

The Synchronization of ASEAN +3 Business Cycles: Prerequisites for Common Currency Union

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Abstract

This study aims to analyze the relationship between the business cycles of the ASEAN +3 countries. In addition, the effects of the spillover value on the coincident indicators are determined. This study employs secondary data and uses multivariate time series of five ASEAN countries, namely, Indonesia, Malaysia, Singapore, Thailand, and the Philippines. The proxy was the real gross domestic product (GDP) collected annually from the CEIC, the IMF, and the World Bank for the period from 1964 to 2016. The data was plotted against two time periods, 1964–1998 as the pre-crisis period, and 1999–2016 as the post-crisis period. The index data was changed to the base year 2010. The data was subsequently separated from the trends and the cyclic components. The cyclic components were obtained by using Hondrick-Prescott filter, and them were further analyzed. The analytical method used was Contemporaneous and Cross-Correlation tools. The results showed that, before and after the crisis, the value of the business cycle correlation between ASEAN +3 countries was stronger and moved together at the same level of lag value. The implication of this research was an initial finding of the ASEAN +3 countries' prerequisites for the formation of a common currency.

Keywords: ASEAN+3, Business Cycle Synchronization, Optimum Currency Area, Economic Integrationn

JEL Classification Code: E32, E42, E52

1. Introduction

Regionalism has been in existence for the past 10 years and has increased rapidly in various parts of the world, particularly in East Asia. Cooperation and the integration of unified trade, investment, finance, and all monetary sectors are considered the best strategies for reducing poverty, and increasing macroeconomic stability and growth in the region. In addition, the Association of Southeast Asian Nations (ASEAN) and the Free Trade Agreement (AFTA), established in 1992, are the

most appropriate indications of close relations between East Asian countries (China, Japan, and South Korea). Recently, other collaboration such as the ASEAN-China FTA (ACFTA, 2010), the ASEAN-South Korea FTA (AKFTA, 2010), and the ASEAN-Japan Comprehensive Economic Partnership (AJCEP 2007) were established, while China, Japan, and South Korea are investigating the possibility of creating a trilateral FTA (Corning, 2009; Park, Park, & Estrada, 2009; Verico, 2017; Aprilia & Handoyo, 2019).

However, there is a relatively high trend of trade affiliations between East Asia and the ASEAN partner countries. The unified trade greatly influences the contribution of ASEAN to economic growth among the East Asian countries, especially the three main trade partners (Shin & Wang, 2003; Allegret & Essaadi, 2011; Dufrénot & Keddad, 2014). Therefore, a measure is established to strengthen trade, financial and monetary integration among the ASEAN countries (Japan, China, and South Korea), better referred to as ASEAN + 3, and also to create a common currency, namely, the Euro derived from the European Union (Cortinhas, 2007; Rana, 2007).

The idea of a currency union (CU) provides benefits and costs for its member countries through substitution, by maintaining the stability of the exchange rate, thereby reducing

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transaction costs, increasing trade and investment between the nations involved (Glick & Rose, 2002; Glick & Rose, 2016). The amount of money paid by a country to join the economic and monetary union (EMU) is due to the independent implementation of the fiscal policy. This tends to contradict the business cycle, therefore a nation tends to discharge its potential stability whenever a country joins a currency union (Frankel & Rose, 1998; Fidrmuc, 2004). In addition, the ability of an independent monetary policy is unstable (Mundell, 1961). Joining a currency union depends on the level of business cycle that correlates with the member countries (Frankel & Rose, 1998). This makes it possible for a nation to become a member of the Optimum Currency Area (OCA). Furthermore, the heightened output and co-movement tends to reduce the cost of establishing a currency union. This varies among countries with an impact on the nominal exchange rate regime of these nations (Artis & Zhang, 1997). In accordance with these reasons, it is necessary to study the nature of the business cycle in the ASEAN region before agreeing to align with the common currency policy. This is because there are diverse economic structures with developed, developing, and underdeveloped countries, therefore it is expected that the formation of the 2015 ASEAN community provides more benefits to its members.

The business cycle also referred to as the economic cycle, is a long-term pattern of economic growth (expansion) and recession (contraction). According to studies conducted by the Center for International Business Cycle Research at Columbia University in New York, the economic expansion between 1854 and 1945 lasted for an average of 29 months while the contraction period was for 21 months (Zarnowitz, 1990). However, since the end of World War II, the cycle of expansion has stretched to approximately double its initial average of 50 months, with a decrease in the contraction period to an average of 11 months. The business cycle is also defined as deviations from the output that tends to trend (Lucas, 1975; Zarnowitz, 1990). From this context, there is a period of expansion and contraction of economic activities. Subsequently, the business cycle has an impact on inflation (Nawatmi, Nusantara, Santosa, & Marlien 2020; Gallegati, Giri, & Palestini, 2019), government expenditures (Bunyan, Duffy, Filis, & Tingbani, 2020), unemployment (Bover, Arellano, & Bentolila, 2002), sales (Jaimovich, Rebelo, & Wong, 2019; Cacciatore, Fiori, & Traum, 2020), production (Osotimehin, 2020), and several aspects of the economy (Bellido & Marcén, 2019; Dong, Li, & Failler, 2020; Nguyen, Hoang, & Nguyen, 2020). It consists of several different stages, namely, expansion, contraction, and the recovery phases. Furthermore, it is also recognized as a proxy of the level of output (Osotimehin, 2019), this shows the magnitude of business rotation in the interactions among associate countries.

The development of the business cycle in ASEAN 5 countries, namely, Indonesia, Malaysia, Singapore, Thailand, and the Philippines, for the last 20 years shows the magnitude

of economic interaction among several trading associate countries in these regions makes it possible for them to carry out their activities. The economy shown by the level of output growth has a tendency to increase periodically. Therefore, the economies of the ASEAN developed in a positive trend from 1992 to 2016 as shown in Figure 2. Conversely, in the economic expansion cycle, Malaysia, Singapore, and Thailand recorded achievements above expectations. Singapore's economic growth accelerated to 8.8% in 2004, while Indonesia and the Philippines also experienced 5% and 6.4% growth, respectively, albeit slowly. Thailand has been able to increase its trade relations with countries in East Asia at an average growth rate of 5% to 10%. However, during the 1997/1998 and 2008 crisis, the economies of ASEAN countries experienced recession, which led to a decline by minus 13%.

Additionally, some results from the empirical studies conducted, show a variety of conceptions and discoveries. Pioneering studies carried the effect of exchange rate mechanism (ERM) in the presence of the economic and monetary union (EMU) between ERM and non-ERM member countries (Artis & Zhang, 1997). Therefore, the business cycle of ERM member countries has transitioned from America to Germany since its inception. This is due to the growth of trade and finance between European countries except Britain that did not transition during the observation period. In accordance with this research, Artis and Zhang (1997) analyzed the correlation in European countries, which was incorporated in the EMU. It was concluded that increase in the intensity of the trade is ambiguous and described the synchronization between European countries. However, bivariate correlation shows a value exceeding 80%, meaning the correlation between European countries is synchronous.

The study on business cycle correlations and the analysis on how these countries responded to shocks were carried out by many researchers (Bayoumi & Eichengreen, 1994; Ng, 2002; Calderon, Chong, & Stein, 2007; Montoya & De Haan, 2008; Moneta & Rüffer, 2009; Lee & Azali, 2012). Previous research by Ng (2002) and Huh, Kim, Kim, and Park (2015) reported the shock correlation and synchronization of the ASEAN business cycle with controls, namely, the European Union (EU) and NAFTA. The research conducted by Ng (2002) showed that external shock was closely related to ASEAN, unlike the NAFTA countries. However, its supply and demand in ASEAN have a low correlation. Indonesia, Singapore, and Malaysia, in certain circumstances, show a high degree of correlation. This is in accordance with the trading patterns existing between Southeast Asian countries, Singapore, Malaysia, and Indonesia in the currency union (CU). The correlation between supply, and demand among the three countries is higher than EU and NAFTA. ASEAN members are good candidates for establishing a monetary union, because they possess more tradable sectors. Furthermore,

in accordance with the research carried out by Huh, Kim, Kim, and Park (2015), the economy of East Asia shows a synchronous response to shocks, that is, their GDP tends to respond in sync with the world and regional economic shocks. Conversely, the synchronous response of East Asia is shown by the fluctuations in GDP through export and import channels and is interpreted as the similarity in business cycle synchronization.

Previous studies (Choe, 2001; Rana, 2007; Puspaningrum, Rin, & Gulati, 2010; Dufrénot & Keddad, 2014) showed findings not aligned with Mele (2012) and Huh, Kim, Kim, and Park (2015). According to Rana (2007), research on the analysis of the synchronization in East Asian shows that an intra-industrial trade is a significant factor that describes the co-movement. However, one interesting fact is that the increase in trade does not encourage the synchronization of business cycles. Puspaningrum, Rin, and Gulati (2010) analyzed the degree of trade integration in the ASEAN +3 countries using the OCA criteria in the region. The analysis shows that the integration of trade did not offer the same benefits for them because nations with lower economic levels have not yet benefited.

Mele (2012) shows the business cycle correlation in association with the trade intensity in ASEAN 4 countries. The analysis showed that the dominant trade intensity leads to a synchronous cycle in the countries, in terms of the use of common currencies. In other side, the bivariate model shows a synchronous relationship that exceeds 90% in Indo-Mal, Phil-Sing, Mal-Phil-Sing-Laos, Laos-Chin, and Laos-Viet. In addition, the correlation value after the 1997–1998 crisis was higher than before, this indicates that ASEAN 9 had a synchronous business cycle after the disaster (Mele, 2012). Therefore, the finding proved that the idea of a common currency union in the ASEAN region needs to be considered as a means to reduce the impact of global crisis.

The differences in the results from previous studies encourage exploration and examination of business cycle between ASEAN +3 countries and economic shocks of other countries. According to the Optimum Currency Area theory (Mundell, 1961; Mckinnon, 1963), synchronization of business cycles and symmetrical output is crucial because the costs of losing independent monetary policies tend to be significantly reduced when countries have similarities with a positive effect on economic shocks (Dufrénot & Keddad, 2014).

2. Literature Review

2.1. Business Cycle

Business cycles are a type of fluctuation in aggregate economic activities (Nguyen, 2020; Tran & Nguyen, 2020), based on cyclical peaks and bottoms. In the long-term trends,

business cycles are determined by deviation of growth where fall takes place in the series by series. In this context, Singleton (1988), Robert, Plosser, and Rebelo (1998), consider an alternative approach for describing business cycles using the Hodrick Prescott filter, and comparing with Baxter and King (1993). The is quite different because it is using an alternative approach that uses spectral analysis of time series. Several approaches were also developed to measure business cycles indicators or the cause behind them. Stadler (1990) posits monetary shocks instead of technological progress as fundamental variable that causes business cycles. Evans (1992) considers what causes business cycles measured through TFP (Total Factor Productivity) by relying on indicators of monetary policy, and Norrbin (1988), with a similar approach, considers data on military spending. On the other hand, the causes of business cycles came from shocks term in oil industry, instead of technological progress as the substantial variable (Stadler, 1990; Pham 2020). From this concept, it is clear that many concepts regarding the business cycle have developed and are quite different when compared to the beginning of the 19th century. Because at that time Mitchell (1927) explained that *“Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals which merge into the expansion phase of the next cycle”*.

Several alternative approaches recently proposed in the business cycle literature addressed trends from components of the time series cycle (Gazda, 2010; Castelnuovo, Lim, & Pellegrino; Yan & Huang, 2020; Widarjono, Anto, & Fakhrunnas). One of these approaches called Hodrick-Prescott (HP) filter minimizes the squared shape to determine the trend component in a particular series. The properties of the HP filter are studied by many authors, including Singleton (1988), Robert, Plosser, and Rebelo (1998), Pedersen (2001) and Hamilton (2018). Dynamic business cycles obtained using HP de-trending methods depend on the characteristics of the studied data. If they are stationary, then the de-trending procedure has favorable characteristics. If the observed data are non-stationary, the HP filter produces spurious business cycle fluctuations. An other approach is based on the spectral analysis of economic time series. The band-pass filter, which filters and traces the long-term trend of the high-frequency changes in a observed time series, was developed by Baxter and King (1993). The approach maintains the components that are associated with the periodicity of a typical business cycle (Christiano & Fitzgerald, 2003; Avezedo, 2011). Usually, this periodicity is between six quarters and eight years. This study used HP filter to analysis the synchronization of ASEAN +3 business cycle as prerequisite for common currency union.

3. Research Methods and Materials

This study employed secondary data, which consist of a multivariate time-series of five ASEAN countries, namely, Indonesia, Malaysia, Singapore, Thailand, and the Philippines. It also consists of three East Asian, namely, China, Japan, and South Korea as well as the United States. The proxy used in this variable was the Real Gross Domestic Product (GDP) collected annually from CEIC, IMF, and the World Bank for the period from 1964 to 2016. The data was plotted against two time periods, 1964–1998, as the pre-crisis period, and 1999–2016 as the post-crisis period. The index data was changed to the base year 2010. The data was subsequently separated from the trend and the cyclic component. The cyclic component was obtained by using Hondrick-Prescott (HP) filter, which was further analyzed.

The de-trending process is carried out using the Hodrick-Prescott (HP) filter method. The HP filter minimizes the combination of y around t with the second derived constraint from s . The HP filter tends to minimize, therefore the equation was adopted from De Jong and Sakarya (2016), which is stated as follows.

$$\sum_{t=1}^T (y_t - s_t)^2 + \lambda \sum_{t=2}^{T-1} (s_{t+1} - 2s_t + s_{t-1})^2 \quad (1)$$

Where T is denoted as the sample size, λ is a (non-negative) smoothing parameter for annual data, the values are chosen are 100 (Dufrénot & Keddad, 2014). While $y = (y_1, \dots, y_T)$ is the data series to be smoothed.

The result from the HP filter is the cyclical component of the GDP of eight ASEAN +3 countries, however, its patterns and characteristics are observed through contemporaneous correlation. This method shows the series of correlations in the same period, therefore it is observed that the degree of synchronization between the series is closer to the business cycles of the countries. The contemporaneous correlation is obtained from the correlation matrix. The correlation matrix is used to test the relationship between the values of the independent and the dependent variables in the regression equation. The correlation matrix value of each ASEAN +3 countries is further tested for its significance by a comparison of the t distribution value. The critical value used in the study of 5% is 1.96. Assuming the absolute value of the t distribution for each country is greater than 1.96, then the correlation values are significant at the real level of 5%. The t distribution value is calculated by the following formula

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \quad (2)$$

where t its distribution value, r its correlation coefficient, and n its a number of observations.

Cross-correlation shows that the economic variables (GDP) of the two countries act as lead, lag, or coincident indicators. Leading indicators show changes in economic variables that progress by preceding the movement of the reference series. Lagging indicators are the changes that progress after the movement of the reference variable, while coincident indicators progress in accordance with the reference series. It shows the de-trending of the cyclic component has a correlation or not. Cross-correlation between two variables, for example, x and y is calculated by

$$r_{xy} = \frac{C_{xy}(l)}{\sqrt{C_{xy}(0)} \cdot \sqrt{C_{yy}(0)}} \quad (3)$$

where $l = 0, \pm 1, \pm 2$

$$C_{xy}(l) = \sum_{t=1}^{T-1} \frac{(x_t - \bar{x})(y_{t+l} - \bar{y})}{T} \quad (4)$$

where $l = 0, 1, 2, \dots$

$$C_{xy}(l) = \sum_{t=1}^{T+1} \frac{(y_t - \bar{y})(x_{t+l} - \bar{x})}{T} \quad (5)$$

According to the cross-correlation, the degree of interrelation between the two cycles, and the phase change tends are analyzed. The degree of interrelation or synchronization is obtained from the maximum correlation, which is the highest outcome of cross-correlation. The higher the value of the cross-correlation between two countries, the higher the degree of interrelation between two business cycles, and they tend to be more related to each other. Conversely, the change in phase is observed from the lead/lag when the maximum correlation is obtained. The smaller the lead/lag, the more the phase change between the two countries tends to be similar.

4. Results and Discussion

The real data from the GDP is ready to be processed, and the trends are separated from the cyclic component using the HP filter, which was further analyzed. However, as stated by Cottarelli, Dell'ariccia, and Vladkova-Hollar (2005), one weakness of HP filters measures the trend of all reviews while ignoring the possibility of structural breaks. In accordance with these considerations, the researchers tried to eliminate all data obtained during the crisis. Furthermore, HP filter testing was carried out on data obtained from January 1968 to December 2016, the period after crisis was also taken into account in order to obtain a long-term trend. The analysis of the business cycles of ASEAN +3 countries using HP filter is shown in Figure 1.

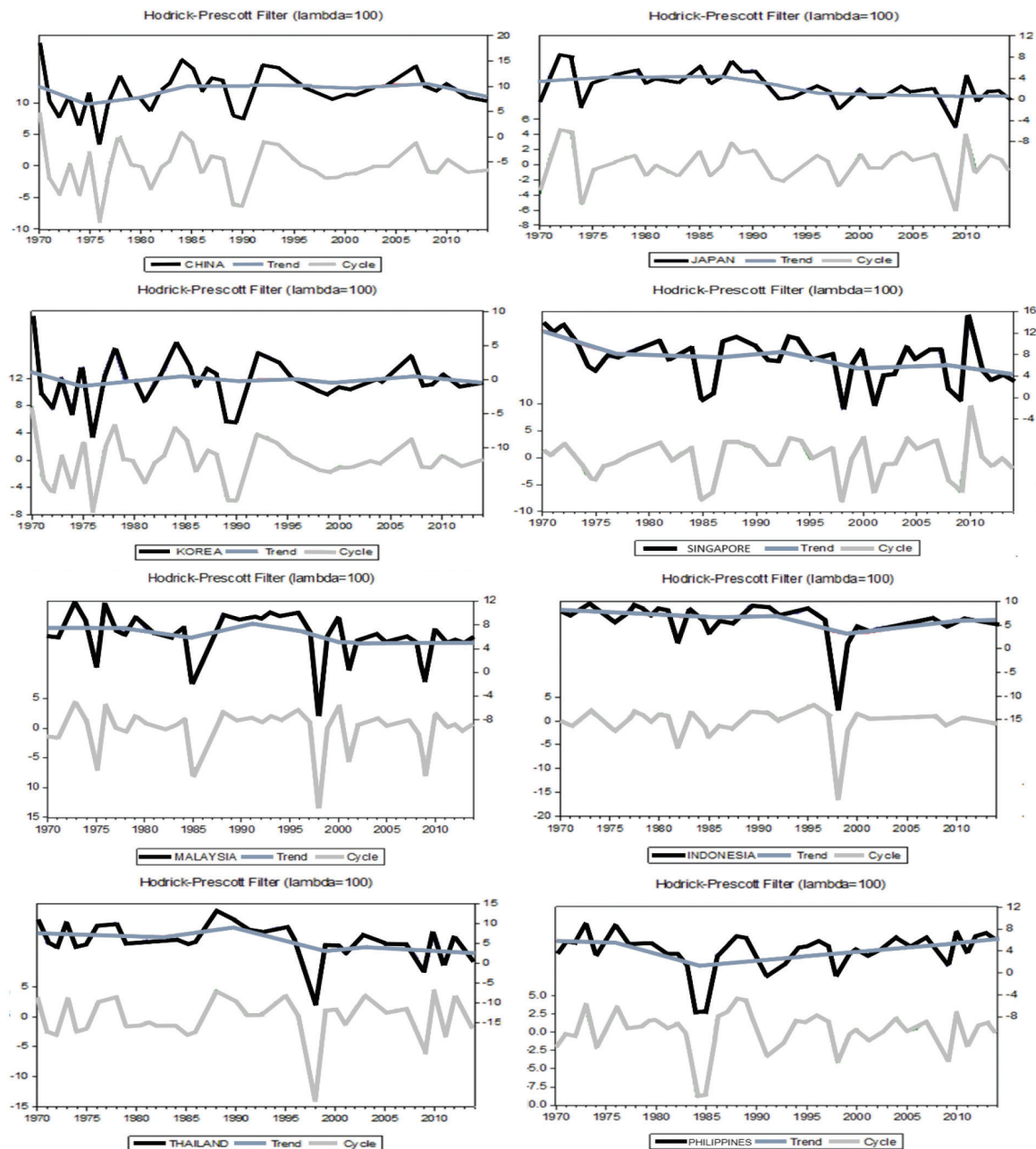


Figure 1: ASEANs +3 Business Cycle (Processed Data, 2019)

Figure 1 shows China's business cycle, which is still within the range of long-term trends and are always stable when using the upper and lower limits of 10 Stdev. It is observed that the initial period is volatile until May 1976, when it experienced a salient increase of -9.7% that lasted for two years. Therefore, the long-term movement of trends is stable. Comparison with Japan shows that Japan's business cycle in the long term

relatively fluctuates between the upper and the lower limits at 6 and 8 Stdev, respectively. In 1974, it experienced a salient depreciation of -5.2% , however, this cycle was repeated in 2009, and a value of -6.1% was obtained. At the end of 2008, a global crisis occurred in Europe and America (supreme mortgage), which had an impact on the Japanese economy because it was their biggest trading partner.

Figure 1 shows that South Korea's economy in the short term has fluctuated with the upper and lower limits of 12 and 8 Stdv, respectively. From 1970–1990, it was relatively highly volatile, as reflected in the sharp depreciation value of -7.5% in 1976, with an increase to 5.2% over the next two years in 1978. The depreciation of its economy occurred from 1981, 1987–1989, and experienced appreciation from 1990–1992. These results show that, in the early days of independence, South Korea was often confronted with civil wars that led to economic shocks, therefore, it was very apparent that its economy in the 1970–1990 era fluctuated. However, after the 1990s, the economy was stable with a positive trend, with its global economy open, thereby, leading to rapid growth.

Then, the economy of Singapore and Malaysia fluctuated after the 1997 crisis, with a negative trend consisting of an upper and lower limit of 10 Stdv. In 1998, its market experienced a huge depreciation of -8.3% , and this was experienced again in 2001 and 2008 at levels of -6.5% and 6.5% , respectively. These three events were due to the ASEAN crisis in 1997/1998 and the financial crisis in America and Europe in 2008. Meanwhile, the economy of Malaysia fluctuated with upper and lower limits of 5 and 15 Stdv, respectively. In general, its economy rapidly depreciated. The sharpest depreciation was experienced in 1998 to the level of -13.2% . This showed how much the influence of the ASEAN crisis in 1997/1998 had an impact on the Malaysian economy.

Moreover, the economies of Indonesia and Thailand were relatively stable, with upper and lower limits of 5 and 20 Stdv, respectively. However, there was a rapid depreciation in 1998 to the level of -16.5% , which was the largest compared to other ASEAN countries. This indicates how much the ASEAN crisis of 1997/1998 influenced the economy. Meanwhile, Thailand's economy moved rapidly with an upper and lower limit of 5 and 15 Stdv, respectively. In general, the business cycle of Thailand rapidly depreciated, with the largest experienced in 1998 to the level of -14.2% . The ASEAN crisis in 1997/1998 originated from Thailand with the fall of the exchange rate of Bath to the US dollar.

The business cycle of the Philippines rapidly fluctuated in the short and long term with upper and lower limits of 5 and 10 Stdv. The sharpest depreciation of the Philippines business cycle occurred in 1985 at the level of -8.85% . However, during the ASEAN crisis in 1997/1998, the Philippines economy was relatively unaffected significantly compared to other ASEAN, it only depreciated to the level of -4.45% . It is furthermore predicted that the Philippines business cycle tends to fluctuate in the coming years due to its continuous dependency on China, Malaysia, and Japan.

The descriptive statistical data provides an overview of the variables studied through sample data, as shown in Table 1. Based on the descriptive statistical tests in

Table 1, the standard deviation of the variables of all ASEAN and 3 other countries, both before and after the crisis in 1997/1998, were above the average value, which shows that the cycle is varied or not grouped. After the crisis, the standard deviation data rose, thereby, indicating that the cycle became more volatile. In China, Japan, and South Korea, the highest scores increased in the post-crisis phase. This shows that the economy experienced a positive movement or growth. Conversely, in China, Japan, and South Korea, the lowest value was at the negative level and higher in the post-crisis phase. This shows that the economy moves rapidly in a positive direction and also tends to move rapidly in the negative. Therefore, the economy of the three countries fluctuated after the crisis.

Based on the descriptive statistical analysis in Table 1 of Singapore, Malaysia, Indonesia, Thailand, and the Philippines, the standard deviation values before and after the crisis were above the average value of the data, and this shows that business cycle data is a moving variable. The maximum value in the phase after the crisis increased above the average value with rapid impact on Indonesia and Philippines. These two countries after the crisis phase have the greatest value of change. For example, in Indonesia, the highest value before and after the crisis was 13.09 and 27.01, respectively. Similarly, in the Philippines, before the crisis, the maximum value of 6.49 increased to 11.46.

The results of this descriptive value are in line with the real economic conditions that the highest value occurred in 1997/1998 when the Southeast Asian crisis occurred. The fall of the Bath exchange rate started from Thailand, which impacted on partner countries, with a contagion effect that triggered a regional crisis. During this period, Indonesia was a partner country to Thailand and was quite strong at that time.

Table 2 shows the contemporaneous correlation values before the Asian crisis in 1997/1998 with a strong business cycle correlation. This is seen from the value of the significant correlation matrix including China with (Japan, Singapore, Malaysia, and Indonesia), Japan with (Singapore and Malaysia), Singapore with (Malaysia, Indonesia, Thailand, and the Philippines), Malaysia with (Indonesia, Thailand and the Philippines), Indonesia with (Thailand and the Philippines) and Thailand with the Philippines.

In the post-crisis phase, there are different correlation values compared to the pre-crisis phase. The change was found in Indonesia, Thailand, and the Philippines with insignificant economic values to each other and a significant positive correlation with developed countries such as China, Japan, South Korea, Singapore, and Malaysia. This shows that the economy of small countries such as Indonesia, Thailand, and the Philippines depends on the economic conditions of developed countries such as China, Japan, South Korea, Singapore, and Malaysia. Meanwhile, developed countries possess a significant positive correlation, as shown

Table 1: Descriptive Statistics ASEANS +3 Countries

Descriptive Statistics + 3 Countries (China, Japan, and South Korea)									
	China			Japan			South Korea		
	All	Precrisis	Postcrisis	All	Precrisis	Postcrisis	All	Precrisis	Postcrisis
Mean	0.42	0.175	-4.41	-0.161	0.56	-4.96	0.0595	0.0215	-1.5
Med	4.82	4.18	-34.61	-9.27	-25.29	0.49	1.12	0.11	1.49
Max	257.6	85.45	318.22	195.03	202.26	185.29	21.84	11.16	16.03
Min	-229.7	-89.84	-233.32	-237.98	-87.82	-241.23	-48.2	-11.79	-24.11
SD.	89.8	34.71	174.03	84.54	78.70	89.22	11.89	6.46	11.82
Descriptive Statistics 3 ASEAN Countries (Singapore, Malaysia, and Indonesia)									
	Singapore			Malaysia			Indonesia		
	All	Precrisis	Postcrisis	All	Precrisis	Postcrisis	All	Precrisis	Postcrisis
Mean	0.02	0.015	-0.16	0.06	0.01	-0.24	0.07	0.04	-1.02
Med	0.21	0.20	1.36	-0.07	-0.04	0.19	-1.13	-0.41	-3.98
Max	8.7	3.92	8.40	13.28	6.04	8.08	59.91	13.09	27.01
Min	-13.4	-3.98	-13.98	-9.60	-4.71	-10.10	-27.28	-12.15	-11.35
SD.	4.3	1.77	6.60	4.14	2.58	4.16	16.27	5.40	11.18
Descriptive Statistics 2 ASEAN Countries (Thailand and Philippines)									
	Thailand			Philippines					
	All	Precrisis	Postcrisis	All	Precrisis	Postcrisis			
Mean	0.05	0.02	-0.51	0.00	-0.01	-0.285			
Med	0.59	0.58	1.34	-0.08	-0.27	-0.34			
Max	23.83	8.50	8.90	11.33	6.49	11.46			
Min	-15.19	-7.83	-10.74	-7.92	-7.98	-7.05			
SD.	8.02	3.83	5.71	3.58	3.45	4.26			

in Table 2, with insignificant changes. This means that the correlation between the business cycles of countries such as China, Japan, South Korea, Singapore, and Malaysia is very close, with interdependent economies. The table shows that the formation of a currency union in ASEAN +3 countries allows for an increase in increasingly synchronized economies and reduces costs due to asymmetric shock. However, the formation of a currency union still needs further study and analysis. The results of this analysis are an early indication that it is possible to form a currency union between the ASEAN +3 countries.

The next approach is to determine the strength or closeness of the business cycle, with analytical testing by looking at the correlation between the ASEAN +3 sample countries. As stated by Corning (2009), the correlation of shocks between member countries that are positive

with high value is more suitable to be an OCA candidate because union-wide policies tend to be used to correct the imbalances that occur. Furthermore, the suitability of joining the currency union depends on the level of correlation with other member countries. The increasing symmetry between countries makes it more likely for it to become an OCA member because an increase in output tends to reduce its formation cost. This method shows the group series and correlations over the same period. Therefore, the degree of synchronization between the series cycles is closer to the economy (Frankel & Rose, 1998).

This section shows the empirical results relating to synchronization of the economic cycle of ASEAN +3 countries from 1996 to 2016, as measured by the contemporaneous correlation obtained from the correlation matrix. Correlation is a statistical test used to determine

Table 2: Contemporaneous Correlation ASEAN+3 Countries

	China	Japan	South Korea	Singapore	Malaysia	Indonesia	Thailand	Philippines
Pre-crisis Period								
China	1.00							
Japan	−0.69709***	1.00						
South Korea	0.315755*	0.119144	1.00					
Singapore	0.445164**	−0.34388*	0.121872	1.00				
Malaysia	0.505831***	−0.4234**	0.189762	0.88821***	1.00			
Indonesia	0.384217**	−0.30950	0.244877	0.74087***	0.89057***	1.00		
Thailand	−0.10467	0.104469	0.300660	0.368686**	0.358871*	0.55056***	1.00	
Philippines	−0.05684	0.082496	0.211997	0.57305***	0.54306***	0.436447**	0.35590*	1.00
Post-crisis Period								
China	1.00							
Japan	−0.09483	1.00						
South Korea	0.034902	0.367689	1.00					
Singapore	0.67296***	0.444945*	0.46949**	1.00				
Malaysia	0.429890*	0.7089***	0.383899	0.61339***	1.00			
Indonesia	0.91168***	0.032902	−0.13364	0.561664**	0.53732**	1.00		
Thailand	0.190773	0.8112***	0.255641	0.585444**	0.63893***	0.203885	1.00	
Philippines	0.047095	0.44850*	−0.26419	0.059806	0.49276**	0.346223	0.16156	1.00

Table 3: Cross Correlation and Lag/Lead in Pre-crisis Period

	China			Japan			South Korea			Singapore		
	Lag	Lead	Max Corr	Lag	Lead	Max Corr	Lag	Lead	Max Corr	Lag	Lead	Max Corr
Singapore	3		0.37		5	0.54		6	0.55			
Malaysia	1		0.46		5	0.58		6	0.54		1	0.70
Indonesia	1		0.51		4	0.63		5	0.46		1	0.63
Thailand	5		0.48		4	0.56		4	0.46	1		0.66
Philippines	5		0.55		9	0.64		4	0.33	1		0.58
	Malaysia			Indonesia			Thailand					
	Lag	Lead	Max Corr	Lag	Lead	Max Corr	Lag	Lead	Max Corr			
Singapore												
Malaysia												
Indonesia	1	0.79										
Thailand	1	0.77	1			0.83						
Philippines	1	0.57	1			0.47		1	0.45			

Table 4: Cross Correlation and Lag/Lead in Post-crisis Period

	China			Japan			South Korea			Singapore		
	Lag	Lead	Max Corr	Lag	Lead	Max Corr	Lag	Lead	Max Corr	Lag	Lead	Max Corr
Singapore	1		0.47		6	0.49			11	0.38		
Malaysia		1	0.23		7	0.35			6	0.31	1	0.40
Indonesia		1	0.57		6	0.42			12	0.24	1	0.48
Thailand	6		0.39		6	0.32			6	0.40	6	0.39
Philippines		1	0.39		8	0.45		4		0.20	2	0.23
	Malaysia			Indonesia			Thailand					
	Lag	Lead	Max Corr	Lag	Lead	Max Corr	Lag	Lead	Max Corr			
Singapore												
Malaysia	0.40											
Indonesia	0.48	1		0.27								
Thailand	0.39	1		0.35	6		–0.34					
Philippines	0.23		1	0.53		1	0.54		8			

the relationship between two or more variables using a coefficient. The correlation coefficient value is between 0–1, and it is declared to have a stronger as well as weaker value closer to 1, and 0, respectively.

The correlation coefficient is either positive or negative. A positive and negative coefficient indicates a positive or negative linear relationship between variables, respectively. Correlation test results between two or more variables are used as evidence that there is an indication of causality. However, not all variables that have a correlation relationship also has a causality relationship. The analysis using contemporaneous correlation shown in the previous explanation provides information on the degree of synchronization between the two sample countries. The analysis shows that there is a regular movement in synchronization between periods before and after the crisis, however, its movement remains unclear. The movement or change is determined by finding the lead/lag when the maximum correlation is obtained using cross-correlation as shown in Tables 3 and 4 in the lag/lead column. The smaller the value from the cross-correlation, the similar the change in phase/movement of the economy between the two countries.

5. Conclusions

Based on the combination of the analysis of contemporaneous, and cross-correlation with the lag/lead value, the study conclusions are as follows: (a) the shocks caused by China before and after the crisis led to an

increasingly strong business cycle with a correlation value that synchronized Malaysia-Indonesia and the Thailand-Philippines. Meanwhile, Singapore had a different business cycle with other countries (out of sync); (b) in the shocks caused by Japan before and after the crisis, the correlation value of the business cycle was not stronger than the shock of China. The results of business cycle correlation values were getting stronger, which synchronized Singapore-Malaysia and Indonesia-Thailand-Philippines; (c) in the shocks caused by Korea before and after the crisis, there was an increasingly strong business cycle correlation value that synchronized Singapore-Malaysia and Thailand-Indonesia-Philippines.

The prerequisites used to form a common currency from the OCA theory are as follows: (i) the similarity of shocks from the business cycle, (ii) high trade integration, (iii) internal labor mobility, and (iv) internal fiscal transfers. This study still considers the synchronization of business cycles as one of the main requirements. Based on the analysis and findings, this study provides justification for the findings of previous studies related to the correlation and synchronization of business cycles in ASEAN +3 countries. Therefore, in the future, currencies can be united and utilized.

References

- Allegret, J. P., & Essaadi, E. (2011). Business cycles synchronization in East Asian economy: Evidences from time-varying coherence study. *Economic Modelling*, 28(1–2), 351–365. <https://doi.org/10.1016/j.econmod.2010.08.014>

- Aprilia, G. T., & Handoyo, R. D. (2019). Impact of Trade Creation and Trade Diversion in ASEAN-Japan Comprehensive Economic Partnership (AJCEP). *Journal of Developing Economics*, 4(2), 25–34. <http://dx.doi.org/10.20473/jde.v4i2.12688>
- Artis, M. J., & Zhang, W. (1997). International business cycles and the ERM: Is there a European business cycle? *International Journal of Finance & Economics*, 2(1), 1–16. [https://doi.org/10.1002/\(SICI\)1099-1158\(199701\)2:1<1::AID-IJFE31>3.0.CO;2-7](https://doi.org/10.1002/(SICI)1099-1158(199701)2:1<1::AID-IJFE31>3.0.CO;2-7)
- Azevedo, J. V. E. (2011). A multivariate band-pass filter for economic time series. *Journal of the Royal Statistical Society: Series C (Applied Statistics)*, 60(1), 1–30. <https://doi.org/10.1111/j.1467-9876.2010.00734.x>
- Baxter, M., & King, R.G. (1993). Fiscal policy in general equilibrium. *The American Economic Review*, 315–334. <https://www.jstor.org/stable/2117521>
- Bayoumi, T. Y., & Eichengreen, B. (1994) “One Money or Many? Analyzing the prospects for Monetary Unification in Various Parts of the World”. *Princeton Studies in International Finance*, 76, 1–37. [https://doi.org/10.1016/S0014-2921\(97\)00035-4](https://doi.org/10.1016/S0014-2921(97)00035-4)
- Bellido, H., & Marcén, M. (2019). Fertility and the business cycle: the European case. *Review of Economics of the Household*, 17(4), 1289–1319. <https://doi.org/10.1007/s11150-019-09449-y>
- Bover, O., Arellano, M., & Bentolila, S. (2002). Unemployment duration, benefit duration and the business cycle. *The Economic Journal*, 112(479), 223–265. <https://doi.org/10.1111/1468-0297.00034>
- Bunyan, S., Duffy, D., Filis, G., & Tingbani, I. (2020). Fiscal policy, government size and EMU business cycle synchronization. *Scottish Journal of Political Economy*, 67(2), 201–222. <https://doi.org/10.1111/sjpe.12233>
- Cacciatore, M., Fiori, G., & Traum, N. (2020). Hours and employment over the business cycle: A structural analysis. *Review of Economic Dynamics*, 35, 240–262. <https://doi.org/10.1016/j.red.2019.07.001>
- Calderon, C., Chong, A., & Stein, E. (2007). Trade intensity and business cycle synchronization: Are developing countries any different? *Journal of International Economics*, 71(1), 2–21. <https://doi.org/10.1016/j.jinteco.2006.06.001>
- Castelnuovo, E., Lim, G., & Pellegrino, G. (2017). A short review of the recent literature on uncertainty. *Australian Economic Review*, 50(1), 68–78. <https://doi.org/10.1111/1467-8462.12210>
- Choe, J. I. (2001). An impact of economic integration through trade: on business cycles for 10 East Asian countries. *Journal of Asian Economics*, 12(4), 569–586. [https://doi.org/10.1016/S1049-0078\(01\)00103-8](https://doi.org/10.1016/S1049-0078(01)00103-8)
- Corning, G. P. (2009). Between bilateralism and regionalism in East Asia: the ASEAN–Japan Comprehensive Economic Partnership. *The Pacific Review*, 22(5), 639–665. <https://doi.org/10.1080/09512740903329749>
- Cortinhas, C. (2007). Intra-industry trade and business cycles in ASEAN. *Applied Economics*, 39(7), 893–902. <https://doi.org/10.1080/00036840500461907>
- Cottarelli, C., Dell’ariccia, G., & Vladkova-Hollar, I. (2005). Early birds, late risers, and sleeping beauties: Bank credit growth to the private sector in Central and Eastern Europe and in the Balkans. *Journal of Banking & Finance*, 29(1), 83–104. <https://doi.org/10.1016/j.jbankfin.2004.06.017>
- De Jong, R. M., & Sakarya, N. (2016). The econometrics of the Hodrick-Prescott filter. *Review of Economics and Statistics*, 98(2), 310–317. https://doi.org/10.1162/REST_a_00523
- Dong, H., Li, Z., & Failler, P. (2020). The Impact of Business Cycle on Health Financing: Subsidized, Voluntary and Out-of-Pocket Health Spending. *International Journal of Environmental Research and Public Health*, 17(6), 1928. <https://doi.org/10.3390/ijerph17061928>
- Dufrénot, G., & Keddad, B. (2014). Business cycles synchronization in East Asia: A Markov-switching approach. *Economic Modelling*, 42, 186–197. <https://doi.org/10.1016/j.econmod.2014.07.001>
- Evans, L. (1992). Productivity Shocks and Real Business Cycles. *Journal of Monetary Economics*, 29(2), 191–208. [https://doi.org/10.1016/0304-3932\(92\)90012-Q](https://doi.org/10.1016/0304-3932(92)90012-Q)
- Frankel, J. A., & Rose, A. K. (1998). The endogeneity of the optimum currency area criteria. *The Economic Journal*, 108(449), 1009–1025. <https://doi.org/10.1111/1468-0297.00327>
- Fidrmuc, J. (2004). The endogeneity of the optimum currency area criteria, intra-industry trade, and EMU enlargement. *Contemporary Economic Policy*, 22(1), 1–12. <https://doi.org/10.1093/cep/byh001>
- Gallegati, M., Giri, F., & Palestrini, A. (2019). DSGE model with financial frictions over subsets of business cycle frequencies. *Journal of Economic Dynamics and Control*, 100, 152–163. <https://doi.org/10.1016/j.jedc.2018.10.004>
- Gazda, J. (2010). Real business cycle theory-Methodology and tools. *Economics & Sociology*, 3(1), 42–48. <https://doi.org/10.14254/2071-789X.2010/3-1/5>
- Glick, R., & Rose, A. K. (2016). Currency unions and trade: A post-EMU reassessment. *European Economic Review*, 87, 78–91. <https://doi.org/10.1016/j.euroecorev.2016.03.010>
- Glick, R., & Rose, A. K. (2002). Does a currency union affect trade? The time-series evidence. *European Economic Review*, 46(6), 1125–1151. [https://doi.org/10.1016/S0014-2921\(01\)00202-1](https://doi.org/10.1016/S0014-2921(01)00202-1)
- Hamilton, J. D. (2018). Why you should never use the Hodrick-Prescott filter. *Review of Economics and Statistics*, 100(5), 831–843. https://doi.org/10.1162/rest_a_00706
- Huh, H. S., Kim, D., Kim, W. J., & Park, C. Y. (2015). A factor-augmented VAR analysis of business cycle synchronization in east Asia and implications for a regional currency union. *International Review of Economics & Finance*, 39, 449–468. <https://doi.org/10.1016/j.iref.2015.07.010>

- Jaimovich, N., Rebelo, S., & Wong, A. (2019). Trading down and the business cycle. *Journal of Monetary Economics*, 102, 96–121. <https://doi.org/10.1016/j.jmoneco.2019.01.026>
- Lee, G. H., & Azali, M. (2012). Is East Asia an optimum currency area? *Economic Modelling*, 29(2), 87–95. <https://doi.org/10.1016/j.econmod.2011.05.006>
- Lucas Jr, R. E. (1975). An equilibrium model of the business cycle. *Journal of Political Economy*, 83(6), 1113–1144. <https://doi.org/10.1086/260386>
- Mckinnon, R. I. (1963). Optimum currency areas. *The American Economic Review*, 53(4), 717–725. Retrieved December 30, 2020, from: <https://www.jstor.org/stable/1811021>
- Mele, M. (2012). Monetary Union for the Countries” ASEAN”: The Analysis on the Business Cycle Synchronisation. *British Journal of Economics, Finance and Management Sciences*, 6(2). Retrieved December 30, 2020, from: [http://www.ajournal.co.uk/EFArticles6\(2\).htm](http://www.ajournal.co.uk/EFArticles6(2).htm)
- Mitchell, W. C. (1927). *Business Cycles: The Problem and Its Setting*. National Bureau of Economic Research. <http://www.nber.org/chapters/c0679>
- Moneta, F., & Rüffer, R. (2009). Business cycle synchronisation in East Asia. *Journal of Asian Economics*, 20(1), 1–12. <https://doi.org/10.1016/j.asieco.2008.08.001>
- Montoya, L. A., & De Haan, J. (2008). Regional business cycle synchronization in Europe?. *International Economics and Economic Policy*, 5(1-2), 123–137. <https://doi.org/10.1007/s10368-008-0106-z>
- Mundell, R. A. (1961). A theory of optimum currency areas. *The American Economic Review*, 51(4), 657–665. Retrieved December 30, 2020, from: <https://www.jstor.org/stable/1812792>
- Nawatmi, S., Nusantara, A., Santosa, A. B., & Marlien, R. A. (2020). Globalization Impact on ASEAN Countries Inflation. *International Journal of Economics and Management Systems*, 5. Retrieved December 30, 2020, from; <https://eprints.unisbank.ac.id/id/eprint/6495>
- Ng, T. H. (2002). Should the Southeast Asian countries form a currency union? *The Developing Economies*, 40(2), 113–134. <https://doi.org/10.1111/j.1746-1049.2002.tb01003.x>
- Nguyen, C. T. (2020). Impact of Working Capital Management on Firm Performance in Different Business Cycles: Evidence from Vietnam. *Journal of Asian Finance, Economics and Business*, 7(12), 863–867. <https://doi.org/10.13106/jafeb.2020.vol7.no12.863>
- Nguyen, V. T. H., Hoang, T. T. T., & Nguyen, S. M. (2020). The Effect of Trade Integration on Business Cycle Synchronization in East Asia. *Journal of Asian Finance, Economics and Business*, 7(8), 225–231. <https://doi.org/10.13106/jafeb.2020.vol7.no8.225>
- Norrbin, S. C. (1988). The Relation Between Price and Marginal Cost in U.S. Industry. A Contradiction. *Journal of Political Economy*, 101(6), 1149–1164. <https://doi.org/10.1086/261918>
- Osoimehin, S. (2019). Aggregate productivity and the allocation of resources over the business cycle. *Review of Economic Dynamics*, 32, 180–205. <https://doi.org/10.1016/j.red.2019.02.003>
- Park, D., Park, I., & Estrada, G. E. B. (2009). Prospects for ASEAN–China free trade area: A qualitative and quantitative analysis. *China & World Economy*, 17(4), 104–120. <https://doi.org/10.1111/j.1749-124X.2009.01161.x>
- Pedersen, T. M. (2001). The Hodrick–Prescott filter, the Slutsky effect, and the distortionary effect of filters. *Journal of Economic Dynamics and Control*, 25(8), 1081–1101. [https://doi.org/10.1016/S0165-1889\(99\)00059-7](https://doi.org/10.1016/S0165-1889(99)00059-7)
- Pham, M. H., & Doan, T.P.L. (2020). The Impact of Financial Inclusion on Financial Stability in Asian Countries. *Journal of Asian Finance, Economics and Business*, 7(6), 47–59. <https://doi.org/10.13106/jafeb.2020.vol7.no6.047>
- Puspaningrum, H., Lin, Y. X., & Gulati, C. M. (2010). Finding the optimal pre-set boundaries for pairs trading strategy based on cointegration technique. *Journal of Statistical Theory and Practice*, 4(3), 391–419. <https://doi.org/10.1080/15598608.2010.10411994>
- Rana, P. B. (2007). Economic integration and synchronization of business cycles in East Asia. *Journal of Asian Economics*, 18(5), 711–725. <https://doi.org/10.1016/j.asieco.2007.07.002>
- Robert, K., Plosser, C., & Rebelo, S. (1998). Production, Growth and Business Cycles: I. The Basic Neoclassical Model. *Journal of Monetary Economics*, 21(2), pp.195–232. [https://doi.org/10.1016/0304-3932\(88\)90030-X](https://doi.org/10.1016/0304-3932(88)90030-X)
- Shin, K., & Wang, Y. (2003). Trade integration and business cycle synchronization in East Asia. *Asian Economic Papers*, 2(3), 1–20. <https://doi.org/10.1162/asep.2003.2.3.1>
- Singleton, K. (1988). Econometric issues in the analysis of equilibrium business cycle models. *Journal of Monetary Economics*, 21 (2–3), 361–386. [https://doi.org/10.1016/0304-3932\(88\)90036-0](https://doi.org/10.1016/0304-3932(88)90036-0)
- Stadler, G. W. (1990). Business cycle models with endogenous technology. *The American Economic Review*, 763–778. <https://www.jstor.org/stable/2006706>
- Tran, S. H., & Nguyen, L. T. (2020). Financial Development, Business Cycle and Bank Risk in Southeast Asian Countries. *Journal of Asian Finance, Economics and Business*, 7(3), 127–135. <https://doi.org/10.13106/jafeb.2020.vol7.no3.127>
- Verico, K. (2017). The ASEAN Economic Community of 2015 and Beyond. In *The Future of the ASEAN Economic Integration* (pp. 185–202). Palgrave Macmillan, London. https://doi.org/10.1057/978-1-137-59613-0_5
- Widarjono, A., Anto, M., & Fakhrunnas, F. (2020). Financing Risk in Indonesian Islamic Rural Banks: Do Financing Products Matter? *Journal of Asian Finance, Economics and Business*, 7(9), 305–314. <https://doi.org/10.13106/jafeb.2020.vol7.no9.305>
- Yan, C., & Huang, K. X. (2020). Financial cycle and business cycle: An empirical analysis based on the data from the US. *Economic Modelling*. <https://doi.org/10.1016/j.econmod.2020.01.018>
- Zarnowitz, V. (1990). A guide to what is known about business cycles. *Business Economics*, 5–13. Retrieved December 30, 2020, from: <https://www.jstor.org/stable/23485990>