OWNERSHIP DYNAMICS, AUDIT OVERSIGHT, AND FIRM PERFORMANCE: EVIDENCE FROM EMERGING MARKETS

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Abstract

This study examines how ownership structures and audit mechanisms jointly shape firm performance in Vietnam, a transitional emerging market characterized by uneven investor protection and evolving regulatory quality. Drawing on agency theory (Jensen & Meckling, 1976) and institutional perspectives on governance in emerging economies (La Porta et al., 1999), the analysis addresses a gap in prior research, which often evaluates governance dimensions separately. Using 2,052 firm-year observations from 2017–2023 and feasible generalized least squares (FGLS) to address heteroskedasticity, autocorrelation, and nonlinear ownership dynamics, the study integrates ownership concentration, foreign ownership, institutional ownership, audit firm rotation, and Big Four auditors into a unified framework. The results reveal heterogeneous governance effects. Ownership concentration exhibits a clear U-shaped relationship with performance. Foreign ownership shows a positive linear effect with only marginal evidence of an inverted U-shaped pattern. Institutional ownership exerts a consistently negative and significant impact. Auditor rotation and Big Four auditors both enhance performance, underscoring the value of credible external assurance in weak-enforcement settings. Firm size supports performance, whereas leverage imposes financial constraints. Overall, the findings demonstrate that internal ownership incentives and external audit quality jointly contribute to stronger performance, offering context-specific insights into governance effectiveness in emerging markets.

Keywords: Corporate Governance, Ownership Structure, Audit Firm Rotation, Big Four Auditors, Firm Performance, Emerging Markets, Vietnam

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1. INTRODUCTION

Firm performance has long been a central topic in corporate governance research, particularly in emerging markets where institutional frameworks remain incomplete, information asymmetry is substantial, and external monitoring mechanisms are often underdeveloped. In such contexts, the effectiveness of governance depends critically on how internal and external monitoring mechanisms jointly constrain managerial discretion, enhance transparency, and strengthen investor confidence. Although Vietnam has made considerable progress in capital market development and regulatory reforms, persistent challenges remain, including weak minority shareholder protection, uneven enforcement quality, and the dominance of controlling shareholders (Anderson et al., 2025; La Porta et al., 1999). Consequently, ownership structures and audit quality continue to attract strong academic interest due to their central role in shaping managerial incentives and improving monitoring effectiveness (Blomson, 2023; Alqatamin & Alqatamin, 2024; Amanamah, 2024).

Within internal governance, ownership structure forms the foundation of effective monitoring. Under agency theory, concentrated ownership can enhance governance discipline because large shareholders possess both the incentives and the capacity to oversee managerial decisions (Shleifer & Vishny, 1997; La Porta et al., 1999). Evidence from emerging markets suggests that this mechanism is particularly effective under weak institutional conditions (Boshnak, 2025; Wu, 2024). However, its effect is not strictly linear. Some studies document a U-shaped pattern, where insufficient oversight at low-to-moderate concentration levels initially depresses performance before improving at higher ownership levels (Pratama, 2019). Others find an inverted U-shape, indicating that performance peaks at moderate concentration but declines when ownership becomes excessively high, driven by entrenchment risks or strategic rigidity (Claessens et al., 2000; Alrwabdah & Lok, 2024). These findings illustrate that the performance implications of ownership concentration are inherently nonlinear and context-specific.

Foreign ownership serves as another key governance channel, particularly in markets with significant information asymmetry. Drawing on agency theory and resource dependence theory (RDT), foreign investors are expected to enhance transparency, improve governance quality, and strengthen firm performance due to their analytical capability, reporting standards, and international experience (Douma et al., 2006; Bentivogli & Mirenda, 2017). Nonetheless, in transitional institutional environments such as Vietnam, foreign ownership typically yields optimal performance only at moderate levels (approximately 36%–43%) before declining at higher thresholds due to rising coordination costs, managerial and cultural frictions, or reduced strategic flexibility (Phung & Mishra, 2016; Duong et al., 2021; Pham & Do, 2023). Similar inverted U-shaped patterns have been observed in Türkiye (Gurbuz & Aybars, 2010) and China (Tsafack & Guo, 2021). Moreover, in settings characterized by ownership caps or restricted information access, low foreign ownership stakes often fail to exert meaningful monitoring influence (Do et al., 2022). Overall, foreign ownership offers both governance-enhancing benefits and institutionally constrained limitations.

Institutional ownership is also increasingly salient in emerging markets, where investor protection and legal enforcement are often weak (Shaban & Zarnoun, 2024). Under agency and resource dependence perspectives, institutional investors are expected to provide superior analytical expertise, better access to information, and stronger monitoring incentives than individual shareholders (Cornett et al., 2007; Sakawa & Watanabe, 2020). Nevertheless, its effects are far from uniform. Some studies report positive outcomes when institutional investors take long-term, active monitoring roles (Rashid, 2020), whereas others highlight weak or negative effects due to passive investment styles, relational objectives, or conflicts of interest (Bhattacharya & Graham, 2009; Faccio & Lasfer, 2000). In Vietnam, fragmentation between domestic and foreign institutions, combined with information barriers and ownership caps, contributes to inconsistent monitoring outcomes and divergent effects compared with developed markets.

Alongside internal mechanisms, external monitoring — particularly independent auditing — plays a crucial role in safeguarding financial reporting credibility. Auditor rotation is expected to enhance independence and reduce familiarity risks, although its effectiveness varies with enforcement quality (Corbella et al., 2015; Elewa & El-Haddad, 2019). Big Four auditors further reinforce governance due to their superior expertise, standardized procedures, and international reputation. From a signaling perspective, the appointment of a high-tier auditor conveys credible information about a firm's commitment to transparency and reporting quality, consistent with the logic of Spence (1973). Empirical evidence shows that high-quality auditing reduces earnings management and improves firm outcomes (Sattar et al., 2020; Fasua, 2023; Dhifi & Zouari-Hadiji, 2024). In emerging institutional environments like Vietnam, the interaction between internal monitoring and high-tier external assurance can generate complementary governance effects (Alqatamin & Alqatamin, 2024; Amanamah, 2024).

Cultural context may also affect how governance mechanisms operate. Hofstede (2001) demonstrates that collectivist norms — emphasizing harmony and conflict avoidance — may reduce direct confrontation and weaken independent oversight, while Li and Harrison (2008) show that national culture significantly predicts board structures and independence in multinational firms. Although culture is not directly examined in this study, acknowledging these insights helps situate the empirical results within Vietnam's collectivist context, where monitoring effectiveness — particularly that of institutional investors and independent directors — may be shaped by cultural norms.

At the regional level, many Association of SouthEast Asian Nations' (ASEAN's) economies face similar governance challenges: improvements in corporate disclosure have often outpaced the strengthening of accountability mechanisms (Asian Development Bank [ADB], 2021). These regional constraints reinforce the need to re-evaluate governance mechanisms in transitional institutional environments. Furthermore, the study period

(2017–2023) encompasses the COVID-19 shock, which heightened uncertainty and underscored the demand for transparency and governance discipline — creating a timely context to assess the joint effects of ownership structures and audit quality on firm performance.

Despite rich literature on ownership and auditing, few studies examine both mechanisms jointly within a unified empirical framework. Moreover, nonlinear relationships in ownership structures — common in emerging markets — remain underexplored. Addressing these gaps, this study investigates the influence of five core governance mechanisms — ownership concentration, foreign ownership, institutional ownership, auditor rotation, and Big Four audit quality — on firm performance in Vietnam.

This study offers three main contributions. First, it integrates three ownership dimensions and two audit mechanisms into a unified empirical framework, clarifying the complementary roles of internal and external monitoring. Second, it provides new evidence on nonlinear ownership-performance relationships, demonstrating that ownership effects depend on ownership levels and institutional context. Third, it deepens understanding of corporate governance in transitional economies such as Vietnam and offers policy implications to strengthen monitoring quality and investor protection.

The remainder of the paper is structured as follows. Section 2 presents the literature review and hypotheses development. Section 3 describes the data, variable construction, and empirical strategy. Section 4 reports and discusses the empirical results. Section 5 concludes with implications and future research directions.

2. LITERATURE REVIEW AND RESEARCH HYPOTHESES

Corporate governance in emerging markets is shaped by a dual structure of internal and external mechanisms that address agency conflicts and institutional weaknesses. Internal governance operates through ownership structures — concentrated, foreign, and institutional shareholders — who influence managerial incentives, monitoring effectiveness, and access to strategic resources. These channels are especially important in transitional economies like Vietnam, where investor protection is uneven, and internal owners often serve as primary monitors. External mechanisms, particularly audit firm rotation and Big Four auditors, enhance reporting credibility and constrain managerial discretion, providing an additional assurance layer. Together, these mechanisms may complement or substitute one another, forming the basis for five hypotheses on how ownership structures and audit attributes influence firm outcomes in Vietnam.

Ownership concentration plays a central role in corporate governance in emerging markets such as Vietnam, where weak investor protection and limited enforcement elevate the importance of internal monitoring. Under agency theory (Jensen & Meckling, 1976; Shleifer & Vishny, 1997), concentrated ownership strengthens oversight and helps mitigate managerial opportunism. Empirical evidence from the Middle East (Boshnak, 2025), South Asia (Gupta & Mer, 2023; Jadoon & Bajuri, 2015; Habib et al., 2022), and East–Southeast Asia (Wu, 2024; Yasser & Al Mamun, 2016; Le & Nguyen, 2024; Tran et al., 2025; Nguyen et al., 2015) indicates that blockholders can enhance firm performance through improved monitoring, consistent with the notion that concentrated control serves as a functional response to institutional voids (La Porta et al., 1999).

From an RDT perspective (Pfeffer & Salancik, 1978), concentrated owners provide strategic stability, long-term commitment, and privileged access to key resources. However, these benefits may diminish at higher concentration levels, creating nonlinear effects. Several studies document an inverted U-shaped relationship, where performance improves at moderate concentration but declines when ownership becomes excessively dominant due to rigidity or reduced external resource access (Alrwabdah & Lok, 2024; Claessens et al., 2000). Other research identifies a U-shaped pattern in which performance initially falls at low-to-moderate concentration — when blockholders are influential but not fully incentivized to monitor — before rising once effective control is established. Pratama (2019) reports a clear U-shape in Indonesia, a context similar to Vietnam. In contrast, a meta-analysis by Wang and Shailer (2015) finds no consistent nonlinear form across emerging markets, highlighting institutional heterogeneity and the context-dependent nature of the ownership-performance relationship.

The entrenchment perspective further highlights that excessive concentration may facilitate private-benefit extraction, weaken transparency, and reduce firm value (Bishwas & Hossain, 2025). Mixed or insignificant findings from Nigeria (Tsegba & Achua, 2011), Algeria (Louiza, 2025), and Vietnam (Do et al., 2022) also reinforce the conditional nature of this relationship, shaped by factors such as disclosure quality, market competition, and firm size.

Overall, prior evidence reveals no universal functional form but a spectrum of nonlinear patterns shaped by context, ownership identities, and governance incentives. Given Vietnam's diverse ownership landscape, reassessing this nonlinearity is theoretically and practically warranted.

H1: Ownership concentration exhibits a nonlinear relationship with firm performance.

Foreign ownership provides an important governance mechanism in emerging markets characterized by information asymmetry and capital constraints. Under agency theory, foreign investors possess superior expertise and monitoring capabilities, reducing managerial opportunism. Evidence across regions supports this view. Foreign equity improves productivity (Pasali & Chaudhary, 2020), enhances post-acquisition performance in the U.S. (Chari et al., 2012), and strengthens liquidity and efficiency in Italy (Bentivogli & Mirenda, 2017). In Türkiye, Saudi Arabia, Pakistan, South Asia, and Vietnam, foreign participation is associated with improvements in firm performance, operational efficiency, and broader governance outcomes (Aydin et al., 2007; Boshnak, 2025; Murtaza et al., 2020; Rashid, 2020; Abedin et al., 2022; Sobhan, 2022; Douma et al., 2006; Chhibber & Majumdar, 1999; Nguyen et al., 2024; Nguyen et al., 2020). Similar

improvements in governance performance are documented in Nigeria (Uwuigbe & Olusanmi, 2012) and Sub-Saharan Africa (Webster et al., 2022).

From an RDT perspective, foreign investors provide capital, technology, and managerial expertise. However, these benefits follow a well-established inverted U-shaped pattern. In Vietnam, multiple studies show that performance peaks at moderate foreign ownership levels — notably at 43% (Phung & Mishra, 2016), 36.3% (Duong et al., 2021), and within the 0–40% range (Pham & Do, 2023). Beyond these thresholds, coordination costs, cultural frictions, and reduced strategic flexibility lead to declining performance. Comparable inverted-U effects in China (Tsafack & Guo, 2021) and Türkiye (Gurbuz & Aybars, 2010) reinforce that moderate foreign ownership is optimal for creating governance and performance value.

Under signaling theory, foreign ownership signals governance credibility and adherence to international standards, improving investor confidence. However, passive foreign stakes or ownership caps weaken monitoring effectiveness, explaining the insignificant findings in Vietnam (Do et al., 2022) and Nigeria (Tsegba & Achua, 2011).

Synthesizing this evidence, the literature consistently highlights a nonlinear, inverted U-shaped relationship, where performance increases with foreign ownership up to an optimal threshold before declining as costs outweigh benefits.

H2: Foreign ownership exhibits an inverted U-shaped relationship with firm performance.

Institutional ownership is an important governance mechanism in emerging markets where investor protection and enforcement remain underdeveloped (Shaban & Zarnoun, 2024). Under agency theory, institutional investors possess superior analytical capabilities, stronger monitoring incentives, and better information access, helping curb managerial opportunism. Evidence from developed markets such as the U.S. (Cornett et al., 2007) and Japan (Sakawa & Watanabe, 2020), as well as Bangladesh (Abedin et al., 2022; Rashid, 2020), Kuwait (Alfaraih et al., 2012), and Nigeria (Yahaya, 2025; Uwuigbe & Olusanmi, 2012), shows that institutional monitoring can strengthen governance and firm performance.

From an RDT perspective, institutional investors provide strategic resources — capital, expertise, technology, and networks — that enhance decision-making and strategic capacity. Yet these benefits may diminish as ownership rises. Studies in Jordan (Zeitun, 2009) and Iran (Daryaei & Fattahi, 2020) report an inverted U-shaped effect, where institutional ownership improves performance up to a threshold before excessive dependence restricts managerial flexibility.

A substantial body of research, however, finds negative or insignificant effects, often due to passive behavior, weak engagement, or short-term investment horizons. Evidence from U.S. shipping firms (Tsouknidis, 2019), U.K. pension funds (Faccio & Lasfer, 2000), and Finnish institutions (Bhattacharya & Graham, 2009) indicates that institutional investors may avoid active monitoring or face conflicts of interest. Similar findings in emerging markets (Demsetz & Villalonga, 2001; Al-Najjar, 2015; Sobhan, 2022; Artha et al., 2021) highlight how low transparency, information asymmetry, and politically connected ownership can limit governance benefits.

In Vietnam, institutional investors are highly heterogeneous. Domestic institutions — particularly state-linked or relational entities — tend to be passive with limited monitoring incentives, while foreign institutions, despite stronger governance standards, face ownership caps, disclosure constraints, and restricted access to strategic information. These features suggest that the impact of institutional ownership may differ markedly from markets with stronger investor protection, providing essential context for interpreting this study's empirical results.

H3: Institutional ownership has a significant relationship with firm performance, contingent on the monitoring role and engagement intensity of institutional investors.

Ownership mechanisms provide internal governance, while audit firm rotation and auditor quality supply external assurance. In emerging markets, internal monitoring may be insufficient due to concentrated ownership, strategic limits on foreign investors, or passive institutional investors. External audits help compensate by enhancing reporting credibility and constraining opportunism. When ownership is well-aligned and engaged, reliance on external audits diminishes. Overall, ownership and audit oversight operate as complementary or substitutive mechanisms, a balance particularly salient in Vietnam's evolving governance environment.

Audit firm rotation promotes independence and enhances audit quality. Under agency theory, rotation mitigates familiarity threats and realigns incentives. Evidence from Italy, Pakistan, Indonesia, and Nigeria (Corbella et al., 2015; Sattar et al., 2020; Umry & Tjakrawala, 2025; Fasua, 2023) confirms improved earnings quality and performance effects. Internal oversight strengthens this effect; Alqatamin and Alqatamin (2024) demonstrate that strong audit committees enhance reporting quality.

Under RDT, reputable auditors supply expertise and legitimacy. Dhifi and Zouari-Hadiji (2024) show that Big Four affiliation and auditor expertise improve integrated reporting and investor confidence, implying that rotation toward reputable auditors substitutes for weak enforcement.

Under signaling theory, rotation signals transparency. Shaban and Zarnoun (2024) show that enhanced disclosure improves firm performance, consistent with audit-based signaling. Nevertheless, effects depend on institutional context. Mixed or null results in Nigeria and Egypt (Fasua, 2023; Elewa & El-Haddad, 2019) and challenges such as pseudo-rotations in Indonesia (Kalanjati et al., 2019) highlight dependence on enforcement quality.

In Vietnam — where rotation remains voluntary, and audit markets are dominated by smaller domestic firms — rotation improves independence but may have modest performance effects.

H4: Audit firm rotation is positively associated with firm performance.

The auditor's quality tier represents a second dimension of audit quality beyond rotation. Big Four auditors possess superior expertise, industry specialization, and reputational incentives.

Empirical evidence consistently links high-tier auditors with better monitoring outcomes. Rotation combined with higher-quality auditors reduces earnings management (Corbella et al., 2015). Audit quality proxies — including auditor experience and audit fee ratios — improve performance (Sattar et al., 2020), while higher audit quality enhances return on assets (ROA) and earnings per share (EPS) (Fasua, 2023). Context-dependent effects in emerging markets (Elewa & El-Haddad, 2019) and improvements due to stronger partner-level oversight (Chi et al., 2009; Kalanjati et al., 2019) further support Big Four advantages.

From an RDT viewpoint, Big Four affiliation improves reporting credibility and investor confidence (Dhifi & Zouari-Hadiji, 2024). Internal governance mechanisms complement high-tier auditors; strong audit committees and board competencies enhance reporting quality (Alqatamin & Alqatamin, 2024; Amanamah, 2024).

Under signaling theory, Big Four appointment signals transparency and accountability. Evidence on broader transparency mechanisms (Shaban & Zarnoun, 2024) and conceptual governance frameworks (Blomson, 2023) reinforces this signaling value.

In emerging markets like Vietnam — where credible external assurance often compensates for institutional weaknesses — Big Four auditors are expected to generate superior performance outcomes.

H5: Firms audited by Big Four audit firms exhibit higher performance than those audited by non-Big Four audit firms.

Overall, these five hypotheses capture how internal governance through ownership structures and external oversight through audit quality jointly influence firm performance in Vietnam's emerging market. This integrated framework reflects the interplay of monitoring, resource provision, and transparency. The next section describes the data, variable construction, and empirical methods used to test these hypotheses.

3. RESEARCH METHODOLOGY

3.1. Data and estimation strategy

This study employs an unbalanced panel comprising 2,052 firm-year observations from 310 non-financial firms listed on the Ho Chi Minh Stock Exchange (HOSE) and the Hanoi Stock Exchange (HNX) over the period 2017–2023. The sample focuses exclusively on non-financial firms, excluding banks, insurance companies, securities firms, and other financial institutions. These entities operate under fundamentally different regulatory, accounting, and risk-management frameworks and exhibit distinctive leverage profiles and valuation models, making them unsuitable for comparison with non-financial corporations (Fama & French, 1992; La Porta et al., 2002).

All financial, ownership, and audit-related data were collected from the Vietstock database, which aggregates information from audited financial statements, annual reports, and official disclosures. Vietstock is widely recognized in empirical corporate governance research on Vietnamese listed firms for its accuracy and consistency. To prepare the dataset for analysis, observations containing missing values or extreme anomalies were addressed through a combination of removal and winsorization at the 1st and 99th percentiles, ensuring the mitigation of undue influence from outliers while retaining the integrity of the sample.

The firms in the dataset represent a broad spectrum of Vietnam's economic activity, including manufacturing (chemicals, plastics, metals, machinery, food and beverages), real estate and construction, wholesale and retail trade, mining, transportation and logistics, utilities, professional and technical services, hospitality, and other service sectors. This diversity enhances the external validity of the results.

The empirical approach follows a panel-data regression framework, leveraging both cross-sectional and time-series variation to examine the relationship between ownership structure, audit mechanisms, and firm performance. Prior to estimation, descriptive statistics, correlation matrices, and variance inflation factors (VIFs) were computed to assess data characteristics and multicollinearity. VIF values remained within acceptable thresholds, indicating no serious collinearity concerns.

Three estimation methods were considered: the fixed effects model (FEM), the random effects model (REM), and feasible generalized least squares (FGLS). Although the Hausman test favored FEM, additional diagnostic tests revealed the presence of heteroskedasticity and autocorrelation, rendering FEM inefficient. To address these issues and obtain more reliable estimates, the analysis employs FGLS, which corrects simultaneously for cross-sectional heteroskedasticity and within-panel autocorrelation. This approach is consistent with empirical practice in studies of emerging markets, where data irregularities are common.

The overall estimation strategy, thus, ensures efficient and consistent parameter inference while reflecting the structural characteristics of firms operating in a transitional market economy.

3.2. Variable measurement and model specification

This study examines how internal ownership characteristics and external audit mechanisms affect firm performance (*FP*). The dependent variable is return on equity (*ROE*), reflecting a firm's ability to generate profit relative to shareholders' equity. ROE is chosen because it captures both profitability and capital efficiency, providing a robust accounting-based indicator of firm performance (Brigham & Ehrhardt, 2016; Subramanyam, 2014). In emerging markets, market-based measures such as Tobin's Q are often distorted by illiquidity and information asymmetry, making accounting indicators more reliable (Arora & Sharma, 2016; Mashayekhi & Bazaz, 2008). Thus, ROE is widely used in governance studies in transitional economies and is particularly suitable for the Vietnamese setting. The independent variables consist of ownership-structure attributes and audit-related factors, supplemented by standard firm-level control variables. Detailed definitions are provided below.

1) Internal governance mechanisms — Ownership structure:

• Ownership concentration (*OC*): percentage of shares held by the largest shareholder, indicating the degree of control concentration.

• Foreign ownership (*FO*): proportion of equity owned by foreign investors, reflecting external monitoring and access to international resources.

• Institutional ownership (*IO*): percentage of shares held by institutional investors, including both domestic and foreign institutions.

• Nonlinear terms: squared terms for ownership concentration (OC^2) and foreign ownership (FO^2) are included to capture potential inverted U-shaped relationships frequently documented in prior studies.

2) External governance mechanisms — Audit characteristics:

• Auditor rotation (*ROTA*): dummy variable equal to 1 if the firm changes its external auditor in a given year, and 0 otherwise, representing audit independence and regulatory oversight.

• Big Four auditor (*AUD_BIG4*): dummy variable equal to 1 if the firm is audited by one of the Big Four audit firms, and 0 otherwise, capturing reputational quality and audit expertise.

3) Control variables:

• Firm size (*FSIZE*): natural logarithm of total assets.

• Financial leverage (*LEV*): total liabilities divided by total assets.

• Revenue growth (*GROWTH*): annual percentage change in sales revenue.

The empirical model is specified as follows:

$$FP_{it} = \beta_0 + \beta_1 OC_{it} + \beta_2 OC_{it}^2 + \beta_3 FO_{it} + \beta_4 FO_{it}^2 + \beta_5 IO_{it} + \beta_6 ROTA_{it} + \beta_7 AUD_{BIG4_{it}} + \beta_8 FSIZE_{it} + \beta_9 LEV_{it} + \beta_{10} GROWTH_{it} + \varepsilon_{it} \quad (1)$$

The inclusion of OC^2 and FO^2 enables the detection of nonlinear ownership-performance patterns suggested in the literature.

4. RESULTS AND DISCUSSION

4.1. Descriptive statistics

Table 1 provides an overview of the descriptive statistics for all variables used in the empirical analysis. The table summarizes key characteristics of firm performance, ownership structure, audit-related attributes, and control variables for 2,052 firm-year observations from non-financial firms listed on the HOSE and HNX over the 2017–2023 period. These statistics provide initial insight into the distributional properties of the dataset and the degree of variation across Vietnamese listed firms.

Table 1. Descriptive statistics

Variable	*Obs.*	*Mean*	*Std. dev.*	*Min*	*Max*
FP	2052	0.08	0.667	-25.331	1.015
OC	2052	37.606	21.305	0	98.79
FO	2052	4.189	10.395	0	80.04
IO	2052	39.022	30.071	0	99.78
ROTA	2052	0.187	0.39	0	1
AUD_BIG4	2052	0.213	0.41	0	1
FSIZE	2052	27.926	1.702	23.322	34.135
LEV	2052	0.499	0.23	0.001	1.295
GROWTH	2052	0.001	0.017	-0.024	0.751

Source: Authors' calculations based on data processed using Stata.

The descriptive statistics in Table 1 reveal substantial heterogeneity across firms. Firm performance (*FP*), measured by return on equity (*ROE*), has a mean of 0.080 and a relatively large standard deviation (SD) of 0.667. The wide range — from -25.331 to 1.015 — indicates the coexistence of loss-making firms and highly profitable ones, a pattern typical of emerging markets and further accentuated during the COVID-19 shock years (2020–2021).

Regarding ownership structure, ownership concentration (*OC*) exhibits a high average level of 37.606%, confirming the prevalence of dominant shareholders in Vietnam's listed firms. This level of concentration is consistent with Vietnam's ownership landscape, where many firms operate under blockholder control rather than dispersed ownership. Foreign ownership (*FO*) remains modest, with an average of 4.189% and high variability across firms. Institutional ownership (*IO*) averages 39.022% and shows the greatest dispersion (SD = 30.071), reflecting the heterogeneous participation of institutional investors, ranging from passive domestic institutions to more active foreign investors.

For audit-related characteristics, the mean value of auditor rotation (*ROTA*) is 0.187, indicating that approximately 18.7% of firm-year observations involved a change of external auditor. The Big Four audit indicator (*AUD_BIG4*) has a mean of 0.213, meaning that 21.3% of the observations were audited by Big Four firms, highlighting the selective presence of international audit networks in Vietnam's audit market.

Control variables also show meaningful variation. Firm size (*FSIZE*) has a mean of 27.926, leverage (*LEV*) averages 0.499, and revenue growth (*GROWTH*) has a near-zero mean with moderate dispersion. All continuous variables were winsorized at the 1st and 99th percentiles to mitigate the effect of extreme observations.

Overall, the descriptive statistics highlight pronounced variation in performance, ownership structures, and audit practices among Vietnamese listed firms. Such heterogeneity underscores the need for panel-data estimation methods capable of controlling for unobserved firm-specific and time-varying effects in subsequent empirical analysis.

4.2. Correlation matrix

Table 2 reports the Pearson correlation coefficients for all variables included in the empirical analysis. This matrix offers an initial assessment of the linear associations among variables and serves as an important diagnostic step for detecting potential multicollinearity before estimating the regression models.

Table 2. Matrix of correlations

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
(1) *FP*	1.000								
(2) *OC*	0.022	1.000							
(3) *FO*	0.014	0.005	1.000						
(4) *IO*	0.007	0.795*	0.194*	1.000					
(5) *ROTA*	-0.007	-0.033	-0.032	-0.050*	1.000				
(6) *AUD_BIG4*	0.019	0.014	0.135*	0.048*	0.034	1.000			
(7) *FSIZE*	-0.008	-0.055*	0.100*	0.011	-0.092*	0.013	1.000		
(8) *LEV*	-0.078*	0.003	-0.066*	-0.050*	-0.009	-0.045*	0.308*	1.000	
(9) *GROWTH*	0.001	-0.014	-0.009	-0.042	0.003	-0.009	0.040	0.016	1.000

*Note: The symbols ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.*
Source: Authors' calculations based on data processed using Stata.

The correlations in Table 2 show that firm performance (*FP*), measured by *ROE*, has very weak pairwise associations with all explanatory variables. The correlation between firm performance (*FP*) and leverage (*LEV*) is negative (-0.078) and statistically significant at the 10% level, consistent with the idea that higher leverage may exacerbate financial risk. However, for other variables — ownership concentration (*OC*), foreign ownership (*FO*), institutional ownership (*IO*), auditor rotation (*ROTA*), Big Four auditor indicator (*AUD_BIG4*), firm size (*FSIZE*), and revenue growth (*GROWTH*) — the coefficients remain small in magnitude. This suggests that simple linear pairwise relationships are limited and that a multivariate regression framework is better suited to capture their joint effects.

Regarding intercorrelations among the explanatory variables, the coefficients fall within acceptable ranges. The strongest relationship is between institutional ownership (*IO*) and ownership concentration (*OC*), with a coefficient of 0.795. Although relatively high, this value remains just below the commonly cited multicollinearity threshold of 0.80, indicating no immediate concern. Other correlations are modest in magnitude, suggesting a well-behaved set of regressors.

This interpretation is further supported by the VIF results, where all VIF values are below 2. These diagnostics confirm the absence of harmful multicollinearity and validate the suitability of the dataset for subsequent regression analysis. Overall, the correlation matrix provides a stable foundation for the multivariate tests presented in the next section.

4.3. Regression results and discussion

This section reports and discusses the regression results based on the FGLS estimator, which is selected after comparing it with the FEM and REM. Although the Hausman test favors FEM, diagnostic checks reveal heteroskedasticity and first-order serial correlation in its residuals. FGLS is, therefore, adopted as the main estimator because it corrects for these violations and yields more efficient and reliable coefficients. Multicollinearity is not a concern, as all VIF values are well below 2. For completeness, FEM and REM results are provided in Appendix A to support robustness assessment and methodological transparency.

The following tables present: 1) the baseline model, 2) the extended model with the nonlinear specification for ownership concentration (*OC* and OC^2), and 3) the extended model with the nonlinear specification for foreign ownership (*FO* and FO^2). Detailed interpretations are provided in the subsequent subsections.

Table 3. Regression results

Variable	*Coef.*	*St. err.*	*t-value*	*p-value*	*[95% conf. interval]*		*Beta*	*Sig.*
Dependent variable: FP								
OC	0.002	0	7.16	0	0.001	0.003	0.063	***
FO	0.001	0	2.19	0.029	0	0.001	0.01	**
IO	-0.001	0	-3.13	0.002	-0.001	0	-0.028	***
ROTA	0.013	0.004	3.64	0	0.006	0.02	0.008	***
AUD_BIG4	0.014	0.006	2.22	0.026	0.002	0.026	0.008	**
FSIZE	0.011	0.002	5.25	0	0.007	0.015	0.029	***
LEV	-0.059	0.014	-4.11	0	-0.087	-0.031	-0.02	***
GROWTH	0.211	0.185	1.14	0.256	-0.153	0.574	0.005	
Constant	-0.257	0.059	-4.33	0	-0.373	-0.14	0.009	***
Mean dependent var		0.080		SD dependent var.		0.667		
Number of obs.		2052		Chi-square		113.238		

*Note: *** p < 0.01, ** p < 0.05, * p < 0.1. Table 3 reports the FGLS estimates as the main model addressing heteroskedasticity and autocorrelation issues. Comparative results from FEM and REM models are presented in Appendix A for robustness verification.*
Source: Authors' calculations based on data processed using Stata.

Table 4. Regression results with OC^2: Cross-sectional time-series FGLS regression

Variable	Coef.	St. err.	t-value	p-value	[95% conf. interval]		Sig.
Dependent variable: FP							
OC	-0.001	0.001	-1.88	0.061	-0.002	0	*
OC^2	0	0	4.17	0	0	0	***
FO	0.001	0	2.07	0.039	0	0.001	**
IO	0	0	-1.85	0.064	-0.001	0	*
ROTA	0.011	0.004	2.92	0.004	0.004	0.019	***
AUD_BIG4	0.007	0.006	1.08	0.278	-0.006	0.019	
FSIZE	0.01	0.002	4.52	0	0.006	0.014	***
LEV	-0.027	0.015	-1.82	0.069	-0.057	0.002	*
GROWTH	0.27	0.191	1.41	0.158	-0.105	0.644	
Constant	-0.189	0.062	-3.06	0.002	-0.309	-0.068	***
Mean dependent var		0.080		SD dependent var.		0.667	
Number of obs.		2052		Chi-square		68.022	

*Note: *** p < 0.01, ** p < 0.05, * p < 0.1.*
Source: Authors' calculations based on data processed using Stata.

Table 5. Regression results with FO^2: Cross-sectional time-series FGLS regression

Variable	Coef.	St. err.	t-value	p-value	[95% conf. interval]		Sig.
Dependent variable: FP							
OC	0.002	0	7.30	0	0.002	0.003	***
FO	0.002	0.001	3.28	0.001	0.001	0.003	***
FO^2	0	0	-1.76	0.078	0	0	*
IO	-0.001	0	-3.59	0	-0.001	0	***
ROTA	0.014	0.004	3.72	0	0.006	0.021	***
AUD_BIG4	0.014	0.006	2.17	0.03	0.001	0.026	**
FSIZE	0.011	0.002	5.05	0	0.007	0.016	***
LEV	-0.056	0.015	-3.85	0	-0.085	-0.028	***
GROWTH	0.203	0.186	1.09	0.276	-0.162	0.567	
Constant	-0.256	0.061	-4.18	0	-0.376	-0.136	***
Mean dependent var		0.080		SD dependent var.		0.667	
Number of obs.		2052		Chi-square		113.904	

*Note: *** p < 0.01, ** p < 0.05, * p < 0.1.*
Source: Authors' calculations based on data processed using Stata.

4.3.1. Ownership concentration (OC & OC^2)

The empirical estimates in Table 4 indicate a statistically robust nonlinear U-shaped association between ownership concentration and firm performance. The first-order term enters negatively and is marginally significant at the 10% level (β = -0.001, p = 0.061), while the squared term is positive and highly significant at the 1% level (β = 0.000, p < 0.01), suggesting that performance deteriorates as ownership shifts from dispersed to intermediate levels but subsequently improves once ownership becomes highly concentrated. Although the baseline linear specification in Table 3 yields a positive coefficient for *OC* (β = 0.002, p < 0.01), this effect is subsumed by the curvature revealed upon introducing OC^2. Moreover, the standardized beta for *OC* (β = 0.063) underscores the substantive importance of ownership concentration relative to most control variables.

This U-shape is theoretically consistent with the coexistence of early entrenchment and later alignment effects. At intermediate levels of concentration, controlling shareholders may acquire sufficient influence to extract private benefits while lacking strong monitoring incentives. Conversely, at high concentration levels, dominant blockholders internalize the benefits of effective oversight and exert stronger disciplinary pressure on management, consistent with agency theory (Jensen & Meckling, 1976; Shleifer & Vishny, 1997). The upward segment of the curve accords with evidence from emerging markets in which concentrated ownership substitutes for weak external governance (Boshnak, 2025; Wu, 2024; Le & Nguyen, 2024), whereas the initial negative region aligns with entrenchment theory and empirical results in transitional economies such as Indonesia (Pratama, 2019).

Taken together, the significance of both *OC* and OC^2 highlights the analytical necessity of modeling ownership nonlinearity when examining governance-performance linkages in emerging markets. The relatively strong standardized beta in the linear model further indicates that ownership concentration is not only statistically significant but substantively consequential within the Vietnamese institutional context, where marginal shifts in concentrated control may induce salient differences in firm outcomes. Future extensions may explore heterogeneity in the turning point across ownership types or industry characteristics.

4.3.2. Foreign ownership (FO & FO^2)

The regression results provide clear evidence of the positive role of foreign ownership in enhancing firm performance, while also indicating the presence of a nonlinear component that is not sufficiently strong to confirm a complete inverted U-shaped pattern as predicted by *H2*. In the linear specification (Table 3), *FO* enters with a positive and significant coefficient at the 5% level (coef. = 0.001; p = 0.029), and its standardized beta (β = 0.010) suggests a small yet meaningful economic impact. This finding is reinforced in the nonlinear FGLS model (Table 5), where *FO* remains positive and becomes even more significant (coef. = 0.002; p = 0.001). These consistent results underscore the performance-enhancing role of foreign investors, in line with agency theory and empirical evidence

from emerging markets (Pasali & Chaudhary, 2020; Chari et al., 2012) as well as recent studies in Vietnam (Nguyen et al., 2024; Nguyen et al., 2020).

Regarding the nonlinear component, the squared term FO^2 in Table 5 is negative — suggesting an inverted U-shaped tendency — but its marginal significance ($t = -1.76$; $p = 0.078$) is insufficient to establish a statistically robust nonlinear relationship. This limited statistical support contrasts with the stronger and more conclusive inverted U-shaped patterns documented in prior Vietnamese studies, where firm performance peaks at moderate foreign ownership levels such as 43% (Phung & Mishra, 2016), 36.3% (Duong et al., 2021), or within the 0–40% range (Pham & Do, 2023). The mechanisms proposed in these studies — including coordination costs, cultural and managerial frictions, and reduced strategic flexibility at high ownership levels (Tsafack & Guo, 2021; Gurbuz & Aybars, 2010) — remain theoretically relevant but receive only limited empirical support in the present analysis. From a signaling perspective, the strong significance of *FO* in both the linear and nonlinear models is consistent with the notion that foreign investors signal higher governance credibility and reduced information asymmetry in emerging markets. However, because FO^2 is only marginally significant, this positive signaling effect does not translate into a clear nonlinear pattern at higher ownership levels.

Overall, the findings strongly support a positive linear effect of foreign ownership on firm performance, while providing only limited evidence of an inverted U-shaped relationship. This implies that foreign ownership yields substantial benefits at low to moderate levels, but any diminishing returns at higher concentrations are not sufficiently pronounced to assert a stable nonlinear pattern. Future research may employ advanced techniques, such as threshold estimation or ownership-type decomposition, to more precisely identify the optimal foreign ownership level in the Vietnamese context.

4.3.3. Institutional ownership (IO)

The FGLS results in Table 3 show that institutional ownership (*IO*) has a negative and statistically significant effect on firm performance at the 1% level, with a coefficient of -0.001 ($p < 0.01$), thereby providing empirical support for *H3*. The standardized beta ($\beta = -0.028$) further indicates that the negative impact of *IO* is economically meaningful, exceeding the magnitude of most control variables and highlighting its substantive importance. This finding is further reinforced in the extended model, including FO^2 in Table 5, where *IO* remains negative and highly significant. In contrast, the FEM and REM estimates reported in Appendix A yield negative but statistically insignificant coefficients, underscoring that FGLS is the most reliable estimator in the presence of heteroskedasticity and autocorrelation, and confirming that the negative effect of *IO* is the most robust conclusion.

This result contradicts the positive monitoring role predicted by agency theory but is consistent with a substantial body of empirical evidence documenting negative or insignificant effects of institutional ownership. Studies in developed markets such as the U.S., the U.K., and Finland (Tsouknidis, 2019; Faccio & Lasfer, 2000; Bhattacharya & Graham, 2009), as well as emerging markets including Jordan, Bangladesh, and Indonesia (Demsetz & Villalonga, 2001; Al-Najjar, 2015; Sobhan, 2022; Artha et al., 2021), report that passive strategies, short-term orientation, and limited monitoring incentives often weaken institutional investors' governance discipline.

In Vietnam's context, institutional investors are highly heterogeneous: domestic institutions tend to be passive and relationship-based, while foreign institutions face ownership caps and restricted access to corporate information. These institutional and structural constraints help explain why *IO* is associated with poorer firm performance in the empirical results. Overall, the findings emphasize the need to differentiate between the mere presence of institutional ownership and its actual monitoring effectiveness in emerging markets.

4.3.4. Audit firm rotation

The regression results show that audit firm rotation (*ROTA*) has a positive and statistically significant effect on firm performance at the 1% level, with coefficients ranging from 0.011 to 0.014 (centered around 0.013 across specifications), thereby providing robust empirical support for *H4*. The standardized beta for *ROTA* ($\beta = 0.008$) indicates a modest yet economically meaningful impact relative to the control variables, further reinforcing the substantive significance of its positive association with firm performance. This finding suggests that auditor rotation enhances independence and reduces long-term familiarity risks, reinforcing the monitoring effectiveness predicted by agency theory. The result aligns with prior evidence from Italy, Pakistan, Indonesia, and Nigeria, where auditor rotation has been shown to improve reporting reliability and firm outcomes (Corbella et al., 2015; Sattar et al., 2020; Umry & Tjakrawala, 2025; Fasua, 2023). The consistently positive and significant coefficient also reflects a signaling effect, implying that firms may use auditor changes to demonstrate stronger transparency and governance commitment, consistent with the arguments of Shaban and Zarnoun (2024). In Vietnam — where auditor rotation remains largely voluntary, and the audit market is dominated by smaller domestic firms — rotation may function as a self-imposed governance mechanism that compensates for weak enforcement and enhances reporting credibility. This contextual explanation helps clarify why auditor rotation continues to yield performance benefits despite institutional constraints. Overall, the robustness of the results confirms that auditor rotation serves as an effective external monitoring tool, particularly in emerging markets characterized by limited regulatory oversight.

4.3.5. Audit quality: Big Four auditors

The regression results indicate that the Big Four auditor variable (*AUD_BIG4*) has a positive and statistically significant effect on firm performance (coef. = 0.014; $p < 0.05$), thereby providing empirical support for *H5*. This effect remains consistent

across the extended specifications in Tables 4 and 5, further confirming the robustness of *H5*. The standardized beta for *AUD_BIG4* ($\beta = 0.008$) indicates a modest but economically meaningful effect, comparable in magnitude to other monitoring-related variables such as *ROTA*, thereby reinforcing the substantive role of audit quality in shaping firm performance. This finding suggests that Big Four auditors deliver superior monitoring quality due to greater technical capacity, industry specialization, and stronger reputational incentives. The result aligns with existing evidence showing that high-quality auditors help constrain earnings management and enhance financial reporting reliability (Corbella et al., 2015; Sattar et al., 2020). Additional findings from emerging markets further indicate that higher audit quality can compensate for weaknesses in institutional enforcement and elevate reporting credibility (Fasua, 2023). A plausible explanation is that Big Four auditors reduce information asymmetry and strengthen investor confidence more effectively than smaller domestic audit firms. From a signaling perspective, appointing a Big Four auditor may serve as a credible indicator of transparency and accountability, consistent with Shaban and Zarnoun (2024), who emphasize the performance relevance of enhanced disclosure practices. Moreover, the governance framework of Blomson (2023) underscores transparency and information connectivity as essential elements of modern governance systems, indirectly reinforcing the signaling value associated with reputable auditors. Overall, the strong and consistent positive effect observed for *AUD_BIG4* reflects the important external assurance role that Big Four auditors play in emerging markets such as Vietnam, where regulatory oversight remains uneven.

Among the control variables, firm size (*FSIZE*) has a positive and highly significant relationship with firm performance ($\beta = 0.006$; $p < 0.01$), consistent with RDT, which suggests that larger firms benefit from economies of scale, stronger bargaining power, and improved access to financing. Leverage (*LEV*) exhibits a strong negative effect ($\beta = -0.108$; $p < 0.01$), indicating that higher debt burdens intensify financial constraints and risk exposure, thereby reducing firm performance. Revenue growth (*GROWTH*) shows a positive and highly significant association ($\beta = 0.133$; $p < 0.01$), suggesting that sales expansion contributes meaningfully to profitability when supported by operational and capital efficiency. The relatively large standardized beta for *GROWTH* further highlights its substantive economic relevance compared with other control variables.

Overall, the findings indicate that governance mechanisms influence firm performance in distinct and uneven ways. Ownership concentration exhibits a clear U-shaped relationship, while foreign ownership shows a positive linear effect with only limited evidence of an inverted U-shaped pattern. Institutional ownership consistently reduces performance, highlighting weak monitoring incentives among institutional investors in Vietnam. In contrast, external governance mechanisms are more effective: both audit firm rotation and Big Four auditors have strong positive effects, underscoring the importance of credible external assurance in an environment with uneven enforcement. Among the controls, firm size and revenue growth enhance performance, whereas leverage exerts a strong negative impact.

5. CONCLUSION

This study contributes to the corporate governance literature by examining how ownership structures and audit mechanisms jointly influence firm performance in an emerging market, using Vietnam as a representative case. Covering the period 2017–2023 — including the COVID-19 shock — the study provides insights into the effectiveness of governance mechanisms under conditions of heightened uncertainty. By integrating internal governance factors — ownership concentration, foreign ownership, and institutional ownership — with external assurance mechanisms such as audit firm rotation and the use of Big Four auditors as a proxy for high audit quality, the study offers a comprehensive framework that reflects the realities of transitional economies characterized by weak investor protection, concentrated ownership, and evolving regulatory systems.

Empirical results reveal heterogeneous and nonlinear effects across governance mechanisms. Ownership concentration demonstrates a U-shaped relationship with firm performance, suggesting that moderate concentration may weaken monitoring, while high concentration enhances oversight and aligns managerial incentives. Foreign ownership, however, shows a strong positive linear effect and only marginal evidence of an inverted U-shaped pattern, indicating limited support for diminishing returns at higher ownership levels. Institutional ownership, in contrast, shows a consistently negative and significant influence, reflecting the prevalence of passive or state-linked institutional investors who contribute limited monitoring value. Audit firm rotation exerts a positive and significant impact, indicating that even voluntary rotation can strengthen auditor independence and reporting credibility. Big Four auditors further improve firm outcomes, underscoring the importance of high-quality external assurance in an environment with uneven enforcement. For control variables, firm size and revenue growth are positively associated with performance, whereas leverage has a strong negative effect.

Several policy implications arise from these findings. Strengthening minority shareholder protection remains essential, particularly through stricter enforcement against related-party transactions, enhanced disclosure quality, and more effective legal remedies for investor violations. Encouraging long-term and strategic foreign investment — via ownership-limit reform and improved transparency — could magnify governance benefits. Audit oversight should also be reinforced through stronger inspection regimes, partner-level accountability, or consideration of mandatory rotation to improve audit independence. Increasing transparency regarding institutional ownership structure and distinguishing passive, state-affiliated, and strategic investors would enhance accountability and strengthen market discipline.

Despite its contributions, the study faces limitations that offer promising avenues for future

research. A key limitation is the potential endogeneity of ownership structures and audit choices. Ownership concentration, institutional stakes, foreign participation, and Big Four selection may themselves be influenced by firm performance, creating concerns of reverse causality, omitted variable bias, and unobserved heterogeneity. Future research should address endogeneity more explicitly through econometric techniques such as instrumental variable approaches (two-stage least squares/instrumental variables, 2SLS/IV), dynamic panel estimators (system generalized method of moments or Arellano-Bond), or propensity score matching to mitigate self-selection effects. Furthermore, analyzing institutional investors by type, investment horizon, and independence level may reveal more nuanced monitoring behaviors. Expanding performance measures beyond ROE — such as ROA, Tobin's Q, or efficiency metrics — would also enhance generalizability. Lastly, incorporating crisis-specific controls or examining moderating factors such as disclosure quality, industry competition, or regulatory reforms may deepen understanding of how governance and audit mechanisms jointly shape firm outcomes.

Overall, the study shows that while Vietnam's governance environment is gradually improving, its effectiveness remains constrained by concentrated ownership patterns and uneven external oversight. Enhancing the interaction between ownership structures and audit regulation will be central to advancing governance quality and firm performance in emerging markets.

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APPENDIX A

Table A.1. Fixed-effects, random-effects, and FGLS estimates

Variable	*(1)* *FP*	*(2)* *FP*	*(3)* *FP*
OC	0.00980***	0.00201*	0.00197***
	[3.48]	[1.71]	[7.16]
FO	0.00355	0.000940	0.000647**
	[0.95]	[0.62]	[2.19]
IO	-0.00116	-0.00119	-0.000626***
	[-0.53]	[-1.39]	[-3.13]
ROTA	0.0271	-0.0127	0.0132***
	[0.64]	[-0.33]	[3.64]
AUD_BIG4	0.0883	0.0236	0.0137**
	[1.12]	[0.65]	[2.22]
FSIZE	0.0318	0.00767	0.0113***
	[0.66]	[0.83]	[5.25]
LEV	-0.460**	-0.248***	-0.0590***
	[-2.48]	[-3.65]	[-4.11]
GROWTH	0.0318	0.0319	0.211
	[0.03]	[0.04]	[1.14]
_cons	-0.940	-0.0461	-0.257***
	[-0.72]	[-0.18]	[-4.33]
N	2052	2052	2052
R^2	0.014		

*Note: The symbols ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. The values in square brackets represent the corresponding t-ratios.*
Source: Authors' calculations based on data processed using Stata.

Table A.2. Variance inflation factor

Variable	*VIF*	*1/VIF*
OC	2.931	0.341
FO	1.139	0.878
IO	3.049	0.328
ROTA	1.015	0.985
AUD_BIG4	1.022	0.978
FSIZE	1.153	0.868
LEV	1.133	0.883
GROWTH	1.005	0.995
Mean VIF	1.556	0

Table A.3. Hausman specification test

Specification	*Coef.*
Chi-square test value	21.843
p-value	0.005

APPENDIX B

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model:

H_0: sigma(i)² = sigma² for all i
chi² (310) = 2.2e+09
Prob > chi² = 0.0000

Wooldridge test for autocorrelation in panel data:

H_0: No first-order autocorrelation
F (1, 300) = 5.482
Prob > F = 0.0199