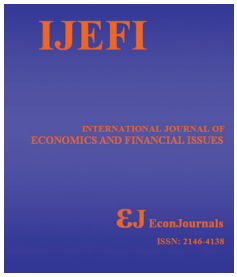


International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2025, 15(3), 110-123.

Capital Mobility between ASEAN+3 and the US: An Analysis of Saving-Investment Relationship

Farihana Shahari[1], Md. Saifur Rahman[2], Mahfuzur Rahman[3]*

[1]Department of Finance, Faculty of Economics and Management Science, International Islamic University Malaysia, Kuala Lumpur, Malaysia, [2]School of Economics and Finance and Marketing, College of Business, RMIT, Melbourne, Australia, [3]Department of Finance and Economics, College of Business Administration, University of Sharjah, Sharjah, United Arab Emirates. *Email: mrahman@sharjah.ac.ae

Received: 09 November 2024 **Accepted:** 01 March 2025 **DOI:** https://doi.org/10.32479/ijefi.18735

ABSTRACT

By using the hedging approach, this paper empirically examines the effectiveness of portfolio diversification in ASEAN+3 and US financial markets. Equity returns which is extracted from equity indices is used in the estimation by spanning data period from January 1991 to June 2018 which is disaggregated between pre-and post-financial cooperation agreement period. The study offers several outcomes for example portfolio with multiple assets is more effective than that of two-asset portfolio. The assets of emerging economies are more effective than that of developed economies due to the reflection of efficient market hypothesis. The study suggests policy recommendation for selecting the right assets to form an effective portfolio diversification.

Keywords: Hedging Approach, Diversification Effectiveness, Portfolio Investment, ASEAN+3 Financial Markets
JEL Classifications: G11, G15, F36, G23

1. INTRODUCTION

The effectiveness of portfolio diversification receives widespread attention at market participants, academics and practitioners following the trend of recent capital markets integration since it gives higher return despite the existing theory of finance 'high risk, high return'. The various studies stated that portfolio investment which consists of assets with different risk levels (both high and low) gives a higher market return (Nukala and Prasada Rao 2021; Zaimovic et al., 2021). Theoretically, it is the most effective when the assets are the low-correlated or different risk-level (Huang 2024; Özdemir 2022). The low-correlated assets can be managed in a portfolio basket when assets are selected from across the borders. Because this strategy recognizes that assets from various countries have differing risk levels influenced by unique economic structures, cultures, and market conditions. By incorporating assets with low correlations from diverse regions, investors aim to reduce the overall risk of the portfolio. This approach leverages the fact that assets from different countries may respond differently to market fluctuations, economic events, or geopolitical factors, thereby providing a level of protection against extreme losses in the portfolio. Diversifying across the borders with low correlated assets allows investors to potentially achieve competitive returns while minimizing risk exposure, enhancing the long-term growth potential of the portfolio.

International portfolio investment broadens the scope of diversification beyond a single country's asset selection. An international portfolio which has different risk levels provides a return higher than that of a single market (Mensi et al. 2021). The risk level of international markets is diverged due to the country-specific criterion such as a degree of moral hazard, market transparency, and operational efficiency. These factors play a crucial role in shaping the risk landscape of financial markets

globally. The degree of these factors in different countries can lead to divergent risk levels in international markets. Countries with high levels of moral hazard, low market transparency, and poor operational efficiency may experience higher risks in their financial markets compared to those with better practices in these areas. The country-specific issue becomes more obvious in the case of the international portfolio when international markets are segmented. Based on the portfolio theory, the recent studies Thomas et al. (2022); Tokat-Acikel et al. (2021); Zaimovic et al. (2021) examined diversification effectiveness with international or multi-asset portfolios, rather than considering a single country' portfolio.

This study employs a hedge approach that has not been studied sufficiently to explore the market potentiality. This approach, unlike others, depends on variance ratio and risk reduction that estimate the effectiveness of portfolio investment accurately regardless of market integration. It provides investors with valuable key insights into the diversification potential and risk characteristics of their portfolios. Other techniques such as integration and ARDL depend on the degree of market integration to justify the portfolio effectiveness for example integrated market implies an ineffective portfolio diversification, while effective one is implied by the segmented markets (Karim et al., 2022; Lee and Choi, 2024; Mishra and Mishra, 2022). Justifying portfolio effectiveness based on this theory contradicts Pirgaip et al. (2021) who states that the international markets still can be effective in diversifying portfolio assets even they are integrated. Considering the contradiction of earlier studies, this study employs a hedge approach to explore the effectiveness of portfolio diversification. By applying this approach, portfolio effectiveness is examined at two stages; two-asset portfolios and multi-asset portfolios to differentiate the effective portfolio between a peer and all markets. This approach involves analyzing the performance of portfolios that consist of two assets and comparing them to portfolios that include multiple assets. The aim to evaluate how well these portfolios perform relative to each other and against broader market trends. This approach allows investors to assess the impact of diversification and risk management strategies on portfolio performance, helping them to make effective decisions based on their investment choices. The markets are disaggregated further among developed, emerging and all markets to present a dynamic result of portfolio effectiveness.

ASEAN+3 financial markets are considered in this study to examine portfolio effectiveness. The financial market of this region has extreme potential for portfolio investment due to its diverged economic structure. Historically, in the aftermath of the Asian financial crisis in 1997, ASEAN+3 financial cooperation agreement is formed to avoid future financial vulnerability and to improve financial stability. As a remedial action, they have employed several initiatives such as regional bond markets, currency swap agreement and regular review of member economies (Rahman and Shahari, 2021). The initiatives were taken by the ASEAN+3 draw the attention of market participants who are interested in diversifying their assets. Therefore, it necessitates an examination of portfolio effectiveness in this region to justify whether potential investors should consider ASEAN+3 financial markets. The US financial market is extremely influential on that of ASEAN+3 during both pre- and post-agreement period (Rahman and Farihana, 2021). The inclusion of the US financial market in the estimation indicates whether it affects the effectiveness of the portfolio investment in ASEAN+3 financial markets.

This study is organized as follows. The second section presents an in-depth review of past studies followed by an introduction. The third section discusses the data, variables, and sources, while section four presents the details of methodology. Section five shows the empirical findings followed by the discussion in section six. A suggestion for future study is provided in section seven followed by the conclusion in section eight.

2. LITERATURE REVIEW

This research reviews ample studies on portfolio investment conducted in different financial markets. These studies can be divided into three categories: Developed markets, developing markets and a mix of both developed and developing markets. First, the different studies examine the degree of optimal portfolio investment in developed economies. Miralles-Marcelo (2015) sourced data from US, UK, and Japan to form a portfolio investment. Employing multivariate VAR-DCC approach, the study examined whether international diversification improves investment return given high market correlation. The study asserted that effective diversification is hindered because of the improvement in international market integration, which is further enhanced by the development of information technology and market liberalisation. However, the estimated result of this study indicated that international diversification in the equity market is effective only when the portfolio comprises a quarterly and monthly basis. Further, Jankowska (2021) examined the proposition that during the onset of the COVID-19 pandemic, stock exchange indices across developed countries became more positively related with each other, reducing the ability of international portfolio diversification to mitigate the volatility of a global investment portfolio. Attia et al. (2023) investigated the benefits of portfolio diversification in USA during the COVID-19 crisis period. By using the daily data from 2007 to 2020, they employed three relevant time-varying and timescale-dependent techniques. The findings indicated that both traditional and Islamic investors in US could achieve significant diversification advantages by partnering with major trading counterparts, particularly for s for very short investment horizons. In addition, Mohsin et al. (2023) employed the regression analysis and the generalized two-step moment method for 25 EU countries from 2000 to 2001 and explored the relationship between green financing and portfolio structure of green climate funds (GCFs). The findings suggested that green finance influences high-quality economic growth. The GCFs enhance the ability to direct public and private funds, reduce risks associated with traditional fundings, increase climate financing, and strengthen GCFs.

The 2nd group of studies have been conducted to document the degree of portfolio investment in developing markets. For instance, Yoshino et al. (2021) theoretically showed that in Japan, allocation of portfolio investments by considering SDG will lead

to distortion in the investment portfolio. The desired portfolio allocation can be achieved by taxing pollution and waste such as CO_2, NOx, and plastics, globally with the same tax rate. Moreover, Duho et al. (2023) examined the effectiveness of portfolio diversification strategy on credit risk and market risk of micro finance institutions (MFIs) in Ghana as sana emerging market. The findings indicated that the income diversification in enhancing loan quality and credit risk management in MFIs. It highlighted those nuanced relationships between income diversification, size, asset tangibility, profitability, and investment strategies, shedding light in the complex dynamics of risk management and financial performance in the microfinance sector. Optimal portfolio management emerges as a critical factor for MFIs to navigate credit risks effectively and make prudent investment decisions, ultimately contributing to their sustainability and success. Moreover, Okwudiri et al. (2022) examined foreign portfolio investments and growth of capital market in Nigeria. By using the time series data sourced from the central bank of Nigeria, the results indicated the positive relationship between foreign portfolio investments and growth of capital market. Therefore, it recommended that to boost foreign portfolio investments inflows, Nigeria's capital market regulatory authorities should focus on offering internationally competitive coupon rates on bonds and improving the country's external reserves. By providing attractive yield and a stable economic environment, Nigeria can attract more foreign investors seeking higher returns. Furthermore, Derbali and Lamouchi (2020) researched to understand and compare the extent and nature of the impact of foreign portfolio investments (FPI) on the stock market volatility particularly in southeast Asian emerging countries. The results suggested that the net inflow of FPI significantly influences stock market returns across various emerging countries. The impact of volatility transmission from FPI market to stock market varies depending on market conditions, Historical data and volatility clustering play a significant role in affecting stock market return volatilities in Southeast Asia emerging countries.

Finally, the 3rd group of studies examines effectiveness of portfolio investment in both developed and developing markets. Utilizing the data of developed (G7) and emerging (top 10) countries, Ordu-Akkaya and Soytas (2020), examined the role of foreign portfolio investment on increasing spillovers between commodity and stock markets, and it suggested that portfolio investment has positive impact on the spillover, whilst controlling for business cycle and term spread. Thus, supporting financialization phenomenon, it found that higher the portfolio investment, higher the spillover between commodity and stock markets. Further, Sugozu et al. (2023) investigated the association between portfolio investment and economic growth in 18 developed countries and 27 developing countries. The results suggested that as compared to developing countries, the long-term portfolio investment is unrelated to economic growth in developed countries. Moreover, the accumulation of capital positively influences growth in developed countries. Conversely, the association between portfolio investment and economic growth in developing countries is positive. Kulanov and Nurgaliyeva (2022) assessed and analysed portfolio investment cash flows in various countries of the world. It implied that capital markets are crucial in the global investment ecosystems. Portfolio investment, which involve passive ownership of financial assets like stock, bonds, are a significant source of external financing for developing nations. Established capital market practices can serve as a model for investing countries to adopt sustainable development worldwide. Other studies have claimed that the subprime crisis affected the effectiveness of portfolio investment in developed and developing markets. Developed markets reacted differently than did developing markets. A developing market is highly regulated during a crisis, which causes further deviation between the risk level of developed and developing markets. Financial markets of neighbouring economies, such as Malaysia and Indonesia, were adversely affected during the period because of the contagion and spill-over effect. As a result, affected economies adopted common policies to strengthen financial relationships. Further, several initiatives, such as regional swap funds and CMI, were adopted to avoid future crises.

3. METHODOLOGY

3.1. Hedging Approach

The hedging approach is used to investigate effective diversification in ASEAN+3 equity markets. Effective diversification of international portfolio investment is measured by the reduction in the variance of the portfolio which consists of domestic and foreign assets. The rate of return on a two-asset portfolio is calculated as follows:

$$R^T = R - hR^* \quad (1)$$

Where R and R^* are the rates of return on the domestic assets and foreign assets respectively. h is the hedge ratio which is needed to construct the portfolio through minimizing the variance in the rate of return. The variance of the portfolio rate of return is calculated following the below formula:

$$\sigma^2(R^T) = \sigma^2(R) + h^2\sigma^2(R^*) - 2h\sigma^2(R,R^*) \quad (2)$$

$\sigma^2(R)$ and $\sigma^2(R^*)$ are the variance in the rate of return of the domestic and foreign assets respectively, while $\sigma^2(R,R^*)$ is the covariance. The minimum hedge ratio is calculated by using the first-order derivative as follows:

$$\sigma^2(R^T) = \sigma^2(R) + h^2\sigma^2(R^*) - 2h\sigma^2(R,R^*) \quad (3)$$

Therefore,

$$h = \frac{\sigma(R,R^*)}{\sigma^2(R^*)} \quad (4)$$

The equation (4) indicates the minimum-risk hedge ratio which is measured from the historical data by using the following regression equation:

$$R_t = \alpha + hR_t^* + \varepsilon_t \quad (5)$$

The equation (5) is a bivariate model, where R_t and R_t^* are the rate of return of domestic and foreign assets respectively. Rate of

return is calculated by the logarithm of the stock price. The domestic asset is hedged by taking the opposite position on the foreign assets. However, the rate of return of multi-asset portfolio can be estimated as follows:

$$R_t = R - \sum_{i=1}^{k} h_i R_{it}^* \tag{6}$$

The minimum-risk of hedge ratio of multi-asset can be calculated by regressing the domestic assets on the k foreign assets by specifying the following equation:

$$R_t = \alpha + \sum_{i=1}^{k} h_i R_{it}^* + \varepsilon_t \tag{7}$$

The variance of the rate of return on domestic asset is compared with that of portfolio asset to measure the effectiveness of the hedge. The following null hypothesis is developed for the explanation of estimated coefficients:

$$H_0: \sigma^2(R) = \sigma^2(R^T)$$

If the null hypothesis against variance in domestic asset return greater than that of portfolio asset is rejected, it implies that international diversification opportunity would be effective in reducing risk. The null hypothesis would be rejected, if the variance ratio, VR, is significant. VR is significant if:

$$R = \frac{\sigma^2(R)}{\sigma^2(R^T)} > F(n-1, n-1) \tag{8}$$

Where n is the number of samples. The variance of portfolio return, $\sigma^2(R^T)$ contains the components of correlation of coefficient between domestic and foreign return. A large negative value of $\sigma^2(R^T)$ indicates a higher VR. Hence, a large negative value of $\sigma^2(R^T)$ indicates effective diversification in reducing risk. Therefore, rejection of the null hypothesis depends on the correlation between domestic and foreign assets. However, the test statistics is complemented by using the variance reduction, VD which is calculated by using the following the formula:

$$VD = 1 - \frac{1}{VR} = 1 - \frac{\sigma^2(R^T)}{\sigma^2(R)} = \frac{\sigma^2(R - hR^*)}{\sigma^2(R)} \tag{9}$$

3.2. Data, Variables, and Sources Definition

The study explores the effectiveness of portfolio diversification in ASEAN+3 economies during both the pre and post financial agreement period. To examine the objective of the paper, the monthly equity indices are collected from each of the ASEAN+3 equity markets. The variable is used following the study of Graham et al. (2012), Guidi and Gupta (2013) and Narayan (2014). A total of nine financial markets are used in this research from ASEAN+3 and US. The markets from five founding countries of ASEAN; Singapore, Malaysia, Thailand, Indonesia, and the Philippines; and Plus-three countries: Japan, South Korea, and China are selected. The remaining five markets of ASEAN such as Brunei Darussalam, Cambodia, Laos, Myanmar, and Vietnam have not been included in this research due to the limitation of data unavailability. The data is collected based on the non-probabilistic sampling technique that depends on the judgment rather than a chance for the selection. The data is collected in a common currency US$ from all active databases and the maximum available common data obtained by using DATASTREAM. The list of countries, index, and definition of equity indices are described in Table 1:

All equity indices are collected over the period from January 1991 to June 2018. These data series have been disaggregated into two periods based on ASEAN+3 financial agreement period between the pre-agreement period (January 1991 to June 1997)

Table 1: Description of equity indices

Country	Index	Definition
Indonesia.	Jakarta stock exchange composite	The Jakarta Stock Price Index is a modified capitalization-weighted index of all stocks listed on the regular board of the Indonesia Stock Exchange.
China	Shanghai equity index	The Shanghai Stock Exchange Composite Index is a capitalization-weighted index. The index tracks the daily price performance of all A-shares and B-shares listed on the Shanghai Stock Exchange
Japan	Tokyo Stock index	The Tokyo Stock Price Index is a capitalization-weighted index of all companies listed on the First Section of the Tokyo Stock Exchange. The index is supplemented by the sub-indices of the 33 industry sectors.
Philippines	Philippine stock exchange composite index	The Philippine Stock Exchange PSEi Index is a capitalization-weighted index composed of stocks representative of the Industrial, Properties, Services, Holding Firms, Financial and Mining and Oil Sectors of the PSE
Malaysia	Kuala Lumpur stock exchange composite index	The FTSE Bursa Malaysia KLCI Index comprises of the largest 30 companies by full market capitalization on Bursa Malaysia's Main Board
South Korea	Korea stock index	Korea stock index is a capitalization-weighted index of all common shares on the Korean Stock Exchanges
Thailand	Bangkok stock exchange index	The Bangkok SET Index is a capitalization-weighted index of stocks traded on the Stock Exchange of Thailand
Singapore	Singapore stock exchange index	It is taken through the FTSE Straits Times Index (STI) which is a capitalization-weighted stock market index that is regarded as the benchmark index for the Singapore stock market. It tracks the performance of the top 30 companies listed on the Singapore Exchange.
US	New York stock exchange composite	The NYSE Composite Index is a float-adjusted market-capitalization weighted index which includes all common stocks listed on the NYSE, including ADRs, REITs and tracking stocks and listings of foreign companies

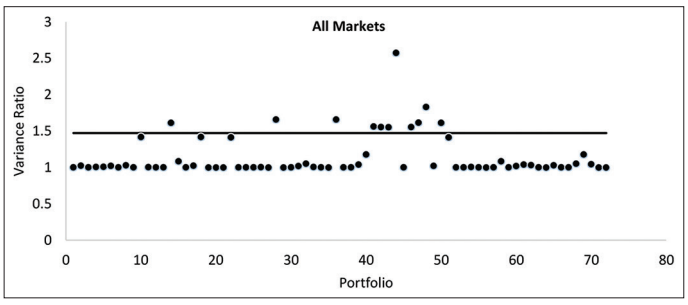
and post-crisis period (January 1999 to June 2018). The data-period has been divided into two periods to examine whether effective diversification opportunity is developed after forming the ASEAN+3 financial cooperation bloc. A short-interval data period from July 1997 to December 1998 is used for a reliable and specific contribution of the agreement on the regional financial markets. The end of the pre-crisis period is considered in June 1997, because the formation of agreement starts in December 1997. The post-agreement period starts from January 1999, because the official formation of the agreement is in December 1998. However, equity indices are converted into equity return to explore the effective diversification opportunity in ASEAN+3 financial markets.

4. EMPIRICAL FINDINGS

The analysis of the empirical findings is segmented between pre- and post-financial cooperation agreement period. Figure 1 represents the VR of a two-asset portfolio that consists of 72 portfolios from all nine markets during the pre-agreement period. The figure is drawn based on the hedge ratio and the variance of domestic and foreign assets provided in Table A1 (Appendix). The horizontal line is the 5% critical value of F-distribution with 73, 73 degree of freedom (1.437), where the dot above the line shows effective diversification. The empirical result shows that 4.72% of the VR is statistically significant, which appears above the line. It indicates that 4.72% of portfolios were effective in diversification during the pre-agreement period when the portfolio consisted of two assets. This result is consistent with that of Fabozzi et al. (2002), who showed inefficient diversification in two-asset portfolios.

The analysis of two-asset portfolios is continued with the result of risk reduction, which is presented in Table 2. The highest risk reduction that shows the most effective diversification is found between Japan and Thailand, followed by the risk reduction between Thailand and Singapore. This result implies a low correlation of Thai return with that of Singapore and Japan. Owing to the lack of a market relationship, the equity market of Thailand is not influenced by that of Japan. Inversely, the least risk reduction is found when a Singaporean asset is hedged by taking an opposite position of an Indonesian asset followed by risk reduction between Indonesia and Singapore. This result implies that hedging becomes the least effective when an Indonesian asset is considered. Ineffective hedging in an Indonesian asset is explained by market openness during the pre-agreement period.

Figure 1: Variance ratio with 5% critical values (two-asset portfolios) during pre-agreement period



The study further examines the diversification effectiveness of multi-asset portfolios by segmenting assets into several portfolios that consist of three assets, five assets, seven assets and all assets. Hedge ratio, domestic and portfolio variance shown in Tables A2 and A3 (Appendix) are used to draw the VR for multi-asset portfolios. The VR of this multi-asset portfolio is presented in Figure 2. The result of three assets and five assets shows four effective portfolios, while seven assets and all assets show five effective portfolios. This means that 44.44% of portfolios are effective for three assets and five assets, while 55.56% of portfolios are effective for seven assets and all assets.

The VR indicates that hedging effectiveness improves when the number of assets increases in the portfolio. Effective portfolios can be explained by the diversity of international markets that can offer different investment opportunities. Interestingly, most portfolios with assets from developed countries are ineffective. Financial integration in developed countries diminishes price differential, thereby reducing portfolio effectiveness. Since financial markets of developed countries are more integrated than those of developing countries, portfolio ineffectiveness in developed countries is reflected because of financial integration (Wagner, 2010).

In Table 3, variance reduction is used to determine which multi-asset combination is more effective in portfolio diversification. The highest risk reduction is found when a Malaysian asset is hedged by taking the opposite position of the remaining assets. A Malaysian asset remains an effective diversifiable asset when the portfolios consist of three assets, five assets, seven assets and all assets. This implies that a Malaysian asset has the most potential component for effective portfolio investment. Malaysia is an emerging economy providing a noteworthy investment prospect during this period. Further, the least effective diversification is found when a Singaporean asset is hedged by taking the opposite position of five assets. The next least effective portfolio is Japan for both seven and all assets. This result implies that developed markets offer the least effective diversification, which can be explained by their level of market integration (Isomidinova et al., 2017).

4.1. Post-agreement Period

Periodical segmentation is used to investigate the difference between the pre-agreement and post-agreement periods. Figure 3 represents the VRs of two-asset portfolios comprising 72 portfolios in nine markets. The horizontal line is the 5% critical value of F-distribution with 233, 233 degree of freedom (1.241). The

Table 2: Variance reduction in two-asset portfolios (Maximum and Minimum)

Domestic	Foreign	VD (Max)	Foreign	VD (Min)
China	US	0.028536	Malaysia	0.000199
Malaysia	Philippine	0.379863	Japan	0.000248
Indonesia	Malaysia	0.294874	Singapore	0.000000
Thailand	Singapore	0.396971	Japan	0.000005
Singapore	USA	0.151700	Indonesia	−0.00001
Japan	Thailand	0.611708	Singapore	0.000255
Philippine	Malaysia	0.379863	USA	0.000137
S. Korea	Malaysia	0.077580	USA	0.000063
USA	Singapore	0.151699	S. Korea	0.000062

A negative variance reduction (VD) indicates that hedging boosts the risk

Figure 2: Variance ratio with 5% critical values (multi-asset portfolios) during pre-agreement period

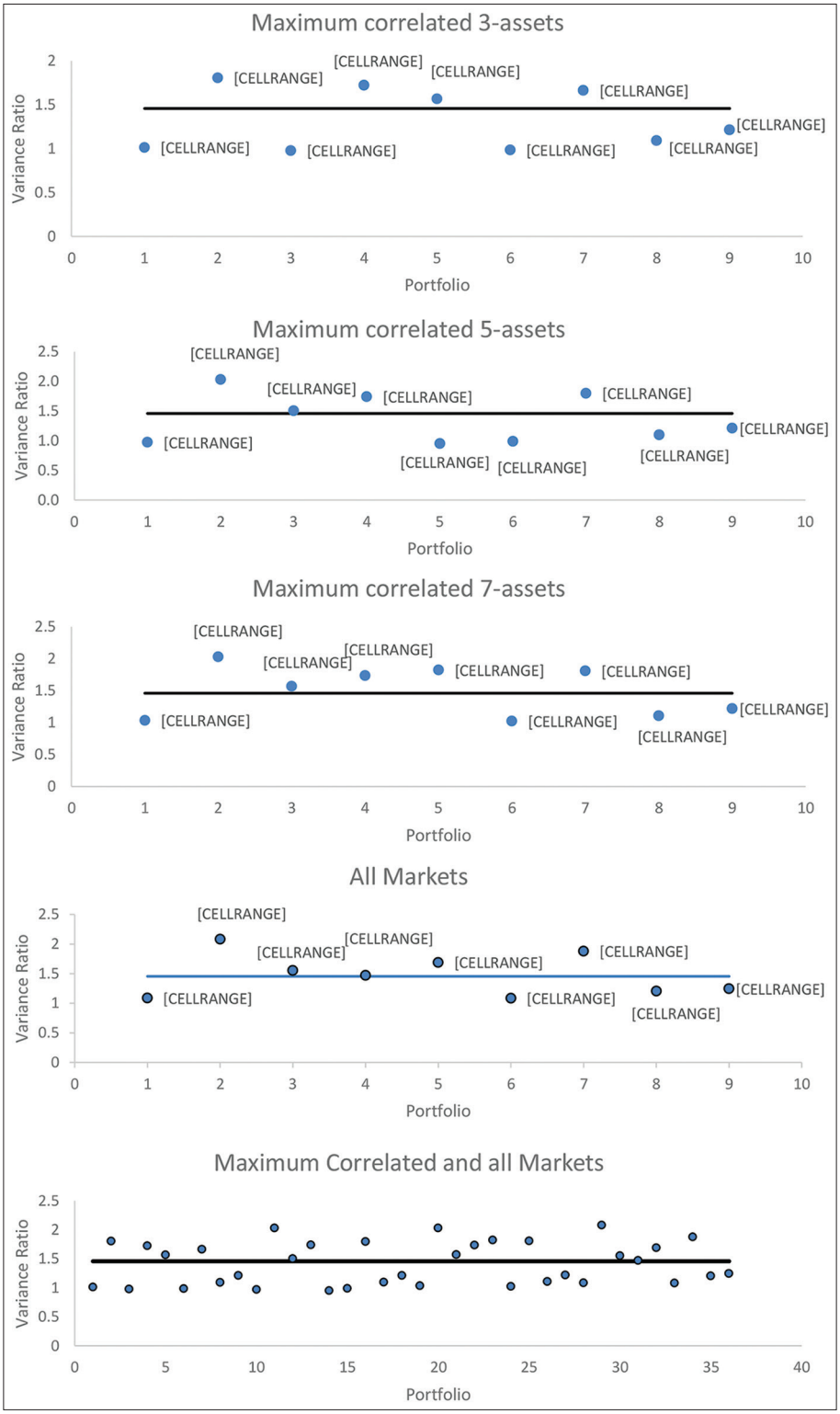


Table 3: Variance reduction in multi-asset portfolios (Maximum and Minimum)

	Pre-agreement period					
Portfolios	**VD (max)**	**Domestic**	**Foreign**	**VD (min)**	**Domestic**	**Foreign**
3 Assets	1.807	Malaysia	PH, KR	0.979	Indonesia	CH, PH
5 Assets	0.507	Malaysia	ID, TH, PH, KR	−0.048	Singapore	TH, JP, KR, US
7 Assets	0.507	Malaysia	ID, TH, PH, KR JP, US	0.023	Japan	MY, ID, TH, SG, PH, US
All Assets	0.520	Malaysia	CH, ID, TH, SG, JP, PH, KR, US	0.077	Japan	CH, MY, ID, TH, SG, PH, KR, US

MY, PH, KR, ID, TH, CH, JP, SG and US represent Malaysia, Philippine, South Korea, Indonesia, Thailand, China, Japan, Singapore, and USA

figure of VR indicates that 20.83% of portfolios are effective in diversifying their investment. This result implies that the degree of effectiveness in portfolio investment increased slightly during this period. Though the degree of effectiveness slightly increased, most portfolios are ineffective when formed with two assets, confirming that two-asset portfolios are less effective in providing higher return and risk reduction.

The specific market that increases portfolio effectiveness can be traced by the result of variance reduction. The result of variance reduction in Table 4 indicates that a portfolio with two assets from the Philippines and Indonesia is the most effective in providing the highest return. Market segmentation between these two markets facilitates the most effective portfolio in the region, supporting the findings of Setyawan (2020). The portfolio comprising assets from Singapore and the US is also effective, which can be explained by their market efficiency. Further, the least effective portfolio is found when the portfolio consists of assets from South Korea and China followed by the portfolio that comprises assets of Indonesia and South Korea. This finding is consistent with earlier studies (Chevallier et al., 2018) showing that the financial cooperation and market openness of South Korea improves financial integration with China and Indonesia, leading reduced diversification effectiveness. Most portfolios that comprise assets from developed economies, such as South Korea, Japan and the US, offer a lower return. This finding shows that asset prices in developed markets are more reflective, indicating the presence of financial integration during the post-agreement period. This is supported by Rahman and Farihana (2019), who provided evidence of financial integration among ASEAN+3 economies during this period.

As presented in Figure 4, this chapter also examines multiple-asset portfolios during the post-agreement period. Any dot above the line in the figure indicates an effective portfolio, while below the line indicates an ineffective portfolio. Most dots are found above the line, indicating effective portfolios during this period; 67–78% of the portfolios were effective when multiple assets were contained in the portfolio. A similar result is reflected on the developed markets of South Korea and the US. This result contradicts the portfolio theory, which states that portfolio effectiveness diminishes when markets are integrated (Markowitz, 1991). However, portfolios of maximum correlated assets are found to be more effective than that of the two-asset portfolio for the same reason, explained earlier. The portfolio remains ineffective when Chinese and Japanese assets are hedged by taking the opposite position for all groups of other correlated assets. This can be explained by the improvement of financial integration, which reduces portfolio effectiveness.

Figure 3: Variance ratio with 5% critical values (two-asset portfolios) during post-agreement period

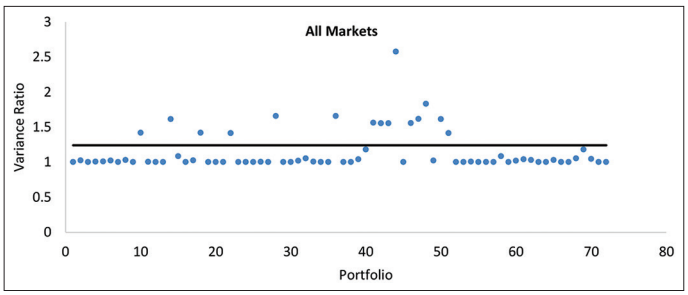


Table 4: Variance reduction in two-asset portfolios (Maximum and Minimum)

Domestic	Foreign	VD (Max)	Foreign	VD (Min)
China	Malaysia	0.066145	Thailand	0.000820
Malaysia	Indonesia	0.357804	S. Korea	0.003231
Indonesia	Philippine	0.396051	S. Korea	0.000039
Thailand	Singapore	0.402309	Japan	0.012600
Singapore	USA	0.460564	Philippine	0.008429
Japan	Indonesia	0.114196	Thailand	0.013482
Philippine	Indonesia	0.668314	USA	0.452796
S. Korea	Singapore	0.421754	China	−0.01043
USA	Singapore	0.459329	Malaysia	0.000230

The result of variance reduction presented in Table 5 can be used to explain the effectiveness of multiple-asset portfolios. Variance ratio shows a group of effective and ineffective portfolios for all sets of assets, while variance reduction indicates which asset offers the least and most effective portfolios. The result shows that hedging a Singaporean asset is the most effective portfolio investment for all groups of max-correlated assets, despite an integrated economy. This finding contradicts the portfolio theory, in which a portfolio comprising the max-correlated asset is supposed to be ineffective, rather than the most effective. However, the finding implies that the Singaporean financial market maintains a unique feature that segments it from other markets in the region providing an opportunity for an effective portfolio.

Inversely, the least risk-reduction approach for three-asset portfolios is found when a Thai asset is hedged by taking an opposite position of other foreign assets. It means the three-asset portfolio is ineffective when a Thai asset is considered. Similarly, the least effective portfolio for five assets and seven assets is determined by hedging a Chinese asset as domestic market, while hedging a Malaysian asset provides the least effectiveness by taking the opposite position of all other foreign assets. This finding implies that developing economies such as Thailand, China and Malaysia became more integrated during the post-agreement period, leading to the least effective portfolio.

5. DISCUSSION

This section discusses several issues based on the empirical findings. First, a two-asset portfolio by hedging a Thailand asset is the most effective during the pre-agreement period. The portfolio is effective because of market segmentation caused by country-specific restrictions during this period.

Financial markets of ASEAN+3 was segmented during the pre-agreement, facilitating an opportunity of portfolio diversification. This finding is supported by Majid et al. (2008), who showed the investment opportunity in ASEAN economies resulted from market segmentation. A two-asset portfolio is the least effective when the Indonesian asset is hedged because Indonesian market openness diminishes portfolio opportunity. Before the agreement period, the Indonesian financial market was not regulated and foreign capital was easily movable, allowing both short and long-term foreign

Figure 4: Variance ratio with 5% critical values (multi-assets portfolios) during post-agreement period

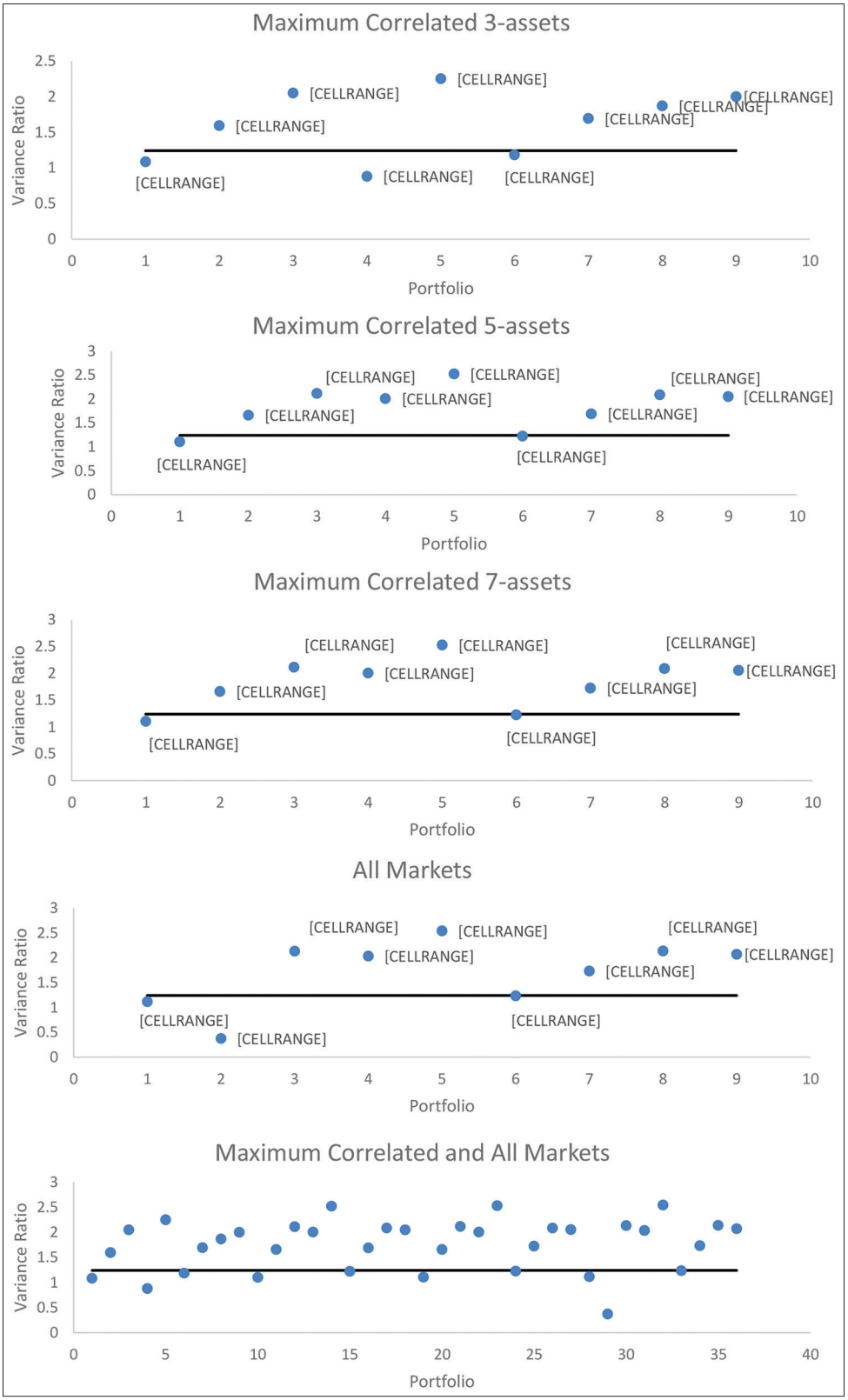


Table 5: Variance reduction in multi-asset portfolios (Maximum and Minimum)

Portfolio assets	VD max	Domestic markets	Foreign markets	VD min	Domestic	Foreign markets
3 Assets	0.556078	Singapore	US, KR	−0.13333	Thailand	SG, KR
5 Assets	0.603843	Singapore	US, KR, TH, JP	0.094175	China	MY, US, JP, SG
7 Assets	0.604567	Singapore	US, KR, TH, JP, ID, MY	0.09531	China	MY, US, JP, SG, PH, ID
9 Assets	0.606843	Singapore	US, KR, TH, JP, ID, MY, PH, CH	−1.66592	Malaysia	MY, US, JP, SG, PH, ID, TH, PH

investment. This study is consistent with Click and Plummer (2005) and Shabri et al. (2009), showing that portfolio investment in Southeast Asia reduces because of market integration.

Second, a multi-asset portfolio is found to be more effective than two-asset portfolios. It is interesting that the number of the effective portfolios rises with the increased number of assets. However, the growth of effective portfolios can be explained by the number of ununiformed asset combinations. The assets that are taken in the portfolio are not completely uniform because of the difference of an individual country's asset-specifications. An additional asset from an individual country increases variation in the portfolio. Therefore, an increasing number of assets in the portfolio improves the effectiveness of portfolio diversification. This result is consistent with Moosa et al. (2015), who observed that a multi-asset portfolio is more effective than a two-asset portfolio.

Third, a portfolio with assets from developed economies such as Japan is not effective. Financial markets of developed economies are generally more integrated, resulting in the price of an identical asset being the same, regardless of location (Rahman and Shahari, 2017). The price in one developed market influences that of other developed markets, meaning that the correlation of asset price in the developed market is extremely high. Therefore, a portfolio that is formed based on the assets of developed markets is ineffective. Inversely, most portfolios consisting of assets from developing economies such as Malaysia are effective during both pre- and post-agreement periods. The market price of an identical asset differs from one market to another in developing economies because of a lack of market integration. The price differential or low correlation leads the portfolio to be effective because it ensures recovery of the loss of one market by the return of another market. This finding is supported by Ghysels et al. (2016), who reported that investment return in emerging economies is normally higher than that of developed economies.

Fourth, the portfolio comprising a Chinese asset is found to be the least effective. Hedging this asset by taking an opposite position of either one or multiple foreign assets gives a similar result. A high volume of financial transactions can be identified as one of the constraints for a portfolio investment to be effective. China had a strong trade relationship with the ASEAN economies during the post-agreement period. Trade openness that leads to financial dealings or capital movement seriously affects portfolio investment. This study is supported by research conducted by the World Bank (2008) that states that China's exports continuously contribute to bringing foreign cash flows. The ratio of export to GDP in 2003 was 14%, while it increased to 40% in 2008 and 18.54% in 2017 (World Bank, 2018). The foreign cash inflows of China through trade openness leads to the movement of foreign capital that causes the ineffectiveness of portfolio investment.

Finally, the structure of portfolio effectiveness in ASEAN+3 financial markets changed over time from the pre-agreement period to the post-agreement period. All sets of portfolios were effective during the pre-agreement period when a Malaysian asset was hedged as a domestic asset. This result implies that Malaysia is segmented from the regional financial markets. Country-specific regulations of Malaysia on its financial market explain portfolio effectiveness. This result is consistent with Roca (2018), who showed that the Malaysian financial market is influenced by its own shocks. Conversely, a Singaporean asset appeared to be an effective portfolio component during the post-agreement period. Theoretically, this result is inconsistent because Singapore is an open economy and is integrated with most regional economies. The openness is further enhanced by the regional initiatives of ASEAN+3 financial cooperation (Rahman and Shahari, 2017). In this regard, portfolio investment consisting of Singaporean assets is supposed to be ineffective, but the empirical result shows the opposite. The effectiveness of the portfolio can be attributed to market transparency and secured transactions. Singapore is a business hub in the southeast region that facilitates foreign investment in several ways to secure portfolio return. This result is supported by Topaloglou et al. (2008) and Morelli (2010), who stated that the opportunity of portfolio investment increased over these periods despite global market integration.

6. CONCLUDING REMARKS

This chapter examines the portfolio effectiveness in ASEAN+3 and US economies by employing the hedging approach. The empirical finding presents several outcomes. First, portfolio effectiveness slightly increased during the post-agreement period. Second, diversified portfolio investment in developing markets is more effective than in developed markets. Third, the portfolio becomes more effective when the number of assets increases in the portfolio, regardless of correlation. Fourth, a multi-asset portfolio is more effective than a two-asset portfolio. Finally, market integration is not found as a constraint for portfolio effectiveness.

This study suggests policy implications for portfolio investors to gain from their portfolio investment. Investors should consider portfolios with multi-assets from developing economies because diversification in this portfolio is more effective.

The study uses equity return as a proxy of a hedged asset to compare the hedge effectiveness between pre and post ASEAN+3 financial cooperation agreement period. The future study is suggested to use another form of financial asset such as bond and derivatives to explore the portfolio effectiveness in the same region. The future study can also reconsider other than hedge approach for a dynamic finding.

REFERENCES

Attia, E.F., Aly, S.M., ElRawas, A.S., Awad, E.O. (2023), Portfolio diversification benefits before and during the times of COVID-19: Evidence from USA. Future Business Journal, 9(1), 26.

Chevallier, J., Nguyen, D.K., Siverskog, J., Uddin, G.S. (2018), Market integration and financial linkages among stock markets in Pacific Basin countries. Journal of Empirical Finance, 46, 77-92.

Click, R.W., Plummer, M.G. (2005), Stock market integration in ASEAN after the Asian financial crisis. Journal of Asian Economics, 16(1), 5-28.

Derbali, A., Lamouchi, A. (2020), Global financial crisis, foreign portfolio investment and volatility: Impact analysis on select Southeast Asian markets. Pacific Accounting Review, 32(2), 177-195.

Duho, K.C.T., Duho, D.M., Forson, J.A. (2023), Impact of income diversification strategy on credit risk and market risk among microfinance institutions. Journal of Economic and Administrative Sciences, 39(2), 523-546.

Ghysels, E., Plazzi, A., Valkanov, R. (2016), Why invest in emerging markets? The role of conditional return asymmetry. The Journal of Finance, 71(5), 2145-2192.

Graham, M., Kiviaho, J., Nikkinen, J. (2012), Integration of 22 emerging stock markets: A three-dimensional analysis. Global Finance Journal, 23(1), 34-47.

Guidi, F., Gupta, R. (2013), Market efficiency in the ASEAN region: Evidence from multivariate and cointegration tests. Applied Financial Economics, 23(4), 265-274.

Huang, L. (2024), The Relationship between cryptocurrencies and convention financial market: Dynamic causality test and time-varying influence. International Review of Economics and Finance, 91, 811-826.

Isomidinova, G., Singh, J.S.K., Singh, K. (2017), Determinants of financial literacy: A quantitative study among young students in Tashkent, Uzbekistan. Electronic Journal of Business and Management, 2(1), 61-75.

Jankowska, B. (2021), International Portfolio Diversification during the covid-19 Onset: A Study of Correlations among CEE Post-transition and Developed Countries. Poland: Poznań University of Economics and Business Press

Karim, M.M., Kawsar, N.H., Ariff, M., Masih, M. (2022), Does implied volatility (or fear index) affect islamic stock returns and conventional stock returns differently? Wavelet-based granger-causality, asymmetric quantile regression and NARDL approaches. Journal of International Financial Markets, Institutions and Money, 77, 101532.

Kulanov, A., Nurgaliyeva, A.M. (2022), Comparative analysis of portfolio investment: World and domestic practice. Bulletin of the Karaganda University Economy Series 106(2), 62-70.

Lee, M.J., Choi, S.Y. (2024), Insights into the dynamics of market efficiency spillover of financial assets in different equity markets. Physica A: Statistical Mechanics and Its Applications, 641, 129719.

Majid, Shabri Abd., M., Kameel Mydin Meera, A., Azmi Omar, M. (2008), Interdependence of ASEAN-5 stock markets from the US and Japan. Global Economic Review, 37(2), 201-225.

Mensi, W., Shafiullah, M., Vo, X.V., Kang, S.H. (2021), Volatility spillovers between strategic commodity futures and stock markets and portfolio implications: Evidence from developed and emerging economies. Resources Policy, 71, 102002.

Mishra, P.K., Mishra, S.K. (2022), Is the impact of COVID-19 significant in determining equity market integration? Insights from BRICS economies. Global Journal of Emerging Market Economies, 14(2), 137-162.

Mohsin, M., Dilanchiev, A., Umair, M. (2023), The impact of green climate fund portfolio structure on green finance: Empirical evidence from EU countries. Ekonomika, 102(2), 130-144.

Markowitz, H. (1952), Portfolio selection. The Journal of Finance, 7(1), 77-91.

Miralles-Marcelo, J.L., del Mar Miralles-Quirós, M., Miralles-Quirós, J.L. (2015), Improving international diversification benefits for US investors. The North American Journal of Economics and Finance, 32, 64-76.

Moosa, I.A., Tawadros, G.B., Hallahan, T.A. (2015), The effectiveness of international diversification: Whole markets versus sectors. Applied Economics, 47(6), 614-622.

Morelli, D. (2010) European capital market integration: An empirical study based on a European asset pricing model. International Financial Markets Institution and Money, 20(4), 363-375.

Nukala, V.B., Prasada Rao, S.S. (2021), Role of debt-to-equity ratio in project investment valuation, assessing risk and return in capital markets. Future Business Journal, 7(1), 1-23.

Narayan, P.K., Sharma, S.S., Thuraisamy, K.S. (2014), An analysis of price discovery from panel data models of CDS and equity returns. Journal of Banking and Finance, 41, 167-177.

Okwudiri, B.O., Onyekachi, G.E., Okechukwu, CM. (2022), Foreign portfolio investment and the growth of Nigeria's capital market. FUOYE Journal of Finance and Contemporary Issues, 3(2), 107-129.

Ordu-Akkaya, B.M., Soytas, U. (2020), Does foreign portfolio investment strengthen stock-commodity markets connection? Resources Policy, 65, 101536.

Özdemir, O. (2022), Cue the volatility spillover in the cryptocurrency markets during the COVID-19 pandemic: Evidence from DCC-GARCH and wavelet analysis. Financial Innovation, 8(1), 12.

Pirgaip, B., Ertuğrul, H.M., Ulussever, T. (2021), Is Portfolio diversification possible in integrated markets? Evidence from South Eastern Europe. Research in International Business and Finance, 56, 1-11.

Rahman, M.S., Farihana, S. (2019), The nexus between Asian and US short-term financing rate. Managerial Finance, 45(12), 1563-1579.

Rahman, M.S., Farihana, S. (2021), Does the US influence ASEAN+3 equity market integration? Journal of Financial Economic Policy, 13(4), 502-524.

Rahman, M.S., Shahari, F. (2021), Does the financial cooperation agreement increase the interdependency among ASEAN+3 equity markets? A markov switching approach. International Economics and Economic Policy, 18(4), 869-899.

Rahman, M.S., Shahari, F. (2017), Does financial cooperation agreement improve the cointegration among ASEAN+ 3 money markets?. International Review of Applied Economics, 31(1), 108-125.

Roca, E.D. (2018). Price Interdependence among Equity Markets in the Asia-Pacific Region: Focus on Australia and ASEAN: Focus on Australia and ASEAN. United Kingdom: Routledge.

Setyawan, B. (2020), Pengaruh kualitas audit, ukuran perusahaan dan profitabilitas terhadap tax avoidance pada perusahaan manufaktur sub sektor otomotif dan komponen di bursa efek indonesia tahun 2013-2017. Journal of Industrial Engineering and Management Research, 1(3), 226-234.

Sugozu, I.H., Yasar, S., Verberi, C. (2023), The Relationship between long-term portfolio investments and growth in the context of asset characteristics and development level. Borsa Istanbul Review, 23(1), 34-43.

Shabri, A.M., Kameel Mydin Meera, A., Azmi Omar, M., Abdul Aziz, H. (2009), Dynamic linkages among ASEAN-5 emerging stock markets. International Journal of Emerging Markets, 4(2), 160-184.

Thomas, N.M., Kashiramka, S., Yadav, S.S., Paul, J. (2022), Role of emerging markets vis-à-vis frontier markets in improving portfolio diversification benefits. International Review of Economics and Finance, 78, 95-121.

Tokat-Acikel, Y., Aiolfi, M., Jin, Y. (2021), Multi-asset value payoff: Is recent underperformance cyclical? Journal of Risk and Financial Management, 14(10), 0477.

Topaloglou, N., Vladimirou, H., Zenios, S.A. (2008), A dynamic stochastic programming model for international portfolio management. European Journal of Operational Research, 185(3), 1501-1524.

Wagner, W. (2010), Diversification at financial institutions and systemic crises. Journal of Financial Intermediation, 19(3), 373-386.

World Bank. (2008), China Quarterly Update. Beijing: World Bank Office.

World Bank. (2018), China Economic Update. Available from: http://www.worldbank.org/en/country/china/publication/china-economic-update-may-2018

Yoshino, N., Taghizadeh-Hesary, F., Otsuka, M. (2021), Covid-19 and optimal portfolio selection for investment in sustainable development goals. Finance Research Letters, 38, 101695.

Zaimovic, A., Omanovic, A., Arnaut-Berilo, A. (2021), How many stocks are sufficient for equity portfolio diversification? A review of the literature. Journal of Risk and Financial Management, 14(11), 0551.

APPENDIX

Table A1: Hedge ratio, domestic variance, portfolio variance and variance ratio (2-assets)

		Pre-agreement period				Post-agreement period			
i	*j*	*h*	σ^2 (*R*)	σ^2 (*R**)	*VR*	*h*	σ^2 (*R*)	σ^2 (*R**)	*VR*
China	Malaysia	0.058	711.872	711.730	1.000	0.444	66.357	61.968	1.071
China	Indonesia	0.599	711.872	694.875	1.024	0.192	66.357	64.552	1.028
China	Thailand	0.045	711.872	711.720	1.000	0.034	66.357	66.303	1.001
China	Singapore	−0.411	711.872	707.832	1.006	0.160	66.357	65.495	1.013
China	Japan	−0.405	711.872	705.794	1.009	0.299	66.357	63.638	1.043
China	Philippine	0.416	711.872	697.304	1.021	0.219	66.357	64.652	1.026
China	S. Korea	−0.198	711.872	710.173	1.002	0.050	66.357	66.245	1.002
China	USA	−1.615	711.872	691.558	1.029	0.230	66.357	65.434	1.014
Malaysia	China	0.003	42.380	42.372	1.000	0.149	22.292	20.817	1.071
Malaysia	Indonesia	0.514	42.380	29.884	1.418	0.403	22.292	14.316	1.557
Malaysia	Thailand	0.042	42.380	42.250	1.003	0.087	22.292	21.933	1.016
Malaysia	Singapore	0.040	42.380	42.343	1.001	0.087	22.292	22.038	1.012
Malaysia	Japan	0.017	42.380	42.370	1.000	0.218	22.292	20.852	1.069
Malaysia	Philippine	0.437	42.380	26.282	1.613	0.374	22.292	17.327	1.287
Malaysia	S. Korea	0.276	42.380	39.093	1.084	0.039	22.292	22.220	1.003
Malaysia	USA	0.046	42.380	42.364	1.000	0.026	22.292	22.279	1.001
Indonesia	China	0.040	47.368	46.237	1.024	0.141	49.146	47.810	1.028
Indonesia	Malaysia	0.574	47.368	33.400	1.418	0.897	49.146	31.563	1.557
Indonesia	Thailand	0.004	47.368	47.367	1.000	0.161	49.146	47.987	1.024
Indonesia	Singapore	−0.001	47.368	47.368	1.000	0.153	49.146	48.459	1.014
Indonesia	Japan	0.007	47.368	47.366	1.000	0.435	49.146	43.420	1.132
Indonesia	Philippine	0.406	47.368	33.498	1.414	0.740	49.146	29.682	1.656
Indonesia	S. Korea	0.034	47.368	47.319	1.001	0.025	49.146	49.144	1.000
Indonesia	USA	−0.053	47.368	47.346	1.000	0.098	49.146	48.997	1.003
Thailand	China	0.005	75.261	75.245	1.000	0.010	46.515	46.490	1.001
Thailand	Malaysia	0.074	75.261	75.030	1.003	0.177	46.515	45.766	1.016
Thailand	Indonesia	0.007	75.261	75.259	1.000	0.156	46.515	45.419	1.024
Thailand	Singapore	1.118	75.261	45.385	1.658	0.715	46.515	27.801	1.673
Thailand	Japan	−0.003	75.261	75.261	1.000	0.086	46.515	45.929	1.013
Thailand	Philippine	0.046	75.261	75.080	1.002	0.146	46.515	45.682	1.018
Thailand	S. Korea	0.182	75.261	73.833	1.019	0.613	46.515	28.373	1.639
Thailand	USA	0.696	75.261	71.487	1.053	0.876	46.515	32.131	1.448
Singapore	China	−0.014	23.891	23.755	1.006	0.076	33.648	33.212	1.013
Singapore	Malaysia	0.022	23.891	23.870	1.001	0.150	33.648	33.272	1.011
Singapore	Indonesia	0.000	23.891	23.891	1.000	0.109	33.648	33.181	1.014
Singapore	Thailand	0.355	23.891	14.407	1.658	0.527	33.648	20.095	1.674
Singapore	Japan	−0.013	23.891	23.885	1.000	0.206	33.648	31.795	1.058
Singapore	Philippine	0.023	23.891	23.848	1.002	0.082	33.648	33.364	1.009
Singapore	S. Korea	0.146	23.891	22.965	1.040	0.546	33.648	19.413	1.733
Singapore	USA	0.682	23.891	20.267	1.179	0.923	33.648	18.151	1.854
Japan	China	−0.021	37.103	36.787	1.562	0.135	30.348	29.105	1.043
Japan	Malaysia	0.015	37.103	37.094	1.554	0.339	30.348	28.427	1.068
Japan	Indonesia	0.006	37.103	37.102	1.553	0.306	30.348	26.882	1.129
Japan	Thailand	−0.002	37.103	37.103	2.575	0.063	30.348	29.939	1.014
Japan	Singapore	−0.020	37.103	37.094	1.000	0.200	30.348	28.644	1.059
Japan	Philippine	0.056	37.103	36.837	1.556	0.285	30.348	27.536	1.102
Japan	S. Korea	−0.160	37.103	35.997	1.616	0.109	30.348	29.634	1.024
Japan	USA	−0.448	37.103	79.427	1.831	0.211	30.348	29.471	1.030
Philippine	China	0.049	84.152	82.430	1.021	0.123	35.500	34.590	1.869
Philippine	Malaysia	0.868	84.152	52.186	1.613	0.599	35.500	27.594	2.343
Philippine	Indonesia	0.721	84.152	59.510	1.414	0.544	35.500	21.444	3.015
Philippine	Thailand	0.052	84.152	83.950	1.002	0.142	35.500	34.891	1.853
Philippine	Singapore	0.080	84.152	84.000	1.002	0.095	35.500	35.198	1.837
Philippine	Japan	0.128	84.152	83.547	1.007	0.329	35.500	32.209	2.007
Philippine	S. Korea	0.054	84.152	84.025	1.002	0.076	35.500	35.308	1.831
Philippine	USA	−0.039	84.152	84.141	1.000	0.104	35.500	35.378	1.827
S. Korea	China	−0.012	43.277	43.173	1.002	−0.007	45.413	45.877	0.990
S. Korea	Malaysia	0.281	43.277	39.919	1.084	0.063	45.413	45.273	1.003
S. Korea	Indonesia	0.031	43.277	43.232	1.001	0.008	45.413	45.406	1.000
S. Korea	Thailand	0.104	43.277	42.455	1.019	0.609	45.413	27.687	1.640
S. Korea	Singapore	0.265	43.277	41.600	1.040	0.710	45.413	26.260	1.729

(Contd..)

Table A1: ***(Continued)***

		Pre-agreement period				Post-agreement period			
i	***j***	***h***	σ^2 ***(R)***	σ^2 ***(R*)***	***VR***	***h***	σ^2 ***(R)***	σ^2 ***(R*)***	***VR***
S. Korea	Japan	−0.187	43.277	41.986	1.031	0.138	45.413	44.403	1.023
S. Korea	Philippine	0.028	43.277	43.211	1.002	0.086	45.413	45.161	1.006
S. Korea	USA	−0.019	43.277	43.274	1.000	0.917	45.413	29.527	1.538
USA	China	−0.018	7.789	7.567	1.029	0.064	17.440	17.198	1.014
USA	Malaysia	0.009	7.789	7.786	1.000	0.037	17.440	17.436	1.000
USA	Indonesia	−0.009	7.789	7.785	1.000	0.044	17.440	17.393	1.003
USA	Thailand	0.072	7.789	7.398	1.053	0.360	17.440	12.057	1.446
USA	Singapore	0.222	7.789	6.607	1.179	0.516	17.440	9.429	1.850
USA	Japan	−0.094	7.789	7.460	1.044	0.135	17.440	16.935	1.030
USA	Philippine	−0.004	7.789	7.788	1.000	0.047	17.440	17.378	1.004
USA	S. Korea	−0.003	7.789	7.788	1.000	0.397	17.440	11.371	1.534

Table A2: Hedge ratio for multi-assets

	Pre-agreement period								
	China	**Malaysia**	**Indonesia**	**Thailand**	**Singapore**	**Japan**	**Philippine**	**S. Korea**	**USA**
Max-correlated 3 assets									
China			0.365				0.205		
Malaysia							0.435	0.246	
Indonesia	0.019						0.374		
Thailand	0.009				1.053				
Singapore				0.294				0.111	
Japan					−0.009		0.033		
Philippine	0.042	0.900							
S. Korea		0.244			0.244				
USA			−0.006		0.222				
Max-correlated 5 assets									
China			0.367	−0.061			0.209	−0.155	
Malaysia			0.265	−0.003			0.334	0.242	
Indonesia	0.027	0.375					0.210		0.095
Thailand	0.008	0.031			1.049		0.038		
Singapore				0.263		0.066		0.122	0.458
Japan		−0.052	0.004		−0.008		0.054		
Philippine	0.031	0.712	0.329	0.039					
S. Korea		0.242		−0.034	0.307				−0.121
USA	−0.034		0.011	0.003	0.220				
Max-correlated 7 assets									
China			0.361	0.065	−0.454	−0.442	0.226	−0.169	
Malaysia			0.266	0.000		0.004	0.333	0.243	−0.048
Indonesia	0.027	0.408				0.011	0.196	−0.081	0.101
Thailand	0.009	0.038	−0.016		1.039	0.041			0.045
Singapore			−0.011	0.263		0.065	0.009	0.122	0.459
Japan		−0.058	0.010	−0.030	0.104		0.048		−0.364
Philippine	−0.003	0.033	−0.149	−0.034	0.304				−0.118
S. Korea	−0.003	0.326	−0.149	−0.034	0.304			−0.118	
USA		−0.007	−0.028		0.227		0.015	0.003	−0.025
All assets of 9 countries									
China		−0.685	0.563	0.078	−0.129	−0.569	0.416	−0.064	−1.612
Malaysia	−0.022		0.273	0.020	−0.073	−0.004	0.338	0.246	−0.050
Indonesia	0.027	0.408		−0.011	0.008	0.010	0.196	−0.081	0.104
Thailand	0.007	0.058	−0.020		1.058	−0.054	0.036	−0.055	0.015
Singapore	−0.003	−0.051	0.004	0.263		0.064	0.027	0.134	0.452
Japan	−0.030	−0.006	0.011	−0.031	0.149		0.035	−0.166	−0.429
Philippine	0.031	0.772	0.301	0.029	0.087	0.049		−0.191	−0.091
S. Korea	−0.004	0.421	−0.093	−0.033	0.326	−0.173	−0.143		−0.202
USA	−0.018	−0.018	0.024	0.002	0.224	−0.091	−0.014	−0.041	
	Post-agreement period								
	China	**Malaysia**	**Indonesia**	**Thailand**	**Singapore**	**Japan**	**Philippine**	**S. Korea**	**USA**
Max-correlated 3 assets									
China		0.439							0.218
Malaysia			0.336				0.125		

(Contd..)

Table A2: ***(Continued)***

	China	Malaysia	Indonesia	Thailand	Singapore	Japan	Philippine	S. Korea	USA
Post-agreement period									
Max-correlated 3 assets									
Indonesia		0.575					0.525		
Thailand					0.466			0.372	
Singapore								0.330	0.628
Japan			0.250		0.191				
Philippine		0.188	0.459						
S. Korea					0.536				0.450
USA					0.367			0.161	
Max-correlated 7 assets									
China		0.383			−0.006	0.194			0.182
Malaysia			0.326		0.024	0.089	0.111		
Indonesia		0.546		0.038		0.149	0.489		
Thailand			0.103		0.357			0.346	0.233
Singapore				0.219		0.110		0.221	0.508
Japan	0.084				0.177		0.121	0.170	
Philippine		0.175	0.439			0.093		0.041	
S. Korea				0.309	0.364		−0.010		0.332
USA	0.028			0.085	0.321			0.132	
Max-correlated 7 assets									
China		0.402	−0.053		−0.004	0.198	0.045		0.180
Malaysia	0.090		0.325	0.013	−0.010		0.111	0.021	
Indonesia		0.544		0.055	−0.004	0.154	0.488		−0.044
Thailand		0.018	0.091		0.356		0.009	0.344	0.234
Singapore		0.025	0.010		0.214	0.100		0.224	0.511
Japan	0.084		0.172		0.155		0.119	0.021	0.013
Philippine	0.016	0.168	0.440	−0.004		0.089		0.043	
S. Korea	0.030	−0.034		0.311	0.363	0.016	−0.002		0.327
USA			−0.022	0.090	0.321	0.011		0.127	
All markets of 9 countries									
China		0.411	−0.055	−0.117	0.098	0.188	0.057	−0.069	0.256
Malaysia	0.092		0.321	0.024	0.024	0.013	0.108	0.035	−0.115
Indonesia	−0.021	0.546		0.102	0.055	0.160	0.488	−0.160	0.013
Thailand	−0.045	0.042	0.102		0.373	−0.083	0.022	0.340	0.248
Singapore	0.022	0.024	0.032	0.216		0.100	−0.050	0.227	0.503
Japan	0.078	0.025	0.173	−0.089	0.186		0.118	0.050	0.037
Philippine	0.020	0.166	0.441	0.020	−0.077	0.098		0.070	0.001
S. Korea	−0.024	0.056	−0.150	0.316	0.364	0.043	0.072		0.327
USA	0.036	−0.073	0.005	0.091	0.320	0.013	0.001	0.130	

Table A3: Domestic Variance, portfolio variance and variance ratio (multi-assets)

		Pre-agreement period			Post-agreement period		
i	***j***	σ^2 (*R*)	σ^2 (*R**)	VR	σ^2 (*R*)	σ^2 (*R**)	VR
Max correlated 3 assets							
China	ID, Ph	672.522	662.909	1.015	66.357	61.137	1.085
Malaysia	ID, Ph	41.569	23.006	1.807	22.292	13.979	1.595
Indonesia	ID, Ph	46.284	47.259	0.979	49.146	23.947	2.052
Thailand	ID, Ph	83.300	48.293	1.725	46.515	52.717	0.882
Singapore	ID, Ph	23.848	15.211	1.568	33.648	14.937	2.253
Japan	ID, Ph	35.563	36.074	0.986	30.348	25.604	1.185
Philippine	ID, Ph	85.831	51.553	1.665	35.500	20.936	1.696
S. Korea	ID, Ph	41.176	37.635	1.094	45.413	24.287	1.870
USA	ID, Ph	8.670	7.141	1.214	17.440	8.721	2.000
Max correlated 5 assets							
China	ID, PH, TH, KR	672.522	691.095	0.973	66.357	60.108	1.104
Malaysia	ID, PH, TH, KR	41.569	20.480	2.030	22.292	13.438	1.659
Indonesia	ID, PH, TH, KR	46.284	30.753	1.505	49.146	23.253	2.114
Thailand	ID, PH, TH, KR	83.300	47.849	1.741	46.515	23.185	2.006
Singapore	ID, PH, TH, KR	23.848	25.002	0.954	33.648	13.330	2.524
Japan	ID, PH, TH, KR	35.563	35.867	0.992	30.348	24.781	1.225
Philippine	ID, PH, TH, KR	85.831	47.695	1.800	35.500	21.032	1.688

(Contd..)

Table A3: ***(Continued)***

		Pre-agreement period			Post-agreement period		
i	***j***	σ^2 (***R***)	σ^2 (***R****)	**VR**	σ^2 (***R***)	σ^2 (***R****)	**VR**
Max correlated 5 assets							
S. Korea	ID, PH, TH, KR	41.176	37.496	1.098	45.413	21.784	2.085
USA	ID, PH, TH, KR	8.670	7.153	1.212	17.440	8.504	2.051
Max correlated 5 assets							
China	ID, PH, TH, KR, SG, JP	672.522	649.794	1.035	66.357	60.033	1.105
Malaysia	ID, PH, TH, KR, SG, JP	41.569	20.475	2.030	22.292	13.434	1.659
Indonesia	ID, PH, TH, KR, SG, JP	46.284	29.461	1.571	49.146	23.227	2.116
Thailand	ID, PH, TH, KR, SG, JP	83.300	47.916	1.738	46.515	23.178	2.007
Singapore	ID, PH, TH, KR, SG, JP	23.848	13.079	1.823	33.648	13.305	2.529
Japan	ID, PH, TH, KR, SG, JP	35.563	34.721	1.024	30.348	24.766	1.225
Philippine	ID, PH, TH, KR, SG, JP	85.831	47.426	1.810	35.500	20.573	1.726
S. Korea	ID, PH, TH, KR, SG, JP	41.176	37.106	1.110	45.413	21.761	2.087
USA	ID, PH, TH, KR, SG, JP	8.670	7.106	1.220	17.440	8.484	2.056
All Assets of 9 Countries							
China	Remaining all	672.522	618.140	1.088	66.357	59.435	1.116
Malaysia	Remaining all	41.569	19.958	2.083	22.292	59.428	0.375
Indonesia	Remaining all	46.284	29.786	1.554	49.146	23.029	2.134
Thailand	Remaining all	83.300	56.539	1.473	46.515	22.846	2.036
Singapore	Remaining all	23.848	14.106	1.691	33.648	13.229	2.544
Japan	Remaining all	35.563	32.808	1.084	30.348	24.578	1.235
Philippine	Remaining all	85.831	45.663	1.880	35.500	20.480	1.733
S. Korea	Remaining all	41.176	34.137	1.206	45.413	21.213	2.141
USA	Remaining all	8.670	6.961	1.246	17.440	8.411	2.073