# “Weak-form market efficiency and integration dynamics in ASEAN capital markets during digital disruption”


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# WEAK-FORM MARKET EFFICIENCY AND INTEGRATION DYNAMICS IN ASEAN CAPITAL MARKETS DURING DIGITAL DISRUPTION

## Abstract

Rising global uncertainty and rapid digital transformation have significantly altered volatility dynamics and cross-market linkages in Southeast Asian equity markets, raising critical questions regarding market efficiency and regional financial integration. This study investigates weak-form market efficiency and examines short-term and long-term integration dynamics across the capital markets of Indonesia, Malaysia, Singapore, the Philippines, Thailand, and Vietnam during the digital disruption period. Monthly stock index data spanning January 2020 to July 2025 are analyzed using quantitative time-series techniques to assess return behavior, information transmission, and long-run market relationships.

The empirical results indicate that all sampled markets broadly exhibit weak-form efficiency, as evidenced by random return behavior and stationary price series. Nevertheless, statistically significant short-term dependence persists, suggesting partial and time-varying inefficiencies. The findings further reveal strong long-term integration among ASEAN capital markets, while short-term interactions remain asymmetric. In particular, the Indonesian market functions as a unidirectional information transmitter to the Thai market. Additional analysis shows that shocks originating from the Philippine market account for approximately 25–28 percent of fluctuations in the Indonesian market, whereas the contribution of the Singapore market is limited to around 5–6 percent, reflecting a higher degree of market independence. Overall, the results suggest that ASEAN capital markets are structurally integrated in the long run, although uneven short-term information transmission continues to limit regional diversification opportunities.

**Keywords** efficiency, integration, cointegration, causality, volatility, diversification, emerging, ASEAN

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## INTRODUCTION

Global financial markets have entered a period characterized by heightened uncertainty and structural transformation. Fluctuations in macroeconomic conditions, shifts in monetary policy, and recurring geopolitical tensions have contributed to increased volatility in equity markets worldwide. These dynamics have altered risk perceptions and challenged conventional investment strategies, particularly in emerging markets where financial systems tend to be more sensitive to external shocks. As a result, understanding how stock markets process information and respond to uncertainty has become increasingly important for both investors and policymakers (MarketMinute, 2025). Alongside these developments, the expansion of digital technologies has fundamentally changed the way financial information is generated, disseminated, and incorporated into stock prices. Advances in electronic trading platforms, real-time data access, and algorithmic trading have reduced information asymmetry and increased market participation. However, faster information flows do not necessarily



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imply more stable markets. In many cases, digitalization amplifies short-term price fluctuations and accelerates the transmission of shocks across interconnected markets, raising new questions regarding market efficiency and financial integration in the digital era.

Within this global setting, the capital markets of the Association of Southeast Asian Nations (ASEAN) represent an important case for examining market efficiency and regional integration. The region comprises economies at different stages of financial development, ranging from mature markets to emerging and frontier systems. Efforts to strengthen cross-border financial cooperation and capital market connectivity are expected to enhance resource allocation and improve regional financial resilience. At the same time, increased openness exposes ASEAN markets to external disturbances, making them a relevant laboratory for studying how integration and efficiency evolve under conditions of structural change (Kurmala, 2025; Sc.com.my, 2025). These developments are expected to foster closer linkages among ASEAN capital markets and increase their exposure to regional and global shocks.

Despite ongoing efforts to promote regional financial integration, ASEAN capital markets remain structurally heterogeneous. Differences in market depth, liquidity, regulatory frameworks, and investor composition continue to generate uneven responses to regional and global shocks. Recent macroeconomic uncertainty and geopolitical pressures have further amplified these disparities, increasing the vulnerability of emerging ASEAN markets to external disturbances (Desk & Allan, 2025).

From a theoretical standpoint, financial integration is expected to enhance informational efficiency by accelerating price adjustment to available information. Under the weak-form Efficient Market Hypothesis, historical price information should be fully reflected in asset prices, thereby limiting return predictability (Fama & French, 1992). However, empirical evidence from ASEAN markets remains mixed. While some studies report improvements in weak-form efficiency and stronger inter-market linkages following liberalization, others continue to identify short-term inefficiencies and asymmetric information transmission.

Most existing studies analyze market efficiency, short-term causality, and long-term integration in isolation. Limited attention has been given to an integrated framework that simultaneously captures these dimensions using recent data from periods of digital disruption and heightened global risk. Consequently, the interaction between short-term information dynamics and long-run market convergence in ASEAN capital markets remains insufficiently explored.

Unlike prior studies that focus on bilateral volatility spillovers using standard VAR–GARCH frameworks, this study adopts a multivariate VAR–VECM system to simultaneously evaluate weak-form efficiency, short-term causality, and long-run integration among six ASEAN markets. The broader regional scope and unified system-based approach distinguish this research from existing bilateral volatility studies.

Accordingly, this study examines weak-form market efficiency, short-term information transmission, and long-term integration among ASEAN capital markets during the digital disruption period. By employing a comprehensive time-series approach, this research provides new evidence on how efficiency and integration jointly evolve within a structurally diverse regional financial system.

## 1. LITERATURE REVIEW AND HYPOTHESES

Given the mixed and evolving evidence on market efficiency and regional financial integration, the literature offers important insights into how information is reflected in asset prices and transmitted across interconnected capital markets. Studies in financial economics highlight that stock market efficiency and convergence are shaped by institutional structures, investor behavior, and exposure to external shocks, particularly in emerging mar-

ket settings such as ASEAN (Bekaert & Harvey, 2003; Kristoufek & Vosvrda, 2014; Lim & Brooks, 2011). In addition, the growing openness of capital flows and financial liberalization policies have intensified cross-market interactions, reinforcing both integration and vulnerability to global shocks (Lean & Smyth, 2015; Shabri Abd Majid & Hj Kassim, 2009).

## 1.1. Efficient market hypothesis and weak-form efficiency

The Efficient Market Hypothesis (EMH) provides the theoretical basis for understanding how information is incorporated into asset prices. In its weak-form version, EMH argues that current stock prices already reflect all information contained in historical price movements, implying that returns follow a stochastic process and are not systematically predictable using past prices (Fama, 1970). Under this framework, information-based trading strategies relying solely on historical price patterns are unlikely to generate persistent abnormal returns.

Empirical evidence on weak-form efficiency, particularly in emerging markets, remains inconclusive. A substantial body of research documents return behavior consistent with random walk dynamics, while other studies identify short-term autocorrelation and volatility clustering, especially during periods of heightened market uncertainty. These deviations are commonly associated with market microstructure frictions, information asymmetry, and heterogeneous investor behavior, which tend to be more pronounced in developing financial systems (Juliana et al., 2023; Sensoy & Tabak, 2016; Shaik & Maheswaran, 2017).

Within the ASEAN context, weak-form efficiency exhibits considerable variation across countries and time periods. Several studies report improvements in market efficiency following financial liberalization and regional integration initiatives, whereas others continue to observe persistent inefficiencies linked to differences in liquidity, market depth, and investor composition (Febriandika et al., 2025; Hartanto, 2018; Karim & Karim, 2012; Kartika et al., 2017). This heterogeneity suggests that ASEAN capital markets do not converge uniformly toward weak-form efficiency, reinforcing the need for further empirical investigation using recent data and a regional integration perspective.

## 1.2. Short-term linkages and information transmission across markets

Beyond individual market efficiency, short-term linkages and information transmission constitute essential dimensions of regional financial integration. In interconnected financial systems, shocks originating in one market may affect return dynamics and volatility in other markets over short horizons. Such interactions reflect both the speed and direction of information flow and provide insight into the effectiveness of cross-border market connectivity (Diebold & Yilmaz, 2012; Forbes & Rigobon, 2000).

Empirical evidence from ASEAN capital markets indicates that short-term integration is generally partial and asymmetric. Certain markets tend to function as information transmitters, while others primarily absorb external shocks without exerting reciprocal influence. Previous studies document the predominance of unidirectional rather than bidirectional causality across market pairs, suggesting that short-term information transmission in the region remains uneven and market-specific (Hartanto, 2018; Waworundeng & Van Rate, 2018).

Short-term integration dynamics are further influenced by global events and systemic shocks. Periods of financial turbulence and heightened global uncertainty are associated with stronger volatility spillovers and more pronounced short-run linkages, although such effects are often temporary and diminish as market conditions stabilize (Candra et al., 2018). This evidence suggests that short-term market interactions are shaped not only by structural integration but also by external disturbances and changing risk perceptions.

## 1.3. Long-term integration and cointegration among capital markets

While short-term dynamics capture immediate information transmission, long-term integration reflects the extent to which capital markets share common equilibrium relationships over time. In


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financial economics, long-term integration is commonly assessed through cointegration analysis, which examines whether stock prices across different markets move together in the long run despite temporary short-term deviations. The presence of cointegration implies that markets are linked by underlying economic and financial fundamentals rather than transitory shocks alone (Kasa, 1992).

A growing body of empirical literature documents increasing long-term integration among regional and international stock markets, particularly following financial liberalization and the expansion of cross-border capital flows. Studies focusing on emerging and Asian markets report evidence of long-run co-movement driven by trade linkages, capital mobility, and coordinated policy frameworks, even when short-term interactions remain weak or asymmetric (Arouri & Nguyen, 2009; Chien et al., 2015; Click & Plummer, 2005; Lean & Smyth, 2015). Within the ASEAN region, several studies identify cointegration across market pairs, suggesting gradual structural convergence among member countries. However, long-term integration does not imply uniform market behavior. Adjustment speeds, shock absorption mechanisms, and the strength of equilibrium relationships differ across markets due to variations in economic structure, financial development, and institutional quality (Ardana, 2017; Kartika et al., 2017). This coexistence of long-run integration and short-run segmentation highlights the complex nature of regional financial integration in ASEAN capital markets.

## 1.4. Market contribution and dominance in regional integration

Another important dimension of regional integration concerns the relative contribution and dominance of individual markets within the regional system. Markets with larger capitalization, higher liquidity, and greater international participation tend to play a more influential role in transmitting information and volatility to other markets. In contrast, smaller or less developed markets are more likely to assume follower roles within regional financial networks (Diebold & Yilmaz, 2012; Ng, 2000; Phylaktis & Ravazzolo, 2005).

Within the ASEAN region, empirical evidence points to heterogeneous market roles shaped by differences in market maturity and openness. Several studies suggest that Singapore functions as a key regional reference market, while Indonesia and Malaysia increasingly exhibit characteristics of intermediate transmitters within the regional system (Hartanto, 2018; Waworundeng & Van Rate, 2018). Frontier markets such as Vietnam generally display limited short-term influence but demonstrate increasing integration over longer horizons as market depth and investor participation improve (Ardana, 2017; Caporale et al., 2019). These patterns indicate that regional integration is influenced not only by collective policy initiatives but also by the structural characteristics of individual markets.

## 1.5. Research gap and hypotheses development

Overall, the literature suggests that market efficiency and regional financial integration in ASEAN are dynamic and multifaceted. Existing studies provide mixed evidence on weak-form efficiency, document asymmetric short-term information transmission, and confirm long-term cointegration among selected markets (Arouri & Nguyen, 2009; Diebold & Yilmaz, 2012; Lim & Brooks, 2011). However, important gaps remain. First, relatively few studies examine weak-form efficiency, short-term causality, and long-term integration simultaneously within a unified empirical framework using recent data that reflect rapid digitalization and heightened global uncertainty. Second, the interaction between asymmetric short-term dynamics and long-run convergence remains insufficiently explored. Third, empirical evidence on the relative contribution and dominance of individual ASEAN markets in shaping regional integration dynamics is still limited.

Accordingly, this study examines weak-form market efficiency and analyzes short-term and long-term integration dynamics among ASEAN capital markets. Based on this objective, the following hypotheses are tested:

*H1: The capital markets of ASEAN countries are weak-form efficient.*

*H2: There is a significant causal relationship between the capital markets of ASEAN countries.*

*H3: There is a long-run relationship (cointegration) between the capital markets of ASEAN countries.*

*H4: There are differences in the contribution and dominance of capital markets in shaping ASEAN financial integration.*

# 2. METHOD

This study employs a quantitative empirical design to investigate weak-form market efficiency and regional financial integration in ASEAN capital markets during the digital acceleration period. The analytical framework is structured to capture both individual market efficiency and cross-market interdependence across different temporal horizons. By integrating return predictability tests with multivariate time-series modeling, the methodology enables a systematic assessment of short-run information transmission and long-run equilibrium convergence within a unified VAR–VECM framework.

## 2.1. Data and sample

This study utilizes secondary data consisting of monthly closing stock index prices from six ASEAN capital markets: Indonesia (JKSE), Malaysia (KLCI), Singapore (STI), the Philippines (PSI), Thailand (SETI), and Vietnam (VNI). The sample period spans from January 2020 to July 2025, yielding 67 monthly observations for each market. All series were aligned to ensure temporal consistency across markets and to avoid missing-value distortions in the multivariate estimation.

Monthly data are employed to capture medium-term adjustment dynamics and to reduce excessive noise commonly present in higher-frequency observations. This frequency is considered appropriate for examining structural integration and persistent efficiency behavior during periods of digital transformation and heightened global uncertainty.

The data were obtained from official market sources, including ASEAN Exchanges and Investing.com. All index prices were transformed into logarithmic returns to ensure variance stabilization and time-additive properties prior to multivariate estimation.

## 2.2. Data analysis techniques

Data analysis was conducted using MS Excel 2010 and EViews 7 with the following analytical steps:

1. Monthly Return Calculation:

The following formula was used to calculate the return in this study.

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}}, \quad (1) \text{ (Tandelilin, 2018)}$$

where $R_t$ – Monthly Index Return or Market Return, $P_t$ – Index for Month $t$, $P_{t-1}$ – Index for Month $t$–1.

2. Weak-Form Market Efficiency Test (H1):

Weak-form efficiency is evaluated through:

- runs test (randomness of return sequences);
- augmented Dickey–Fuller (ADF) test (stationarity of returns);
- autocorrelation diagnostics (short-run serial dependence).

These complementary tests jointly assess whether historical price information is fully reflected in current returns.

3. Short-Run Causality (H2)

Short-term information transmission is examined using a multivariate Vector Autoregression (VAR) model. Granger causality is evaluated within the system to identify directional relationships across markets. This system-based approach avoids bilateral bias and captures the interconnected structure of regional capital markets.

4. Long-Run Integration and Market Dominance (H3 and H4)


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Long-run relationships are tested using the Johansen cointegration procedure within a multivariate framework. The presence of cointegration vectors indicates shared stochastic trends and structural convergence among markets.

To further evaluate relative influence and dominance within the system, a Vector Error Correction Model (VECM) is estimated. Impulse Response Functions (IRF) and Forecast Error Variance Decomposition (FEVD) are employed to quantify shock transmission intensity and to identify hierarchical integration patterns across ASEAN markets.

# 3. RESULTS

Unlike conventional studies that examine market efficiency, causality, and cointegration in isolation or through bilateral comparisons, this study adopts a system-level analytical framework to capture the multi-layered structure of ASEAN capital market dynamics. By integrating weak-form efficiency testing with multivariate causality, cointegration, and variance decomposition within a unified VAR–VECM setting, the analysis emphasizes temporal differentiation between short-run fragmentation and long-run convergence. Moreover, the use of monthly data covering the digital acceleration period (2020–2025) allows the examination of market adjustment behavior under conditions of rapid technological diffusion and heightened global uncertainty. This integrated perspective enables a more comprehensive understanding of how efficiency and regional integration jointly evolve within an emerging and structurally heterogeneous financial system.

## 3.1. Descriptive statistics and return characteristics

The distributional profile of ASEAN equity returns reflects pronounced non-normality across most markets, characterized by excess kurtosis and asymmetric return distributions. Elevated kurtosis values indicate fat-tailed behavior consistent with episodic volatility clustering during the digital acceleration period. Vietnam and Thailand exhibit the highest dispersion, suggesting heightened sensitivity to cross-border shocks and speculative trading dynamics. These stylized facts align with emerging market characteristics but do not inherently contradict weak-form efficiency, as distributional irregularities may coexist with rapid information incorporation.

## 3.2. Weak-form capital market efficiency (H1)

Weak-form capital market efficiency test results for six ASEAN countries show interesting dynamics when applied using Runs, Autocorrelation, and Unit Root Tests. These tests represent important aspects of the weak-form efficiency test.

The results summarized in Table 2 indicate that ASEAN equity markets broadly conform to weak-form efficiency during the observation period. The failure to reject return randomness across all markets suggests that price changes do not follow systematic sign patterns, while the stationarity of return series confirms the absence of persistent deterministic trends. Together, these findings imply that historical price information is largely incorporated into current market valuations, limiting the potential for abnormal returns derived solely from past price movements.

However, the presence of short-run dependence across markets indicates that informational adjustment is not entirely instantaneous. Rather than constituting a direct violation of the Efficient Market Hypothesis, this pattern is more consistent with a conditional or adaptive efficiency framework, in which markets evolve over time

**Table 1.** Descriptive statistics of ASEAN monthly returns (2020–2025)

| Statistic | JKSE | KLCI | STI | PSI | SETI | VNI |
|---|---|---|---|---|---|---|
| Mean | 0.003630 | –0.000131 | 0.004618 | –0.001725 | –0.001642 | 0.009003 |
| Std. Dev. | 0.045223 | 0.034880 | 0.038593 | 0.055645 | 0.062055 | 0.067270 |
| Skewness | –1.302312 | –0.141885 | –1.226446 | –1.002182 | 0.513896 | –0.727417 |
| Kurtosis | 7.096595 | 2.940424 | 8.752410 | 5.032499 | 5.592562 | 4.970195 |
| Jarque–Bera | 65.78886 | 0.234709 | 109.1734 | 22.74797 | 21.71284 | 16.74502 |
| Probability | 0.000000 | 0.889270 | 0.000000 | 0.000011 | 0.000019 | 0.000231 |
| Observations | 67 | 67 | 67 | 67 | 67 | 67 |

**Table 2.** Summary of weak-form capital market efficiency test (monthly data, 2020–2025)

| Market | Randomness (Runs) | Stationary (ADF) | Short-run Dependence | Efficiency Assessment |
|---|---|---|---|---|
| JKSE | Not Rejected | Stationary | Present | Adaptive Weak-form Efficient |
| KLCI | Not Rejected | Stationary | Present | Adaptive Weak-form Efficient |
| STI | Not Rejected | Stationary | Present | Adaptive Weak-form Efficient |
| PSI | Not Rejected | Stationary | Present | Adaptive Weak-form Efficient |
| SETI | Not Rejected | Stationary | Present | Adaptive Weak-form Efficient |
| VNI | Not Rejected | Stationary | Present | Adaptive Weak-form Efficient |

and gradually improve in processing information. In emerging financial systems, such transitional dynamics may reflect liquidity segmentation, heterogeneous investor behavior, and temporary frictions in information diffusion.

Overall, the evidence suggests that ASEAN capital markets operate within a dynamic efficiency structure. While broad compliance with weak-form principles is observed, short-term dependencies persist, highlighting the coexistence of informational maturity and structural frictions. This dual characteristic reflects the evolving nature of regional financial systems amid ongoing digital transformation and increasing cross-border integration. These findings support Hypothesis 1, indicating that ASEAN capital markets generally exhibit weak-form efficiency.

## 3.3. Short-term causality (H2)

The Granger causality test results reflect the short-term dynamics of information transmission between capital markets in the context of financial market integration.

The short-run causality matrix reported in Table 3 reveals a predominantly fragmented structure of information transmission across ASEAN equity markets. Most bilateral relationships are statistically insignificant, indicating limited short-term interdependence within the region. This suggests that monthly return adjustments remain largely market-specific rather than synchronized across borders.

A single significant directional linkage is observed from Indonesia to Thailand, implying that the Indonesian market functions as a short-term information transmitter to the Thai market. The absence of reciprocal causality indicates asymmetry in price discovery dynamics. Such asymmetry may reflect differences in market depth, capitalization, and investor participation across the region.

Overall, the results suggest that short-run regional integration remains partial and uneven. While long-term convergence may exist, short-term interactions are characterized by selective and asymmetric transmission channels rather than a fully interconnected network structure. Therefore, Hypothesis 2 is partially supported, as only limited and asymmetric short-term causal relationships are observed among ASEAN capital markets.

## 3.4. Long-term cointegration (H3)

Cointegration tests are used to detect the presence of a long-run equilibrium relationship among two or more capital markets. In the context of financial markets, cointegration indicates that stock prices across markets move together in the long run, reflecting regional financial integration and cross-border information transmission.

**Table 3.** Granger causality matrix (lag = 5, monthly data)

| From / To | JKSE | KLCI | STI | PSI | SETI | VNI |
|---|---|---|---|---|---|---|
| JKSE | – | 0.553 (0.735) | 1.175 (0.334) | 0.388 (0.855) | 2.482 (0.044) | 0.630 (0.677) |
| KLCI | 1.236 (0.306) | – | 1.588 (0.180) | 1.260 (0.296) | 0.276 (0.924) | 1.337 (0.264) |
| STI | 0.497 (0.777) | 2.006 (0.094) | – | 0.672 (0.646) | 0.628 (0.679) | 0.646 (0.666) |
| PSI | 1.639 (0.167) | 0.966 (0.447) | 1.170 (0.337) | – | 2.152 (0.074) | 0.475 (0.793) |
| SETI | 1.862 (0.118) | 0.315 (0.902) | 1.025 (0.413) | 1.292 (0.282) | – | 0.593 (0.705) |
| VNI | 1.257 (0.297) | 1.248 (0.301) | 1.064 (0.391) | 0.148 (0.980) | 0.869 (0.509) | – |

*Note:* Values represent F-statistics. P-values are reported in parentheses. Bold indicates significance at the 5% level.


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**Table 4.** Johansen multivariate cointegration test results for six ASEAN capital markets (2020M04–2025M07, N = 64, lag 1–2, linear trend)

**Panel A.** Trace test

| Hypothesized Rank | Eigenvalue | Trace Statistic | 5% Critical Value | Probability |
|---|---|---|---|---|
| r = 0 | 0.640384 | 201.5233 | 95.75366 | 0.0000 |
| r ≤ 1 | 0.451902 | 136.0693 | 69.81889 | 0.0000 |
| r ≤ 2 | 0.374042 | 97.58596 | 47.85613 | 0.0000 |
| r ≤ 3 | 0.356144 | 67.60377 | 29.79707 | 0.0000 |
| r ≤ 4 | 0.316335 | 39.42582 | 15.49471 | 0.0000 |
| r ≤ 5 | 0.210015 | 15.08743 | 3.841465 | 0.0001 |

**Panel B.** Maximum eigenvalue test

| Hypothesized Rank | Eigenvalue | Max-Eigen Statistic | 5% Critical Value | Probability |
|---|---|---|---|---|
| r = 0 | 0.640384 | 65.45404 | 40.07757 | 0.0000 |
| r ≤ 1 | 0.451902 | 38.48332 | 33.87687 | 0.0131 |
| r ≤ 2 | 0.374042 | 29.98219 | 27.58434 | 0.0241 |
| r ≤ 3 | 0.356144 | 28.17796 | 21.13162 | 0.0043 |
| r ≤ 4 | 0.316335 | 24.33838 | 14.26460 | 0.0009 |
| r ≤ 5 | 0.210015 | 15.08743 | 3.841465 | 0.0001 |

*Note:* MacKinnon–Haug–Michelis (1999) p-values.

In this research, the testing was conducted using the Johansen (1988) cointegration procedure. This method measures the presence and number of cointegration vectors using Trace and Maximum Eigenvalue Statistics. There is a long-term relationship between the tested variables when both statistical values exceed the critical value at the 5% significance level.

The trace statistics reported in Panel A strongly reject the null hypothesis of no cointegration at the 5 percent significance level. The rejection persists across successive ranks, indicating the presence of multiple long-run equilibrium relationships within the six-market system.

The multivariate Johansen cointegration test provides strong empirical evidence of long-run integration among the six ASEAN capital markets. As reported in Table 4, both the trace and maximum eigenvalue statistics consistently reject the null hypothesis of no cointegration at the 5 percent significance level. The trace statistic for r = 0 (201.5233) substantially exceeds the critical value (95.75366), indicating the presence of at least one cointegrating relationship. Similar rejection patterns persist across subsequent ranks.

The maximum eigenvalue test further confirms this result, with all statistics exceeding their respective critical values at conventional significance levels. The consistency between the trace and maximum eigenvalue statistics indicates the existence of multiple long-run equilibrium relationships within the six-market VAR system.

These findings demonstrate that ASEAN equity markets are structurally interconnected over the long run. Despite short-term asymmetries observed in the causality analysis, stock price movements across Indonesia, Malaysia, Singapore, the Philippines, Thailand, and Vietnam exhibit a common stochastic trend. Deviations from long-run equilibrium are therefore expected to be temporary, with adjustment occurring through the error-correction mechanism embedded in the VECM framework. These results support Hypothesis 3, confirming the existence of long-run integration among ASEAN capital markets.

## 3.5. Contribution and market dominance in integration (H4)

While cointegration confirms long-run convergence among ASEAN markets, it does not indicate which markets exert a stronger influence within the regional system. To capture this dimension, variance decomposition analysis is applied to assess the relative contribution of external shocks to domestic return variability. By examining the

**Table 5.** Forecast error variance decomposition of Indonesia (12-month horizon)

| Source of Shock | Contribution to Indonesia Variance (%) | Integration Intensity |
|---|---|---|
| Philippines (PSI) | 25–28% | High |
| Thailand (SETI) | 11–15% | Moderate |
| Malaysia (KLCI) | 11–15% | Moderate |
| Vietnam (VNI) | 11–15% | Moderate |
| Singapore (STI) | 5–6% | Low |
| Indonesia (JKSE) | Dominant | Endogenous Stability |

*Note:* Contributions measured at the 12-period forecast horizon based on VECM estimation.

proportion of forecast error variance explained by each market, the analysis reveals the differentiated roles and dominance patterns that characterize ASEAN financial integration.

The results at the twelve-month horizon are presented in Table 5.

The variance decomposition results reported in Table 5 reveal heterogeneous shock transmission patterns within the ASEAN equity system. At the twelve-month horizon, shocks originating from the Philippine market account for the largest proportion of forecast error variance in Indonesia, indicating relatively strong interdependence between markets with similar volatility structures. This suggests that markets sharing comparable risk profiles tend to exhibit stronger mutual influence in the long run.

In contrast, Singapore's contribution remains comparatively limited. Despite its role as a mature regional financial hub, its relatively small variance contribution reflects a higher degree of informational autonomy rather than weak integration. Mature markets with deeper liquidity and stronger institutional frameworks often absorb shocks internally without transmitting excessive volatility to neighboring markets.

Meanwhile, Malaysia, Thailand, and Vietnam demonstrate moderate influence levels, indicating partial but meaningful integration. The coexistence of high, moderate, and low transmission intensities confirms that ASEAN integration is not uniform but network-based, characterized by differentiated market roles.

Overall, the FEVD evidence supports the presence of structural long-run integration accompanied by asymmetric shock propagation. While markets are cointegrated at the systemic level, volatility transmission remains uneven, reflecting structural heterogeneity in market depth, capitalization, and investor composition. Accordingly, Hypothesis 4 is supported, indicating differences in market contribution and dominance within the ASEAN regional financial system.

## 4. DISCUSSION

*H1: Weak-Form Market Efficiency*

The empirical findings provide substantive support for Hypothesis 1, indicating that ASEAN capital markets generally conform to weak-form efficiency during the study period. The predominance of random return behavior, together with evidence of stationarity in stock price series, suggests that historical price information is largely incorporated into current market valuations. This condition implies that investors are unlikely to consistently generate abnormal returns through trading strategies based solely on past price movements. Nevertheless, the detection of short-term autocorrelation indicates that market efficiency in the region is not absolute, but rather conditional and time-varying. Such deviations from full efficiency may arise from temporary information frictions, liquidity constraints, or behavioral biases among heterogeneous market participants, which are commonly observed in emerging markets undergoing structural and institutional development.

Overall, these results reinforce the notion that ASEAN markets have made progress toward informational efficiency while still exhibiting episodic inefficiencies in the short run. This evidence is consistent with prior studies documenting evolving and non-uniform market efficiency


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across ASEAN and other emerging economies (Febriandika et al., 2025; Juliana et al., 2023; Shaik & Maheswaran, 2017).

*H2: Short-Term Causality and Information Transmission*

Hypothesis 2 is only partially supported, as the empirical results reveal asymmetric rather than reciprocal short-term causal relationships among ASEAN capital markets. The limited presence of bidirectional causality indicates that short-term regional integration remains incomplete. Instead of a fully interconnected system, information transmission appears to follow selective and uneven pathways across markets. In particular, the unidirectional causality from the Indonesian market to the Thai market highlights disparities in informational influence within the region. This pattern suggests that certain markets play a more prominent role in short-term price discovery, while others act primarily as information receivers. Such asymmetry may reflect differences in market size, liquidity depth, investor base composition, and trading activity. Consequently, short-term interactions among ASEAN markets are shaped more by structural heterogeneity than by synchronized market behavior. These findings are consistent with earlier evidence that ASEAN capital market integration is characterized by partial and uneven information transmission (Hartanto, 2018; Waworundeng & Van Rate, 2018).

*H3: Long-Term Cointegration*

The empirical results provide strong support for Hypothesis 3, confirming the existence of long-term cointegration among ASEAN capital markets. Despite evidence of segmentation and asymmetry in the short run, stock prices across markets tend to move together over longer horizons. This convergence indicates the presence of a stable long-term equilibrium relationship driven by underlying economic and financial linkages. Such behavior is consistent with theoretical predictions that increased trade integration, capital mobility, and regional policy coordination foster long-run convergence in asset prices (Kasa, 1992). The findings further imply that shocks affecting one market are eventually transmitted to others, reinforcing regional financial interconnectedness over time. While short-term volatility and asymmetric disturbances may temporarily disrupt market alignment, these effects do not persist in the long run. This result aligns with prior studies on Asian and emerging markets documenting strengthened long-term integration amid ongoing short-term fluctuations (Ardana, 2017; Arouri & Nguyen, 2009).

*H4: Market Contribution and Dominance*

Hypothesis 4 is supported by the variance decomposition analysis, which reveals heterogeneity in the contribution and dominance of individual ASEAN capital markets. The results indicate that markets sharing similar structural characteristics tend to exhibit stronger mutual interdependence. In contrast, more mature and internationally integrated markets demonstrate greater informational autonomy in explaining their own return dynamics. The relatively limited influence of the Singapore market reflects its higher level of efficiency, depth, and integration with global financial systems. Meanwhile, stronger spillovers among other ASEAN markets suggest varying degrees of regional dependence and susceptibility to external shocks. These differences highlight the role of market-specific fundamentals such as market size, liquidity, openness, and investor participation in shaping cross-market interactions. Overall, the findings corroborate existing literature emphasizing structural heterogeneity as a central feature of regional financial integration (Ng, 2000; Phylaktis & Ravazzolo, 2005).

A synthesis of the findings from Hypotheses 1 through 4 indicates that ASEAN capital markets exhibit stable long-term relationships while remaining fragmented in the short run. Although cointegration constrains long-term diversification benefits through price convergence, short-term inefficiencies and uneven information transmission continue to create diversification opportunities for investors. This combination of integration and segmentation reflects the transitional stage of financial development within the ASEAN region. From a policy standpoint, the results point to the need for stronger regulatory harmonization, greater market transparency, and more advanced technological infrastructure to mitigate informational asymmetries and improve the effectiveness of short-term information transmission. Over time, closer coordination among ASEAN financial authorities may contribute to a more balanced and resilient regional capital market system.

## CONCLUSION

This study provides empirical evidence on weak-form market efficiency and regional financial integration in ASEAN capital markets during a period of heightened global uncertainty and accelerated digital transformation. By examining both short-term interactions and long-term equilibrium relationships, this research contributes to a deeper understanding of how efficiency and integration evolve within emerging financial markets.

The findings indicate that ASEAN capital markets generally exhibit weak-form efficiency, suggesting that historical price information is largely incorporated into current returns. However, short-term dynamics remain heterogeneous, with asymmetric and predominantly unidirectional information transmission across markets. In contrast, the strong presence of long-term cointegration confirms that regional stock markets are structurally integrated and tend to converge toward a common equilibrium over time. Differences in market contribution and dominance further reveal heterogeneity in regional integration, where more mature markets demonstrate greater informational independence while others remain more interdependent.

From a theoretical perspective, these results support the notion that market efficiency and financial integration in emerging economies are dynamic and conditional rather than static phenomena. From a practical perspective, the coexistence of long-term integration and fragmented short-term dynamics implies that diversification benefits within ASEAN may be limited in the long run but remain feasible in the short run. For policymakers, the findings highlight the importance of strengthening regulatory coordination, improving market transparency, and enhancing digital infrastructure to foster more balanced and resilient regional capital market integration.

## AUTHOR CONTRIBUTIONS

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