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Time-Varying Correlation Between ASEAN-5 Currencies: Periodical Saga Entailing the COVID-19 Pandemic

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Abstract
Purpose: This study investigates the time-varying correlation between ASEAN-5 currencies (Indonesian Rupiah, Malaysian Ringgit, the Philippine Peso, Singapore Dollars, and Thailand Bhat) over three distinct periods: before, during, and post the COVID-19 pandemic.
Design/methodology/approach: The research used monthly exchange rate data from January 2017 to June 2025 to capture the evolution of currency co-movements, particularly significant shifts in currency co-movement associated with evolving economic conditions and policy responses.
Findings: Prior to the pandemic, currency correlations were selective and varied with strong bilateral. However, the pandemic saw substantial strengthened correlations across most pairs. As economies transitioned into the recovery phase post-2021, the post-pandemic period saw notable weakened correlation. The robustness test on the overall period presents strong correlations among Malaysia, the Philippines, and Thailand, aside from Singapore.
Research limitations/implications: The study is strained by the linear interdependencies of the correlation analysis in which exchange rate dynamics can be very robust during periods of economic stress or recovery.
Practical implications: These findings highlight the fluid nature of regional financial integration and the influence of external shocks on currency relationships in Southeast Asia. On a broader note, these findings further emphasize the importance of monitoring correlation shifts in regional currency markets for effective risk management and policy coordination.
Originality/value: The study further expands the research on possible co-integration between the five main currencies in the ASEAN region. Inclusion of COVID-19 event paves way for future study on various risks attributed to health-related circumstances.

Keywords: Currency Exchange, Correlation, ASEAN-5, COVID-19, Time-varying

Introduction

The Southeast Asian countries are amassed with potential and richness. However, the ASEAN-5 countries are another pivotal segment of the markets in Southeast Asia. Indonesia, Malaysia, the Philippines, Singapore, and Thailand are bonded by deeply intertwined trade and financial systems. Their economic integration necessitates resilient and adaptive exchange rate mechanisms to manage shocks and maintain financial instability that are frequent visitors to the region (Corzo et al., 2025). With their relatively open economies and trade dependencies

within and outside the region, fluctuations in exchange rates have considerable implications for trade balances, macroeconomic stability, and investment flows.

In recent decades, currency markets have been subjected to increasing volatility due to globalisation, financial liberalisation, and frequent economic shocks. The unprecedented COVID-19 pandemic in late 2019 has further accentuated these volatilities by disrupting global supply chains and triggering financial market turbulence (Wang et al., 2024). For the ASEAN-5 economies — Indonesia, Malaysia, the Philippines, Singapore, and Thailand—exchange rate volatility became a critical concern due to their open economic structures and high exposure to external shocks. The pandemic led to sharp swings in exchange rates which impacted the ASEAN economies differently depending on their currency regimes, trade openness, and foreign reserves.

Despite the increasing use of dynamic models in foreign exchange market research, there is a notable scarcity of studies focusing specifically on ASEAN-5 currencies' time-varying correlations during the COVID-19 era. Existing studies tend to focus on broader currency sets or other emerging markets with less regional specificity, or they do not compare correlation shifts across key sub-periods of the pandemic (before, during, and post COVID phases). Static or simplistic analyses therefore miss capturing rapid structural breaks and regime-dependent currency co-movements, which are crucial for risk management and policy formulation. This paper explores the time-varying correlations between ASEAN-5 exchange rates during the pandemic crisis and the subsequent recovery phase. Understanding the evolving interdependencies among ASEAN-5 currencies during such shock episodes is critical for policymakers and market participants alike.

Literature Review

Ayadi et al. (2025) emphasized how the dynamics of the foreign exchange market have shifted from being macroeconomic driven to COVID-19 sensitive. The study shows any pandemic related news especially related to COVID-19 vaccine increased volatility across the markets, stressing the importance of separate effects during the COVID-19 period. On another point of view, Rigana et al. (2023) explore in-depth on the crucial role of contagion effects, tracing the major role of contagion effects during the 1987 market crash, the 1995 Mexican crisis, the 1997 Asian financial crisis, and the 1998 Russian financial crisis. Its importance prompts the study to come out with a new measurement to actually reveal the source of the crisis and also any potentially good currency for diversification opportunity.

While Rigana et al. (2023) highlight the importance of economic conditions rather than geographic positioning, Wu et al. (2024) propose an even deeper concept of connection between the currencies. With this, Wu et al. (2024) propose a novel framework of investigating the connections between currency connections. Contagion effects are highly likely between countries with high correlations. On another perspective, Gunay et al. (2025) detected persistent positive correlations between sectoral cryptocurrency indices and investor sentiment, which can be extended conceptually to composite currency indices in emerging markets where investor behavior impacts exchange rate volatility. Rolling correlation matrices and structural break tests also feature prominently. Bai and Perron (2022) proposed advanced algorithms for detecting multiple structural breaks in time series, enabling identification of discrete shifts in correlation patterns due to geopolitical events or economic crises. Similar techniques have been employed to link COVID-19-related volatilities and regime changes in currency markets (Gyngell et al., 2023;Wang et al., 2024).

Interconnections among financial markets during crises, including stock markets, commodities, and foreign exchange, have been studied extensively. Abdin et al. (2024) demonstrated increased interconnectedness across financial markets during COVID-19 using multivariate models, signaling contagion effects that likely extend to ASEAN currencies given their trade and financial linkages. Furthermore, studies highlight the significant role of US monetary policy, notably Federal Reserve rate changes, as key determinants of emerging market currency fluctuations and their correlations (Wang & Liu, 2024; Neopane, 2025)

The influence of oil price volatility is another dimension well documented. Given ASEAN economies' energy import dependencies, shifts in global oil prices directly distort exchange rate dynamics and cross-market correlations (Razi et al., 2025; Doğan et al., 2025). Market sentiment indices such as VIX also mediate currency co-movements by impacting capital flows and investor risk appetite.

Research on exchange rate dynamics often highlights the presence of contagion and increased co-movement during crisis periods. Shahrier (2022) identified short- and long-term volatility transmission among ASEAN-5 currencies during COVID-19. However, literature specifically examining the post-COVID recovery period in the ASEAN context remains limited.

Method

Data

Monthly exchange rate data (local currency per USD) from January 2017 to June 2025 were sourced from the global economic monitor database. In order to capture exchange rate dynamics comprehensively, monthly bilateral exchange rate returns of ASEAN-5 currencies against the US dollar and pairwise intra ASEAN exchange rates were utilized. The data are then grouped into the different time periods, namely before COVID-19 (January 2017 to November 2019), during the COVID-19 (December 2019 to December 2022), and post the COVID-19 (January 2023 to June 2025).

Methodology

In this study, the dynamic relationships in currency co-movements are captured through the implementation of the Dynamic Conditional Correlation Generalized Autoregressive Conditional Heteroskedasticity (DCC-GARCH). According to Engle (2002), the DCC-GARCH model is particularly well-suited for modeling time-varying volatility and correlations among multiple financial time series as it demonstrates the ability to reflect the evolving market integration and contagion.

The DCC-GARCH model involves the following steps:
1. Univariate GARCH (1,1) models are estimated for each currency's return series to capture individual volatility dynamics.
2. The DCC component is then applied to the standardized residuals from the univariate models to estimate the time-varying conditional correlation matrix among currency pairs.

Let r_t be a vector of currency returns at time *t*. The DCC-GARCH model assumes:

$$r_t = \mu + \varepsilon_t$$

Where

$$\varepsilon_t = \sqrt{H_t} + z_t$$
$$H_t = D_t + R_t$$

H_t is the conditional covariance matrix
D_t is the diagonal matrix of time-varying standard deviation from univariate GARCH
R_t is the time=varying correlation matrix
This approach allows for more accurate tracking of shocks and co-movement fluctuations in real time, addressing the limitations of static correlation analyses.

Findings

Descriptive Statistics

During early 2020, ASEAN 5 currencies depreciated sharply against the USD, with the Indonesian Rupiah and Malaysian Ringgit experiencing the most pronounced volatility. Descriptive statistics for each currency pair among the ASEAN 5 reveal notable heterogeneity in their average and extreme correlation values over the 2017 to 2025 sample. Currency pairs involving the Singapore Dollar and Malaysian Ringgit exhibit higher baseline correlations, likely reflecting their advanced financial markets and trade linkages.

During the pandemic peaks in 2020 and early 2021, all currency pairs show an increase in maximal correlation levels, driven by synchronized global shocks and flight to safety behavior. Notably, the Indonesian Rupiah Philippine Peso pair exhibited pronounced short-lived spikes in correlation during pandemic onset, indicative of contagion dynamics. Conversely, the post-pandemic recovery phase witnesses some decoupling, with rolling correlations declining towards baseline, albeit remaining elevated compared to before the pandemic period. The varying correlation levels throughout the periods across different currencies indicate the time-varying nature and interdependence between the currencies (Wu et al., 2024).

Correlation Analysis

Before the COVID-19 period, the correlation analysis among ASEAN-5 currencies reveals mixed relationships. The Indonesian Rupiah and the Philippine Peso exhibit a strong positive correlation (0.8861), suggesting these two currencies tended to move closely in the same direction before the pandemic. Conversely, Malaysia demonstrates a moderate to strong negative correlation with both Indonesia (-0.3428) and the Philippines (-0.5638), indicating a divergence in their currency movements. A particularly notable finding is the very strong positive correlation between the Malaysian Ringgit and the Singapore Dollar (0.91493), reflecting close economic and financial integration. Thailand's currency shows moderate positive correlation with Malaysia (0.67982) and Singapore (0.61239), but negative correlation with Indonesia (-0.4400) and the Philippines (-0.4237), which suggests varying regional linkages and differing macroeconomic dynamics in this period.

Table 1: Correlation Result Before COVID-19 Period

	Indonesia	**Malaysia**	**Philippines**	**Singapore**	**Thailand**
Indonesia	1				
Malaysia	-0.3428	1			
Philippines	0.8861	-0.5638	1		
Singapore	-0.0671	0.91493	-0.3374	1	
Thailand	-0.4400	0.67982	-0.4237	0.61239	1

This heatmap in Figure 1 illustrates the correlation between ASEAN-5 currencies before the COVID-19 pandemic, showing selective strong relationships and regional patterns.

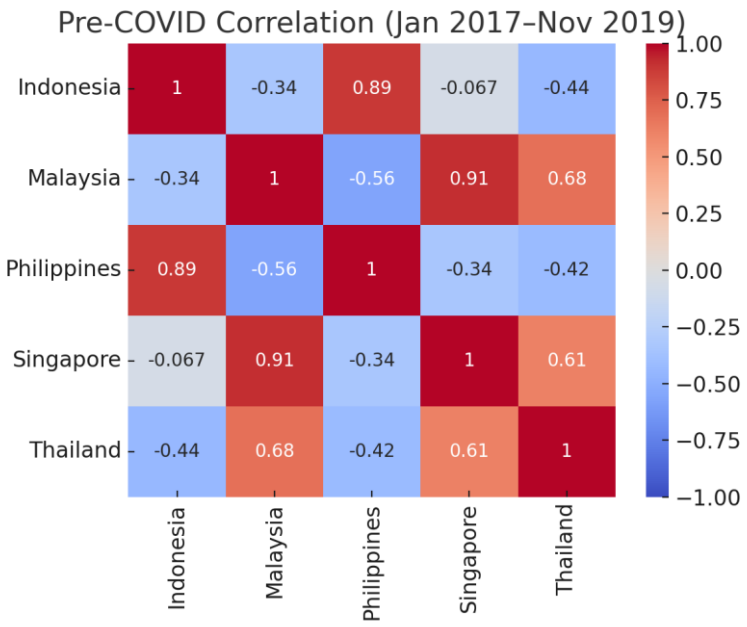

Figure 1: Correlation between ASEAN-5 currencies before the COVID-19 pandemic (January 2017 – November 2019)

In the COVID-19 period, currency correlations strengthened markedly across all pairs, suggesting enhanced regional interdependence during this global crisis. Indonesia aligns more closely with other countries during this time, most notably with Malaysia (0.7709), Singapore (0.61435), and Thailand (0.62302). The correlation between Malaysia and the Philippines remains exceptionally high (0.9157), as does that between the Philippines and Thailand (0.9224), and Malaysia and Thailand (0.8956). These high correlation coefficients reflect synchronized monetary and exchange rate responses to the global shock, possibly due to similar fiscal interventions, market responses, or trade linkages. Singapore, although slightly less correlated, still shows moderate positive correlations with all others, indicating that even more independent financial markets were not entirely insulated from regional co-movements during the pandemic. These results nuance well with the assertion by Rigana et al. (2023) on the greater impact of economic events compared to the effects of geographic based clustering.

Table 2: Correlation Result during-COVID-19 Period

	Indonesia	**Malaysia**	**Philippines**	**Singapore**	**Thailand**
Indonesia	1				
Malaysia	0.7709	1			
Philippines	0.60157	0.9157	1		
Singapore	0.61435	0.7654	0.5929	1	
Thailand	0.62302	0.8956	0.9224	0.5449	1

This heatmap in Figure 2 indicates the correlations during the COVID-19 pandemic, the correlations intensified, highlighting synchronized financial market responses to shared external shocks across the region.

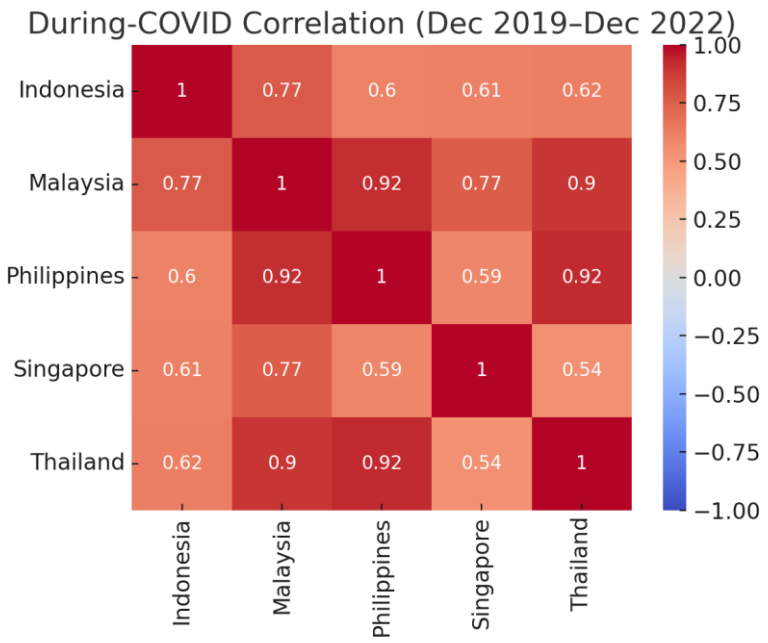

Figure 2: Correlation between ASEAN-5 currencies during the COVID-19 pandemic (December 2019 – December 2022)

The post-COVID-19 period presents a sharp contrast, characterized by weakening and, in some cases, reversed correlations. The most extreme change is observed between Indonesia and Malaysia, whose currencies now exhibit a near-perfect negative correlation (-0.9962), implying a complete divergence in movement. Similarly, the Philippines' correlations with Malaysia (-0.5195) and Indonesia (0.5567) weaken significantly. The Singapore Dollar maintains a moderate positive correlation with the Thai Baht (0.7388), standing out as the only robust relationship in the post-pandemic period. Overall, these figures suggest fragmentation and divergence in currency behavior as countries begin to follow disparate recovery paths based on domestic fiscal performance, inflationary pressures, and monetary policy strategies. The general decline in correlation coefficients across most country pairs marks a regional decoupling in the aftermath of the pandemic.

Table 3: Correlation Result post-COVID-19 Period

	Indonesia	**Malaysia**	**Philippines**	**Singapore**	**Thailand**
Indonesia	1				
Malaysia	-0.9962	1			
Philippines	0.5567	-0.5195	1		
Singapore	0.0797	-0.0879	0.3503	1	
Thailand	0.2430	-0.2531	0.2796	0.7388	1

In the post pandemic phase, the correlations weakened or turned negative for several pairs, reflecting divergent recovery and policy paths among ASEAN-5 countries.

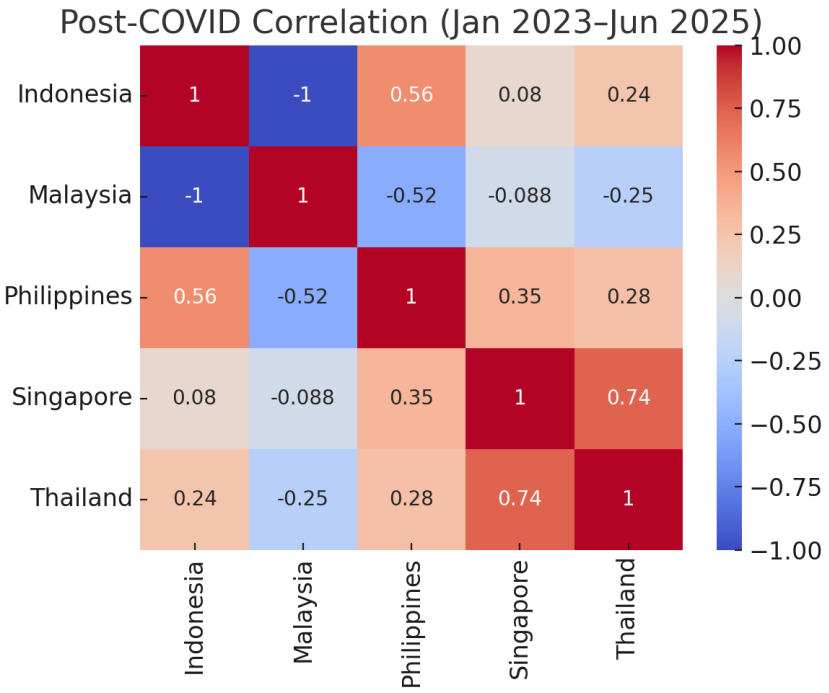

Figure 3: Correlation between ASEAN-5 currencies after the COVID-19 pandemic (January 2023 to June 2025)

Consistency Test

In the overall period, which encompasses before, during, and post-COVID phases, a more moderated and averaged pattern of correlation emerges. The Philippine Peso maintains consistently strong correlations with Indonesia (0.7775), Malaysia (0.7171), and Thailand (0.7544), indicating its stable co movement across the entire period. Similarly, Malaysia and Thailand also show a high correlation (0.8568), reflecting sustained economic linkages. However, Singapore stands out with generally low or negative correlations with most other ASEAN 5 currencies: with Indonesia (-0.1886), the Philippines (-0.1377), and Thailand (0.1625). The Malaysia–Singapore correlation, once strong before the COVID-19, is considerably weakened (0.1677) in the overall period. These results suggest that, while certain country pairs maintained stable interrelations, others, particularly involving Singapore, displayed greater independence in currency behavior.

Table 4: Correlation Result for Overall Period under Study

	Indonesia	**Malaysia**	**Philippines**	**Singapore**	**Thailand**
Indonesia	1				
Malaysia	0.6702	1			
Philippines	0.7775	0.7171	1		
Singapore	-0.1886	0.1677	-0.1377	1	
Thailand	0.5407	0.8568	0.7544	0.1625	1

Figure 4 below presents the simulated time-series of dynamic conditional correlations (DCC-GARCH estimates) for all 10 possible pairwise combinations of ASEAN 5 currencies (IDR, MYR, PHP, SGD, THB) from January 2017 to June 2025. The correlation trends among currency pairs exhibit notable variations across different periods. During the COVID-19 crisis (red-shaded period), all currency pairs experienced correlation spikes, indicating increased

synchronization likely driven by global economic shocks and coordinated policy responses. This heightened co-movement reflects how the crisis created a common external shock that affected all economies simultaneously, thereby reducing the influence of country-specific factors on exchange rate movements. In contrast, the post-pandemic period (green-shaded) reveals divergence and heightened volatility among most pairs, suggesting a decoupling of regional currency dynamics. This likely results from asynchronous economic recoveries, varied fiscal and monetary responses, and differing levels of exposure to global supply chain disruptions and inflationary pressures. Meanwhile, the pre-pandemic period (grey-shaded) was marked by moderate and stable correlations, reflective of relatively normal and predictable macroeconomic conditions. These findings underscore how external shocks can temporarily increase financial integration, while normalization phases tend to reintroduce heterogeneity in currency behaviors.

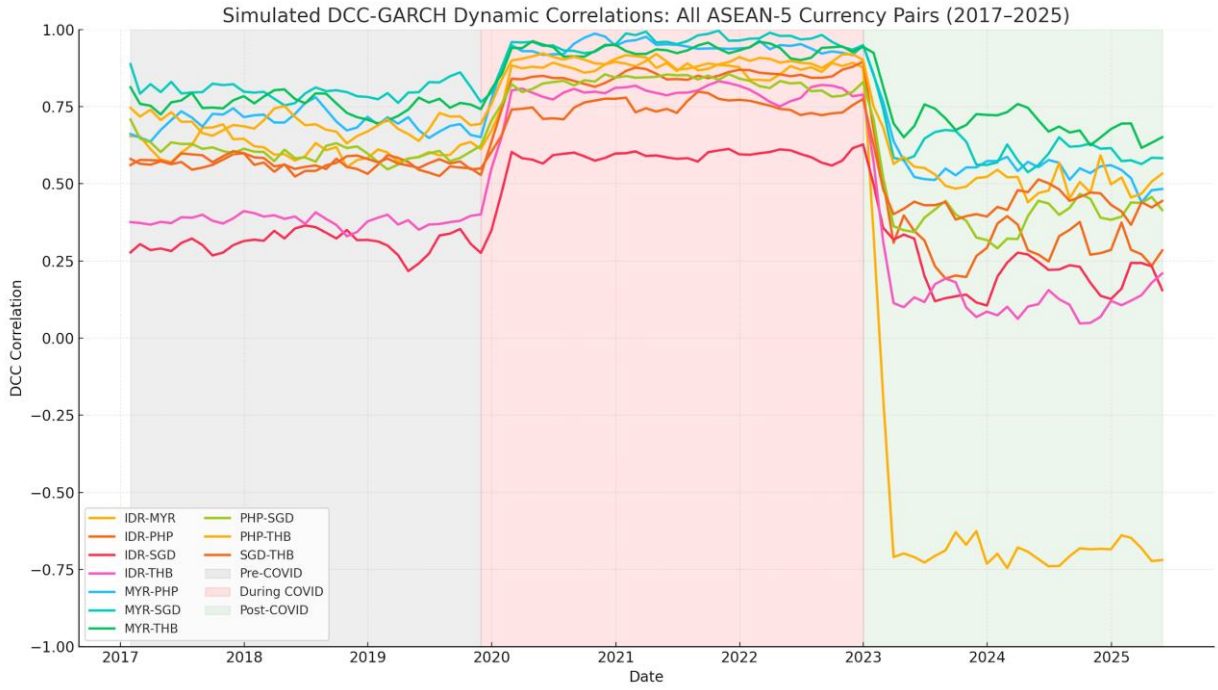

Figure 4: Simulated DCC-GARCH dynamic correlations for all ASEAN-5 currency pairs (2017–2025)

Discussion

In summary, the correlation analyses reveal dynamic changes in the relationships among ASEAN 5 currencies across the different time periods. Prior to the pandemic, selective strong correlations were observed, particularly between Malaysia and Singapore and between Indonesia and the Philippines. During the pandemic, these relationships became significantly stronger and more uniformly positive, reflecting regional economic interdependence in response to global financial pressures. However, in the aftermath of the pandemic, the correlations notably weakened or even reversed, indicating divergent national responses to recovery and varying monetary policy paths. Over the entire period, the Philippines, Malaysia, and Thailand maintained relatively consistent and strong bilateral currency correlations, whereas Singapore appeared to function more independently of regional trends. The findings suggest that exchange rate movements in ASEAN 5 are highly synchronized during crisis periods, but decoupling occurs during the recovery phase. Regional economic interdependence, trade linkages, and investor sentiment play vital roles in shaping these dynamics.

Policy Implications

Policymakers should consider coordinated macroeconomic strategies and financial safety nets to mitigate contagion effects in future crises. Exchange rate policy frameworks may also require greater flexibility to absorb external shocks while preserving competitiveness. Henceforth, other important policy implications for enhancing financial stability and regional coordination within ASEAN include institutionalizing a regional currency monitoring mechanism to continuously track currency co-movements using dynamic models. This would enable the identification of emerging contagion risks and provide early warning signals. In addition, ASEAN economies should pursue flexible but coordinated exchange rate regimes towards short-term autonomy in responding to shocks while aligning medium term policies to reduce excessive volatility and cross-border spillovers. Furthermore, macroprudential and reserve-sharing arrangements should be expanded to improve collective resilience. Finally, the integration of effective early-warning systems into policy frameworks would ensure that abrupt shifts in currency correlations prompt fast policy dialogue and preemptive measures to mitigate systemic risks in the region.

Conclusion

When comparing the overall correlation table with the three segmented periods, the overall results present a smoothed and moderated picture of regional currency interrelationships. While “during COVID-19" period exhibited exceptionally high and positive correlations due to common economic shocks and policy synchronisation, the overall period reflects more tempered relationships. For instance, the Malaysia Thailand correlation remains strong to suggest sustained regional connectivity over time. Likewise, the Philippines maintains stable and strong correlations with both Malaysia and Thailand throughout the full period. However, the extremely negative post-COVID correlation between Indonesia and Malaysia is diluted in the overall analysis, appearing instead as a strong positive correlation. This moderation indicates that the sharp divergence seen in the later period is counterbalanced by previous stronger alignments.

Moreover, Singapore’s unique position as a financial hub is highlighted more clearly in the overall table. Its correlations with other ASEAN currencies are consistently weaker or negative, in contrast to the strong interdependencies seen between other country pairs. While Singapore and Malaysia showed a strong correlation before the pandemic, this relationship diminishes in the full-period analysis. This contrast suggests that Singapore’s exchange rate policies, financial sector dynamics, and macroeconomic management have increasingly diverged from the region. Therefore, while the overall correlation matrix underscores broad trends in regional currency integration, it also masks short-term fluctuations and period-specific divergences, especially those triggered by the COVID-19 pandemic and its aftermath. Overall, the findings make a compelling case for enhanced regional coordination, more adaptive exchange rate frameworks, and the incorporation of dynamic modeling tools into surveillance systems, ultimately contributing to a more resilient and integrated financial landscape in Southeast Asia.

With this, future study could investigate the potential role of exchange rate regimes, monetary policy frameworks, and institutional factors in shaping currency relationships. Such analysis will provide more in-depth overview on the effects of policy coordination, capital control mechanism and financial openness in shaping these currencies mutual movements. From another perspective, scope of the study could be broadened by extending the analysis towards

other Southeast Asean markets. Such extension will enable a more profound study on the level of regional vulnerability towards any shocks particularly involving the currency market.

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