

Asymmetric Market Efficiency in Vietnam's Emerging Capital Markets: Panel Data Evidence from Cross-Border M&A Announcement Effects on Stock Volatility Dynamics

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ABSTRACT: This study investigates the asymmetric market efficiency patterns in Vietnam's emerging capital markets through comprehensive panel data analysis of cross-border merger and acquisition announcement effects on stock volatility dynamics. Employing a robust econometric framework spanning 2005-2017, this research examines 847 M&A announcements involving Vietnamese publicly listed firms and foreign acquirers, utilising advanced panel data techniques including fixed effects, random effects, and generalised method of moments estimators. The analysis reveals substantial evidence of asymmetric market efficiency, characterised by differential volatility responses contingent upon transaction characteristics, firm-specific factors, and market conditions. The findings demonstrate that cross-border M&A announcements generate significantly higher abnormal volatility compared to domestic transactions, with pronounced asymmetric effects based on acquirer nationality, deal size, and target firm characteristics. Advanced diagnostic tests confirm the presence of cross-sectional dependence and heteroskedasticity, necessitating robust estimation procedures. The research contributes novel empirical evidence to market efficiency theory in emerging market contexts, demonstrating that information processing mechanisms exhibit systematic asymmetries that challenge traditional efficient market hypotheses. These findings possess significant implications for portfolio management, regulatory policy, and corporate finance decision-making in Vietnam's rapidly evolving capital market environment.

KEYWORDS: asymmetric market efficiency, emerging markets, cross-border M&A, stock volatility, panel data analysis

1. INTRODUCTION

The theoretical foundations of market efficiency have undergone substantial evolution since Fama's (1970) seminal articulation of the Efficient Market Hypothesis, yet emerging capital markets continue to present compelling empirical puzzles that challenge conventional theoretical frameworks. Vietnam's capital market development trajectory exemplifies this complexity, characterised by rapid institutional evolution, increasing foreign investment flows, and persistent informational asymmetries that generate systematic deviations from theoretical efficiency predictions (Bekaert & Harvey, 2003). The phenomenon of asymmetric market efficiency, wherein market responses to information exhibit systematic directional biases and differential processing mechanisms, represents a particularly salient manifestation of these theoretical challenges in emerging market contexts.

Cross-border merger and acquisition activities constitute one of the most significant information events affecting stock market dynamics, generating substantial wealth effects and volatility patterns that reveal underlying market microstructure characteristics (Jensen & Ruback, 1983). The increasing prominence of international M&A transactions in Vietnam, accelerated by economic liberalisation policies and regional integration initiatives, provides an optimal empirical laboratory for examining market efficiency phenomena in emerging market settings. These transactions typically involve substantial information asymmetries between domestic and foreign market participants, complex valuation uncertainties, and regulatory considerations that may generate asymmetric market responses inconsistent with traditional efficiency assumptions.

The theoretical urgency of this investigation stems from several converging factors. Firstly, existing market efficiency literature predominantly focuses on developed market contexts, with limited empirical evidence from emerging Asian markets characterised by distinct institutional features and investor behaviour patterns (Harvey, 1995). Secondly, the growing significance of cross-border capital flows in regional economic integration necessitates enhanced understanding of information processing mechanisms in recipient markets. Thirdly, asymmetric market responses to corporate events may generate systematic risk-return patterns with substantial implications for portfolio diversification strategies and regulatory policy frameworks.

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This study advances several novel contributions to the existing literature. The research develops a comprehensive panel data framework specifically designed to capture asymmetric efficiency patterns in emerging market contexts, incorporating advanced econometric techniques that address the complex statistical challenges inherent in cross-sectional and time-series dependencies. The investigation provides the first systematic empirical analysis of cross-border M&A announcement effects on Vietnamese stock market volatility dynamics, utilising a dataset spanning thirteen years of market development. Furthermore, the study introduces innovative theoretical perspectives on asymmetric market efficiency that synthesise information asymmetry theory with behavioural finance insights specific to emerging market investor populations.

From a practical perspective, these findings possess substantial implications for multiple stakeholder groups. Portfolio managers operating in emerging market environments require sophisticated understanding of systematic efficiency deviations to optimise risk-adjusted return profiles. Corporate finance practitioners engaged in cross-border transactions need empirical guidance regarding market response patterns to inform timing and structuring decisions. Regulatory authorities benefit from evidence-based insights regarding market microstructure dynamics to enhance policy effectiveness and market development strategies.

The remainder of this manuscript proceeds as follows. The literature review synthesises existing theoretical frameworks and empirical evidence to develop testable hypotheses regarding asymmetric market efficiency in cross-border M&A contexts. The methodology section presents the econometric framework, data construction procedures, and diagnostic testing protocols. The results section reports comprehensive empirical findings, including descriptive statistics, diagnostic test outcomes, main estimation results, and robustness checks. The final section discusses theoretical and practical implications whilst acknowledging study limitations and suggesting future research directions.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1. Foundational Theories

2.1.1. Market Efficiency Theory and Emerging Market Contexts

The theoretical foundations of market efficiency, as articulated in Fama's (1970) influential framework, posit that security prices rapidly and accurately reflect all available information, precluding systematic opportunities for abnormal returns through information-based trading strategies. This foundational theory encompasses three distinct forms of market efficiency: weak-form efficiency, wherein prices reflect all historical price information; semi-strong form efficiency, characterised by price incorporation of all publicly available information; and strong-form efficiency, involving price reflection of all information, including private information sources.

Subsequent theoretical developments have substantially refined and extended these foundational concepts, particularly in response to emerging empirical evidence of systematic deviations from efficiency predictions. Lo & MacKinlay (1988) developed the Adaptive Market Hypothesis, proposing that market efficiency varies dynamically in response to evolutionary pressures, market conditions, and participant behaviour patterns. This theoretical framework proves particularly relevant for emerging market contexts, where institutional development, regulatory evolution, and investor sophistication levels undergo continuous transformation.

The application of market efficiency theory to emerging market contexts presents distinctive theoretical challenges. Harvey (1995) demonstrated that emerging markets exhibit systematic characteristics inconsistent with traditional efficiency assumptions, including higher return volatility, lower correlations with global markets, and predictable return patterns. These empirical regularities suggest that information processing mechanisms in emerging markets may exhibit systematic asymmetries absent from developed market contexts.

Bekaert & Harvey (2003) extended this theoretical framework by demonstrating that emerging market efficiency evolves dynamically in response to liberalisation processes, foreign investment flows, and institutional development initiatives. Their findings suggest that efficiency patterns exhibit substantial heterogeneity across markets and time periods, with systematic relationships to economic development levels, regulatory quality, and market microstructure characteristics.

The theoretical concept of asymmetric market efficiency emerges from this literature as a framework for understanding systematic directional biases in information processing mechanisms. Unlike traditional efficiency assumptions that presuppose symmetric and rapid information incorporation, asymmetric efficiency theory recognises that market responses may exhibit systematic variations based on information source, transaction characteristics, and participant behaviour patterns (Chordia et al., 2005).

2.1.2. Information Asymmetry Theory and Cross-Border Transactions

Information asymmetry theory, pioneered by Akerlof's (1970) groundbreaking analysis of market mechanisms under asymmetric information conditions, provides essential theoretical foundations for understanding cross-border M&A market responses. The theory posits that systematic information differences between market participants generate predictable effects on transaction

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pricing, market liquidity, and volatility patterns. Myers & Majluf (1984) extended this framework to corporate finance contexts, demonstrating that information asymmetries between managers and investors create systematic effects on security issuance decisions and market responses.

The application of information asymmetry theory to cross-border M&A contexts reveals several distinctive theoretical insights. Cross-border transactions typically involve substantial information asymmetries between domestic and foreign market participants, arising from differences in regulatory frameworks, accounting standards, cultural factors, and local market knowledge (Rossi & Volpin, 2004). These asymmetries may generate systematic effects on market response patterns, with differential impacts on acquirer and target firm valuations.

Theoretical extensions of information asymmetry theory specifically address emerging market contexts. Stulz (1999) demonstrated that information asymmetries in emerging markets exhibit systematically different characteristics compared to developed markets, reflecting lower transparency levels, limited analyst coverage, and reduced institutional investor participation. These factors may amplify information asymmetry effects in cross-border transactions involving emerging market targets.

The concept of informational home bias provides additional theoretical insights relevant to cross-border M&A analysis. Gehrig (1993) demonstrated that investors possess systematically superior information regarding domestic securities compared to foreign investments, generating predictable patterns of portfolio allocation and market response behaviour. This theoretical framework suggests that cross-border M&A announcements may generate asymmetric market responses reflecting differential information processing capabilities between domestic and foreign market participants.

Behavioural finance theory contributes additional theoretical perspectives on information asymmetry effects in emerging market contexts. Barberis & Thaler (2003) demonstrated that investor behaviour exhibits systematic biases and heuristics that may amplify information asymmetry effects, particularly in contexts characterised by high uncertainty and limited information availability. These behavioural factors may prove particularly relevant in emerging market cross-border M&A contexts, where cultural differences, regulatory uncertainties, and limited precedent transactions create substantial ambiguity regarding valuation implications.

2.2. Review of Empirical Studies and Hypothesis Development

The empirical literature examining cross-border M&A announcement effects presents a rich tapestry of findings that illuminate the complex dynamics underlying international corporate transactions. Early seminal studies by Jensen & Ruback (1983) established the foundational empirical framework for M&A announcement effect analysis, demonstrating systematic positive abnormal returns for target firms and mixed results for acquiring firms in domestic transaction contexts. However, the extension of these findings to cross-border contexts and emerging market environments reveals substantially more complex patterns.

Comprehensive meta-analytical studies by Bruner (2002) synthesised extensive empirical evidence regarding M&A announcement effects, revealing systematic heterogeneity in findings across geographical contexts, time periods, and methodological approaches. The analysis demonstrated that cross-border transactions exhibit systematically different announcement effect patterns compared to domestic transactions, with particularly pronounced differences in emerging market contexts. These findings suggest that traditional M&A announcement effect theories may require substantial modification to accommodate cross-border and emerging market characteristics.

Empirical investigations specifically focused on emerging market cross-border M&A transactions have generated several important insights. Chari et al. (2010) examined cross-border acquisitions in emerging markets, demonstrating that announcement effects exhibit systematic relationships to target country characteristics, including regulatory quality, financial market development, and institutional factors. Their findings suggest that market efficiency patterns in emerging markets may be systematically influenced by institutional development levels and foreign investment regulatory frameworks.

The empirical literature on stock volatility responses to M&A announcements reveals additional complexity. Schwert (1996) provided comprehensive analysis of volatility patterns surrounding M&A announcements, demonstrating that transaction announcements generate systematic increases in target firm volatility that persist substantially beyond initial announcement periods. These volatility effects exhibit systematic relationships to transaction characteristics, including deal size, payment method, and competitive bidding dynamics.

Recent empirical investigations have begun to address asymmetric market efficiency patterns specifically. Chordia et al. (2005) demonstrated that market efficiency exhibits systematic time-varying patterns related to market conditions, trading volume, and institutional participation levels. Their findings suggest that efficiency assumptions may require dynamic specification to capture evolving market microstructure characteristics, particularly in emerging market contexts characterised by rapid institutional development.

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The empirical literature on Vietnamese capital market characteristics provides essential context for this investigation. Vo & Phan (2013) examined Vietnamese stock market efficiency patterns, demonstrating that the market exhibits systematic deviations from efficiency assumptions, particularly in response to information events involving foreign investment flows. Their findings suggest that Vietnamese market participants may exhibit systematic behavioural biases that generate predictable asymmetric responses to cross-border transaction announcements.

Based on this comprehensive literature synthesis, this study develops several formal hypotheses regarding asymmetric market efficiency patterns in Vietnamese cross-border M&A contexts:

Hypothesis 1: Cross-border M&A announcements involving Vietnamese target firms generate systematically higher abnormal stock volatility compared to domestic M&A announcements, reflecting enhanced information asymmetries and uncertainty levels associated with international transactions.

Hypothesis 2: Stock volatility responses to cross-border M&A announcements exhibit systematic asymmetries based on acquirer nationality, with transactions involving acquirers from developed markets generating different volatility patterns compared to those involving regional emerging market acquirers.

Hypothesis 3: The magnitude of abnormal volatility responses to cross-border M&A announcements varies systematically with transaction characteristics, including deal size, payment method, and target firm size, reflecting differential information asymmetry and uncertainty levels across transaction types.

Hypothesis 4: Abnormal volatility patterns surrounding cross-border M&A announcements exhibit systematic persistence effects that extend substantially beyond initial announcement periods, indicating incomplete information processing and gradual market adjustment mechanisms characteristic of emerging market contexts.

Hypothesis 5: The relationship between cross-border M&A announcements and stock volatility responses exhibits systematic variation across different market conditions and time periods, reflecting dynamic market efficiency patterns associated with Vietnamese capital market development processes.

These hypotheses collectively address the central research question regarding asymmetric market efficiency patterns in Vietnamese cross-border M&A contexts, while providing specific empirical predictions that enable rigorous econometric testing using advanced panel data methodologies.

3. RESEARCH METHODOLOGY

3.1. Model Specification

This study employs a comprehensive panel data framework to investigate asymmetric market efficiency patterns in Vietnamese cross-border M&A contexts. The baseline econometric model specification follows established event study methodologies while incorporating panel data structures that enable sophisticated analysis of cross-sectional and temporal variations in market response patterns.

The primary econometric model specification takes the following form:

$$VOL_{it+k} = \alpha_i + \beta_1 CBMA_{it} + \beta_2 SIZE_{it} + \beta_3 ACQUIRER_DEV_{it} + \beta_4 PAYMENT_CASH_{it} + \beta_5 FIRM_SIZE_{it} + \beta_6 LEVERAGE_{it} + \beta_7 ROA_{it} + \beta_8 MARKET_CAP_{it} + \lambda_t + \varepsilon_{it}$$

Where VOL_{it+k} represents the abnormal stock volatility for firm i at time $t+k$, measured as the standardised difference between realised volatility and predicted volatility based on historical patterns. The variable k represents different time horizons ($k = 0, +1, +5, +10, +20$ days) to capture both immediate and persistent volatility effects.

The key independent variable $CBMA_{it}$ constitutes a binary indicator variable that equals one if firm i announces a cross-border M&A transaction at time t , and zero otherwise. This variable captures the primary treatment effect of cross-border M&A announcements on stock volatility dynamics.

The control variables incorporated in the model specification include several theoretically motivated factors. $SIZE_{it}$ represents the natural logarithm of transaction value, capturing deal size effects on market response patterns. $ACQUIRER_DEV_{it}$ constitutes a binary variable indicating whether the acquiring firm originates from a developed market economy, enabling analysis of acquirer origin effects on market responses.

$PAYMENT_CASH_{it}$ represents a binary indicator for transactions involving cash payment methods, distinguishing cash transactions from stock or mixed payment structures. Theoretical frameworks suggest that payment method characteristics may influence information asymmetry levels and market response patterns through different risk-sharing and signalling mechanisms.

Firm-specific control variables include $FIRM_SIZE_{it}$, measured as the natural logarithm of market capitalisation, $LEVERAGE_{it}$, calculated as the ratio of total debt to total assets, and ROA_{it} , representing return on assets as a profitability measure. $MARKET_CAP_{it}$ captures broader market capitalisation effects that may influence individual firm volatility responses.

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The model specification incorporates firm-specific fixed effects (α_i) to control for unobserved heterogeneity across firms that may systematically influence volatility patterns. Time fixed effects (λ_t) control for common market-wide factors affecting all firms simultaneously, including macroeconomic conditions, regulatory changes, and market sentiment variations.

Extended model specifications incorporate interaction terms to capture asymmetric effects:

$$VOL_{it+k} = \alpha_i + \beta_1 CBMA_{it} + \beta_2 CBMA_{it} \times ACQUIRER_DEV_{it} + \beta_3 CBMA_{it} \times SIZE_{it} + [Control\ Variables] + \lambda_t + \varepsilon_{it}$$

These interaction specifications enable direct testing of hypotheses regarding systematic variations in cross-border M&A announcement effects based on transaction and acquirer characteristics.

3.2. Data and Sample

This investigation utilises comprehensive panel data comprising Vietnamese publicly listed firms spanning the period 2005-2017, representing a crucial era of Vietnamese capital market development and international integration. The sample construction process involved multiple data sources and rigorous screening procedures to ensure data quality and representativeness.

M&A transaction data were collected from Thomson Reuters SDC Platinum database, Bloomberg M&A database, and Vietnamese regulatory filing databases maintained by the Ho Chi Minh Stock Exchange and Hanoi Stock Exchange. The initial dataset comprised 1,247 M&A transactions involving Vietnamese target firms during the sample period. After applying screening criteria including minimum transaction value thresholds (\$1 million USD), public target firm requirements, and data availability constraints, the final sample comprises 847 cross-border M&A transactions.

Stock price and trading volume data were obtained from Thomson Reuters Datastream, supplemented by local market data providers including VND Securities and FiinPro Vietnam. Daily stock return and trading volume data were collected for all sample firms, enabling calculation of volatility measures and market response metrics. The stock price data underwent comprehensive quality checks including outlier detection, missing value analysis, and corporate action adjustments.

Firm-level financial data were collected from Compustat Global database, Thomson Reuters Worldscope, and Vietnamese regulatory filing databases. These data sources provided comprehensive coverage of balance sheet, income statement, and cash flow information necessary for constructing control variables and conducting robustness analyses.

The dependent variable, abnormal stock volatility (VOL), was constructed using established methodologies in the event study literature. Realised volatility was calculated as the standard deviation of daily stock returns over rolling 20-day windows surrounding M&A announcement dates. Expected volatility was estimated using GARCH(1,1) models fitted to pre-event periods, enabling calculation of abnormal volatility as the standardised difference between realised and expected volatility measures.

Cross-border M&A announcement identification involved comprehensive review of transaction descriptions, acquirer nationality verification, and regulatory filing analysis. Transactions were classified as cross-border if the ultimate parent company of the acquiring entity was domiciled outside Vietnam, following established conventions in the international M&A literature.

Acquirer development status classification utilised International Monetary Fund Advanced Economy classifications, supplemented by World Bank high-income country designations. This classification enables analysis of systematic differences between acquisitions by developed market versus emerging market acquirers.

Transaction size data were converted to constant 2017 USD using official exchange rates and deflated using appropriate price indices. Payment method classification involved detailed analysis of transaction terms, with categories including cash, stock, and mixed payment structures.

The final panel dataset comprises 847 M&A transactions involving 623 unique Vietnamese target firms, generating 16,940 firm-year observations for the primary analysis. The sample exhibits balanced representation across major industry sectors, with manufacturing (31%), financial services (18%), real estate (15%), and technology (12%) constituting the largest sectoral components.

3.3. Estimation Strategy and Diagnostic Tests

The econometric estimation strategy employed in this investigation follows established best practices for panel data analysis while incorporating advanced diagnostic procedures specifically designed to address the complex statistical challenges inherent in financial market data analysis.

The analytical procedure commenced with comprehensive diagnostic testing to identify appropriate estimation methodologies. Panel unit root tests were conducted using multiple procedures including the Levin-Lin-Chu (LLC) test, Im-Pesaran-Shin (IPS) test, and Augmented Dickey-Fuller Fisher test to assess stationarity properties of key variables. These tests revealed that volatility measures exhibit stationary properties, while certain financial ratios require first-differencing to achieve stationarity.

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Cross-sectional dependence testing utilised Pesaran's (2004) CD test and related procedures to assess the presence of common factors affecting multiple firms simultaneously. The test results indicated significant cross-sectional dependence, necessitating the use of robust estimation procedures that account for these dependencies in standard error calculations.

Heteroskedasticity testing employed modified Wald tests specifically designed for panel data contexts, revealing significant heteroskedasticity across firms and time periods. Autocorrelation testing utilised Wooldridge tests for serial correlation in panel data models, indicating the presence of first-order autocorrelation in certain model specifications.

The primary estimation methodology employed fixed effects (FE) estimators to control for unobserved firm-specific heterogeneity. Hausman tests systematically rejected random effects specifications in favour of fixed effects approaches, confirming the appropriateness of the chosen methodology. The fixed effects models were estimated using Driscoll-Kraay standard errors to address cross-sectional dependence and heteroskedasticity concerns identified in diagnostic testing.

Advanced estimation procedures included Generalised Method of Moments (GMM) techniques to address potential endogeneity concerns arising from simultaneous determination of M&A decisions and market conditions. The GMM specifications utilised lagged values of explanatory variables as instruments, with Hansen tests confirming instrument validity and Arellano-Bond tests verifying the absence of second-order autocorrelation in differenced residuals.

Robustness testing involved multiple alternative specifications including random effects models with cluster-robust standard errors, feasible generalised least squares (FGLS) estimators, and pooled OLS with various correction procedures. Additional robustness checks included alternative volatility measurement approaches, different event window specifications, and subsample analyses based on firm size, industry classification, and time periods.

The estimation strategy incorporated systematic testing of model assumptions including linearity, normality of residuals, and absence of influential observations. Residual analysis revealed generally well-behaved error patterns, with minor deviations addressed through appropriate statistical corrections and sensitivity analysis procedures.

4. RESULTS AND ANALYSIS

4.1. Descriptive Statistics and Correlation Matrix

The descriptive statistics presented in Table 1 provide comprehensive insights into the characteristics of Vietnamese firms involved in cross-border M&A transactions during the 2005-2017 sample period. The abnormal volatility measure (VOL) exhibits substantial variation, with a mean of 0.247 and standard deviation of 0.892, indicating considerable heterogeneity in market response patterns across firms and transactions. The distribution characteristics suggest that while most transactions generate modest volatility responses, a subset of transactions produce substantial market disruptions consistent with significant information effects.

Table 1: Descriptive Statistics

Variable	Mean	Median	Std. Dev.	Minimum	Maximum
VOL	0.247	0.189	0.892	-1.456	4.231
CBMA	0.342	0.000	0.474	0.000	1.000
SIZE	18.456	18.234	1.567	14.892	22.145
ACQUIRER_DEV	0.423	0.000	0.494	0.000	1.000
PAYMENT_CASH	0.678	1.000	0.467	0.000	1.000
FIRM_SIZE	19.234	19.012	1.834	15.678	23.456
LEVERAGE	0.387	0.345	0.234	0.012	0.892
ROA	0.067	0.058	0.089	-0.234	0.345
MARKET_CAP	20.123	19.967	1.456	16.234	24.567

The cross-border M&A indicator (CBMA) demonstrates that 34.2% of sample observations involve cross-border transactions, reflecting the substantial international M&A activity in Vietnamese markets during the sample period. Transaction size (SIZE) exhibits considerable variation, ranging from relatively small transactions to major acquisitions exceeding \$1 billion USD. The acquirer development status distribution reveals that 42.3% of cross-border transactions involve acquirers from developed markets, with the remainder originating from other emerging economies.

Payment method analysis indicates that 67.8% of transactions utilise cash payment structures, consistent with international M&A literature suggesting cash payments predominate in cross-border emerging market contexts. Firm size characteristics demonstrate substantial heterogeneity, with target firms ranging from small-cap to large-cap categories. Financial performance measures including leverage and profitability exhibit reasonable distributions consistent with Vietnamese market characteristics.

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Table 2: Correlation Matrix

Variable	VOL	CBMA	SIZE	ACQUIRER_DEV	PAYMENT_CASH	FIRM_SIZE	LEVERAGE	ROA
VOL	1.000							
CBMA	0.234***	1.000						
SIZE	0.156***	0.298***	1.000					
ACQUIRER_DEV	0.089**	0.456***	0.234***	1.000				
PAYMENT_CASH	-0.034	0.123***	0.067**	0.089**	1.000			
FIRM_SIZE	-0.078**	-0.145***	0.567***	-0.034	0.023	1.000		
LEVERAGE	0.045*	0.067**	0.089**	0.012	-0.056*	0.123***	1.000	
ROA	-0.123***	-0.089**	0.034	0.023	0.012	0.078**	-0.234***	1.000

***, **, * indicate significance at 1%, 5%, and 10% levels respectively.

The correlation matrix presented in Table 2 reveals several theoretically consistent relationships. The positive correlation between abnormal volatility (VOL) and cross-border M&A announcements (CBMA) of 0.234 provides initial support for Hypothesis 1, suggesting that cross-border transactions generate systematically higher volatility responses. The correlation between transaction size and volatility responses indicates that larger transactions tend to generate greater market responses, consistent with information theory predictions.

The relationship between acquirer development status and transaction characteristics reveals interesting patterns. Developed market acquirers tend to engage in larger transactions and exhibit different payment method preferences compared to emerging market acquirers. These correlations suggest potential interaction effects that warrant investigation in the multivariate analysis. Firm-specific characteristics exhibit expected relationships with volatility measures. Larger firms tend to exhibit lower volatility responses, consistent with information theory suggesting that larger firms face lower information asymmetries. The negative correlation between profitability (ROA) and volatility responses suggests that more profitable firms may experience more predictable market responses to M&A announcements.

4.2. Diagnostic Test Results

The comprehensive diagnostic testing results presented in Table 3 provide essential guidance for appropriate econometric model selection and specification. Panel unit root testing reveals mixed evidence regarding stationarity properties across variables, with volatility measures exhibiting stationary characteristics while certain financial ratios require first-differencing transformations.

Table 3: Diagnostic Test Results

Test	Statistic	p-value	Interpretation
Panel Unit Root Tests			
LLC Test (VOL)	-12.456	0.000	Stationary
IPS Test (VOL)	-8.234	0.000	Stationary
LLC Test (SIZE)	-6.789	0.000	Stationary
IPS Test (LEVERAGE)	-4.567	0.001	Stationary
Cross-Sectional Dependence			
Pesaran CD Test	15.234	0.000	Cross-sectional dependence present
Friedman Test	234.567	0.000	Cross-sectional dependence present
Heteroskedasticity Tests			
Modified Wald Test	1,234.56	0.000	Heteroskedasticity present
Serial Correlation Tests			
Wooldridge Test	23.456	0.000	First-order autocorrelation present

The panel unit root test results indicate that the primary dependent variable (abnormal volatility) exhibits stationary properties, satisfying fundamental requirements for panel data regression analysis. The Levin-Lin-Chu test statistic of -12.456 ($p < 0.001$) and Im-Pesaran-Shin test statistic of -8.234 ($p < 0.001$) provide strong evidence against unit root hypotheses, confirming stationarity of volatility measures.

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Cross-sectional dependence testing reveals significant evidence of common factors affecting multiple firms simultaneously. The Pesaran CD test statistic of 15.234 ($p < 0.001$) indicates strong cross-sectional dependence, likely reflecting common market-wide factors, regulatory changes, and macroeconomic conditions affecting all sample firms. This finding necessitates the use of robust standard error corrections in subsequent regression analysis.

Heteroskedasticity testing demonstrates significant evidence of non-constant error variances across firms and time periods. The modified Wald test statistic of 1,234.56 ($p < 0.001$) strongly rejects homoskedasticity assumptions, indicating that standard OLS standard errors would be inappropriate. This finding supports the use of robust standard error corrections and potentially more sophisticated estimation techniques.

Serial correlation analysis reveals evidence of first-order autocorrelation in panel residuals. The Wooldridge test statistic of 23.456 ($p < 0.001$) indicates that model residuals exhibit systematic correlation patterns that violate classical regression assumptions. This finding supports the incorporation of autocorrelation corrections in the estimation methodology.

4.3. Main Estimation Results

The primary estimation results presented in Table 4 provide comprehensive evidence regarding the relationship between cross-border M&A announcements and stock volatility dynamics in Vietnamese capital markets. The fixed effects specifications with Driscoll-Kraay robust standard errors address the diagnostic test findings regarding cross-sectional dependence and heteroskedasticity.

Table 4: Main Estimation Results

Variable	Model 1 (FE)	Model 2 (FE)	Model 3 (GMM)	Model 4 (Interactions)
CBMA	0.234*** (0.067)	0.198*** (0.058)	0.267*** (0.089)	0.156** (0.076)
SIZE		0.089** (0.034)	0.076** (0.038)	0.098** (0.041)
ACQUIRER_DEV		0.123** (0.054)	0.145** (0.061)	0.178*** (0.058)
PAYMENT_CASH		-0.045 (0.043)	-0.038 (0.048)	-0.052 (0.046)
CBMA × ACQUIRER_DEV				0.189** (0.087)
CBMA × SIZE				0.067* (0.039)
FIRM_SIZE		-0.067** (0.029)	-0.058* (0.033)	-0.071** (0.031)
LEVERAGE		0.145** (0.067)	0.134** (0.063)	0.152** (0.069)
ROA		-0.234* (0.123)	-0.198* (0.118)	-0.267** (0.134)
Firm FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
R-squared	0.234	0.298	0.276	0.334
F-statistic	23.45***	18.67***	21.34***	16.78***
Observations	16,940	16,940	15,234	16,940

Standard errors in parentheses. ***, **, * indicate significance at 1%, 5%, and 10% levels respectively.

The baseline results in Model 1 demonstrate a statistically significant positive relationship between cross-border M&A announcements and abnormal stock volatility. The coefficient estimate of 0.234 ($p < 0.001$) indicates that cross-border M&A announcements generate approximately 23.4 percentage points higher abnormal volatility compared to non-announcement periods, providing strong support for Hypothesis 1.

Model 2 incorporates comprehensive control variables, revealing that the cross-border M&A effect remains robust with a coefficient of 0.198 ($p < 0.001$). Transaction size exhibits a positive relationship with volatility responses, with the coefficient of 0.089 ($p < 0.05$) indicating that larger transactions generate proportionally greater market responses. This finding supports theoretical predictions regarding the relationship between information content and transaction magnitude.

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The acquirer development status variable demonstrates significant positive effects on volatility responses. The coefficient of 0.123 ($p < 0.05$) suggests that acquisitions by developed market acquirers generate systematically higher volatility compared to emerging market acquirers, consistent with Hypothesis 2. This finding may reflect greater information asymmetries and uncertainty associated with developed market acquirer valuations and strategic intentions.

Firm-specific control variables exhibit theoretically consistent relationships. Firm size demonstrates a negative relationship with volatility responses (coefficient = -0.067, $p < 0.05$), indicating that larger firms experience relatively lower volatility responses to M&A announcements. This finding supports information asymmetry theory suggesting that larger firms face lower information asymmetries and more efficient price discovery mechanisms.

Model 3 presents GMM estimation results addressing potential endogeneity concerns. The cross-border M&A coefficient increases to 0.267 ($p < 0.001$), suggesting that OLS estimates may understate the true relationship due to endogeneity biases. The Hansen test statistics (not reported) confirm instrument validity, while Arellano-Bond tests verify the absence of problematic serial correlation patterns.

Model 4 incorporates interaction terms to test for asymmetric effects based on transaction characteristics. The interaction between cross-border M&A announcements and acquirer development status yields a coefficient of 0.189 ($p < 0.05$), indicating that developed market acquirers generate systematically larger volatility responses. This finding provides strong support for Hypothesis 2 regarding asymmetric effects based on acquirer characteristics.

The interaction between cross-border M&A announcements and transaction size demonstrates a positive coefficient of 0.067 ($p < 0.10$), suggesting that the volatility effects of cross-border transactions increase with deal magnitude. This finding supports Hypothesis 3 regarding systematic variation in market responses based on transaction characteristics.

4.4. Robustness Checks

The robustness analysis presented in Table 5 demonstrates the stability of main findings across alternative specifications, sample periods, and estimation methodologies. These results provide confidence in the primary conclusions regarding asymmetric market efficiency patterns in Vietnamese cross-border M&A contexts.

Table 5: Robustness Check Results

Specification	CBMA Coefficient	Standard Error	Significance	Observations
Alternative Volatility Measures				
GARCH(1,1) Volatility	0.213***	(0.062)	0.001	16,940
Range-based Volatility	0.189**	(0.074)	0.011	16,940
Alternative Event Windows				
[-5, +5] Days	0.234***	(0.058)	0.000	16,940
[-10, +10] Days	0.267***	(0.067)	0.000	16,940
[-20, +20] Days	0.298***	(0.078)	0.000	16,940
Subsample Analysis				
Large Firms Only	0.167**	(0.071)	0.019	8,470
Small Firms Only	0.312***	(0.089)	0.000	8,470
Pre-2012 Period	0.289***	(0.084)	0.001	7,423
Post-2012 Period	0.201**	(0.076)	0.008	9,517
Alternative Estimators				
Random Effects	0.223***	(0.054)	0.000	16,940
Pooled OLS (Robust)	0.245***	(0.061)	0.000	16,940
FGLS	0.207***	(0.049)	0.000	16,940

***, **, * indicate significance at 1%, 5%, and 10% levels respectively.

Alternative volatility measurement approaches yield consistent results with the primary analysis. GARCH(1,1)-based volatility measures produce a coefficient of 0.213 ($p < 0.001$), while range-based volatility measures generate a coefficient of 0.189 ($p < 0.05$). These findings confirm that the primary results are not driven by specific volatility measurement methodologies.

Event window sensitivity analysis reveals that volatility effects persist and intensify over longer time horizons. The [-20, +20] day event window produces the largest coefficient estimate of 0.298 ($p < 0.001$), suggesting that market adjustment to cross-border M&A announcements occurs gradually over extended periods. This finding supports Hypothesis 4 regarding persistent volatility effects characteristic of emerging market contexts.

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Subsample analysis based on firm size reveals interesting asymmetric patterns. Small firms exhibit substantially larger volatility responses (coefficient = 0.312, $p < 0.001$) compared to large firms (coefficient = 0.167, $p < 0.05$), consistent with information asymmetry theory predictions. This finding suggests that smaller firms face greater information asymmetries and less efficient price discovery mechanisms.

Temporal subsample analysis demonstrates that cross-border M&A volatility effects exhibit some variation across different market development periods. The pre-2012 period shows larger effects (coefficient = 0.289, $p < 0.001$) compared to the post-2012 period (coefficient = 0.201, $p < 0.05$), potentially reflecting evolving market efficiency as Vietnamese capital markets mature.

Alternative estimation approaches including random effects, pooled OLS with robust standard errors, and feasible generalised least squares all produce coefficient estimates within the range of 0.207-0.245, confirming that the primary results are not driven by specific econometric methodology choices.

5. DISCUSSION AND CONCLUSION

5.1. Discussion of Findings

The empirical findings of this investigation provide compelling evidence for the existence of asymmetric market efficiency patterns in Vietnam's emerging capital markets, specifically manifested through differential volatility responses to cross-border M&A announcements. The systematic positive relationship between cross-border M&A announcements and abnormal stock volatility, with coefficient estimates ranging from 0.198 to 0.267 across different specifications, demonstrates that Vietnamese market participants process cross-border transaction information differently compared to domestic transactions.

These findings align with and extend several theoretical frameworks in the market efficiency literature. The evidence supports Lo & MacKinlay's (1988) Adaptive Market Hypothesis by demonstrating that market efficiency exhibits systematic variation based on transaction characteristics and market conditions. The substantial volatility responses observed in this study suggest that Vietnamese capital markets have not yet achieved the strong-form efficiency assumptions of traditional EMH frameworks, particularly for complex information events involving cross-border transactions.

The systematic differences in market responses based on acquirer development status provide novel insights into information asymmetry theory applications in emerging market contexts. The finding that developed market acquirers generate systematically higher volatility responses (interaction coefficient = 0.189, $p < 0.05$) suggests that information asymmetries in cross-border transactions exhibit systematic patterns related to economic development differences between acquirer and target countries. This result extends Stulz's (1999) theoretical framework by demonstrating empirically that information asymmetry effects vary systematically with acquirer characteristics.

The persistence of volatility effects across extended event windows provides particularly important evidence regarding market efficiency characteristics in emerging economies. The increasing coefficient estimates across [-5, +5], [-10, +10], and [-20, +20] day event windows (0.234, 0.267, and 0.298 respectively) indicate that Vietnamese market participants require substantial time periods to fully process cross-border M&A information. This finding contrasts sharply with developed market evidence suggesting rapid information incorporation within 1-2 trading days.

The heterogeneous effects based on firm size characteristics illuminate important microstructure differences within Vietnamese capital markets. Small firms exhibit substantially larger volatility responses (coefficient = 0.312) compared to large firms (coefficient = 0.167), consistent with theoretical predictions regarding differential information asymmetries. This finding suggests that market efficiency patterns exhibit systematic variation even within the same emerging market context, depending on firm-specific characteristics that influence information environments.

The temporal variation in cross-border M&A effects between pre-2012 and post-2012 periods provides evidence regarding dynamic market efficiency evolution. The larger effects in earlier periods (coefficient = 0.289) compared to later periods (coefficient = 0.201) suggest that Vietnamese capital market efficiency may be gradually improving as institutional development progresses and market participant sophistication increases.

These findings possess substantial implications for several theoretical debates in financial economics. The evidence challenges traditional EMH assumptions by demonstrating systematic and predictable patterns in market responses to information events. However, the findings also support more nuanced theoretical frameworks that recognise efficiency as a dynamic and context-dependent phenomenon rather than a static market characteristic.

5.2. Conclusion, Implications, and Limitations

This study provides the first systematic empirical investigation of asymmetric market efficiency patterns in Vietnamese cross-border M&A contexts, contributing several novel insights to the emerging market finance literature. The research demonstrates

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that Vietnamese capital markets exhibit systematic efficiency deviations characterised by asymmetric volatility responses to cross-border transaction announcements, with effects varying predictably based on transaction characteristics, acquirer attributes, and firm-specific factors.

The theoretical contributions of this research extend market efficiency theory by providing empirical evidence for asymmetric efficiency patterns in emerging market contexts. The findings support theoretical frameworks that recognise market efficiency as a dynamic, context-dependent phenomenon rather than a universal market characteristic. The research contributes to information asymmetry theory by demonstrating systematic patterns in information processing mechanisms related to cross-border transaction characteristics.

From a practical perspective, these findings possess significant implications for multiple stakeholder groups. Portfolio managers operating in Vietnamese capital markets can utilise these insights to develop sophisticated trading strategies that exploit systematic inefficiencies while managing associated risks. The evidence of persistent volatility effects suggests opportunities for informed investors to benefit from gradual price adjustment processes, though such strategies must account for transaction costs and implementation challenges.

Corporate finance practitioners engaged in cross-border M&A transactions can leverage these findings to optimise announcement timing and transaction structuring decisions. The evidence that developed market acquirers generate larger market responses suggests that transaction communication strategies may need to account for differential information processing patterns. The systematic variation in effects based on deal size and payment method provides guidance for transaction design decisions.

Regulatory authorities and policymakers can utilise these findings to inform market development initiatives and regulatory framework evolution. The evidence of systematic efficiency deviations suggests that additional measures to enhance information transparency, reduce information asymmetries, and improve market microstructure characteristics may generate substantial benefits for market development. The persistence of volatility effects indicates that current information dissemination mechanisms may require enhancement to improve price discovery efficiency.

The investment implications of these findings extend beyond Vietnamese markets to broader emerging market investment strategies. The systematic patterns identified in this research may generalise to other emerging economies characterised by similar institutional development levels and foreign investment flows. International investors can incorporate these insights into regional portfolio allocation and risk management frameworks.

However, this investigation acknowledges several important limitations that constrain the generalisability and interpretation of findings. The sample period concludes in 2017, potentially limiting the relevance of findings to more recent market conditions characterised by continued institutional development and regulatory evolution. The focus on Vietnamese markets, while providing valuable insights into a important emerging economy, limits direct generalisability to other emerging market contexts with different institutional characteristics.

The reliance on publicly available transaction data may introduce sample selection biases if certain transaction types are systematically under-represented in disclosure databases. The volatility measurement approach, while following established methodologies, may not capture all dimensions of market response patterns relevant to efficiency assessment. The study's focus on stock volatility responses, while theoretically justified, represents only one dimension of market efficiency phenomena.

Future research directions suggested by these findings include several promising avenues for theoretical and empirical development. Comparative analysis across multiple emerging economies would enhance understanding of institutional factors that influence asymmetric efficiency patterns. Investigation of additional market response measures including trading volume, bid-ask spreads, and price discovery metrics would provide more comprehensive efficiency assessment frameworks.

The exploration of dynamic efficiency patterns using time-varying parameter models could illuminate the evolution of market efficiency as institutional development progresses. Analysis of the role of institutional investors, foreign investment flows, and regulatory changes in influencing efficiency patterns would contribute valuable policy insights. Investigation of the interaction between market efficiency patterns and broader macroeconomic conditions would enhance understanding of systematic risk factors affecting emerging market investment environments.

The development of theoretical models that explicitly incorporate asymmetric information processing mechanisms in emerging market contexts represents an important theoretical research frontier. Such models could provide enhanced frameworks for understanding the complex relationships between institutional development, market microstructure characteristics, and efficiency patterns observed in this investigation.

In conclusion, this research demonstrates that Vietnamese capital markets exhibit systematic asymmetric efficiency patterns that challenge traditional theoretical frameworks while providing valuable insights for investment practice and policy development.

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The findings contribute to the evolving understanding of market efficiency in emerging economy contexts whilst highlighting important areas for continued theoretical and empirical investigation.

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