

Capital Market Cointegration Based on ASEAN-4 Capital Market Financial Sector Stock Price Index

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Abstract. This research aims to test and analyze the ASEAN capital market integration plan, which has been declared since 2004, and whether the ASEAN capital market was integrated or segmented during the research sample period of 2008–2020. This research will test cointegration based on sectoral stock price indices, namely the financial sector index (FIN) from four ASEAN countries: Indonesia (IDX), Malaysia (KL), Thailand (SET), and the Philippines (PHS). Using a vector autoregressive (VAR) model and time series data, a series of tests have been carried out, especially stationarity, stability, and cointegration tests, to capture the existence of long-term relationships between variables in the VAR system. Empirical evidence shows that using the Granger Causality, Impulse Response Function (IRF), and Variance Decomposition (VD) test approaches, all three found relatively the same thing: the industrial and financial sector index of the ASEAN-4 Exchange tends to be segmented rather than integrated. This finding follows the results of the 2015 ASEAN Capital Market Forum (ACMF) study, where ASEAN capital market integration only showed limited progress because many obstacles still had not been resolved.

Keywords: ASEAN-4, capital market integration, sectoral index, ACMF, Vector autoregressive

Introduction

The Association of Southeast Asian Nations (ASEAN) was first founded by five countries: Indonesia, Malaysia, the Philippines, Singapore, and Thailand in 1967. The initial aim was to promote regional peace and security. In the next few years, this association continued to grow; from 1984 - 1999, it began with the joining of Brunei Darussalam, followed by Cambodia, the Lao Democratic Republic, Myanmar, and Vietnam, so that at the end of 1999, the number of ASEAN members became ten countries. ASEAN economic cooperation began in 1977 with preferential trade arrangements and several industries with cooperation schemes. Economic integration began with the establishment of the ASEAN Free Trade Area (AFTA) in 1992, which included trade in goods, complemented by the ASEAN Framework Agreement on Services (AFAS) in 1995 and the ASEAN Investment Area (AIA) agreement in 1998. Furthermore, in 2003, it was agreed to deepen economic integration by establishing the ASEAN Economic Community to create an integrated, production-based market through the free flow of goods, services, foreign investment, skilled labor, and capital investment. At the end of 2015, the ASEAN Economic Community (AEC) was fully implemented (Chia, 2014).

To strengthen economic integration in line with the AEC Vision 2015 and 2025, the ASEAN Finance Minister Meeting (AFMM) in Singapore in 2004 agreed to establish the ASEAN Capital Market Forum (ACMF) to develop a deep, liquid and integrated regional capital market. An essential task of the ACMF is to harmonize the rules and regulations of the financial systems of ASEAN countries before implementing capital market integration. The ACMF vision is in line with the Vision of the ASEAN Economic Community (AEC)

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because the ACMF is to strengthen the position of the ASEAN economic community. ACMF's 2025 vision is to create an ASEAN Capital Market that is interconnected, inclusive, and resilient. Meanwhile, the AEC 2025 Vision is for the ASEAN Economic Community to become highly integrated, cohesive, competitive, innovative, and dynamic by increasing connectivity and sectoral cooperation and more resilient, inclusive, and people-oriented communities integrated with the global economy.

Stavárek (2012) studied financial integration in the European Union. The study concluded that financial integration has several benefits, including providing more opportunities for risk sharing and diversification, better capital allocation, and the potential for higher economic growth. Many pieces of evidence suggest that financial integration encourages higher economic growth. However, financial integration has weaknesses, such as increasing vulnerability to external macroeconomic shocks and financial crises, leading to output and consumption volatility. Orłowski (2020) also conducted a study on the European Union, which stated that deep and resilient capital market integration is necessary to achieve financial stability, mitigate systemic risk, and support sustainable economic growth. The unification of capital markets will positively impact increasing sources of equity and debt financing to support the economic growth of regional countries.

The results of the ASEAN Capital Markets Forum (ACMF) study in 2015 and 2017 provide the basis for the importance of ASEAN in carrying out capital market integration, including: *first*, to strengthen financial intermediation, capacity and risk management to support national and regional growth; *second*, working together to reduce vulnerability to external shocks and market volatility, considering that the ASEAN region has twice experienced the negative impact of financial crises: the Asian financial crisis in 1997/1998 and the global financial crisis in 2008/2009; *third*, facing increasingly fierce competition from global players, and pressure for consolidation and increased efficiency due to technological and regulatory changes, making regional capital market integration an urgent policy concern and requiring a comprehensive strategy (Wolff, 2022). The need for ASEAN countries to integrate their capital markets first became a concern in 1997/1998, when the Asian financial crisis hit. The crisis negatively impacted the economies of ASEAN countries because they relied heavily on short-term foreign debt channeled through their banking systems.

ASEAN's economic strength in terms of GDP refers to a PwC study in 2018 which declared this region as one of the world's fastest growing regions, with ASEAN's population in 2020 reaching 661.8 million, and projected ASEAN GDP growth at the end of 2020 reaching US\$ 4,090 billion, or become the world's fifth largest economic power after America, China, Japan and Germany (Wijeratne & Clayton, 2018). This ASEAN GDP projection implies that countries in this region need large sources of investment funding to increase national and regional economic growth, this is the reason for building an integrated capital market in ASEAN.

The purpose of this study is to investigate the integration of ASEAN capital markets. Currently, research on capital market cointegration mainly focuses on composite capital market indices (Arsyad, 2015; Click & Plummer, 2005; Qizam et al., 2015; Robiyanto, 2018). However, research on capital market integration based on sectoral indices is limited, so this study aims to contribute to studying capital market integration based on sectoral indices. The financial sector of the ASEAN-4 Exchange will be used as a sample in this study. This sectoral index was chosen because different industrial sectors have varying levels of risk and risk factors. Studying a specific industry sector will allow identifying unique investment opportunities and early trends in the industry cycle. These results will help investors to find profitable risk and return trade-offs. It is worth noting that returns and risks differ between industrial sectors, even for stocks within the same sector. However, the overall

risk of an industrial sector is relatively stable over time (Reilly, 2019). Meanwhile, the financial sector index sampling was taken because this sector is unique. Financial sector shares often recover first from economic slowdowns or recessions, so that this sector is ready to become a source of funding from other industrial sectors when the economy recovers (Reilly, 2019). With this research, it can be seen whether the financial sector index of the ASEAN-4 Exchange is integrated or segmented. This research is expected to be useful for portfolio investors in making decisions. The relationship between the financial sectors of the ASEAN-4 Exchange is conceptually explained in Figure 1.

Theoretical Background

World financial markets have rapidly integrated over the past few decades. This integration has been driven by the loosening of controls over capital flows, the liberalization of foreign exchange transactions, banking deregulation, and advances in information technology. The main advantage of financial integration is an increase in risk sharing across national borders achieved through the removal of investment restrictions (Bekaert et al., 2006; Gourinchas & Jeanne, 2006; Mensah & Premaratne, 2018). Lestari (2011) analyzes the effects of globalization and liberalization on the world economy, which have led to the integration of various regions. Countries within a region work together to integrate economically in order to increase their ability to compete with countries in other regions. This process is prevalent in almost all regions, and many have collaborated in the economic sector to strengthen their regional economies and enter the era of free trade. The success of the European Union has inspired the faster development of trade and investment blocs in various regions (Lestari, 2012), including ASEAN, which officially launched its economic community at the end of 2015, intending to achieve similar success.

Economic integration can reduce the impact of regional shocks on domestic consumption. However, it may also affect economic growth in the long run by changing the allocation of resources and savings. On the other hand, broader financial integration may lead to more vigorous joint movements between financial markets, allowing contagion effects between countries to occur, which could ultimately result in a crisis (Mensah & Premaratne, 2018). Nevertheless, the integration of global financial markets has been empirically proven to facilitate international capital flow to developing countries, driven by the need for international investors to diversify their portfolios. As a result, fluctuations in a country's financial markets are caused more by external than domestic factors (Shu et al., 2018).

Financial market integration is closely related to the law of one price. This law states that in an efficient financial market, two identical financial assets with the same risk and return must have the same price, irrespective of the market in which they are traded. Investors take advantage of this by buying assets in low-priced markets and selling them in high-priced markets simultaneously to ensure that the market is efficient and fair for all investors (Bodie, 2015). Financial market liberalization can be beneficial in reducing investment financing barriers for domestic companies by increasing foreign capital flows. Full financial market liberalization can lessen the susceptibility and instability of domestic financial markets. However, it is essential to note that countries with weak economies, poor institutional quality, and underdeveloped financial sectors may not experience any reduction in market volatility through capital market liberalization (Bekaert et al., 2006). Therefore, it is essential to have a high-quality financial market liberalization process for successful capital market integration in the ASEAN region.

Several previous studies on ASEAN-5 capital market integration, both between ASEAN capital markets and between global capital markets and ASEAN capital markets, have been widely documented, including: Click and Plummer; (2003) found that the ASEAN-5 capital markets have been economically integrated, but not completely; Majid et al

(2009) stock markets in the ASEAN region have been integrated before and after the 1997 Asian financial crisis; Janor et al (2007), Chen et al (2009), Krisnandi et al (2012), Chandra (2015) found that capital markets between ASEAN-5 were more strongly integrated before and after the Asian financial crisis. Wu (2020) Integration of the ASEAN-5 capital market with the Chinese, Japanese and Korean capital markets for the period 1999 - 2019, found that there was quite high linkage between the two regions but with varying time patterns; Ling et al (2010) found that there was partial integration for pre-crisis, and post-crisis integration of capital markets in 5 ASEAN countries was in full effect; Robiyanto et al (2018) found the occurrence of co-movement between the capital markets of Indonesia, Malaysia, Singapore and Thailand during the period January 1997 – December 2013; Mensha et al (2018) found broad transmission, with the Singapore banking sector index transmitting to the other four ASEAN banking sector indices.

Methodology and Data

Research Methodology

The analysis model in this research is a vector autoregressive (VAR) model. This non-structural approach describes the mutually causal relationships between variables in the model. The VAR approach tries to let *the data speak for itself* by making all variables potentially endogenous variables. In the VAR framework, each variable in either level or first difference is treated symmetrically in a system of equations containing the same regressors. In the non-structural VAR model, if the time series data is not stationary at the level but is stationary at *the first difference* and is cointegrated, then the vector error correlation model (VECM) will be used to show the existence of a theoretical relationship between the variables in the model (Gujarati, 2011).

The strength of the integration of ASEAN-4 capital market financial sector indices, Indonesia Stock Exchange (IDX), Malaysia Exchange (KLSI), Thailand Exchange (SET), and Philippine Exchange (PHS), will be investigated and analyzed using a vector autoregression (VAR) framework with the following formula:

$$X_t = A_0 + \sum_{k=1}^p A_k X_{t-k} + e_t$$

X_t is a 4 x 1 variable vector, A_0 is a 4 x 1 constant vector, A_t is the coefficient of the 4 x 4 matrix, e_t is the 4 x 1 error term with zero mean, and p is the autoregression order. In this research, we will use *Granger causality*, *impulse response functions* (IRF), and *variance decompositions* (VD) to evaluate interactions between variables.

Applying the VAR equation in the first stage will carry out several tests on the time series data used. *First*, the unit root test is intended to test the level of stationarity of time series data. Economic and financial data generally is stochastic or has a trend, so the value does not fluctuate around the average; this cannot be used as a model estimation tool. The stationarity test is used to avoid false regression problems. The stationarity test was carried out at the *level* and *first difference level*. This test will use *the Augmented Dickey-Fuller Test* (ADF) at a fundamental level of five percent. *Second*, the optimal lag test helps find out how long it takes for a variable to react to other variables in the system. This test is also to eliminate autocorrelation problems in the VAR system. The optimal lag test is based on the *Akaike Information Criterion* (AIC) at the five percent level.

Third, the VAR stability test, detected from the unit root, produces a modulus value of less than one and is located within the unit circle. If the VAR model is declared stable, then the use of *impulse response function* (IRF) and *variance decomposition* (VD) analysis is declared valid. *Fourth*, the cointegration test is used to determine whether there is a long-term

relationship between variables in the VAR model. This cointegration test will use the *Johansen Cointegration method* at the five percent level. Next, the Granger causality test is used to determine whether there is a causal relationship between two variables in the past. *Granger causality* is a stochastic autoregressive model for identifying causal connectivity in time series data. Ekananda (2019) states that the *Granger causality test* uses the *F-test* to test whether the information lag in variable Y provides significant statistical information about variable X in explaining changes in Y; if not, then Y has no causal relationship with the variable X. There are four patterns of Granger causality: one-way causality from X_t to Y_t ; one-way causality from Y_t to X_t ; two-way causality, from X_t to Y_t and from Y_t to X_t ; there is no causal relationship. Granger causality test to find out the extent of convergence of the ASEAN-4 capital market, which is the sample for this research.

The impulse response function (IRF) is used to measure the response of an endogenous variable to a shock to a particular endogenous variable. The shock of variable I not only affects the I variable itself but is transmitted to all other endogenous variables in the dynamic structure or lag structure in the VECM model. IRF is a form of applying vector moving averages to find traces of the current response to a future response to a shock of one standard deviation from other variables in the VAR system. Variance decomposition (VD) explains the relative importance of each variable in the VAR system due to shocks. VD is useful for predicting the contribution (in percentage) of the variance of each variable due to changes in certain variables in the VAR system.

Data

The ASEAN-4 stock exchange financial sector index (FIN) consists of the Indonesia Stock Exchange (IDX), Malaysia Stock Exchange (KL), Thai Stock Exchange (SET), and Philippine Stock Exchange (PHS). The research period was January 2008 – December 2020, totaling 156 observations. Data is downloaded from investing.com. The financial sector stock price index is based on the *Jakarta Stock Exchange Industrial Classification* (JASICA), valid from 28 December 1995 to 31 December 2020, consisting of nine industrial sectors. In January 2021, the Indonesian Stock Exchange published the IDX Industrial Classification (IDX-IC), consisting of eleven industrial sectors.

Results and Analysis

VAR Results

The stationarity test was conducted for two industrial sectors, both at the level and first difference level. For this test, the Augmented Dickey-Fuller Test (ADF) was used at a fundamental level of one percent. Table 4.1 presents the results of the stationarity test. The unit root test for the financial sector at the level still indicates non-stationarity. However, the unit root test at the first difference level shows stationarity at the one percent accurate level.

Table 1. Unit Root Test of the financial sector index of the ASEAN-4 Exchange

Financial Sector	ADF test statistics	
	Levels	1 st Difference
IDX-FIN	-1.459363	-11.99279
KL-FIN	-1.724880	-8.304149
PHS-FIN	-2.020554	-8.762137
SET-FIN	-1.587324	-10.04411

Note: based on test critical values 1% level

A lag length test can be performed to determine the time it takes for a variable to react to other variables. This test is also valuable for identifying and eliminating autocorrelation issues in the VAR system. The optimal lag can be determined by using the Aike information criterion (AIC), Likelihood ratio (LR), Schwarz information criterion (SC), or Hannan-quin criterion (HQ). The lag length test was conducted for the financial sector and reached its optimal value at a minimum AIC of 33.62307 for a lag of 3. Furthermore, the results of the VAR stability test revealed that the VAR system was stable as all unit-roots had a value less than one (0.309701 – 0.964261) and were within the unit circle. If the VAR system is considered stable, the IRF and VD analysis can be declared valid.

Additionally, the cointegration test results were obtained using Johansen's trace statistics. The cointegration relationship can be determined by comparing the trace statistic value with the critical value. Suppose the trace statistic exceeds the critical value at the 5 percent level. In that case, it is deemed that there is a cointegration relationship. The results of the cointegration test are presented in Table 2.

Table 2. Unrestricted Cointegration Rank Test (Trace) Financial Sector ASEAN-4 Stock Exchange

Hypothesized No. of CE(s)	Eigenvalues	Trace Statistics	Critical Value 0.05	Prob**
None *	0.336807	166.0037	47.85613	0.0000
At most 1*	0.265234	103.9896	29.79707	0.0000
At most 2*	0.255687	57.45082	15.49471	0.0000
At most 3*	0.081649	12.86149	3.841466	0.0003

Source: Eviews 10 output

The cointegration test aims to determine whether, in the long term, there is a co-movement pattern between financial sector market indices on the ASEAN-4 Exchange: Indonesia, Malaysia, Thailand, and the Philippines.

Granger Causality Test

In this study, a bivariate causality test was conducted using the Pairwise Granger causality test, which revealed a causal relationship between variables at lag 3. The Granger causality test compares F-statistics and F-table. If F-statistics is greater than F-table, then there exists a causal relationship between variables. With a total of 4 variables and 156 observations, the F-table (5 percent) equals 2.78, and the F-table (10 percent) equals 2.19.

The results of the Granger causality test indicate that there is a one-way causal relationship between the financial sector index of the Thai Stock Exchange (SET_FIN), the Malaysia Stock Exchange (KL_FIN), and the Philippine Stock Exchange (PHS_FIN) with the financial sector index of the Indonesian Stock Exchange (IDX_FIN). However, there is no such relationship in the opposite direction. Additionally, the financial sector index of the Thai Stock Exchange (SET_FIN) has a one-way causal relationship with the financial sector index of the Malaysian Stock Exchange (KL_FIN), but there is no reverse relationship.

The analysis reveals three main findings: Firstly, there is no two-way causal relationship between the financial sector indices of the ASEAN-4 Exchange. Therefore, the financial sector indices of the ASEAN-4 Exchange are likely to be segmented. Secondly, the financial sector index of the Indonesian Stock Exchange is more affected by the three financial sector indices of the other ASEAN Exchanges. Hence, the financial sector of the Indonesian Stock Exchange is expected to receive more significant spillovers if there are any innovations in the financial sectors of other ASEAN Exchanges.

In contrast to the research results of Mensah and Premaratne (2018) on the integration of the ASEAN banking sector index, for the period January 2000 – December 2012, using the granger causality approach to *conditional variance*, the ASEAN banking sector: Indonesia, Singapore, Malaysia, Thailand and the Philippines was detected to be more integrated. because there are three ASEAN banking sector indices that have a two-way causal relationship (Singapura – Malaysia; Singapore – Thailand; and Malaysia – Indonesia), and the rest have a one-way relationship. Meanwhile, using the granger causality approach to *conditional asymmetry* shows that the Singapore banking sector index is not influenced by other ASEAN banking sectors. The two-way causality relationship only occurs in the Malaysian and Indonesian banking sector indices, and in the remainder the causality relationship is one-way. Thus, the Singapore banking sector is superior because its volatility is not influenced by variations in other ASEAN banking indices. Overall, the results of this approach indicate that the ASEAN banking sector has more limited integration.

Oh et al. (2010) used econometric analysis to measure the co-movement volatility of the ASEAN-5 stock market. They employed GARCH and Granger causality methods to determine the integration of the stock market in the pre-crisis period (January 1987 – July 1997) and the post-crisis period (August 1997 – December 2007). The study revealed that before the crisis, the Indonesian Stock Exchange market index had a one-way causal relationship with the Singapore and Philippine Stock Exchange market indices. In contrast, after the financial crisis, the Indonesian Stock Exchange market index was influenced by the other four ASEAN stock exchange market indices (Malaysia, Thailand, Singapore, and the Philippines) with a one-way causal relationship. Additionally, the Bursa Malaysia market index and the Indonesian Stock Exchange market index had a two-way causal relationship. Therefore, before the financial crisis, the ASEAN-5 exchanges were segmented. However, after the crisis, the ASEAN capital markets remained segmented, with the Indonesian Stock Exchange receiving dominant influence from the other four exchanges. The Indonesian Stock Exchange and the Malaysian Stock Exchange were the most integrated.

Research by Robiyanto (2018) investigated the integration of capital markets in ASEAN countries: Indonesia, Malaysia, Singapore, Thailand and the Philippines, for the period 1997 – 2013, using the granger causality model, finding: the Singapore capital market has a one-way causal relationship with the Indonesian capital market and Malaysia; the Thai capital market has a causal relationship with the Malaysian and Singaporean capital markets; The Malaysian capital market has a one-way causal relationship with the Indonesian capital market. During the period 1997 - 2013, including the period of the Asian financial crisis (1997-1998), it is indicated that the ASEAN-5 capital market tends to be more segmented. Hence, from previous studies, all agree that the ASEAN capital market tends to be segmented, and this is in line with the financial sector of the ASEAN-4 Exchange, which tends to be segmented.

Impulse Response Function (IRF) ASEAN-4 Stock Exchange Financial Sector Index

The Impulse Response Function (IRF) is a valuable tool to measure the effects of shocks on an endogenous variable caused by other endogenous variables. The IRF analysis and variance decomposition generally produce the same results. Although this research does not delve into variance decomposition, its output is attached at the end of this paper.

Figure 1 shows the impulse response of the financial sector of the ASEAN-4 Exchange. In the first month, fluctuations in the Indonesian Stock Exchange Financial Sector Index (IDX_FIN) were caused by shocks from the sector index. The shocks to the Bursa Malaysia Financial Sector Index (KL_FIN) in the second month had a positive impact on IDX_FIN. In contrast, the shocks to the Thai Stock Exchange Financial Sector Index (SET_FIN) and the Philippine Stock Exchange (PHS_FIN) had a negative impact. These three financial sector

indices have a significant influence on the volatility of IDX_FIN . The shocks to these indices occurred between the second and ninth months, after which they began to weaken and reached equilibrium again until the end of the 12th year.

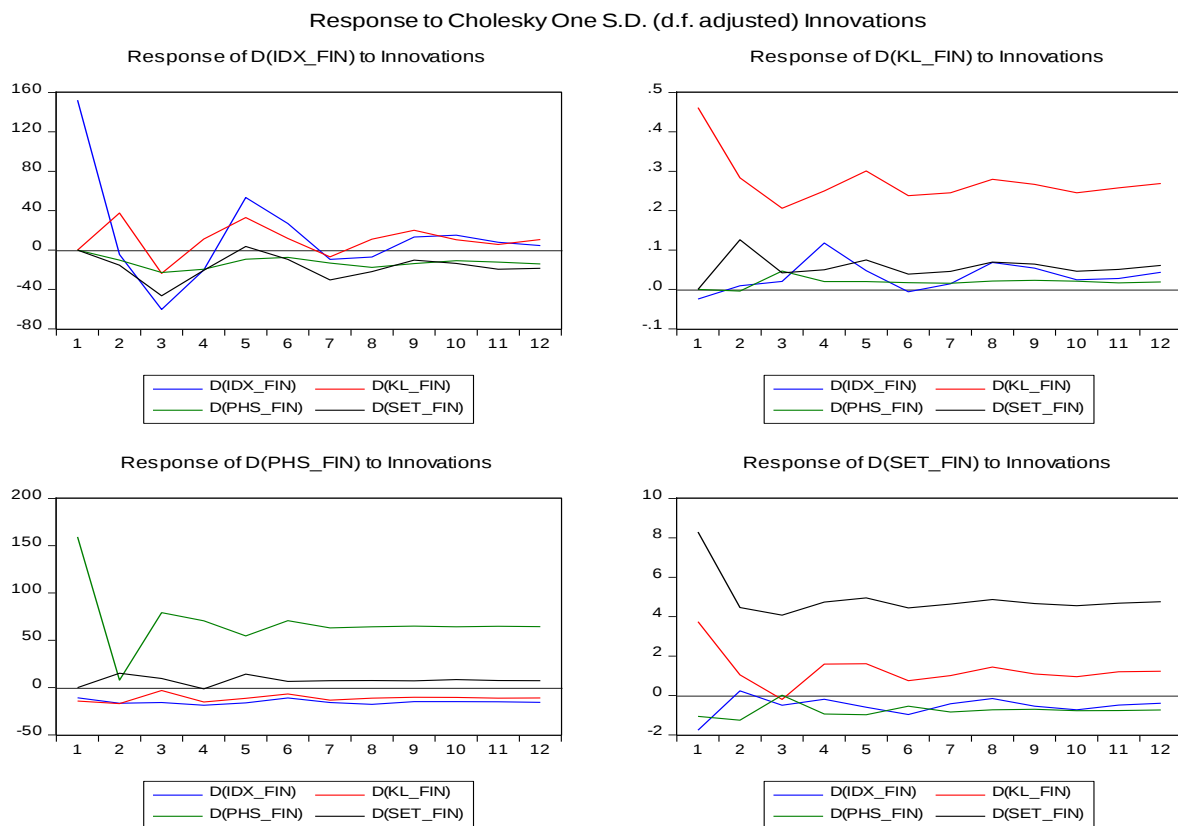


Figure 1. Impulse Response Function ASEAN-4 Stock Exchange Financial Sector Index

The financial sector of Malaysia experienced low fluctuations over 12 years, averaging less than one percent. During the second month to the twelfth month, shocks to the financial sector indexes of the Indonesian Stock Exchange (IDX_FIN), Philippine Stock Exchange (PHS_FIN), and Thai Stock Exchange (SET_FIN) had little effect on the financial sector index of the Malaysian Stock Exchange (KL_FIN).

In the first month, the financial sector index of the Philippine Stock Exchange (PHS_FIN) experienced a 159 percent fluctuation due to shocks from its index, as well as the financial sector indexes of the Malaysian Stock Exchange (KL_FIN) and the Indonesian Stock Exchange (IDX_FIN). In the second month, the financial sector index of the Philippine Stock Exchange (PHS_FIN) responded negatively to shocks from the financial sector indexes of the Indonesia Stock Exchange (IDX_FIN) and Bursa Malaysia (KL_FIN) but positively to shocks from the financial sector index of the Thai Stock Exchange (SET_FIN). Shocks to the financial sector indexes of these three exchanges had a significant impact on fluctuations in the financial sector of the Philippine Stock Exchange (PHS_FIN) from the first to the seventh month. After the seventh month, the shocks weakened, and the financial sector indexes regained balance by the twelfth month.

The fluctuation in the financial sector index of the Thai Exchange (SET_FIN) in the first month was 8.29 percent, caused by shocks in the sector index itself, but also by the financial sector indexes of the Malaysian Exchange (KL_FIN), the Indonesian Stock Exchange (IDX_FIN), and the Philippine Exchange (PHS_FIN). Shocks to the financial

sector index of the Indonesian Stock Exchange (IDX_FIN) and the Philippine Stock Exchange (PHS_FIN) were responded negatively by the financial sector index of the Thai Stock Exchange (SET_FIN). In contrast, shocks to the financial sector index of the Malaysian Stock Exchange (KL_FIN) responded positively. Shocks in these three financial sector indices only had a small impact on fluctuations in the financial sector of the Stock Exchange of Thailand (SET_FIN) from the first month to the end of the 12th month.

Based on the results of the Impulse Response Function (IRF) and variance decomposition, it has been revealed that the financial sector index of the Indonesian Stock Exchange witnessed significant fluctuations from 2008 to 2020. These fluctuations occurred primarily from the first to the ninth month due to internal and external shocks. This suggests that the Indonesian Stock Exchange's financial sector index is closely linked to the financial sector indices of other stock exchanges in the ASEAN region. On the other hand, the Philippine Stock Exchange's financial sector index is primarily affected by its internal shocks, indicating that it is almost independent of the financial sectors of other stock exchanges in the region. As for the financial sector indexes of Malaysia and Thailand stock exchange, they exhibit weak fluctuations, resulting from their internal shocks as well as external shocks from other sector indexes. These results imply that these two financial sector indices have a weak connection with other financial sector indices in the region.

Finding research on ASEAN capital market cointegration based on industrial sector indices, particularly the financial sector, can be challenging. As a result, the results of industrial sector integration research are often compared to research findings based on composite capital market indices. It would be interesting to compare these two things to determine whether the cointegration of sectoral indices is consistent with the cointegration of the composite capital market index. These results differ significantly from the research results of the ASEAN-4 Stock Exchange financial sector index by Shabri Abd. Majid et al. (2009). Their research aimed to examine the stock market integration of five ASEAN-5 countries using two periods: the financial crisis period (October 1987 – July 1997) and the post-crisis period (January 1988 – December 31, 2006). The research findings showed that ASEAN-5 stock markets were cointegrated before, during, and after the financial crisis. However, markets moved toward greater integration during and after the 1997 financial crisis. Using error correction measures, it appears that all other ASEAN capital markets, except for the Indonesian capital market, were important carriers of short-term adjustments to shocks in the region's long-term equilibrium relationships during both the pre and post-financial crisis periods. Based on the ASEAN-5 capital market index during this research period, it seems that the ASEAN-5 capital market tends to have strong ties.

Another study (Phuan et al., 2009) on ASEAN-5 stock market integration and financial liberalization covered three sample periods. The first period observed was from 2 January 1986 to 31 August 1987, wherein only Singapore had liberalized its stock market. The second period was from 1 September 1987 to 30 June 1991, during which three countries - Thailand, Malaysia, and Indonesia - had liberalized their stock markets. The third period, from 1 July 1991 to 30 June 1997, saw the Philippines liberalizing its capital market, with five ASEAN countries also liberalizing their capital markets during this timeframe. Daily periods and VAR models were used in the research. The primary analysis used a variant of CE decomposition to find that over the three research periods, the variation in the Singapore capital market index was more significant due to the forecast error variance itself.

In contrast, the variations in the Thai and Malaysian market indices were not only explained by their forecast error variance but also by the error variance in the Singapore capital market index. The more significant variation in the Indonesian capital market index was explained by its forecast error variance, except in period 3, which was explained by the error variance in the Singapore capital market index (21.94 percent). The study found no

significant interrelationship or cointegration between ASEAN capital market indices during any of the three research periods used. The findings of Majid et al. (2009) and Phuan et al. (2009) indicate that the ASEAN capital market is more likely to be segmented, which is consistent with the findings on the financial sector of the ASEAN Stock Exchange being more likely to be segmented.

Conclusion

This research uses the VAR model, and three approaches are used: the Granger causality test, IRF, and VD. These three approaches are used to test whether the industrial sector index and financial sector index of the ASEAN-4 Exchange are integrated or segmented. The three approaches produce relatively similar decisions, namely that the ASEAN-4 Stock Exchange financial sector index tends to be segmented rather than integrated. This finding is not much different from the results of the ASEAN Capital Market Forum (ACMF) study in 2015, which concluded that regional integration of the ASEAN capital market has only shown limited progress because there are still many factors that are obstacles.

The research shows that the volatility of the financial sector index of the Indonesian Stock Exchange is significantly affected by the financial sector indices of other ASEAN Stock Exchanges. Suppose a financial shock occurs in the ASEAN Stock Exchange. In that case, it can have a significant impact on the financial sector of the Indonesian Stock Exchange. During the research period (2008 - 2020), if the financial sector index is used as a benchmark, the ASEAN capital market tends to be segmented. This result means portfolio investors can benefit from diversifying within the ASEAN capital market environment.

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