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Stock Market Co-movements in RCEP Participating Countries

Wenwen Zhang
Fudan University

Abstract

In this paper, we describe the dynamic co-movement of the stock markets of RCEP participating countries over the past ten years. The empirical results of DCC-GARCH model and wavelet analysis indicated that the stock market dynamic co-movement between China and other RCEP countries generally increased over this period. This finding is particularly significant given China's efforts to expedite its financial opening up since 2016. On the other hand, we found that the dynamic co-movement between China and other RCEP countries became significantly more marked during the global financial disruptions that occurred in 2012, 2015, and 2020, further confirming the market contagion hypothesis.

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Contact: Wenwen Zhang - zhang_wenwen3@126.com.
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1. Introduction

The numerous studies that have explored the co-movement of stock markets have generally explained the phenomenon in terms of either the economic foundation hypothesis, the market contagion hypothesis, or the theory of significant events of financial liberalization. Our research on The Regional Comprehensive Economic Partnership (RCEP) countries took into account these theories. Also, most earlier studies made use of conventional multivariate volatility models, such as DCC-GARCH, GO-GARCH, GJR-GARCH, which generally yield good estimates of conditional covariance for exploring the interdependence of markets. However, these models cannot capture the variation in trading frequencies. Wavelet transformation can serve to calculate the level of interdependence and the lead-lag relationship on various frequency scales. In this manner, Jiang, Nie, and Monginsidi (2017) explored the co-movement of ASEAN stock markets, and Tsai and Chang (2018) studied the co-movement of money and economic growth in 15 Asia-Pacific countries. Similarly, Si, Liu, and Kong (2019) explored the co-movement between the stock market and business cycles in China. Since it was only ratified recently, there have been few empirical studies focused on the RCEP. Of these, Wu et al. (2020) investigated RCEP countries from the perspectives of urbanization, response to disasters, and the development of tourism, and Al-Qudah, Al-Okaily, and Hamza (2021) found that RCEP countries have benefitted considerably from sustainable development. The present paper contributes to this literature by considering market co-movement and spill-over effects involving China and the other members of the RCEP.

The Regional Comprehensive Economic Partnership (RCEP) is a free-trade agreement signed by the Asia-Pacific nations of China, Japan, South Korea, Singapore, Thailand, Indonesia, Malaysia, Brunei, the Philippines, Vietnam, Laos, Cambodia, Myanmar, Australia, and New Zealand in November 2020. The 15 member countries accounted for more than 30 per cent of the world's population and about 30 per cent of total global GDP as of the signing, making this the largest trade bloc yet formed. The idea of a trade pact including a mix of high-, middle-, and low-income countries was conceived in 2011, with formal negotiations commencing the following year. The pact was designed to eliminate approximately 90% of the tariffs on imports among the signatories within 20 years of coming into force and to establish common rules for e-commerce, trade, and intellectual property. The unified rules are expected to expedite international supply chains and reduce export costs throughout the bloc. More generally, the objective of the RCEP Agreement, announced in its official summary, is to establish a modern, comprehensive, high-quality, and mutually beneficial economic partnership that facilitates the expansion of regional trade and investment and contributes to global economic growth and development. Accordingly, the agreement will create opportunities for businesses to build market share and individuals to find remunerative employment throughout the region. Thus, it works alongside and supports an open, inclusive, and rules-based multilateral trading system. The exploration of such regional comprehensive economic partnerships has significant policy implications for competition and cooperation among nations (Gao and Gregory 2021).

2. Methodology

2.1 DCC-GARCH model

Our DCC model used a nonlinear combination of univariate GARCH models with time-varying cross-equation weights to model the matrix of errors for the conditional variances. Since our data for the daily stock market returns were skewed, we employed a skewed normal density assumption to estimate the DCC model.

While the DCC model provided information about the dynamic relationship between the movements of the stock markets in China and other RCEP countries, it relied on a fixed scale. Real-world markets, however, often include consumers and investors operating on various time scales. The correlations among the movements of various stock markets could diminish in the short-term (a high-frequency occurrence) or prove to be long-term (a low-frequency occurrence). Accordingly, we performed continuous wavelet analysis to capture the dynamic relationship among the indicators in various time scales.

2.2 Continuous wavelet analysis

The continuous wavelet transform expands time series $x(t)$ and $y(t)$ into a time frequency plane. Based on a mother wavelet ψ, a family of "wavelet daughters" is defined as

$$\psi_{\tau,s}(t) = \frac{1}{\sqrt{|s|}}\psi\left(\frac{t-\tau}{s}\right), \tau, s \in \mathbb{R}, s \neq 0 \tag{1}$$

In this study, we choose the Morlet wavelet as our "mother wavelet" because it is the wavelet transform most commonly used in economic analyses. The Morlet wavelet is defined as

$$\psi(t) = \frac{e^{i\omega_0 t - \frac{t^2}{2}}}{\pi^{\frac{1}{4}}} \tag{2}$$

where ω_0 is the central frequency. The continuous wavelet transform can then be defined as

$$W_{x;\psi}(\tau, s) = \int_{-\infty}^{\infty} x(t)\frac{1}{\sqrt{|s|}}\psi^*\left(\frac{t-\tau}{s}\right)dt \tag{3}$$

where the $*$ denotes the complex conjugation of the Morlet wavelet. Following the continuous wavelet transform, we introduced the wavelet power spectrum to measure the local variance for a time series at each frequency, represented as

$$WPS_x(\tau, s) = |W_x(\tau, s)|^2 \tag{4}$$

Moreover, we extended the cross-wavelet transform and the cross-wavelet power spectrum of the two series to investigate the relationship between the variables $x(t)$ and $y(t)$. The cross-wavelet transform of the two series is defined as

$$W_{xy}(\tau, s) = W_x(\tau, s)W_y^*(\tau, s) \tag{5}$$

where $W_x(\tau,s)$ and $W_y(\tau,s)$ are the continuous wavelet transforms of $x(t)$ and $y(t)$, respectively. When $y = x$, the wavelet power spectrum $W_{xx}(\tau,s) = |W_x(\tau,s)|^2 = (WPS)_x(\tau,s)$. The cross-wavelet power is then defined as

$$XWP_{xy}(\tau,s) = |W_{xy}(\tau,s)| \quad (6)$$

Based on the wavelet power spectrum and the cross-wavelet power, we performed wavelet coherence analysis to investigate the dynamic correlation in the time-frequency domain. The complex wavelet coherence δ_{xy} is defined as

$$\delta_{xy} = \frac{S(W_{xy})}{\left[S\left(|W_x|^2\right) S\left(|W_y|^2\right)\right]^{\frac{1}{2}}} \quad (7)$$

where S denotes a smoothing operator in both time and scale. The wavelet coherence is defined as the absolute value of the complex wavelet coherence

$$R_{xy} = \frac{|S(W_{xy})|}{\left[S\left(|W_x|^2\right) S\left(|W_y|^2\right)\right]^{\frac{1}{2}}}, \quad 0 \le R_{xy} \le 1 \quad (8)$$

Since the wavelet coherence remains positive, it cannot serve to distinguish whether the correlation is positive or negative. Therefore, we applied the phase difference to compensate for this defect. The complex coherence δ_{xy} can be expressed in polar form as $\delta_{xy} = |\delta_{xy}|e^{i\varphi xy}$. The angle φ_{xy} is the phase difference, which can be defined as

$$\phi_{xy} = tan^{-1}\left(\frac{\Im(S(W_{xy})}{\Re(S(W_{xy}))}\right), \quad \phi_{xy} \in [-\pi, \pi] \quad (9)$$

When $\varphi_{xy} \in (0, \frac{\pi}{2}) \cup (-\frac{\pi}{2}, 0)$, $x(t)$ and $y(t)$ correlate positively, in the former case, $x(t)$ leads $y(t)$, while the opposite is true in the latter case. When $\varphi_{xy} \in (-\pi, -\frac{\pi}{2}) \cup (\frac{\pi}{2}, \pi)$, $x(t)$ and $y(t)$ correlate negatively, again, in the former case, $x(t)$ leads $y(t)$, while the opposite is true in the latter case. In addition, a value of $\varphi_{xy} = 0$ indicates a positive relationship while a value of $\varphi_{xy} = \pi$ or $-\pi$ indicates a negative relationship.

3. Data and results

3.1 Data

We collected the MSCI indices for 11 RCEP countries for the period from January 2011 to December 2020. Excluding the differences in the open trading days among the markets, our final dataset consisted of 2,605 observations.

Table Ⅰ. Summary Statistics (mean, minimum, maximum, standard deviation, skewness and kurtosis)

	Mean	Min	Max	SD	Skewness	Kurtosis
CHINA	0.00027	-0.06390	0.06760	0.01292	-0.1289	2.5889
SINGAPORE	-0.00002	-0.07630	0.07590	0.01037	-0.1644	5.8309
THAILAND	0.00015	-0.11200	0.08610	0.01307	-0.4345	9.5292
INDONESIA	0.00009	-0.10880	0.16920	0.01575	0.0316	10.260
VIETNAM	0.00011	-0.06550	0.05500	0.01236	-0.3129	2.6494
PHILIPPINES	0.00023	-0.13510	0.08310	0.01297	-0.9145	10.256
JAPAN	0.00024	-0.08200	0.07390	0.01158	-0.1558	5.0580

KOREA	0.00029	-0.10410	0.10670	0.01429	-0.0426	5.7343
MALAYSIA	-0.00009	-0.05830	0.07470	0.00888	0.0081	6.7289
AUSTRALIA	0.00009	-0.10670	0.07900	0.01303	-0.5860	7.3199
NEW ZEALAND	0.00037	-0.08990	0.08780	0.01172	-0.0574	4.1996

Table II. Diagnostic Test Results (J-B test, ADF test, Ljung-Box test and Lagrange multiplier test)

	J-B	ADF	$Q(12)$	$Q^2(12)$	ARCH(12)
CHINA	737.15*	-47.663*	36.019*	761.57*	304.73*
JAPAN	2794.2*	-57.289*	52.631*	687.28*	429.33*
KOREA	3578.2*	-52.395*	36.585*	2091.1*	782.45*
SINGAPORE	3710.6*	-48.964*	45.044*	2597.5*	697.13*
THAILAND	9958.1*	-51.641*	24.660*	1180.9*	486.66*
INDONESIA	11448*	-46.901*	40.782*	1215.3*	512.10*
PHILIPPINES	11803*	-49.780*	14.482	1045.4*	616.61*
VIETNAM	806.96*	-45.788*	65.342*	757.30*	337.62*
MALAYSIA	4925.5*	-46.955*	41.520*	1110.8*	443.08*
AUSTRALIA	5977.6*	-50.784*	34.602*	2780.4*	812.40*
NEW ZEALAND	1920.8*	-49.483*	27.840	571.29*	336.89*

Tables I and II display the summary statistical properties and diagnostic test results for each index variable. The average index return was highest in New Zealand, followed by Korea and China, while Malaysia and Singapore realized negative average returns over the past decade. Further, Indonesia showed the greatest market volatility and Malaysia the least. The Jarque-Bera statistics provided evidence of a non-normal distribution for each series. Most countries skewed negatively, especially the Philippines, but the results also showed the markets in Malaysia and Indonesia to be positively skewed. Further, the Philippines and Indonesia showed the heaviest tails. The ADF statistics indicated a rejection of the unit root hypothesis, meaning that all of the series were stationary, while the Ljung-Box test revealed the existence of autocorrelation and the Lagrange multiplier test confirmed the ARCH effects that we observed. Having obtained these results, we proceeded with our DCC model and the continuous wavelet transforms assuming a skew-normal distribution.

Table III. DCC Results（coefficients results of DCC models on the return series）

	$\bar{\rho}$	λ_1	λ_2
SINGAPORE	0.5700	0.0196	0.9731
THAILAND	0.4448	0.0198	0.9718
VIETNAM	0.1687	0.0097	0.9705
INDONESIA	0.4319	0.0297	0.9566
PHILIPPINES	0.3869	0.0224	0.9628
JAPAN	0.3512	0.0069	0.9846
KOREA	0.5694	0.0175	0.9772
MALAYSIA	0.4746	0.0263	0.9653
AUSTRALIA	0.4744	0.0227	0.9676
NEW ZEALAND	0.2664	0.0127	0.9784

3.2 Results

Table III and Figures 1-2 display the estimation results for our DCC model. Significant spill-over across markets is apparent, while the DCC parameters further confirmed the persistence of the correlations. However, the dynamic conditional correlation fluctuated considerably over time. First, the conditional covariance showed three peaks for most countries corresponding to heightened systemic risks in 2012, 2015, and 2020. Specifically, these peaks correspond to the three major disruptions in the global market that occurred during our period of study, the Euro Debt Crisis, a period of turbulence in the Chinese stock market, and the Covid-19 Pandemic, respectively.

Second, the markets in most of these countries diverged sharply from the Chinese market in 2015 owing to the turbulence just mentioned, but they soon recovered and showed sharp increases in 2016. The turbulence resulted from China's ongoing capital market reforms, including the launch of the Shanghai-Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect Programs. We extended the wavelet analysis to capture the interdependence of the markets across time and frequencies, as shown in Figures 3-4. The directions of the arrows in these figures show the difference in the phases of the market cycle between the two series, as indicated by Table IV.

Table IV. Meaning of the Directions of the Arrows in the Wavelet Coherence Maps

Direction	Meaning
→	The first index is in phase with the second.
←	The first index is not in phase with the second.
↗&↙	The first index leads the second.
↘&↖	The first index lags and follows the lead of the second.

Figure 3 and Figure 4 depicts the wavelet coherence between China and the other countries that we investigated. Unsurprisingly, the stock markets in most of these countries showed a significant correlation with the Chinese market. We note in particular that, first, the coherence between the market in China and those in developed RCEP countries is largely consistent with the results of our DCC model, while the coherence between the market in China and those in emerging RCEP countries showed an upward trend over the decade. Notably, a boost in wavelet coherence has been apparent since 2018. Second, while the markets in most of the countries in our sample showed consistently high coherence with China's, we found certain "blue holes" in the coherence maps that, intuitively, seem attributable to a decrease in regional cooperation or increase in political and economic conflict. Thus, Thailand, Malaysia, Indonesia, and the Philippines showed significant blue holes during the recent flare-up of territorial disputes in the South China Sea. Lastly, the coherence maps indicate that, compared with most other RCEP countries, China's trading periods appear to have lagged by 64 to 128 days before 2014 and after 2018, while the situation reversed for short-term and mid-term trades in 2015-2016.

3.3 Discussion

From the perspective of economic foundation, stock markets become integrated gradually and automatically as their real economic cycles converge. The RCEP has worked to bring the member countries together, especially by strengthening their economic ties. Our dynamic conditional correlation results demonstrate that the enhancement of these ties has increased the co-movement between the market in China and those in other RCEP countries. We also note that geographic proximity contributes naturally to the variation within the overall high level of coherence, with that of Korea and Japan being the highest.

On the other hand, from the perspective of market contagion theory, the routes for contagion are financial crises, expected behaviours, and cross-border capital flow. Thus, one result of the trend toward increased globalization is the increasing contagion of financial crises, which influence, in turn, household economic behaviour through transmission and, eventually, lead to the herd effect in stock markets. Cerra and Saxena(2002) pointed out that there were contagions in Indonesia, Thailand and Korea stock market. Sever (2018) found the risks in neighbouring countries could influence domestic output negatively with no evidence for rebound. In our research, over the previous decade, the market co-movement showed conspicuous peaks during the Euro Debt Crisis, the period of Chinese stock market turbulence, and the Covid-19 pandemic. The irrational behaviour of the participants in the markets has contributed significantly to the market contagion; thus, irrational investors may enhance the co-movement of stock markets.

At the same time, significant events in terms of financial liberalization and regional economic and political conflict also significantly influenced stock market co-movements. Some of these events were related to China's financial opening, including the launch of the Shanghai-Hong Kong Stock Connect program in 2014 and the Shenzhen-Hong Kong Stock Connect program in 2016. China has also developed a series of corporation plans with RCEP member countries since 2016, further contributing to the coherence among these countries' markets. China is playing an ever-larger role in world affairs that is reflected in the results of our continuous wavelet analysis confirming the ever-changing nature of the lag-lead relationship between China's market and other markets around the world. The economic sanctions imposed by the United States in 2018 disrupted the co-movement between the Chinese market and markets in the developed world. However, once China demonstrated its sincerity in trade negotiations, the co-movement quickly resumed. Conversely, a wave of anti-Chinese protests in the Philippines and Indonesia in 2014-2017 increased the uncertainty regarding the connections among those countries' markets, and the political situation in Thailand resulted in a decrease in the co-movement of the markets in that country and China. Together, these regional economic and political conflicts have had the effect of decreasing the co-movement of markets. Further, the unprecedented impact of the Covid-19 pandemic that began in 2020 appears to be far-reaching and lasting, and the timetable for recovery is far from clear. At this juncture, the nations of the world are undergoing perhaps the most dramatic economic and political changes in history. The trends are generally toward increasing volatility and instability, conditions in which traditional econometric methodologies are proving inadequate.

4. Conclusions

We investigated the co-movement of the stock markets in China and other RCEP countries over the previous decade. We found a consistent trend toward co-movement that has been strengthened by an intensification of economic cooperation among these countries and by China's ongoing process of financial opening. China's economic and financial reforms have proved remarkably successful and thus deserve to be extended. On the other hand, we found that the stock market co-movement increased dramatically during periods of global crisis, as did regional economic and political uncertainties. These findings are consistent with economic foundation and market contagion theories advanced by Aloui and Hkiri (2014) and Tiwari, Mutascu, and Albulescu (2016). It is our hope that our findings prove useful to cross-boundary international investors involved in RCEP projects when designing hedging strategies, allocating assets, and managing risks as well as to the managers of global companies, government officials, members of NGOs, and others interested in the direction of world markets in the coming decades.

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Appendix

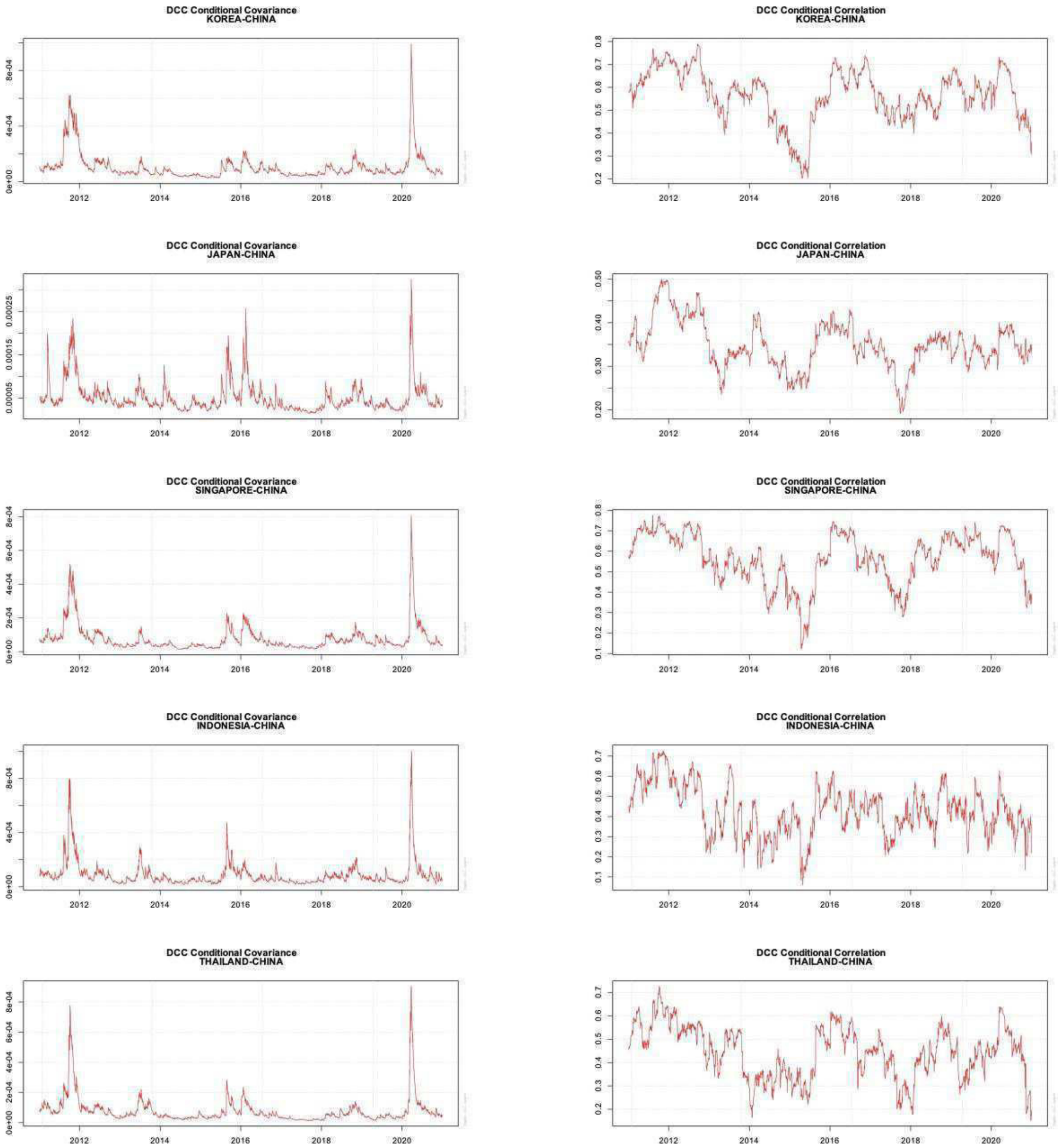

Figure 1. Dynamic Conditional Correlations

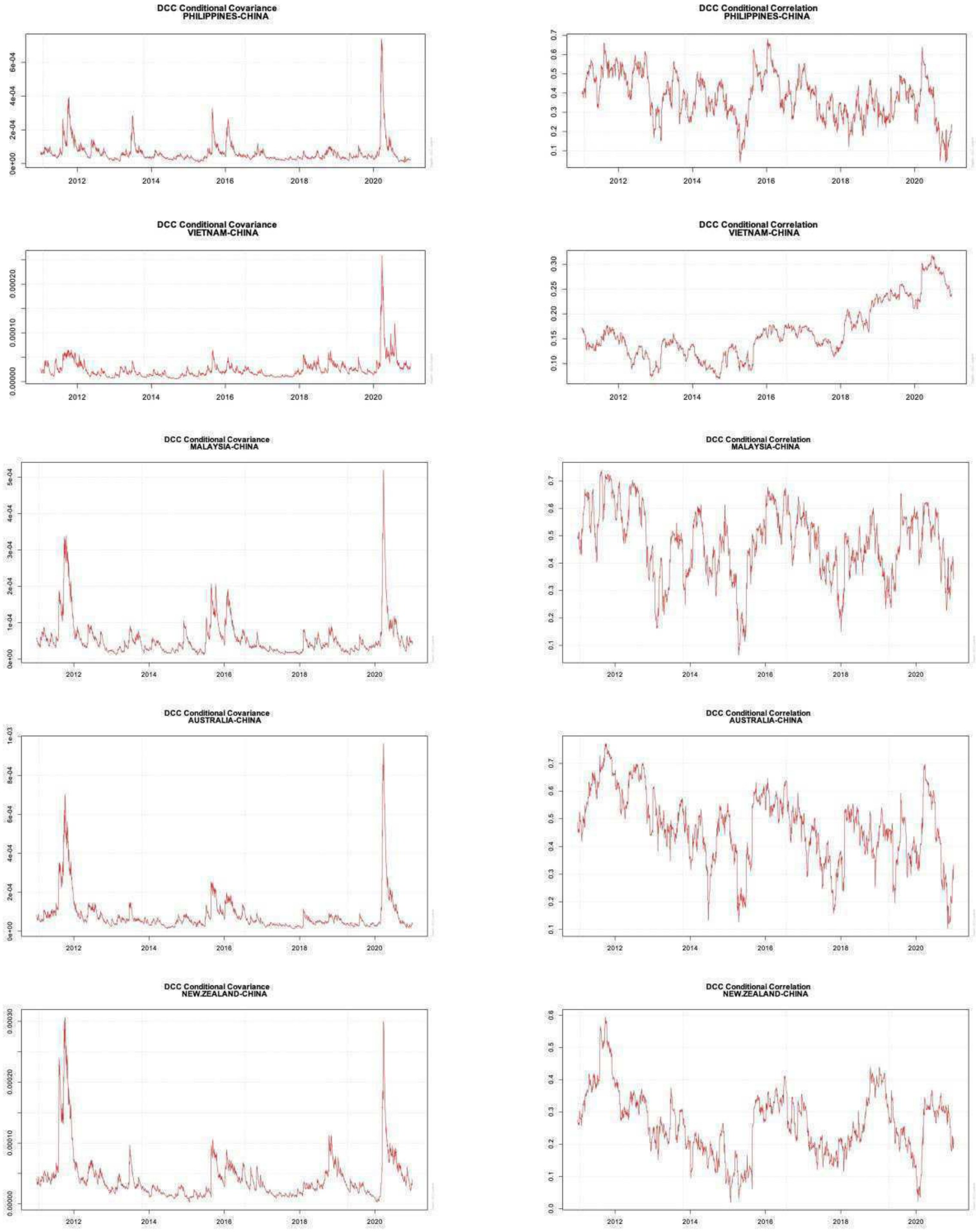

Figure 2. Dynamic Conditional Correlations (cont.)

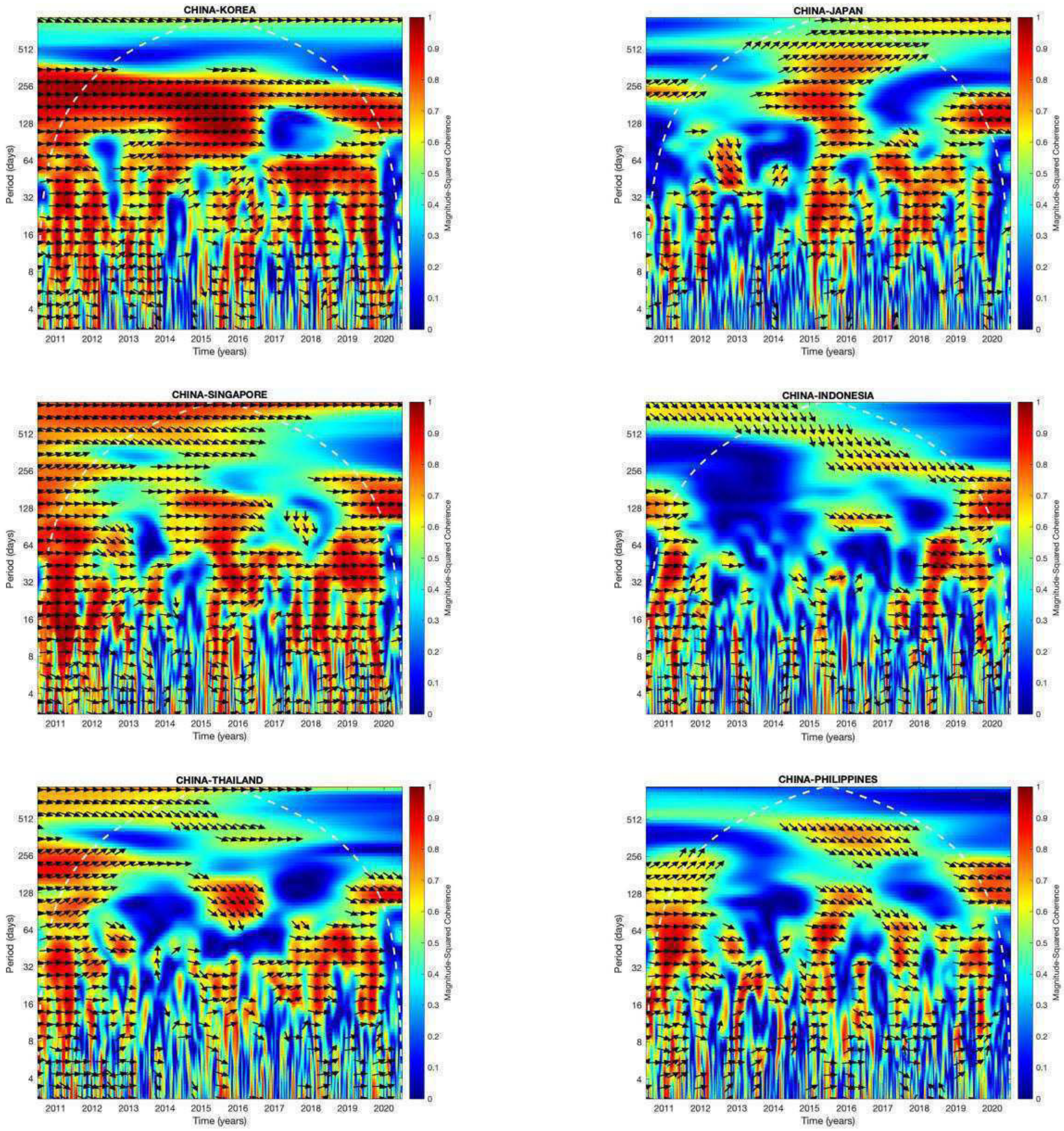

Figure 3. Wavelet Coherence Maps

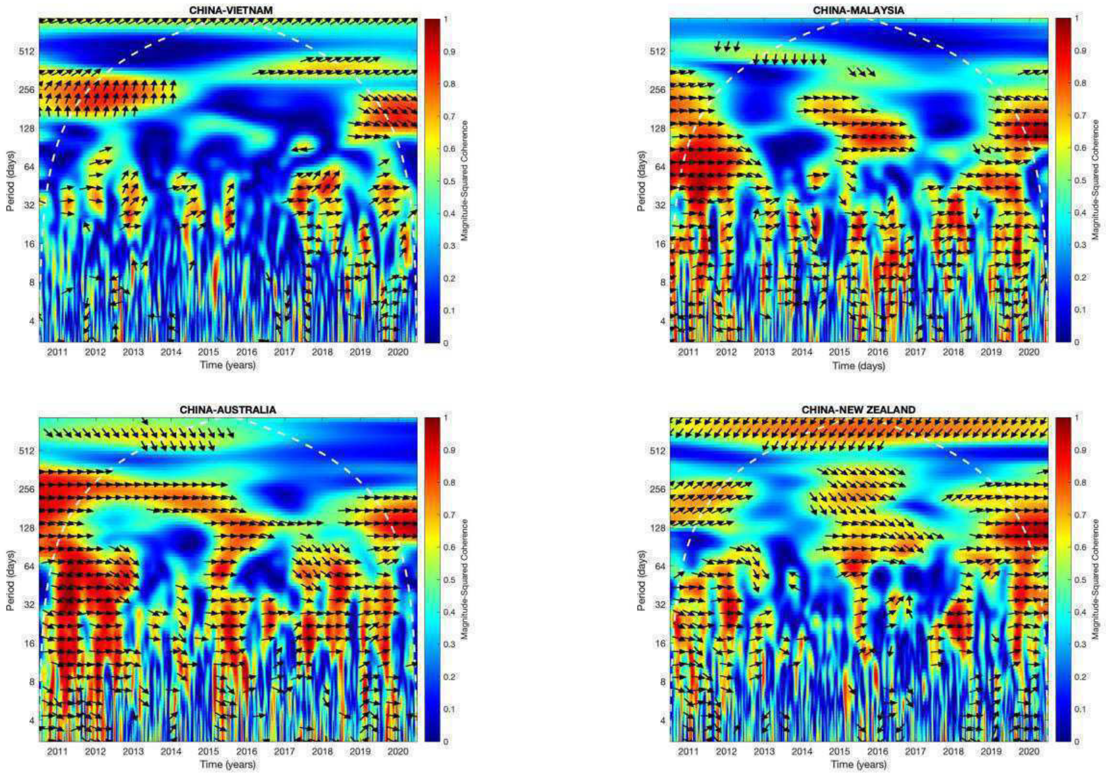

Figure 4. Wavelet Coherence Maps (cont.)