1363** [0.0000]	0.0067 [0.9350]	1.8180 [0.7692]
New Zealand VS the U.S.	DLNZX → DLS&P500	7.4217 [0.2836]	8.5078 [0.1304]	0.1099 [0.7403]	2.6319 [0.6212]
	DLS&P500 → DLNZX	24.9453** [0.0003]	8.3131 [0.1398]	7.5569** [0.0060]	5.1345 [0.2738]
Philippines VS the U.S.	DLPSEI → DLS&P500	13.6052* [0.0344]	8.1048 [0.1506]	0.1160 [0.7334]	6.8672 [0.1431]
	DLS&P500 → DLPSEI	9.4095 [0.1518]	11.0007 [0.0514]	0.6174 [0.4320]	10.7801* [0.0292]
ROK VS the U.S.	DLKOSPI → DLS&P500	7.7865 [0.2542]	7.2146 [0.2052]	0.0422 [0.8372]	11.3196* [0.0232]
	DLS&P500 → DLKOSPI	22.8378** [0.0009]	18.7155** [0.0022]	0.3209 [0.5711]	2.1036 [0.7167]
Singapore VS the U.S.	DLSTI → DLS&P500	16.6459* [0.0107]	6.7672 [0.2385]	1.5947 [0.2067]	7.9982 [0.0916]
	DLS&P500 → DLSTI	15.6678* [0.0157]	12.1971* [0.0322]	0.2099 [0.6468]	2.7282 [0.6043]
Thailand VS the U.S.	DLSETI → DLS&P500	6.2280 [0.3981]	16.2525** [0.0062]	2.2201 [0.1362]	6.3308 [0.1758]
	DLS&P500 → DLSETI	12.2765 [0.0561]	17.7733** [0.0032]	0.2572 [0.6120]	6.0851 [0.1929]
Vietnam VS the U.S.	DLVNI → DLS&P500	3.7192 [0.7146]	4.5601 [0.4719]	3.5876 [0.0582]	6.2957 [0.1781]
	DLS&P500 → DLVNI	3.8809 [0.6928]	5.1907 [0.3930]	0.1639 [0.6856]	6.1088 [0.1912]

Note: Asterisk (**) and (*) indicate significance at the 1% and 5% levels, respectively. P-value is presented in the parenthesis [ ]

Source: Author's calculation using Eviews-9 statistical software

Appendix Table 17. Short-run Relationships between Euro Area and RCEP Stock Price Indices (Empirical Results by Performing Vector Error Correction [VEC] Granger Causality Tests)

Country	Causality Direction	262 Days before COVID-19 Crisis	262 Days during COVID-19 Crisis	338 Days before GFC	338 Days during GFC
Australia VS Euro Area	DLASX →DLEUROSTOXX	6.9323 [0.3272]	11.0704* [0.0500]	5.4753 [0.6022]	1,883.789** [0.0000]
	DLEUROSTOXX → DLASX	8.2278 [0.2219]	4.5401 [0.4745]	12.1319 [0.0963]	6.4522 [0.0916]
China VS Euro Area	DLSHCOMP → DLEUROSTOXX	10.7906 [0.0951]	6.6237 [0.2502]	18.4232* [0.0102]	3.7305 [0.2921]
	DLEUROSTOXX →DLSHCOMP	10.0608 [0.1221]	8.0422 [0.1539]	12.6366 [0.0815]	4.2655 [0.2342]
Indonesia VS Euro Area	DLJCI → DLEUROSTOXX	6.7072 [0.3488]	5.3845 [0.3708]	9.9176 [0.1933]	1.5053 [0.6810]
	DLEUROSTOXX → DLJCI	7.1426 [0.3079]	11.1290* [0.0489]	9.6395 [0.2099]	2.9647 [0.3971]
Japan VS Euro Area	DLNIKKEI → DLEUROSTOXX	7.7975 [0.2533]	22.4657** [0.0004]	12.4178 [0.0876]	3.3378 [0.3424]
	DLEUROSTOXX → DLNIKKEI	6.7559 [0.3440]	13.4060* [0.0199]	3.9759 [0.7825]	0.9581 [0.8114]
Malaysia VS Euro Area	DLKLCI → DLEUROSTOXX	2.5362 [0.8644]	8.9865 [0.1096]	8.1721 [0.3177]	4.8287 [0.1848]
	DLEUROSTOXX → DLKLCI	3.1720 [0.7870]	1.8115 [0.8746]	5.9023 [0.5512]	2.2559 [0.5210]
New Zealand VS Euro Area	DLNZX → DLEUROSTOXX	4.6004 [0.5960]	12.5507* [0.0280]	3.6950 [0.8142]	2.2298 [0.5261]
	DLEUROSTOXX → DLNZX	6.9182 [0.3285]	6.3276 [0.2756]	8.9919 [0.2532]	1.5510 [0.6706]
Philippines VS Euro Area	DLPSEI → DLEUROSTOXX	6.6413 [0.3553]	3.4595 [0.6295]	6.0811 [0.5303]	1.9847 [0.5756]
	DLEUROSTOXX → DLPSEI	4.4605 [0.6146]	3.5889 [0.6100]	10.0944 [0.1833]	0.4628 [0.9270]
ROK VS Euro Area	DLKOSPI → DLEUROSTOXX	9.7590 [0.1352]	11.1370* [0.0487]	7.1156 [0.4169]	4.3214 [0.2288]
	DLEUROSTOXX → DLKOSPI	11.9456 [0.0632]	9.5689 [0.0884]	8.1919 [0.3160]	0.4854 [0.9221]
Singapore VS Euro Area	DLSTI → DLEUROSTOXX	16.6887* [0.0105]	13.8359* [0.0167]	25.1678** [0.0007]	2.2016 [0.5316]
	DLEUROSTOXX → DLSTI	10.6751 [0.0990]	6.5170 [0.2591]	12.4844 [0.0857]	1.3673 [0.7132]
Thailand VS Euro Area	DLSETI → DLEUROSTOXX	6.6803 [0.3514]	44.3792** [0.0000]	6.9431 [0.4348]	7.7003 [0.0526]
	DLEUROSTOXX → DLSETI	4.4466 [0.6165]	11.2695* [0.0463]	3.1094 [0.8747]	1.7903 [0.6171]
Vietnam VS Euro Area	DLVNI → DLEUROSTOXX	3.5449 [0.7380]	3.4010 [0.6384]	5.6229 [0.5844]	1.5469 [0.6715]
	DLEUROSTOXX → DLVNI	7.6618 [0.2639]	6.1091 [0.2957]	5.9285 [0.5481]	3.7643 [0.2881]

Note: Asterisk (**) and (*) indicate significance at the 1% and 5% levels, respectively. P-value is presented in the parenthesis [ ]

Source: Author’s calculation using Eviews-9 statistical software