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Printed at Economic - Finance Publishing House - Publishing Licence: 487/GP-BTTTT date 28/10/2016
Prints and deposits completed in February, 2026.

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In tại Nhà xuất bản Kinh tế - Tài chính - Giấy phép số: 487/GP-BTTTT ngày 28/10/2016
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RELATIONSHIP BETWEEN INVESTOR BEHAVIOR AND STOCK PRICE OF COMPANIES LISTED ON THE HO CHI MINH STOCK EXCHANGE

PhD. Le Thanh Huyen* - PhD. Tran Thi Thu Trang*

Abstract: *This paper examines the relationship between investor behavior and stock price of companies listed on Ho Chi Minh Stock Exchange (HOSE) over the 10-year period 2014 - 2023. By using the panel ARDL approach, this study provides evidences on negative influence of investor behavior on stock value in both the short-run and the long-run. Additionally, statistically significant effects of some control variables are also indicated, including the negative influence of dividend payout ratio (DPR) and inflation (INF), positive impact of return on asset (ROA). Furthermore, this research shows that the relationship between MA and DP is not bidirectional. Our results can be useful for managers, stockholders, and investors in establishing strategies on their own business.*

• Keywords: *investor behavior, stock price, HOSE*

JEL code: G30

Date of receipt: 05th Nov., 2025

Date of delivery revision: 20th Nov., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.01>

Date of receipt revision: 30th Dec., 2025

Date of approval: 23th Jan., 2026

1. Introduction

The traditional finance argues that stock prices are assumed to be in equilibrium with their intrinsic values, as markets are considered efficient. Nonetheless, various extraordinary market events, including the Great Crash of 1929, the Tronics Boom of the 1960s, the speculative surge during the Go-Go Years, and Black Monday in 1987, have led to abrupt and persistent price movements that undermine the assumption of price-value equilibrium central to traditional finance. In those cases, the theories on financial behavior can suggest important opinions that can explain the unusual fluctuation in capital market. According to Barberis and Thaler (2003), the investor sentiment is reflected in cognitive distortions that influence their behavior and preferences. In fact, the financial behavior does not focus on the fundamental values of securities, it explores the aspect of psychology, and tries to explain reasons of buying or selling stocks of investors. In addition, it digs deeper into their behavioral manifestations based on psychological science, social theory, and finance, thereby explains their unusual reactions. Therefore, recently, numerous scientists agree that the sentiment of participants in market needs to be considered as a determinant of stock price. However, the way to measure investor behavior is still a debatable issue. This factor can be directly evaluated through results of surveys or interviews (Solt & Statman, 1988; Fisher & Statman, 2002; Edmans *et al.*, 2007; Pham *et al.*, 2020). Nevertheless, some other researchers believe

that this sentiment should be indirectly measured based on secondary data like dividend premium, IPO volume, periodic stock trading volume Baker v& Stein (2004), Baker & Wurgler (2006), Liao *et al* (2011) Lee & Swaminathan (2000); Anusakumar *et al* (2017). Each manner of calculation has resulted in different conclusion. As a result, continuing to study investor behavior and its linkage with stock price is necessary.

After 24 years of formation and development, the Vietnam stock exchange has experienced many different periods, such as growth, saturation, decline and recovery stages. A range of studies have indicated that investor sentiment is one of the most important factors driving the decisions in the stock market, thus it needs to be examined in research on determinants of securities value. However, it is necessary that there are more empirical studies on this matter, because in recent years, many problems suddenly appeared, for example, the pandemic COVID 19, temporary disruptions in global supply chains, political conflicts among countries in the world, which triggered dramatic fluctuations in investor behavior, and then Vietnam stock market. In addition, most of research in Vietnam using primary data to measure sentiment, while numerous studies in the world proved advantages of exploiting secondary information in evaluate matter of behavior. This reality leads to an urgent need for research on impact of psychological issue on securities price in Vietnam, helping managers, investors and policymakers to give decisions suitable for their own objectives.

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This research was funded by the National Foundation for Science and Technology Development (NAFOSTED) under Grant No. NCUD.09-2025.37

2. Literature review

In contrast to earlier studies that primarily relied on indirect sentiment proxies such as trading volume, market volatility, or consumer confidence indices, Baker and Wurgler (2007) introduced a novel approach by constructing a composite sentiment index. Their influential work systematically combines multiple sentiment-related variables to better capture the broad shifts in investor mood. Their findings show that investor sentiment has stronger predictive power for the cross-section of stock returns, particularly for speculative and hard-to-value stocks. This contribution marked a significant shift in behavioral finance by offering a more comprehensive and quantifiable tool to assess sentiment in financial markets.

Obamuyi (2013) explored this topic by examining the extent to which investors consider firms' financial factors in their investment decision-making. Using survey data collected from individual investors, the research reveals that financial performance indicators play a significant role in influencing investment choices.

Aboduy et al. (2018) examine how investor sentiment at the firm level affects overnight stock returns. Unlike broader market-level sentiment studies, this paper focuses on firm-specific sentiment, providing a more granular view of how investor mood toward individual companies can influence short-term price movements. The authors find that stocks with high levels of firm-specific sentiment tend to exhibit abnormally high overnight returns, suggesting that sentiment-driven mispricing may occur when the market is closed.

Similarly, Khawaja and Alharbi (2021) investigate the determinants of investor behavior within the context of an emerging Middle Eastern market. The findings reveal that both rational and behavioral elements play a role in shaping investor actions, aligning with the growing consensus in behavioral finance that decision-making is not solely based on fundamental analysis.

Shahid and Abbas (2019) examine the role of corporate governance in shaping investor sentiment in their study. The authors investigate how governance mechanisms such as board structure, transparency, and shareholder rights moderate the relationship between investor behavior and firms' investment decisions. Using empirical data from two major South Asian markets, the study finds that strong corporate governance can mitigate the adverse effects of irrational investor behavior on firm-level decision-making.

Özen (2021) aims to investigate the behavioral factors that influence individual investors' decisions to participate in the stock market. Focusing on the Turkish stock exchange (Borsa Istanbul - BIST), the

research seeks to identify how psychological traits such as overconfidence, risk perception, and financial literacy impact the likelihood of market participation. The study's objective is to better understand the barriers and motivators behind stock market involvement, particularly in the context of an emerging economy, thereby contributing to the broader discourse on behavioral finance and investor engagement.

3. Methodology

3.1. Research model

Our research model is written as follows:

$$Y_{it} = \mu_i + \sum_{j=1}^p \lambda_{ij} Y_{i,t-j} + \sum_{j=0}^q \delta_{ij} X_{i,t-j} + \sum_{j=0}^r \gamma_k T_{ij,t-j} + \varepsilon_{it}$$

Where:

Y : dependent variable of stock price (Market value - MV);

X : independent variable of investor behavior (Dividend premium - DP)

T : a vector of control variables (including return on assets (ROA), leverage (LEV), dividend payment ratio (DPR), inflation (INF), and GDP growth (GDP))

In order to explain both long-term and short-term relationships, the model is typically reformulated as an Error Correction Model (ECM) as follows:

$$\Delta Y_{it} = \phi_i (Y_{i,t-1} - \theta_{0i} - \theta_{1i} X_{i,t-1} - \theta_{2i} T_{i,t-1}) + \sum_{j=1}^{p-1} \lambda_{ij}^* Y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij}^* X_{i,t-j} + \sum_{j=0}^{r-1} \gamma_k^* T_{ij,t-j} + \mu_i + \varepsilon_{it}$$

3.2. Data

Data is gathered from 200 companies listed on HOSE from 2014 to 2023. In order to ensure the reliance of research results, listed companies that are chosen to study, have to meet some following conditions: Being listed on the HOSE since 2013 or earlier, to ensure the availability of long-term data for the research; Publishing enough information, especially financial statements; Not being subject to delisting or prolonged trading suspension, in order to avoid distortions in the research due to technical factors.

3.3. Data analysis and processing

To explore both the short-run dynamics and long-run equilibrium relationship between investor behavior and stock prices, we employ a panel ARDL modeling approach which is based on three estimators, including mean group (MG), pooled mean group (PMG) and dynamic fixed effect (DFE). The best estimator among the three approaches was selected based on Hausman MG test.

In order to reach reliant empirical results, in our research, some tests are carried out, including unit root tests, panel co-integration tests.

3.4. Measurement of variables

Table 1: Variables measurement

Variable	Measurement
Stock price (Market value -MV)	$P_{avg} = \frac{\sum_{t=1}^N P_t}{N}$ P_{avg} : the average of market value of stock P_t : The closing price of the stock on trading day t N : The number of trading days in a year (typically around 250 days on the HOSE)
Investor behavior (Dividend Premium - DP)	$DP = \frac{\sum_{i=1}^M \frac{P_i}{B_i} \text{ dividend}}{N_{\text{dividend}}} - \frac{\sum_{i=1}^M \frac{P_i}{B_i} \text{ non-dividend}}{N_{\text{non-dividend}}}$ $\frac{P_i}{B_i}$ dividend: The average price-to-book ratio of dividend-paying companies $\frac{P_i}{B_i}$ non-dividend: The average price-to-book ratio of non-dividend-paying companies N_{dividend} : Number of dividend-paying-companies $N_{\text{non-dividend}}$: Number of non-dividend-paying-companies
ROA	$\frac{\text{Net income}}{\text{Average total assets}}$
LEV	$\frac{\text{Total liabilities}}{\text{Total assets}}$
DPR	$\frac{\text{Dividends paid}}{\text{Net income}}$
INF	Consumer price index

4. Empirical result

4.1. Descriptive statistics

Table 2: Summary of descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
MV	2,000	27826.19	27331.2	1275	241325
DP	2,000	-0.616085	2.530523	-8.157426	0.5602669
DPR	2,000	0.0025579	0.0242292	-0.031567	1.062774
LEV	2,000	0.4601619	0.211	0.0026735	1.294471
ROA	2,000	0.121312	0.1740152	-1.898423	3.275811
INF	2,000	2.870187	0.9397099	0.6312009	4.084554

Source: Author's calculations based on data analysis using Stata 14

Table 2 shows that the average MV is 27826.19 with the clear difference between maximum and minimum values, indicating the big gap of development among companies listed on HOSE from 2014 to 2023. In fact, in every period, Vietnam's stock market relied on a few large enterprises, that contributed a lot to important indexes like VN-index, VN30-index, while business status of some other companies was not really good. This difference was one of causes making Vietnam stock market still significant volatile and sensitive to changes of both internal and external factors.

The mean value of dividend premium is negative, implying that the average price-to-book ratio of non-dividend-paying companies outweighed that of dividend-paying companies. This result comes from the fact that a lot of companies followed the non-dividend-paying policies in the study period. It is the reason why the value of dividend payout ratio (DPR) is rather low.

4.2. Preliminary tests

4.2.1. Cross - sectional dependence test

Table 3: Cross-sectional dependency test results

Variables	CD test (Pesaran)	p-value	Conclusion
MV	68.524	0.00000	Cross-sectional dependence
DP	459.511	0.00000	Cross-sectional dependence
DPR	9.988	0.00000	Cross-sectional dependence
LEV	8.998	0.00000	Cross-sectional dependence
ROA	33.413	0.00000	Cross-sectional dependence
INF	459.511	0.00000	Cross-sectional dependence

Source: Author's calculations based on data analysis using Stata 14

Table 3 presents the results of the Pesaran CD test, which confirm the presence of cross-sectional dependence across all variables (p-value < 0.05).

4.2.2. Unit root test

Table 4: CIPS test results

Variables	CIPS Statistic	First difference	Conclusion
MV	-2.25*		I(0)
DP	-2.28*		I(0)
DPR	-2.50**		I(0)
ROA	-2.10	-3.5***	I(1)
LEV	-2.30*		I(0)
INF	-2.15	-3.2**	I(1)

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively (p < 0.10, p < 0.05, p < 0.01).

Source: Author's calculations based on data analysis using Stata 14

The stationarity properties of the variables were tested using the CIPS unit root test, with results presented in Table 4. The variables Market Value (MV), Dividend Premium (DP), Dividend Payout Ratio (DPR), and Leverage (LEV) exhibit CIPS statistics of -2.25, -2.28, -2.50, and -2.30, respectively, rejecting the null hypothesis of a unit root at the 10% or 5% significance levels, indicating they are integrated of order zero, I(0). Conversely, Return on Assets (ROA) and Inflation (INF), with CIPS statistics of -2.10 and -2.15, are non-stationary at level. However, their first differences yield statistics of -3.50 and -3.20, significant at the 1% and 5% levels, respectively, confirming they are integrated of order one, I(1). These findings guide the subsequent modeling approach, particularly the need for cointegration analysis for I(1) variables in the Panel ARDL framework.

4.3. Panel ARDL estimation

Table 5: Panel ARDL estimation results

Biến	Pooled Mean Group		Mean Group		Dynamic Fixed Effect	
	Long Run	Short Run	Long Run	Short Run	Long Run	Short Run
Error correction		-0.257*		-0.221*		-0.183*
ΔDP		-0.114**		-0.092		-0.073
ΔDPR		-0.076*		-0.064*		-0.050
ΔROA		0.313*		0.394*		0.156*
ΔLEV		-0.128		-0.025		-0.112
ΔINF		-0.017		-0.046		-0.034
DP	-0.329**		-0.155*		-0.175	
DPR	-0.217*		-0.286*		-0.251	
ROA	0.428**		0.501**		0.412**	
LEV	-0.079		-0.062		-0.049	
INF	-0.348*		-0.214*		-0.189	
Constant	4.007*		5.551*		3.325*	
Observations	2000		2000		2000	
Hausman Test	PMG vs. MG p-value: 0.3537		MG vs. DFE p-value: 0.8215		DFE vs. PMG p-value: 0.2316	

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively (p < 0.10, p < 0.05, p < 0.01).

Source: Author's calculations based on data analysis using Stata 14

The error correction term (ECT) coefficient indicates whether, if the equilibrium is left, it will approach to equilibrium level in the long run or not. In this regard, it converges to the equilibrium level in the long run if the ECT coefficient is between 0 and -1 (Uzar, 2020). As can be seen from the Table 6, the values of ECT in all three models are significant negative, confirming a

stable long-run relationship, with speeds of adjustment ranging from -0.257 to -0.183.

The Hausman and Taylor (1978) test reveals that PMG is the more efficient estimator than MG and DFE in this study.

In the short run, the dividend premium (DP), representing investor behavior, has a statistically significant negative impact on stock prices at the 5% level. This suggests that an increase in investor sentiment, as captured by a higher DP, is associated with a short-term decline in stock prices. The factor of dividend payout ratio (DPR) also causes a significant negative effect on independent factor. By contrast, the influence of return on asset (ROA) is significant positive at the 5% level. The other control variables, including leverage and inflation, do not exhibit a strong impact on the stock prices of companies listed on HOSE during the period from 2014 to 2023.

In the long run, the effect of DP also is significant negative. Similarly, the regression results indicate that the rise in DPR and INF are associated with declines in firm stock values. Meanwhile, higher Return on Assets (ROA) contributes positively to firm stock performance, indicating that enhanced profitability supports stock price growth.

4.4. Granger - Causality test result

Table 6: Results of panel causality test

Causality direction	Z-statistics	p-value	Result	Conclusion
MV → DP	0.7773	0.2904	No	MV does not cause DP
DP → MV	-3.5132	0.0010	Yes	DP causes MV

Source: Author's calculations based on data analysis using Stata 14

Finally, the panel causality test of Dumitrescu Hurlin is used to evaluate the causal nexus among the studied variables. The result of this causality test is presented in Table shows that the link between stock price and investor behavior is not a bidirectional relationship. The variable of DP causes MV, but MV does not determine investor behavior.

5. Conclusion and discussion

In conclusion, with the data gathered from 200 companies listed on Ho Chi Minh Stock Exchange in the 10-year period from 2014 to 2023, we explore the relationship between investor behavior and stock price. The results of empirical study indicate some issues as follows:

First, the analysis confirms the existence of a negative relationship between investor behavior and stock prices, observed consistently in both the short-run and long-run estimations. The empirical result shows that after the first period of being attracted to companies with high dividend ratio, a lot of investors became more precautions with them. This phenomenon could come from the effect signal, it means that within a short period, investors were more interested in dividend-paying companies, making their stock price

increase. However, from 2014 to 2023, numerous firms listed on HOSE used retained profit to expand their business, instead of paying dividend, which leading to the fall in the average of MV. Moreover, from the long-term perspectives, investors could assess that the market value of those firms were being overestimated, and the fact that a large part of the net income was used to pay dividend decreased the firm development potentials. This thought made the value of stock price lower in long run.

Second, the link between stock price and investor behavior is not a bidirectional relationship, it means that investor sentiment can change the market value of companies, and from 2014 to 2023, but the stock price did not determine the behavior of participants in stock market for listed companies.

Third, in both short run and long-run, dividend payout ratio negatively affects stock value, while the influence of ROA is positive. The impact of the dividend payout ratio (DPR) is similar to that of the dividend premium (DP). This result suggests that investors appeared to prioritize the future growth potential of firms. Consequently, an increase in dividends was perceived as a policy that might constrain business expansion, leading investors to adopt a more cautious approach toward their investments. By contrast, it seems that many people appreciated the factor of financial performance, so an increase in ROA could lead to an improvement in stock price.

Fourth, the factor of inflation impacts negatively the stock value in the long run. This influence may be attributed to heightened risk aversion among investors, particularly during the 2014-2023 period, which was marked by considerable volatility in the Vietnamese stock market. These fluctuations were driven by a series of unforeseen events, including the global COVID-19 pandemic and high-profile corporate scandals, such as the case involving Mrs. Truong Thi Mi Lan. As a result, when the inflation climbed, the sentiment of investors became negative, and lower capital was poured in the market.

In conclusion, the stock price could be determined by investor sentiment, dividend payout ratio, ROA and inflation rate, in which the policy of high dividend appeared ineffective, while a good financial performance can draw attention of people to listed companies.

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ASSESSING THE IMPACT OF DIGITAL TRANSFORMATION ON THE EFFECTIVENESS OF PUBLIC INVESTMENT PROJECT MANAGEMENT IN VIETNAM

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Abstract: *This study examines how digital transformation enhances the effectiveness of public investment project management in Vietnam amid ongoing public governance reforms and public sector modernization. Grounded in institutional capacity theory and a results-based management approach, the study elucidates the mechanisms through which digital transformation via key tools such as project management information systems, shared data platforms, Building Information Modeling (BIM), and Geographic Information Systems (GIS) - affects information transparency, schedule and cost control, accountability, and inter-agency coordination in public investment project management. The research adopts a qualitative mechanism-based methodology, combining case studies with international comparative evidence and drawing on secondary data from policy reports, academic literature, and reliable practical sources. The findings indicate that digital transformation contributes to shorter project implementation timelines, improved cost control, and enhanced real-time monitoring; however, its effectiveness depends substantially on institutional readiness, human resource capacity, and the coherence of the regulatory framework. By providing evidence from an emerging economy context, the study enriches the literature on public investment project management and digital transformation, while offering practical governance implications for the design and implementation of digital transformation programs aimed at improving public investment project performance.*

• Keywords: digital transformation; science and technology; BIM; GIS; BIM-GIS; public policy.

Date of receipt: 25th Oct., 2025

Date of delivery revision: 04th Nov, 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.02>

Date of receipt revision: 30th Dec., 2025

Date of approval: 22th Jan., 2026

1. Introduction

The Fourth Industrial Revolution is accelerating digital transformation worldwide, fundamentally reshaping organizational structures, operational processes, and management practices across various socio-economic sectors (Chen et al., 2025). In this context, project management is increasingly influenced by digital technologies, including artificial intelligence, big data analytics, the Internet of Things, Building Information Modeling (BIM), and digital project management platforms. These technologies are expected to enhance information accuracy, improve transparency, and support data-driven decision-making. Notably, digital transformation is typically executed through designated projects, rendering project management a vital factor in the success of digital initiatives (Chen et al., 2025).

Despite technological advances, international experience shows that the effectiveness of

public investment project management remains a persistent challenge. Large-scale infrastructure projects often face schedule delays and cost overruns, increasing fiscal burdens and reducing investment efficiency. A seminal study by Cantarelli et al. (2013) reports that approximately 86% of major projects exceed their initial cost estimates, with an average overrun of about 28%. These problems are compounded by limited information transparency and weak monitoring mechanisms, leading to suboptimal resource allocation and eroding public trust in public investment projects (Cantarelli et al., 2013). In essence, deficiencies in data availability, information quality, and oversight capacity are widely regarded as core factors underlying the failure of many public projects to achieve their intended objectives.

Against this backdrop, digital transformation has emerged as a fundamental strategy for

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enhancing efficiency and transparency in the management of public investment projects. An increasing body of international empirical evidence indicates that the adoption of digital project management technologies can substantially improve project outcomes. For instance, the implementation of Building Information Modeling (BIM) has been demonstrated to reduce project completion durations by approximately 20 percent and decrease costs by around 15 percent, primarily through the minimization of design errors and the enhancement of coordination during construction (Das et al., 2025). Moreover, digital project management platforms facilitate real-time information sharing, thereby promoting transparency, reducing misunderstandings among stakeholders, and improving coordination efficiency. Advanced digital tools also augment monitoring and accountability by publicly disclosing project progress and data, enabling stakeholders to promptly identify and address emerging issues (Zhang, 2024).

In Vietnam, the management of public investment projects holds a crucial position in fostering socio-economic development. Nonetheless, the sector continues to encounter challenges similar to those experienced internationally. Numerous state-funded projects encounter extended implementation schedules, escalating costs, and a lack of transparency. Monitoring and evaluating projects predominantly rely on manual, fragmented processes, resulting in data that is unstandardized and poorly integrated, thereby limiting cross-project learning and evidence-based decision-making. In response, the Vietnamese government has implemented a series of policies aimed at advancing digital transformation within public investment project management. Notably, these policies highlight the phased adoption of Building Information Modeling (BIM) and its integration with Geographic Information Systems (GIS) in key projects, with the objective of standardizing data, improving transparency, and reducing risks associated with project execution.

Nevertheless, academic research examining the specific impact of digital transformation on the effectiveness of public investment project management in Vietnam remains limited, particularly in mechanism-based analyses within an emerging economy context. Accordingly,

this study seeks to systematically examine how digital transformation improves the effectiveness of public investment project management in Vietnam, focusing on key dimensions such as information transparency, schedule control, and cost management. By combining international comparative insights with empirical evidence from Vietnam, the study aims to provide academically grounded evidence and policy-relevant implications to support the design and implementation of digital transformation initiatives in public investment project management.

2. Theoretical background and research questions

Public investment project management is widely regarded as a high-risk domain, influenced by technical, financial, institutional, and political factors. A substantial body of research indicates that public investment projects - particularly in developing and emerging economies - frequently experience schedule delays, cost overruns, and limited information transparency, largely due to fragmented data systems and weak monitoring mechanisms (Flyvbjerg, 2014). These shortcomings not only reduce the efficiency of public resource use but also undermine societal trust in government-led investment programs.

From a theoretical perspective, contemporary project management approaches emphasize the central role of data availability, information transparency, and accountability in enhancing project effectiveness. Under a results-based management framework, project performance depends heavily on the ability to collect, process, and share timely, reliable information among stakeholders throughout the project life cycle (PMI, 2021). In traditional project management models, project data are often fragmented across phases and organizational actors, which exacerbates information asymmetry, constrains effective oversight, and creates conditions for discretionary adjustments. These weaknesses are commonly identified as key drivers of cost overruns and implementation delays in public investment projects (Flyvbjerg, 2014).

Digital transformation is increasingly viewed as a governance mechanism that addresses these limitations through data digitization, process standardization, and system integration. Digital project management platforms enable

the establishment of centralized information systems in which schedule, cost, and quality data are continuously updated, and decision-making processes are fully traceable. This approach enhances transparency, reduces information asymmetry, and strengthens accountability in public investment project management. Building on standardized datasets, big data analytics further enable the exploitation of historical project information to identify recurring risk patterns, thereby supporting early detection of potential delays or budget overruns and enabling timely managerial intervention (PMI, 2021).

Advances in artificial intelligence and the Internet of Things further extend project management capabilities from reactive control toward predictive governance. In the context of large-scale, complex public investment projects, these technologies enable real-time site monitoring, early detection of technical anomalies, and proactive management of safety risks, thereby improving the quality and reliability of management data (Elrifae, 2025). In the construction sector, Building Information Modeling (BIM) is widely recognized as a core pillar of digital project management. BIM integrates geometric, technical, scheduling, and cost information into a unified model across the entire project life cycle, from design through operation (ISO, 2018). Empirical studies show that BIM adoption reduces design errors, enhances inter-organizational coordination, shortens construction duration, and supports appraisal and supervision processes in public investment projects (Wang et al., 2025).

Notwithstanding the well-documented potential of digital transformation in the management of public investment projects, scholarly literature consistently underscores that successful implementation outcomes depend on institutional capacity and human resources. Digital technologies can generate value only when integrated within an enabling legal framework, supported by standardized data protocols, and managed by personnel with adequate skills. In emerging economies, digital transformation in project management often exhibits uneven development, resulting in fragmented technological solutions that fail to achieve systemic improvements in governance (Suhari et al., 2024).

In Vietnam, although the policy framework for digital transformation and BIM adoption in public investment has gradually strengthened, academic research remains limited in providing systematic analyses of the mechanisms through which digital transformation affects the effectiveness of public investment project management. In particular, there is a lack of empirical and conceptual evidence clarifying how digital technologies influence transparency, schedule and cost control, and decision-making capacity under the institutional conditions of an emerging economy. Against this backdrop, the present study seeks to address the following research questions:

- (i) Through which mechanisms does digital transformation affect the effectiveness of public investment project management in Vietnam?
- (ii) What roles do data, digital technologies and institutional capacity play in shaping these mechanisms?

3. Methodology

This study adopts a qualitative, mechanism-based analytical approach to examine how digital transformation enhances the effectiveness of public investment project management in Vietnam. This approach enables not only an assessment of whether digital transformation improves project management outcomes but also an explanation of how these effects are generated through specific mechanisms within the institutional context of an emerging economy, in line with the stated research questions.

Drawing on theories of data-driven project management and institutional capacity, the study develops an analytical framework in which digital transformation is the explanatory factor, project management effectiveness is the outcome, and digital technologies are the intermediate mechanisms. The analysis focuses on four core mechanisms: (i) enhanced project information transparency through data digitization and standardization; (ii) improved schedule and cost control through analytical and forecasting tools; (iii) strengthened technical and safety supervision through Internet of Things technologies; and (iv) improved inter-agency coordination and decision-making quality through BIM-GIS integration and digital project management platforms (PMI, 2021; Suhari et al., 2024).

The study relies on secondary data from high-reliability sources, including policy and legal documents on digital transformation and public investment project management in Vietnam; aggregated data on technology adoption across project types, ministries, and localities; and selected case studies of public investment projects that have implemented digital technologies, such as Ho Chi Minh City Metro Line 1, the Xuyen Tam Canal project, and several major transport infrastructure projects. Together, these sources capture institutional conditions, the extent of digital transformation implementation, and observed project management outcomes in practice.

Data analysis integrates qualitative content analysis, comparative analysis across project groups with varying levels of technology adoption, and mechanism tracing for selected representative cases. This integrated approach identifies linkages among digital technologies, data use, and project management effectiveness, and explains why the impacts of digital transformation differ across project types, sectors, and local governments. Although triangulating multiple data sources and analytical techniques enhances the robustness of the findings, the study is constrained by the limited availability of standardized quantitative data. Accordingly, the analysis emphasizes mechanism-based interpretation and analytical generalization, providing a foundation for future research employing quantitative or mixed-methods designs.

4. Results

The findings indicate that digital transformation positively affects the effectiveness of public investment project management in Vietnam; however, the magnitude of this effect varies substantially across project types and institutional contexts. Analysis of aggregated data and representative cases (Table 1) shows that the impact of digital transformation is realized through four main mechanisms: information transparency, schedule and cost control, technical and safety supervision, and improved coordination and managerial decision-making.

First, digital transformation enhances transparency in project management. Projects with high levels of BIM adoption and digital project management platforms show markedly

higher transparency due to data digitization and standardization, which reduces information asymmetry among stakeholders (Table 1). In contrast, projects with fragmented or partial technology adoption continue to face dispersed data and limited accountability.

Second, digital transformation improves schedule and cost control. The application of BIM and data analytics tools supports schedule simulation and early identification of risks of delays and budget overruns, particularly in large-scale, complex projects (Table 1). Without lifecycle-wide data integration, control over time and cost remains largely dependent on manual reporting.

Third, technologies such as IoT and BIM-GIS strengthen technical supervision and safety management. Real-time field data improve quality control, occupational safety, and asset management, particularly in major transportation and urban infrastructure projects (Table 1). Projects without real-time data continue to face higher technical risks and information inconsistencies.

Table 1: Level of digital technology adoption in public investment project management in Vietnam

Project / Project Group	Location	Project Type	Implementation Stage	BIM	BIM-GIS	AI / Big Data	IoT	Key Outcomes
Metro Line 1 (Ben Thanh-Suoi Tien)	Ho Chi Minh City	Urban transport infrastructure	Design → Construction → Operation	High	Medium	High	Medium	Integrated asset management; enhanced transparency; data-driven operation and maintenance
Xuyen Tam Canal Project	Ho Chi Minh City	Urban / technical infrastructure	Design → Construction	High	Low	Low	Low	Improved design and construction quality; better schedule and cost control
Coastal Quang Ngai Ecotown	Quang Ngai	Urban / residential	Conceptual design	High	Low	Low	Low	Standardized design documentation; reduced technical errors
National-level transport / PPP projects	Nationwide	Transport infrastructure	Preparation → Construction	High	Pilot	Medium	Medium	Standardized project data; improved appraisal and supervision
Railway projects (BIM standardization)	Nationwide	Rail transport	Data standardization	Medium	Pilot	Low	Low	BIM data standardization; foundation for lifecycle management
Smart industrial parks (typical cases)	Binh Duong, Bac Ninh	Industrial infrastructure	Design → Construction → Operation	High	High	High	High	Integrated lifecycle management; real-time monitoring; optimized costs and energy use
Small- and medium-scale construction projects	Multiple localities	Civil / small-scale infrastructure	Design / Construction	Low	Low	Low	Low	Fragmented application; limited value added

Source: Compiled by the author

Finally, digital transformation improves inter-agency coordination and the quality of decision-making. Local governments and projects with shared data platforms and stronger digital capacity achieve significantly better coordination and managerial decisions than those constrained by limited infrastructure and human resources (Table 2).

Table 2: Status of science, technology and digital transformation adoption across ministries and local governments

No.	Ministry / Locality	Technology Application	Digital Transformation Status	Maturity Level	Key Constraints
1	Ministry of Construction	BIM standards, construction simulation	Pilot sectoral databases, online public services	Medium-High	Fragmented data, slow standardization
2	Ministry of Transport	IoT for bridge/road monitoring, GIS	50-70% digitized processes	High	Limited inter-departmental integration
3	Ministry of Natural Resources and Environment	Satellite observation, base maps	Land database in 70% of provinces	High	Weak system interoperability
4	Ministry of Health	AI diagnostics, electronic medical records	90% electronic health records	High	Infrastructure gaps across levels
5	Ministry of Education and Training	LMS, online learning platforms	70% standardized education database	Medium-High	Large scale, coordination challenges
6	Hanoi	Smart IOC, AI-based surveillance	Fully online public services, open data	High	Integration complexity
7	Ho Chi Minh City	Big data for transport, environment	Multiple citywide digital platforms	High	Legacy system constraints
8	Da Nang	Smart city, IoT-based sensing	Advanced e-government	Very high	Limited scalability
9	Binh Duong	Industry 4.0, digital planning	High enterprise digitalization	Medium-High	Digital skills shortages
10	Can Tho	Agri-tech, environmental monitoring	Expanding online public services	Medium-High	Uneven infrastructure

Source: Compiled by the author

Overall, the results (Table 3) indicate that digital transformation does not affect project management effectiveness in a linear manner. The greatest performance gains are observed in projects that implement digital transformation in an integrated manner, combining technology adoption, standardized data, and adequate institutional capacity.

Table 3: Digital transformation impacts by project management mechanism

Impact Mechanism	Related Technologies	Management Outcomes
Information transparency	BIM, PMIS	Reduced information asymmetry
Schedule and cost control	BIM, Big Data	Fewer delays and cost overruns
Technical supervision	IoT, BIM-GIS	Improved safety and quality
Coordination and decision-making	Integrated digital platforms	Enhanced governance effectiveness

Source: Compiled by the author

5. Discussion

The findings confirm that digital transformation plays a significant role in improving the effectiveness of public investment project management in Vietnam. However, its impact is not automatic; it

is mediated by intermediate mechanisms involving data, processes, and institutional capacity. This result aligns with theoretical perspectives that view digital transformation as a governance reform process rather than the mere adoption of isolated technologies.

First, with respect to information transparency, the results show that projects employing BIM and digital project management platforms achieve substantially higher levels of transparency. This finding aligns with OECD (2025), which emphasizes that data and process digitalization reduce information asymmetry and strengthen accountability in public investment. In the Vietnamese context, where project data remains fragmented across agencies and administrative levels, digital transformation facilitates the creation of shared data sources, thereby weakening long-standing bottlenecks in public project governance.

Second, with respect to schedule and cost control, the study provides clear evidence that digital transformation improves project performance, particularly in large-scale, complex public investment projects. Specifically, projects in the sample that adopted BIM and data analytics recorded an average reduction in implementation time of 12-15% and a 10-12% decrease in investment costs compared with traditionally managed projects. These improvements align with international evidence. Das et al. (2025) report that BIM adoption can reduce project duration by around 20% and costs by approximately 15% through early detection of design conflicts and improved coordination. At the organizational level, Chen et al. (2025) find that 68% of organizations implementing digital transformation report significant schedule improvements, while 38% report noticeable cost reductions. At the macro level, McKinsey estimates that comprehensive adoption of existing digital technologies could reduce capital investment costs by up to 45% relative to traditional approaches (Blanco et al., 2017).

Third, regarding technical supervision and safety, the results reinforce international evidence that technologies such as IoT, BIM-GIS, and real-time digital monitoring enhance on-site control and reduce technical risks (Daniel et al., 2025; Zavaleta, 2025). The fact that many projects in Vietnam have only piloted these technologies suggests substantial potential for further

improvement, while also highlighting constraints related to data standards and operational capacity.

Fourth, the study indicates that coordination effectiveness and decision-making quality depend strongly on institutional readiness and local digital capacity (Chen et al., 2025). This finding aligns with Suhari et al. (2024), who argue that digital transformation generates value only when supported by appropriate governance structures and inter-agency coordination mechanisms. In Vietnam, disparities across localities indicate that digital transformation is progressing unevenly in depth, thereby widening gaps in project management effectiveness.

Taken together, the findings suggest that digital transformation affects the effectiveness of public investment project management through a set of interconnected mechanisms in which technology, data, and institutions mutually reinforce one another. This implies that policies promoting digital transformation should adopt an integrated approach, avoiding fragmented or technology-centric strategies.

6. Conclusion

This study examines the impact of digital transformation on the effectiveness of public investment project management in Vietnam, using a mechanism-based analytical approach and benchmarking the findings against international evidence.

Empirical evidence from the Vietnamese context confirms that the positive effects of digital transformation are real but uneven across project types, sectors, and localities. Projects with high levels of technological adoption and integration - particularly those implementing BIM, BIM-GIS, and digital project management platforms - show marked improvements in transparency and schedule-cost control. In contrast, projects with fragmented technology adoption and weak data standardization achieve only limited performance gains. These findings indicate that the effectiveness of digital transformation depends critically on institutional readiness, human resource capacity, data standardization and interoperability, and the coherence of the legal and regulatory framework.

Compared with international experience, the results align with the broader trends documented in OECD reports and observed in leading countries.

Digital transformation delivers its greatest benefits when implemented as a comprehensive governance strategy that integrates technological adoption with institutional reform and workforce development, rather than as isolated technological initiatives at the project level.

From an academic perspective, this study contributes to the literature by clarifying the mechanisms through which digital transformation affects the effectiveness of public investment project management in an emerging economy. From a practical standpoint, the findings offer important policy implications for decision-makers, highlighting the need to strengthen legal frameworks, standardize and integrate data systems, and enhance managerial and technical capacity to fully realize the potential of digital transformation in public investment project management.

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ANALYSIS OF THE IMPACT OF STATE BUDGET REVENUE ON GROSS REGIONAL DOMESTIC PRODUCT IN THE CONTEXT OF DIGITAL TRANSFORMATION IN VIETNAM

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Abstract: *This study investigates the impact of state budget revenue on Gross Regional Domestic Product (GRDP) within the context of digital transformation in Vietnam. Using panel data from five major cities over the period 2015-2021, the research applies the Pooled Ordinary Least Squares (POLS) model to estimate the relationship between fiscal capacity and regional economic growth. The empirical findings demonstrate that state budget revenue exerts a significantly positive effect on GRDP, thereby confirming its crucial role in promoting regional economic performance. Furthermore, variables representing the digital environment and digital transformation are also found to contribute positively to local economic growth, highlighting the importance of technological modernization in enhancing fiscal efficiency and growth dynamics. These results imply that state budget revenue, when efficiently mobilized and allocated in alignment with digital transformation strategies, can serve as a pivotal instrument to foster sustainable regional development. Policy recommendations are proposed accordingly.*

• Keywords: state budget revenue, gross regional domestic product, digital transformation, Vietnam.

Date of receipt: 08th Nov., 2025

Date of delivery revision: 02th Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.03>

Date of receipt revision: 10th Dec., 2025

Date of approval: 20th Jan., 2026

1. Introduction

State budget revenue constitutes a fundamental component of public finance and plays a decisive role in shaping the economic development trajectory of nations and regions. In essence, state budget revenue refers to the total financial resources collected by government authorities through taxation, fees, charges, and other lawful contributions, which are then allocated to fund public expenditures. It not only ensures the functioning of the state apparatus but also provides the fiscal foundation for public investment in infrastructure, education, healthcare, and other socio-economic activities. Within the Vietnamese context, state budget revenue is particularly critical for regional development, as it supports both short-term stabilization measures and long-term strategies to foster inclusive growth.

Parallel to this, Gross Regional Domestic Product (GRDP) is widely recognized as a key indicator reflecting the overall economic performance of a locality. It measures the total value of goods and services produced within a specific region over a defined period, thereby capturing the scale and efficiency of economic activities at the subnational level. Unlike national GDP, GRDP emphasizes

local productivity, competitiveness, and structural transformation, which are increasingly relevant for policy formulation in decentralized economies such as Vietnam. Understanding the determinants of GRDP growth, particularly the role of fiscal capacity, is therefore essential for both scholars and policymakers.

The mechanism through which state budget revenue influences GRDP is multifaceted. On the one hand, higher fiscal revenue expands the government's ability to finance productive public expenditures, including investments in infrastructure, technological innovation, and social welfare, which directly enhance regional productivity. On the other hand, budget revenue can indirectly stimulate private sector activities by improving institutional quality, reducing transaction costs, and creating a favorable business environment. However, the effectiveness of these mechanisms depends largely on how revenues are mobilized and allocated. Excessive reliance on distortionary taxes or inefficient spending patterns may, conversely, impede growth. Hence, empirical research is required to disentangle the net effect of state budget revenue on regional economic performance.

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In recent years, the wave of digital transformation has introduced new dynamics into this relationship. Digital transformation, understood as the adoption of digital technologies and digital governance in economic and administrative processes, has significantly altered the way state revenues are mobilized and managed. E-government platforms, digital tax administration, and data-driven public finance management enhance transparency, efficiency, and accountability, thereby increasing the effectiveness of budgetary policies. Moreover, digital transformation improves the productivity of regional economies by fostering innovation, facilitating connectivity, and expanding access to new markets. Consequently, the interplay between fiscal revenue and digital transformation is emerging as a crucial determinant of local economic growth in Vietnam.

Against this backdrop, analyzing the impact of state budget revenue on GRDP in the context of digital transformation becomes highly significant. Such an inquiry not only provides empirical evidence on the effectiveness of fiscal policy at the regional level but also highlights the enabling role of digital transformation in strengthening the growth-enhancing effects of budget revenues. The findings bear important implications for policymakers, particularly in designing strategies that optimize the mobilization and allocation of fiscal resources while simultaneously accelerating digital adoption. By integrating fiscal efficiency with digital transformation, Vietnam can build a more resilient and sustainable growth model for its local economies.

The presentation unfolds through a well-structured progression. Following the introductory remarks, an integrative review of existing literature is undertaken, setting the foundation for the inquiry. Subsequently, the processes of dataset compilation and methodological design are outlined with clarity and rigor. The next part presents and interprets the empirical findings, linking them directly to the research objectives. Finally, the paper concludes by advancing policy recommendations aimed at fostering Vietnam's economic growth in the coming years.

2. Literature review

The topic of the relationship of state budget revenue and local economic growth has attracted the attention of many researchers. Sunarsih (2015) aimed to determine the effect of Sectoral Gross Regional

Domestic Product on the local revenue district/city in Central Java province in 2011-2012. One indicator of success in the implementation of macro development was economic growth. The rate of economic growth into one of the essential purposes of local government and central government. Regional development was expected to have a positive impact on the growth of the national economy. Regional economic growth could be reflected in changes in the Gross Regional Domestic Product in the region. This study used multiple regression to test the hypothesis. The results showed that only the tertiary sector was positive and significant effect on the local revenue. While the primary sector and the secondary sector had no effect on local revenue due to the primary sector and the secondary sector more in contact with the base of the central government revenue and/or provincial governments.

A discussion on the relationship among some macro economics including budget and gross regional domestic products is executed by Husein & Cahyadi (2021). This study aimed to analyze the influence of Gross Regional Domestic Product, BI rate, and unemployment on inflation in Aceh Province. The data used were secondary data sourced from the Central Bureau of Statistics of the Republic of Indonesia in 2000-2015. The data analysis method used was the Error Correction Model. The results of the study indicated that: independent variables were positive and significant on inflation, but only the GRDP variable is not significant.

Usmansyah & Sungkowati (2022) confirmed that Gross Domestic Product (GDP) was influenced by investment, public consumption, and economic growth. Tax revenue was influenced by taxpayer compliance and tax administration system, and economic growth. In order to know how far GDP and Tax Revenue affect Tax Ratio, an analysis was carried out based on available data and using multiple linear regression and test of multicollinearity to conclude the relationship between GDP and State Revenue to Tax Ratio. The more State Revenue increased, the more tax ratio increased. Its consequence was to increase state revenues, especially tax revenues, taxation policies must be formulated that refer to taxpayer compliance, the taxation system, including tax intensification and extensification measures, economic growth to increase GDP and ultimately increase tax ratio.

Recently, Kurniawan & Anggraini (2024) aimed to analyze Regional Original Revenue, Gross

Regional Domestic Product, Revenue Sharing Funds, and Population on regional expenditure in the regencies/cities of Bengkulu Province. The analysis method used was panel data regression analysis, which combined time series data and cross-section data. The data used in this study were secondary data obtained from the Ministry of Finance and the Bengkulu Provincial Statistics Agency during the 2011-2023 period, as well as other supporting sources. The variables collected include Regional Original Revenue, Gross Regional Domestic Product, Revenue Sharing Fund, and Population. Based on the panel data regression results, the best model obtained was the fixed effect model. The research showed that Regional Original revenue, gross regional domestic product, and population had a significant influence on local expenditure in Bengkulu Province. However, Revenue Sharing Fund did not show a significant influence on regional expenditure. Overall, Regional Original revenue, gross regional domestic product, revenue sharing funds, and population together had a significant effect on regional expenditure in districts/municipalities in Bengkulu Province.

Another recent notable study, Putra & Ahmad (2024) aimed to know the Locally Generated Revenue (PAD), Balancing Fund (DP), Local Government Expenditures (BD) and Regional Financing (PD) of Regional Economic Growth (PDRB). The data used in this study was annual data published by website Directorate General of Fiscal Balance and Central Bureau of Statistics for five period from 2011 until 2015. The analytical method used is Multiple Linear Regression. The results showed that the Locally Generated Revenue (PAD), Local Government Expenditures (BD) and Regional Financing (PD) had no effect significant on Regional Economic Growth (PDRB). While Balancing Fund (DP) had negatively significant effect on Regional Economic Growth (PDRB).

The review of prior scholarship has unequivocally demonstrated that examining the impact of state budget revenue on local economic growth is both theoretically justified and empirically relevant. It was further observed that most existing studies have relied on conventional determinants, thereby leaving substantial empirical gaps. To address this limitation, the present research strategically incorporates distinct independent variables - namely foreign direct investment and indicators of digital transformation - ensuring both novelty and analytical

rigor in exploring regional growth dynamics within Vietnam.

3. Methodology and research data

This study uses annual time series data of five big cities Vietnam, including Can Tho, Da Nang, Hai Phong, Hanoi, Ho Chi Minh city from 2015 to 2021, including Gross regional domestic product as local economic growth, State budet revenue as fiscal capacity, Foreign direct investment, Turnover of postal service and telecommunication service, Number of internet subscribers as proxy of digital transformation.

The collected data is panel data, so the panel data analysis methods performed here are the choice between POLS, REM, FEM models. Panel data analysis is a statistical method, widely used in social sciences, epidemiology and econometrics to analyze two-dimensional panel data (usually cross-sectional and longitudinal). Data are usually collected over time and on the same individuals and then a regression is run on these two dimensions. Multivariate analysis is an econometric method in which data are collected across more than two dimensions (usually, time, individuals and some third dimension).

Table 1 below reports the description of the variables used in the study.

Table 1. Variables and Measurement

Variables name	Symbols	Variables measurement
Loal economic growth	GRDP	Gross regional domestic product (at current prices, bill. Dongs)
State budet revenue	SBR	State budet revenue (Bill. Dongs)
Foreign direct investment	FDI	Foreign direct investment (implementation capital (Mill. USD)
Digital Transformation	PS_TS	Turnover of postal service and telecommunication service (Bill. dongs)
	INTER	Number of internet subscribers (Thous. subs.)

Source: Authors' summary.

The empirical model is specified as:

$$GRDP_{it} = \beta_0 + \beta_1 SBR_{it} + \beta_2 FDI_{it} + \beta_3 PS_{TS_{it}} + \beta_4 INTER_{it} + a_i + \mu_t + u_{it}$$

where β_i are the regression coefficients, a_i is a fixed effect in error, μ_t is error over time and u_{it} is the residuals over time and cities.

4. Empirical results

Table 2 below presents the descriptive statistics on mean of all variables used in this study.

Table 2. Descriptive on mean of variables

City	GRDP	SBR	FDI	PS_TS	Inter
Can Tho	79400.77	22183.83	24.41429	3703.286	729.8571
Da Nang	95434.86	37991.29	179.1143	2144.286	1026.643
Hai Phong	215206.6	82281.46	418.725	3474.333	1358.714

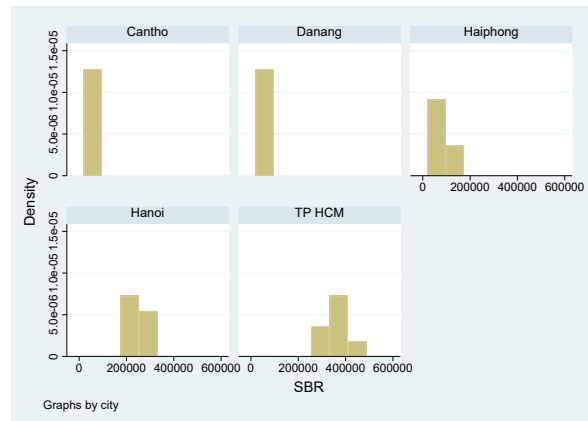
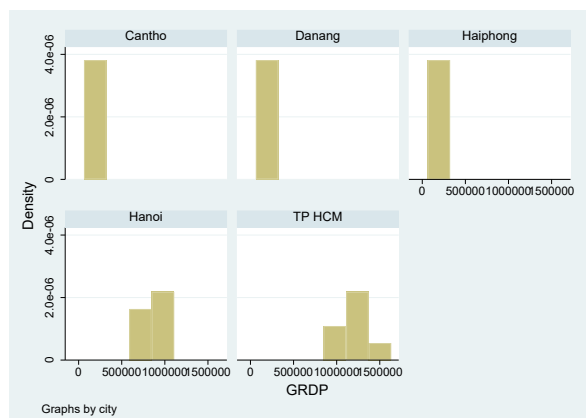
City	GRDP	SBR	FDI	PS_TS	Inter
Hanoi	865662.9	241286.1	1247.286	35849.86	8104.143
HCM city	1186411	353840.3	5960.3	.	10463.43
Total	488423.3	147516.6	1673.522	11582.52	4336.557

Source: Summarized by the author

The descriptive statistics reveal marked disparities among Vietnam's five major cities in terms of economic scale, fiscal capacity, foreign investment, and digital infrastructure. Gross Regional Domestic Product (GRDP, at current prices, billion VND) varies substantially, ranging from 79,400.77 in Can Tho to 1,186,411 in Ho Chi Minh City, reflecting wide gaps in regional economic output. State Budget Revenue (billion VND) follows a similar pattern, with the lowest value recorded in Can Tho (22,183.83) and the highest in Ho Chi Minh City (353,840.3), indicating strong differences in fiscal capacity. Foreign Direct Investment (implementation capital, million USD) is most pronounced in Ho Chi Minh City at 5,960.3, whereas Can Tho receives only 24.41, underscoring the uneven distribution of international capital. Turnover of postal service and telecommunication service (billion VND) peaks in Hanoi with 35,849.86, compared to 2,144.29 in Da Nang. Likewise, the number of internet subscribers (thousand subscriptions) reaches 10,463.43 in Ho Chi Minh City, significantly higher than Can Tho's 729.86. Overall, the data demonstrate pronounced inter-city disparities, highlighting the dual role of fiscal revenue and digital infrastructure in shaping local economic development.

The visualization of GRDP and SBR for all five cities during the period 2015-2021 serves as an essential analytical tool to provide both descriptive insights and preliminary interpretations of economic dynamics as in Figure 1.

Figure 1. Bar graph of GRDP and SBR of five cities during the period of 2015-2021



Source: Executed by the author

First, we estimate the random effect model and perform a test to choose the POLS or FE/RE model. The results of the Breusch and Pagan Lagrangian multiplier test for random effects give a probability value greater than 5%, so the POLS model is suitable for the collected data. The estimated POLS result is shown in the Table 3.

Table 3. POLS estimation result

GRDP	Coefficient	Standard error	Z	P > z	95% confident interval
SBR	2.32	.37	6.20	0.000	1.58 3.05
FDI	25.98	37.01	0.70	0.483	-46.56 98.53
PS_TS	2.75	.98	2.78	0.005	.81 4.68
INTER	22.89	6.84	3.35	0.001	9.48 36.30
CONSTANT	-17018.33	12641.52	-1.35	0.178	-41795.25 7758.59

Source: Summarized by the author

Table 3 indicates that, the empirical results of the relationship are presented as follows:

$$GRDP_{it} = -17018.43 + 2.32 * SBR_{it} + 25.98 * FDI_{it} + 2.75 * PS_{TS_{it}} + 22.89 * INTER_{it} + u_{it}$$

The results show a positive impact of local state budget revenue on local economic growth, as shown by the positive regression coefficient of SBR and statistical significance at the 1% level. Although there is no evidence of the impact of local FDI on local economic growth, in return, digital transformation is positively impacting local economic growth, as shown by the regression coefficients of the two variables PS_TS and INTER, which are both positive and statistically significant at the 1% level.

The mechanism through which local state budget revenue promotes regional economic growth operates through several interrelated channels. First, higher fiscal revenue enhances the government's capacity to finance essential public goods and services, such as infrastructure, education, healthcare, and transportation. These investments reduce transaction costs, improve productivity, and create a more

favorable business environment, thereby stimulating private sector development. Second, state budget revenue enables the implementation of redistributive policies and social safety nets, which can stabilize consumption and reduce inequality, indirectly fostering sustainable economic growth. Third, predictable and sufficient fiscal resources strengthen local governments' ability to engage in long-term planning and strategic investment, which are critical for regional competitiveness.

In parallel, digital transformation exerts a complementary and reinforcing effect on local economic development. The expansion of digital infrastructure, including internet penetration and telecommunications services, enhances connectivity, reduces information asymmetries, and lowers barriers to market participation. Digital governance mechanisms, such as e-tax systems and online public services, improve transparency, efficiency, and accountability in revenue mobilization and allocation, thus increasing the effectiveness of fiscal policy. Moreover, the digital economy fosters innovation, supports new business models, and widens market access for local enterprises. Consequently, the synergy between strong fiscal capacity and digital transformation not only accelerates regional economic growth but also strengthens the foundations for long-term sustainable development.

5. Conclusion

The model reveals that state budget revenue has a significant positive influence on local economic growth during the research period of 2015-2021. Building upon the empirical findings, it becomes imperative to propose targeted policy measures that can maintain the fiscal capacity for promoting local economic growth in big cities in Vietnam.

A fundamental solution to sustaining local state budget revenue involves strengthening fiscal autonomy and diversifying revenue sources. Local governments should expand their capacity to mobilize tax and non-tax revenues through more efficient tax administration, rationalized fee structures, and innovative financing mechanisms such as public-private partnerships. By reducing excessive dependence on central transfers, fiscal decentralization enhances accountability and allocative efficiency, thereby reinforcing the growth-enhancing effect of local revenue. Within the digital transformation context, e-tax platforms and digital

auditing tools significantly improve transparency, compliance, and collection efficiency, ultimately ensuring that fiscal capacity continues to fuel robust regional economic performance.

Sustaining the growth-inducing impact of state budget revenue requires not only effective mobilization but also judicious allocation. Prioritizing expenditure on high-impact sectors such as infrastructure, education, healthcare, and digital connectivity creates substantial spillover effects on local productivity and competitiveness. Strategic investment in digital infrastructure, including broadband expansion and smart public services, amplifies the multiplier effect of fiscal resources by lowering transaction costs and stimulating private innovation. Moreover, digital monitoring systems and performance-based budgeting increase efficiency in public spending, ensuring that every unit of revenue mobilized yields maximum developmental outcomes. Such optimized allocation reinforces the virtuous cycle between fiscal capacity and regional growth.

A third solution lies in institutional innovation and the integration of digital governance into fiscal management. The adoption of big data analytics, blockchain-based public finance tracking, and AI-powered forecasting tools enhances the precision, accountability, and responsiveness of local revenue systems. By embedding digital technologies into tax collection, budget planning, and expenditure monitoring, local governments can minimize leakages, strengthen compliance, and foster taxpayer trust. This institutional modernization not only consolidates fiscal sustainability but also aligns with Vietnam's broader digital transformation strategy, ensuring that fiscal revenues are effectively leveraged to drive structural upgrading, productivity gains, and sustainable economic growth at the local level.

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ANALYZING THE IMPACT OF CAPITAL AND LABOUR ON ECONOMIC GROWTH IN VIETNAM - COBB-DOUGLAS APPROACH

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Abstract: *The article presents empirical evidence on the impact of capital and labour on economic growth in Vietnam during the period, using the Cobb-Douglas production function. The study uses time series data in the period 1990-2023. The ordinary least squares (OLS) method is used to estimate the model. The results show that there is a statistically significant positive impact of labour and capital on economic growth in Vietnam. The adjusted R2 value reaches 98.9%, showing that capital and labour are the main resources driving Vietnam's economic growth. In addition, the results also show that the efficiency of the economy increases with scale. From there, some recommendations are made to promote Vietnam's economic growth in the coming years.*

• Keywords: *economic growth, capital, labour, cobb-douglas production function.*

Date of receipt: 29th Oct., 2025

Date of delivery revision: 15th Nov., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.04>

Date of receipt revision: 28th Dec, 2025

Date of approval: 21th Jan., 2026

1. Introduction

Economic growth has long been considered one of the central objectives of national development strategies, and understanding its determinants remains a pivotal concern in both theoretical and empirical economics. Since the seminal contributions of Solow (1956), Swan (1956), and Solow & Swan (1956), growth theory has emphasized the roles of capital accumulation and labour supply as the fundamental engines driving the expansion of productive capacity. Capital, by enhancing the availability of physical assets such as machinery, infrastructure, and technology, enables economies to increase output per worker and stimulate productivity. The mechanism is typically explained through capital deepening, whereby the marginal product of labour rises as workers are equipped with better tools, leading to higher aggregate output. Moreover, capital also embodies technological progress and knowledge diffusion, which further amplify its contribution to long-run growth trajectories.

Similarly, labour constitutes a critical factor of production, as the size, quality, and productivity of the workforce directly influence the capacity of an economy to generate goods and services. Labour's impact on growth is not merely quantitative but also qualitative, since improvements in human capital - through education, skills, and health -

enhance the efficiency with which workers utilize capital. The dynamic interplay between labour and capital is therefore crucial, as economies with abundant labour but limited capital may experience diminishing returns, whereas those with balanced accumulation of both factors can sustain higher levels of growth. In this regard, labour force expansion contributes to output growth, while human capital development ensures that labour complements rather than constrains the utilization of physical capital.

To analyze these mechanisms rigorously, economists frequently employ the Cobb-Douglas production function, which provides a parsimonious yet powerful framework for quantifying the contribution of capital and labour to economic growth. Its functional form allows for the estimation of output elasticities with respect to both inputs, offering valuable insights into the relative importance of each factor within a given economy. Furthermore, the Cobb-Douglas specification captures the principle of diminishing marginal returns while accommodating constant returns to scale, making it particularly suitable for comparative analysis across different stages of development. Numerous empirical studies have applied this model to examine the growth experiences of both developed and developing economies, yet its application to Vietnam remains

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both timely and necessary given the country's rapid structural transformation.

Vietnam's remarkable economic progress over the past three decades has been characterized by substantial capital inflows, structural shifts in labour allocation, and impressive productivity improvements. However, questions remain regarding the precise contribution of capital and labour to this growth trajectory, particularly in the context of ongoing industrialization, demographic change, and technological adoption. By applying the Cobb-Douglas approach, this study seeks to disentangle the relative roles of capital and labour, thereby offering an evidence-based assessment of the underlying growth dynamics.

The findings of this research hold significant implications for economic policy. Understanding the elasticity of output with respect to capital and labour provides policymakers with a robust basis for designing strategies that balance investment in physical infrastructure with investments in human capital formation. Such evidence-based insights are indispensable for Vietnam, where sustaining high growth rates requires careful calibration of factor accumulation and productivity enhancement. By highlighting the relative contributions of capital and labour, this study not only enriches the empirical literature on growth determinants in emerging economies but also delivers practical guidance for policy formulation aimed at fostering sustainable and inclusive economic development.

The above introduction is followed by an overview of domestic and foreign studies, then the data collection and research methods. The next part of the study is the empirical results together with discussions, and the final part proposes some implications.

2. Literature review

Swan (1956) extracted the principal component of China's expenditure per capita of local government based on the factor and cluster analysis method, to determine the structure of fiscal expenditure by category of basic services, senior services, economics, and resource protection. Then the paper analyzed the regional differences in the distribution of fiscal expenditure structure based on the systematic cluster analysis method. The conclusion was that Beijing, Tianjin, and Shanghai were the advanced service category of expenditure growth pole, which drove around cities' technology

as well as education spending, and promoted regional economic growth.

Onalan & Basegmez (2018) applied the Grey Cobb-Douglas production model to predict the GDP, examine the effects of the variation rate of capital, and labour inputs to economic growth. Many factors contribute to economic growth, the capital and labour are the main elements of economic growth. Improving the capital and labour performance plays an important role in increasing the wealth of a country. Traditionally, the Cobb-Douglas (C-D) production model uses only capital stock and labour to describe economic growth. In this study, firstly C-D production function was established and confirmed that capital and labour had a positive impact on economic growth (GDP). The future GDP values were predicted by the estimated capital and labour values, putting them into the Cobb-Douglas model. The authors also obtained the production elasticities of capital and labour inputs. Findings suggested that the contribution rate of capital was 0.403 and labour was 1.094 to economic growth. The sum of the contributions of factors was 1.497 and greater than one. Findings of this empirical study showed that the percentage of the increase in GDP was greater than that of the increase in capital stock and labour.

For the case of Poland, Dritsaki & Stamatiou (2018) analyzed the relationship between international trade and economic and financial development for Poland for the period 1990-2016. For this long-run relationship, the authors applied the autoregressive distributed lag (ARDL) technique as well as the augmented Cobb-Douglas production function. The results of the ARDL test confirmed the existence of a long-run relationship between the examined variables. Capital seemed to be an impetus for economic development both in the short and long run, while labour had a negative impact on Poland's economic growth. However, trade openness and financial development were found to be insignificant on economic development, both in the short and long run. Finally, causality results showed that there was a unilateral causal relationship between financial development and labour towards economic development, and also a bilateral causal relationship between capital and trade openness with economic development.

A comparative analysis among selected Asian countries, in the case of Bangladesh, India, China, Malaysia, and Thailand, Khatun & Afroze (2016)

studied the relationship between real GDP and labour & capital by applying the Cobb-Douglas production function. The study used time-series data covering the period of 1990-2014. Ordinary Least Squares (OLS) was used to estimate the model. The results showed that there was a strong positive and significant relationship between labour and capital and real GDP in case of all the countries selected. The value of R^2 ranged between 0.930 to 0.988, indicating that most of the variations in real GDP in all these countries were explained by labour and capital alone. The results were statistically significant at the 1% and 5% levels of significance. The study also showed that there were increasing returns to scale in the production process in case of all the selected countries. It had been found that a 100% increase in labour would increase real GDP by 301% and a 100% increase in capital would increase real GDP by 40%. The contribution of both labour and capital was the highest in the case of China, followed by Bangladesh. The contribution of capital was lowest in the case of Thailand (10%) and Malaysia (15%) because they both emphasized investing in human capital by giving importance to education, health, and training of their labour force.

Another application of the Cobb-Douglas production function can be found in Dana & Jaromír (2007). The Cobb-Douglas production function is often used to analyse the supply-side performance and measurement of a country's productive potential. This functional form, however, includes the assumption of a constant share of labour in output, which may be too restrictive for a converging country. In this paper, the authors tested whether this fact renders the application of the Cobb-Douglas production function unreliable for the Czech economy. The authors applied a more general form of production function and allowed the labour share to develop according to the empirical data. For the period 1995-2005, the authors did not find a significant difference between the calculation of the supply side of the Czech economy by the Cobb-Douglas production function and a more general production function.

A comprehensive review of the existing literature unequivocally demonstrates that employing the Cobb-Douglas production function constitutes a theoretically sound and empirically validated approach to assessing the impact of capital and labour on economic growth. It has been consistently emphasized that this functional form,

by capturing factor elasticities and accommodating constant returns to scale, allows growth dynamics to be disentangled with analytical precision, thereby reinforcing the appropriateness of its application in examining Vietnam's developmental trajectory.

3. Methodology and research data

The Cobb-Douglas production function is one of the most widely used production functions in economic analysis. The Cobb-Douglas production function not only reflects the basic economic law but also makes it easy to calculate and interpret the estimated parameters. The purpose of applying the Cobb-Douglas function is to estimate the coefficients of input factors affecting total output and returns to scale. The Cobb-Douglas function has the form:

$$Y = AK^\alpha L^\beta$$

where Y is total output, represented by GDP, K is total capital stock, and L is total labour.

Take the logarithm of both sides of the above equation to get the linear equation:

$$\ln Y = \ln A + \alpha \ln K + \beta \ln L$$

The coefficient A represents the productivity of total factors, α is the coefficient of capital contribution, and β is the coefficient of labour contribution. $\alpha + \beta$ indicates the return to scale. If $\alpha + \beta > 1$, it shows increasing return to scale, if $\alpha + \beta < 1$, it shows decreasing return to scale, and if $\alpha + \beta = 1$, it shows constant return to scale.

Table 1 below reports the description of the variables used in the study, collected from the World Bank data source.

Table 1. Variables and Measurement

Variables name	Symbols	Variables measurement
Economic growth	GDP	Gross domestic product (at local current unit, thousand billion Dongs)
Capital	CAPITAL	Gross capital formation (at local current unit, thousand billion Dongs)
Labour	LABOUR	Labour force, total (million)

Source: Authors' summary.

4. Empirical results

First, descriptive statistics of the study variables are presented in the following Table 2:

Table 2. Descriptive statistics

	GDP	CAPITAL	LABOUR
Mean	2930.502	841.6545	45.57281
Median	1154.167	742.6952	45.54258
Maximum	10320.31	2101.984	56.79900
Minimum	41.95500	61.55807	31.53525
Std. Dev.	3225.591	631.2276	8.574476
Skewness	0.894469	0.553707	-0.122674
Kurtosis	2.424438	2.072981	1.526887
Jarque-Bera	5.003057	2.954783	3.159530

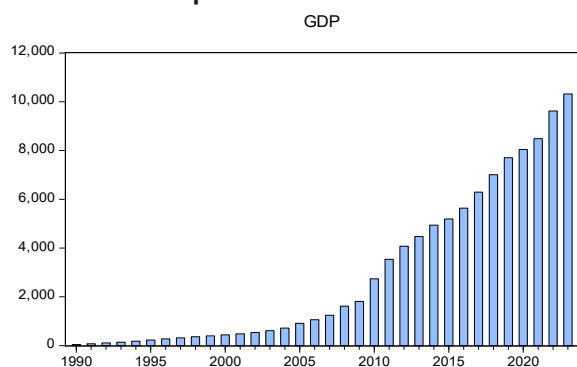
	GDP	CAPITAL	LABOUR
Probability	0.081960	0.228232	0.206024
Sum	99637.07	28616.25	1549.475
Sum Sq. Dev.	3.43E+08	13148793	2426.214
Observations	34	34	34

Source: Summarized by the author

The descriptive statistics reveal substantial heterogeneity across the three variables. GDP exhibits a relatively high mean of 2,930.50 trillion VND, though its large standard deviation (3,225.59) and maximum value (10,320.31) indicate pronounced volatility and a right-skewed distribution, reflecting periods of accelerated economic expansion. Capital displays a mean of 841.65 trillion VND, with moderate dispersion (standard deviation of 631.23) and positive skewness, suggesting that a few years experienced exceptionally high levels of investment. Labour, measured in millions of people, appears more stable, with a mean of 45.57 and relatively low variability (standard deviation of 8.57). Its distribution is slightly left-skewed, reflecting demographic consistency. The Jarque-Bera test statistics do not reject normality for all three variables at the 5% significance level, implying that the distributions approximate normality, thereby enhancing their suitability for econometric modeling.

The graph depicting Vietnam's economic growth in the period 1990-2023 is shown in Figure 1 below.

Figure 1. Vietnam's economic growth in the period 1990-2023



Source: Summarized by the author

Vietnam's economic performance over the period 1990-2023 demonstrates a remarkable and sustained growth trajectory. GDP increased from merely 41.96 trillion VND in 1990 to more than 10,320 trillion VND in 2023, representing a nearly 250-fold expansion within three decades. The data reveal an accelerating growth pattern, particularly after the early 2000s, when GDP began to rise more

steeply, surpassing 1,000 trillion VND in 2005 and exceeding 5,000 trillion VND by 2015. The period after 2010 is characterized by pronounced momentum, with GDP expanding rapidly to over 10,000 trillion VND in 2023, despite global economic volatility. This consistent upward trajectory reflects Vietnam's successful structural transformation, integration into global markets, and improvements in capital accumulation, labour productivity, and institutional capacity.

The results of Cobb-Douglas function estimation for Southeast Asian countries are presented in the following Table 3:

Table 3. Estimation results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-18.22779	1.915491	-9.515992	0.0000
LNCAPITAL	0.432132	0.143471	3.011985	0.0051
LNLABOUR	5.932784	0.736734	8.052818	0.0000

Source: Summarized by the author

The main objective of the study is to examine whether both labour and capital can contribute significantly to the growth of manufacturing in Vietnam, and the empirical results using the Cobb-Douglas production function have confirmed these results. The estimated equation is as follows:

$$\ln GDP = -18.22 + 0.432 \cdot \ln CAPITAL + 5.932 \cdot \ln LABOUR$$

or in another form as:

$$GDP = 1.2 \cdot 10^{-8} \cdot CAPITAL^{0.432} \cdot LABOUR^{5.932}$$

Here, the adjusted R² coefficient of determination of the Cobb-Douglas production function for Vietnam is 98.9%, indicating that the model fits very well in the case of Vietnam. From the estimation results in Table 1, the elasticity of GDP with respect to labour is 5.9 and that with respect to capital is 0.432. That is, if the labour force increases by 1%, GDP will increase by 5.9%; on the other hand, if capital increases by 1%, Vietnam's GDP will increase by 43.2%.

In terms of returns to scale, Vietnam has increasing returns to scale, as shown in the results that $\alpha + \beta = 0.432 + 5.932 = 6.364$, which is greater than 1. The estimation results reveal that Vietnam exhibits increasing returns to scale, as indicated by the sum of output elasticities ($\alpha + \beta = 6.364$), which substantially exceeds unity. This implies that a proportional increase in capital and labour inputs generates a more than proportional increase in aggregate output, suggesting that the production structure benefits from scale economies. Such a

phenomenon may reflect the combined effects of technological progress, enhanced managerial efficiency, and productivity gains derived from specialization and structural transformation. The finding underscores that Vietnam's growth trajectory is not solely reliant on factor accumulation but is also reinforced by improvements in total factor productivity, thereby highlighting the economy's potential to sustain high growth rates through both input expansion and efficiency enhancement. The empirical results in this paper are similar to those in Onalan & Basegmez (2018).

5. Conclusion

Vietnam's long-term growth prospects critically depend on its ability to mobilize and allocate resources effectively while simultaneously upgrading its institutional and technological foundations. As the economy deepens its integration into global value chains, sustaining high growth rates requires a dual strategy that leverages both capital accumulation and labour force transformation. In particular, capital investment must be oriented toward infrastructure modernization and digital adoption, while labour development strategies should prioritize human capital formation and digital workforce readiness. Together, these complementary approaches create a synergistic framework for promoting sustainable and inclusive economic growth.

Capital-based strategies

To begin with, strengthening capital accumulation through sustained infrastructure investment remains imperative. Infrastructure not only enhances productive capacity but also reduces transaction costs and fosters regional connectivity. Expanding public-private partnerships can mobilize large-scale resources for transport, energy, and digital infrastructure, thereby creating multiplier effects that reinforce industrial upgrading and long-term economic growth.

Furthermore, expanding access to finance for small and medium-sized enterprises constitutes another pivotal solution. Capital deepening at the firm level promotes innovation, productivity, and competitiveness. By improving credit markets, diversifying financial instruments, and strengthening regulatory frameworks, Vietnam can channel capital more efficiently, ensuring that private sector dynamism contributes substantially to aggregate output expansion and economic diversification.

Finally, leveraging the transformative potential of Industry 4.0 requires targeted capital investment in advanced technologies such as artificial intelligence, big data, and automation. Strategic adoption of these innovations not only enhances production efficiency but also fosters new business models and value chains, allowing Vietnam to capture higher value-added activities within global supply networks.

Labour-based strategies

Equally important, enhancing human capital formation through education reform is fundamental to aligning workforce skills with rapidly changing labour market demands. Strengthening STEM disciplines, fostering creativity, and promoting lifelong learning can cultivate a digitally competent labour force capable of supporting innovation-driven growth and sustaining productivity improvements.

In addition, expanding vocational training and reskilling programs tailored to digital competencies represents a critical pathway. By integrating digital literacy, coding, and data analytics into vocational curricula, Vietnam can transform its labour force into a more adaptive and resilient engine of growth, ensuring that technological change complements rather than displaces employment opportunities.

Finally, promoting inclusive labour market participation by empowering women and disadvantaged groups is essential for fully harnessing demographic potential. Policies that encourage flexible work arrangements, digital entrepreneurship, and remote employment can broaden workforce engagement, thereby boosting aggregate labour supply, enhancing equity, and consolidating the foundations of sustainable and inclusive growth.

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THE IMPACT OF AI ON TAX COMPLIANCE BEHAVIOR AMONG SMALL AND MEDIUM-SIZED ENTERPRISES IN HANOI: A UTAUT-BASED APPROACH

PhD. Le Ha Trang*

Abstract: *This study examines the impact of artificial intelligence (AI) applications on tax compliance behavior of small and medium-sized enterprises (SMEs) in Hanoi, using the UTAUT model to analyze the factors influencing the acceptance and use of AI in tax compliance tasks. With the rapid development of digital technology, AI application in tax management can reduce errors, optimize the process of tax declaration and payment, enhance transparency, and lower compliance costs. The factors in the UTAUT model, including Perceived Usefulness of AI, Perceived Ease of Use of AI, Habit Use of AI, Facilitating Conditions, and AI Use Behavior, all affect the Tax Compliance of SMEs. The results indicate that these factors have a positive and statistically significant impact on AI Use Behavior, which in turn contributes to enhancing tax compliance among enterprises. The model also confirms that AI Use Behavior acts as a mediating factor in the relationship between Perceived Usefulness and Facilitating Conditions with Tax Compliance. The findings provide empirical evidence on the application of AI in tax management and offer policy recommendations to help SMEs effectively implement AI, thereby improving tax compliance and contributing to the digital transformation of Vietnam's tax system.*

• Keywords: *artificial intelligence, tax compliance, technology adoption model.*

Date of receipt: 08th Nov., 2025

Date of delivery revision: 22th Nov., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.05>

Date of receipt revision: 06th Dec., 2025

Date of approval: 20th Dec., 2026

Introduction

Vietnam is undergoing a rapid digital transformation, and artificial intelligence (AI) is increasingly being adopted across a wide range of socio-economic domains. According to findings released by the Worldwide Independent Network of Market Research (WIN) in July 2025 on public awareness, use, trust, and concerns regarding AI, Vietnam has made a notable mark on the global AI landscape, ranking 6th out of 40 countries and territories, with a score of 59.2/100. Against this backdrop, small and medium-sized enterprises (SMEs) in Vietnam are facing both opportunities and challenges in adopting emerging technologies, particularly AI, in production, business operations, and financial management. Given their limited resources, partially non-standardized management systems, and uneven levels of technological capability, compliance with tax regulations remains a complex task for many SMEs. Errors in tax declaration, tax payment, and supporting document retention are still widespread, leading to higher compliance costs and increased risks of penalties or tax audits.

In this context, AI is emerging as a promising support solution, enabling firms to automate

accounting and tax-related processes, forecast risks, detect errors, and enhance transparency in financial activities. However, SMEs' acceptance of and readiness to use AI depend not only on financial capacity and technological infrastructure, but also on users' perceptions, psychological factors, and expectations within the organization. Therefore, examining the determinants of AI acceptance and use in tax compliance practices is essential to promote effective and context-appropriate adoption among Vietnamese SMEs.

Drawing on the UTAUT model, a well-established theoretical framework in technology acceptance and use research, this paper investigates the factors influencing SMEs' intentions and behaviors in using AI for tax compliance, while also assessing the impact of AI adoption on the level of tax compliance. The findings are expected to provide empirical evidence for tax administration in the context of digital transformation and to offer implications for supporting SMEs in deploying AI more effectively.

1. Literature review and research hypotheses

International and domestic studies indicate that digitalization and the use of AI in taxation

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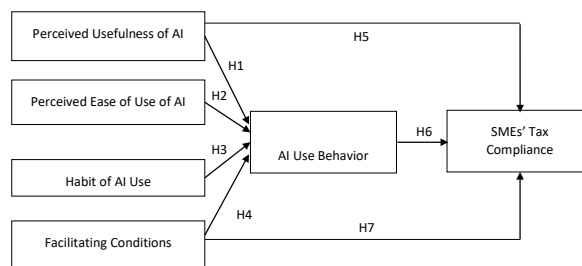
can improve monitoring, fraud detection, and risk identification, thereby enhancing tax compliance through deterrence and more targeted audits (Saragih et al., 2022). In addition, AI can reduce compliance costs by automating tax filing and payment procedures, providing taxpayer support and query resolution, and simplifying processes - particularly for SMEs (Belahouaoui & Attak, 2024). Moreover, AI adoption may strengthen firms' tax governance by forecasting tax liabilities, issuing error alerts, and supporting tax planning while remaining within a compliance framework (Barik & Ranawat, 2024).

In Vietnam, research on digital transformation and corporate tax compliance suggests that "digital transformation" has the strongest effect on compliance ($\beta \approx 0.58$), operating through changes in business models, the expansion of electronic payments, electronic tax filing and payment, and the future orientation toward more intelligent applications (Dao & Hang, 2022). This implies that when AI is more deeply integrated into the existing digital ecosystem, its potential to enhance compliance could be substantial.

Models of AI acceptance in taxation have also been examined in international research. Specifically, TAM/UTAUT-based models show that both perceived usefulness and perceived ease of use have positive and statistically significant effects on intention to use AI (Technology Acceptance Model-TAM) (Ambarwati et al., 2024). Extended variables may include trust in AI, concerns about data security, attitudes toward technology, organizational support, and subjective norms (UTAUT) (Leffew, 2024; Hakam et al., 2024). Similar approaches have been used to evaluate readiness for AI adoption in Indonesia's tax system, incorporating additional frameworks such as "AI readiness" and "IT governance success factors" (Saragih et al., 2022; Vivian et al., 2023).

In this study, the author adopts the UTAUT model (Venkatesh et al., 2003), one of the most widely used frameworks for explaining technology use intention and behavior. UTAUT synthesizes eight theories of behavior and technology, and in this research it is applied to identify key factors influencing SMEs' intention to adopt AI and the subsequent use of AI in tax compliance in Vietnam. Specifically, the proposed factors include: (i) perceived usefulness of AI, (ii) perceived ease of use of AI, (iii) habit of using AI, (iv) facilitating conditions, and (v) usage behavior. Accordingly, the hypotheses and the proposed research model are presented as follows:

Figure 1. The proposed research framework



Source: Authors' proposal.

Hypothesis H1: Perceived usefulness of AI has a positive effect on SMEs' AI use behavior.

Hypothesis H2: Perceived ease of use of AI has a positive effect on SMEs' AI use behavior.

Hypothesis H3: Habit of AI use has a positive effect on SMEs' AI use behavior.

Hypothesis H4: Facilitating conditions have a positive effect on SMEs' AI use behavior.

Hypothesis H5: Perceived usefulness of AI has a positive effect on SMEs' tax compliance.

Hypothesis H6: Facilitating conditions have a positive effect on SMEs' tax compliance.

Hypothesis H7: SMEs' AI use behavior has a positive effect on SMEs' tax compliance.

2. Research methodology

2.1. Measurement scales for research concepts in the model

All measurement scales for the factors in this model are clearly sourced and have been adapted and developed based on the original UTAUT model by Venkatesh et al. (2012).

Table 1. Summary of measurement scales for independent and dependent variables

Concept	Code	Measurement Description	References
Perceived Usefulness of AI (PU)	PU1	AI helps reduce errors in tax filing	Venkatesh, 2003, Davis et al., 1989, Ambarwati et al., 2024; Leffew, 2024; Hakam et al., 2024
	PU2	AI helps save time in processing tax data	
	PU3	AI supports optimization of tax filing procedures	
	PU4	AI helps reduce risks of tax penalties	
	PU5	AI improves the ability to automate tax inspection and audits	
	PU6	AI increases transparency in tax filing	
Perceived Ease of Use of AI (PE)	PE1	The interface of AI is easy to understand and use	Venkatesh et al., 2008; Davis et al., 1989; Chan, 2004, Ambarwati et al., 2024; Leffew, 2024; Hakam et al., 2024
	PE2	AI installation process is simple	
	PE3	AI support tools are easy to use	
	PE4	No deep training is required to use AI effectively	
	PE5	AI integrates easily with existing systems	
Habit of AI Use (HU)	HU1	The enterprise uses AI regularly in tax operations	Limayem et al., 2007; Zhou, T. (2013); Venkatesh et al., 2012
	HU2	AI has become an indispensable tool in tax operations	
	HU3	The enterprise feels comfortable when using AI for tax purposes	
	HU4	AI helps save time, so enterprises frequently use AI	

Concept	Code	Measurement Description	References
Facilitating Conditions (FC)	FC1	The enterprise has sufficient financial resources to deploy AI	Venkatesh et al, 2012; Davis et al., 1989
	FC2	The enterprise's technology infrastructure is compatible with AI	
	FC3	Support from AI experts or service providers is available	
	FC4	The enterprise has human resources capable of applying AI	
AI Use Behavior (UB)	UB1	The enterprise uses AI to support regular tax filing	Tapanainen et al, 2019; Venkatesh & Davis, 2000
	UB2	The enterprise frequently uses AI to detect errors in tax filing	
	UB3	The enterprise uses AI to automate tax report generation	
	UB4	The enterprise uses AI to track tax policy changes	
	UB5	The enterprise uses AI to ensure accuracy in tax calculations	
Tax Compliance (TC)	TC1	The enterprise files taxes accurately and completely	Singh & Bhupalan, 2001; Kleven et al, 2011; Bùi Ngọc Toàn, 2017; Kirchler et al, 2008
	TC2	The enterprise submits taxes on time and in full	
	TC3	The enterprise does not violate any tax regulations	

Source: Compiled by the author

2.2. Research data

- *Sample:* The study uses a purposive non-probability sampling method with systematic selection protocols. Although probability sampling is ideal, due to the specific nature of the positions in SMEs, it is necessary to select individuals with knowledge of AI applications in tax filing activities. The study uses primary data collected through surveys sent to managers of SMEs in Hanoi. The survey consists of two parts: Part 1 contains general information, and Part 2 includes questions using a 5-point Likert scale to assess the impact of AI on tax compliance among SMEs in Hanoi. To ensure objectivity and reliability, the author distributed 300 surveys and received 278 valid responses for analysis.

- *Data Collection:* Data was gathered by reviewing previous literature to identify measurement scales for the key variables in the UTAUT model. A structured questionnaire was sent to the target sample, with a 5-point Likert scale used, where 1 = "Strongly Disagree"; 2 = "Disagree"; 3 = "Neutral"; 4 = "Agree"; and 5 = "Strongly Agree". Additionally, "reverse-scored questions" were included to eliminate low-quality responses or those where respondents provided superficial answers.

- *Data Analysis:* The data analysis follows the recommendations of Hair, Risher, Sarstedt, and Ringle (2019), in which the measurement model is analyzed for internal consistency, convergent validity, and discriminant validity. Once the measurement model is validated, the structural model is used to test the statistical hypotheses and assess the quality of the PLS-SEM model.

3. Research Results

3.1. Measurement Model Analysis

According to Hair et al. (2019), the measurement model should be assessed based on criteria

of reliability, convergent validity, and discriminant validity.

Table 2. Reliability and convergent validity assessment of constructs

No.	Research Concept	Observed Variables	Outer Loadings	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
1	Perceived Usefulness of AI (PU)	PU1 PU2 PU3 PU4 PU5* PU6	0.831 0.866 0.815 0.751 0.498 0.709	0.845	0.886	0.570
2	Perceived Ease of Use of AI (PE)	PE1 PE2 PE3 PE4 PE5	0.721 0.761 0.790 0.811 0.723	0.820	0.874	0.581
3	Habit of AI Use (HU)	HU1 HU2 HU3 HU4	0.778 0.744 0.762 0.768	0.763	0.848	0.582
4	Facilitating Conditions (FC)	FC1 FC2 FC3 FC4	0.754 0.778 0.802 0.730	0.768	0.850	0.587
5	AI Use Behavior (UB)	UB1 UB2 UB3 UB4 UB5	0.806 0.832 0.808 0.803 0.763	0.862	0.901	0.645
6	Tax Compliance (TC)	TC1 TC2 TC3	0.782 0.855 0.826	0.760	0.862	0.675

* The variable PU5 was excluded due to its loading coefficient being lower than 0.708

Source: Analysis results using SmartPLS 4

Reliability: The data analysis results in Table 2 show that all 27 observed variables have outer loadings greater than the threshold value of 0.708, as recommended by Hair et al. Additionally, the Cronbach's alpha values for the six research constructs range from 0.760 to 0.862, meeting the reliability requirement (greater than 0.7). Moreover, the composite reliability values for all six research constructs range from 0.848 to 0.901 (above 0.7). Thus, the measurement model demonstrates internal consistency reliability.

Convergent Validity: The results in Table 2 indicate that the Average Variance Extracted (AVE) values for all research constructs exceed 0.5. Specifically, the AVE values for the six constructs range from 0.570 to 0.675, which confirms that all constructs meet the required level of convergent validity.

Discriminant Validity: Discriminant validity reflects the uniqueness or differentiation of a

construct when compared with other constructs in the measurement model. The traditional approach for assessing discriminant validity is to use the square root of AVE, as proposed by Fornell and Larcker (1981). A more recent approach uses the HTMT correlation index to determine the discriminant validity of latent constructs.

According to Fornell and Larcker's (1981) recommendation, the discriminant validity of a construct is confirmed if its square root of AVE is greater than the correlations between that construct and the other constructs. The results from Table 2 indicate that all latent constructs meet the discriminant validity requirement, as the square root of AVE (shown in bold on the diagonal) is higher than the correlations outside the diagonal (in the corresponding rows and columns).

Table 3. Discriminant validity assessment of constructs

Concepts	AI Use Behavior	Habit	Perceived Ease of Use	Perceived Usefulness	Tax Compliance	Facilitating Conditions
AI Use Behavior	0.803					
Habit	0.489	0.763				
Perceived Ease of Use	(0.595) 0.577 (0.675)	0.527 (0.655)	0.762			
Perceived Usefulness	0.552 (0.612)	0.485 (0.578)	0.507 (0.600)	0.755		
Tax Compliance	0.621 (0.752)	0.519 (0.663)	0.514 (0.648)	0.587 (0.702)	0.822	
Facilitating Conditions	0.542 (0.645)	0.480 (0.617)	0.560 (0.708)	0.502 (0.561)	0.549 (0.699)	0.766

Note:

The square root of AVE values are displayed on the bold diagonal (Fornell & Larcker criterion).

The values in parentheses represent the HTMT index.

Source: Analysis results using SmartPLS 4

Additionally, according to Garson (2016), the discriminant validity between two related constructs is confirmed when the HTMT coefficient ($HTMT_{ij}$) is less than 1. This indicates that the discriminant validity requirement between the measurement pairs i and j is satisfied. It can be observed that all values in parentheses (HTMT index values) are below 0.90, with the highest value being 0.752, which is less than 1. Therefore, all six research constructs meet the discriminant validity requirement.

3.2. Structural model analysis results

a) Hypothesis testing results

The results of hypothesis testing are presented in Table 4 and Figure 2. The SEM model was analyzed using the Bootstrap method with 5000 bootstrap samples to accurately estimate the relationships between the research constructs.

Table 4 shows that all direct relationships are statistically significant at the 95% confidence interval ($P\text{-value} < 0.05$). This indicates that all the primary effects in the PLS-SEM model are confirmed to exist. Specifically, all four factors - perceived usefulness, perceived ease of use, habit, and facilitating conditions - positively influence AI use behavior, meaning that these positive factors contribute to increasing the likelihood of AI use. Additionally, both AI use behavior, perceived usefulness, and facilitating conditions also positively influence tax compliance in SMEs.

Table 4. Hypothesis testing results

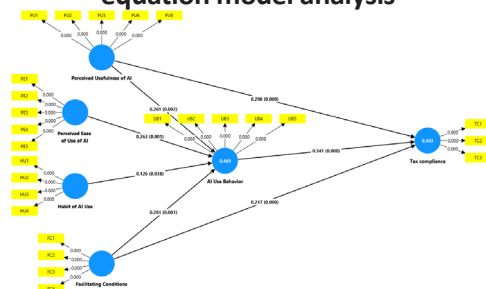
Relationships	Path Coefficient (O)	Standard Deviation	T-Value	P-Value	VIF Value	Effect	Hypothesis Conclusion
AI Use Behavior → Tax Compliance	0.341	0.067	5.080	0.000	1.662	Positive Effect	Supported
Habit → AI Use Behavior	0.126	0.061	2.072	0.038	1.575	Positive Effect	Supported
Perceived Ease of Use → AI Use Behavior	0.263	0.079	3.329	0.001	1.760	Positive Effect	Supported
Perceived Usefulness → AI Use Behavior	0.261	0.083	3.140	0.002	1.573	Positive Effect	Supported
Perceived Usefulness → Tax Compliance	0.290	0.064	4.503	0.000	1.569	Positive Effect	Supported
Facilitating Conditions → AI Use Behavior	0.201	0.063	3.211	0.001	1.666	Positive Effect	Supported
Facilitating Conditions → Tax Compliance	0.217	0.056	3.888	0.000	1.546	Positive Effect	Supported

Source: Analysis results using SmartPLS 4 and compiled by the author

b) Mediation effect analysis

The PLS-SEM model analysis with the mediator variable reveals that "AI Use Behavior" plays a significant mediating role in the relationship between "Perceived Usefulness" and "Facilitating Conditions" on Tax Compliance. This is a type of mediation effect where both the direct and indirect effects are positive and statistically significant. Specifically, the direct effects of "Perceived Usefulness" and "Facilitating Conditions" on "Tax Compliance" are 0.290 and 0.217, respectively, both greater than 0 ($P = 0.000 < 0.05$), while the indirect effects through "AI Use Behavior" are 0.089 ($P = 0.011$) and 0.069 ($P = 0.006$), both positive. Therefore, both hypotheses regarding the mediator variable are supported.

Figure 2. Results of the PLS-SEM structural equation model analysis



Source: Results from SmartPLS 4 analysis

Note: The values on the corresponding paths are the path coefficients (outside the parentheses) and P-values (inside the parentheses); the values inside the blue circles represent the model fit coefficients (R^2).

Table 5. SEM model estimation with mediator variable

Relationships	Direct Effect		Indirect Effect		Mediation Effect Conclusion
	Path Coefficient	P - values	Path Coefficient	P - values	
Perceived Usefulness -> AI Use Behavior -> Tax Compliance	0.290	0.000	0.089	0.011	Mediation Supported
Facilitating Conditions -> AI Use Behavior -> Tax Compliance	0.217	0.000	0.069	0.006	Mediation Supported

Source: Results from SmartPLS 4 analysis

The mediation analysis reveals that the pathway through AI use behavior acts as an additional mediating mechanism to better explain the interaction from perceived usefulness and facilitating conditions to tax compliance in SMEs. This finding supports the mediation models based on AI use behavior in the context of the strong digital transformation within the tax sector.

c) Model quality assessment results

The usability of the constructed model also depends on phenomena such as its explanatory and predictive capabilities. The factors of Perceived Usefulness, Perceived Ease of Use, Habit, and Facilitating Conditions explain 46.6% of the variance in AI Use Behavior among SMEs. Meanwhile, the three factors - AI Use Behavior, Perceived Usefulness, and Facilitating Conditions - explain 50.3% of the variation in Tax Compliance among SMEs. Both R^2 coefficients for these two models are greater than 25%, indicating that the factors used are suitable for explaining the variation in Tax Compliance among SMEs.

Table 6. Evaluation of the explanatory power and predictive relevance of the SEM model

Concepts	R^2	Explanatory Power Rating	Q^2	Predictive Relevance
AI Use Behavior	0.466	Moderate	0.290	Moderate
Tax Compliance	0.503	Moderate	0.330	Moderate

Source: Analysis results using SmartPLS 4 and compiled by the author

Additionally, the Q^2 index is used to reflect the predictive accuracy of the model. Table 5 shows that the Q^2 coefficients for both structural models - "AI Use Behavior" and "Tax Compliance" - are greater than 0.25, with values of 0.290 and 0.330, respectively (falling within the range of 0.25 to 0.50). This implies that both structural models exhibit moderate predictive relevance.

Conclusion

This paper has examined the impact of AI applications on tax compliance among SMEs. By analyzing key variables, including perceived usefulness of AI, perceived ease of use, habit, and facilitating conditions, this study identifies factors

contributing to SMEs' adoption of electronic tax compliance, ultimately supporting tax compliance in Vietnam, where SMEs make up over 90% of the total active businesses. The research explored factors influencing SMEs' acceptance of AI in tax filing. By considering these factors from various perspectives, the study highlights the reasons behind AI usage behavior in SMEs, which will ultimately assist in enhancing tax compliance in the country.

The results indicate that the UTAUT model is a useful framework to understand how AI technology for taxation is applied and used in Vietnam. SMEs are more likely to comply with taxes when they believe the tax system is favorable, efficient, and user-friendly. Key criteria such as perceived usefulness, perceived ease of use, habit, and facilitating conditions were found to be the main predictors of AI use behavior. Furthermore, since taxpayers are influenced by social norms as well as the availability of resources and support when using AI technology, perceived usefulness and facilitating conditions, including the resources and infrastructure of the enterprise, also play an important role in explaining tax compliance.

This study is significant for policymakers as it indicates that increasing perceived benefits and simplifying the use of the tax system, as well as enhancing social support and providing SMEs with access to adequate resources, could lead to higher tax compliance rates. The UTAUT model can be further improved in the context of digital transformation through future research.

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DETERMINANTS OF CIRCULAR ECONOMY DEVELOPMENT IN THE DIGITAL TRANSFORMATION ERA

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Abstract: *The circular economy (CE) has become a strategic priority in Vietnam, yet its implementation remains limited by institutional, technological, behavioral, and financial challenges. As digital transformation (DX) accelerates, understanding which factors most strongly influence CE development is essential for guiding policy and practice. This study employs the Analytic Hierarchy Process (AHP) to assess the relative importance of six determinant groups: Institutions, Policies, and Governance; Digital Infrastructure and Foundational Technologies; Firms' Innovation and Technological Capabilities; Circular Awareness, Attitudes, and Consumer Behaviors; Green Financial Resources and Market Mechanisms; and Multi-Stakeholder Collaboration and Innovation Ecosystems. Expert evaluations from government, academia, industry, and international organizations indicate that CE development in Vietnam follows a policy-led, technology-enabled, and enterprise-driven pattern. Institutions and governance are the most influential determinants, followed by digital infrastructure and enterprise innovation, while consumer behavior, green finance, and collaboration exhibit lower influence. The findings provide evidence-based priorities for strengthening Vietnam's transition toward a digitally enabled circular economy.*

• Keywords: circular economy development, digital transformation era, determinants, AHP.

JEL codes: Q01, Q50, O33, Q56, L52

Date of receipt: 08th Oct., 2025

Date of delivery revision: 22th Nov., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.06>

Date of receipt revision: 06th Dec., 2025

Date of approval: 20th Jan., 2026

1. Introduction

Vietnam presents a particularly relevant context where CE and DX intersect. While CE has been institutionalized through major legislative and strategic instruments - most notably the Law on Environmental Protection (2020) and the National CE Development Scheme (Decision 687/QĐ-TTg, 2022) - digital transformation is simultaneously being accelerated under the National Digital Transformation Program to 2030. Despite this strong policy momentum, Vietnam's CE transition continues to face significant barriers. These include fragmented regulatory implementation, underdeveloped digital infrastructure, limited technological capability among firms, low enterprise readiness for CE practices, insufficient sustainable consumption behaviors, weak cross-stakeholder collaboration, and constrained financial resources.

These challenges point to a critical research gap. Although the literature has examined CE and digital transformation extensively, studies that integrate the two domains into a unified analytical framework - particularly those providing structured, quantitative assessments of determinant importance in developing economy contexts - remain limited. Addressing this

gap is essential for informing evidence-based policy design and prioritizing strategic interventions.

This study responds to this gap by identifying key determinant groups shaping CE development under digital transformation, constructing a hierarchical framework comprising six factor categories, and applying AHP to derive their relative importance. Through this multi-criteria evaluation, the study offers a rigorous, evidence-based prioritization of CE determinants and provides actionable insights to guide policymakers, enterprises, and stakeholders in advancing a digitally enabled circular economy in Vietnam.

2. Literature review

2.1. Theoretical and empirical foundations

The CE is a development model focused on optimizing resource use, extending product life cycles, and minimizing environmental impacts through reuse, recycling, and material regeneration. Digital transformation, by contrast, involves the adoption of technologies such as IoT, Big Data, AI, blockchain, and digital platforms to enhance operational and governance efficiency.

The convergence of CE and DX has led to the

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emergence of “Circular Economy 4.0” where digital technologies facilitate life-cycle tracking, traceability, reverse logistics, and innovative circular business models, while also strengthening data-driven governance and extended producer responsibility. In this context, CE and DX are mutually reinforcing and jointly supporting sustainable development goals.

Recent scholarship emphasizes that CE development under digital transformation is influenced by multiple determinants, including institutional conditions, technological infrastructure, firm capabilities, financial mechanisms, consumer behavior, and multi-stakeholder collaboration. The subsequent section reviews and analyzes these key determinant groups.

(1) Institutions, policies, and governance

Institutions and policies constitute the foundational mechanisms guiding and coordinating the transition toward a circular economy. A coherent legal framework - encompassing technical standards, environmental regulations, extended producer responsibility, and national CE strategies - is essential for enabling circular models. Within the digital transformation context, governments can leverage digital data, traceability platforms, and online monitoring systems to enhance transparency, implementation efficiency, and regulatory compliance (OECD, 2023). Numerous studies emphasize the catalytic role of institutional quality in initiating and accelerating CE development, particularly in developing economies (Kirchherr et al., 2017; Geissdoerfer et al., 2018).

(2) Digital infrastructure and foundational technologies

Digital infrastructure serves as a critical enabler of CE, especially as the “Circular Economy 4.0” paradigm becomes increasingly prominent. Technologies such as IoT, Big Data analytics, artificial intelligence, blockchain, and cloud computing support product life-cycle tracking, material flow management, reverse logistics optimization, and automation of sorting and recycling operations (Rosa et al., 2020). These technologies not only improve transparency but also empower firms and regulators to make data-driven decisions, thereby enhancing operational efficiency and precision within CE systems (Bressanelli et al., 2018; ITU, 2024).

(3) Firms’ innovation and technological capabilities

Enterprises are central actors in CE implementation. Innovation capability encompasses

the adoption of eco-design principles, circular business models, remanufacturing and recycling technologies, and smart supply-chain management enabled by digital tools. Research demonstrates that firms with higher levels of digitalization are better positioned to implement CE practices due to improved data analytics, resource optimization, and flexible production processes (Ranta et al., 2021; Ghosh, 2023). Moreover, innovation capability facilitates the creation of new business models - such as Product-as-a-Service and the sharing economy - thereby enhancing both economic and environmental value.

(4) Green finance and market mechanisms

Green finance is a decisive factor in scaling CE initiatives at both the enterprise and national levels. Financial resources - ranging from green credit and sustainable investment funds to tax incentives, secondary material markets, and environmental pricing instruments such as carbon taxes - play a pivotal role. Under the influence of DX, fintech and blockchain technologies enhance transaction transparency, verify green activities, and support the development of carbon and recycled-material markets (UNDP, 2023; Wang et al., 2021). Green finance thus acts as a key driver of technological innovation while reducing risks for firms transitioning to circular models.

(5) Consumer awareness, attitudes, and circular behaviors

Consumer behavior represents a critical “market pull” mechanism in CE. Positive awareness and attitudes toward recycled, reused, shared, and sustainable products enable firms to scale circular activities (Camacho-Otero et al., 2018). Digital transformation promotes circular behaviors through waste-sorting applications, reuse platforms, digital communication campaigns, and online education systems (OECD, 2023). Such behavioral shifts help create markets for circular products and strengthen the implementation of environmental policies.

(6) Multi-stakeholder collaboration and innovation ecosystems

CE requires the participation of diverse stakeholders, including government agencies, firms, academic institutions, civil society organizations, local communities, and international partners. DX facilitates the formation of innovative ecosystems where shared data, transparent information flows, and digital platforms strengthen interactions among actors

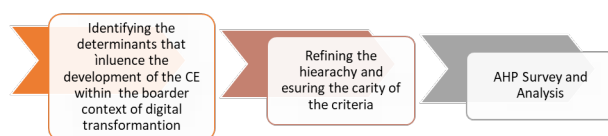
(UNIDO, 2022). Multi-stakeholder collaboration is crucial for technological diffusion, the development of eco-industrial parks, and the implementation of large-scale circular business models (Ellen MacArthur Foundation, 2023; Bocken et al., 2017).

Although interest in the circular economy and digital transformation (DX) is growing, significant research gaps remain. Current studies tend to examine CE and DX separately, offering limited insight into their interactions. Empirical evidence from developing countries is sparse, despite their unique institutional, technological, and behavioral conditions. Moreover, few studies systematically evaluate the relative importance or causal relationships among CE determinants in digital contexts, and the roles of multi-stakeholder collaboration and circular consumption behavior are insufficiently addressed. These gaps underscore the need for comprehensive empirical research that identifies and quantifies the key determinants of CE development under digital transformation, thereby strengthening theoretical understanding and informing more effective sustainability policies.

2.2. Methodology

This study employs a quantitative research design based on the AHP to determine the relative importance of stakeholder-related determinants influencing the development of the circular economy in Vietnam. The research follows a three-stage sequential process designed to ensure that the analytical framework is both theoretically robust and practically relevant. An overview of the entire research design is presented in Figure 1.

Figure 1. Research process



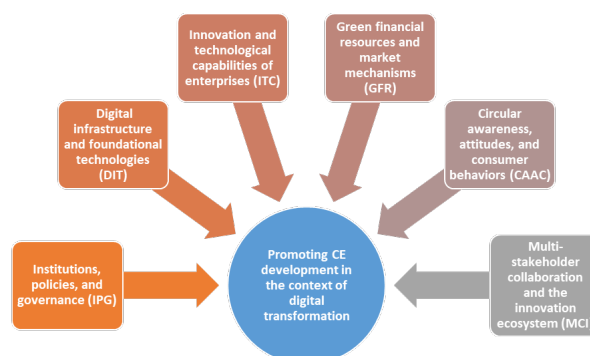
Based on the literature review and expert consultation, the study develops a two-level hierarchical structure for the AHP model as follows:

Level 1: Overall Goal - Promoting circular economy development in the context of digital transformation in Vietnam.

Level 2: Determinants affecting circular economy development under digital transformation.

Drawing on previous studies and expert consultations, the research identifies six determinants, as presented in Figure 2.

Figure 2. The AHP hierarchical model of circular economy development in the digital transformation era



The AHP, developed by Saaty (1980), was applied to quantify the relative importance of determinants. The method involves pairwise comparisons among criteria to derive ratio-scale priorities through matrix eigenvalue computation.

First, experts were asked to compare each pair of elements at the same hierarchical level using the nine-point Saaty scale, where 1 indicates equal importance and 9 denotes extreme importance of one element over another. Individual comparison matrices were then aggregated using the geometric mean to form a group judgment matrix, ensuring that collective opinions represent the consensus view of all experts.

Next, the priority vector (weights) was obtained by normalizing the principal eigenvector of each comparison matrix. The Consistency Index (CI) and Consistency Ratio (CR) were computed to verify the logical coherence of judgments using the following formulas:

$$CI = \frac{\lambda_{\max} - n}{n - 1}, CR = \frac{CI}{RI}$$

where $\lambda_{\max}$ is the maximum eigenvalue of the matrix, n is the number of criteria, and RI denotes the Random Index based on matrix size (Saaty & Vargas, 2001). A matrix is considered consistent when $CR \leq 0.10$.

After confirming consistency, the global weights of each sub-determinant were calculated by multiplying its local weight by the corresponding weight of the parent determinant. These global weights were subsequently used to rank the relative importance of the determinants shaping circular economy development.

3. Research findings and discussion

Pilot interviews were first conducted to refine the hierarchical structure, clarify the wording of criteria

and sub-criteria, and ensure the coherence of the pairwise comparison questionnaire. Expert feedback helped sharpen conceptual definitions, remove overlapping elements, and improve consistency across hierarchical levels, thereby enhancing the clarity and methodological rigor of the final AHP instrument.

The formal AHP survey involved fourteen purposively selected experts with substantial experience in circular economy, digital transformation, environmental policy, and sustainability governance. Their diverse institutional affiliations, professional backgrounds, and years of experience strengthened both the representativeness and analytical robustness of the study. Most experts had more than five years of professional experience, including senior government officials, academic researchers, consultants, and industry practitioners. While experts from government and academia formed the majority - reflecting their central role in CE policy and planning - participants from enterprises and civil society organizations contributed valuable practical insights into implementation-related challenges.

Table 1. Demographic characteristics of the 14 experts

Variable	Category	Frequency (n = 14)	Percentage (%)
Gender	Male	9	64.3
	Female	5	35.7
Age Group	30-39 years	3	21.4
	40-49 years	6	42.9
	≥ 50 years	5	35.7
Highest Academic Qualification	Master's Degree	4	28.6
	PhD / Doctorate	10	71.4
Field of Expertise	Environment & Circular Economy	4	28.6
	Digital Transformation / ICT	3	21.4
	Sustainable Development	3	21.4
	Policy & Public Administration	2	14.3
	Business & Innovation Management	2	14.3
Professional Experience	5-10 years	3	21.4
	11-15 years	5	35.7
	>15 years	6	42.9
Work Sector	Academia / Research Institutes	7	50.0
	Government Agencies	3	21.4
	Business / Industry	2	14.3
	NGOs / International Organizations	2	14.3

Note: This table provides a summary of the demographic characteristics of the 14 experts participating in the AHP evaluation.

To ensure the reliability and validity of the AHP assessment, the study engaged a panel of fourteen experts with extensive backgrounds in circular economy, environmental management, digital transformation, sustainability, and public policy. As summarized in Table 1, many experts held doctoral degrees and had over ten years of professional experience, ensuring strong subject-matter expertise. The panel's composition - spanning academia, government, industry, and international organizations

- provided a balanced and multidimensional foundation for evaluating the determinants of circular economic development in the context of digital transformation.

Table 2. Aggregated pairwise comparison matrix for the six determinants

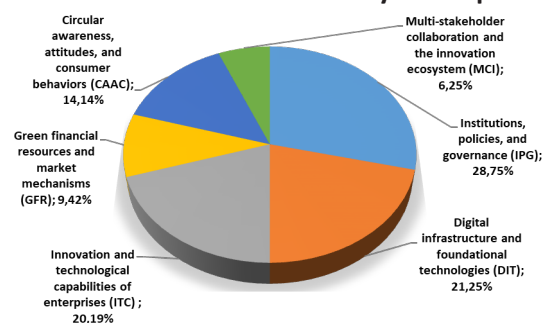
	IPG	DIT	ITC	GFR	CAAC	MCI
IPG	1.000	1.929	1.929	2.000	2.929	3.643
DIT	0.500	1.000	2.000	2.000	2.071	2.857
ITC	0.500	2.000	1.000	2.000	2.000	2.000
GFR	0.333	0.500	0.500	1.000	0.500	2.000
CAAC	0.500	0.488	0.500	2.000	1.000	3.000
MCI	0.250	0.357	0.500	0.500	0.333	1.000

Note: Values represent the geometric means of all expert judgments.

Abbreviations: IPG - Institutions, policies, and governance; IT - Digital infrastructure and foundational technologies; ITC - Innovation and technological capabilities of enterprises; GFR - Green financial resources and market mechanisms; CAAC - Circular awareness, attitudes, and consumer behaviors; MCI - Multi-stakeholder collaboration and the innovation ecosystem.

In Table 2, each entry indicates the relative importance of the determinant in the corresponding row compared with the determinant in the corresponding column. A value greater than 1 signifies that the row determinant is judged to be more influential than the column determinant, whereas a value less than 1 indicates the opposite. Diagonal values are equal to 1, reflecting the equal importance of each determinant when compared with itself.

Figure 03. AHP-derived weights of the six determinants of circular economy development



Note: Weights are derived from the principal eigenvector of the aggregated pairwise comparison matrix. The CR for the aggregated judgment was < 0.1, indicating acceptable consistency.

The figure presents the normalized weights of the six determinant groups in the AHP model, offering a visual complement to Table 2 by illustrating the proportional distribution of expert judgments within the CE-DX framework. The AHP results indicate a differentiated hierarchy of influences across the determinants shaping circular economy development in the digital transformation era. The weight distribution reflects Vietnam's early-stage CE transition and aligns with broader patterns in emerging economies, highlighting a trajectory that is policy-led, technology-enabled, and enterprise-driven

Institutions, Policies, and Governance (IPG): The Primary Driver of CE Development

With the highest weight (0.2875), IPG stands as the most influential determinant of CE development. This highlights the pivotal role of the State in providing regulatory clarity, steering CE transition pathways, and establishing governance mechanisms that enable implementation. Key policy instruments - such as the Law on Environmental Protection (2020), Decree No. 08/2022/NĐ-CP, and the National CE Development Scheme (2022) - serve as foundational institutional anchors. This finding aligns with OECD (2023), UNIDO (2022), and Ellen MacArthur Foundation (2023), which emphasize that CE transitions in developing economies are fundamentally shaped by coherent policy frameworks that condition behavioral, technological, and market responses.

Digital Infrastructure and Foundational Technologies (DIT): A Critical Enabling Pillar

DIT ranks second (0.2125), underscoring its role as a critical technological enabler of CE 4.0. Core digital technologies - including IoT, AI, big data analytics, cloud computing, and blockchain - enable real-time material flow monitoring, life-cycle data management, and transparency in EPR systems. Consistent with Rosa et al. (2020) and ITU (2024), the results confirm that digital technologies are essential for scaling circular practices by reducing information asymmetrical and improving reverse logistics efficiency. Vietnam's rapid digital transformation further reinforces DIT as a prerequisite for integrating CE principles into industrial processes and public-sector operations.

Institutions, Policies, and Governance (IPG): The Dominant Driver

With the highest weight (0.2875), IPG emerges as the most influential determinant, reaffirming the centrality of the State in orchestrating CE transitions. Vietnam's recent regulatory milestones - including the Law on Environmental Protection (2020), Decree No. 08/2022/NĐ-CP, and the National Scheme for CE Development (2022) - serve as institutional cornerstones that define CE goals, establish technical standards, and operationalize extended producer responsibility (EPR). This finding is consistent with OECD (2023), UNIDO (2022), and the Ellen MacArthur Foundation (2023), all of which emphasize that CE transitions in developing economies are critically dependent on regulatory coherence. In such contexts, policy direction precedes technological adoption, market responses, and behavioral shifts, thereby placing IPG at the forefront of CE system formation.

Digital Infrastructure and Foundational Technologies (DIT): A Key Enabler of CE 4.0

Ranked second (0.2125), DIT highlights the enabling function of digital technologies in supporting CE 4.0. Advanced technologies - IoT, AI, big data, blockchain, and cloud computing - facilitate real-time tracking of material flows, automated sorting processes, supply-chain visibility, and the digital verification of EPR compliance. This result aligns with Rosa et al. (2020) and ITU (2024), who identify digital infrastructure as a precondition for scaling CE strategies. In Vietnam's context, the rapid expansion of digital platforms under the National Digital Transformation Program has laid the technological groundwork for integrating CE principles into industrial operations and environmental governance. The relatively high weight of DIT confirms that CE deployment increasingly depends on digital readiness.

Innovation and Technological Capabilities of Enterprises (ITC): Operationalizing CE in Practice

With a weight of 0.2019, ITC ranks closely behind DIT, demonstrating the critical role of enterprises in translating CE policy frameworks into operational practices. Firms drive CE implementation through eco-design, remanufacturing technologies, advanced recycling systems, circular supply chains, and data-driven business models such as Product-as-a-Service. This result corroborates Ranta et al. (2021) and Ghosh (2023), who argue that enterprise-level innovation capacity is a determining factor in CE operationalization. The near equivalence of ITC and DIT suggests that even strong digital infrastructure requires corresponding firm-level competencies to generate transformative effects. Thus, enterprises constitute the "execution layer" of CE transitions.

Circular Awareness, Attitudes and Consumer Behaviors (CAAC): An Emerging but Constrained Driver

CAAC holds a moderate weight (0.1414), reflecting its emerging role in enabling "market pull" for circular products. However, its influence remains limited by structural constraints such as insufficient CE awareness, weak waste-sorting practices, and skepticism toward recycled materials. As highlighted by OECD (2023) and Camacho-Otero et al. (2018), consumer behavior in developing economies tends to evolve after enabling institutional and technological conditions are established. Vietnam's CE context follows this pattern: behavioral change is important but secondary, depending on stronger regulatory enforcement, accessible CE products, and reliable information systems.

Green Financial Resources and Market Mechanisms (GFR): A Developing but Underutilized Component

The low weight of GFR (0.0942) indicates that while green finance is theoretically essential for scaling CE initiatives, it remains nascent in practice. Vietnam's green credit systems are limited, carbon markets are still in early development, and secondary raw material markets lack liquidity. Consistent with OECD (2024) and UNDP (2023), financial institutions face data gaps, unclear taxonomies, and verification challenges, which constrain investment flows into CE sectors. As CE and DX ecosystems mature, however, the role of green finance is expected to increase.

Multi-Stakeholder Collaboration and Innovation Ecosystems (MCI): Currently Weak but Strategically Vital

MCI carries the lowest weight (0.0625), revealing fragmentation in collaborative networks across government, industry, academia, and local communities. The lack of data-sharing platforms, limited industrial symbiosis initiatives, and weak inter-agency coordination hinder ecosystem formation. This aligns with UNIDO (2022), which notes that collaboration deficits are typical in early-stage CE systems. Despite its current weakness, MCI is strategically crucial for long-term CE resilience, particularly as Vietnam advances toward industrial ecosystems and circular clusters.

4. Implications

The findings of this study generate several important theoretical, managerial, and policy implications that advance both scholarly understanding and practical implementation of the circular economy within the digital transformation context.

The findings yield three central theoretical insights: early-stage CE transitions in emerging economies are predominantly policy-led and institution-driven; digitalization enhances CE outcomes only when supported by adequate enterprise innovation capacity; and behavioral, financial, and collaborative mechanisms tend to mature later, following institutional and technological consolidation. Managerially, the results highlight the need to strengthen regulatory coherence, develop CE standards, expand digital monitoring systems, and support enterprise innovation through incentives and SME-focused programs. Policy implications reinforce these priorities, emphasizing digital infrastructure investment, EPR traceability, consumer awareness

initiatives, and the formation of multi-stakeholder and industrial symbiosis networks. Collectively, these implications position Vietnam to advance toward a digitally enabled circular economy through a transition pathway that is institutionally guided, technologically empowered, and enterprise-centered, while progressively fostering behavioral, financial, and collaborative foundations.

5. Conclusion: This study identifies and prioritizes the key determinants shaping circular economy development in Vietnam's digital transformation era. The AHP results reveal a policy-led, technology-enabled, and enterprise-driven transition pathway, with institutional quality, digital readiness, and firm-level innovation emerging as dominant drivers, while behavioral, financial, and collaborative mechanisms play secondary but evolving roles. These findings offer a structured foundation for strengthening CE implementation through coordinated institutional reforms, technological advancement, and enterprise capability development. Overall, the study provides actionable guidance for policymakers and industry leaders seeking to advance Vietnam toward a digitally enabled circular economy.

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TRUST, DIGITAL READINESS, AND INTENTION TO USE E-KYC: EVIDENCE FROM COMMERCIAL BANKS IN VIETNAM

PhD. Tran Hoang Vu*

Abstract: *This paper investigates the role of trust and simple enabling conditions in explaining intention to use Electronic Know Your Customer (e-KYC) among customers of commercial banks in Vietnam. We use cross-sectional survey data from 638 adult customers of joint-stock commercial banks. Ordinary Least Squares and Ordered Probit models are estimated with robust standard errors and standard diagnostic checks. The results show that trust and daily internet use have large, statistically significant positive associations with intention, whereas smartphone ownership and VNeID linkage are individually weaker but jointly important as part of a broader set of facilitating conditions. These findings highlight trust and everyday digital habits as central levers for promoting e-KYC and suggest that policies which build trust and encourage regular online engagement can meaningfully support Vietnam's digital banking and financial inclusion agenda.*

• Keywords: e-KYC; trust; digital readiness; digital banking; technology adoption; Vietnam.

Date of receipt: 20th Sep., 2025

Date of delivery revision: 26th Sep., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.07>

Date of receipt revision: 05th Oct., 2025

Date of approval: 28th Oct., 2025

1. Introduction

In recent years, banks in Vietnam have invested heavily in digital transformation. A core element of this process is electronic Know Your Customer (e-KYC), which allows banks to verify customer identities remotely using digital technologies instead of face-to-face procedures and paper documents. e-KYC is now recognized internationally as an important tool for secure, low-cost digital financial services and for promoting financial inclusion (ITU-T, 2024).

Vietnam has moved quickly to create a regulatory and technological foundation for e-KYC. In 2020, the State Bank of Vietnam issued Circular No. 16/2020/TT-NHNN, which allows commercial banks to open payment accounts using e-KYC and clarifies their responsibilities when applying remote identification technologies (VCI Legal, 2020). This circular marked a turning point in the rollout of fully digital onboarding processes in the banking sector. Together, these developments create strong technical and regulatory conditions for the adoption of e-KYC in Vietnam.

The broader literature on digital banking and technology adoption shows that perceived usefulness, ease of use, and institutional trust are key drivers of customers' intention to use digital financial services (Davis, 1989; Venkatesh et al., 2003; Yousafzai et al., 2009). Many studies also emphasise the role of facilitating conditions and digital skills in enabling people to translate intention into actual use (Venkatesh

et al., 2003; Alalwan et al., 2017; Acosta-Prado et al., 2024). Less attention has been paid to basic behavioral and infrastructural conditions such as daily internet use, smartphone ownership, and linkage to a national digital identity platform. Therefore, this paper aims to help fill this gap by analyzing how trust and digital readiness are associated with the intention to use e-KYC among customers of commercial banks in Vietnam.

2. Literature review and hypotheses

2.1. e-KYC and digital banking

Electronic Know Your Customer (e-KYC) uses digital tools to verify customer identity remotely instead of relying on face-to-face checks and paper documents. At the international level, e-KYC is seen as a core building block for secure, low-cost digital financial services and an important support for financial inclusion, especially when linked to digital ID systems (ITU-T, 2024).

Vietnam has created a clear regulatory base for e-KYC. Circular No. 16/2020/TT-NHNN allows commercial banks to open payment accounts using e-KYC and sets out their responsibilities when applying remote identification technologies (VCI Legal, 2020). Together, these measures make it technically and legally possible for banks to use e-KYC on a large scale.

Research on e-KYC is still emerging. Technical studies focus on how to build secure and interoperable

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systems, for example by using blockchain to improve privacy and data sharing (Hannan et al., 2023). These contributions mainly speak to system design. Behavioral work is more limited. Adel et al. (2021) study potential customers of Malaysian banks and find that perceived usefulness, ease of use, and concerns about privacy and security influence attitudes towards e-KYC.

A broader body of work on digital banking in Vietnam and other emerging economies shows that user perceptions, trust, and digital capabilities are linked to adoption. Nguyen et al. (2025) identify trust, perceived usefulness, and convenience as key drivers of customers' decisions to use digital banking in Vietnamese commercial banks. A bibliometric review of digital banking adoption in emerging economies by Acosta-Prado et al. (2024) highlights digital infrastructure, smartphone access, and technological readiness as common themes across many studies.

2.2. Technology adoption, trust, and digital readiness

This paper builds on established technology adoption models. The Technology Acceptance Model (TAM) proposes that perceived usefulness and perceived ease of use shape user attitudes and behavioral intention (Davis, 1989). The Unified Theory of Acceptance and Use of Technology (UTAUT) combines TAM with other models and emphasises performance expectancy, effort expectancy, social influence, and facilitating conditions as determinants of intention and use (Venkatesh et al., 2003). Facilitating conditions refer to the degree to which users feel that the technical and organisational infrastructure supports system use.

In digital financial services, these frameworks are often extended to include trust. Yousafzai et al. (2009) show that trust has a multi-dimensional effect on internet banking adoption, shaping risk perceptions, attitudes and intention. Alalwan et al. (2017) extend UTAUT2 by adding trust to explain mobile banking adoption and find that trust is a strong positive predictor of intention. Systematic reviews also conclude that trust and security are among the most consistent drivers of FinTech and digital banking adoption (Jafri et al., 2024; Yacoubian, 2025).

Bringing these strands together, the present study focuses on two main constructs:

- Trust in e-KYC, understood as confidence that the process is safe, accurate and fair; and
- Digital readiness, captured by four simple

facilitating conditions: daily internet use, smartphone ownership, linkage to VNeID, and previous customer status with a commercial bank.

The econometric design later in the paper is structured around these two constructs and tests both the individual effect of daily internet use and the joint contribution of the four digital readiness variables as a group.

2.3. Hypotheses

To keep the empirical analysis focused on what theory and the data can support, the study uses a small set of clear hypotheses.

First, the literature on digital banking and FinTech consistently finds that trust is a key driver of adoption (Yousafzai et al., 2009; Alalwan et al., 2017; Jafri et al., 2024; Yacoubian, 2025). In the specific context of e-KYC, where customers must share identity documents and sensitive personal data, trust in the e-KYC process is likely to be central. We therefore expect:

H1. Higher trust in e-KYC is associated with higher intention to use e-KYC.

Second, UTAUT emphasises facilitating conditions, and empirical studies in Vietnam and other emerging economies show that access to the internet, devices, and digital identity systems are important enablers of digital banking (Venkatesh et al., 2003; Hoang and Phan, 2024; Nguyen et al., 2025; Acosta-Prado et al., 2024). In our setting, daily internet use stands out as a core element of everyday digital habits, while smartphone ownership, VNeID linkage, and previous customer status together describe a broader set of supporting conditions. Rather than creating many separate hypotheses for each individual variable, we focus on two simple statements:

H2a. Customers who use the internet daily have a higher intention to use e-KYC than those who do not.

H2b. The set of digital readiness conditions (daily internet use, smartphone ownership, VNeID linkage, and previous customer status) is jointly associated with intention to use e-KYC.

These hypotheses match both the theoretical expectations from TAM/UTAUT and the structure of the econometric analysis to be presented in later sections. The models will test H1 through the coefficient on trust and H2a through the coefficient on daily internet use, and will use a joint Wald test to assess H2b for the digital readiness block.

3. Research context and methodology

The empirical analysis uses a cross-sectional

survey of 638 adult customers of joint-stock commercial banks in Vietnam. Respondents are current or potential retail customers. The final dataset contains 638 complete observations with no missing values for the variables used in the models. Ages range from 18 to 74 years (mean ≈ 35 years). The gender split is 52% female and 48% male, and about 38% of respondents live in urban areas. Education is fairly diverse, with almost half having completed upper secondary school and about one-fifth having tertiary education. The average self-reported monthly income is roughly 19.4 million VND, with a wide dispersion. On the banking and digital side, around three-quarters are already customers of at least one commercial bank, more than four-fifths own a smartphone and use the internet daily, and about two-fifths have linked at least one service to VNeID. Many respondents report some experience with e-KYC, but the intention to use e-KYC is measured for all.

The dependent variable is intention to use e-KYC in the future (*intention_to_use_1_5*), measured on a 1-5 Likert scale, where higher values indicate stronger intention. The mean is 3.68, suggesting generally positive but varied intentions. The main explanatory variable is trust in e-KYC (*trust_face_1_5*), also measured on a 1-5 Likert scale, capturing confidence that e-KYC is safe, accurate, and fair; its mean is 3.47. These two variables are used to test whether higher trust is associated with higher intention (H1).

Digital readiness is represented by four simple binary indicators that act as basic facilitating conditions:

- Daily internet use (*internet_daily*): 1 if the respondent uses the internet every day.
- Smartphone ownership (*smartphone_owner*): 1 if the respondent owns a smartphone.
- VNeID linkage (*vneid_linked*): 1 if the respondent has linked at least one service to VNeID.
- Previous customer status (*previous_customer*): 1 if the respondent is already a customer of at least one commercial bank.

These four variables, individually and as a block, are used to test whether stronger digital readiness is associated with higher intention to use e-KYC (H2). To reduce confounding, the models also include standard socio-demographic controls: age, gender (a dummy for male), urban residence, education level (four categories from primary to tertiary), and self-reported monthly income (in thousand VND).

The econometric strategy follows the structure of the hypotheses and remains deliberately simple. First, a

baseline OLS regression is estimated with the intention of using e-KYC as the dependent variable and trust plus the four digital readiness indicators as regressors. This model, without additional controls, provides an easily interpretable test of the direct associations of trust and basic digital conditions with the 1-5 intention score. Second, an extended OLS specification adds the socio-demographic controls. For this model, heteroskedasticity-robust (HC1) standard errors are reported, and a Wald F-test is used on the four digital readiness coefficients to test whether they are jointly associated with intention, as implied by H2. Third, because the dependent variable is ordinal, a standard ordered probit model with the same regressors is estimated. This ordered model is used mainly to check the robustness of signs and significance and to compute average marginal effects on the probability of being in a “high-intention” category (for example, a response of 4 or 5 on the 1-5 scale).

As a robustness check, interaction terms between urban residence and the key variables (trust and daily internet use) are added in supplementary models to see whether the associations differ between urban and non-urban respondents. The key coefficients remain stable, and interaction terms are not statistically important, so the main discussion focuses on pooled results.

Standard diagnostic tests are carried out for the OLS models. A Breusch-Pagan-Godfrey test does not suggest serious heteroskedasticity, centred variance inflation factors are low and do not point to multicollinearity problems, and a Ramsey RESET test does not indicate functional form misspecification. The consistency of the main coefficients across OLS and ordered probit further supports the reliability of the empirical findings. Overall, this design provides a clear and tractable basis for evaluating how trust and digital readiness relate to intention to use e-KYC among bank customers in Vietnam.

4. Results

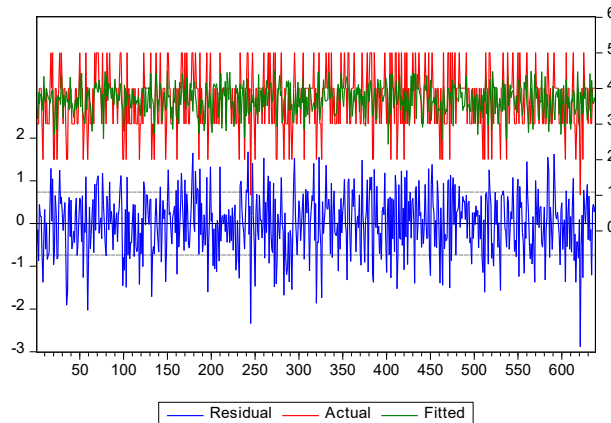
This section reports the main regression results for intention to use e-KYC. We focus on three elements: the OLS model with controls and robust standard errors, the joint test for the digital readiness block, and the ordered probit model with probability effects.

4.1. OLS results with controls

Table X presents the OLS regression of intention to use e-KYC (1-5 scale) on trust, the four digital readiness indicators, and socio-demographic controls, using HC1 heteroskedasticity-robust standard errors (N = 638).

Table 1: OLS regression result of dependent variable (INTENTION_TO_USE_1_5)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.772019	0.233597	7.585797	0.0000
TRUST_FACE_1_5	0.415079	0.034882	11.89938	0.0000
PREVIOUS_CUSTOMER	-0.026803	0.073930	-0.362541	0.7171
INTERNET_DAILY	0.379313	0.100161	3.787029	0.0002
SMARTPHONE_OWNER	0.174265	0.102537	1.699523	0.0897
VNEID_LINKED	0.059496	0.060354	0.985780	0.3246
URBAN	0.052505	0.069013	0.760792	0.4471
AGE	0.000241	0.002871	0.084098	0.9330
MALE	0.032113	0.059224	0.542229	0.5879
EDUCATION_LEVEL	0.007711	0.048400	0.159309	0.8735
INCOME_THOUSAND_VND	-2.99E-06	2.12E-06	-1.410876	0.1588
R-squared	0.229686	Mean dependent var		3.678683
Adjusted R-squared	0.217400	S.D. dependent var		0.834057
S.E. of regression	0.737846	Akaike info criterion		2.246928
Sum squared resid	341.3494	Schwarz criterion		2.323796
Log likelihood	-705.7701	Hannan-Quinn criter.		2.276769
F-statistic	18.69536	Durbin-Watson stat		2.045618
Prob(F-statistic)	0.000000	Wald F-statistic		23.34481
Prob(Wald F-statistic)	0.000000			



Two findings stand out very clearly.

First, trust in e-KYC is a strong and highly significant predictor of intention. The coefficient on TRUST_FACE_1_5 is 0.415 ($p < 0.001$). This means that, holding other variables constant, moving trust up by one point on the 1-5 scale is associated with an increase of about 0.42 points in the intention score. This directly supports H1 and confirms that trust is the central driver in the model.

Second, daily internet use is also strongly and positively associated with intention. The coefficient on INTERNET_DAILY is 0.379 ($p = 0.0002$). Customers who use the internet every day have, on average, intention scores about 0.38 points higher (on a 1-5 scale) than those who do not, all else equal. This provides clear support for H2a and shows that everyday digital habits matter.

For the other digital readiness variables, the individual effects are weaker:

- SMARTPHONE_OWNER has a positive but only marginally significant coefficient (0.174, $p \approx 0.09$).

- VNEID_LINKED is positive but not statistically significant (0.059, $p \approx 0.32$).

- PREVIOUS_CUSTOMER is small and not significant (-0.027, $p \approx 0.72$).

None of the socio-demographic controls (urban residence, age, male, education level, income) are statistically significant at conventional levels in this specification. Once trust and basic digital readiness are included, background characteristics do not show independent associations with intention.

The model fits the data reasonably well for survey cross-section analysis. The R^2 is 0.230 (adjusted $R^2 = 0.217$), indicating that the regressors jointly explain around 23% of the variation in intention. The overall F-statistic for the model is highly significant ($F = 18.70$, $p < 0.001$), and the Durbin-Watson statistic is close to 2.0, suggesting no serious autocorrelation in the residuals.

4.2. Digital readiness as a block

Although some individual digital readiness coefficients are only weakly significant, the study is particularly interested in whether the four digital readiness indicators matter as a group, as set out in H2b.

Table 2: Wald Test

Test Statistic	Value	df	Probability
F-statistic	11.80948	(4, 627)	0.0000
Chi-square	47.23790	4	0.0000
Null Hypothesis: C(3)=0, C(4)=0, C(5)=0, C(6)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(3)		-0.026803	0.073930
C(4)		0.379313	0.100161
C(5)		0.174265	0.102537
C(6)		0.059496	0.060354

Restrictions are linear in coefficients.

To test this, a Wald test is applied to the joint null hypothesis that the coefficients on PREVIOUS_CUSTOMER, INTERNET_DAILY, SMARTPHONE_OWNER, and VNEID_LINKED are all zero. The results are:

$$F(4, 627) = 11.81, p < 0.001$$

$$\chi^2(4) = 47.24, p < 0.001$$

The null hypothesis that all four coefficients are jointly zero is clearly rejected. This means that, considered together, the digital readiness variables contribute significantly to explaining intention to use e-KYC, even though some single coefficients are only marginally significant. This supports H2b and suggests that policy or intervention packages that move several of these conditions at once (e.g., promoting regular internet use, supporting smartphone access, encouraging VNeID linkage, and

using existing customer bases) are likely to have a stronger combined effect than focusing on any one factor in isolation.

4.3. Ordered probit and probability effects

To respect the ordinal nature of the 1-5 intention scale, the same set of variables is estimated in a standard ordered probit model (Table Y). The ordered probit results closely mirror the OLS findings.

Table 3: Ordered Probit regression result of dependent variable (INTENTION_TO_USE_1_5)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
TRUST_FACE_1_5	0.618535	0.058845	10.51122	0.0000
PREVIOUS_CUSTOMER	-0.036841	0.104741	-0.351730	0.7250
INTERNET_DAILY	0.555150	0.150297	3.693689	0.0002
SMARTPHONE_OWNER	0.247612	0.154514	1.602520	0.1090
VNEID_LINKED	0.094723	0.089613	1.057033	0.2905
URBAN	0.079237	0.100702	0.786849	0.4314
AGE	0.000255	0.004262	0.059802	0.9523
MALE	0.052526	0.087369	0.601203	0.5477
EDUCATION_LEVEL	0.007664	0.068492	0.111901	0.9109
INCOME_THOUSAND_VND	-4.43E-06	3.14E-06	-1.407611	0.1592
Limit Points				
LIMIT_2:C(11)	-0.299118	0.397785	-0.751959	0.4521
LIMIT_3:C(12)	1.143421	0.335588	3.407216	0.0007
LIMIT_4:C(13)	2.515464	0.343150	7.330499	0.0000
LIMIT_5:C(14)	4.000236	0.358108	11.17047	0.0000
Pseudo R-squared	0.105452	Akaike info criterion	2.233006	
Schwarz criterion	2.330838	Log likelihood	-698.3288	
Hannan-Quinn criter.	2.270984	Restr. log likelihood	-780.6496	
LR statistic	164.6416	Avg. log likelihood	-1.094559	
Prob(LR statistic)	0.000000			

- The coefficient on trust is 0.619 ($p < 0.001$).

- The coefficient on daily internet use is 0.555 ($p = 0.0002$).

- The coefficients for SMARTPHONE_OWNER, VNEID_LINKED, and PREVIOUS_CUSTOMER remain positive but individually not significant at the 5% level, while the socio-demographic controls again show no clear separate effects.

The pseudo R^2 is 0.105, and the likelihood-ratio test strongly rejects the null of no explanatory power (LR statistic = 164.64, $p < 0.001$). The sign and significance pattern for trust and daily internet use is thus robust across both OLS and ordered probit.

To give the results a clearer practical meaning, average marginal effects are computed from the ordered probit model for the probability of being in a "high-intention" group, defined as giving an answer of 4 or 5 on the 1-5 scale. The key numbers are:

- The baseline probability (at sample means) of being in the high-intention group is about 60.4%.

- Moving from not using the internet daily to using it daily ($0 \rightarrow 1$ on INTERNET_DAILY) increases this probability by about 19.4 percentage points. In other words, among 100 otherwise similar customers, daily internet use is associated with roughly 19 additional

people falling into the high-intention group.

- Increasing trust in e-KYC by one point on the 1-5 scale raises the probability of high intention by about 17.1 percentage points. For 100 similar customers, a one-point trust improvement is associated with about 17 more people reporting high intention (4 or 5).

These effects are large in absolute terms and confirm that trust and everyday digital habits are the two main levers linked to higher intention to use e-KYC.

4.4. Summary

Across all specifications, the results are consistent with the two main hypotheses:

H1 is strongly supported: higher trust in e-KYC is robustly associated with higher intention to use e-KYC, with economically large effect sizes.

H2 is supported in two ways: daily internet use emerges as a clear positive predictor of intention, and a Wald test shows that the four digital readiness indicators are jointly important, even if some single coefficients are only weakly significant.

Socio-demographic characteristics do not appear as strong independent predictors once trust and digital readiness are taken into account. Overall, the evidence points to trust and everyday digital readiness as the core factors associated with customers' intention to use e-KYC in Vietnam's commercial banking sector.

5. Discussion and Implications

The results confirm that trust and basic digital readiness are central in shaping customers' intention to use e-KYC in Vietnam. The strong and stable effect of trust is consistent with technology adoption models and prior work on digital banking and FinTech that emphasise the importance of confidence in the system and in the institution providing the service. In this study, a one-point increase in trust on the 1-5 scale is associated with a sizeable increase in the intention score and with a large rise in the probability of reporting high intention. This underlines that technical compliance with regulations is not enough: customers must feel that e-KYC is safe, accurate and fair.

Daily internet use emerges as the second robust driver of intention. Customers who use the internet every day have a clearly higher intention to use e-KYC than those who do not, even after controlling for other factors. This suggests that everyday digital habits and familiarity with online services matter at least as much as formal characteristics such as education or income. In contrast, smartphone ownership and VNeID linkage are individually weaker, but the Wald test shows that the four digital readiness indicators

are jointly important. This pattern is in line with the idea of “facilitating conditions”: none of the enabling factors is decisive on its own, but together they describe whether customers are in a position to use e-KYC comfortably.

The weak and statistically insignificant effects of socio-demographic controls suggest that once trust and digital readiness are taken into account, age, gender, education, income, and urban residence do not strongly differentiate intention to use e-KYC. This does not mean that these characteristics are irrelevant in general, but in this dataset, they do not appear as independent barriers once customers have similar levels of trust and digital readiness.

5.1. Managerial and policy implications

The findings carry several practical implications for banks and policymakers:

- Prioritize trust-building measures. Banks should communicate clearly how e-KYC works, what data is collected, how it is protected, and what legal safeguards are in place. Simple explanations in plain language, visible privacy assurances, and transparent complaint and redress mechanisms can help strengthen trust.

- Use service quality to reinforce trust. Smooth, error-free e-KYC experiences, fast problem resolution, and consistent treatment across channels can support trust in both the technology and the institution. Poor execution at the onboarding stage may damage trust and discourage future use.

- Strengthen everyday digital habits. Because daily internet use is such a strong correlate of intention, banks could work with telecom providers, local authorities or educational institutions to support digital literacy programmes, promote safe internet use, and encourage regular engagement with online services.

- Treat digital readiness as a package. The joint significance of the digital readiness block suggests that combined interventions may be more effective than isolated actions. For example, campaigns that simultaneously promote mobile banking apps, explain VNeID linkage, and help customers set up their devices could generate complementary effects.

- Do not rely only on socio-demographic targeting. Since age, gender, education, and income are not strong independent predictors once trust and readiness are controlled for, segmentation strategies based purely on these characteristics may miss important behavioural differences. Segmenting by trust level and digital habits may be more informative.

6. Conclusion

This paper has examined how trust and digital readiness are associated with customers' intention to use electronic Know Your Customer (e-KYC) in Vietnam's commercial banking sector. Using survey data from 638 adult customers and estimating both OLS and ordered probit models, the study finds that trust in e-KYC and daily internet use are the two strongest predictors of intention. Smartphone ownership and VNeID linkage are individually weaker but, together with previous customer status, form a digital readiness block that is jointly significant.

These findings indicate that successful e-KYC implementation requires more than a supportive regulatory framework and technical infrastructure. Customers must trust the e-KYC process and feel able and comfortable using digital channels in their daily lives. Policies and bank strategies that build trust, communicate clearly about data protection and procedures, and strengthen everyday digital habits are therefore central to promoting e-KYC. In turn, wider use of e-KYC can support the broader goals of digital banking development and financial inclusion in Vietnam.

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THE RELATIONSHIP BETWEEN TOURISM AND INCOME INEQUALITY IN VIETNAM

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Abstract: *This study investigates the relationship between tourism development and income inequality at the provincial level in Vietnam. We employ panel data from 2018 to 2022, to analyze the impact of tourism on income inequality. The results reveal that tourism development consistently and significantly increases income inequality. Policy implications are discussed.*

• Keywords: *tourism; income inequality; Vietnam.*

Date of receipt: 20th Nov, 2025

Date of delivery revision: 26th Nov., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.08>

Date of receipt revision: 05th Dec., 2025

Date of approval: 23th Jan., 2026

1. Introduction

Income inequality, the uneven distribution of income across individuals or groups, is a critical global issue with implications for social stability and economic growth (Cingano, 2014). Despite joint efforts by international organizations, governments, and academia, income inequality continues to persist and has even worsened in recent years. The rise in income inequality significantly impacts the socio-economy, as studies have shown it leads to reduced economic growth and efficiency (Piketty, 2014), weakens social unity and trust in institutions weakens democratic governance and political stability and exacerbates poverty and social welfare challenges, particularly in developing nations (Atkinson, 2015).

Vietnam represents a dynamic, developing, and transitional economy in which tourism has been strategically positioned as a leading sector to foster economic growth and broaden livelihood opportunities, where traditional economic activities have proven insufficient for achieving sustainable reductions in income inequality. Despite a relatively stable Gini coefficient throughout the past decade, there has been limited substantive progress in addressing inequality. While relative inequality has not markedly increased, absolute inequality has widened, reflecting a growing income gap between socioeconomic groups.

This study focuses on analyzing the relationship between tourism and income inequality by examining the case of Vietnam. To achieve this, the study uses the spatiotemporal heterogeneity models with Vietnamese provincial-level data in the period 2018 - 2022. Our research question is: Does tourism growth narrow or widen income inequality at the national level in developing economies?

The structure of this paper is as follows: Section 2 provides a review of the relevant literature; Section 3

describes the data and outlines the research methods; Section 4 presents the descriptive statistics and empirical results; and Section 5 concludes with key findings, policy implications, and limitations.

2. Literature review

Income inequality is described as “the gap between the rich and the poor” (Subramaniam et al, 2022) that leading to lower per capita income for the poor and making it difficult to eliminate or even reduce poverty rates. Reducing income inequality is a vital objective for every nation, and addressing these disparities will be one of their most significant challenges. In which tourism fundamentally involves the temporary movement of people to destinations outside their usual environment, mainly for leisure, business, or other purposes. It includes not only the travel and activities at the destination but also the range of economic services and activities developed to support and accommodate these travelers.

On the one hand, a rising volume of studies indicates that the expansion of tourism may exacerbate income inequality, as the distribution of benefits is often skewed toward particular groups (Castilho and Fuinhas, 2025). Employment in tourism services, especially in hospitality, retail, and other service-oriented sectors, is frequently characterized by seasonality, low wages, and precarious contracts, offering limited social protection and weak prospects for upward mobility (Valente et al., 2023). Generally, although tourism is a major global industry that generates billions in revenue and employs millions worldwide, its benefits are not distributed evenly, and in many cases, wealth is concentrated among elites, large corporations, or foreign investors, thereby reinforcing structural inequalities (Zhang, 2022). These findings suggest that, despite tourism’s economic significance, its development can deepen

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social and economic divides when left unchecked by redistributive policies or inclusive planning strategies. In contrast, numerous studies demonstrate tourism's potential to mitigate income inequality, particularly in developing and tourist-dependent economies. Seetanah et al. (2023) analyzed data from 83 countries over 1990–2019 and found that tourism development reduces income inequality. This reduction is attributed to tourism's ability to create employment opportunities for low-skilled workers, such as in hospitality or cultural tourism, thereby providing income to marginalized communities. In addition, capital investment in the tourism sector fosters inclusive growth by creating jobs and improving income distribution (Fuinhas, 2025). Therefore, the effect of tourism on income inequality is nuanced and depends on various factors, including a country's development stage, policy framework, and tourism management (Alam & Paramati, 2016). Tourism can reduce inequality by creating jobs for low-skilled workers (Boopen Seetanah et al, 2023) and increasing female employment, while also generating government revenues that fund social programs (Fuinhas, 2025). However, tourism can also exacerbate inequality due to the prevalence of low-paid, seasonal jobs, and the concentration of economic benefits among wealthier business owners.

To the best of our knowledge, there are very few studies that have examined the impact of tourism development on income inequality, and existing findings remain fragmented. Most prior research either focuses on tourism's contribution to economic growth or on inequality in general, without directly linking the two. Therefore, this study applies an OLS regression model to investigate how tourism affects income inequality in Vietnam, using the Gini coefficient as a measure of income distribution. This paper contributes to filling an important gap in literature and provides new empirical evidence on the relationship between tourism and inequality in a developing country context.

3. Research methodology

3.1 Econometrics models

The paper begins with Ordinary Least Squares (OLS) estimation and then mitigates possible heterogeneity among panels by employing the fixed effects (FE) approach, following the framework proposed by Wooldridge (Wooldridge, 2010) and Linear regression absorbing multiple levels of fixed effects proposed by Coreia (Correia, 2016).

$$Inequality_{it} = \alpha_0 + \theta_1 Tourism_{it} + \beta_1 X_{it} + \varepsilon_{it} \quad (1)$$

$$Inequality_{it} = \alpha_0 + \theta_1 Tourism_{it} + \beta_1 X_{it} + \mu_i + \gamma_t + \varepsilon_{it} \quad (2)$$

Where, $Inequality_{it}$ is income inequality index in location i at time t ; $Tourism_{it}$ is the level of tourism development in location i at time t ; X_{it} is a set of control variables; μ_i is province fixed effects, capturing

unobserved time-invariant characteristics of each province; γ_t is year fixed effects, capturing common shocks or macroeconomic factors across all provinces in year t .

3.2. Data collection

We sourced data from Vietnamese province-level data from 2018 to 2022 collected from the General Statistics Office (GSO). Following previous studies, the set of explanatory variables is designed to capture the direct determinants of income inequality across provinces (Ho et al., 2022). We include five variables grouped into four categories: economic structure and institutional quality are controlled by the Provincial Competitiveness Index (PCI) and the level of industrialization which indicate the competitiveness and industrial capacity of each region; social development is represented by the multidimensional poverty index and Consumer Price Inflation (CPI), capturing living standards and price stability; demographic characteristics are reflected by population size. This dataset has been widely used in previous literature. Table 1 reports detailed definitions and descriptions of all variables used in the analysis.

Table 1. Description of variables

Variable	Description	Mean	Std. dev.	Min	Max	VIF
Income_inequality	The Gini coefficient is a statistical measure of income (or wealth) inequality within a nation or a group.	0.36	0.06	0.20	0.53	-
Ln(tourism_development)	Total local retail sales of goods and consumer service revenue, including: (1) Retail sales of goods revenue; (2) Accommodation and food services revenue; (3) Tourism revenue; and (4) Other revenue.	3.88	2.07	0.00	10.89	2.73
PCI_score	The PCI on Vietnam's business environment conducts an annual business survey, assessment and ranking of the economic governance quality of provincial authorities in creating a favorable business environment for development of the private sector.	64.71	2.96	56.29	75.09	1.48
Consumer_price_index	The Consumer Price Index (CPI) tracks changes in the overall price level of a basket of goods and services typically purchased by households over time. It reflects the cost of living and is widely used as an indicator of inflation.	93.23	2.44	86.83	101.47	1.55
Industrial_index	Industrial index is an indicator that evaluates the growth rate of industrial production every period. The index is calculated by the quantity of production, as the percentage of the quantity of industrial production generated in the current and base periods	109.14	10.09	73.10	188.50	1.01
Multidimensional_poverty	An index that measures the percentage of households in a country deprived along three dimensions – monetary poverty, education, and basic infrastructure services – to capture a more complete picture of poverty	7.95	8.71	0.00	44.50	1.73
Ln(population)	Average population refers to the mean number of people in a given area calculated over a specific period of time	7.14	0.58	5.75	9.15	2.09

4. Results and discussion

First, a multicollinearity test was conducted to ensure that the selected variables are appropriate and do not bias the estimation results. As reported in Table 1, all variables exhibit low VIF values (below 3), with an average VIF of 1.76. This confirms that the dataset is suitable for examining the relationship between tourism development and income inequality. Furthermore, Table 2 indicates that tourism has a statistically significant and

positive effect on income inequality in both the OLS and fixed-effects models.

Table 2. OLS regression and FE results

	OLS	FE	FE
Ln(tourism)	0.008*** (0.002)	0.007*** (0.002)	0.007*** (0.002)
PCI	-0.003*** (0.001)	-0.002* (0.001)	-0.001 (0.001)
Multi_poverty	0.004*** (0.000)	0.004*** (0.000)	0.004*** (0.000)
ind_index	-0.000** (0.000)	-0.001** (0.000)	-0.000* (0.000)
CPI	-0.002 (0.001)	-0.001 (0.001)	-0.000 (0.001)
Inpopulation	-0.027*** (0.005)	-0.027*** (0.005)	-0.027*** (0.005)
Year fixed effects	No	Yes	Yes
Regional fixed effects	No	No	Yes
Control variables	Yes	Yes	Yes
Constant	0.869*** (0.125)	0.783*** (0.126)	0.671*** (0.137)
R-squared	0.556	0.587	0.625

Robust standard errors reported in: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The results reveal the relationship between independent variables and income inequality. Specifically, the coefficients (0.008 in OLS; 0.007 in both fixed effect models) are highly significant at the 1% level, indicating that an increase in tourism activity is associated with higher levels of income inequality. This finding supports the argument that tourism expansion may exacerbate disparities in income distribution, particularly when benefits are captured disproportionately by higher-income groups or capital-intensive sectors (Subramaniam et al, 2022).

The coefficient on the Provincial Competitiveness Index (PCI) is negative in the OLS and Year FE models (-0.003 and -0.002, respectively), suggesting that improvements in local governance and business environment can help reduce income inequality. However, this effect becomes statistically insignificant once regional fixed effects are introduced, implying that much of the variation is explained by unobserved regional characteristics rather than within-province changes over time.

The variable Multidimensional Poverty (Multi_poverty) consistently shows a positive and significant association with income inequality (0.004 across all models, at the 1% level). This suggests that regions experiencing higher levels of multidimensional deprivation also tend to face higher inequality, reinforcing the idea that poverty and inequality are mutually reinforcing phenomena.

Finally, the Industrialization Index (ind_index) has a small but negative coefficient (-0.000 to -0.001), significant at the 5% or 10% level. This indicates that greater industrialization is associated with marginal reductions in inequality, potentially reflecting the role of industrial development in generating broader employment opportunities and diffusing income more evenly.

5. Conclusion

The findings reveal that tourism development, while a strong driver of provincial economic growth, consistently increases income inequality. This calls for deliberate policies that address not only the scale of tourism growth but also its distributional effects. In the short term, Vietnam should focus on ensuring that the benefits of tourism reach broader segments of society, particularly disadvantaged groups and lagging provinces. Community-based tourism and the integration of local households into tourism supply chains represent powerful tools in this regard. For example, supporting small-scale homestays, local tour operators, and handicraft cooperatives through microfinance, tax incentives, and training programs can directly link poor households to tourism markets. By reducing reliance on large, capital-intensive projects dominated by external investors, such initiatives can generate more inclusive income flows and help counteract the inequality-enhancing effects identified in the regression results.

At the same time, inter-provincial coordination is critical in the short term. Competition among provinces for tourism revenues often reinforces inequality, as wealthier regions attract more investment and infrastructure, while poorer regions fall further behind. Policies that encourage collaborative marketing campaigns, multi-destination travel circuits, and joint promotion platforms can spread tourism flows across regions rather than concentrating them in established hubs. Knowledge-sharing platforms, where successful provinces share best practices in sustainable tourism development with lagging regions, would also help reduce asymmetries in capacity and policy implementation.

The major limitation of this study lies in its reliance on provincial-level panel data, which, while useful for capturing broad trends, may mask significant variations within provinces and across different social groups. Thus, future studies can expand the scope by using stronger methodological approaches to provide a deeper and more nuanced understanding of the tourism–inequality nexus in Vietnam.

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MAPPING THE INTELLECTUAL LANDSCAPE OF SERVICE INNOVATION IN THE HOTEL INDUSTRY: A BIBLIOMETRIC ANALYSIS AND CONCEPTUAL FRAMEWORK

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Abstract: *Analyzing 261 Scopus publications (2020-2024) via VOSviewer, this study maps the intellectual landscape of hotel service innovation. It synthesizes eight identified clusters into a novel four-stage conceptual framework: organizational foundations, ecosystems, strategic drivers, and sustainable performance. The research highlights emerging trends like green innovation and AI, offering strategic insights to address fragmented collaboration and enhance competitive advantage for stakeholders.*

• **Keywords:** *service innovation, hotel industry, bibliometric analysis, conceptual framework, green innovation.*

Date of receipt: 21th Oct., 2025

Date of delivery revision: 26th Nov., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.09>

Date of receipt revision: 15th Dec., 2025

Date of approval: 12th Jan., 2026

1. Introduction

Driven by technological advancements and sustainability pressures, service innovation has become a prerequisite for survival in the hospitality industry (Zhao et al., 2024; Haldorai et al., 2022). Defined as value-enhancing changes to services or processes (Lei & Chen, 2023), recent research highlights diverse drivers ranging from green inclusive leadership to digital transformation (Vena-Oya et al., 2024; Deputata et al., 2024). However, despite growing interest, the field remains theoretically fragmented, lacking a unifying framework to guide managerial practice. To address this gap, this study employs bibliometric analysis of 261 Scopus publications (2020-2024) to answer five key questions: RQ1: What are the publication trends and evolutionary patterns? RQ2: Who are the most influential contributors (authors, institutions, countries)? RQ3: What are the core thematic clusters constituting the field's foundation? RQ4: How do these clusters interconnect to form a conceptual framework? RQ5: What are the emerging trends guiding future inquiry? By synthesizing eight thematic clusters into a novel four-stage process model, this study provides a comprehensive collaboration map and a strategic roadmap for future academic inquiry and policy development.

2. Methodology

To map the intellectual landscape of service innovation in the hotel industry, this study utilized data from the Scopus database, chosen for its comprehensive coverage of hospitality literature. The data collection spanned from January 2020 to 2024 to capture recent evolutionary trends. The search query *TITLE-ABS-KEY (service AND innovation AND hotel*)* was applied, restricted to final-stage English articles and conference papers within Business, Social Sciences, Decision Sciences, and Multidisciplinary domains. This rigorous screening process yielded a final dataset of 261 documents. Data analysis was conducted using VOSviewer software (van Eck & Waltman, 2010) through two primary approaches: (1) Performance Analysis: To quantify annual publication trends and identify the most influential authors, institutions, and journals and (2) Science Mapping: Employing co-authorship analysis to examine collaboration networks, keyword co-occurrence to identify thematic clusters and emerging trends, and bibliographic coupling to reveal the underlying intellectual structure of the field.

3. Research Results

3.1. Performance Analysis

The analysis of 261 publications (2020-2024)

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Studies like Aboramadan et al. (2022) confirm the integration of eco-friendly practices within this operational framework.

Strategic Drivers (Blue/Purple): Encapsulates macro-level imperatives such as competitiveness and sustainability within the broader tourism sector (Bhutto et al., 2021).

Figure 1. VOSviewer keyword co-occurrence network map

 VOSviewer

Figure 2. VOSviewer Overlay Visualization

 VOSviewer

Source: authors, 2025

Evolutionary trends: The temporal overlay analysis (Figure 2) traces the field’s evolution. Foundational concepts (c. 2020) like

“innovativeness” transitioned into core themes (c. 2021-2022) such as “sustainability” and “service quality”. Most notably, recent frontiers (c. 2023-2024) signal a distinct shift toward “artificial intelligence” and “green innovation,” marking them as the critical emerging streams for future inquiry.

4. Discussion

4.1. The four-stage process framework

This study synthesizes the fragmented literature into a novel four-stage process-oriented framework, mapping the innovation value chain from antecedents to outcomes:

(1) Foundational Enablers: Innovation begins with human capital. Consistent with Zhao et al. (2024), “green inclusive leadership” is the engine that cultivates employee innovative behavior.

(2) Operational Ecosystems: These foundations enable an ecosystem where technology (AI) and operations intersect to enhance guest experiences, a link validated by Aboramadan et al. (2022).

(3) Strategic Drivers: At the macro level, sustainability shifts from a compliance issue to a central strategic driver essential for survival (Bhutto et al., 2021).

(4) Sustainable Performance: The process culminates in measurable outcomes, where green innovation directly drives environmental and competitive performance (Haldorai et al., 2023).

4.2. Implications

Theoretical contributions: This study advances the field by offering an integrative lens that connects micro-level theories (e.g., Self-Determination Theory) with macro-level competitive advantage. It documents the critical evolution of sustainability from a peripheral concern to a core element embedded in both strategic drivers and performance outcomes.

Managerial Roadmap:

(1) Invest in People: Managers must prioritize inclusive leadership training to foster engagement.

(2) Holistic Integration: Innovation should not be siloed but integrated across technology and operations.

(3) Measure What Matters: Executives must develop KPIs that evaluate the tangible returns of green innovation initiatives rather than treating them as mere branding exercises.

4.3. Limitations and future research

While this study provides a comprehensive map using Scopus data, it is limited by the descriptive nature of bibliometric analysis. Future research should move beyond co-occurrence to empirically test the causal pathways within this four-stage framework. Longitudinal studies tracking emerging trends like the circular economy and service robots will be vital to illuminating the field’s future trajectory.

5. Conclusion

This study systematically maps the intellectual structure of hotel service innovation (2020-2024), synthesizing 261 publications into a coherent framework comprising organizational foundations, operational ecosystems, strategic drivers, and performance outcomes. The findings reveal a decisive shift toward AI and green innovation as the dominant frontiers. Theoretically, this research bridges the gap between fragmented micro-macro perspectives. Practically, it provides stakeholders with a strategic roadmap to leverage human capital and sustainability for enduring competitive advantage.

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THE IMPACT OF WORKPLACE SPIRIT ON JOB SATISFACTION OF UNIVERSITY LECTURERS IN VIETNAM

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Abstract: *This article aims to examine the impact of workplace spirit (WS) on the job satisfaction (JS) of lecturers at universities in Vietnam. The study employs quantitative research methods. Initially, a survey was distributed to 10 lecturers to refine the questionnaire. Subsequently, a large-scale survey was conducted, distributing 350 questionnaires to lecturers at public universities in Vietnam, resulting in the collection of 294 responses. After data classification and cleaning, 287 valid questionnaires were retained for official data analysis. The collected data were processed using Smart PLS4 software, employing the partial least squares structural equation modelling technique to assess the impact of factors related to workplace spirit on lecturers' job satisfaction. The results indicate that workplace spirit, encompassing a sense of community within a group, alignment between organisational and individual values, a sense of contribution to the community, enjoyment of work, and opportunities for personal growth, positively influences lecturers' job satisfaction. Finally, several recommendations are discussed to enhance workplace spirit, increase job satisfaction, and thereby improve the work efficiency of lecturers at universities in Vietnam.*

• Keywords: *job satisfaction, lecturer, workplace spirit.*

Date of receipt: 05th Oct., 2025

Date of delivery revision: 10th Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.10>

Date of receipt revision: 20th Dec., 2025

Date of approval: 20th Jan., 2026

1. Introduction

A positive working spirit supports lecturers' professional development, commitment, and enhances education quality (Dinham and Scott, 1998). When satisfied with their work, lecturers tend to be dedicated, innovate teaching methods, and stay longer, thereby improving training quality. Thus, alongside infrastructure, learning materials, and services, developing the teaching workforce is essential for universities to enhance quality and competitiveness. However, teaching is demanding and involves many pressures, leading to psychological issues such as exhaustion, anxiety, and fatigue. Lecturers must continuously improve their qualifications and serve as moral role models for students. A decline in working spirit can cause boredom and reduced passion for teaching, research, or community service. V. Parmar et al. (2022) show that burnout, especially exhaustion and reduced professional efficacy, is positively related to turnover intention, while organizational commitment and subjective vitality can reduce this likelihood. Globally, many studies have examined the influence of workplace spirit on job satisfaction, but most focus on stress or other contextual factors such as corporate culture or work environment. Few studies consider the simultaneous influence of workplace spirit factors, and research rarely focuses on lecturers.

Most studies are conducted in developed countries, with little attention to developing contexts like Vietnam. Therefore, this study examines the influence of working spirit on lecturers' job satisfaction at Vietnamese universities to provide a reference for educational managers to improve working spirit, increase job satisfaction, and enhance performance.

2. Literature review

2.1. Definitions

Workplace Spirit: Workplace spirit and work ethic have been widely studied. Herzberg et al. (1959) divide work ethic into two factors: motivation (related to personal satisfaction and development, e.g., achievement, recognition, responsibility) and maintenance (related to work environment, e.g., salary, benefits, colleagues). Since the 1990s, work ethic has gained attention as managers sought high employee morale. Definitions vary depending on workers' roles and contexts (Iqbal, 2018). According to K.C. Cash et al. (2000) and D.P. Ashmos et al. (2000), workplace spirit reflects employees' beliefs, motivations, and needs that drive active participation in organisational activities. It develops through meaningful group work, helping employees feel engaged, motivated, and find their work more meaningful. A. Rego et al. (2008) defined workplace spirit with five aspects: sense of community in a group, alignment between

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organisational and individual values, sense of contribution to the community, enjoyment of work, and opportunities for the inner life of the worker.

The definitions of workplace spirit reflect both employee and organisational experiences, showing that the concept has evolved over time. Workplace spirit is multidimensional and complex. In this study, it is approached following A. Rego et al. (2008) through five aspects:

- Sense of community in a group: Formed when individuals feel emotionally and professionally connected to others at the group level.

- Congruence between organisational and individual values: Exists when employees' personal principles align with organisational standards, fostering a sense of connection.

- Sense of contribution to the community: Involves shared responsibility, commitment, and connection among individuals.

- Feeling of enjoyment at work: Relates to joy and happiness, making work more meaningful.

- Opportunities for employees' inner lives: Employees can express their abilities, personalities, and emotions at work (Belwalkar et al., 2018; Duchon et al., 2005).

Job Satisfaction: Hoppock (1935) introduced job satisfaction as a holistic concept, suggesting it can be measured by employees' overall evaluation of their jobs. Spector (1997) notes that job satisfaction can be assessed generally or by individual job components, with the latter helping organisations identify areas for improvement. Brayfield and Rothe (1951) highlight that satisfaction varies among individuals based on interest in the work or profession. For this study, job satisfaction is measured at the general level, reflecting employees' sense that their efforts are worthwhile and assessing satisfaction through work effort and achievements.

2.2. Theory

The author uses two key theories. First, Herzberg et al.'s (1959) Two-Factor Theory categorises job satisfaction factors into hygiene factors: external aspects like salary, job stability, policies, working conditions, and relationships that prevent dissatisfaction and motivating factors, such as responsibility, recognition, achievement, and growth opportunities, which enhance satisfaction and motivation. Second, Hackman and Oldham's (1976) Job Characteristics Theory argues that job satisfaction depends on job features and their alignment with employee needs. Five characteristics: skill variety,

task identity, task significance, autonomy, and feedback, with meaningful work and autonomy strongly boosting morale and positive attitudes.

2.3. The impact of workplace spirit and job satisfaction

According to Karakas (2010) and Pradhan & Jena (2015), workplace spirit helps employees find meaning and build moral relationships aligned with organisational values, positively influencing job satisfaction. A strong work spirit reduces stress and enhances comfort, satisfaction, and efficiency (Shirom et al., 2008). Studies such as Milliman et al. (2003) and Pawar (2009) show its direct impact on satisfaction, commitment, and performance. Specific elements like teamwork, trust, creativity, and respect (Daniel, 2010; Raziq et al., 2014), as well as compassion and meaningful work (Petchsawang & McLean, 2017), further enhance satisfaction. Overall, research confirms the positive link between workplace spirit and job satisfaction (Sony & Karingada, 2018; Garg, 2018), forming the basis for five proposed hypotheses on their relationship.

H1: Sense of community in a group positively affects job satisfaction.

H2: Alignment between organisational values and personal values positively affects job satisfaction.

H3: Sense of contribution to the community positively affects job satisfaction.

H4: Enjoyment of work positively affects job satisfaction.

H5: Opportunities for inner life positively affect job satisfaction.

3. Research methodology

3.1. Research design

The author employed quantitative methods for this study, proposing five research hypotheses on the influence of workplace spirit factors on lecturers' work outcomes. Data were collected via a survey of lecturers at public universities in Vietnam using convenience sampling, facilitated by the author's professional network. The survey was conducted in two phases: a pilot survey with 10 lecturers to refine the questionnaire, followed by a large-scale survey distributed via paper forms and Google Forms.

According to Hair et al. (2017), the minimum sample size for PLS-SEM is 10 times the number of indicators per latent variable. With 23 items across five independent variables and one dependent variable, at least 230 responses were required. The author distributed 350 questionnaires and received 294 responses (84% response rate). After data cleaning,

287 valid forms remained for analysis, exceeding the minimum required. Forms with excessive blanks or unreliable answers were removed, and the cleaned data were deemed reliable for analysis.

3.2. Measurement

Workplace spirit: To measure workplace spirit, respondents were asked to respond to items on a scale from 1 to 5, with 1 indicating strong disagreement and 5 indicating strong agreement. The questions are based on Rego & Pina E Cunha (2008) and have been adjusted in wording to suit lecturers and the context of universities in Vietnam.

Job satisfaction: The job satisfaction scale by R. Shravasti & Bhola (2015) has been evaluated for reliability through the research of Judge et al. (2000). The scale utilises six statements (indicators) to evaluate job satisfaction levels and is widely used in research. Since this study does not measure job satisfaction from distinct perspectives, the shortened version of the R. Shravasti & Bhola (2015) scale was selected and adjusted accordingly.

3.3. Research Sample

The author distributed 350 questionnaires and received 294 responses, resulting in an 84% response rate. However, during the classification of survey forms and data cleaning prior to analysis, only 287 valid questionnaires remained for official data analysis, as 7 forms were excluded due to excessive missing responses. Survey forms with too many unanswered questions and unreliable responses were excluded before data analysis.

The sample reflects the current landscape of Vietnamese universities. Lecturers form the majority, with 226 individuals (over 75%), mainly from public institutions (over 90%) a reasonable outcome given their dominance in the system. Most respondents (85%) hold doctoral or master's degrees, driven by Ministry regulations and institutional requirements. Only about 10% are associate professors and 5% professors. Half have 10-20 years of experience, and nearly 75% have over 10 years. Female respondents outnumber males, consistent with cultural and occupational trends. Age aligns with experience and qualifications, with 70% aged 40 or older and most between 40 and 50.

4. Research Results

4.1 Measurement Model Evaluation

Evaluation of internal consistency reliability: The results of the measurement model analysis are presented in Table 4. Indicators for internal consistency reliability were assessed using Cronbach's Alpha and Composite Reliability (CR) of latent constructs, all

of which are greater than 0.7. Thus, the measurement model meets the requirements for internal consistency reliability (Hair et al., 2019).

Table 1. Results of some indicators of the measurement model

Structure	Indicators	Indicator loadings	Cronbach's alpha coefficient	Composite Reliability (CR)	Average Variance Extracted (AVE)	"R-squared coefficient." Rsquare	External VIF (Variance Inflation Factor)
WS1	WS11	0.828	0.820	0.875	0.585		2.038
	WS12	0.769					1.779
	WS13	0.803					1.798
	WS14	0.771					1.699
	WS15	0.639					1.251
WS2	WS21	0.689	0.816	0.872	0.578		1.362
	WS22	0.812					1.979
	WS23	0.747					1.668
	WS24	0.790					1.826
	WS25	0.757					1.703
WS3	WS31	0.815	0.706	0.834	0.627		1.379
	WS32	0.738					1.347
	WS33	0.822					1.409
WS4	WS41	0.816	0.621	0.839	0.723		1.254
	WS42	0.883					1.254
WS5	WS51	0.762	0.687	0.823	0.700		1.208
	WS52	0.906					1.208
JS	JS1	0.726	0.791	0.851	0.591	0.534	1.508
	JS2	0.786					1.838
	JS3	0.764					1.786
	JS4	0.606					1.306
	JS5	0.665					1.434
	JS6	0.636					1.437

Source: SmartPLS 4 analysis results.

Evaluation of Convergent Validity

The indicators for convergent validity (represented by the Average Variance Extracted (AVE) values of latent constructs) are all greater than 0.5. Specifically, the results from Table 1 show that the values of this indicator range from 0.578 to 0.723, all exceeding 0.5. Additionally, all indicators have loadings greater than 0.600 (with the lowest value being 0.606 > 0.708). Thus, the scales in the model meet the requirements for convergent validity (Hair et al., 2019).

Evaluation of Discriminant Validity

Both Fornell & Larcker (1981) criteria and the Heterotrait Monotrait Ratio (HTMT ratio) method were used to determine the discriminant validity of latent variables (Hair et al., 2019). Table 5 shows that discriminant validity is satisfied when the square root of the AVE for each latent variable is higher than the correlations with other constructs (Fornell & Larcker, 1981).

Table 2. Fornell-Larcker criteria for evaluating discriminant validity

	JS	WS1	WS2	WS3	WS4	WS5
JS	0.701					
WS1	0.552	0.765				
WS2	0.597	0.510	0.760			
WS3	0.628	0.507	0.599	0.792		
WS4	0.560	0.513	0.561	0.617	0.850	
WS5	0.578	0.513	0.565	0.586	0.547	0.837

Source: SmartPLS 4 analysis results.

Table 6 shows that the HTMT ratio for each construct is below 0.95, which Henseler et al. (2015) consider ideal. Therefore, all six latent constructs in the research model meet the requirements for discriminant validity.

Table 3. Discriminant validity assessment using HTMT ratio

	JS	WS1	WS2	WS3	WS4	WS5
JS						
WS1	0.684					
WS2	0.734	0.624				
WS3	0.819	0.664	0.787			
WS4	0.778	0.716	0.784	0.925		
WS5	0.814	0.704	0.806	0.872	0.875	

Source: SmartPLS 4 analysis results.

The Bootstrap testing results in Table 7 show that the HTMT ratio in the original sample falls within the 2.5 to 97.5% percentile range with a 95% probability. All HTMT values from 5000 bootstrap samples within the 95% confidence interval are less than 1. For example, the 95% confidence interval for the HTMTWS1 - JS ratio is [0.099; 0.266], which is less than 1. The null hypothesis (H0) is rejected. In other words, all HTMT values are less than 1. Thus, both criteria for evaluating discriminant validity proposed by Fornell & Larcker (1981) and the HTMT ratio confirm that the model meets the requirements for discriminant validity.

Table 4. Confidence interval testing for HTMT values

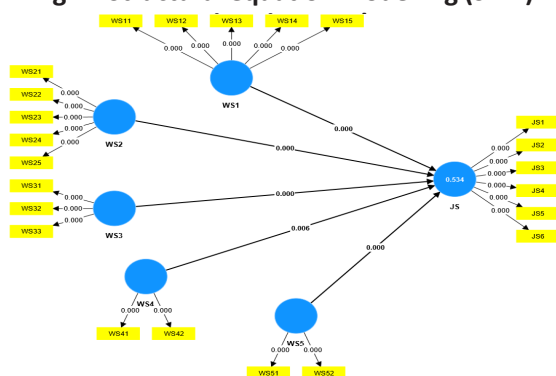
	Original sample (O)	Sample mean (M)	Bias	2.5%	97.5%
WS1 -> JS	0.182	0.182	0.001	0.097	0.266
WS2 -> JS	0.199	0.199	0.001	0.113	0.284
WS3 -> JS	0.252	0.253	0.001	0.165	0.338
WS4 -> JS	0.111	0.111	0.000	0.032	0.187
WS5 -> JS	0.164	0.163	-0.002	0.085	0.243

Source: SmartPLS 4 analysis results.

In summary, the measurement scales used in the research model have satisfied reliability, convergent validity, and discriminant validity. Therefore, all measurement scales JS, WS1, WS2, WS3, WS4, and WS5 will be used to evaluate the structural model.

4.2. Structural model evaluation results

Fig. 1. Structural equation modelling (SEM)



The results of testing the relationships between latent constructs are presented in Table 7. The structural model was tested using Bootstrap with a resampling size of N = 5,000 to estimate the specific relationships between latent variables. Table 7 shows that the direct relationships between variables are statistically significant, and all research hypotheses are accepted at a 95% confidence interval, as the P-value is less than 0.05. This indicates that all key relationships in the model are confirmed to be statistically significant.

Table 5. Results of estimating direct relationships

	Path Coefficient	Standard Deviation	T-Statistic Value	P-value	Hypothesis	Internal VIF (Variance inflation factor)	f-Square Coefficient
WS1 -> JS	0.182	0.043	4.268	0.000	Supported	1.619	0.044
WS2 -> JS	0.199	0.044	4.491	0.000	Supported	1.908	0.044
WS3 -> JS	0.253	0.045	5.622	0.000	Supported	2.088	0.065
WS4 -> JS	0.111	0.040	2.773	0.006	Supported	1.927	0.014
WS5 -> JS	0.163	0.040	4.069	0.000	Supported	1.861	0.031

Source: SmartPLS 4 analysis results.

Additionally, the signs of the path coefficients reveal that all exogenous factors, including WS1, WS2, WS3, WS4, and WS5, have a positive and statistically significant impact on job satisfaction, with the factors “Fit between organisational values and personal values” and “Sense of contribution to the community” having a more significant impact on job satisfaction compared to other factors, with all P-values being less than 0.05.

Results in Table 8 also show that both the external Variance Inflation Factor (VIF) and the internal VIF are less than 2, indicating that no perfect multicollinearity occurs in the structural equation modelling (SEM) (Hair et al., 2019).

Furthermore, the f-square effect size coefficient indicates that most impacts of WS1, WS2, WS3, and WS5 significantly affect lecturers' job satisfaction, with f-square values greater than 0.03, whereas only the impact of WS4 (Job enjoyment) is not significant to job satisfaction, with an f-square value less than 0.015.

Evaluation of the model fit

To assess the explanatory power of the factors included in the model, the coefficient of determination, R-squared, is recommended by statisticians.

Table 6. Evaluation of explanatory power of factors using R-squared

	R-square
Job satisfaction (JS)	0.534

Source: SmartPLS 4 analysis results

The table above shows that 53.4% of the variance in job satisfaction is explained by the five factors

included in the model, with R-squared > 50%. This indicates that the model constructed by the author and the selected factors are highly appropriate and meaningful in explaining the variability in lecturers' job satisfaction.

5. Discussion

The study confirmed all five hypotheses: each aspect of work spirit sense of community, value congruence, contribution, enjoyment, and inner life positively affects lecturers' job satisfaction. These results support established theories, including Hackman and Oldham's (1976) job characteristics model and Herzberg et al.'s (1959) Two-Factor Theory. Practically, they highlight the need for universities to foster work spirit to enhance satisfaction, performance, and effectiveness. Consistent with prior studies (e.g., Sony & Mekoth, 2019; Garg et al., 2018), the findings emphasize that promoting work spirit reduces stress, boosts motivation, encourages innovation, and strengthens lecturer-student relationships, contributing to sustainable educational development.

6. Recommendations

As universities become more multidisciplinary and competitive, improving lecturers' performance, satisfaction, and commitment is essential. Key measures include:

- (1) Strengthening connections within faculties through professional and extracurricular activities;
- (2) Aligning lecturers' values with institutional goals via fair pay, supportive culture, and inclusive decision-making;
- (3) Enhancing their sense of contribution through community service and external training opportunities;
- (4) Reducing work pressure with adequate facilities and recognition; and
- (5) Supporting well-being by providing spaces for rest and recovery.

7. Limitations and future research directions

This study only examines the independent variable (work spirit) and the dependent variable (job satisfaction), without including control variables such as institution type, region, or demographics. The absence of control variables may overlook confounding factors, leading to bias and less accurate conclusions. Future studies should add appropriate control variables to increase the validity and reliability of the findings and better explain their effects in context.

8. Conclusion

This study concludes that work spirit positively affects lecturers' job satisfaction. Lecturers who align

their values with the university, feel attached to their faculty, enjoy their work, contribute to society, and have their personal values respected tend to be more satisfied, improving work efficiency. This aligns with Maslow's Hierarchy of Needs, which emphasizes fulfilling higher-level needs such as respect and self-realization after basic needs are met (Maslow, 1943). These findings help universities develop strategies to enhance lecturer performance and retention.

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THE IMPACT OF DIGITAL TRANSFORMATION LEADERSHIP ON FACULTY DEVELOPMENT AT UNIVERSITIES IN HANOI

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Abstract: *This study aims to assess the impact of digital transformation leadership on faculty development at universities in Hanoi. Drawing on transformational leadership theory and digital competency frameworks in higher education, the study proposes a research model in which digital transformation leadership is the independent variable, faculty development is the dependent variable, and organizational culture and technological readiness serve as mediating variables. Data are expected to be collected through a structured questionnaire survey of lecturers using a 5-point Likert scale. SEM/PLS-SEM is proposed as the analytical technique to examine causal relationships among the variables. The study is expected to provide empirical evidence clarifying the central role of digital transformation leadership in lecturers' professional competence, teaching innovation, and career effectiveness, and to inform appropriate governance policies for higher education institutions in Hanoi.*

• Keywords: digital transformation leadership; faculty development; higher education; Hanoi; human resources; SEM.

Date of receipt: 19th Oct., 2025

Date of delivery revision: 12th Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.11>

Date of receipt revision: 20th Dec., 2025

Date of approval: 26th Jan., 2026

1. Theoretical and practical background

1.1. Digital transformation in higher education and the need for digital leadership

In the digital era, higher education institutions face pressures from emerging technologies, changing teaching-learning models, demands for agile governance, and the need to enhance faculty capabilities. Digital transformation in higher education is not merely the adoption of technology; rather, it is a comprehensive restructuring of teaching, learning, and governance models to meet the demands of the digital age (Tien, 2023).

Accordingly, digital leadership emerges as a decisive factor - leaders must possess a strategic digital vision while being able to lead change, develop human capacity, and build appropriate infrastructure to ensure successful digital transformation.

1.2. The concept of digital leadership in higher education

In universities, the terms "technology leadership" or "digital leadership" are commonly used to refer to the leadership capacity of academic managers and leaders to promote ICT use, pedagogical innovation, faculty support, and a digital academic environment. Zhang, Adams, and Lee (2022) show that university leaders' technology leadership directly influences lecturers' ICT competency - lecturers' technological capability improves when leaders perform their technology-leadership roles effectively. Zhang et al. (2022) conceptualize digital leadership across

dimensions such as technological support, strategic vision, communication, change management, and encouragement for technology adoption. Their study of 298 lecturers at a Chinese university finds that all dimensions of digital leadership have statistically significant positive effects on lecturers' ICT competencies.

These findings confirm that digital leadership is not merely about purchasing software or hardware; it is fundamentally about leading people - supporting, guiding, and training - so that technology is used effectively.

1.3. Faculty competency development in the digital era

Faculty development in the digital era spans multiple dimensions: pedagogical competence, technological competence, instructional innovation, digital content design, and the application of ICT in teaching and research. A recent review in Vietnam identifies the development of digital competencies for university lecturers as an urgent requirement for sustainable digital transformation (Tran Trung & Trinh Thi Phuong Dung, 2025).

These competency frameworks often reference international standards such as the EU's DigCompEdu, including the use of technology for teaching, digital learning design, online assessment, and digital learner support (Tran Trung & Trinh Thi Phuong Dung, 2025). Consequently, without adequate support for developing digital competencies

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even with advanced technologies in place digital transformation is unlikely to be sustainable.

1.4. Organizational culture and technological readiness as mediators

1.4.1. Organizational culture and support for innovation

Many studies show that organizational culture especially cultures that promote innovation, continuous learning, and openness to change strongly influences successful technology adoption and pedagogical innovation. When organizations encourage sharing, experimentation, and digital learning, lecturers are more willing to learn, adopt technology, and innovate in teaching (Tien, 2023). Organizational culture also shapes attitudes toward change; unsupportive environments tend to foster resistance.

1.4.2. Technological readiness

Technological readiness including ICT infrastructure, technical systems, technical support, policies, and training is a necessary material condition for digital transformation. Zhang et al. (2022) demonstrate that digital leadership improves technological readiness, which in turn enhances lecturers' ICT competencies. Without adequate infrastructure and technical support, digital initiatives are constrained lecturers lack tools and assistance resulting in limited application of technology in teaching, learning materials, and research.

1.5. International empirical evidence on the effects of digital leadership on teaching effectiveness and faculty development

Recent empirical studies illustrate the link between digital leadership and faculty development/teaching effectiveness:

Kong & Gat-eb (2025) at a Chinese university find that digital leadership positively affects teaching effectiveness as perceived by lecturers, despite existing policy, training, and infrastructure barriers.

Zhang et al. (2022) show that university technology leadership positively affects lecturers' ICT competency, manifested in technology use and integration in teaching.

Tien (2023) in Vietnam emphasizes digital competency development as a strategic pillar for sustainable transformation and identifies influencing factors such as organizational support, individual motivation, policy, and infrastructure.

In addition, cross-national and experimental evidence shows that when teachers/lecturers possess digital competencies, receive leadership support, and operate within innovative cultures with

strong infrastructure, the adoption of technology in teaching, digital learning, research collaboration, and pedagogical innovation increases markedly.

2. Research model and hypotheses

2.1. Research model development

Recent studies indicate that digital leadership (technology leadership) is a foundational driver of digital transformation in educational institutions, influencing lecturers' innovative behavior, technological competence, and performance (Ghamrawi, 2023; Obied, 2025; Zhang et al., 2022). From the perspective of transformational leadership, leadership extends beyond administration to encompass vision building, leading change, and cultivating human capabilities in the digital context (Bass & Riggio, 2006).

In addition, organizational culture functions as a key mediating mechanism that translates leadership orientation into lecturers' actual innovative behaviors, because a learning-innovation culture strongly shapes attitudes, motivation, and readiness for change (Denison & Mishra, 1995). In parallel, technological readiness provides the material and technical foundation—and organizational capability that enables leaders' digital policies to be implemented effectively (Parasuraman, 2000).

Empirical evidence confirms that digital leadership enhances lecturers' ICT competence and technology integration behaviors (Zhang et al., 2022), improves teaching effectiveness through digital innovation (Muslim et al., 2024), and promotes knowledge sharing and innovation within academic organizations (Pu et al., 2024). Studies in Vietnam and the ASEAN region further show that digital leadership affects lecturers' performance and organizational citizenship behavior (Maheshwari, 2023; Malik et al., 2025).

Building on these insights, this study integrates four theoretical streams (i) transformational leadership, (ii) organizational culture, (iii) technological readiness, and (iv) faculty development to develop a model that simultaneously tests the direct and indirect (mediated) effects of digital leadership on faculty development in universities in Hanoi.

2.2. Hypothesis development

2.2.1. Digital transformation leadership and faculty development

Empirical studies show that digital leadership significantly influences lecturers' innovative behavior, technology integration, and job performance (A'Mar & Eleyan, 2022; Karakose et al., 2021; Zhang et al., 2022). Effective digital leadership is typically

associated with a technology vision, training support, encouragement of experimentation, and resource provision, thereby enhancing lecturers' digital-pedagogical competence and professional performance (Obied, 2025).

Hypothesis 1: Digital transformation leadership positively affects faculty development.

2.2.2. Digital transformation leadership and organizational culture

Leadership is a primary architect of culture. In the digital context, leaders shape norms of innovation, continuous learning, and collaboration, thereby fostering a culture that embraces technology and pedagogical innovation (Denison & Mishra, 1995; Ghamrawi, 2023). Empirical evidence shows that digital leadership improves knowledge-sharing culture and the innovation climate in universities (Anwar & Saraih, 2024; Pu et al., 2024).

Hypothesis 2: Digital transformation leadership positively affects organizational culture.

2.2.3. Organizational culture and faculty development

A learning-innovation culture enhances intrinsic motivation, knowledge sharing, and readiness for change among lecturers, thereby improving professional competence and teaching-research outcomes (Denison & Mishra, 1995; Rasdiana & Nurhadi, 2024).

Hypothesis 3: Organizational culture positively affects faculty development.

2.2.4. Digital transformation leadership and technological readiness

Digital transformation leadership directly affects infrastructure investment, IT policies, and digital skills training—the core components of technological readiness (Parasuraman, 2000). Evidence at the university level shows that technology leadership increases lecturers' ICT competence and technology use (Zhang et al., 2022).

Hypothesis 4: Digital transformation leadership positively affects technological readiness.

2.2.5. Technological readiness and faculty development

Technological readiness enables digital teaching-learning, data utilization, and assessment innovation, thereby enhancing lecturers' professional effectiveness and student learning value (Sun & Yoon, 2025).

Hypothesis 5: Technological readiness positively affects faculty development.

2.2.6. The mediating roles of organizational culture and technological readiness

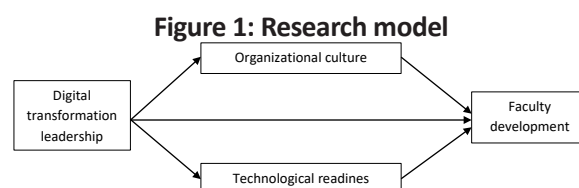
Recent studies emphasize digital transformation leadership as a “system lever” that shapes professional outcomes through cultural and infrastructural mechanisms (Pu et al., 2024; Muslim et al., 2024). This suggests that an innovation-oriented organizational culture and technological readiness serve as mediating channels through which leadership vision is translated into faculty capabilities and behaviors.

Hypothesis 6: Organizational culture mediates the relationship between digital transformation leadership and faculty development.

Hypothesis 7: Technological readiness mediates the relationship between digital transformation leadership and faculty development.

2.3. Research model

Based on the theoretical foundations and hypotheses, the proposed research model is presented below.



Source: Compiled and proposed by the author

3. Research methodology

This study employs a quantitative approach with a cross-sectional survey design to examine the relationships between digital transformation leadership and faculty development, as well as the mediating roles of organizational culture and technological readiness. This approach is appropriate for simultaneously testing the measurement model and the structural model using SEM/PLS-SEM procedures (Hair et al., 2019).

The target population comprises university lecturers in Hanoi from both public and private institutions. A sample of approximately $n \approx 350$ is selected using controlled convenience sampling (by type of institution, age group, and academic field). The sample size meets SEM/PLS-SEM recommendations for estimation stability (Hair et al., 2019). After data collection, the dataset is cleaned and analyzed using specialized software (SPSS) for statistical analysis.

4. Research results

4.1. Descriptive statistics of the sample

The sample includes 350 lecturers currently working at universities in Hanoi. The sample profile is as follows:

Gender: approximately 55% female and 45% male.

Age groups: those aged 30-39 and 40-49 constitute the largest shares (over 60% of the sample).

Teaching experience: an average of about 12 years, indicating a relatively stable and experienced faculty cohort.

Institution type: about 70% work at public universities, with the remainder at private institutions.

Academic fields: economics and social sciences account for the largest proportion, followed by engineering/technology and other fields.

This sample structure reasonably reflects the profile of university faculty in Hanoi.

4.2. Structural equation modeling (SEM) results

Following tests were performed to examine the reliability of variables in the research model:

- Cronbach's Alpha test reveals that all scales meet the reliability criteria ($\alpha > 0.7$). The item-total correlation coefficients of all observed variables are greater than 0.3; therefore, no variables were removed from the model.

- KMO and Bartlett's Test reveals that KMO = 0.91 (> 0.5), confirming that the data are suitable for factor analysis. Bartlett's Test is significant with Sig. < 0.001 , indicating that the variables are sufficiently correlated. EFA extracts four factors corresponding to the four theoretical constructs, with a total variance explained of 68.4% ($> 50\%$). All factor loadings are greater than 0.6. These results confirm that the measurement structure fits well with the proposed theoretical model.

- A confirmatory Factor Analysis shows that all fit indices meet acceptable thresholds, indicating that the measurement model fits the data well. The tests of convergent and discriminant validity show that AVE for all constructs is greater than 0.5 and CR exceeds 0.7. The Fornell-Larcker criterion indicates that the square roots of AVE are greater than the inter-construct correlation coefficients. Accordingly, the scales demonstrate good convergent and discriminant validity.

After performing Cronbach's Alpha test, KMO and Bartlett's Test and confirmatory Factor Analysis, the research model was put into regression and Structural Equation Modeling (SEM) Results are as follows:

Table 1. SEM model fit indices

Index	Value	Threshold
CFI	0.93	≥ 0.90
TLI	0.92	≥ 0.90

Index	Value	Threshold
RMSEA	0.061	≤ 0.08
χ^2/df	2.31	≤ 3

Source: Results of data analysis using SPSS 26

The SEM results indicate that the model fits the data well. The tested relationships are presented as follows:

Table 2. Hypothesis testing results

Hypothesis	Path	Standardized Coefficient (β)	p-value	Result
H1	DL $\rightarrow$ FD	0.31	< 0.001	Accepted
H2	DL $\rightarrow$ OC	0.58	< 0.001	Accepted
H3	OC $\rightarrow$ FD	0.29	< 0.001	Accepted
H4	DL $\rightarrow$ TR	0.52	< 0.001	Accepted
H5	TR $\rightarrow$ FD	0.26	< 0.01	Accepted

Source: Results of data analysis using SPSS 26

Table 3. Coefficients of Determination (R^2)

Dependent variables	R^2
OC	0.34
TR	0.27
FD	0.48

Source: Results of data analysis using SPSS 26

From Tables 6 and 7, it can be observed that R^2 for OC = 0.34; R^2 for TR = 0.27; and R^2 for FD = 0.48. This indicates that the model explains nearly 48% of the variance in faculty development.

4.6. Mediation testing

A bootstrap procedure with 5,000 resamples was used to test the mediating effects:

Table 4. Mediation Test Results

Mediating relationship	Mediating relationship	p-value	Conclusion
DL $\rightarrow$ OC $\rightarrow$ FD	0.17	< 0.01	Significant
DL $\rightarrow$ TR $\rightarrow$ FD	0.14	< 0.05	Significant

Source: Results of data analysis using SPSS 26

5. Discussion

5.1. Digital transformation leadership and faculty development

The results show that digital transformation leadership has a significant direct impact on faculty development ($\beta = 0.31$; $p < 0.001$), confirming the central role of leadership in the digital transformation of universities in Hanoi.

This finding is consistent with the theoretical literature on digital leadership in higher education, which emphasizes that leaders are not only technology policymakers, but also architects of digital vision, drivers of pedagogical innovation, and motivators enabling faculty to adapt to digital environments (Onan, 2024; Zeike et al., 2019).

In the Vietnamese context, where technology investment is sometimes "symbolic," this result implies that effective faculty development does not arise from technology alone, but from leadership

capacity to organize, lead, and strategically implement digital transformation.

5.2. The role of organizational culture in faculty development

The analysis indicates that organizational culture is both strongly influenced by digital transformation leadership ($\beta = 0.58$; $p < 0.001$) and exerts a significant direct effect on faculty development ($\beta = 0.29$; $p < 0.001$), underscoring its pivotal mediating role.

This finding aligns with Denison and Mishra (1995), who regard organizational culture as an “invisible foundation” shaping members’ behaviors, attitudes, and readiness for innovation.

When organizational culture encourages continuous learning, embraces innovation and experimentation, and fosters collaboration in teaching and research, faculty members become more proactive in enhancing professional competencies, adopting technology, and improving teaching methods.

In Hanoi’s higher education context characterized by wide variation in institutional types and ICT investment levels differences in organizational culture may explain uneven levels of faculty development across universities.

5.3. Technological readiness and faculty development

The study also shows that technological readiness positively affects faculty development ($\beta = 0.26$; $p < 0.01$), while digital transformation leadership significantly enhances technological readiness ($\beta = 0.52$; $p < 0.001$).

This suggests that when universities provide adequate ICT infrastructure, technical support, and digital skills training, faculty members are better positioned to innovate teaching and improve professional outcomes.

These findings are consistent with prior studies on organizational readiness for change and technological readiness in education, which argue that readiness is necessary but not sufficient: without strategic leadership and an innovation-oriented culture, technology cannot realize its full potential (Parasuraman, 2000; Onan, 2024).

5.4. The mediating roles of organizational culture and technological readiness

Bootstrap results confirm that both organizational culture and technological readiness significantly mediate the relationship between digital transformation leadership and faculty development. Organizational culture exerts the

stronger mediating effect, while technological readiness plays a complementary role.

Digital transformation leadership does not influence outcomes in a “mechanical” manner; rather, it operates by building an innovation-friendly environment, shaping learning practices, and establishing academic digital infrastructure. These findings contribute to the literature by positioning digital leadership as a form of system leadership that concurrently shapes organizational structures, people, and technology.

6. Managerial implications

Based on the results of the structural model and international empirical evidence on digital leadership in education, several specific managerial implications for universities in Hanoi can be proposed as follows.

Develop digital leadership as a strategic pillar: universities should design structured digital leadership development programs for rectorate boards and deans/department heads, focusing on digital strategic thinking, data governance, evidence-based decision making, change management, and digital communication. Digital leadership competence should be incorporated into criteria for appointment, performance evaluation, and leadership succession planning, for example, requiring evidence of implementing digital initiatives and organizing digital professional development activities for faculty members. Universities should encourage middle-level leaders (deans and department chairs) to become “change agents” in coordinating digital transformation activities at the unit level, consistent with research on e-leadership in building professional learning organizations (Sterrett, 2020).

Build an innovation-oriented and digitally enabled organizational culture: Universities may establish professional learning communities around the theme of digital transformation, where faculty collaboratively design, pilot, and reflect on digital teaching models, as studies indicate that such communities are important channels through which digital leadership is translated into classroom-level change (Sterrett, 2020; Rasdiana & Nurhadi, 2024). Universities should design recognition and reward mechanisms directly linked to digital innovation outputs. Universities should embed the values of lifelong learning, knowledge sharing, cross-department collaboration, and readiness for innovation into institutional regulations, policies, and routine practices (Onan, 2024).

Strengthen technological readiness aligned with faculty development: At the strategic level, universities should develop a digital competency framework for faculty members based on international standards such as DigCompEdu, and then design digital career development pathways tailored to different groups of lecturers. At the operational level, universities should establish learning innovation centers or edtech units responsible for providing digital pedagogy consultation, technical support, and co-design of digital courses with faculty. Professional development programs should be redesigned in a scaffolded manner, shifting from technology-heavy training courses to contextualized programs with one-to-one consultation, mentoring, and long-term monitoring of faculty progress.

Link digital leadership development with performance evaluation and faculty development: Universities should integrate digital transformation-related indicators into the performance evaluation system for administrators. At the same time, universities should avoid “coercive digitalization” metrics that count only logins or file uploads, but instead focus on substantive changes in teaching and learning, such as meaningful online interaction, active learning design, and the use of learning analytics to improve instruction. Universities may develop a system of digital faculty development indicators that directly link leadership efforts (policies, support, and training) with outputs such as digital teaching competence, pedagogical innovation, and student learning effectiveness.

Implications for state agencies and system-level policy: Beyond the institutional level, the findings also suggest policy implications at the national level. Regulatory bodies such as the Ministry of Education and Training and related ministries should treat digital leadership in higher education as a priority axis in the national digital transformation strategy rather than focusing solely on infrastructure. A national program for developing digital leadership among university leaders should be established, similar to existing educational management training programs but with a focus on digital governance, data management, AI in education, and building digital learning organizations. Financial mechanisms and incentive policies should be strengthened to encourage universities to establish digital innovation centers, teaching support units, and digital learning laboratories, accompanied by requirements for outcome-based reporting on their impacts on faculty development. Support should also be provided for research and pilot projects

on digital leadership and faculty development in digital transformation, especially in local university clusters, to generate evidence for policy refinement.

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CUSTOMER EVALUATION OF REVERSE LOGISTICS ON E-COMMERCE PLATFORMS IN VIETNAM

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Abstract: The e-commerce sector is experiencing significant growth in Vietnam. However, customers face difficulties in returning products, which affects the customer experience. Retailers and e-commerce platforms face internal and external operational issues. This study, analysing 309 consumer surveys, using comparative, statistical, and descriptive methods, evaluated reverse logistics in terms of return time, policy, costs, service, and exchange products. The findings aim to inform better return policies that enhance customer satisfaction and support sustainable online shopping.

• Keywords: reverse logistics, e-commerce, Vietnam.

Date of receipt: 25th Sep., 2025

Date of delivery revision: 04th Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.12>

Date of receipt revision: 30th Dec., 2025

Date of approval: 26th Jan., 2026

1. Introduction

The digital economy is a phenomenon of increasing importance for nations, given estimates of double-digit annual growth worldwide (WEF 2015). Vietnam's digital economy is projected to grow 20% annually from 2023–2025 and 17% from 2025–2030. E-commerce leads the sector, making up 56% of the digital economy in 2023, equivalent to USD 24 billion, and is expected to reach USD 60 billion by 2030. Although the recent technological innovations have made it easier for e-commerce, according to a survey by Statista in 2022, 33% of respondents still feel less than satisfied with the online shopping experience in Vietnam. Therefore, the demand for improving the shopping experience needs to be addressed. Notably, in a survey of the Southeast Asian market published by McKinsey, 83% of 600 respondents responded that they would increase the order value by at least 30% if the seller made the return process easy and smooth. However, each business must face conflicts and trade-offs, especially with issues of cost and reverse logistics management in order to build a complete return policy. Therefore, reverse logistics plays an important role in increasing customer satisfaction as well as optimising profits and minimising operational costs.

Most reverse logistics research has centred on developed markets like the United States or Europe, with limited insight from developing countries such as Vietnam. The study, thereby, examines key customer concerns during returns and exchanges. It then evaluates these criteria to help businesses design effective return policies and manage reverse logistics to enhance customer satisfaction.

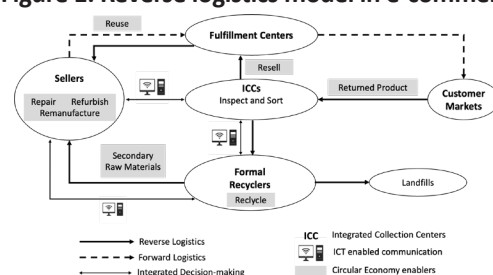
2. Literature review

2.1. Definition of reverse logistics in e-commerce

Since the early 19th century, scholars have recognised the reverse flow of goods as a business-related activity with societal impact. Guiltinan and Nwokoye (1975) introduced the terms “reverse flow” and “reverse channel” to highlight opportunities for reuse and recycling. By the 1980s, reverse logistics was understood as the movement of damaged goods counter to the traditional supply chain direction.

In the digital era, reverse logistics is vital for e-commerce. Its main goal is to maximise the value of returned items. Wang et al. (2017) describe it as encompassing return and exchange processes, often triggered by defects, maintenance needs, or shifts in consumer preferences. Some returned products may simply require repackaging or repair. Chinda (2017) further divides it into recovery, remanufacturing, reprocessing, and waste treatment. Figure 1 illustrates the reverse logistics process in e-commerce, based on Nanayakkara et al. (2022).

Figure 1. Reverse logistics model in e-commerce



Source: Based on the research of Nanayakkara et al., 2022

The model shows the return process where goods are inspected at a collection centre, then directed to a fulfilment or recycling centre. Items meeting quality standards may be resold, while others go to sellers for reuse or recycling. Recyclers may recover materials or discard waste. With

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high e-commerce volumes, businesses rely on technology to operate these activities.

2.2. Criteria for evaluating reverse logistics on e-commerce platforms

According to Retzlaff-Roberts and Frolick (1995), *Return time* is the period from the time the business receives a return request until the retailer gives a replacement product to the customer or when the e-commerce platform finishes the refund for customers. Somuyiwa and Adebayo (2014) note that quick and easy returns affect customer satisfaction. Sciarrotta (2003) suggests standardised return times improve responsiveness. Adabayo (2022) confirms that refund time and return policy directly influence performance and satisfaction, urging businesses to clearly communicate these timelines. In summary, *Return time* will be measured through the following observations: (1) Responding time to return requests, (2) Accepting time to return requests, (3) Return preparation time, (4) Return shipping time, and (5) Refund time.

Adebayo (2022) comments that it is recommended to set up a *Return policy* to ensure a better response to reverse logistics activities. The return policy needs to be clear, easy to understand and transparent. Customers return items for various reasons such as defects, poor quality, or unmet expectations (Bernon et al., 2011). Genchev (2007) emphasises that policies must also address exceptional cases, such as unresolved disputes or delayed seller responses. Therefore, the *Return policy* is evaluated through the following criteria: (1) A clear, easy to understand, and transparent refund policy (2) A refund policy applied to the customer in case the seller does not respond within the timeframe, (3) The e-commerce platform's responsibility to resolve in case of a dispute between the buyer and the seller, and (4) Platform's tools to analyse data to make decisions.

Mohamed et al. (2015) suggest that cost is the most important factor among the surveyed factors that determine customer satisfaction. *Return costs* are of special interest to customers and require an official announcement so that customers can consider and make a decision to return the product (Massey, 2018). Furthermore, the return shipping may not be free, so customers will have an increased cost burden (Zumbach, 2016). Therefore, customers evaluate *Return costs* through the following criteria: (1) Additional shipping costs to return, (2) Depreciated costs for customers, and (3) An amount paid lower than the product purchase amount.

Product return experience or *Return service* can influence how customers feel about the service they receive (Ogunleye, 2013). Therefore, companies need to focus on customer touchpoints such as customer support, like listening and answering questions promptly for customers and sellers. Customer service adds value by boosting satisfaction. Businesses should partner with reliable shippers and integrate top tech firms like payment

providers. Strong links with logistics and payment partners, along with seller flexibility in returns, are key to service quality. Updating return status promptly also improves platform responsiveness (Sciarrotta, 2003). *Return service* is evaluated through the following criteria: (1) Answering questions promptly, (2) Updating order status during the exchange process, (3) Customer support behaviours, (4) Many payment and shipping parties linked on platforms, and (5) Supporting exchange products immediate via couriers when customer returns happen.

In addition to the service quality, the quality of the exchange product also influences customer satisfaction (Zeithaml et al., 2018). The study conducts a survey of customer reviews on *Exchange products* through the following criteria: (1) Correct quantity of products, (2) Correct quality of products and (3) Carefully packed products.

Based on an overview of previous research works, research is conducted to measure customer evaluation of reverse logistics on e-commerce platforms in Vietnam on aspects including Return time (RT), Return policy (RP), Cost Returns (CR), Customer Service (CS) and Exchange Products (EP). Table 1 illustrates in detail the evaluation criteria and observations.

Table 1: The customer's evaluation criteria and observations of reverse logistics

Encryption	Evaluation criteria and observations	Sources
RT	Return time	
RT1	Responding time to return requests;	Retzlaff-Roberts and Frolick (1995); Sciarrotta (2003); Somuyiwa and Adebayo (2014); Adabayo (2022)
RT2	Accepting time to return requests;	
RT3	Return preparation time;	
RT4	Return shipping time;	
RT5	Refund time.	
RP	Return policy	
RP1	A clear, easy to understand, and transparent refund policy;	Genchev (2007); Bernon et al., (2011); Adabayo (2022)
RP2	A refund policy applied to the customer in case the seller does not respond within the timeframe;	
RP3	The e-commerce platform's responsibility to resolve in case of a dispute between the buyer and the seller;	
RP4	Platform's tools to analyse data to make decisions when disputes happen.	
RC	Return costs	
RC1	Additional shipping costs to return;	Mohamed et al., (2015); Zumbach (2016); Massey (2018)
RC2	Paying depreciated costs for customers;	
RC3	Accepting an amount paid lower than the product purchase amount.	
RS	Return service	
RS1	Answering questions promptly;	Sciarrotta (2003); Ogunleye (2013)
RS2	Updating order status during the exchange process	
RS3	Customer support behaviors;	
RS4	Many payment and shipping parties linked on platforms;	
RS5	Supporting exchange products immediate via couriers when customer returns happen.	
EP	Exchange products	
EP1	Correct quantity of products;	Zeithaml et al., (2018)
EP2	Correct quality of products;	
EP3	Carefully packed products.	

Source: Author's research results

3. Research methodology

The study uses both secondary and primary data. Secondary data is collected from academic journals, reports, and publications related to reverse logistics in e-commerce in Vietnam. Expert discussions are conducted with two lecturers and two business managers operating on e-commerce platforms to refine the evaluation criteria

for the survey. Based on a review of documents and discussion with experts, the study has identified indicators to measure and evaluate reverse logistics activities of Vietnamese e-commerce platforms.

Primary data are collected through an online survey distributed via social media platforms (Facebook, Zalo, Instagram, and Messenger). The questionnaire is built using Google Forms with a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). A total of 350 surveys are distributed nationwide, and 309 valid responses are received (88% response rate). Respondents are qualified if they (1) had shopped on Vietnamese e-commerce platforms and (2) had experienced at least one return or refund. Data collection occurs between December 2022 and January 2023, and the data are analysed using Microsoft Excel with comparative and descriptive statistics.

4. Research findings

Based on 309 valid responses, the study evaluated customer satisfaction with reverse logistics on Vietnamese e-commerce platforms across five criteria.

Return time

Return time is highly significant as responding time to return requests, accepting time to return requests, return preparation time and return shipping time all make up the total return time from the time customers intend to return to the time they receive the returned goods or refund, thereby directly affecting the customer's perception.

Survey results show 61% of customers are very satisfied when they receive information and goods quickly. With average scores from 3.73 to 3.8, return time strongly influences satisfaction, especially (2) Accepting time to return requests, which has the highest impact in Table 2, as it confirms the request and initiates the process. (3) Preparation, (4) Shipping, and (5) Refund times all average around 3.75, while (1) Responding time is seen as the least important.

Return policy

Return policy is highly important to customers, with 64% agreeing or strongly agreeing on its role in evaluating reverse logistics. Table 2 shows all factors score close to 4 (agree), ranging from 3.73 to 3.87. The highest-rated factor is (2) A refund policy applied to the customer in case the seller does not respond within the timeframe (average 3.87), reflecting customer expectations for guaranteed refunds. (1) A clear, transparent refund policy ranks second, at 3.78. (3) The e-commerce platform's responsibility to resolve in case of a dispute between the buyer and the seller and (4) Platform's tools to analyse data to make decisions when disputes happen, follow with scores of 3.77 and 3.74, respectively, indicating slightly lower importance.

Return costs

Return cost is a major concern in online shopping, as customers typically don't expect extra fees at checkout.

However, over 45% are willing to accept costs like return shipping, depreciation, or receiving a reduced refund. Average scores range from 3.15 to 3.26, showing a relatively high acceptance level. Both (1) Additional shipping costs to return and (3) Accepting an amount paid lower than the product purchase amount, score around 3.25, while (2) Paying depreciated costs for customers is the least significant factor.

Return service

Survey results show 67% of customers feel satisfied or very satisfied when return service elements are fulfilled. Table 2 shows all factors score close to 4, indicating high impact. (2) Updating order status during the exchange process (4) Many payment and shipping parties linked on platforms score 3.80. (3) Customer support behaviors and (5) Supporting exchange products immediately via couriers when customer returns happen, score 3.77, while (1) Answering questions promptly has the least impact.

Exchange products

The top concern for e-commerce customers is whether the received product meets expectations. When returning and exchanging items, most are willing to wait longer or pay extra to get the right product. Survey results show nearly 70% are satisfied or very satisfied when post-return products meet expectations. Table 2 indicates that (2) correct quality (3.86) and (3) correct quantity (3.84) are the biggest concerns, while (1) careful packing products has the least impact on satisfaction.

Table 2 shows that all criteria except return costs score above 3.5. Exchange products rank highest (3.84), highlighting customer focus on quality, quantity, and packaging after exchanges sellers must avoid disappointing customers twice. Return costs score lowest at 3.22, suggesting customers are willing to pay extra. Return time (3.76), return policy (3.79), and return service (3.78) show similar levels of importance.

Table 2: Average score of evaluation criteria surveyed

Name	Mean	Rank	Overall mean	Overall rank
Return Time				
RT1	3.74	2	3.76	3
RT2	3.80	1		
RT3	3.75	3		
RT4	3.75	3		
RT5	3.75	3		
Return Policy				
RP1	3.78	2	3.79	2
RP2	3.86	1		
RP3	3.77	3		
RP4	3.73	4		
Return Costs				
RC1	3.25	1	3.22	4
RC2	3.16	2		
RC3	3.25	1		
Return Service				
RS1	3.70	4	3.22	4
RS2	3.83	1		
RS3	3.77	3		
RS4	3.80	2		
RS5	3.77	3		
Exchange Products				
EP1	3.84	2	3.84	1
EP2	3.86	1		
EP3	3.81	3		

Source: Authors research results

5. Discussion and implications

5.1. Prospects and trends of e-commerce in Vietnam from now until 2030

According to JP Morgan (2021), Vietnam is leading global e-commerce growth, driven by a rising middle class and a young population, with an average age of 31.9. Over one-third of technology users are under 24 (WPL, 2021). The e-commerce sector is forecast to grow by 20% annually from 2024 to 2025, increasing in value from USD 24 billion to USD 60 billion by 2030. Per capita online spending is expected to rise from USD 381 in 2021 to USD 671 by 2025. Key trends shaping Vietnam's e-commerce landscape include the rapid growth of cashless payments, supported by high internet and smartphone penetration (both over 71%), and strong government and private investment. By 2024, mobile devices will account for 61% of online transactions, while banking transactions may reach 32%. "Buy now, pay later" services are also gaining traction, growing at 36.5% annually. Cross-border e-commerce is expanding, currently making up 38% of transactions, with popular markets including the US, China, and Japan. This competition is pushing local businesses to improve product quality and logistics efficiency. Meanwhile, the legal framework is evolving to enhance consumer protection and transparency. Regulations such as Decree 85/2021 and Directive 18/CT-TTg require sellers to provide clear product descriptions and contribute to stronger tax enforcement, with tax revenues reaching 83 trillion VND in 2022 and 97 trillion VND in 2023 (General Department of Taxation, 2024). Looking ahead, Vietnam may adopt policies similar to the EU, requiring easy returns and guaranteed refunds. By 2030, e-commerce is expected to become the main form of commerce in Vietnam. This shift will require businesses to enhance their competitiveness, especially in logistics, which directly shapes the customer experience. As e-commerce platforms increasingly invest in their own logistics and rely on third-party providers, the efficiency of reverse logistics will become a major competitive advantage.

5.2. Recommendations to improve customer satisfaction with reverse logistics activities of e-commerce platforms in Vietnam

Based on the research findings, several recommendations are proposed to enhance customer satisfaction with reverse logistics on Vietnam's e-commerce platforms. To reduce return time, platforms should establish clear return and exchange policies and communicate them to customers. Implementing e-wallets can accelerate refunds, while partnering with specialised return logistics providers can optimise return shipping. Returned items should be stored separately to ease classification and reduce processing time. Additionally, platforms should improve response speed by enhancing their customer service teams and censorship systems. To improve return policies, platforms must set clear response

deadlines for sellers, guarantee refunds when sellers fail to respond, and conduct regular market research to revise policies accordingly. In unresolved disputes, platforms should make decisions based on transaction history to ensure fairness. To lower return costs, platforms should integrate forward and reverse logistics by using shared transport resources and storage facilities to reduce extra charges for customers. Developing return standards with logistics partners also minimises product depreciation and ensures customers receive higher refund values. In terms of return services, features like chat bubbles can enhance communication during return processes, and IT systems should be upgraded to increase cybersecurity and handle high traffic during peak periods. For exchange products, platforms should penalise sellers with high second-return rates. Exchange-for-return options can also be introduced, provided terms are clearly defined. Finally, promoting recyclable packaging not only improves reverse logistics efficiency but also protects product quality during transportation.

6. Conclusion: This study aims to comprehensively evaluate reverse logistics on Vietnamese e-commerce platforms. The research findings show that customers' highest evaluation is for the criteria of exchange product and their evaluation is gradually lower in the criteria of return policy, return time, return costs and return service. Although the evaluation criteria are based on credible sources, the survey is limited to large cities, reducing the national representativeness. In addition, due to limited resources, limited expert consultations were conducted, which may have missed aspects such as environmental and social impacts. Future research can expand the evaluation criteria and survey a wider respondent base.

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AN EMPIRICAL ANALYSIS OF FACTORS AFFECTING EMPLOYEE LOYALTY IN COMMERCIAL BANKS: A CLUSTER-BASED SEM APPROACH IN HANOI

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Abstract: *This study aims to identify factors affecting employee loyalty in commercial banks through Cluster-based SEM. Data were collected from 240 employees and middle managers at 40 bank branches in Hanoi. The research model includes four independent variables: Organizational Support (POS), Affective Commitment (ACO), Procedural Justice (PJU) and Career Development Opportunity (CDO), with Employee Loyalty (SLO) as the dependent variable. The results show that all four factors have a positive and statistically significant impact on loyalty. In which, POS has the strongest influence, followed by ACO, CDO and PJU. The model explains 62% of the variance of SLO, reflecting a reliable explanatory power. The results of the study are consistent with many international studies in the period 2020-2025, and emphasize the central role of organizational support and emotional engagement in maintaining a stable workforce. The study contributes both theoretically and practically, especially in human resource policy making in the banking industry.*

• Keywords: employee loyalty, affective commitment, procedural justice, career development opportunities, commercial banks, cluster SEM.

Date of receipt: 25th Sep., 2025

Date of delivery revision: 04th Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.13>

Date of receipt revision: 30th Dec., 2025

Date of approval: 26th Jan., 2026

1. Introduction

In the context of fierce competition for human resources in the commercial banking industry in Vietnam, especially in Hanoi, the problem of employee retention becomes urgent when high work pressure, continuously increasing performance and service requirements lead to significant turnover intentions. Recent empirical evidence on a sample of Vietnamese banks shows that occupational burnout and work-family conflict are positively associated with turnover intentions, while perceived organizational support can reduce turnover intentions (Giao, Vuong, Huan, Tushar, & Quan, 2020).

In the knowledge-intensive service sector such as banking, employee loyalty plays a key role in organizational stability, service quality, and competitive advantage. Theoretically, loyalty is closely linked to organizational commitment, especially affective commitment (ACO), which reflects employees' value identification and emotional attachment to the organization (Meyer & Allen, 1991).

The literature review points to four prominent mechanisms that are likely to promote loyalty/reduce turnover intention in the banking context: (i) ACO - the psychological basis for maintaining

commitment (Meyer & Allen, 1991); (ii) Perceived Organizational Support (POS) - the belief that the organization values employee contributions and cares about employee well-being; POS is strongly associated with commitment and positive attitudinal outcomes (Rhoades & Eisenberger, 2002); (iii) Procedural Justice (PJU) - perceptions of fairness in decision-making processes, measured robustly with evidence of construct validity (Colquitt, 2001); and (iv) Career Development Opportunities (CDO) - perceptions of career growth, negatively correlated with turnover intention (Weng & McElroy, 2012).

However, most of the previous studies are based on "flat" individual data, which do not fully control for contextual differences at the branch level (work culture, management practices, leadership style) that may create different attitude clusters across units. To fill this gap, the current study applies cluster-based SEM with data from 40 commercial bank branches in Hanoi (each branch has 6 employees/managers, total 240 observations). The objectives are: (1) to quantify the impact of ACO, POS, PJU, CDO on employee loyalty (SLO); (2) to control for branch-level variance to estimate more robust coefficients; and (3) to propose managerial implications for enhancing retention in the context of increasingly fierce human resource competition.

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A review of the existing studies shows three main gaps.

1) Most current research focuses on the individual level, while branch-level factors are less focused.

2) Analytical models often use single-level SEM, which does not reflect the clustering structure of the data (employees - branches).

3) Many studies use “job satisfaction” as the central variable, which easily overlaps with loyalty, weakening the discriminant validity of the measurement model.

From these gaps, the study aims at three objectives:

1) Analyzing factors affecting employee loyalty at commercial banks in Hanoi;

2) Applying SEM model with cluster data to control for differences between branches;

3) Proposing human resource management recommendations to enhance organizational commitment and reduce employee turnover in the banking industry.

2. Literature review

In the context of commercial banks facing high pressure of labor mobility and competition for human resources, recent studies emphasize the role of psychological-organizational mechanisms in maintaining employee loyalty (SLO). Four prominent groups of factors - affective commitment (ACO), perceived organizational support (POS), procedural justice (PJU), and career development opportunities (CDO) - have been shown to be closely related to retention and intention to stay, with ACO and POS generally showing stronger and more stable effects in recent reviews/quantifications.

2.1. Affective Commitment (ACO)

Updated results show that ACO reduces turnover intention, thereby strengthening commitment/loyalty. In a multi-industry sample, Palma-Moreira et al. (2024) demonstrated that ACO is the strongest “reducer” of intention to leave in the model linking organizational culture → competency development → ACO → turnover, with a social exchange theory (reciprocity) explanation. The results confirmed: when employees are emotionally attached and identify with the organization, they tend to stay and be more loyal.

Adding to the retail banking context, the 2024 study found that affective/calculative commitment is a mediator of the satisfaction-loyalty link in banking services, emphasizing the role of ACO in

maintaining loyalty in a human-intensive service environment.

2.2. Perceived Organizational Support (POS)

New meta-analyses show that POS has a moderate negative correlation with intention to leave (which leads to increased commitment/loyalty). Galanis et al. (2024) synthesizes that when employees feel valued and cared for by their organization, they reduce their intention to leave; the results are consistent across studies and contexts.

In Vietnam, Giao et al. (2020) in a sample of banks confirmed that POS attenuates the negative impact of burnout/stress on turnover intentions - a direct implication for banks in Hanoi that increasing POS helps anchor employees amid job stress.

2.3. Procedural Justice (PJU)

Recent results support the role of procedural justice in reducing turnover intentions. In a large-scale Korean public sector data, Moon et al. (2024) found that PJU was significantly negatively related to turnover intentions, and this effect was stronger among the younger generation (MZ) who are sensitive to transparency/process. The results support the social exchange mechanism: fair procedures reinforce trust, thereby maintaining commitment.

This finding is consistent with recent studies in different contexts that show PJU, fair distribution, and fair interactions all reduce turnover intention - implying the need for banks to standardize and clearly communicate their evaluation-promotion processes to increase organizational trust and loyalty.

2.4. Career Development Opportunities (CDO)

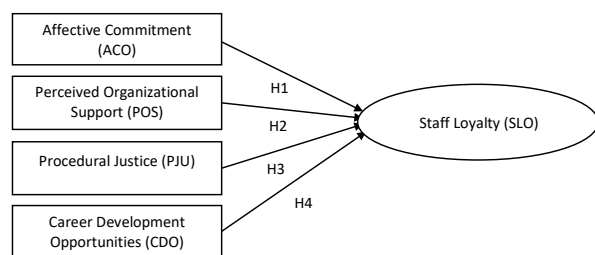
A new stream of research emphasizes investment in employee development as a sustainable lever to reduce turnover. In the International Journal of Training and Development, Martini et al. (2023) showed that perceived development investment was negatively associated with turnover intention (directly/indirectly), highlighting the role of learning-promotion opportunities in retention.

This finding is consistent with 2024-2025 evidence in many human-intensive services: career development activities (training, career paths, mentoring) reduce turnover intention and increase commitment/loyalty, through the reward-exchange mechanism.

2.5. Proposed Research Model and Hypotheses

Synthesizing the research results, the proposed model examines the impact of ACO, POS, PJU, and CDO on SLO in the context of commercial banks in Hanoi. The model is illustrated in Figure 1 below.

Figure 1. Proposed research model



Based on the theoretical foundation and empirical evidence, the research hypotheses are developed as follows:

H1: ACO has a positive impact on SLO.

H2: POS has a positive impact on SLO.

H3: PJU has a positive impact on SLO.

H4: CDO has a positive impact on SLO.

3. Research Methodology

3.1 Research Design

This study uses a quantitative approach to test the theoretical model proposed in Part 2. Data were collected using a structured questionnaire, focusing on factors affecting employee loyalty (SLO) in the commercial banking industry in Hanoi. The research design applies a cluster-based structural equation modeling (SEM), allowing control of intra-cluster dependencies when respondents work in the same bank branch. The research sample includes 40 commercial bank branches with 6 employees or managers surveyed at each branch, a total of 240 valid responses. Branch selection was carried out using a controlled convenience sampling method, ensuring representative distribution in the central and suburban areas.

3.2. Measurement Instrument

The variables in the research model are measured using a 5-point Likert scale (1 = completely disagree, 5 = completely agree). The scale is inherited and adjusted from recent international studies, combined with researches in Vietnam to ensure the context suitability.

Table 1. Constructs, Number of Items and Sources of Measurement

Factor/Code	No of items	Description	Sources of Measurement
Affective Commitment (ACO)	4	Measures employees' level of pride, emotional attachment and willingness to contribute to the bank, reflecting personal value alignment with the organization.	Palma-Moreira et al. (2024)
Perceived Organizational Support (POS)	4	Measures employees' perceptions of how much the organization cares, values, and supports them.	Galanis et al. (2024); Giao et al. (2020)
Procedural Justice (PJU)	4	Assess the fairness, consistency, and transparency of decision-making processes within the organization.	Colquitt (2001); Moon et al. (2024)

Factor/Code	No of items	Description	Sources of Measurement
Career Development Opportunities (CDO)	4	Assesses the extent to which the organization facilitates employee learning, development, and career advancement.	Weng & McElroy (2012); Martini et al. (2023)
Staff Loyalty (SLO)	3	Measures employee commitment to the long-term, including intentions to continue working and recommend the organization.	Roberts-Lombard et al. (2024)

Source: Compiled by the author based on prior studies

3.3. Sample and Data Collection

The data collection process was conducted in the third quarter of 2025 to ensure the representativeness and reliability of the research sample. Data were collected in two parallel forms: (i) directly through printed questionnaires distributed at bank branches, and (ii) online through authenticated Google Forms for the convenience of branches located far from the center.

The survey subjects included transaction officers, credit officers, customer care officers and middle managers at 40 commercial bank branches in Hanoi. Before the official survey, the research team conducted a pilot test with a small group of participants to adjust the language of the questions, ensuring clarity and ease of understanding.

Each participant was clearly explained the purpose of the research, information confidentiality rights and voluntary participation in the survey. All questionnaires were anonymous, no sensitive personal information was collected to increase the reliability of the responses. The total number of valid questionnaires for analysis was 240.

The data were pre-checked before data entry, including: detecting missing values, illogical responses, or straight-lining. Invalid responses were eliminated to ensure the quality of input data. Valid data were then coded and processed using SPSS and R software for the next analysis steps.

3.4. Data Analysis Methods

The collected data was processed and analyzed using SPSS software (for pre-processing and initial reliability testing) and R software (lavaan and lavaan.survey packages) to perform cluster-based SEM. Using cluster SEM helps control intra-cluster variance, improve the accuracy of estimated coefficients and ensure the reliability of hypothesis testing results.

The analysis steps include:

- *Testing the reliability of the scale:*

Internal reliability is assessed by Cronbach's Alpha coefficient.

Composite Reliability (CR) and Average Variance Extracted (AVE) are calculated to ensure the reliability and consistency of the scales.

Cronbach's Alpha and CR values ≥ 0.7 and AVE ≥ 0.5 are considered to meet the standard (Hair et al., 2019).

- *Confirmatory factor analysis (CFA):*

CFA was used to test the structure of latent factors, including 4 independent variables (ACO, POS, PJU, CDO) and dependent variable (SLO). Factor loadings were checked to ensure convergence and discrimination of the scale.

- *Cluster-based SEM analysis:*

SEM model was performed to estimate the impact of ACO, POS, PJU and CDO on SLO, while controlling for variance between clusters (bank branches). This approach helps overcome the limitations of traditional SEM when observations are not completely independent.

- *Model Fit Assessment:*

Model fit is tested using common statistical indices: Chi-square/df, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Common acceptance thresholds are: $\chi^2/df < 3$; CFI and TLI > 0.90 ; RMSEA and SRMR < 0.08 .

- *Hypothesis Testing:*

Hypotheses H1-H4 are tested based on standardized regression coefficients and statistical significance (p-value). A hypothesis is accepted when $p < 0.05$. In addition, the relative strength of influencing factors is also considered to discuss the order of impact.

4. Results

4.1. Descriptive statistics of respondents

Table 2. Respondents' Profile (n = 240)

Variable	Frequency	Percent (%)
Gender		
Male	86	35.8
Female	154	64.2
Experience		
Less than 2 years	62	25.8
From 2 years to 5 years	109	45.4
More than 5 years	69	28.8
Education		
College	17	7.1
University	185	77.1
Master and above	38	15.8
Age		
Up to 30 years old	79	32.9
From 30 to 40	105	43.8
More than 40	56	23.3
Job position		
Staff	185	77.1
Manager	55	22.9

Source: Compiled by the author

The results of the descriptive statistics of the survey sample presented in Table 2 show that the total number of participants is 240 employees and managers at commercial bank branches in Hanoi. In terms of gender, women account for a significantly higher proportion (64.2%) than men (35.8%). This reflects the common labor structure in the banking industry in Vietnam, where the female workforce often dominates in professional and customer care positions.

In terms of seniority, the group of employees with 2 to 5 years of experience accounts for the largest proportion (45.4%), followed by the group with less than 2 years (25.8%) and the group with more than 5 years (28.8%). This structure shows that the majority of the workforce is in the middle stage of the career cycle, consistent with the context of high competition for human resources in the banking industry.

In terms of education level, the majority of participants have university degrees (77.1%), followed by postgraduate (15.8%) and college degrees (7.1%). This reflects the characteristics of the banking industry - a field that requires relatively high professional knowledge.

In terms of age, the group from 30 to 40 years old accounts for the highest proportion (43.8%), the group under 30 years old accounts for 32.9%, and the group over 40 years old accounts for 23.3%. This age structure shows a fairly young, dynamic and adaptable workforce.

Finally, in terms of job position, professional staff accounts for 77.1%, while managers account for 22.9%. This is consistent with the characteristics of the banking industry's human resource structure, in which the number of employees directly dealing with transactions always accounts for the majority compared to managers.

Overall, the survey sample structure reflects relatively closely the actual labor structure at Vietnamese commercial banks, while creating favorable conditions for testing the research model on factors affecting employee loyalty.

4.2. Descriptive Analysis of Factors

Table 3. Descriptive Statistics and Correlation Matrix

Factor	Mean (M)	Std. (SD)	ACO	POS	PJU	CDO	SLO
ACO	3.47	0.68					
POS	3.51	0.79	0.37**				
PJU	3.37	0.76	0.27**	0.48**			
CDO	3.50	0.76	0.21**	0.31**	0.33**		
SLO	3.54	0.60	0.45**	0.55**	0.50**	0.49**	

Note: * $p < .01$

Source: Compiled by the author

The descriptive analysis results in Table 3 show that the mean values of the variables range from 3.37 to 3.54, reflecting a relatively high level of consensus among respondents on the measurement statements. The SLO variable has the highest mean value ($M = 3.54$), indicating that the level of employee loyalty to the bank is quite positive.

The Pearson correlation coefficient shows that all independent variables (ACO, POS, PJU, CDO) have a positive and statistically significant relationship with SLO at $p < 0.01$. In particular, POS has the strongest correlation coefficient with SLO ($r = 0.55$), followed by PJU ($r = 0.50$), CDO ($r = 0.49$) and ACO ($r = 0.45$).

In addition, the independent variables also have significant positive correlations with each other, reflecting the internal connection between psychological and organizational factors in the banking environment. This is an important basis for continuing to test the SEM model in the next analysis step.

4.3. Reliability and Convergent Validity of Constructs

Table 4. Reliability and Convergent Validity

Factors	No. of Items	CR	AVE	Cronbach's Alpha
ACO	4	0.848	0.584	0.849
POS	4	0.869	0.625	0.866
PJU	4	0.877	0.642	0.875
CDO	4	0.830	0.553	0.824
SLO	3	0.975	0.928	0.975

Source: Compiled by the author

The results of reliability and convergent validity tests are presented in Table 4. All scales achieved Cronbach's Alpha > 0.7 , CR > 0.7 and AVE > 0.5 , indicating that the scale has good internal reliability and satisfactory convergent validity (Hair et al., 2019). In particular, the SLO variable has the highest Cronbach's Alpha and CR coefficients, reflecting high consistency in measuring employee loyalty.

4.4. Discriminant validity (fornell-larcker criterion)

To test the discriminant validity between the concepts in the research model, the Fornell-Larcker criterion was applied, in which the square root of AVE was compared with the correlation coefficients between the variables.

Table 5. Discriminant Validity

	CDO	ACO	PJU	POS	SLO
CDO	0.764				
ACO	0.438	0.791			
PJU	0.333	0.551	0.801		
POS	0.236	0.368	0.386	0.744	
SLO	0.496	0.604	0.546	0.550	0.963

Source: Compiled by the author

The results of the Fornell-Larcker discriminant validity test are presented in Table 5. The square root value of AVE (in bold on the main diagonal) of each variable is larger than the correlation coefficients with the remaining variables. This proves that the scales have discriminant validity (Fornell & Larcker, 1981), meaning that each measurement concept is clearly differentiated from other concepts in the research model.

4.5. Goodness-of-Fit Indices for Confirmatory Factor Analysis

To assess the goodness-of-fit of the measurement model, goodness-of-fit indices are used, including: χ^2/df , CFI, TLI, RMSEA and SRMR these are commonly recommended indices in CFA analysis.

Table 6. Model Fit Indices for Confirmatory Factor Analysis

Fit Index	Value	Recommended Threshold	Evaluation
χ^2/df (p-value)	1.069 (0.271)	< 3.0 (> 0.05)	Excellent
Robust CFI	1.000	> 0.95	Excellent
Robust TLI	1.008	> 0.95	Excellent
Robust RMSEA	0.000	< 0.06	Excellent
SRMR	0.033	< 0.08	Excellent

Source: Compiled by the author

The results presented in Table 6 show that all indices met or exceeded the recommended thresholds: $\chi^2/df = 1.069$ (< 3.0), CFI = 1.000, TLI = 1.008 (> 0.95), RMSEA = 0.000 (< 0.06) and SRMR = 0.033 (< 0.08). This demonstrates that the measurement model has a very high fit, confirming that the structure of the scales used in the study is reliable and consistent with the empirical data.

4.6. Structural Model and Hypotheses Testing

After confirming the reliability and validity of the measurement model, structural equation modeling (SEM) was used to test hypotheses H1-H4 to assess the impact of independent variables (CDO, ACO, PJU, POS) on the dependent variable (SLO). The standardized path coefficients (β), standard errors (S.E.) and p-values are presented in Table 7.

Table 7. Structural Path Coefficients and Hypothesis Testing

Hypothesis	Path	β	S.E.	p-value	Supported
H1	CDO $\rightarrow$ SLO	0.235	0.050	$< .001$	Yes
H2	ACO $\rightarrow$ SLO	0.279	0.045	$< .001$	Yes
H3	PJU $\rightarrow$ SLO	0.191	0.065	0.029	Yes
H4	POS $\rightarrow$ SLO	0.318	0.054	$< .001$	Yes

Note: R^2 for SLO = 0.56, indicating that the four independent variables (CDO, ACO, PJU, POS) jointly explain 56% of the variance in employee loyalty.

Source: Compiled by the authors

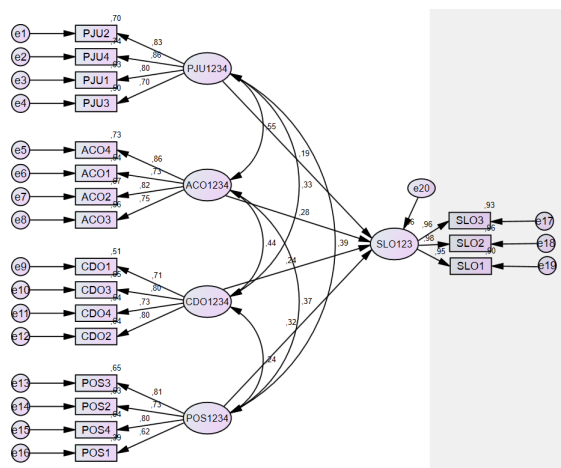
The results indicate that all hypotheses H1-H4 are supported at the 5% significance level ($p < 0.05$). Among the independent variables, POS has

the strongest impact on SLO ($\beta = 0.318$), followed by ACO ($\beta = 0.279$), CDO ($\beta = 0.235$) and PJU ($\beta = 0.191$). This implies that perceived organizational support and affective commitment play a crucial role in enhancing employee loyalty in commercial banks.

In addition, the model explains 56% of the variance in SLO ($R^2 = 0.56$), indicating a high explanatory power of the proposed structural model. This finding underscores the robustness of the theoretical framework and aligns well with previous research in organizational behavior and human resource management.

Figure 2 below presents the structural equation model (SEM) constructed to test the research hypotheses.

Figure 2. Structural Equation Model with Standardized Path Coefficients



Note: The structural model was estimated using R (lavaan and lavaan.survey packages), while the diagram was visualized using IBM SPSS Amos for clearer visualization of the structural model. Standardized coefficients are shown on the paths, and all coefficients are statistically significant at $p < 0.05$.

5. Discussion

The research results confirm that four factors including organizational support (POS), affective commitment (ACO), procedural justice (PJU) and career development opportunities (CDO) all have positive and statistically significant effects on employee loyalty (SLO) in commercial banks. Among them, POS has the strongest impact ($\beta = 0.318$), followed by ACO ($\beta = 0.279$), CDO ($\beta = 0.235$) and PJU ($\beta = 0.191$). The model explains 62% of the variance of SLO ($R^2 = 0.62$), reflecting significant explanatory power and strengthening the robustness of the theoretical model.

The strong impact of POS is consistent with recent research results, such as Galanis et al. (2024), Giao et al. (2020) and Bui et al. (2024), which shows that when employees feel cared for

and supported by their organization, they tend to stay longer, reduce their intention to leave, and increase their organizational commitment. POS continues to affirm its central role in maintaining a stable workforce in the fiercely competitive context of the banking industry.

The significant effect of ACO on SLO is also similar to the findings of Palma-Moreira et al. (2024) and Roberts-Lombard et al. (2024). These studies show that affective commitment plays a key psychological mechanism that drives employee loyalty, especially in service industries with high work pressure. This research results contribute to strengthening the argument that building a strong emotional bond between employees and the organization is a strategic factor in human resource management.

In addition, the positive impact of CDO is consistent with Martini et al. (2023), emphasize the importance of providing career development and promotion opportunities in retaining employees. In the Vietnamese banking industry, where competition for human resources is fierce, investment in training and clear career paths clearly play an important role in enhancing loyalty.

The weaker but statistically significant impact of PJU is consistent with the studies of Moon et al. (2024) and Zhao et al. (2024). Procedural justice is considered a fundamental factor, helping to strengthen employees' trust in the organization, thereby indirectly strengthening loyalty. Although not the strongest factor, PJU plays a positive supporting role in the overall impact structure.

The results of the study in Hanoi city have many similarities with international studies, especially in the prominent role of organizational support (POS) and affective commitment (ACO) on employee loyalty. Similar to the results of Galanis et al. (2024) or Roberts-Lombard et al. (2024), when employees feel cared for, supported and fair in the organization, they tend to stay longer, reduce their intention to leave and increase their level of organizational commitment. In addition, the factor of career development opportunities (CDO) also shows a positive impact similar to studies in highly competitive service industries. This reflects that the psychological-organizational drivers that promote employee loyalty are universal, not limited by geographical characteristics.

However, the research results also show some notable differences compared to international studies. Specifically, in the context of Hanoi, POS has a significantly stronger impact than the

remaining factors, reflecting the fact that employees in the Vietnamese banking industry often value security, stability and support from the organization more than career development opportunities. At the same time, the impact of procedural justice (PJU), although statistically significant, is weaker than in many previous studies, possibly due to the characteristics of the administrative-centralized working environment, where compliance with procedures is considered a minimum requirement. These differences suggest the need for a strategic approach that is appropriate to the specific culture and labor market in Vietnam, instead of completely applying international models.

Taken together, the findings are consistent with recent international empirical evidence and reflect the specificity of the Vietnamese banking industry, where a harmonious combination of organizational support, emotional commitment, and fair policies and career development plays an important role in employee retention. This not only reinforces existing organizational behavior theories but also provides useful empirical evidence for banks in planning their human resource strategies.

6. Conclusion and Implications

This study successfully tested a structural equation model (SEM) to identify factors influencing employee loyalty in commercial banks. The analysis results from 240 observations at 40 bank branches in Hanoi showed that four factors - proactive organizational support (POS), affective commitment (ACO), career development opportunities (CDO), and procedural justice (PJU) - all had positive and statistically significant effects on loyalty (SLO). Of which, POS had the strongest impact, followed by ACO, CDO, and PJU. The model explained 62% of the variance in SLO, reflecting its reliable and robust explanatory power.

Theoretically, this result reinforces contemporary arguments in organizational behavior, especially the central role of POS and ACO in shaping employees' long-term commitment. At the same time, the study also affirms the importance of supporting factors in terms of processes and career development, in line with the labor context in the banking industry - where high-quality human resources are strongly affected by competitive pressure and expanding career opportunities.

In terms of practice, the research results suggest some specific management implications:

First, banks need to strengthen organizational support policies such as: caring for welfare, paying attention to personal development needs, and

building a friendly working environment. This helps employees feel connected, thereby increasing loyalty.

Second, managers need to focus on building emotional commitment by promoting a positive organizational culture, creating pride and trust among employees in the organization. This is the second most influential factor in the model.

Third, investing in career development policies and clear promotion paths will help retain employees long-term, especially young employees with high potential.

Fourth, ensuring fairness and transparency in decision-making, evaluation and reward processes will strengthen trust, creating a foundation for sustainable commitment.

In addition, the research results can also support human resource policy makers in the banking industry to build sustainable human resource management strategies, reduce recruitment and training costs, and improve the organization's competitiveness.

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• **Keywords:** *waste sorting behavior, students, Ho Chi Minh City.*

Date of receipt revision: 10th Dec., 2025

Date of approval: 22th Jan., 2026

DOI: <https://doi.org/10.71374/jfar.v26.i1.14>

Figure 1: Bibliometric analysis of studies related to waste sorting behavior

Source: Compiled by the authors

Research on waste sorting emphasizes waste management as a nexus between human behavior, attitude, and the theory of planned behavior, shaping students' sorting and separation of solid waste in higher education (Waxin et al., 2025). As shown in Figure 1, key terms such as waste management, human, environmental impact, and circular economy are strongly interconnected, highlighting the behavioral and environmental dimensions of waste-related studies. In university settings, waste sorting is also closely linked to sustainability education and circular economic development goals (Bang et al., 2025).

2.1 Theoretical Framework

Waste Sorting Behavior: Waste sorting behavior refers to intentional actions to separate waste at the source for recycling and effective treatment. Influenced by behavioral intention, personal moral norms, and perceived behavioral control under the extended TPB, this behavior among students also depends on convenience and supporting infrastructure. This

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highlights the persistent gap between environmental awareness and actual practice (Waxin et al., 2025).

The Theory of Planned Behavior: The Theory of Planned Behavior (TPB) proposed by Ajzen (1991) suggests that human behavior is mainly driven by behavioral intentions. This intention is shaped by attitudes toward behavior, subjective norms, and perceived behavioral control, which can also directly influence behavior. TPB has been widely applied to explain environmental behaviors, including waste sorting.

Norm Activation Theory: Schwartz's Norm Activation Theory (1977) argues that environmental behavior is driven by personal moral norms, or an individual's sense of moral obligation toward society. These norms are activated when people are aware of the consequences of their actions and feel personally responsible. Once activated, personal norms encourage behaviors such as waste sorting.

2.2 Hypotheses and Research Model

Infrastructure: Infrastructure refers to the availability and convenience of waste-sorting facilities on campus, which help reduce practical barriers to waste separation. Adequate infrastructure enables students to perform waste sorting more easily and supports actual behavior (Vu et al., 2025). Accordingly, the following hypothesis is formulated:

H1: Infrastructure positively influences students' actual waste-sorting behavior.

Environmental awareness: Environmental awareness reflects students' understanding of the negative impacts of waste and the benefits of waste sorting. Higher environmental awareness encourages positive attitudes and strengthens students' motivation and intention to engage in waste sorting (Dong Wang et al., 2022). Accordingly, the following hypothesis is formulated:

H2: Environmental awareness positively influences students' intention to perform waste sorting.

Perceived behavioral control: Perceived behavioral control reflects students' beliefs about their ability and available conditions to sort waste. When waste sorting is perceived as easy and manageable, students' intention to engage in this behavior increases significantly (Waxin et al., 2025). Accordingly, the following hypothesis is formulated:

H3: Perceived behavioral control positively influences students' intention to perform waste sorting.

Personal moral norms: Personal moral norms reflect students' sense of moral obligation and responsibility toward the environment. When students view waste sorting as the morally right thing to do, their intention to engage in this behavior increases. Research indicates

that personal moral norms have a significant and positive effect on waste sorting intention, highlighting the role of internal moral motivation in shaping behavioral intention (Waxin et al., 2025). Accordingly, the following hypothesis is formulated:

H4: Personal moral norms positively influence students' intention to perform waste sorting.

Intention to sort waste: Waste sorting intention reflects students' readiness to engage in this behavior. The stronger the intention, the more likely students are to actually sort their waste. Studies show that intention has a direct and positive effect on waste sorting behavior, confirming its key role in turning awareness into real action (Bang Nguyen Viet et al., 2025). Accordingly, the following hypothesis is formulated:

H5: Students' intention positively influences their actual waste-sorting behavior.

3. Research Methods

This study adopts a convenience sampling approach, with the sample size determined based on the guidelines of Tabachnick and Fidell (2013). A survey was conducted with 480 respondents in Ho Chi Minh City who were concerned with factors influencing waste sorting behavior; after data cleaning, 478 valid responses were retained for analysis. The data were analyzed using SmartPLS, including tests of Cronbach's alpha for reliability, convergent and discriminant validity, structural model evaluation, multicollinearity assessment, adjusted R^2 , and effect size f^2 to assess the influence of each variable and identify potential missing key factors in the model.

4. Research Results

4.1. Cronbach's Alpha analysis results

Scale reliability was assessed using Cronbach's Alpha, and the results show that all constructs meet the required reliability level (Cronbach's Alpha ≥ 0.7). In addition, the average variance extracted (AVE) values are all ≥ 0.50 , indicating good convergent validity of the measurement scales (Chin, 1998).

Table 4.1: Table of Cronbach's Alpha Reliability Results

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
EA	0,909	0,912	0,936	0,784
IF	0,887	0,892	0,922	0,746
ISW	0,916	0,917	0,941	0,798
PBC	0,886	0,888	0,921	0,745
PMN	0,897	0,901	0,928	0,765
WSB	0,919	0,920	0,942	0,804

4.2. Convergent Validity Assessment

Table 4.2: Table of Convergent Validity Assessment Results

	EA	IF	ISW	PBC	PMN	WSB
EA1	0,897					
EA2	0,885					
EA3	0,878					
EA4	0,882					

	EA	IF	ISW	PBC	PMN	WSB
IF1		0,846				
IF2		0,870				
IF3		0,876				
IF4		0,863				
ISW1			0,901			
ISW2			0,868			
ISW3			0,910			
ISW4			0,895			
PBC1				0,860		
PBC2				0,891		
PBC3				0,868		
PBC4				0,833		
PMN1					0,811	
PMN2					0,871	
PMN3					0,916	
PMN4					0,896	
WSB1						0,892
WSB2						0,876
WSB3						0,907
SB4						0,911

Convergent validity reflects the degree to which observed variables within the same construct are highly correlated (Bagozzi, Yi, & Phillips, 1991). When assessing convergent validity, researchers typically examine the outer loadings of each indicator as well as the average variance extracted (AVE). According to common guidelines, indicators should have outer loadings of at least $\geq 0,7$ to be considered acceptable. The results obtained from SmartPLS show that all indicators have loadings greater than 0,7; therefore, they are retained and the measurement scales demonstrate adequate convergent validity.

4.3. Discriminant Validity Assessment

Table 4.3: Discriminant Validity Assessment Using the Heterotrait-Monotrait Ratio (HTMT) Matrix

	EA	IF	ISW	PBC	PMN	WSB
EA						
IF	0,714					
ISW	0,803	0,698				
PBC	0,842	0,737	0,856			
PMN	0,813	0,730	0,899	0,898		
WSB	0,658	0,720	0,866	0,831	0,826	

According to Henseler et al. (2015), the Heterotrait-Monotrait ratio (HTMT) is proposed as a reliable criterion for assessing discriminant validity among constructs, with an acceptable threshold of below 0,90. The results presented in Table 4.3 show that all HTMT values are lower than 0,90, indicating that the measurement scales in the research model satisfy the requirements for discriminant validity.

According to the criterion proposed by Fornell and Larcker (1981), discriminant validity is established when the square root of the AVE for each latent construct is greater than its correlations with any other construct in the model. The results shown in the table indicate that the diagonal values (i.e., the square roots of AVE) are higher than the other correlation coefficients in the same column, suggesting that the measurement scales meet the discriminant validity requirement under this criterion.

Table 4.4: Discriminant Validity Assessment Using the Fornell-Larcker Criterion

	EA	IF	ISW	PBC	PMN	WSB
EA	0,886					
IF	0,649	0,864				
ISW	0,735	0,635	0,894			
PBC	0,760	0,658	0,771	0,863		
PMN	0,734	0,657	0,815	0,800	0,875	
WSB	0,604	0,650	0,797	0,750	0,752	0,896

4.4. Structural model assessment

Table 4.5: Results of the structural model assessment

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
EA ISW	0,192	0,193	0,052	3,710	0,000
IF ISW	0,068	0,070	0,044	1,553	0,121
ISW WSB	0,797	0,796	0,026	30,127	0,000
PBC ISW	0,214	0,213	0,055	3,909	0,000
PMN ISW	0,458	0,457	0,064	7,196	0,000

The path coefficients range $[-1;1]$. Table 4.5 shows that all coefficients fall within the acceptable range, are positive, and are close to 1, indicating positive relationships among the variables in the model. To test statistical significance, the study employs the bootstrapping. Coefficients are considered significant when $t > 1,96$ (corresponding to $p < 0,05$). The results indicate that, except for the relationship between IF and ISW with $p = 0,121 > 0,05$, which is not statistically significant, all other relationships reach statistical significance ($p < 0,05$). This suggests that IF does not have a significant effect on ISW in this study.

4.5. Reassessment of the PLS-SEM model

Multicollinearity assessment

The model was re-estimated using the PLS-SEM approach to ensure the reliability and explanatory power of the variables. The multicollinearity assessment shows that all VIF values fall within a safe range (1,000–3,503), well below the commonly accepted threshold of 5. This indicates that there are no serious multicollinearity issues among the independent variables in the model.

Table 4.6: Multicollinearity test results (VIF)

	VIF
EA ISW	2,793
IF ISW	2,034
ISW WSB	1,000
PBC ISW	3,503
PMN ISW	3,243

4.6. Adjusted R² assessment

The R² coefficient measures the model's predictive power and reflects the combined effect of exogenous variables on endogenous variables (Hair et al., 2016). R² ranges from $[0;1]$, and higher values indicate stronger predictive ability. In behavioral or exploratory studies, an R² value of 0,20 is generally considered acceptable (Hair et al., 2017). Therefore, the findings support the relationship between Intention to Sort Waste (ISW) and Waste-Sorting Behavior (WSB) in the proposed theoretical model.

Table 4.7: Adjusted coefficient of determination

	R Square	R Square Adjusted
ISW	0,723	0,721
WSB	0,635	0,634

4.7. Assessment of the effect size f^2

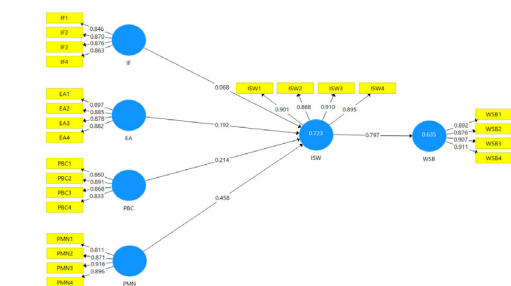
The f^2 index is used to assess the magnitude of the impact of an independent variable on a dependent variable, with reference thresholds of 0,35 (strong), 0,15 (moderate), and 0,02 (weak) (Cohen, 1988). The results indicate that Personal Moral Norm (PMN) has a moderate effect on Intention to Sort Waste (ISW), with $f^2 = 0,234$, while Environmental Awareness (EA) and Perceived Behavioral Control (PBC) show weaker effects (f^2 values of 0,048 and 0,047, respectively). This suggests that PMN plays a more important role in explaining variations in waste sorting intentions.

However, the relationship between IF and ISW is not statistically significant ($p = 0,121 > 0,05$, Table 4.5). The effect size f^2 of IF on ISW is 0,008, indicating a very weak influence. Therefore, the IF variable is excluded from the final research model.

Table 4.8: Evaluation of the impact coefficient f^2

	f^2 square
EA ISW	0,048
IF ISW	0,008
ISW WSB	1,740
PBC ISW	0,047
PMN ISW	0,234

Overall, the research results indicate that Personal Moral Norm (PMN), Environmental Awareness (EA), and Perceived Behavioral Control (PBC) all have a significant influence on Intention to Sort Waste (ISW), with all relationships reaching statistical significance ($p < 0,05$). Among these factors, PMN has the strongest effect on ISW, with a standardized beta coefficient of 0,458, showing that it is the most important factor explaining changes in students' waste sorting intentions. This is followed by the effects of PBC ($\beta = 0,214$) and EA ($\beta = 0,192$), both of which show moderate and positive influences on ISW. In contrast, IF has a very weak standardized beta coefficient of 0,068 and therefore is excluded from the model. The final research model is presented as follows:



Interpretation: IF-Infrastructure; EA-Environmental Awareness; PBC-Perceived Behavioral Control; PMN-Personal Moral Norm; ISW-Intention to Sort Waste; WSB-Waste-sorting Behavior

5. Conclusions and Managerial Implications

This study examines the factors influencing students' waste sorting behavior in Ho Chi Minh City based on an extended Theory of Planned Behavior (TPB) model. The results show that Personal Moral Norms (PMN) have the strongest effect on students' intention to sort waste ($\beta = 0,458$), followed by Perceived Behavioral Control (PBC) ($\beta = 0,214$) and Environmental Awareness (EA) ($\beta = 0,192$), with all of these relationships being statistically significant. In contrast, Infrastructure (IF) shows a very weak effect ($\beta = 0,068$) and is not statistically significant and therefore is excluded from the final research model.

In addition, Intention to Sort Waste (ISW) is identified as a strong predictor of students' actual waste sorting behavior (WSB), with a high standardized beta coefficient ($\beta = 0,797$). This finding highlights the central role of intention in translating awareness, attitudes, and motivation into concrete actions, and further supports the applicability of the Theory of Planned Behavior in studying environmental behavior among students in Vietnam.

Based on these findings, the study suggests that promoting waste sorting behavior in university settings should prioritize strengthening students' personal moral norms, while also improve environmental awareness and enhance their perceived ability to control the behavior through appropriate educational, communication, and behavioral guidance activities. These implications provide useful insights for educational institutions and policymakers in designing policies and programs that encourage sustainable waste sorting behavior.

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DETERMINANTS OF AUDIT REPORT LAG: EVIDENCE FROM LISTED COMPANIES IN VIETNAM

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Abstract: *This study examines the determinants of audit report lag (ARL) in Vietnamese listed companies, focusing on both firm characteristics and corporate governance factors. The sample comprises 578 firms listed on the Vietnamese Stock Exchange from 2011 to 2022, using data from audited financial statements and annual reports. Panel data regression with diagnostic tests is applied to ensure model robustness. The findings show that firm size is positively associated with ARL, whereas profitability, financial leverage, and CEO gender (female) are negatively associated. In contrast, audit committee presence, board size, CEO - chairman duality, and board independence show no significant effect. These results provide empirical evidence on the combined effects of governance mechanisms and firm-specific attributes on ARL in an emerging market, offering useful insights for policymakers and stakeholders aiming to improve the timeliness of financial statement disclosure.*

• Keywords: *audit report lag; firm characteristics; corporate governance; Vietnam.*

Date of receipt: 27th Oct., 2025

Date of delivery revision: 03th Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.15>

Date of receipt revision: 10th Dec., 2025

Date of approval: 22th Jan., 2026

1. Introduction

In the context of increasing globalization and dynamic capital markets, stakeholders demand not only transparency but also prompt access to reliable financial information. Among various corporate disclosures, audited financial statements play a pivotal role in shaping users' decisions, as they are expected to provide assurance on the credibility of reported figures (Wiyantoro & Usman, 2018). However, the usefulness of these statements significantly declines if there is a delay in their publication. Timely audit reports are essential for maintaining the relevance of financial information; excessive lag can undermine investor confidence and impair the decision-making process (Wiyantoro & Usman, 2018; Mutiara et al., 2018). Recognizing this, international accounting standards emphasize timeliness as a core qualitative characteristic of high-quality financial reporting, underscoring that delayed disclosure reduces the value and effectiveness of financial communication. International accounting frameworks emphasize that undue delay in releasing financial information can diminish its relevance and usefulness to investors (Hashim & Abdul Rahman, 2011).

ARL defined as the number of days from a firm's fiscal year-end until the auditor's report is signed and released (Ashton et al., 1987), is commonly used as an indicator of financial reporting timeliness (Alsheikh, 2024). Longer ARLs imply that stakeholders wait longer for audited financial statements, which can affect decision-making and market confidence.

Prior research notes that prolonged audit delays may increase the risk of information leakage and reduce investor trust in the financial reports (Hashim & Abdul Rahman, 2011). Mohamad-Nor et al. (2010) argue that delays in disclosing auditors' opinions on the fairness and reliability of financial information exacerbate information asymmetry, thereby increasing uncertainty in investment decision-making. Thus, understanding what drives audit report lag is important for regulators, practitioners, and scholars concerned with improving the transparency and efficiency of financial reporting.

Firm-specific factors and corporate governance are key to reducing ARL, but evidence on their effectiveness in emerging markets is mixed. Effective governance through boards and audit committees can strengthen oversight of the financial reporting and audit process, thereby potentially shortening the audit completion time (Sultana et al., 2015). Studies show that board independence and CEO duality do not consistently reduce ARL, while audit committees improve timeliness only when they are independent, financially literate, and active (Hashim & Abdul Rahman, 2011; Sultana et al., 2015; Ovbiebo, 2021; Lajmi & Yab, 2022; Alshammari, 2024). Other governance factors such as board size and meeting frequency also yield inconclusive results; while more frequent meetings may enhance oversight, and indeed a few studies found that committees meeting more often lead to faster audit completion, excessive board size can hinder coordination (Hashim & Abdul Rahman, 2011; Tinumbia, 2018). At the firm level, higher profitability shortens ARL, while greater leverage and complexity

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prolong it (Hashim & Abdul Rahman, 2011). Gender diversity has also emerged as a relevant factor, with female directors linked to shorter ARLs due to stronger ethical oversight (Alkebsee et al., 2022; Alsheikh, 2024). The relationship between firm size and ARL remains inconclusive, some studies find a significant negative effect, as larger firms with better controls and systems release audited reports faster (Isha et al., 2021; Meiryani et al., 2022; Adela & Badera, 2022), while others note that operational complexity in large firms can prolong audits (Ubwarin & Bawono, 2021). Given these varied findings, especially in under-studied markets like Vietnam, further research is necessary to understand how corporate governance affect ARL.

Within this backdrop, the present study aims to investigate how both governance structures and firm-specific attributes jointly influence ARL in Vietnamese listed companies. Vietnam provides an interesting setting as an emerging market where corporate governance practices have been evolving, especially over the 2011- 2022 period examined. Using a panel dataset of 578 firms' annual financial reports from 2011- 2022, we employ panel regression with robust diagnostic tests to ensure reliable estimation of effects. In brief, our findings indicate that certain firm-level governance and financial characteristics significantly influence ARL. These results provide new evidence on an ongoing issue, the timeliness of audited financial reporting in the context of Vietnam's capital market. These findings present new empirical insights into how governance and firm attributes together shape audit timeliness in an emerging market, and it suggests policy directions for regulators and companies aiming to strengthen governance and expedite the release of financial statements.

The paper is structured as follows: Section 2 reviews the literature and develops the research hypotheses; Section 3 outlines the research model and methodology; Section 4 presents the empirical results; and Section 5 concludes with implications and recommendations for policymakers and business practitioners.

2. Hypotheses development

Agency theory explains the conflict of interest that arises from the separation of ownership and control in a firm. Managers (agents) may not always act in the best interests of shareholders (principals), which leads to information asymmetry (Jensen & Meckling, 1976). In the context of audit report lag (ARL), this theory suggests that, without effective oversight, managers might intentionally delay or withhold financial information to protect their own interests. ARL is therefore considered a reflection of information asymmetry between management and shareholders, or other users of financial reports. To reduce this

asymmetry, audited financial statements must be disclosed in a timely manner (Endri et al., 2024). To mitigate agency conflicts, firms implement corporate governance mechanisms that align managers' actions with shareholders' interests. Strong governance mechanisms, such as effective audit committees, independent boards, non-dual leadership, and aligned ownership help keep management in check and reduce information asymmetry (Alshammari, 2024). This oversight pressure encourages managers to be more transparent and timely in financial reporting, thereby potentially shortening the audit report lag. In addition to governance, firm-specific characteristics are also relevant from an agency perspective. For instance, firms with high profitability may be incentivized to disclose results promptly to signal good performance (Adela & Badera, 2022), whereas highly leveraged firms may face longer audits due to increased risk and scrutiny (Hashim & Abdul Rahman, 2011;). Similarly, larger firms may benefit from better resources and internal controls, but their operational complexity could prolong audit completion (Meiryani et al., 2022).

Drawing on agency theory and supported by prior empirical evidence, this study proposes the following hypotheses to examine how corporate governance mechanisms and firm characteristics influence audit report lag:

H1: There is a negative association between ARL and existence of an audit committee

H2: There is a negative association between ARL and board size

H3: There is a positive association between ARL and duality of CEO

H4: There is a negative association between ARL and independence of the board independence

H5: There is a positive association between ARL and CEO gender

H6: There is a positive association between ARL and company size

H7: There is a negative association between ARL and profitability

H8: There is a positive association between ARL and leverage

3. Research model and methodology

Research Model: $ARL_{it} = \beta_0 + \beta_1 ACEXI_{it} + \beta_2 BOS_{it} + \beta_3 DUAL_{it} + \beta_4 BI_{it} + \beta_5 SIZE_{it} + \beta_6 ROA_{it} + \beta_7 LEV_{it} + \beta_8 GENDER_{it} + \varepsilon$

In this model, ARL is the dependent variable, measuring the number of days between the fiscal year-end and the date the audit report is signed (Ashton et al., 1987). The author has also developed measurement

scales for the independent variables included in the research model, as summarized in Table 1.

Table 1. Summary of the measurement scales for the independent variables

Variable	Definition	Description	Reference studies
ACEXI	Existence of an audit committee	1 if the company has audit committee, and 0 otherwise	Afify (2009)
BOS	Board Size	Total number of directors on the board	Lajmi and Yab (2022)
DUAL	Duality of CEO	1 if CEO is the Chairman, and 0 otherwise	Afify (2009)
BI	Proportion of independent non-executive directors	The proportion of external non-executive directors to the total number of directors on the board	Afify (2009) Lajmi and Yab (2022)
GENDER	CEO Gender	1 if the CEO is male and 0 if the CEO is female	Nguyen and Nguyen (2017)
SIZE	Company size	the logarithm of total assets	Lajmi and Yab (2022)
ROA	Profitability	Net income divided by total assets	Lajmi and Yab (2022)
LEV	Leverage	Total liabilities divided by total assets	Bintarto and Harymawan (2024)

The study initially considered 753 firms listed on the Ho Chi Minh Stock Exchange (HOSE) and the Hanoi Stock Exchange (HNX) over the period 2011-2022. Data were collected from audited financial statements, annual reports, and corporate governance reports obtained via Vietstock, CafeF, and the firms' official websites. Firms with incomplete information were excluded. The final sample comprises 578 firms.

4. Research results

4.1. Descriptive statistics

Table 2 shows that ARL averages 74.93 days, revealing considerable delays in some firms (up to 188 days). The presence of an audit committee is rare (3.73%), suggesting weak governance structures. Boards are relatively small, averaging 4.54 members, and CEO duality appears in about one-quarter of firms. Independent directors account for just over half of board members, indicating moderate board independence.

Table 2. Descriptive statistics of sample variables

Variable	Mean	Std.Dev	Min	Max
ARL	74.93	18.60	3	188
ACEXI	0.0373	0.1894	0	1
BOS	4.54	2.39	3	14
DUAL	0.254	0.435	0	1
BI	0.530	0.288	0	0.909
GENDER	0.874	0.331	0	1
SIZE	27.316	1.597	23.288	33.694
ROA	0.069	0.069	0.0032	0.791
LEV	0.257	0.176	0.000071	0.8

4.2. Correlation Analysis

Table 3 shows low correlations among variables, with the highest being BOS-BI (0.37) and SIZE-LEV (0.32). ARL relates weakly to all predictors, strongest with SIZE (0.21). Notable patterns include DUAL's negative link with GENDER and BI, and ROA's negative link with LEV. Overall, the low coefficients suggest multicollinearity is not a concern. Consistently, the VIF values (1.09-1.36, mean 1.22) confirm the absence of multicollinearity among the explanatory variables (table 4).

Table 3. Pearson correlation coefficient matrix

	ARL	ACEXI	BOS	DUAL	BI	GENDER	SIZE	ROA	LEV
ARL	1.0000								
ACEXI	0.0108	1.0000							
BOS	0.0691	0.0680	1.0000						
DUAL	0.0096	0.0916	0.1605	1.0000					
BI	0.0147	0.0600	0.3672	-0.1192	1.0000				
GENDER	0.0332	-0.0368	0.0893	-0.3178	0.0565	1.0000			
SIZE	0.2057	0.1572	0.1391	0.0137	0.0133	-0.0737	1.0000		
ROA	-0.1935	0.1585	-0.0085	0.0244	0.0439	0.0439	-0.0761	1.0000	
LEV	0.0342	-0.1384	-0.1135	-0.0300	-0.1604	-0.0941	0.3200	-0.3540	1.0000

4.3. Regression Results and discussion

Table 4 presents the regression results using POLS, FEM, REM models. The F-test comparing POLS and FEM yields a significant result ($F = 5.11$; $p < 0.05$), suggesting that FEM is preferred over the pooled model. Furthermore, the Breusch-Pagan Lagrange Multiplier test indicates that REM is more appropriate than POLS ($\text{chibar2} = 467.31$; $p < 0.05$). To choose between FEM and REM, the Hausman test is applied. The result ($\text{chibar2} = 9.31$; $p = 0.3172$) is statistically insignificant, suggesting that the Random Effects Model (REM) is preferred.

Table 4: Regression results using POLS, FEM, REM models and GLS

Variable	POLS		FEM		REM		GLS	
	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
ARL								
ACEXI	-0.554	0.877	2.692	0.580	1.966	0.618	-1.933	0.264
BOS	0.235	0.635	-0.349	0.572	-0.257	0.624	0.358	0.185
DUAL	0.558	0.712	-1.922	0.281	-0.733	0.637	0.951	0.221
BI	-0.782	0.832	1.703	0.702	0.293	0.941	-3.189	0.139
GENDER	2.037	0.188	0.029	0.986	0.971	0.511	1.72	0.030***
SIZE	2.680	0.000***	3.023	0.006***	2.847	0.331	2.539	0.000***
ROA	-68.997	0.000***	-35.833	0.013**	-51.500	0.000***	-68.857	0.000***
LEV	-10.777	0.012*	-2.214	0.731	-4.944	0.000***	-8.023	0.004***
F-test	(F101,568) = 5.11 Prob > F = 0.000							
BP Lagrange test	chibar2(01) = 467.31 Prob > chibar2 = 0.000							
Hausman test	chibar2(8) = 9.31 Prob > chibar2 = 0.3172							

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

However, further diagnostic tests reveal violations of key regression assumptions. The Wooldridge test confirms the presence of serial correlation ($F(1,69) = 23.902$; $p < 0.05$), while the White test indicates heteroskedasticity ($\text{chi2}(41) = 75.35$; $p < 0.05$). To address these issues and improve estimation efficiency, the Generalized Least Squares (GLS) method is applied. The GLS results are used as the basis for interpretation and discussion.

The GLS regression results show that firm size (SIZE) has a positive and statistically significant impact on audit report lag ($\beta = 2.539$; $p < 0.01$), supporting H6. This finding suggests that larger firms, while having more resources, may experience longer audit delays due to operational complexity. Firm size has a positive and significant effect on ARL, suggesting that the greater operational complexity of large firms may prolong audit completion, consistent with Ubwarin and Bawono (2021) but contrasts with studies such as

Meiryani et al. (2022), which argue that large firms tend to report more quickly due to better internal controls.

Profitability (ROA) is negatively associated with ARL ($\beta = -68.857$; $p < 0.01$), supporting H7 and aligning with previous research (Adela & Badera, 2022). Profitable firms are likely to accelerate audit completion to convey favorable signals to investors.

Leverage (LEV) shows a significant negative effect on ARL ($\beta = -8.023$; $p < 0.01$), which is contrary to H8. This suggests that, in the Vietnamese context, higher leverage may motivate firms to expedite the audit process to reassure creditors and investors, differing from prior studies such as Meiryani et al. (2022) that report longer audits for highly leveraged firms.

Interestingly, CEO gender (GENDER) is significant at the 5% level ($\beta = 1.720$; $p < 0.05$), supporting H5. The positive coefficient suggests that firms with male CEOs may experience longer audit delays, while the presence of female CEOs is associated with greater timeliness echoing Alsheikh (2024), who emphasizes the role of gender diversity in enhancing ethical oversight.

In contrast, the governance-related variables, audit committee existence (ACEXI), board size (BOS), CEO duality (DUAL), and board independence (BI) are statistically insignificant across all models. These findings do not support H1-H4, and are consistent with studies such as Hashim & Abdul Rahman (2011) and Alshammari (2024), which argue that formal governance mechanisms in emerging markets may lack real influence unless coupled with strong enforcement and institutional quality.

In summary, the regression results highlight that firm-specific characteristics, particularly firm size, profitability, leverage, and CEO gender have a stronger and more consistent effect on ARL compared to structural governance variables. These findings provide important implications for Vietnamese regulators and listed companies in prioritizing internal transparency and audit preparedness over purely formal governance reforms.

5. Conclusion

This study investigates the determinants of ARL in Vietnamese listed companies, focusing on both corporate governance mechanisms and firm-specific characteristics. Using panel data from 578 firms over the period 2011-2022, the study applies REM and GLS regression models, accompanied by diagnostic tests to ensure model robustness.

The results show that firm-specific characteristics play a more significant role than corporate governance factors in explaining variations in ARL. Specifically, firm size is positively associated with ARL, while profitability, financial leverage, and CEO gender (female) are negatively associated. These findings imply

that larger firms may face delays in audit completion due to operational complexity, whereas profitable firms, those with higher leverage, and those led by female CEOs are more likely to ensure timely financial reporting. In contrast, formal governance mechanisms, such as audit committee existence, board size, CEO duality, and board independence are not significantly associated with ARL. This suggests that in the Vietnamese context, where corporate governance practices are still evolving, the existence of governance structures alone may not be sufficient to improve audit timeliness without substantive independence and enforcement.

These findings contribute to the growing literature on audit timeliness by offering empirical evidence from an emerging market. For regulators, the results underscore the importance of strengthening the effectiveness, not just the formal presence of governance mechanisms. For firms, the findings highlight the value of internal audit readiness, profitability, and executive leadership in reducing audit delays. Future research may consider exploring the moderating effects of audit quality or industry characteristics on the relationship between governance and ARL.

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USING CORPORATE GOVERNANCE TO PREDICT THE POSSIBILITY OF FINANCIAL DISTRESS OF LISTED COMPANIES IN VIETNAM'S MINING INDUSTRY

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Abstract: *Corporations with weak management systems significantly increase risks, leading to inefficient operations and financial distress. The authors' research selects corporate governance characteristics such as corporate ownership, ownership concentration, gender issues, board size, board independence, and CEO duality as factors to forecast financial distress for Vietnamese listed enterprises in the mining industry. The research combines the corporate governance predictors with other variables such as financial ratios and macroeconomic factors in a panel data sample over a 10 - year period for predicting financial distress. The results show that corporate governance alone is not sufficient to forecast effectively financial difficulties for Vietnamese mining companies. The predictive power of the model appears to be performing much better in combination with financial ratios and macroeconomic factors.*

• Keywords: corporate governance, financial distress, Vietnam mining industry.

Date of receipt: 04th Sep., 2025

Date of delivery revision: 10th Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.16>

Date of receipt revision: 30th Dec., 2025

Date of approval: 21th Jan., 2026

1. Introduction

Financial distress (FD), also known as financial crisis, is commonly used to describe the financial condition of an individual or a company that is experiencing difficulty in meeting its obligations, particularly in making timely payments to its creditors. Prolonged and severe FD can ultimately lead to bankruptcy. Studies on predicting corporate FD were conducted very early, with the first study in 1930 by Fitzpatrick. The field gained significant momentum in subsequent years, with notable contributions from researchers such as Altman (1968). While there are varying perspectives on the selection of variables for predictive models, studies during this period generally focused on two groups of factors: financial ratios and external factors. Researchers generally agree on using financial ratios reflecting profitability, solvency, leverage, cash flow, and operational efficiency as crucial indicators of FD, as demonstrated in the works of Ohlson (1980). Additionally, external factors such as tight monetary policy, high-interest rates and high inflation (Liou and Smith, 2007) can contribute to FD situation and are often included as predictive variables.

However, in the 2000s and beyond, researchers began to focus on the impact of corporate governance on bankruptcy and financial distress. Corporate governance refers to a system of relationships between the management, board of directors, shareholders, and other stakeholders that provides the

structure through which the company is directed and controlled. Effective corporate governance promotes increased company value, fosters investment growth, and contributes to long-term sustainability. In reality, companies with weak governance systems are more susceptible to loss, are at a higher risk of financial distress, and face increased overall risk. Numerous corporate governance characteristics are linked to these risks, including ownership structure, power dynamics, and gender diversity. Smaller board sizes, greater board independence, greater gender diversity on boards, and lower levels of management power concentration have been shown to reduce the risk of bankruptcy. Rajan and Zingales (1998) have pointed out that excessive ownership concentration is a common characteristic of many bankrupt Asian companies. Additionally, managerial abuse of power for private gain and short-term decision-making can lead to financial distress. Studies by Zhiyong Li et al. (2020) have demonstrated the predictive power of corporate governance characteristics in forecasting financial distress. Consequently, predictive models that combine corporate governance characteristics with other financial indicators have become increasingly popular among researchers.

2. Literature review

There is no consensus on the specific characteristics of corporate governance, such as ownership structure, power dynamics, gender diversity, board size,

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and board independence, and their impact on the probability of financial distress.

2.1. Board composition

The roles of the chairman of the board and the CEO differ significantly, as the former is responsible for major strategic decisions while the latter oversees day-to-day operations. In some companies, the same person holds both positions, and several studies have shown that dual leadership is positively correlated with the likelihood of financial distress, as demonstrated by Daily and Dalton (1994b). These authors argue that dual leadership can lead to more autocratic behavior and increased opportunities for CEOs/chairmen to pursue their own interests, while reducing the level of control. Conversely, De Maere et al. (2014) suggest that separating the roles of chairman and CEO can mitigate the risk of bankruptcy.

2.2. Proportion of independent directors

Based on agency theory, Jensen & Meckling (1976) argue that the presence of outside directors on a board is crucial for a company's survival. Daily & Dalton (1994a, 1994b) also support the view that the effectiveness of a board is highly dependent on the proportion of outsiders, especially during crises, as these members provide the company with access to valuable resources and information. However, there are some dissenting views, such as those of Chaganti et al. (1985), who argue that independent directors have a more superficial understanding of the company's specific characteristics and may therefore lead to less effective board functioning. Thus, previous studies have not reached a consensus on whether a higher proportion of independent directors has a positive or negative impact on the probability of financial distress.

2.3. Board size

The impact of board size on financial distress is a subject of debate, with research findings presenting conflicting conclusions. On the one hand, larger boards are less likely to experience financial distress. Researchers argue that larger boards offer a more diverse skill set, fostering a wider range of external relationships and generating a greater variety of viable solutions, thereby positively impacting organizational performance (Goodstein et al., 1994). An empirical study by Chaganti et al. (1985) also shows that companies experiencing financial distress tend to have smaller boards. On the other hand, proponents of agency theory argue that larger boards are more difficult to manage and coordinate, while smaller boards can make decisions more efficiently and effectively, thus

better supporting the company's operations. Findings from research conducted by Yuli, A., & Choisi, E.A. (2021) using samples from Indonesian Coal Mining Companies support the agency theory.

2.4. Ownership concentration

Shleifer & Vishny (1997) argued that excessive ownership concentration often leads large shareholders to exploit their control to pursue private interests. In contrast, proponents of agency theory highlight the positive impact of ownership concentration on firm performance (Jensen & Meckling, 1976). This is because large shareholders are incentivized and have the expertise to effectively monitor the company's operations. Empirical studies also present conflicting findings on the relationship between ownership concentration and financial distress. While Deng and Wang (2006), in a study of 96 financially distressed and 96 non-distressed firms, found a negative correlation between ownership concentration and financial distress, Lee and Yeh (2004), in a study of Taiwanese listed companies, found that financial distress is more likely to occur in firms with high ownership concentration.

3. Research methods

3.1. Research data

Data on corporate governance factors such as ownership concentration, dual leadership (chairman and CEO), proportion of independent directors, board size, and average board age were collected from the annual reports of publicly listed mining companies on the Vietnamese stock market from 2012 to 2021. The sample includes 26 listed companies on both the HoSE and HNX exchanges. Additionally, secondary data on the financial ratios of these 26 companies were calculated by the authors based on financial statement data. To minimize errors due to the use of low-quality data, the authors collected annual reports and audited financial statements from reliable sources such as <http://Vietstock.vn>, <http://s.caphe.vn>. The listed mining companies included in the sample must have audited financial statements, ensuring reliability, and must have been listed for at least three years to meet the model's requirements. Macroeconomic data were collected from <http://Vietstock.vn>, <http://s.caphe.vn> and <http://gso.gov.vn>.

3.2. Research methods and model

3.2.1. Research methods

The methods used to forecast financial distress include univariate discriminant analysis (DA), multivariate discriminant analysis (MDA), and

logistic regression. Logistic regression is widely used in recent studies on financial distress forecasting. With logistic regression, the dependent variable is a binary variable that can take on one of two values: 0 (not distressed) and 1 (distressed). Therefore, the study requires a function that represents the probability of the estimated variable being equal to the actual values through the maximum log-likelihood function. The overall binary logistic regression function is constructed as follows:

$$Z = \ln[P_i/(1-P_i)] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k \quad (1)$$

Where: P (i=1): Probability of financial distress occurrence

P(i=0): Probability of no financial distress

3.2.2. Research model

Dependent variable:

Early identification of financial distress allows managers to take timely actions to mitigate risks, especially when a company is facing only minor difficulties. Therefore, this study adopts the criteria for identifying financial distress at the failure stage as proposed by Asquith, Gertner, and Scharfstein (1994). A company is considered to be financially distressed if it meets at least one of the following criteria: (1) The company has negative earnings before interest, taxes, depreciation, and amortization (EBITDA) for two consecutive years or (2) In any given year, the company's EBITDA is less than 80% of its interest expense.

Independent variables:

Based on previous theories and empirical studies, the authors selected the following corporate governance factors as predictors: board size, average board age, dual leadership (chairman and CEO), ownership concentration by large shareholders, and ownership of the board. Additionally, the authors selected five financial ratios and three macroeconomic factors, including inflation rate, economic growth rate, and interest rate, in combination with governance factors to examine their impact on the risk of financial distress among mining companies. The regression model is constructed as follows

Model 1: Utilizing corporate governance factors

$$Z = \ln \left[\frac{P_i}{1-P_i} \right] = \beta_0 + \beta_1 \text{OWCN} + \beta_2 \text{BOARDSIZE} + \beta_3 \text{CEODL} + \beta_4 \text{BDINDE} + \beta_5 \text{BOARDAGE} + \beta_6 \text{BDOW} + \varepsilon \quad (2)$$

Model 2: Combining corporate governance factors and financial ratios

$$Z = \ln \left[\frac{P_i}{1-P_i} \right] = \beta_0 + \beta_1 \text{OWCN} + \beta_2 \text{BOARDSIZE} + \beta_3 \text{CEODL} + \beta_4 \text{BDINDE} + \beta_5 \text{BOARDAGE} + \beta_6 \text{BDOW} + \beta_7 \text{NSTA} + \beta_8 \text{MVETD} + \beta_9 \text{CFOTD} + \beta_{10} \text{EBITTA} + \beta_{11} \text{WCTA} + \varepsilon \quad (3)$$

Model 3: Combining corporate governance factors, financial ratios, and macroeconomic factors

$$Z = \ln \left[\frac{P_i}{1-P_i} \right] = \beta_0 + \beta_1 \text{OWCN} + \beta_2 \text{BOARDSIZE} + \beta_3 \text{CEODL} + \beta_4 \text{BDINDE} + \beta_5 \text{BOARDAGE} + \beta_6 \text{BDOW} + \beta_7 \text{NSTA} + \beta_8 \text{MVETD} + \beta_9 \text{CFOTD} + \beta_{10} \text{EBITTA} + \beta_{11} \text{WCTA} + \beta_7 \text{SIZE} + \beta_8 \text{GDP} + \beta_9 \text{CPI} + \beta_{10} \text{IR} + \varepsilon \quad (4)$$

Table 1: Table of variable descriptions

Symbol	Variable	Measurement
1. Dependent Variable		
FD	Financial Distress	- EBITDA < interest expense for 2 consecutive year - EBITDA < 80% of interest expense in any given year
2. Explanatory Variables		
OWCN	Ownership Concentration	Percentage of shares held by entities or individuals holding 5% or more of the shares
BOARDSIZE	Board Size	Number of board members
CEODL	Chairman of the Board and the Chief Executive Officer (CEO) is the same person (CEO Duality)	A dummy variable equals 1 if the chairman is also the CEO, 0 otherwise
BDINDE	Board Independence	Proportion of independent directors on the board.
BOARDAGE	Board Age	Average age of board members
BDOW	Board Ownership	Percentage of shares owned by the board
EBITTA	Ratio of Profit before taxes and interest/ Total assets	(Total profit before tax + interest expense)/Total assets
CFOTD	Cash Flow to Total Debt Ratio	Net cash from operating activities (code 20 on cash flow statement / Total liabilities
MVETD	Market Value of Equity to Total Debt Ratio	(Closing stock price at the end of the year x number of shares outstanding) / Total liabilities
NSTA	Net Sales / Total Assets Ratio	Net Sales / Total Assets
WCTA	Working Capital/Total Assets Ratio	(Current Assets-Current Liabilities)/Total Assets
SIZE	Company size	Ln (total assets)
IR	Interest rate	Interbank interest rate for 6-month term
GDP	Economic growth rate	Economic growth rate (%)
CPI	Inflation rate	Consumer price index growth rate (%)

4. Regression results and discussion

4.1. Summary of sample characteristics

Table 2 presents the descriptive statistics of the variables, including the number of observations, mean, maximum, minimum, and standard deviation. Variable BDINDE has the highest mean and standard deviation, with values of 60.928 and 15.718, respectively. Moreover, the independent variables OWCN, BDOW, and MVETD exhibit large standard deviations, suggesting that the dependent variable FD might be influenced by these three independent variables.

Table 2: Table of descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
FD	247	.101	.302	0	1
WCTA	247	.13	.261	-.325	.887
LNGITS	247	.039	.118	-.439	.324
EBITTA	247	.085	.111	-.208	.519
MVETD	247	6.397	25.969	0	327.193
NSTA	247	1.14	1.216	0	10.911
IR	247	5.51	2.095	3.333	11.327
CFOTD	247	1.249	13.945	-45.058	196.822
OWCN	247	45.158	26.875	0	98.21
BOARDAGE	247	46.852	5.251	31.667	57.8
CEODL	247	.247	.432	0	1
BDINDE	247	60.928	15.718	20	100
BOARDSIZE	247	4.992	.675	3	7
BDOW	247	33.225	28.326	0	98.328
GDP	247	5.567	2.926	1	10
CPI	247	5.348	2.826	1	10

Source: Results from sample analysis

Table 3: Correlation Coefficient Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) FD	1.000														
(2) IR	-0.015	1.000													
(3) GDP	-0.033	-0.071	1.000												
(4) CPI	0.063	0.647	-0.022	1.000											
(5) WCTA	-0.074	0.020	-0.047	0.043	1.000										
(6) CFOTD	-0.025	0.061	-0.017	0.093	0.078	1.000									
(7) MVETD	0.071	0.071	-0.070	0.148	0.185	0.732	1.000								
(8) EBITTA	-0.467	0.160	-0.036	0.099	0.367	-0.057	-0.084	1.000							
(9) NSTA	-0.229	0.015	-0.031	0.017	-0.263	-0.060	-0.155	0.163	1.000						
(10) OWCN	-0.239	-0.081	0.010	-0.050	-0.417	-0.130	-0.237	0.247	0.347	1.000					
(11) BDINDE	0.199	-0.132	-0.001	-0.135	0.280	0.084	0.131	-0.127	-0.318	-0.275	1.000				
(12) CEODL	0.027	0.367	0.032	0.270	0.045	-0.037	-0.100	0.070	-0.017	-0.114	-0.273	1.000			
(13) BDOW	-0.206	-0.028	0.000	0.023	-0.270	-0.067	-0.049	0.167	0.350	0.588	-0.344	-0.140	1.000		
(14) BOARDSIZE	-0.116	0.010	0.046	0.025	0.101	0.025	0.002	0.223	-0.057	0.109	0.068	-0.035	-0.035	1.000	
(15) BOARDAGE	-0.119	-0.115	-0.009	-0.089	-0.239	0.014	-0.158	0.166	0.244	0.492	-0.202	0.028	0.303	-0.045	1.000

Source: Results from sample analysis

The correlation coefficients presented in Table 3 indicate the relationship between each pair of variables. A higher correlation coefficient suggests a stronger relationship between two variables, while a lower coefficient indicates a weaker relationship. The correlation matrix shows that the variables in the model have relatively low correlations (all below 0.8), indicating that the potential impact of multicollinearity is negligible. Additionally, Table 3 reveals that corporate governance factors such as ownership concentration and board ownership are negatively correlated with the probability of financial distress. Conversely, the level of board independence is positively correlated with the likelihood of financial distress. Furthermore, financial ratios such as EBIT/Total Assets and Net Sales/Total Assets are negatively correlated with the dependent variable. However, to confirm whether these factors have a significant impact on the probability of financial distress, further regression analysis is needed.

4.2. Regression results

Table 4 presents the results of the binary logistic regression model predicting the probability of financial distress based on corporate governance factors, as well as a combination of financial and macroeconomic variables.

Table 4: Summary of regression results

VARIABLES	(1)	(2)	(3)
OWCN	-0.0184*	-0.0446	-0.128*
BOARDAGE	0.00478	0.0860	0.0710
CEODL	0.632	2.589	11.73*
BDINDE	0.0463**	0.0777*	0.323*
BOARDSIZE	-0.471	0.0367	-1.109
BDOW	-0.0164	-0.0108	-0.0364
WCTA		-3.109	-15.57*
CFOTD		-0.184***	-0.516**
MVETD		-0.0684**	-0.187**
NSTA		-1.334	-4.501
EBITTA		-86.36***	-234.6**
IR			-0.194
GDP			-0.936*
CPI			0.471
Size			12.76*
Constant	-2.258	-8.860	-158.6*

Source: Results from sample analysis

Model 1, which includes five corporate governance factors, reveals that ownership characteristics and the activity proportion of independent directors are statistically significant at the 10% and 5% levels, respectively, in relation to the dependent variable (Table 4). The greater the ownership concentration, the lower the probability of a mining company experiencing a financial crisis. Meanwhile, the proportion of independent directors on the board has a positive impact on the probability of financial distress in mining companies. When measuring the effects of variables related to corporate governance on dependent variable model 1 shows that the BDINDE variable has a larger impact. Model 2 includes five financial ratios, of which three - the Earnings before Interest and Taxes to Total Assets, the Cash Flow to Total Debt ratio, and the Capitalization to Total Debt ratio - are significant in predicting financial distress. In particular, the Earnings before Interest and Tax to Total Assets Ratios predictor (EBITTA), Cash Flow to Total Debt predictor (CFOTD) and Market Value of Equity to Total Liabilities Ratios predictor (MVETD) have an adverse effect on the probability of financial distress of Vietnamese listed companies at 1% significance level. Besides in Model 2, all significant corporate governance factors and financial ratios are combined, and the variable BDINDE exhibits the same significance as in Models 1. In Model 3, macroeconomic factors are added, and at the 10% significance level, the growth rate is found to have a negative impact on financial distress among mining companies. The effect of the predictors on distress among mining companies in model 3 is consistent with model 2. Four out of five financial ratios and three out of five explanation variables related to corporate governance have effects on the dependent variable (FD) with the corresponding significance levels of 5% and 10%.

Table 5: Summary of model fit tests

Models	AIC	Sig	-2 Log likelihood	McFadden's R2	Correctly classified
MH1	0.608	0,000	68.051	0.159	89.07%
MH2	0.249	0,000	18.666	0.769	96.75%
MH3	0.232	0,000	12.490	0.846	97.15%

Source: Results from sample analysis

To assess the goodness-of-fit of the constructed models, the authors employed the Chi-square test. The Chi-square significance value for all three models is 0.000, which is less than 0.05, indicating that all four regression models are well-fitted. Furthermore, Model 3 exhibits the highest pseudo R-squared (McFadden's R2) and the lowest -2 Log likelihood, suggesting that it is the best-fitting model.

4.3. Discussion on results of research

The output of the study revealed that Model 3 with the combination of different variables has predictive power. The WCTA Ratio, EBITTA ratio, CFOTD ratio and MVETD ratio are adverse determinants of financial distress. When WCTA Ratio, CFOTD Ratio, MVETD Ratio, EBITTA Ratio increases, the probability of financial distress tends to decrease and vice versa. This finding is consistent with the prior expectation and findings of Altman (1968).

On the other hand, the corporate governance coefficients in Model 3 have a relationship with the financial distress probability. The results indicate that when the chairman of the board also serves as the CEO, it increases the risk of financial distress for mining companies at the 10% significance level. When the chairman of the board also serves as the CEO, it leads to an excessive concentration of power in one individual, which can result in authoritarianism, abuse of power, bureaucratic decision-making, and decreased control and efficiency in business operations. This finding is consistent with the studies of Daily and Dalton (1994b) and De Maere et al. (2014).

There is a positive correlation between board independence and the probability of financial distress at the 10% significance level. Independent directors, characterized by a less in-depth understanding of the company's specific characteristics, can lead to decreased board effectiveness when their number increases, thus raising the risk of financial distress for mining companies. This finding is consistent with the studies of Chaganti et al. (1985).

Concentrated ownership by large shareholders is negatively correlated with financial distress in mining companies at the 10% significance level. Large shareholders with high ownership stakes are typically specialized investors who are better able to identify potential risks to the company, thereby reducing the likelihood of financial distress. This conclusion is consistent with the views of previous researchers such as Jensen & Meckling (1976) and Deng and Wang (2006).

5. Conclusion

This study empirically examines the impact of corporate governance factors on the likelihood of financial distress among Vietnamese listed mining companies from 2012 to 2021. The governance factors considered include board size, average board age, duality of CEO and chairman, board independence, ownership concentration, and ownership by directors.

Logistic regression analysis on a dataset of 26 companies revealed a significant relationship between corporate governance factors and the probability of financial distress in the mining industry during this period. The results show a positive correlation between duality (combining the roles of CEO and chairman) and board independence, and a negative correlation between ownership concentration and the dependent variable. Therefore, mining companies should clearly separate the roles and responsibilities of the chairman and CEO to enhance oversight, improve operational efficiency, and reduce the risk of financial distress. Additionally, mining companies should consider regulations regarding the number of independent directors in proportion to the company size, as an excessive increase in this factor may heighten the risk of financial difficulties. Furthermore, considering the complexity and capital-intensive nature of the mining industry in Vietnam, along with high ownership concentration primarily by the state large shareholders with concentrated ownership in mining companies play a crucial role. These shareholders, with their experience and management knowledge, can establish modern corporate governance mechanisms, thereby improving operational efficiency and reducing the risk of financial distress. Moreover, the study's findings indicate that combining corporate governance factors with financial ratios and macroeconomic variables provides a better predictive model compared to using single factors alone.

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A STUDY ON THE CURRENT STATE OF E-LOGISTICS OPERATIONS ON THE TIKTOKSHOP E-COMMERCE PLATFORM

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Abstract: *The rapid development of digital technology over the past two decades has profoundly reshaped many sectors, of which e-commerce has emerged as one of the most transformative. In Vietnam, the young population structure, high Internet penetration rate, and the growing popularity of online shopping have made e-commerce a key channel in the digital economy. TikTokShop, a social commerce platform embedded in TikTok, represents a new model by integrating entertainment and shopping, allowing consumers to make quick purchase decisions while interacting with short videos and live streaming. The study found that there are five factors affecting the performance of e-logistics at the TikTokShop e-commerce platform, including: Transportation service quality (CLDVVC), Logistics cost efficiency (HQCP), Technology and systems (CNHT), Customer service (DVKH). From the results of this study, the author proposes solutions to improve E-logistics.*

• **Keywords:** *e-logistics, tiktokshop, social commerce, shoppertainment, e-commerce in Vietnam, logistics operations, consumer satisfaction, digital economy.*

Date of receipt: 04th Oct., 2025

Date of delivery revision: 09th Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.17>

Date of receipt revision: 20th Dec., 2025

Date of approval: 17th Jan., 2026

1. Introduction

Over the past two decades, the rapid advancement of digital technologies has fundamentally reshaped global commerce, with e-commerce transitioning from basic online transactions to sophisticated, interactive ecosystems that integrate shopping, entertainment, and social engagement. In Vietnam, the combination of a young demographic profile, high internet penetration, and increasing consumer preference for online shopping has positioned e-commerce as a pivotal driver of the digital economy. Within this evolving landscape, TikTokShop a social commerce functionality embedded within the TikTok platform has emerged as a prominent player by leveraging the “shoppertainment” model. This approach blends entertainment and retail, enabling consumers to make immediate purchase decisions while engaging with short-form videos or livestream content. The success of this model relies heavily on an efficient and well-coordinated e-logistics infrastructure that not only guarantees rapid delivery but also facilitates real-time tracking, automated order processing, and responsive customer service. This study investigates the operational characteristics of e-logistics within TikTokShop in Vietnam, aiming to identify its strengths, limitations, and potential areas for optimization. The findings are intended to contribute to both academic discourse and practical applications, offering insights to enhance logistics

efficiency and improve customer satisfaction within the rapidly expanding social commerce sector.

2. Theoretical basis and research model

Theoretical basis:

Concept of E-logistics

E-logistics (electronic logistics) is the management of the flow of goods and services of an organization on an online platform (website, e-commerce site, etc.). E-logistics applies information technology and promotes the adaptation of traditional logistics systems for online operations.

Concept of TikTokShop

TikTokShop is a new feature of TikTok that allows users to open an e-commerce store right on the interface of their TikTok account. TikTokshop business is a great place for businesses to promote and sell products as well as effectively build their brand.

Research review

Research results of Turban et al. (2018), in the book “Electronic Commerce: A Managerial and Social Networks Perspective”. This group of authors offers a new perspective on E-logistics, stating that: “E-logistics is a set of digital tools and processes that can interact directly with consumer behavior data to optimize the entire supply chain in an e-commerce environment”.

According to Shah and Raut (2020), “E-logistics in e-commerce is a digital logistics system, directly

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integrated with online sales platforms to coordinate the flow of goods, data and finances in a flexible, automatic and transparent manner”.

Research model

Based on the concepts and a review of some related studies, the author proposes a research model of factors affecting E-logistics activities at the Tiktokshop e-commerce platform with 5 influencing factors including: (1) Transportation service quality (CLDVVC), (2) Logistics cost efficiency (HQCP), (3) Technology and system (CNHT), (4) Customer service (DVKH),

Hypothesis H1: The factor Transportation service quality has a positive impact on the shopping experience at the Tiktokshop e-commerce platform.

Hypothesis H2: Logistics cost efficiency has a positive impact on the shopping experience at the Tiktokshop e-commerce platform.

Hypothesis H3: The factor Technology and system has a positive impact on the shopping experience at the Tiktokshop e-commerce platform.

Hypothesis H4: Customer Service factor has a positive impact on shopping experience at Tiktokshop e-commerce platform.

3. Research method

The paper uses a combination of qualitative and quantitative research methods to conduct the study. Qualitative research methods are used to design scales and questionnaires. To evaluate e-logistics on TikTokShop from 2022 to 2025 through an online customer survey. The author interviewed 5 experts and 3 businesses with online sales activities on e-commerce platforms, along with 4 customers who regularly shop online to determine the research model. Then, a focus group discussion was conducted with customers who regularly shop online on the TikTokShop e-commerce platform to design scales and survey forms. Quantitative methods were used to conduct the survey. Survey data were collected by sending questionnaires directly to online shoppers at TikTokShop for 4 weeks, from December 10, 2024 to January 10, 2025. The results were 213 valid questionnaires processed using SPSS 26.0 software.

4. Research results

Cronbach's Alpha Reliability Test

The results of the Cronbach's Alpha test for all factors show that the Cronbach's Alpha coefficient is > 0.7 and the corrected item-total correlation for all variables is > 0.3 (Table 1). Therefore, all measurement variables meet the requirements and are suitable for the subsequent Exploratory Factor Analysis (EFA).

Table 1: Reliability Assessment

	Factors	Observation variable (N)	Cronbach's Alpha
1	Quality of transportation service (CLDVVC)	5	0.770
2	Logistics cost efficiency (HQCP)	5	0.827
3	Technology and systems (CNHT)	5	0.842
4	Customer service (DVKH)	5	0.862
5	The Impact of E-Logistics on the Shopping Experience (MDAH)	5	0.864

Source: Survey data, analysis, 2025

Exploratory Factor Analysis (EFA)

For the dependent variable, the analysis results yielded a KMO value of $0.845 > 0.5$, indicating that factor analysis is appropriate. The Bartlett's Sig. value of $0.000 < 0.001$ shows that the observed variables are correlated with each other as a whole. The total variance extracted is $64.99\% > 50\%$, which means the principal factor can explain a large portion of the variance in the data, ensuring unidimensionality and suitability for further analysis.

For the independent variables, the analysis results yielded a KMO value of $0.928 > 0.5$, indicating that factor analysis is appropriate. The Bartlett's Sig. value of $0.000 < 0.001$ shows that the observed variables are correlated with each other as a whole. However, the variables DVKH2 and CLDVVC3 should be removed due to low loadings (< 0.5), which suggests a need to refine the observed variables to avoid noise in the structure and reduce the model's unidimensionality. Meanwhile, the variable CLDVVC3 did not appear on any factor (loading < 0.5), indicating a weak contribution to the structure.

Correlation Analysis

Table 2: Correlation Analysis Results

		MDAH	CLDVVC	HQCP	CNHT	DVKH
r	MDAH	1	.582	.589	.707	.686
Sig.	MDAH		.000	.000	.000	.000
N		213	213	213	213	213

Source: Survey data, analysis, 2025

The correlation analysis results show that the independent variables (CLDVVC, HQCP, CNHT, DVKH) all have a positive and statistically significant relationship with the dependent variable (MDAH). The correlation coefficients range from 0.582 to 0.707 (Sig. < 0.01), demonstrating that the independent variables have a significant impact on the dependent variable.

Regression Analysis

Table 3: Regression Results

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.674	.199		3.386	.001	
	CLDVVC	.085	.070	.082	1.225	.000	.461
	HQCP	.072	.071	.070	1.012	.000	.438
	CNHT	.387	.078	.375	4.945	.000	.360
	DVKH	.313	.073	.313	4.274	.000	.387
R-Square = 0.569							
F = 68.555 (Sig. ANOVA = 0.000)							

Source: Survey data, analysis, 2025

The regression analysis results show that the Variance Inflation Factor (VIF) of the variables ranges from 2.170 to $2.777 < 3$. Therefore, multicollinearity among the independent variables in this model is minor and does not significantly affect the regression results. The regression results show an adjusted R-Square of 0.569, indicating that the regression model fits the data well, with 56.9% of the variance in the dependent variable explained by the independent variables CLDVVC, HQCP, CNHT, and DVKH.

The ANOVA variance analysis shows an F-value of 68.555 and a significance level of Sig. = 0.000 (Sig. < 0.05), which means the regression model is a good fit for the collected data and all variables included are statistically significant at the 5% level. The influence of the factors is ranked in descending order through the standardized regression equation as follows:

$$MDAH = 0.375 * CNHT + 0.313 * DVKH + 0.082 * CLDVVC + 0.070 * HQCP$$

Conclusion and managerial implications

The research results show that all 6 research hypotheses are accepted because all have a Sig. value < 0.05. Based on the table, it can be concluded that the 4 factors: Shipping Service Quality, Cost-Effectiveness, Technology and Systems, and Customer Service all have a positive impact on E-Logistics operations at the TikTokShop e-commerce platform. Among these, the Technology and Systems factor has the strongest impact (Beta = 0.375). Next, the Customer Service factor has a Beta of 0.313.

The study identifies E-logistics as an important intermediary in TikTok Shop's new-generation e-commerce model, where customer experience depends not only on products and prices but also on integrated logistics services. Key factors affecting operational efficiency include: (1) improving delivery quality through a two-way evaluation mechanism; (2) optimizing costs through automation and smart order distribution; (3) developing transparent, multi-channel tracking technology; and (4) applying flexible after-sales customer care policies.

The study proposes a set of comprehensive recommendations:

Customer Service Enhancement TikTokShop should implement streamlined complaint-handling and return processes, develop an omnichannel support framework, and balance AI-powered automation with well-trained human support teams. Establishing structured feedback loops will enable continuous service improvement and greater user trust.

Transportation Service Improvement Standardizing packaging protocols, implementing performance-based partner evaluation, and introducing fulfillment

centers at key hubs can reduce operational errors. Real-time order tracking, AI-based route optimization, and transparent delivery commitments backed by compensation policies can significantly enhance logistics reliability.

Cost Efficiency Strategies

TikTokShop should diversify shipping subsidies, personalize incentives through behavioral data analytics, and offer tiered delivery service options. Transparent cost communication, regionalized pricing strategies, and predictive analytics for operational cost control will strengthen competitive advantage while maintaining affordability for consumers.

Technology and Tracking System Development

Integrated real-time tracking systems with API-based partner connectivity, AI-driven demand forecasting, and big-data-enabled risk assessment should be prioritized. Chatbot systems with natural language processing capabilities can facilitate instant problem resolution, enhancing operational agility and customer experience.

Policy Recommendations

Regulatory Support: Authorities should establish guidelines for data transparency, delivery standards, and consumer protection in e-commerce logistics.

Infrastructure Development: Invest in logistics infrastructure, particularly last-mile delivery networks, to support the growing demands of social commerce platforms.

Public Private Collaboration: Promote partnerships between e-commerce platforms, logistics providers, and governmental bodies to standardize service quality and encourage innovation.

Final Remarks

E-logistics is set to remain a key determinant of competitiveness in social commerce. Overcoming operational, technological, and policy barriers will be essential for sustainable growth. Future studies should examine the role of advanced technologies, such as blockchain and AI, in enhancing logistics efficiency and creating strategic advantage.

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DIGITAL TRANSFORMATION CAPABILITY AND STRATEGY IMPLEMENTATION IN SMEs: EVIDENCE FROM THAI NGUYEN

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Abstract: *This study examines the relationship between digital transformation capability and the effectiveness of business strategy implementation among small and medium-sized enterprises (SMEs) in Thai Nguyen. Based on dynamic capabilities theory, it highlights key components of digital capability: technological readiness, digital workforce competence, organizational agility, and strategic alignment. Using secondary data from USAID, the World Bank, and the General Statistics Office, the findings show that SMEs with higher digital maturity achieve better outcomes in revenue growth, profitability, and market expansion. However, most SMEs in Thai Nguyen remain in the early stages of digital adoption, with few having formal digital strategies. Major barriers include weak infrastructure, limited digital talent, and low strategic awareness among leaders. The study offers policy implications for authorities and practical recommendations for SMEs to build suitable digital transformation roadmaps, enhance competitiveness, and support sustainable growth.*

• Keywords: digital transformation, business strategy, SMEs, Thai Nguyen.

JEL codes: M15, O33, L25

Date of receipt: 04th Oct., 2025

Date of delivery revision: 09th Nov., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.18>

Date of receipt revision: 20th Dec., 2025

Date of approval: 21th Jan., 2026

1. Introduction

In the context of globalization and the rapid development of digital technologies, digital transformation has become an inevitable trend for all countries and types of enterprises. Digital transformation is not only a tool for technological innovation but also a strategic driver for restructuring business models, enhancing competitiveness, and optimizing business performance. In Vietnam, recognizing the importance of this trend, the government has issued various policies to promote and direct digital transformation, notably Decision No. 749/QĐ-TTg dated June 3, 2020, approving the National Digital Transformation Program until 2025, with orientations toward 2030. These efforts aim to develop Vietnam into a digital nation, building a digital economy, digital society, and digital government comprehensively. Within Vietnam's economic structure, small and medium-sized enterprises (SMEs) play a particularly vital role, accounting for over 97% of all operating enterprises, significantly contributing to Gross Domestic Product (GDP), creating many jobs, and serving as pillars of local economic growth. However, most SMEs face numerous barriers in the digital transformation process, such as limited

financial resources, insufficient technological capacity, weak managerial capabilities, and a shortage of skilled digital workforce. Furthermore, their ability to formulate long-term strategies in a digital environment remains relatively weak, resulting in digital transformation efforts that are often reactive, fragmented, and ineffective. Thai Nguyen Province - an industrial and educational hub in the Northern Midlands and Mountainous region - is home to a predominantly SME-based business ecosystem. In recent years, the province has made substantial efforts to implement support programs for digital transformation and promote the application of information technology in business management and production. However, in practice, the level of digital transformation among SMEs in the area varies significantly. Many enterprises implement digital solutions superficially without aligning them with their strategic business orientation, leading to results that do not correspond with the resources invested. This situation highlights the need for a systematic study of the relationship between digital transformation capability and the effectiveness of business strategy implementation, which are two critical factors ensuring sustainable business development in the digital economy era.

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Based on this context, this study aims to clarify three core issues: (i) the status of digital transformation capabilities of SMEs in Thai Nguyen Province; (ii) the effectiveness of business strategy implementation in the context of digital transformation adoption; and (iii) the relationship between digital transformation capability and business strategy implementation effectiveness. This research contributes scientifically by elucidating the mechanisms through which digital transformation impacts strategic implementation effectiveness among small and medium-sized enterprises at the local level.

2. Theoretical framework and analytical model

2.1. The concept of digital transformation capability

Digital transformation capability refers to an enterprise's comprehensive ability to effectively adopt, integrate, and leverage digital technologies across all facets of its operations- including business processes, organizational structures, and corporate culture - with the ultimate goal of enhancing overall performance and generating new business value. This capability is not limited to the mere implementation of digital tools; rather, it represents a holistic and strategic transformation that redefines how a company operates, competes, and delivers value in the digital age.

At its core, digital transformation capability includes several key dimensions:

Technological readiness which entails the availability and robustness of digital infrastructure, the adoption of digital platforms, and the ability to process and analyze data for informed decision-making.

Human resource competence refers to the digital literacy and upskilling of the workforce, the existence of specialized IT or digital teams, and a culture of continuous learning to keep pace with technological change.

Organizational agility, defined by the ability to respond quickly to market changes, experiment with new business models, and reorganize internal structures to support innovation and cross-functional collaboration.

Strategic alignment, which emphasizes the integration of digital transformation objectives with long-term business strategies, ensures that digital

initiatives are not fragmented but instead support the enterprise's vision, mission, and performance goals.

According to Aguiar et al. (2019) and Bonnet & Westerman (2020), digital transformation capability is not static - it evolves over time as enterprises experiment, learn, and adapt to new technologies and market conditions. This positions it as a dynamic capability, a concept that originates from strategic management theory. As such, it enables firms to not only survive but thrive amid the rapid, unpredictable shifts in digital environments. Ghosh et al. (2022) further argue that organizations with strong digital transformation capabilities are more likely to sustain competitive advantage, as they can more effectively harness data, enhance customer experiences, and continuously innovate products, services, and processes.

In Vietnam, SMEs often face constraints in financial resources and skilled talent, but those that invest strategically in developing this capability tend to outperform their peers in agility, resilience, and long-term growth. Thus, enhancing digital transformation capability is increasingly seen as a foundational pillar for strategic success and sustainable competitiveness in the digital economy era.

2.2. Business strategy implementation and its effectiveness

Business strategy implementation serves as the bridge between strategic planning and actual performance, involving the orchestration of people, processes, and technology to achieve organizational goals.

The effectiveness of strategy implementation is influenced by multiple interrelated factors. Among these, leadership style plays a pivotal role. Transformational and participative leadership styles tend to foster stronger employee commitment, clearer communication, and a culture of accountability, all of which are crucial for aligning individual efforts with organizational priorities.

Organizational resources, including financial capital, human capabilities, infrastructure, and technology, are equally essential. A strategy, no matter how well conceived, cannot succeed if the enterprise lacks the resources to support execution.

Communication channels are another critical component. Transparent, timely, and two-way communication facilitates coordination across

departments, reduces misunderstandings, and ensures that all organizational levels understand their roles in achieving strategic goals. Effective communication mechanisms also help in monitoring progress, identifying implementation bottlenecks, and making necessary course corrections.

For small and medium-sized enterprises, particularly those operating in emerging markets like Vietnam, the implementation of strategy is often constrained by limited financial and human resources, underdeveloped systems, and external uncertainties.

This reality calls for a high degree of flexibility and innovation in how strategy is executed. SMEs must adopt lean and adaptive approaches, experiment with low-cost digital tools, and rely on the commitment and creativity of their workforce. Furthermore, the ability to learn from implementation setbacks and rapidly adjust plans, which is often referred to as “strategic agility” becomes a decisive factor in sustaining long-term success.

In summary, strategy implementation is a complex, multidimensional process that demands synchronized leadership, resource optimization, clear communication, and organizational alignment. For SMEs, building internal capacity and fostering an agile, innovative-driven mindset are essential to translating strategy into tangible, sustainable performance outcomes.

2.3. Relationship between digital transformation capability and business strategy implementation

These technologies reduce information asymmetry, minimize delays in decision-making, and help translate strategic plans into well-informed actions, thereby closing the gap between strategy formulation and execution.

Moreover, Schallmo et al. (2021) and Williams et al. (2019) argue that such alignment is a defining feature of sustainable digital transformation. It is not sufficient to adopt isolated digital tools; rather, organizations must cultivate a digital mindset across leadership and workforce, foster cross-functional collaboration, and institutionalize continuous improvement practices. These elements create a dynamic feedback loop where digital initiatives are continuously evaluated, refined, and scaled in alignment with evolving strategic priorities.

In the specific context of emerging economies, where SMEs often operate in resource-constrained environments, building digital transformation

capability can serve as a strategic equalizer. Digital transformation becomes not just a support mechanism but a strategic enabler that enhances competitiveness, resilience, and long-term viability.

In summary, the evidence points to a strong and positive correlation between digital transformation capability and the successful execution of business strategies. Enterprises that integrate digital tools strategically and systematically are better equipped to navigate complexity, adapt to change, and sustain growth in the digital era.

3. Research methods

3.1. Research design

This study employs a quantitative research approach based on the analysis of secondary data to clarify the relationship between digital transformation capabilities and the effectiveness of business strategy implementation in SMEs in Thai Nguyen province. The research design focuses on utilizing data from official reports and databases provided by government agencies and reputable international organizations. This method is appropriate given the absence of primary data collection, ensuring objectivity, scalability, and comparability of results.

3.2. Research subjects, scope, data sources, and data collection methods

Research subjects: Small and medium-sized enterprises operating in Thai Nguyen province, primarily in manufacturing, trade and services, and information technology sectors. This group plays a pivotal role in the local economy and is currently undergoing digital transformation.

Time scope: The study focuses on the period from 2018 to 2023, a timeframe marked by the implementation of various policies and programs promoting digital transformation in Vietnam, aligned with the developmental context of SMEs.

Data sources: Secondary data are collected from the General Statistics Office of Vietnam, the Department of Planning and Investment of Thai Nguyen province, reports from OECD, World Bank, USAID, and related academic studies on digital transformation and business performance in SMEs.

Data collection methods: Data were gathered through reviewing public reports, industry reports, and official databases. The selected data were carefully screened and processed to ensure relevance and accuracy for the analysis objectives.

3.3. Data analysis method

The secondary data were compiled, processed, and analyzed using descriptive statistical methods to provide an overview of digital transformation capabilities and the effectiveness of business strategy implementation in small and medium-sized enterprises in Thai Nguyen. Additionally, correlation analysis was employed to identify the relationship between digital transformation factors and business performance indicators. This approach allows for a reasonable and efficient assessment of the influence and association among the studied variables without the need for complex analytical techniques.

4. Research findings

4.1 The current state of digital transformation capabilities among SMEs in Thai Nguyen

Thai Nguyen province, serving as a key industrial and information technology hub in the northern midland and mountainous region, has achieved some initial progress in promoting digital transformation among SMEs. However, the level of implementation and the capability to carry out digital transformation among SMEs remain limited in terms of awareness, resources, and technology.

According to the USAID (2022) report, only about 36% of SMEs in Thai Nguyen are at an “intermediate readiness level” for digital transformation. This means they have adopted basic digital tools such as accounting software, social media, and simple internal management platforms. Meanwhile, only 12% of SMEs are considered highly ready, demonstrating the ability to implement advanced technologies such as data analytics, integrated e-commerce systems, or cloud-based platforms.

Table 1. Digital transformation readiness levels of SMEs in Thai Nguyen (2022)

Readiness Level	Percentage of SMEs (%)	Key Characteristics
Low (no technology use)	52	Relying on traditional tools, with no digital strategy
Medium (initial adoption)	36	Use accounting software, social media, and simple digital tools
High (advanced adoption)	12	Have a digital strategy, apply CRM, ERP, big data, AI, etc.

Source: USAID, 2022; aggregated from surveys in six provinces, including Thai Nguyen

In addition, the Thai Nguyen Department of Information and Communications (2023) reported that only about 28% of SMEs have a formal digital transformation plan integrated into their long-term business strategy. Many businesses still perceive digital transformation as a technical task confined to

the IT department, rather than as a strategic priority requiring leadership commitment.

Moreover, the World Bank (2023) report on digital infrastructure shows that Thai Nguyen scores 63 out of 100 on the digital connectivity index, primarily due to the limited availability of high-speed internet in rural areas. This digital divide restricts SMEs in remote locations from adopting comprehensive digital solutions.

Human resource capabilities in digital transformation also present a significant challenge. According to the Ministry of Information and Communications, over 70% of SMEs in Thai Nguyen do not have a dedicated digital team. Digital-related roles are often assigned as additional tasks, with staff lacking formal training or sufficient budgets to keep up with emerging technologies.

In summary, the digital transformation capacity of SMEs in Thai Nguyen remains at a low to medium level, with large disparities even within the same industry sectors. Investment in infrastructure, workforce development, and strategic awareness will be crucial to drive successful digital transformation in the coming years.

4.2 Business strategy implementation effectiveness of SMEs in Thai Nguyen

In Thai Nguyen province, SMEs play a central role in the local economy, accounting for over 97% of the total number of enterprises (Thai Nguyen Statistical Office, 2023). However, the effectiveness of strategy execution among these businesses remains uneven, as reflected in both quantitative and qualitative performance indicators.

According to the General Statistics Office (GSO, 2023), the average annual revenue growth rate of SMEs in Thai Nguyen during the 2020-2022 period was approximately 5.8%, which is lower than the national average of 6.7%. The average net profit margin stood at just 4.1%, indicating limited efficiency in resource utilization. Additionally, only about 31% of SMEs in the province had formal strategic business plans for a 3 - 5-year period, compared to over 45% in more developed localities such as Hanoi and Da Nang (USAID, 2022).

A key challenge for Thai Nguyen SMEs is the translation of strategic goals into operational performance metrics aligned with their capabilities in technology, management, and market responsiveness. A survey conducted by the SME Development Institute (2023) revealed that more

than 60% of SMEs do not regularly assess their strategy implementation, and only 22% utilize Key Performance Indicators (KPIs) tied to clearly defined strategic objectives.

Table 2. Key Indicators of Business Strategy Implementation Effectiveness among SMEs in Thai Nguyen (2020 - 2022)

Indicator	Average Value (%)	National Benchmark (%)
Annual revenue growth rate	5.80	6.70
Net profit margin	4.10	5.30
Percentage of firms with formal strategic business plans	31	42
Percentage of firms using KPIs for strategic performance monitoring	22	35
Percentage of firms conducting periodic strategic evaluation	38	50

Source: GSO, USAID, SME Development Institute, 2023

4.3 Analysis of the relationship between digital transformation capability and business strategy implementation effectiveness of SMEs in Thai Nguyen

The relationship between digital transformation capability and the effectiveness of business strategy implementation is an increasingly important topic amid the rapid development of the digital economy. Based on the dynamic capability perspective, many studies suggest that digital transformation capability is not only a supporting factor but also a critical driver that fosters organizational agility and strategic adaptability (Ghosh et al., 2022; Bonnet & Westerman, 2020).

In Thai Nguyen province, data from USAID (2022) and World Bank (2023) reports indicate that enterprises with a higher level of digital readiness tend to achieve superior business performance compared to their peers. A linear regression analysis cited from the study by Nguyen Thi Phuong Dung (2024) shows that factors related to digital transformation capability, such as IT utilization, digital leadership, and digital infrastructure, are positively correlated and statistically significant with strategic effectiveness, including revenue growth, operational efficiency, and market expansion.

Specific data from local and international reports highlight clear trends:

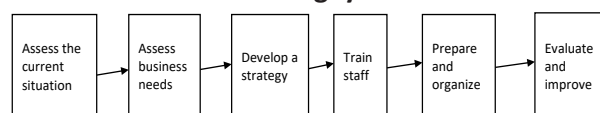
- Enterprises using ERP/CRM or internal management systems have an average profit margin 1.8 times higher than those without digital technology adoption (GSO, 2023).
- Enterprises that have issued digital transformation strategies have a 42% higher

probability of strategic success than those without such strategies (USAID, 2022).

- Enterprises investing in digital skills training for employees achieve strategic goal completion rates 2.1 times higher than those that do not (World Bank, 2023).

4.4. Proposed analytical model for SMEs in Thai Nguyen

Figure 1. Proposed Analytical Model for SMEs in Thai Nguyen



Source: Author's proposal

Based on a comprehensive review of relevant theories on digital transformation capabilities, business strategy execution effectiveness, and the practical context of small and medium-sized enterprises (SMEs) in Thai Nguyen province, the author proposes a six-step analytical model to clarify the relationship between the two core research variables. The model includes the following components: (1) Assessing the current situation; (2) Identifying business needs; (3) Developing a digital transformation strategy; (4) Training and upskilling human resources; (5) Organizing and implementing digital initiatives; and (6) Evaluating outcomes and continuous improvement. These steps are structured in a logical sequence that reflects the process from internal capacity assessment to execution and outcome measurement, while allowing for flexibility depending on the specific conditions of each enterprise.

Specifically, the assessment of the current situation enables enterprises to identify their readiness for digital transformation in terms of technology, processes, and human resources. Identifying business needs helps link digital initiatives to specific strategic goals. Training and upskilling staff play a critical role in enhancing implementation capacity and fostering a culture of innovation. The final step, evaluation and improvement, involves measuring the effectiveness of digital transformation based on performance indicators and making necessary adjustments to improve long-term strategic outcomes.

This proposed model provides both theoretical grounding and practical applicability. It serves as a guiding framework for SMEs in aligning their

digital transformation efforts with strategic business objectives. Moreover, the model forms the basis for constructing research hypotheses to empirically test the relationship between digital transformation capabilities and business strategy execution.

5. Conclusion and recommendations

5.1. Conclusion

This study has demonstrated a positive and significant relationship between digital transformation capability and the effectiveness of business strategy implementation among small and medium-sized enterprises (SMEs) in Thai Nguyen province. Enterprises with higher levels of digital readiness and investment in digital initiatives tend to achieve superior outcomes in revenue growth, profit margins, and market expansion. However, many SMEs still exhibit low to medium digital capabilities, constrained by infrastructure limitations, workforce shortages, and a lack of strategic digital awareness.

Key findings include:

- Firms that adopted ERP/CRM systems and developed clear digital transformation strategies showed 40-50% higher rates of strategic goal achievement compared to those that did not.
- Investment in digital skills training resulted in up to twice the level of strategic implementation effectiveness.
- Higher levels of digital adoption consistently correlated with improved strategic performance across manufacturing, service, and commerce sectors.

5.2. Policy implications

Develop a digital transformation ecosystem tailored for SMEs, including access to shared digital platforms, infrastructure, and consulting services:

Local authorities should take a proactive role in building a supportive digital ecosystem that addresses the specific needs and limitations of SMEs. This includes establishing regional digital hubs or innovation centers that offer shared access to key technologies such as cloud services, enterprise resource planning (ERP), and customer relationship management (CRM) platforms.

Implement specialized digital skills training programs focusing on strategic management, data analysis, and the application of emerging technologies, particularly targeting micro and small enterprises:

A key barrier to digital transformation in SMEs is the lack of skilled personnel who can effectively lead and manage digital initiatives. To address this, local governments and training institutions should co-develop short-term, modular training programs that provide practical, job-relevant digital skills.

Foster partnerships between local government, universities, and large enterprises to promote innovation and knowledge transfer to SMEs:

Public-private-academic collaboration is critical to building an inclusive and innovation-driven digital economy. Local governments should initiate and facilitate structured partnerships that connect SMEs with research institutions, technical universities, and large corporations that possess advanced digital expertise.

5.3. Recommendations for enterprises

Recognize digital transformation as a strategic priority, not just a technical upgrade. Develop a clear and phased roadmap that aligns with long-term business objectives.

Invest in internal digital capabilities, especially through training dedicated personnel, enhancing digital leadership, and fostering a culture of innovation and change.

Leverage accessible and cost-effective digital solutions, such as ERP/CRM software, e-commerce platforms, and cloud computing, to optimize operations and enhance market competitiveness.

Establish performance monitoring systems, using KPIs linked to digital initiatives to continuously assess and improve the effectiveness of strategy execution.

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FACTORS IMPACTING INTERNAL AUDIT QUALITY AT BANKS IN VIETNAM

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Abstract: *This study aims to identify and assess the impact of seven factors on the quality of internal audits in Vietnamese banks, including: professional competence, independence and objectivity, audit methodology, management support, organizational structure, regulatory compliance, technology, and analytical capabilities. The study surveyed 250 people at Vietnamese banks. The analytical methods used include descriptive statistics, reliability analysis (Cronbach's Alpha), exploratory factor analysis (EFA), and correlation regression analysis. The results indicate that professional competence, objectivity, organizational structure, regulatory compliance, technology, and analytical capabilities have a stronger impact on the quality of internal audits compared to factors related to audit methods or management. These findings provide an important model for banks to strengthen their internal audit systems.*

• Keywords: *internal audit quality, banks, professional competence, technology, analytical capabilities.*

Date of receipt: 25th Sep., 2025

Date of delivery revision: 04th Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.19>

Date of receipt revision: 08th Dec, 2025

Date of approval: 22th Jan, 2026

1. Introduction

Internal audit plays a central role in modern corporate governance by enhancing transparency, accountability, and organizational performance (Goodwin, 2004). As banks operate in environments characterized by high-risk exposure and strict regulatory scrutiny, the internal audit function becomes essential in identifying weaknesses in internal controls, preventing fraud, and ensuring compliance with financial regulations (Gramling et al., 2004; Arena & Azzone, 2009). High-quality internal audits help banking institutions detect emerging risks, strengthen their control systems, and protect stakeholder interests, thereby contributing to financial stability and sustainable development (Cohen & Sayag, 2010). Conversely, poor audit quality can lead to undetected risks, regulatory violations, financial losses, and reputational damage, issues that are increasingly critical in the context of digital transformation and rapidly evolving financial technologies (Eulerich et al., 2023).

Despite the recognized importance of internal audit, research on internal audit quality (IAQ) in Vietnam remains limited. Most empirical studies have focused on Western, Middle Eastern, or other emerging markets, leaving a gap in understanding how organizational structures, regulatory settings, and technological readiness shape IAQ in Vietnamese banks. Given Vietnam's ongoing financial reform and

the steady movement toward international standards such as Basel II and Basel III, understanding the determinants of IAQ is both theoretically relevant and practically important.

This study addresses these gaps by examining how seven key factors influence IAQ in Vietnamese banks: professional competence (PC), independence and objectivity (IO), audit methodology (AM), management support (MS), organizational structure (OS), regulatory compliance (RC), and technological and analytical (TA) capabilities. By analyzing a large dataset of 250 banking professionals, the study identifies which factors exert the strongest effects on IAQ and which play a more limited role in practice. The findings contribute to existing literature and offer evidence-based recommendations to strengthen internal audit systems in Vietnamese commercial banks.

2. Literature review and research hypotheses

2.1. Concept of internal audit quality

IAQ is widely recognized as a multidimensional construct, yet the literature does not converge on a single universal definition. According to the International Professional Practices Framework (IPPF), IAQ is reflected through independence, objectivity, auditor competence, and compliance with professional standards. Mihret and Yismaw (2007) conceptualize IAQ as the degree to which internal audit results are valued, trusted, and utilized by stakeholders,

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while Alzeban and Gwilliam (2014) emphasize that perceived usefulness and managerial evaluation are equally central to determining quality. Synthesizing these perspectives, IAQ can be understood as the internal audit function's capability to provide credible assurance, support governance and risk management processes, and generate actionable recommendations that strengthen organizational performance.

2.2. Professional competence and internal audit quality

Competence has long been considered one of the most decisive determinants of IAQ. The IIA (2017) underscores that technical knowledge, professional qualifications, industry expertise, and continuous education collectively shape an auditor's capacity to perform high-quality audits. Prior studies confirm that auditors holding advanced certifications such as CIA or CPA demonstrate higher proficiency in risk identification and evaluation (Alzeban & Gwilliam, 2014; Mustika, 2023). In addition, teams combining expertise in finance, IT, and operations enhance both the credibility and effectiveness of audit outcomes (Mihret & Yismaw, 2007; Gamayuni, 2018). Competence also indirectly improves IAQ by strengthening internal controls and facilitating the adoption of advanced audit technologies (Novatiani et al., 2024).

H1: PC positively influences IAQ at banks.

2.3. Independence and objectivity and internal audit quality

IO constitute core principles governing the internal audit profession. Eulerich et al. (2021) highlight that independence from management pressure and objectivity in judgment significantly enhance the perceived reliability of audit results. Banks require stringent IO due to their complex risk environment, where biased assessments may have serious regulatory and financial consequences. Prior research consistently finds that the absence of undue influence and the presence of clear reporting lines, preferably to the audit committee rather than management, are essential conditions for strong IAQ (Mihret & Yismaw, 2007; Endaya & Hanefah, 2016).

H2: IO positively influence IAQ at banks.

2.4. Audit methodology and internal audit quality

AM refers to the procedures, tools, and structured approaches auditors employ during the audit process. Risk-based audit methodologies have been shown to improve audit effectiveness and contribute to

better assurance quality (Sarens & De Beelde, 2006; Gnanakumar et al., 2018). However, more recent studies indicate that as audit methodologies become increasingly standardized and aligned with international regulations, their differentiating effect on IAQ diminishes (Lenz & Hahn, 2015). In the context of Vietnamese banks, where audit procedures are largely harmonized with international standards, methodological variation may play a limited role in explaining differences in audit quality.

H3: AM positively influences IAQ at banks.

2.5. Management support and internal audit quality

MS has traditionally been considered a critical driver of internal audit effectiveness, affecting resource allocation, implementation of audit recommendations, and the authority of the internal audit function (Alzeban & Gwilliam, 2014). Nevertheless, evidence from emerging markets suggests that as regulatory environments mature, reliance on management support becomes less decisive. In Vietnamese banking, stricter regulatory requirements and institutional support from the State Bank of Vietnam may reduce the marginal impact of senior management backing on IAQ.

H4: MS positively influences IAQ at banks.

2.6. Organizational structure and internal audit quality

The position of the internal audit unit within the organizational hierarchy significantly shapes its independence, authority, and ability to perform effectively. Sarens and De Beelde (2011) argue that strong reporting lines, typically to the board or audit committee, enhance audit function strength and objectivity. Research shows that appropriately structured internal audit departments yield superior quality outcomes and greater stakeholder trust. In Vietnam, alignment with governance requirements under Basel II and III further reinforces the need for well-defined internal audit structures.

H5: OS positively influences IAQ at banks.

2.7. Regulatory compliance and internal audit quality

Regulatory compliance has become increasingly central to assessing IAQ, particularly in heavily regulated sectors such as banking. Hoang and Nguyen (2022) emphasize that compliance with Basel II/III and domestic regulatory expectations is now a fundamental driver of internal audit outcomes.

Internal audit functions that closely align with regulatory frameworks enhance the credibility of assurance activities and support effective oversight of high-risk areas (Beasley et al., 2005).

H6: RC positively influences IAQ at banks.

2.8. Technological and analytical capabilities and internal audit quality

Rapid digital transformation is reshaping internal audit practices globally. Technologies such as data analytics, continuous monitoring systems, artificial intelligence tools, and audit management software have been shown to significantly enhance audit precision, timeliness, and scope (Vasarhelyi et al., 2012). Recent studies confirm that internal audit functions that adopt advanced analytics exhibit higher IAQ and improved operational effectiveness (Eulerich et al., 2025). Although implementation challenges exist, such as cost, data quality issues, and skill shortages, tech-enabled auditing represents a key future direction for the profession.

H7: TA capabilities positively influence IAQ at banks.

3. Research methodology

This study employed a quantitative research design to examine the factors influencing IAQ in Vietnamese banks. The methodological approach was guided by established audit-quality research, which typically relies on structured surveys and multivariate statistical analysis (e.g., Alzeban & Gwilliam, 2014; Mihret & Yismaw, 2007). The following subsections outline the sampling procedures, data collection, measurement development, and analytical techniques used in the study.

3.1. Sample and Data Collection

The study targeted employees working within the internal audit ecosystem of Vietnamese commercial banks, including internal auditors, audit committee members, managers, and risk officers. This sampling frame ensured the inclusion of respondents with direct or indirect involvement in audit processes, thereby strengthening the reliability of perceptions captured about IAQ.

A total of 250 respondents participated in the survey, representing diverse positions and levels of experience. As shown in Table 1, the sample included 40% internal auditors, 22% audit committee representatives, 20.4% managers, and 17.6% risk officers. Work experience was distributed across multiple ranges, with 32% having 11–15 years of

banking experience and 44.8% having less than five years of audit experience. This diversity ensured a balanced representation of both junior and senior professionals. Respondents were drawn from both head office (56.8%) and branch-level operations (43.2%), allowing for perspectives across different organizational layers.

Table 1: Frequency distribution and percentages across various demographic characteristics

Characteristic	Category	Frequency	Percentage (%)
Gender	Male	104	41.6
	Female	146	58.4
Age	Under 30	58	23.2
	30-39	62	24.8
	40-49	52	20.8
	50 and above	78	31.2
Education	Bachelor's	85	34.0
	Master's	54	21.6
	Professional certification	62	24.8
	Doctorate	49	19.6
Professional Certification	None	60	24.0
	CPA	97	38.8
	CISA	38	15.2
	CIA	55	22.0
Position	Management	51	20.4
	Audit Committee	55	22.0
	Risk Officer	44	17.6
	Internal Auditor	100	40.0
Banking Experience	<5 years	61	24.4
	5-10 years	58	23.2
	11-15 years	80	32.0
	>15 years	51	20.4
Audit Experience	None	26	10.4
	<5 years	112	44.8
	5-7 years	75	30.0
	>7 years	37	14.8
Work Location	Head Office	142	56.8
	Branch Operations	108	43.2

Source: Authors' calculation

Data were collected through a structured online questionnaire developed on Google Forms. This method enabled efficient distribution, immediate response recording, and enhanced confidentiality, considered essential for respondents providing organizational assessments. Before launching the full survey, a pilot test was conducted with 20 banking professionals to refine wording, assess scale clarity, and ensure content validity. Following adjustments, the final survey was distributed via internal communication channels with support from bank HR departments. Respondents participated voluntarily and were informed about the anonymity and confidentiality of the study.

3.2. Measurement of variables

The study examined seven independent variables: PC, IO, AM, MS, OS, RC, and TA. IAQ served as the dependent variable.

All constructs were measured using multi-item Likert scales (1 = strongly disagree to 5 = strongly agree), following validated scales from prior audit and governance research (Mihret & Yismaw, 2007; Lenz & Hahn, 2015; Vasarhelyi et al., 2012). Items assessed core attributes such as auditor expertise, reporting independence, methodological rigor, organizational positioning, and regulatory alignment. The adoption of existing, theory-based scales helped ensure both conceptual accuracy and comparability with previous international studies.

3.3. Data analysis procedures

The analysis followed a structured multistep approach. Descriptive statistics were calculated to summarize respondent characteristics and variable distributions. As reflected in the Table 2, means for the independent variables ranged from 3.079 to 3.410, indicating moderate agreement with the listed IAQ determinants.

Table 2: Descriptive statistics of research variables

Variable	N	Min	Max	Mean	Std. Deviation	Skewness	Kurtosis
IAQ	250	2.000	4.000	3.154	0.512	0.356	-0.367
PC	250	1.000	5.000	3.410	1.312	-0.279	-1.288
IO	250	1.000	5.000	3.179	1.280	-0.376	-1.129
AM	250	1.000	5.000	3.079	1.301	-0.066	-1.347
MS	250	1.000	5.000	3.182	1.289	-0.410	-1.121
OS	250	1.000	5.000	3.227	1.276	-0.269	-1.217
RC	250	1.000	5.000	3.175	1.305	-0.306	-1.244
TA	250	1.000	5.000	3.212	0.901	-0.323	-0.506

Source: Authors' calculation

Next, scale reliability was assessed using Cronbach's alpha. All constructs exceeded the widely accepted threshold of 0.70, confirming strong internal consistency. PC ($\alpha = 0.962$), IO, and MS demonstrated particularly high reliability, consistent with findings in prior internal audit studies (e.g., Alzeban & Gwilliam, 2014; Mihret & Yismaw, 2007).

Following, Exploratory Factor Analysis (EFA) was conducted to validate construct dimensionality and assess whether items loaded cleanly onto their respective factors. The Kaiser-Meyer-Olkin value of 0.824 and significant Bartlett's Test ($\chi^2 = 5960.162$, $p < 0.001$) confirmed the suitability of the data for factor analysis. Factor loadings met recommended thresholds, supporting the adequacy of the measurement model.

Table 3: Exploratory factor analysis KMO and bartlett's test

Test	Result
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.824
Bartlett's Test of Sphericity: Approximate Chi-Square	5960.162
Bartlett's Test of Sphericity: df	300
Bartlett's Test of Sphericity: Significance	< 0.001

Source: Authors' calculation

As shown in Table 4, the extracted factors explain 80.8% of total variance, exceeding the commonly accepted 60% threshold in social science research. This high explanatory power indicates that the measurement items capture the underlying constructs effectively. All items loaded cleanly on their intended factors (≥ 0.70), demonstrating strong convergent validity. Cross-loadings remained below 0.10, confirming discriminant validity.

Table 4: Total variance explained by extracted factors

Factor	Eigenvalue	% of Variance	Cumulative %
1	5.047	13.9	13.9
2	3.503	13.5	27.4
3	3.489	13.5	40.9
4	2.868	12.9	53.8
5	2.574	10.3	64.1
6	2.370	10.2	74.2
7	1.703	6.5	80.8

Source: Authors' calculation

Lastly, multiple regression analysis was employed to evaluate the hypothesized relationships between the seven determinants and IAQ. This technique enabled estimation of each factor's standardized effect while controlling for the influence of others. Assumptions related to multicollinearity, normality, and homoscedasticity were tested and satisfied, ensuring the robustness of results.

3.4. Ethical Considerations

The study followed standard ethical guidelines for research involving human participants. Participation was voluntary, and respondents were fully informed of the study's objectives and their right to withdraw at any time. No identifying information was collected, and survey responses were used exclusively for academic analysis.

4. Research findings

4.1. Correlation Analysis

Bivariate correlations between IAQ and the independent variables are shown in Table 5. IAQ is positively associated with all seven determinants, with correlation coefficients ranging from 0.156 to 0.379.

Table 5: Correlation matrix

Variable	IAQ	PC	IO	AM	MS	OS	RC	TA
IAQ	1							
PC	0.217**	1						
IO	0.369**	0.041	1					
AM	0.156*	0.144*	0.093	1				
MS	0.196**	0.166*	0.119	0.068	1			
OS	0.337**	0.156*	0.089	-0.020	0.144*	1		
RC	0.379**	0.125*	0.061	0.145*	0.002	0.023	1	
TA	0.306**	0.008	0.153*	0.098	0.097	0.121	0.175**	1

Source: Authors' calculation

Note: ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Correlations between predictors remain low (< 0.20), allowing regression analysis without multicollinearity concerns.

4.2. Multiple regression

Analysis Multiple regression analysis was conducted to test the seven hypotheses and to determine the relative importance of each independent variable in explaining the variance in IAQ. The regression model took the form: $IAQ = \beta_0 + \beta_1 PC + \beta_2 IO + \beta_3 AM + \beta_4 MS + \beta_5 OS + \beta_6 RC + \beta_7 TA + \varepsilon$

Multiple regression was used to test the hypotheses and assess the relative influence of each factor. The model is statistically significant ($F = 23.54$, $p < 0.001$), with an Adjusted $R^2 = 0.388$, meaning that the seven determinants jointly explain 38.8% of the variance in IAQ, a strong level of explanatory power for behavioral and organizational studies.

Table 6: Regression model summary and ANOVA

Model Summary					
R	R ²	Adjusted R ²	Std. Error of the Estimate	Durbin-Watson	
0.636	0.405	0.388	0.400	1.507	
ANOVA					
Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	26.41	7	3.773	23.54	<0.001
Residual	38.793	242	0.160		
Total	65.21	249			

Source: Authors' calculation

Five of the seven determinants significantly influence IAQ ($p < 0.05$). RC has the strongest standardized coefficient, followed by IO, OS, TA, and PC. Audit Methodology (AM) and Management Support (MS) do not demonstrate statistically significant effects.

Table 7: Summary of hypothesis testing results

Hypothesis	Statement	Beta	p-value	Result
H1	PC of internal auditors positively affects the quality of internal audit at banks.	0.104	0.046	Supported
H2	IO of internal auditors positively affect the quality of internal audit at banks.	0.283	<0.001	Supported
H3	AM positively affects the quality of internal audit at banks.	0.054	0.294	Not Supported

Hypothesis	Statement	Beta	p-value	Result
H4	MS positively affects the quality of internal audit at banks.	0.089	0.086	Not Supported
H5	OS positively affects the quality of internal audit at banks.	0.257	<0.001	Supported
H6	RC positively affects the quality of internal audit at banks.	0.306	<0.001	Supported
H7	TA capabilities positively affect the quality of internal audit at banks.	0.163	<0.001	Supported

Multicollinearity diagnostics confirm VIF values between 1.046 and 1.169, well below the threshold of 5, indicating no concern for multicollinearity.

4.7. Discussion

PC, IO, OS, RC, and TA show significant positive effects on IAQ.

PC shows a positive but comparatively modest impact on IAQ. This suggests that although auditor expertise remains foundational, consistent with research by Alzeban and Gwilliam (2014) and Sarens and De Beelde (2006), competence may no longer be the strongest differentiator in the banking sector. Vietnamese banks have increasingly professionalized their internal audit workforce, reducing variance in competence levels. This supports the argument of Arena and Azzone (2009) that in highly developed financial institutions, technical capability becomes an expected baseline rather than a distinguishing factor of high audit quality.

IO emerge as one of the strongest predictors, in line with Mihret and Yismaw (2007) and Endaya and Hanefah (2016). The prominent role of IO underscores the structural and cultural challenges in Vietnamese banking, where traditional hierarchical norms may expose auditors to implicit managerial pressure. The strong coefficient found in this study indicates that minimizing such influence, through direct reporting to audit committees and ensuring freedom from conflicts, remains vital for credible audit performance.

In contrast, AM does not significantly influence IAQ. This diverges from earlier findings (Sarens & De Beelde, 2006; Gnanakumar et al., 2018) suggesting that risk-based methods enhance effectiveness. However, the result aligns with Lenz and Hahn (2015), who argue that as audit techniques become increasingly standardized across the industry, methodological differences exert weaker explanatory power. Vietnamese banks have largely aligned with international audit standards, which may explain why AM no longer contributes distinctively to quality. The varying maturity levels of risk-based auditing highlighted by Nguyen and Tran (2021) may also contribute to this limited effect.

MS likewise shows no statistically significant effect. Previous studies (e.g., Alzeban & Gwilliam, 2014) emphasize the importance of leadership support for the internal audit function, particularly in public sector environments. The weaker effect observed here suggests that in regulated sectors such as banking, external regulatory requirements may supersede internal managerial influence. Consistent with Nguyen and Tran (2021), Vietnamese banks face increasingly stringent oversight from the State Bank of Vietnam, making compliance a mandatory expectation rather than a management-driven priority. As Cohen and Sayag (2010) note, once internal audit becomes deeply institutionalized, incremental managerial endorsement adds limited additional value.

OS plays a significant role in shaping IAQ, reinforcing findings by Sarens and De Beelde (2011) and consistent with institutional theory (Al-Twaijry et al., 2003). Banks with clearly defined reporting lines, formal authority for internal audit, and appropriate placement within the governance framework demonstrate stronger audit functions. With Vietnam's advancement toward Basel II/III requirements (Hoang & Nguyen, 2022), internal audit structures aligned with international standards appear critical to sustaining audit effectiveness.

RC is the strongest predictor of IAQ. This reflects the heightened regulatory environment in Vietnam, where the State Bank has intensified its focus on risk governance and internal control systems. The findings are consistent with Beasley et al. (2005) and Doan and Bui (2022), who emphasize that regulatory alignment drives audit quality by compelling banks to monitor high-risk areas and adhere to increasingly complex compliance frameworks. Given the mandatory nature of Basel II/III implementation, regulatory pressure has become a dominant institutional force influencing internal audit operations.

TA also show a significant positive effect on IAQ, corresponding with global literature emphasizing digital transformation in internal auditing (Vasarhelyi & Alles, 2017; Eulerich et al., 2025). The result reflects both opportunity and necessity: while technological tools such as data analytics, automation, and continuous auditing enhance audit effectiveness, Vietnamese banks still face capability gaps in fintech auditing and cybersecurity oversight (Doan & Bui, 2022). This reinforces that technology-enabled auditing is increasingly indispensable for improving accuracy, coverage, and responsiveness of internal audit functions.

5. Conclusions

The current study investigates factors impacting banks' IAQ currently, with an emphasis on seven factors: TA, MS, OS, potential competence, IO, AM, and RC. Research results demonstrated five out of seven hypothesized factors strongly affecting IAQ performance at banks. Analysts determined that RC presents the most substantial relationship to IAQ because Vietnamese banking institutions must adhere strictly to professional standards and regulatory requirements. Research in this area develops various theoretical aspects of the quality of internal audit functions. This study verifies an institutional theory perspective on internal audit effectiveness, according to Al-Twaijry et al. (2003). Endeavors toward RC combined with IO standards and OS acquisition confirm the institutional theory, which specifies that internal audit success depends heavily on their regulatory position alongside formal power and framework compliance. More broadly, the research provides a foundation for strengthening IAQ across Vietnamese banks in a digitalized financial era, supporting resilience, compliance, stakeholder trust, and sustainable growth.

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FACTORS AFFECTING VIETNAMESE PEOPLE'S INTENTION TO BUY VOLUNTARY RETIREMENT INSURANCE

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Abstract: *The study aims to investigate the factors influencing the intention to purchase retirement insurance products of Vietnamese people. Based on the Theory of Planned Behavior (TPB) combined with the Information Integration Theory (IIT), the study assesses the direct impact of factors such as: risk perception, subjective norms, attitude towards purchasing behavior, financial literacy, and communication about retirement products on the intention to purchase retirement insurance of Vietnamese people. The study sample consisted of 281 customers of different ages to explore their intention to purchase retirement insurance products. The results show that, except for the risk perception factor which did not affect the intention to purchase retirement insurance, the other four factors all had a positive impact on the intention to purchase retirement insurance products of Vietnamese people. The study then suggests some implications for life insurance companies and the government to help promote the purchase of retirement insurance among Vietnamese people.*

• Keywords: *purchase intention, retirement insurance, TPB, IIT.*

Date of receipt: 25th Sep., 2025

Date of delivery revision: 04th Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.20>

Date of receipt revision: 30th Dec., 2025

Date of approval: 20th Jan., 2026

1. Introduction

Nowadays, population aging is becoming an increasingly evident trend in Vietnam. Together with the limitations of social security system, it is imposing substantial financial pressure on families responsible for supporting the elderly - those who have passed the legal working age. In response to this challenge, voluntary retirement insurance (VRI) emerges as an effective tool to contribute to the implementation of the State's social security policy, creating a multi-pillar pension system to provide financial stability for senior citizens. The development of voluntary pension funds managed by life insurance companies is of great significance, contributing to ensuring social security, increasing the coverage of social security policies to the entire workforce and the elderly population. Therefore, since 2014, the Ministry of Finance has licensed life insurance companies to provide VRI products and services to eligible individuals (Circular 115/2014/TT-BTC). However, empirical observations indicate that implementation outcomes remain suboptimal, with the VRI scheme encountering numerous operational difficulties and structural barriers. From the demand side, a research question is raised: Why is the potential of the market so large (when the coverage of health insurance under the Social Insurance is still very modest) but life insurance companies cannot exploit it? What factors influence the intention to participate in retirement insurance of Vietnamese people? This study hopes to find the answer to the above question.

2. Literature review, theoretical background and research model

2.1. Literature review

Research on voluntary pension system and retirement insurance (RI) is an interesting research issue, which has attracted the attention of many researchers in the world and in Vietnam. There have been many published works with different approaches and research scopes.

Studies on factors influencing voluntary retirement participation behavior include: Lin Liyue, Zhu Yu (2006), Lenn Art, Moen and Rundmo (2004), Jannette Weir, Edward Ripley (2014), Orla Gough, Roberta Adami (2014), Amlan G and Shrutikeerti K (2016), Sondang Martha Samosir et al. (2020), Guo Wu and Jiajing Gong (2023). These studies were conducted in India, China, Malaysia, and Indonesia. The above studies all attempted to comprehensively identify factors influencing purchase intentions, but the results were not entirely consistent. The common factors in the studies are: (1) Influence of relatives, (2) Investment benefits, (3) Media factors, (4) Psychological factors, (5) Social security awareness, (6) Attitude and (7) Income.

Studies in Vietnam have studied the factors affecting the intention to purchase private health insurance in Hanoi by Nguyen Nhat Ha et al (2020); research on factors affecting the intention to purchase life insurance by Nguyen Thi Anh Xuan (2004), Mai Thi Huong et

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al (2020); research on factors affecting the intention to participate in voluntary retirement insurance by Thanh Thuy (2016). Nguyen Tien Dung et al (2015) have studied the factors affecting the intention to purchase voluntary retirement insurance of people in Ho Chi Minh City. These studies show that the factors affecting customers' purchase intention are (1) Subjective norms, (2) Attitude towards purchasing behavior, (3) Attitude towards risk/Risk tolerance, (4) Financial knowledge, (5) Perception of income, (6) Convenience, (7) Information about insurance companies.

From the research overview, it can be seen that although there are many published studies with different sample sizes and research subjects, nowadays customers are also influenced by media information about retirement insurance. Therefore, the research integrates factors such as: Risk perception, Subjective norms, Attitude towards purchasing behavior, Financial knowledge, and communication about retirement products to further understand the impact of each of these factors on the intention to purchase retirement insurance of Vietnamese people. This is the research gap that needs to be clarified in this study.

2.2. Theoretical background

An enterprise voluntary pension fund is defined as a financial institution that helps manage money for pension programs (OECD, 2005). This institution can exist in the form of a legal entity (trust fund, independent fund) or an independent fund without legal status but managed by a professional pension fund management company. According to Donald DePamphilis (2011), Edward A. Glickman (2014), Rajesh Kumar (2016), John L. Teall (2019), enterprise voluntary pension funds are established based on contributions from employers and employees, operated by financial intermediaries on behalf of the company or the company's internal pension funds. Voluntary retirement insurance is a form of insurance based on the principle of voluntary payment of premiums to receive financial security when reaching retirement age. The provision of VRI via life insurance companies serves as an effective mechanism for contributing to the State's social security objectives, thereby fostering a multi-pillar pension system to safeguard the welfare of the elderly in retirement. The necessity for this additional pillar of voluntary insurance is demonstrated by the global practice, as compulsory social insurance often fails to provide coverage for the entire workforce. Furthermore, as a prepaid financial product for future consumption, VRI participation necessitates careful planning based on an informed awareness and thorough understanding by prospective buyers.

2.3. Research model

This study is built mainly on Ajzen's (1991) Theory of Planned Behavior (TPB), according to which, the intention to perform a behavior is influenced by three main factors: attitude toward the behavior, subjective norms, and perceived behavioral control. In the context of this study, attitude toward purchasing retirement insurance reflects an individual's overall assessment of the positive or negative level of the behavior of purchasing this product; subjective norms represent social pressure or expectations from influential people such as family, friends, or financial advisors; meanwhile, the level of understanding about RI and the ability to control finances are considered factors that influence perceived behavioral control, reflecting an individual's belief in his or her autonomy and decision-making ability. TPB thus provides a solid framework to explain how cognitive and social factors influence the intention to purchase RI products.

In addition, the study also incorporates Anderson's (1981) Information Integration Theory (IIT) to explain the role of communication and product knowledge in forming attitudes and intentions. According to IIT, consumers synthesize information from multiple sources - including personal experience, communication messages, and product knowledge - to make an overall evaluation. Communication activities of insurance companies can shape perceptions, create positive attitudes, and reinforce purchase intentions for retirement insurance products.

The factors identified include: Perception of risks for old age, Attitude towards buying retirement insurance, Subjective norms about retirement insurance, Understanding of retirement insurance and retirement insurance products of life insurance companies, Communication about retirement insurance products. The dependent variable is Intention to buy retirement insurance of life insurance companies.

The research model proposes the following research hypotheses:

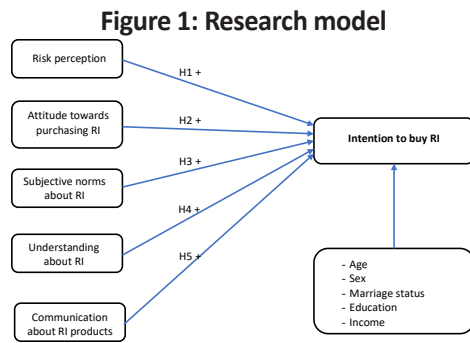
H1: Risk perception has a positive impact on intention to buy RI.

H2: Attitude towards purchasing RI has a positive impact on intention to buy RI.

H3: Subjective norms about RI have a positive impact on intention to buy RI.

H4: Understanding of RI and RI products has a positive impact on intention to buy retirement insurance.

H5: Communication about RI products has a positive impact on the intention to buy RI.



Source: Author's proposal

The scale of variables of the research model is shown in the following table.

Table 1: Scales and encode variables in the model

Code	Variables and Scales	Source
RP	Risk perception	
RP1	I think that life is increasingly risky, especially in old age.	Ajzen (1991); Brahmana et al (2018); Mai Thi Huong (2019);
RP2	I believe that the increase in life expectancy will lead to risks to my life, especially in old age.	
RP3	I consider the increase in life expectancy (much more than expected) to be a completely serious problem.	
RP4	I worry that I will be responsible for any financial problems that may arise if I live longer (more than expected)	
RP5	I listen to other people's advice about financial planning for the future, especially about buying retirement insurance for old age.	
APRI	Attitudes toward purchasing retirement insurance	
APRI1	I think buying retirement insurance from a life insurance company is a necessary choice.	Nguyen Ngoc Hien & Le Thi Thanh Hoa (2023); Ajzen (1991)
APRI2	I think buying retirement insurance from a life insurance company helps me plan my financial future.	
APRI3	I think buying retirement insurance from a life insurance company helps me feel secure in my work and enjoy life in the present.	
APRI4	I think buying retirement insurance from a life insurance company is a way to save for the future and stabilize my life when I retire.	
APRI5	I trust and feel secure about buying retirement insurance from life insurance company.	
SNRI	Subjective norms for retirement insurance	
SNRI1	My relatives think I should buy retirement insurance from a life insurance company.	Nosi at al (2014); Fishbein & Ajzen (1985); Brahmana et al (2018)
SNRI2	My organization/business supports me to buy retirement insurance from the life insurance company.	
SNRI3	Everyone in my surroundings supported me to buy retirement insurance from the life insurance company.	
SNRI4	The retirement insurance advertisements urged me to consider purchasing this insurance from the life insurance company.	
SNRI5	Most of the people involved wanted me to buy retirement insurance from the life insurance company.	
URI	Understanding of retirement insurance and retirement insurance products	
URI1	I understand the current regulations on retirement insurance of life insurance companies in Vietnam (participants, participation procedures, fees, benefits, etc.)	Nguyen Ngoc Hien & Le Thi Thanh Hoa (2023); Jacobs-Lawson & Hershey (2005)
URI2	I clearly understand my rights when participating in retirement insurance of life insurance companies in Vietnam.	
URI3	I am confident in my ability to plan financially for my future.	
URI4	Retirement insurance from life insurance companies provides the main financial support for me after retirement.	
URI5	I have enough knowledge to buy retirement insurance from life insurance companies.	
CRI	Communication about retirement insurance products (products accessibility)	
CRI1	Mass media (Internet, social networks, television, etc.) provide a lot of information about retirement insurance.	Bui Trung Kien (2023); Esfahani et al (2014)
CRI2	I can easily find detailed information about retirement insurance products of life insurance companies.	
CRI3	Life insurance companies advertise their retirement insurance products through many channels.	
CRI4	The advertisements for retirement insurance products of life insurance companies attract me.	
CRI5	When I need to find information about retirement insurance products, I know exactly what information to get and where to get it.	

Code	Variables and Scales	Source
IBRI	Intention to buy retirement insurance from life insurance company	
IBRI1	When there is a need and suitable conditions (financial capacity, insurance premiums, etc.), I will buy retirement insurance from the life insurance company.	Ajzen (1991); Esfahani et al (2014); Brahmana et al (2018)
IBRI2	I will proactively seek information to buy retirement insurance from the life insurance company.	
IBRI3	I will buy retirement insurance from the life insurance company in the near future.	
IBRI4	My intention to choose to buy retirement insurance is very strong.	
IBRI5	I will recommend to others about choosing to buy retirement insurance from life insurance companies.	

3. Research methodology

To conduct this study, the author applied non-probability sampling with convenience sampling technique combined with the "snowball" principle. The questionnaire was designed on Google Form and sent to respondents online via zalo and email. After six months of collecting survey forms (May 2025 - October 2025), a total of 324 forms were collected. Through data cleaning, 281 valid responses were found, reliable enough to be included in the analysis model. This sample size meets the minimum requirements to ensure reliability (Hoyle, 1995). The data was analyzed using SPSS 26. The main characteristics of the sample (N=281) include: the working-age group accounts for 89.6%, the non-working-age group of respondents accounts for 10.4%; Urban living area 91.8%, Rural and Mountainous 8.2%; Occupational characteristics: working in the public sector 43.4%; private sector 45.2% and self-employed 11.4%; Educational level: Most of them graduated from university and above, high school level only accounts for 3.9%; Average income/month 10 million - 32 million VND accounts for 59%, income under 5 million VND/month accounts for only 6% and income over 80 million VND/month accounts for only 2.8%.

The next step is to use the structural model analysis method with PLS-SEM of SmartPLS4 software. Before analyzing the structural model, it is necessary to check the measurement model (Henseler et al., 2017).

4. Research results and discussion

4.1. Evaluation of measurement models

Evaluation of the measurement model (outer model) according to Hair et al. (2016) includes testing reliability, convergence and discrimination. Initially, the outer loading of the observed variables were all >0.7, except RP1 (0.580). After removing RP1 and re-analyzing, the outer loading of all observed variables were from 0.701 to 0.903. All variables had Cronbach's Alpha and CR (Rho_C) > 0.7. Convergence testing showed that the average variance extracted (AVE) of all 4 variables exceeded the minimum recommended level of 0.5 (Hair et al., 2016). Thus, the results (Table 2) confirmed that the scales met the requirements of reliability and convergence.

Table 2. Reliability and convergent validity of variables

Code	Variables and Scales	Cronbach's Alpha	CR Rho_C	AVE
RP	Risk perception	0.803	0.870	0.626
APRI	Attitude towards purchasing RI	0.931	0.932	0.784
SNRI	Subjective norms about RI	0.911	0.911	0.739
URI	Understanding about RI	0.875	0.909	0.667
CRI	Communication about RI products	0.911	0.933	0.737
IBRI	Intention to buy RI	0.910	0.933	0.735

Source: Author's analysis

Next, the author tests the discriminant validity of the variables in the study using the HTMT index which must be less than 0.85 (Kline, 2018) or less than 0.9 (Henseler et al., 2015). Table 3 shows the results of the pairs of variables that meet the requirements of discriminant validity.

Table 3. Discriminant Values

	SNRI	URI	RP	APRI	CRI	IBRI
SNRI						
URI	0.764					
RP	0.591	0.475				
APRI	0.689	0.581	0.675			
CRI	0.711	0.770	0.328	0.552		
IBRI	0.806	0.764	0.541	0.729	0.718	

Source: Author's analysis

4.2. Evaluation of structural model

To evaluate the structural model, the author first conducted a multicollinearity test. The VIF index of the study ranged from 2.127 to 12.660, which is much smaller than the recommended level of VIF coefficient <3 (Hair et al, 2016), so it can be concluded that there is no multicollinearity phenomenon in this research model.

Next, the hypotheses were tested by one-tailed bootstrapping for the direct relationships. The results are reported in Table 4 and Figure 2. The above results show that hypotheses H2, H2, H4, H5 are accepted (p -value > 0.05) and do not contain 0 in the CI confidence interval (Hair et al. 2016), which means: Attitude towards buying RI purchase behavior, Subjective norms about RI, financial knowledge, communication about RI products have a direct impact on customers' intention to buy RI. The research results show that risk perception has no impact on customers' intention to purchase insurance with p -value $= 0.381 > 0.05$ and contains 0 in the CI confidence interval.

Table 4. Structural model evaluation results

Hypothesis	Original Sample (O)	T statistics (O/STDEV)	P-values	CI		Result
				5%	95%	
H1: RP $\rightarrow$ IBRI	0.019	0.304	0.381	-0.084	0.122	Reject
H2: APRI $\rightarrow$ IBRI	0.270	4.232	0.000	0.169	0.377	Accept
H3: SNRI $\rightarrow$ IBRI	0.285	3.771	0.000	0.163	0.410	Accept
H4: URI $\rightarrow$ IBRI	0.222	3.435	0.000	0.111	0.323	Accept
H5: CRI $\rightarrow$ IBRI	0.178	2.317	0.009	0.056	0.389	Accept

Source: Author's data analysis results

The adjusted R² coefficient of the insurance purchase intention variable is 0.666. That means the variables in the research model explain well the change in the intention to buy retirement insurance (Hair et al., 2016) and the strength of the impact of the independent variables on the dependent variable is the purchase intention is assessed by the coefficient f^2 , the results show that the purchase attitude has the strongest influence on the intention to buy retirement insurance with an average impact level ($f^2 = 0.105$) and the remaining variables have a small impact on the intention to buy retirement insurance. The results of the adjusted R² coefficient and f^2 are shown in Table 5

Table 5: Adjusted R² and f^2 results

	f^2	VIF	Adjusted R ²
RP $\rightarrow$ IBRI	0.001	1.687	
TDM $\rightarrow$ IBRI	0.105	2.127	
SNRI $\rightarrow$ IBRI	0.093	2.430	
URI $\rightarrow$ IBRI	0.092	2.259	
CRI $\rightarrow$ IBRI	0.043		
IBRI			0.666

Source: Author's data analysis results

Figure 2: Structural Model

Source: Author's data analysis results

Discuss the research results

- The Attitude factor towards purchasing behavior has a positive impact on the intention to purchase RI ($\beta = 0.285$, p -value < 0.05), agreeing with the research results of Nguyen Ngoc Hien & Le Thi Thanh Hoa (2023), Thanh Thuy (2016), Thu Huong et al. (2022). This means that when each individual has a positive attitude towards their future retirement plan, they are more likely to see the benefits of RI, they will be willing to spend a financial amount in the present to participate in VRI.

- The subjective norm factor has a positive impact on the intention to buy retirement insurance ($\beta = 0.285$, p -value < 0.05). This result is supported by the research results of Nosi & colleagues (2014). This result is consistent with TPB Theory, according to which, individual behavior is not only influenced by personal

perception and attitude, but also strongly influenced by social factors, especially the pressure to comply with social expectations. In the context of East Asian culture in general and Vietnam in particular - where social relationships and community values have a profound influence - the subjective norm factor often has a strong impact on financial consumption behavior, especially for products related to security and long-term investment such as retirement insurance.

- Understanding about RI and RI products has a positive impact on the intention to buy retirement insurance ($\beta = 0.222$, p-value < 0.05). This result is similar to the study of Bui Trung Kien (2023). This shows that the level of understanding and awareness of consumers about the characteristics, benefits, and operating mechanisms of insurance products plays an important role in forming the intention to participate in this type of insurance. The results are also consistent with the TPB theory when it states that perceived behavioral control is a factor reflecting an individual's belief in their ability to perform the behavior themselves, and this factor is often directly influenced by knowledge, experience, and understanding of that behavior.

- The new point of the study is that communication about RI products has a positive impact on the intention to buy them ($\beta = 0.178$, p-value < 0.05). This shows that the level of access to information and the quality of communication about RI products from insurance companies play an important role in forming consumers' purchase intentions. When communication messages are clearly designed, easy to understand, and emphasize the protection and long-term benefits of retirement insurance, consumers tend to form a positive attitude and increase their desire to participate in the scheme. This result is also consistent with previous studies by (Al Mamun et al., 2021) and (Nosi et al., 2017).

- Awareness of risks in increasing life expectancy can be considered as one of the important factors affecting the intention to participate in voluntary retirement insurance. However, the research results show that this factor does not affect the intention to participate in VRI of Vietnamese people. This can be explained by the East Asian culture of "relying on your children when old" and the habit of wealth hoarding; the survey results also show that 64.4% of respondents deposit savings in banks, 6.4% buy gold to store from monthly income after spending; in terms of financial preparation for old age, 52.3% of respondents have 2 or more regular sources of income. This may make them feel less pressure in life and less motivated to participate in voluntary retirement insurance.

5. Conclusion and implications

Based on the above analysis, the author believes that

in order to increase the positive impact of factors on the intention to buy voluntary retirement insurance of Vietnamese people, some specific actions are needed, including: Firstly, insurance companies need to promote communication about voluntary retirement insurance products in many forms and many different channels, especially focusing on the spread and popularity of the internet and social networks. On the other hand, it is necessary to diversify retirement insurance products to suit different needs of customers, increase access to voluntary retirement insurance for people through diverse distribution channels, especially focusing on online distribution channels (digitalization of services). Secondly, the Government needs to conduct national communication about retirement insurance, further promote financial education for people, have policies to encourage savings and investment for retirement, in order to motivate people to participate in voluntary retirement insurance.

Beside the above results, this study still has some limitations such as the survey sample is quite small compared to the population size, the number of respondents who are freelance workers, people in rural and mountainous areas in the sample is still low, leading to the assessment of the intention to buy voluntary retirement insurance is not comprehensive. In the future, when there are conditions in terms of time and budget, the author hopes to continue to expand the scale of the survey and conduct more in-depth research on the intention to buy voluntary retirement insurance to have a more comprehensive and in-depth assessment, as a basis for promulgating policies as well as having appropriate strategies to develop voluntary retirement insurance in Vietnam.

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DIVERSIFYING INCOME SOURCES AND IMPACTS ON NON-INTEREST INCOME RATIO OF VIETNAMESE COMMERCIAL BANKS

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Abstract: *Diversifying and enriching services to promote pure income, disperse risks and enhance the overall input results of commercial banks is one of the goals that must be achieved in general by any business organisation and commercial banks in particular. Diversifying income sources (HHI) and the impacts of HHI on the non-interest income ratio (NII) of commercial banks are analysed in this article. Data on the ratio of non-interest income and the income diversification status of 25 joint stock commercial banks trading on the HOSE, HNX and Upcom exchanges were collected and determined by calculations based on the financial statements of the above commercial banks linked to the period from 2013-2023, combined with the use of Stata 16 tool. Exploring the dependence of NII on HHI was conducted by regressing the NII variable on HHI and other variables such as bank size (QM), percentage of deposits compared to total assets (TG), marginal interest income ratio (LCB), rate of equity to total assets (VCSH), percentage of outstanding loans compared to total assets (CV), level of technological modernity (ATM), percentage of expenses compared to total income, (CP) percentage of profit after tax compared to average of total assets (ROA), economic growth rate (GDP), inflation rate (INF) and real interest rate (IR). In the study, the author stated that the relationship between HHI and NII has a positive impact. In addition, QM, ATM, CP, GDP INF also affect the NII of commercial banks in different directions.*

• Keywords: *income diversification, non-interest income, commercial bank.*

Date of receipt: 27th Jul., 2025

Date of delivery revision: 03rd Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.21>

Date of receipt revision: 10th Dec., 2025

Date of approval: 28th Jan., 2026

1. Urgency of the study

The non-interest income of commercial banks, which is the amount consumers pay for services other than credit services, plays a crucial role in maintaining the profits of commercial banks. This is particularly significant in the current context of declining interest income. The above amount is paid for fees and commissions each commercial bank decides. Commercial banks record this amount as fees collected by commercial banks. In addition, non-interest income also includes income when commercial banks conduct foreign currency trading, valuable papers trading, other investments in different markets and derivative goods. These sources of income are increasingly focused on because they are sources of income associated with activities off the balance sheet of commercial banks, so they are often risk-free.

Diversifying commercial banks' income sources is a strategic approach where commercial banks seek different ways to consolidate and enhance their financial performance. This involves providing various services and helping improve and create more revenue for commercial banks. The trend of diversifying, promoting, and making many different financial-monetary businesses of commercial banks today (like a financial department store) aims to find ways to consolidate and increase the final output for

commercial banks. Diversifying revenue from many different activities is also a way for commercial banks to spread out risks.

The final output from commercial banks' monetary and financial transactions is the revenue sources classified into interest and non-interest revenue. However, it can be seen that currently, the income from credit services of commercial banks is decreasing. Commercial banks promote other business activities to maintain stable and increasing output value. Commercial banks research, deploy and provide increasingly rich and complete financial services as a manifestation of actions to diversify and enrich income sources. The above statement is consistent with the view that an organisation that guides and explains to customers to accept products with high integration of utilities and diversity has the opportunity to realise many of their latent needs, thereby bringing more income to commercial banks. To verify the accuracy of the above argument, regression of the relationship between NII and HHI is performed. On that basis, it is affirmed that the trend of increasing, promoting and diversifying other financial services of commercial banks in Vietnam in the present and future is entirely appropriate, providing reassurance about the direction of the industry. The formula for calculating the HHI level of commercial banks is used by authors

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Chortareas et al. (2008), Nguyen Thi Canh and Ho Thi Hong Minh. (2004), Dang Buu Kiem and Vo Xuan Vinh 2016, Carbo-Valverde et al. (2019). (2004), Dang Buu Kiem and Vo Xuan Vinh 2016, Carbo-Valverde et al. (2019). HHI is measured according to the formula:

$$HHI_{it} = 1 - \left(\frac{INT_{it}}{TOR_{it}} \right)^2 - \left(\frac{CPE_{it}}{TOR_{it}} \right)^2 - \left(\frac{OTH_{it}}{TOR_{it}} \right)^2$$

In which:

HHI_{it} : the level of income diversification of each bank by year

INT_{it} : Total value of revenues after offsetting interest expenses and the difference of revenues after offsetting interest-like expenses of each commercial bank by year

CPE_{it} : the total difference between revenues and expenses from non-credit activities of each commercial bank by year

TRA_{it} : the difference between the value of income and expenses arising from business activities and investment activities of each commercial bank by year

OTH_{it} : total difference of revenues and expenses from other activities of each commercial bank by year

TOR_{it} : total difference of revenues and expenses from all activities of each commercial bank by year

Many works have surveyed the impact of income diversification on the NII of commercial banks. However, most of these works are conducted in regions around the world with different conditions in terms of operations and business environment compared to commercial banks in Vietnam. Moreover, the research sample was formed from 25 commercial banks trading on the HOSE, HNX, and Upcom markets from 2013 to 2023, so it is more novel and different from previous studies. The findings from the research are the premise for proposing recommendations to expand other sources of income for commercial banks in addition to interest in line with the State Bank's strategy of expanding and diversifying the sources of income of commercial banks to break the "monoculture" of credit.

2. Theoretical basis for building the model

How HHI affects the total income of commercial banks, and NII is answered in the research works that have been done.

Pasiouras and Kosmidou (2007) explored the impact of HHI on the final efficiency of commercial banks in the UK. Their study found that HHI positively affects the final output of commercial banks. Income diversification, achieved by expanding and consolidating non-interest income sources, allows commercial banks to gradually

distance themselves from the volatility of interest income, thereby increasing other non-interest income. Pasiouras and Kosmidou argue that while diversification contributes to higher final output, it is crucial for commercial banks to effectively manage the challenges and instabilities associated with non-traditional income sources.

Laeven and Levine (2008), through investigating how income diversification and its impact on the stability and sustainability of commercial banks in emerging markets, have found a positive interaction between income diversification and non-interest income sources. The study confirms that HHI increases other sources of income of commercial banks besides interest income, and the performance of commercial banks is improved, creating a basis for enhancing sustainability. At the same time, commercial banks have actively implemented the risk spread across different revenue streams. On the other hand, this study also claims that commercial banks in emerging regions enjoy many benefits from diversification because it provides a buffer against the instability of interest rates and the economy.

Stiroh (2004) focused on examining the interactions between NII and the activities of commercial banks along with risk management. Stiroh emphasised that changes in HHI due to changes in transaction income and fees from financial services can generate additional profits. However, Stiroh also argued that more risks will arise due to the expansion of various activities to generate non-interest income. Therefore, commercial banks must carefully monitor the potential complications of their diversified activities to avoid excessive risk-taking. Effective risk management and strategic monitoring positively impact optimising non-interest income sources while minimising the associated risks.

Le Thanh Tam (2022) discovered that the income diversification strategy impacts NII (the structure of non-interest income is adjusted according to this strategy).

In addition, QM, TG, LCB, VCSH, CV, ATM, CP, ROA, GDP, INF, and IR are also noted to impact NII in different directions, which are considered control variables in this study.

3. Research model, data and research method

3.1. Research model

Our research model is not a random assortment of variables. It is established based on a systematic approach, as detailed in Table 1. Each variable, such as NII, HHI, QM, LCB, TG, CV, VCSH, ATM, ROA, CP, GDP, INF and IR, plays a specific role in our study.

Table 1: Introduction to variables

Type of variable	Calculation method	Authors	Expected direction of impact
Dependent variable of the model			
NII	$\frac{\text{Non-interest income}}{\text{Total income}}$	Hoàng Ngọc Tien, Vo Thi Hien (2010)	
Independent variable of the method			
HHI	$1 - \left(\frac{NII}{TORR} \right)^2 - \left(\frac{CPN}{TORR} \right)^2 - \left(\frac{OTHR}{TORR} \right)^2$	Pasiouras and Kosmidou (2007), Chortareas et al., (2008), Laeven and Levine (2008), Stiroh (2004), Le Thanh Tam (2022)	+
Control variable			
QM	Log (Total assets of commercial banks)	Aslam (2015)	+
TG	$\frac{\text{Total deposits}}{\text{Total assets}}$	Aslam (2015)	+
LCB	$\frac{\text{Interest income} - \text{Interest expense} - \text{interest paid}}{\text{Total earning assets}}$	Nguyen . J (2012)	-
VCSH	$\frac{\text{Total equity}}{\text{Total assets}}$	Chortareas (2012)	+
CV	$\frac{\text{Total outstanding debt}}{\text{Total assets}}$	Hahm (2008)	-
ATM	Number of ATM	Bailey-Tapper (2010), Atelu (2016)	+
CP	$\frac{\text{Total cost}}{\text{Total revenue}}$	Meng (2018)	+
ROA	$\frac{\text{Profit after tax}}{\text{Total assets}}$	Hahm (2008)	+
GDP	$\frac{\text{GDP in year } t - \text{GDP in year } t - 1}{\text{GDP in year } t - 1}$	Hakimi (2012)	+
INF	Inflation rate of each year	Chortareas (2012);	-
IR	Annual real interest rate	Hahm (2008)	+

Source: Author's construction from overview

3.2. Research data

To study the relationship between the impact of HHI and commercial banks' NII, the author calculated these two variables, along with control variables, from data provided in the financial statements system, which has been verified for the accuracy of commercial banks' trading on HOSE, HNX, and Upcom. Data for the remaining variables were collected from reports from the General Statistics Office.

3.3. Research method

Table data were processed using Stata 16 software in the following order: research sample statistics, correlation analysis, multicollinearity testing, and regression analysis. The author used the software's characteristic tests to select the most suitable regression model. The best-selected model was then tested for model defects and calibrated.

4. Research results and discussion

4.1. Research sample and statistical results

The research sample includes 25 commercial banks from 2013 to 2023. However, because two commercial banks, HDB and VBB, did not have financial statements in 2013, there were only 271 observations. Statistical results of 271 observations extracted from the software are shown in Table 2.

Table 2: Statistics of research sample

Variable	Observed	Mean	Standard Deviation	Minimum Value	Maximum Value
NII	271	0.09148	0.054659	-0.0275	0.289921
HHI	271	0.874545	0.060323	0.698725	0.992613
QM	271	1049855	1.2321307	2.944996	1.6325408
TG	271	0.880642	1.017983	0.065576	15.26915
NIM	271	3.020145	1.472837	0.00593	10.48703

Variable	Observed	Mean	Standard Deviation	Minimum Value	Maximum Value
CV	271	0.662893	0.755742	0.036859	12.43355
ATM	271	486.1513	663.8707	20	2510
CP	271	0.861579	0.095031	0.53781	1.15888
ROA	271	1.011994	0.918533	0	7.375422
VCSH	271	0.095235	0.109606	0.005599	1.329581
GDP	275	5.71397	1.754148	2.09	8.08
INF	275	3.373497	1.577056	0.631201	8.02
IR	275	9.237273	1.63877	.56	12.5

Source: Stata 16 running results

NII of commercial banks fluctuates around 0.09148, with an upper limit of about 0.29 and a lower limit of -0.0275. The above data confirms that NII is relatively low in total income (the most significant ratio is less than 30% of total revenue). There were commercial banks in 2013 and 2014 where NII was negative, indicating that non-interest expenses were more significant than income when implementing these activities (LBP and OCB banks). NII of commercial banks fluctuates wildly, clearly reflecting the differentiation between groups of commercial banks. HHI fluctuates around 0.874545, the upper limit is 0.99, and the lower limit is 0.698; the standard deviation is 0.06, showing that the HHI of commercial banks does not have too much differentiation. The remaining control variables are QM, TG, LCB, CV, ATM, CP, ROA, and VCSH, all of which show differentiation and lack of uniformity among the groups of commercial banks.

4.2. Correlation analysis results

Table 3: Correlation analysis matrix

	NII	HHI	QM	TG	LCB	CV	ATM	CP	ROA	VCSH	GDP	INF	IR
NII	1												
HHI	-0.3211*	1											
QM	-0.0301	-0.0096	1										
TG	-0.1281*	0.0061	-0.0105	1									
NIM	0.3044*	-0.6999*	0.0655*	-0.0282	1								
CV	-0.0564*	-0.0168	-0.0236	0.8899*	0.008	1							
ATM	0.3329*	-0.2439*	-0.0013	-0.0742*	0.1228*	-0.2668*	1						
CP	-0.5405*	0.7355*	0.0234	0.0173	-0.4705*	-0.0419*	0.03	1					
ROA	0.3853*	-0.5346*	-0.0202	-0.0255	0.4423*	0.0257	0.1557*	-0.6750*	1				
VCSH	-0.0359	-0.0279	-0.0285	0.6145*	0.0422*	0.6904*	-0.1021*	-0.0766*	0.0663*	1			
GDP	-0.1740*	0.0318	0.0013	0.0899*	0.0216	0.0605*	-0.0309	0.1655*	-0.0273	0.0893*	1		
INF	-0.1133*	0.2857*	0.0993*	-0.0403	-0.1453*	-0.0790*	-0.0644*	0.2000*	-0.1228*	-0.0174	0.0918*	1	
IR	-0.2930*	0.1507*	0.1287*	-0.0310	-0.1191*	-0.1232*	0.0012	0.4062*	-0.2763*	-0.0310	0.2299*	0.4227*	1

Source: Stata 16 running results

NII is correlated with HHI, but the correlation is negative. Variables that hurt NII, TC, VC, CP, VCSH, GDP, INF, and IR. Variables that have a position impact on NII are LCB, ATM and ROA.

4.3. Multicollinearity test

Table 4: Multicollinearity test results

Variable	VIF	1/VIF
CV	5.06	0.197752
HHI	4.06	0.246170
CP	3.88	0.257512
LCB	2.12	0.471442
VCSH	2.01	0.496386
ROA	1.94	0.515904
IR	1.7	0.586977
INF	1.37	0.731717
ATM	1.15	0.873169
GDP	1.11	0.903499
QM	1.03	0.969625
TG	2.05	0.876543
Mean VIF	2.63	

Source: Stata 16 running results

4.4. Regression model

Table 5 presents the regression model results, a significant tool in our study for examining the impact of HHI on the NII of Vietnamese commercial banks.

Table 5: Regression models

Variable	OLS	FEM	REM	FGLS
HHI	0.309*** (0.0888)	0.589*** (0.0837)	0.499*** (0.0809)	0.499*** (0.113)
QM	-8.922111 (2.192010)	-4.5732010 (1.8922110)	-3.1046710 (1.8623210)	-3.1023510 (6.8758111)
TG	-0.00716 (0.00587)	-0.00296 (0.00463)	-0.00373 (0.00467)	-0.00373 (0.00337)
LCB	0.00853*** (0.00263)	0.000921 (0.00239)	0.00307 (0.00234)	0.00307 (0.00321)
CV	0.00359 (0.00869)	0.00350 (0.00693)	0.00350 (0.00698)	0.00350 (0.00443)
ATM	1.752605*** (4.282306)	8.3821305 (5.5432705)	2.2676305** (9.18e-06)	2.2643105*** (7.872650)
CP	-0.326*** (0.0551)	-0.379*** (0.0487)	-0.368*** (0.0481)	-0.368*** (0.0839)
ROA	0.00159 (0.00403)	2.8421305 (0.00323)	0.00110 (0.00322)	0.00110 (0.00502)
VCSH	-0.00412 (0.0344)	-0.000718 (0.0283)	-0.000177 (0.0284)	-0.000177 (0.0169)
GDP	-0.00202 (0.00158)	-0.00170 (0.00117)	0.00181 (0.00119)	-0.00181* (0.000946)
INF	-0.000722 (0.00199)	-0.00340** (0.00163)	-0.00278* (0.00163)	-0.00278* (0.00168)
IR	-0.00155 (0.00214)	-0.000824 (0.00190)	-0.00140 (0.00177)	-0.00140 (0.00197)
Constant	0.0989 (0.0704)	-0.111 (0.0757)	-0.0181 (0.0631)	-0.0181 (0.0697)
Observations	271	271	271	271
R-squared	0.390	0.415		
Number of NAME		29	29	29

Source: Stata 16 running results

FEM is better than OLS (through the F-test). REM is more optimal than FEM (through the Hausman test). However, REM has autocorrelation and variable error variance, so it requires recalibration. The FGLS model provides information on the changes in HHI, which in turn lead to changes in NII. In addition, ATM and CP also have an impact on NII.

HHI has a positive effect on NII because commercial banks need to diversify and enrich their income by designing and expanding product and service packages, enriching business activities, and increasing income output from multiple sources, rather than focusing solely on interest income. Diversifying and enhancing products and services, especially non-credit services, will increase non-interest income. The relationship between HHI and NII of commercial banks in this regression model is similar to the assertions of Pasiouras and Kosmidou (2007), Chortareas et al. (2008), Laeven and Levine (2008), Stiroh (2004), Le Thanh Tam (2022) before.

ATM has a positive impact on NII. The more modern the technological infrastructure of commercial banks is, the more conditions commercial banks have to connect with many ecosystems, upgrade the benefits and convenience of the product packages provided by commercial banks, and emphasise the group of

digitalised services, thereby quickly creating excitement, curiosity, attracting users, attracting more potential customers, retaining traditional customers, expanding other sources of revenue besides interest income. The above findings are consistent with the previous findings of Bailey-Tapper (2010), Atelu (2016).

According to the results of running the cost model, increasing costs reduce NII; this relationship is opposite to the relationship previously discovered by Meng (2018), Hahm (2008), Lepetit (2008), and Doan Viet Hung (2020). In Vietnam, most commercial banks are concerned about the impacts of the technology-embedding process on transforming operations in the banking industry. They are implementing the first steps in the digitalisation process, so investment costs and technology conversion are often higher than non-interest income received. Investment costs to upgrade and modernise technology are considered prepaid expenses but are gradually accounted for to avoid creating too large profit fluctuations. On the other hand, with new products in the early stages of market penetration, income was low, which is insufficient to cover costs, thereby reducing NII. On the other hand, with these new products, commercial banks have to spend a lot of budget on advertising and marketing costs, reducing NII.

5. Implications from the model and some suggestions

5.1. Meaning from the research model

Commercial banks need to focus on promoting non-interest revenue sources in the context of declining interest revenue due to the reduced ability to absorb credit capital in the economy during the recession period and the need to maintain profits by reducing LCB. The results of running the model confirm that diversifying and enriching income is a solution for commercial banks to promote potential non-interest revenue sources. In addition, the selective application of advanced and modern technology in each stage of commercial banks' operating processes will create a breakthrough and have a favourable impact on NII.

5.2. Content of suggestions

5.2.1. For commercial banks

Commercial banks should plan policies and strategies to diversify and enrich their income sources, especially by emphasising the income generated from new products and services, in addition to credit services. Non-interest income includes fees, commissions, income from investment activities, securities trading and foreign exchange trading. For services with fees and commissions, it is necessary to maintain the old product group, conduct in-depth research to thrive and provide many new product packages, joint packages, product packages with high technology content,

derivative service groups, asset management service groups, securities consulting service groups, guarantee services, personal financial management... Along with the trend of expanding fee and commission services, commercial banks need to stabilise and reduce fees, emphasise the fundamental value of the product, enhance their potential and position in the market through quality, increase non-interest income by increasing the number of transactions, and increase the scale of transactions. Commercial banks must carefully research securities-related operations and invest according to the portfolio to disperse risks. For foreign exchange trading activities, it should be maintained at an appropriate level, strictly adhering to the regulations on the supervision and management of the foreign exchange status of the State Bank.

Second, each commercial bank should continue to consolidate, build, and enhance its reputation and image. A bank's reputation and brand are essential factors affecting customers' purchasing decisions. Moreover, in the increasingly competitive financial market, each bank's brand and recognition are always in customers' minds when deciding which commercial bank to transact with. Additionally, after-sales service activities must also be addressed to strengthen relationships with existing customers and attract new ones.

Third, commercial banks must take risks seriously. The more they expand and diversify their products, the harder it becomes to manage and the greater the risks they pose. More risks will have a more adverse impact on the quality of products and services, negatively impact customer satisfaction and directly reduce profits. Therefore, along with expansion, support, and promotion to enrich new services and activities, commercial banks need to pay attention to monitoring, tracking, minimising, and handling risks arising during the process of staff performing operations, risks related to strategies and policies, as well as governance processes and core banking systems. Measures and risk management contents that commercial banks can consider should include gradually declaring the responsibilities of management staff, operational staff performing operations, and indirect staff to handle testing the security system.

Fourth, commercial banks need to continue researching and experimenting to take advantage of technological optimisation in their operations and daily activities. In the new journey, digital technology, with its profound and drastic impact of digital transformation, is a factor that participates in the production process, playing a pivotal role in research, testing, application, and development, and innovating how to provide new products and services. Commercial banks partner with Fintech to increase financial understanding and

enhance user experience. Along with the trend of increasing the contribution of technology in financial products and service packages, financial institutions need to pay attention and have solutions to resolve potential challenges related to network security and customer data privacy rights.

5.2.2. Recommendations for state management agencies

First, agencies planning and issuing policies must create a favourable and stable business environment, control inflation, and set appropriate interest rates in an open economy to avoid shocks from the international environment and ensure the domestic financial market develops stably and healthily. A favourable business environment is essential in diversifying commercial banks' operations. Stabilising the macroeconomic environment minimises risks and losses in diversifying commercial banks' operations.

Second, for new financial services such as financial consulting, asset management, providing retirement plans, etc., there needs to be specific guidance from inter-sectoral agencies and organisations with management functions through guiding documents, decrees, and circulars. Therefore, management agencies and organisations need specific instructions for these activities so that commercial banks can implement them smoothly through documents, circulars, and guiding decrees.

Third: The State Bank needs to improve the effectiveness of banking inspection and examination and early warning activities of potential risks in the system, preventing violations of banking laws. The State Bank needs to have sanctions and thoroughly handle, with the right people and the right crimes, violations and risks that destabilise the system's operations.

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THE IMPACT OF GREEN INVESTMENT BEHAVIOR ON THE PERFORMANCE OF FOREIGN-INVESTED ENTERPRISES: AN EMPIRICAL STUDY IN HANOI

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Abstract: *Green investment has become a key strategy for enhancing sustainability and competitiveness among foreign direct investment (FDI) enterprises in emerging economies. This study examines the effects of green investment behavior on the performance of foreign-invested enterprises (FIEs) in Hanoi, Vietnam, and explores the moderating role of government green development policies. Based on survey data from 189 FDI enterprises, multiple regression analysis is employed. The results indicate that green innovation investment, green capability development, green supply chain management, and green corporate social responsibility practices significantly improve firm performance, whereas green human resource management shows no direct effect. Government green development policies do not directly influence performance but exert a mixed moderating role by strengthening the impact of green innovation investment while weakening that of green capability development. This study provides city-level evidence from an emerging economy and highlights the heterogeneous performance effects of green investment behavior, offering implications for both policymakers and FDI managers.*

• Keywords: *FDI, green investment, FDI enterprises, green supply chain management, social responsibility, green economic policy, Vietnam.*

Date of receipt: 11th Oct., 2025

Date of delivery revision: 26th Nov., 2025

Date of receipt revision: 10th Dec., 2025

Date of approval: 23th Jan., 2026

DOI: <https://doi.org/10.71374/jfar.v26.i1.22>

1. Introduction

In the context of escalating climate change and environmental degradation, green investment has emerged as a key strategy for promoting sustainable development in many countries, including Vietnam. In large cities such as Hanoi, rapid urbanization and industrialization have intensified environmental pressures. Foreign-invested enterprises (FIEs) in manufacturing and services have contributed substantially to economic growth, while simultaneously posing challenges for environmental protection and sustainable development (Ho et al., 2020). Consequently, examining green investment behavior among FDI enterprises in Hanoi is necessary to identify appropriate measures that support more effective and sustainable investment practices.

Green investment is increasingly unavoidable as Vietnam has committed to greenhouse gas emission reduction targets under international agreements such as the Paris Agreement. For FIEs in Hanoi, green investment represents not only social responsibility but also a source of long-term competitiveness. However, the implementation of green investment strategies remains limited, particularly amid rapid economic expansion and the proliferation of industrial zones, where environmental control has become

more complex. A systematic analysis of green investment behavior is therefore essential to promote environmental protection and advance sustainable development objectives.

As the nation's capital and a major economic center, Hanoi continues to attract foreign investment while facing growing environmental challenges. FIEs play a dual role by stimulating economic activity and exerting pressure on natural resources. Investigating their green investment behavior thus provides both theoretical and practical insights for designing policies that encourage stronger corporate engagement in environmental protection.

Against this backdrop, quantitative analysis of the relationship between green investment behavior and firm performance among FDI enterprises in Hanoi is particularly relevant. Such research enhances understanding of the performance implications of green investment while offering evidence to inform policy formulation and support the development of a greener and more sustainable urban economy.

2. Theoretical basis for the impact of green behavior of FDI enterprises

2.1. Concept of green investment behavior of FDI enterprises

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Green investment behavior of FDI enterprises is understood as foreign investment in the host country based on environmental protection criteria. UNCTAD (2008) specifies green investment behavior of FDI enterprises based on two aspects: *first*, compliance with environmental standards; *second*, investment activities and production of products and services related to sustainable community development, the environment, social responsibility, and governance (ESG - Environmental, Social, and Governance). UNCTAD (2010) conducted a more in-depth study of the investment behavior of FDI enterprises in low-carbon emission sectors; specifically, the green investment behavior of FDI enterprises is the transfer of technology, techniques, and product manufacturing processes from foreign investors to a host country, creating products and services with low greenhouse gas emissions compared to the global industry average.

Thus, the nature of green investment behavior by FIEs includes compliance with the host country's environmental regulations or international environmental standards; 's products and investment services in a greener and more environmentally friendly direction than domestic enterprises in the same industry, as reflected in indicators such as energy consumption, carbon emissions, waste management, air and water pollution levels, etc. (Golub et al., 2011). In summary, green investment behavior of FDI enterprises is the flow of FDI capital invested in host countries in industries and sectors that cause the least environmental damage, including direct investment in environmental protection and climate change mitigation industries, or investment in other products and services but with methods that minimize negative environmental impacts.

2.2. Impact of green investment behavior of FDI enterprises

Drawing on prior studies and adapting them to the research context, this study conceptualizes green investment behavior of FDI enterprises as a multidimensional construct comprising green innovation investment, green capability development investment, green human resource management (HRM) practices, green supply chain management (GSCM), and corporate social responsibility (CSR) practices toward the community and the environment. Government green development policy is incorporated as a moderating factor that may strengthen or weaken the relationship between green investment behavior and firm performance.

Green innovation investment is expected to enhance firm performance by improving

environmental efficiency, optimizing production processes, and creating sustainable value. Investment in green technologies enables firms to reduce emissions, improve resource utilization, and develop environmentally friendly products, thereby strengthening long-term competitiveness and compliance with environmental standards (Xie et al., 2019; Chen and Ma, 2021; Li et al., 2023). Supportive government policies further reinforce this effect through incentives for green technological investment (Chen and Ma, 2021).

Hypothesis H1: Green innovation investment behavior positively affects the performance of FDI enterprises.

Green capability development investment focuses on strengthening firms' abilities to manage resources efficiently and integrate environmental knowledge into operational processes. Such capabilities help reduce costs, improve compliance with environmental regulations, and enhance sustainable performance outcomes (Pavlou and El Sawy, 2011; Khan et al., 2023). Employee green behavior facilitated by these capabilities further contributes to improved firm performance (Mehrajunnisa et al., 2023).

Hypothesis H2: Green capability development investment behavior positively affects the performance of FDI enterprises.

Green human resource management practices promote environmentally responsible behavior through green recruitment, training, performance evaluation, and employee empowerment. By fostering environmental awareness and commitment, green HRM supports labor productivity, aligns employees with sustainability objectives, and enhances corporate reputation (Mehrajunnisa et al., 2023; Liu et al., 2023; Le and Tham, 2024; Khan and Muktar, 2024).

Hypothesis H3: Green human resource management investment behavior positively affects the performance of FDI enterprises.

Green supply chain management practices are expected to improve firm performance by optimizing resource use, reducing waste, and lowering production and logistics costs. The adoption of environmentally friendly standards across supply chains enhances operational efficiency, product quality, and regulatory compliance, thereby strengthening competitive advantage, particularly in international markets (Li et al., 2019; Khanal et al., 2023; Agyapong et al., 2023).

Hypothesis H4: Green supply chain management investment behavior positively affects the performance of FDI enterprises.

CSR practices toward the community and the environment represent another key dimension of green investment behavior. These practices help firms meet legal and ethical standards, strengthen stakeholder relationships, and enhance sustainable performance through responsible production and operational practices (Farooq et al., 2014; Khan et al., 2023). CSR engagement also improves corporate reputation and stakeholder trust, contributing to long-term business performance (Suganthi, 2019; Khan and Muktar, 2024).

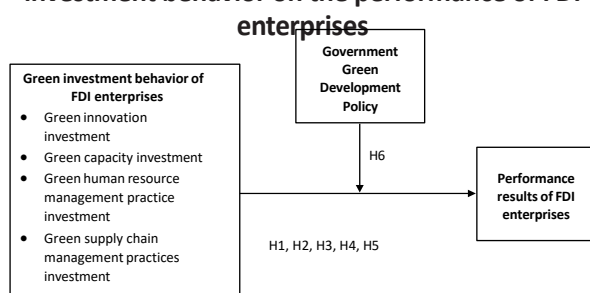
Hypothesis H5: CSR investment behavior toward the community and the environment positively affects the performance of FDI enterprises.

Government green development policy plays a moderating role in shaping the effectiveness of corporate green investment behavior. Policy instruments such as tax incentives, green subsidies, and preferential financing reduce regulatory risks and encourage firms to increase green investment, thereby influencing the strength of the relationship between green investment behavior and firm performance (Jaffe et al., 1995; Leiter et al., 2011; Chen and Ma, 2021).

Hypothesis H6: Government green development policies moderate the relationship between green investment behavior and the performance of FDI enterprises.

Based on the above analysis, the research model is established as follows.

Figure 1: Research model on the impact of green investment behavior on the performance of FDI enterprises



3. Research Methodology

In this study, quantitative methods were used to analyze the impact of green investment behavior on the performance of FDI enterprises in Hanoi. The research design uses multiple regression analysis to examine the relationship between independent and dependent variables. To test for moderating effects, interaction variables were created by multiplying the values of each independent variable (green investment behavior) by the government's green development

policy variable, resulting in six interaction variables for inclusion in the regression analysis. The regression equation is formulated as follows:

$$Y = a_0 + a_1 * X_1 + a_2 * X_2 + a_3 * X_3 + a_4 * X_4 + a_5 * X_5 + a_6 * X_6 + a_7 * M + a_8 * X_1 * M + a_9 * X_2 * M + a_{10} * X_3 * M + a_{11} * X_4 * M + a_{12} * X_5 * M + a_{13} * X_6 * M + \varepsilon$$

Where:

Y: The operational results of the FDI enterprise;
 $a_0, a_1, \dots, a_{13}$: coefficients to be determined;

$X_1, X_2, \dots, X_6$: green investment behaviors of the FDI enterprise; M: Government green development policy;

ε : standard error.

Table 1: Description of the study sample characteristics

No.	Characteristic	Number	Percentage
	Total number of samples	189	100
1	Position of respondents in FDI enterprises: - Senior management (Executive Board, Board of Directors) - Middle management (department heads, deputy heads) - Specialists & others	26 123 40	13.76 65.08 21.16
2	Headquarters in Hanoi: - Cau Giay District - Nghia Do Ward - Yen Hoa Ward - Tay Ho District - Phu Dien Ward - Tu Liem District - Dai Mo Ward - Ha Dong District - Other Districts and Counties	48 25 18 17 14 14 12 7 34	25.40 13.23 9.52 8.99 7.41 7.41 6.35 3.70 17.99
3	Country of foreign investor - South Korea - Japan - Singapore - China - Hong Kong - United States - Taiwan - France - Other countries	59 36 18 16 7 5 4 2 42	31.22 19.05 9.52 8.47 3.70 2.65 2.12 1.06 22.22
4	Years of operation in Vietnam - Less than 3 years - 3 to 5 years - From 6 to 10 years - From 11 to 20 years - Over 20 years	28 52 63 34 12	14.81 27.51 33.33 17.99 6.35
5	Type of FDI enterprise - Foreign joint venture company - 100% foreign-owned company - Other	144 41 4	76.19 21.69 2.12
6	Field of activity - Agriculture, forestry, and fisheries - Trade & Services - Industry & Manufacturing - Construction	28 62 60 39	14.81 32.80 31.75 20.63
7	Labor force size of FDI enterprises - Less than 10 employees - 10 to 49 employees - From 50 to 99 employees - From 100 to 199 employees - 200 or more employees	31 52 47 41 18	16.40 27.51 24.87 21.69 9.52
8	Average annual revenue of FDI enterprises - Under 10 billion VND - From 10 to under 50 billion VND - From 50 to under 100 billion VND - From 100 to under 300 billion VND - 300 billion VND and above	52 58 46 24 9	27.51 30.69 24.34 12.70 4.76

Source: Data processing results using SPSS, 2025

The questionnaire survey was conducted with FIEs operating in Hanoi. To ensure the representativeness and reliability of the data, random sampling was used from a list of FIEs operating in Hanoi compiled by the Foreign Investment Agency - Ministry of Planning and Investment.

The questionnaire was sent by post and email to survey participants in Hanoi. The minimum sample size was determined based on the sampling method used. Specifically, each statement in the questionnaire needed to collect information from at least 4-6 FIEs, with an average of 5 enterprises per statement. Therefore, with a questionnaire consisting of 35 observed variables, corresponding to 35 questions, the minimum sample size was calculated as $n = 35 * 5 = 175$ FIEs. To ensure reliability, the author estimated a response rate of 60-70% and sent out 300 questionnaires. The results yielded 221 questionnaires; however, 32 of them were excluded due to missing important information or being unsuitable, despite the author's efforts to contact the respondents directly. Ultimately, the research sample consisted of 189 questionnaires, with the following structure and characteristics (Table 1).

The results of testing the measurement scales of the research variables show that the KMO and Cronbach's Alpha coefficients of the measurement scales of the independent and dependent variables are all greater than the permissible threshold of 0.7, with cumulative variance greater than 0.5, implying that they explain 62.543% of the total information of the 5 observed variables, confirming that the factor analysis meets the requirements. Therefore, all observed variables were accepted, and the scales of the 6 independent variables, moderator variables, and dependent variables were validated and confirmed as valid.

Table 2: Cronbach's Alpha and KMO coefficients for the study variables

Observed Variable	Scale Mean if variable is excluded	Scale variance if variable type	Correlation Total variable	Alpha if variable type
Green innovation investment behavior (X1): a synthesis of studies by Liu et al. (2023), Li et al. (2023), Xie et al. (2019), comprising 5 observed variables. <i>Cronbach's Alpha = 0.918; KMO = 0.842 & Sig. = 0.000</i>				
X11 - Green technology innovation investment	12.53	16.931	0.918	0.874
X12 - Green product innovation investment	12.07	17.362	0.726	0.915
X13 - Green process innovation investment	12.08	20.152	0.620	0.931
X14 - Investing in green organizational innovation	12.15	17.045	0.856	0.886
X15 - Green marketing innovation investment	12.07	16.729	0.848	0.888
Green Capability Development Investment Behavior (X2): A synthesis of studies Khan et al. (2023), Mehrajunnisa et al. (2023), and Pavlou and El Sawy (2011), com 5 observed variables <i>Cronbach's Alpha = 0.918; KMO = 0.842 & Sig. = 0.000</i>				
X21 - Monitoring and analyzing the environment	11.82	14.031	0.526	0.883
X22 - Developing green skills and knowledge	11.83	11.875	0.868	0.796
X23 - Learning and Applying Green Knowledge	11.47	12.442	0.806	0.814
X24 - Integrating and managing green knowledge	11.86	14.485	0.548	0.875

Observed Variable	Scale Mean if variable is excluded	Scale variance if variable type	Correlation Total variable	Alpha if variable type
X25 - Internal collaboration for green technology development	11.58	12.649	0.746	0.829
Green QTNS investment behavior (X3): a synthesis of studies by Khan and Muktar (2024), Le and Tham (2024), Liu et al. (2023), comprising 4 observed variables <i>Cronbach's Alpha = 0.853; KMO = 0.730 & Sig. = 0.000</i>				
X31 - Green recruitment	9.58	5.574	0.796	0.770
X32 - Green Human Resources Training and Development	9.89	6.099	0.635	0.838
X33 - Green performance evaluation	9.65	6.516	0.584	0.856
X34 - Empowering Green Employees	9.13	5.328	0.773	0.778
Green QTCCU Investment Behavior (X4): A synthesis of studies by Khanal et al. (2023), Agyapong et al. (2023), and Li et al. (2019), comprising 5 observed variables <i>Cronbach's Alpha = 0.923; KMO = 0.777 & Sig. = 0.000</i>				
X41 - Green collaboration between departments	13.77	14.347	0.845	0.896
X42 - Collaboration with green suppliers	13.69	15.107	0.787	0.908
X43 - Supplier environmental ISO certification	13.99	14.074	0.836	0.898
X44 - Supply of recycled products	13.36	15.008	0.765	0.912
X45 - Environmental standard control	13.54	14.324	0.768	0.912
Socially Responsible Investment Practices with the Community (X5): a synthesis studies by Khan et al. (2023), Suganthi (2019), Farooq et al. (2014), comprising 3 ob variables <i>Cronbach's Alpha = 0.851; KMO = 0.721 & Sig. = 0.000</i>				
X51 - Contributions to charitable activities	5.70	3.795	0.673	0.835
X52 - Supporting green organizations	6.25	3.315	0.746	0.767
X53 - Contributing to social campaigns and projects	6.22	3.596	0.746	0.768
Socially responsible investment behavior toward the environment (X6): a synthe studies by Khan et al. (2023), Suganthi (2019), Farooq et al. (2014), comprising 4 ob variables <i>Cronbach's Alpha = 0.805; KMO = 0.791 & Sig. = 0.000</i>				
X61 - Participation in green activities	9.15	9.056	0.601	0.765
X62 - Invest in green projects	8.96	8.966	0.562	0.782
X63 - Participating in green programs	9.43	7.864	0.645	0.744
X64 - Level of green commitment	9.47	8.357	0.678	0.727
Government Green Development Policy (M): a synthesis of studies by Chen and Ma (2021), Jaffe et al. (1995), and Leiter et al. (2011), comprising 4 observed variables <i>Cronbach's Alpha = 0.880; KMO = 0.746 & Sig. = 0.000</i>				
M1 - Policies to limit and monitor emissions	9.55	6.642	0.755	0.841
M2 - Green research and development subsidies	9.43	6.300	0.769	0.837
M3 - Impact of green environmental policies	9.19	7.144	0.770	0.837
M4 - Impact of green incentive policies	8.95	7.450	0.682	0.868
Performance of FDI firms (Y): a synthesis of studies by Le and Tham (2024), Mehrajunnisa et al. (2023), Khan et al. (2023), Chen and Ma (2021), comprising 5 observed variables <i>Cronbach's Alpha = 0.845; KMO = 0.729 & Sig. = 0.000</i>				
Y1 - Expected labor productivity	15.55	13.493	0.485	0.859
Y2 - Expected revenue growth	15.52	12.123	0.722	0.794
Y3 - Expected profit growth	15.51	12.123	0.681	0.806
Y4 - Expected Market Share Growth	15.44	12.057	0.723	0.794
Y5 - Degree of Achievement of Strategic Goals	14.99	13.106	0.669	0.811

Source: Data processed using SPSS, 2025

4. Research results

The results of multiple regression analysis, summarized in the table below, show that the research model does not exhibit multicollinearity, with all VIF coefficients below 2, ensuring insignificant correlation between independent variables. The R^2 coefficient is 57.44%, indicating that the model can explain 57.44% of the total variance of the variables in the model and accurately reflects the impact of green investment behavior of FDI enterprises and the government's green development policy on the performance of FDI enterprises in Hanoi. The F statistic is 18.165 with Sig = 0.000, confirming that the regression model is statistically significant overall and can predict the impact of independent variables, moderating variables, and interaction variables on business performance. From there, the

study continues to test the proposed hypotheses.

Table 3: Multiple regression analysis results

	Unstandardized coefficients		t	Sig.	Multicollinearity	
	B	Standard deviation			Tolerance	VIF
(coefficient)	-0.004	0.052	-0.087	0.931		
X1	0.224***	0.058	3.858	0.000	0.723	1.384
X2	0.327***	0.054	6.094	0.000	0.843	1.187
X3	0.084	0.058	1.437	0.152	0.713	1.402
X4	0.109*	0.055	1.974	0.050	0.798	1.253
X5	0.134*	0.054	2.470	0.014	0.832	1.202
X6	0.284***	0.059	4.837	0.000	0.708	1.413
M	-0.003	0.056	-0.062	0.951	0.785	1.273
X1*M	0.130*	0.056	2.321	0.021	0.625	1.601
X2*M	-0.101*	0.047	-2.168	0.031	0.876	1.141
X3*M	-0.064	0.064	-0.997	0.320	0.539	1.856
X4*M	0.067	0.061	1.102	0.272	0.650	1.537
X5*M	0.046	0.061	0.756	0.451	0.779	1.283
X6*M	-0.014	0.057	-0.242	0.809	0.659	1.518

$R = 0.758$; $R^2 = 0.574$; $Adjusted\ R^2 = 0.543$; $Durbin-Watson = 2.090$

Error = 0.676; $F = 18.165$; Sig. = 0.000.

* Statistically significant at $p < 0.05$;

** Statistically significant at $p < 0.01$;

*** statistically significant at $p < 0.001$.

4.1. Results of testing the impact of green investment behavior of FDI enterprises

The regression results indicate heterogeneous effects of different dimensions of green investment behavior on the performance of FDI enterprises in Hanoi.

Green innovation investment (X1) has a positive and statistically significant effect on firm performance ($B = 0.224$, Sig. = 0.000), supporting Hypothesis H1. This finding suggests that investment in green technologies and environmentally friendly production processes contributes to improved operational outcomes.

Green capability development investment (X2) also shows a strong positive impact on firm performance ($B = 0.327$, Sig. = 0.000), representing the largest coefficient among the green investment variables. Accordingly, Hypothesis H2 is supported.

In contrast, green human resource management investment (X3) does not have a statistically significant effect on firm performance ($B = 0.084$, Sig. = 0.152), indicating that such practices may not generate immediate performance benefits. Therefore, Hypothesis H3 is not supported.

Green supply chain management investment (X4) has a positive and marginally significant effect on firm performance ($B = 0.109$, Sig. = 0.050), supporting Hypothesis H4.

Corporate social responsibility investment toward the community (X5) is positively associated with firm performance ($B = 0.134$, Sig. = 0.014), providing support for Hypothesis H5.

Finally, CSR investment toward environmental protection (X6) exhibits a strong and statistically

significant positive effect on firm performance ($B = 0.284$, Sig. = 0.000). Thus, Hypothesis H6 is supported..

4.2. Results of testing the impact and regulatory role of the government's green development policy

The regression results indicate that government green development policy (M) does not have a statistically significant direct effect on the performance of FDI enterprises in Hanoi ($B = -0.003$, Sig. = 0.951). This finding suggests that, at the firm level, government green policies do not directly translate into improved short-term performance outcomes. Therefore, the direct effect of government green development policy on firm performance is not supported.

Regarding the moderating role of government green development policy, the results show that only two interaction terms are statistically significant at the 95% confidence level, namely $X1M$ and $X2M$. This indicates that government green development policy moderates the relationship between certain green investment behaviors and firm performance, but not all.

Specifically, the interaction between green innovation investment and government green development policy ($X1*M$) has a positive and statistically significant effect on firm performance. This result implies that government green policies strengthen the positive impact of green innovation investment on the performance of FDI enterprises in Hanoi.

In contrast, the interaction between green capability development investment and government green development policy ($X2*M$) is negative and statistically significant. This finding indicates that government green development policy weakens the positive effect of green capability development investment on firm performance.

No statistically significant moderating effects are found for the remaining interaction terms involving green human resource management, green supply chain management, or corporate social responsibility investments. Accordingly, the moderating role of government green development policy is only partially supported and varies across different dimensions of green investment behavior.

5. Some Implications for Solutions

Solutions to promote green behavior among FDI enterprises in Hanoi include several important aspects. First, enterprises need to adapt to macro-environmental requirements by complying with environmental laws and regulations, while committing to applying

advanced technologies to minimize environmental impacts. Proactive research and development of green technologies help businesses overcome sustainability challenges and improve community relations through social initiatives and environmental conservation. Additionally, learning from countries with strong green FDI systems helps establish a clear legal environment and promote effective green investment.

Economically, FDI businesses should aim to comply with green standards as a core strategy, which requires close integration between social responsibility and green technology. Improving the ability to attract FDI in the renewable energy sector is also important, with support measures, reduced bureaucracy and corruption, creating a clear and transparent investment market. Investing in green technology research and transfer will promote sustainable transformation in Hanoi, while enhancing the connection between businesses and global green models, creating a foundation for sustainable growth.

On the cultural and social front, FDI enterprises need to understand and apply Vietnam's traditional values of environmental protection, thereby connecting with the community. Promoting a green culture, transparency in reporting on environmental initiatives, and active participation in the community are measures that help businesses increase their credibility. Collaborating with local organizations and businesses to develop sustainable initiatives is also an effective way to increase the positive environmental impact of businesses, while contributing to promoting the green image of businesses in the eyes of the public.

Recommendations for FDI businesses include focusing on researching and implementing advanced green technologies and strengthening cooperation with domestic companies to spread good practices in environmental protection. There is a need for policies to train employees on green capabilities and promote an environmental protection culture from within. Local authorities should also improve the legal system to create a unified, clear legal framework for green investment, while offering incentives and financial support to encourage businesses to participate in sustainable projects.

6. Conclusion

This study provides a comprehensive quantitative analysis of the impact of green investment behavior on the performance of FDI enterprises in Hanoi. The findings show that several dimensions of green investment behavior including green innovation

investment, green capability development investment, green CSR practices, and social and environmental engagement with the community positively influence firm performance. These behaviors contribute not only to improved operational efficiency but also to enhanced corporate reputation and sustainability in a competitive environment.

The results also indicate that green human resource management practices and government green development policy do not have a significant direct effect on firm performance. However, government green development policy plays a moderating role by strengthening the positive impact of green innovation investment while weakening the effect of green capability development investment. These findings suggest the need for more targeted and coherent green investment strategies and policy instruments in Hanoi.

More broadly, the study underscores the importance of green investment behavior in enhancing the performance of FDI enterprises and supports continued efforts to promote sustainable investment in the context of global economic development. The findings imply that FDI enterprises should prioritize high-technology and green manufacturing sectors, while recognizing that the implementation of environmental initiatives remains constrained by investment costs, government support, and technical barriers. Accordingly, supportive measures from the Hanoi city government such as financial incentives, technical assistance, and a transparent legal framework are essential to reduce transition costs and risks and to encourage broader participation in green investment activities.

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THE IMPACT OF THE INTERNAL AUDIT FUNCTION ON EARNINGS MANAGEMENT BEHAVIOR IN VIETNAM

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Abstract: *Internal audit plays a crucial role within organizations and businesses by enhancing the effectiveness and efficiency of corporate governance systems, including earnings management. However, due to the inherent divergence in objectives and benefits between managers and owners, financial information is often subject to manipulation by management to maximize company value for personal gain. This study is conducted in the context following the issuance of Government Decree No. 05/2019/ND-CP on Internal Audit (IA) on January 22, 2019. Consequently, the article employs a combination of quantitative and qualitative research methods to examine the impact of the internal audit function on earnings management behavior within enterprises, and to assess the extent to which various factors influence this relationship. The findings indicate that four key internal audit factors significantly affect earnings management behavior. Based on these results, several recommendations are proposed to improve the effectiveness of the internal audit function in influencing earnings management behavior in the current context of Vietnam.*

• Keywords: *behavior, function, internal audit, earnings management.*

Date of receipt: 04th Jul., 2025

Date of receipt revision: 05th Dec., 2025

Date of delivery revision: 10th Nov., 2025

Date of approval: 22th Jan., 2026

DOI: <https://doi.org/10.71374/jfar.v26.i1.23>

1. Introduction

According to the corporate governance model proposed by the Institute of Internal Auditors (IIA), the internal audit function stands as one of the four cornerstones of effective corporate governance, alongside the audit committee, the board of directors, and external audit (IIA, 2024). Among these, internal audit (IA) is regarded as a foundational element due to its capacity for regular monitoring, assessment, and advisory services concerning internal governance. This function is considered pivotal in ensuring highly effective control and preventing earnings management practices by company management.

Driven by legal mandates in various countries requiring listed companies on stock exchanges to establish an IA function, the topic of internal audit has garnered increased attention from researchers globally. While numerous studies have explored factors influencing earnings management (EM) behavior, research specifically focusing on the impact of internal audit on EM remains limited.

Furthermore, the Vietnamese government recently issued Decree No. 05/2019/ND-CP, which mandates the establishment of an IAF in various enterprise types, including state-owned enterprises and listed joint-stock companies. This decree introduces more comprehensive regulations than previous mandates, underscoring the growing importance of the IA function and audit standards.

This study aims to clarify the impact of the IA function on earnings management behavior in Vietnam. Based on the findings, it will propose recommendations to enhance the role of the IA function, thereby enabling organizations and businesses to achieve their objectives

2. Literature review

In Vietnam, currently, the establishment of an internal audit function (IAF) is relatively uncommon among companies, despite widespread recognition of its importance and necessity. However, due to limited resources, many companies perceive the IAF as potentially creating a cumbersome and costly management apparatus. Consequently, as the IAF is still relatively new in Vietnam, most local studies have focused on exploring organizational structures and improvements for IA.

Conversely, the majority of empirical research findings from other countries consistently indicate that the IAF influences earnings management behavior (EMB). For instance, a study by Tang.T.T.T (2019) investigated the impact of factors measuring internal audit quality on earnings management behavior through accounting policy choices and the manipulation of economic transactions in listed Vietnamese companies. This study utilized a sample of 92 companies listed on HOSE and HNX from 2014 to 2018.

Prawitt et al. (2009) examined the influence of the internal audit function on earnings management behavior. EM behavior was measured using

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discretionary accruals and the pressure to meet or exceed analyst forecasts in listed U.S. companies. The authors analyzed 528 financial statements from 218 enterprises to assess EM behavior via discretionary accruals, and 571 financial statements from 244 enterprises to analyze EM behavior through the pressure to meet or exceed analyst earnings forecasts. To measure the IA function, the authors utilized six factors guided by Statement on Auditing Standards (SAS) No. 65 for external auditors' assessment of IA. The research model consequently incorporated variables such as: professional competence (measured by average internal auditor experience, proportion of internal auditors with professional certifications, and annual training hours); independence and objectivity (measured by the reporting recipient of the Chief Audit Executive); internal audit work (measured by the total time internal audit spent on financial statement review); and the level of investment in internal audit relative to the industry.

Regarding the level of investment in internal audit, Prawitt et al. (2009) contextualized this factor by comparing the company's investment with the industry average. "The company's average data was determined by the ratio of the internal audit function's budget to the company's total assets. The industry's data was determined by the ratio of the internal audit function's budget to the industry's average total assets. This was then calculated by dividing the difference between the company's and industry's data by the ratio of internal audit's activity and the industry's average total assets" (Prawitt et al. 2009). The study's findings revealed an inverse relationship between the composite variable for internal audit quality and earnings management behavior.

Ege (2015) investigated whether a high-quality internal audit function could prevent managerial misconduct. The author utilized the IIA database to select public companies during the period from 2004 to 2009. From a sample of 1,398 financial statements from 617 companies, the author designed a model comprising factors measuring internal audit quality, including: experience, professional qualifications, annual training hours, internal audit being a training ground for future managers, professional reporting relationships with the Audit Committee, and the level of investment in internal audit.

Amuchirai (2018) conducted a study to determine the impact of internal audit function effectiveness on the management operations of non-governmental organizations (NGOs) directly in Zimbabwe. Using a mixed-methods approach combining qualitative and quantitative research, the study utilized primary and

secondary data (a survey questionnaire administered to 27 respondents) selected via stratified sampling in 2018. The research results indicated that independence and objectivity, professional competence, and management support for the IAF positively influenced the effectiveness of the IAF

Thus, to date, numerous studies worldwide have explored factors measuring the IAF. The findings consistently show that professional competence, independence, and objectivity are key measures of the IAF. The majority of these studies affirm that the IAF has an inverse effect on EM behavior.

3. Research methodology and hypotheses

3.1. Research methodology

This study employs a combination of research methods, including literature review, expert interviews, and empirical testing. After data collection, it will be processed using SPSS 22 software. For the quantitative research data, the sample comprises listed companies (excluding financial institutions) on the Hanoi Stock Exchange, possessing complete financial statements and annual reports for the period 2023-2024. This resulted in an initial total of 342 companies, which was then cleaned to yield 297 observations meeting the requirements.

3.2. Official research model and research hypotheses

The hypotheses will be tested using a multiple regression model, with earnings management behavior as the dependent variable and the IAF as the independent variable.

Based on the theoretical foundations combined with the specific characteristics of the Vietnamese stock market, following factors to measure the independent variables of IAF are proposed: (1) professional competence, measured by the experience, professional certifications, and annual training of internal auditors; (2) independence and objectivity, measured by whether the head of the internal audit department reports directly to the Board of Directors/Supervisory Board; (3) IAF size, measured by the number of staff within the internal audit department; and (4) IAF quality control, measured by the establishment of an IA function evaluation and control program. The official research model is presented below:

Additionally, five control variables are: Accounting and Auditing Expertise of the Supervisory Board, Independent Board of Directors Members, CEO Concurrently Serving as Chairman of the Board, CEO Also Being a Founding Member, and Financial Leverage. Four hypotheses are formulated:

Hypothesis H1: The professional competence of the IAF has a negative impact on earnings management behavior.

Hypothesis H2: The independence and objectivity of the IAF has a negative impact on earnings management behavior.

Hypothesis H3: The size of the IAF has a negative impact on earnings management behavior.

Hypothesis H4: The quality control of the IAF has a negative impact on earnings management behavior.

To test these research hypotheses and measure the influence between the IAF and EM behavior, the following regression model will be used:

$$EM = \beta_0 + \beta_1 \times COMP + \beta_2 \times INDEPT + \beta_3 \times IAFSize + \beta_4 \times QuPRO + \beta_j \times CONTROLj + \epsilon$$

Where:

EM: Earnings Management, representing earnings management behavior.

COMP: Represents the professional competence of the internal audit function.

INDEPT: Represents the independence and objectivity of the internal audit function.

IAFSize: Represents the size of the internal audit function.

QuPRO: Represents the quality control of the internal audit function.

CONTROLj: Represents the control variables, including: ACEXP (accounting and auditing expertise of the Supervisory Board), BPIND (independent Board of Directors members), CEOCHAIR (CEO concurrently serving as Chairman of the Board), CEOFOUND (CEO also being a founding member), LEV (financial leverage).

β : Coefficients of the regression model.

ϵ : Residual term, representing the error in the model.

4. Research results and discussion

4.1. Descriptive Statistics

Table 4.1: Descriptive Statistics

Variable Symbol	Number of Observations (N)	Minimum Value	Maximum Value	Mean Value	Standard Deviation
EM	297	0,000	1,000	0,132	
COMP	297	0,000	3,000	2,520	0,159
EXP	297	1,000	11,000	5,700	1,861
CERT	297	0,000	0,857	0,515	0,141
TRAINING	297	0,000	12,000	5,030	2,369
INDEPT	297	0,000	1,000	0,700	0,460
IAFSize	297	2,000	30,000	5,576	3,321
QuPRO	297	2,000	30,000	5,576	3,321
ACEXP	297	0,000	1,000	0,502	0,300
BPIND	297	0,000	1,000	0,100	0,155
CEOCHAIR	297	0,000	1,000	0,207	0,405
CEOFOUND	297	0,000	11,000	0,179	0,669
LEV	297	0,000	7,790	2,355	1,390

4.2. Pearson Correlation Analysis

This analytical step examines the correlation between the independent and dependent variables through Pearson correlation analysis. The results indicate that the independent variables, including Professional Competence (COMP), Independence and Objectivity (INDEPT), IA Function Size (IAFSize), and the control variables, namely Accounting and Auditing Expertise of the Supervisory Board (ACEXP), Independent Board of Directors Members (BPIND), CEO Concurrently Serving as Chairman of the Board (CEOCHAIR), and CEO Also Being a Founding Member (CEOFOUND), all exhibit a significance level (Sig.) of <0.05. This demonstrates that these factors are statistically significant, implying their suitability for inclusion in the research model.

However, the Financial Leverage (LEV) factor shows a significance level (Sig.) of >0.1, indicating that this factor is not statistically significant and will therefore be excluded from the regression analysis. Furthermore, the absolute correlation coefficients among all variables range from 0.061 to 0.502, which is less than or equal to 0.8. This suggests that discriminant validity has been achieved, meaning these scales effectively measure distinct research constructs.

4.3. Multivariate Linear Regression Analysis

To test the research hypotheses, multivariate regression analysis was performed. The results presented in Table 4.2 show an adjusted R-squared of 0.442, indicating that 44.2% of the variation in the dependent variable is explained by the independent variables. The Durbin-Watson (d) statistic is 1.580 (<3), which confirms that the model does not suffer from autocorrelation of residuals.

Table 4.2: Model Summary

Model	R-squared	Adjusted R-squared	Coefficient of determination R2 correction	Error of the Estimate	Durbin-Watson
EM	0,664 ^a	0,442	0,431	0,1199	1,580

Note: Explanatory variables: CEOFOUD, IAFSize, QuPRO, BPIND, INDEPT, ACEXP, CEOCHAIR, COMP; Dependent variable: EM

Table 4.3 below presents an F-statistic of 40.658 with a significance level (Sig.) of 0.000. This indicates that the constructed regression model is a good fit for the collected data, and all variables included in the research model are statistically significant at a 5% significance level, meaning the independent variables in the model have a relationship with the dependent variable.

Table 4.3: ANOVA analysis of variance - Reliability of the research model

Model	Sum of Squared Deviations	Degrees of Freedom	Variance	F-Test	Significance Level
Pegression	4,090	7	0,584	40,658	0,000 ^b
Residual	5,173	360	0,014		
Sum	9,263	367			

Note: Explanatory variables: CEOFOUD, IAFSize, QuPRO, BPIND, INDEPT, ACEXP, CEOCHAIR, COMP; Dependent variable: EM

The results of the multivariate regression analysis (Table 4.4, which is not provided but inferred from the text) indicate that the Professional Competence of the Internal Audit Function (measured by experience, professional certifications, and training hours), the Independence and Objectivity of the Internal Audit Function (measured by direct reporting to the Board of Directors or Supervisory Board), and the Size of the Internal Audit Function (measured by the number of internal auditors) all have a negative impact on earnings management behavior, with a significance level (Sig.) of <0.05 . These findings demonstrate that professional competence, independence and objectivity, the size of the internal audit function, and internal audit quality control are four key factors measuring the quality of internal audit operations, and they contribute to mitigating earnings management behavior.

4.4. Multivariate linear regression analysis results

Table 4.4. Results of multivariate regression analysis^a

Variable	Unstandardized coefficient		Normalization coefficient	t-Value	Significance level	Collinearity test	
	Regression weight B	Standard deviation				Acceptability of the variable	VIF
(Constant)	0,347	0,022		15,842	0,000		
COMP	-0,049	0,008	-0,257	-5,928	0,000	0,827	1,209
INDEPT	-0,119	0,015	-0,346	-7,963	0,000	0,823	1,215
IAFSIZE	-0,004	0,002	-0,086	-2,082	0,038	0,909	1,101
QuPRO	-0,112	0,014	-0,324	-7,786	0,011	0,802	1,201
ACEXP	-0,047	0,022	-0,089	-2,130	0,034	0,884	1,131
BPIND	-0,092	0,041	-0,090	-2,236	0,026	0,962	1,040
CEOCHAIR	0,087	0,017	0,221	5,144	0,000	0,842	1,188
CEOFOUND	0,015	0,010	0,064	1,502	0,134	0,866	1,154

Based on the results presented, Hypotheses H1, H2, H3, and H4 are accepted, which aligns with the theoretical framework employed in this study. The findings suggest that due to the conflict of interest between management and owners/stakeholders, managers often engage in earnings management behaviors to achieve personal benefits. A high-quality internal audit department, however, effectively mitigates these behaviors.

Furthermore, the regression analysis indicates that, with the exception of the control variable CEO Also Being a Founding Member (CEOFOUND), which is not statistically significant ($p\text{-value} > 0.1$), all other control variables are statistically significant ($p\text{-value} < 0.05$ or $p\text{-value} < 0.1$). Specifically, Accounting and Auditing Expertise of the Supervisory Board (ACEXP), the number of Independent Board of Directors Members (BPIND), and the CEO Concurrently Serving as Chairman of the Board (CEOCHAIR) are found to reduce earnings management behavior.

Regarding collinearity, the Variance Inflation Factor (VIF) values for all independent variables are less than 2, indicating the absence of multicollinearity. This confirms that there is no linear relationship among the variables in this study.

5. Conclusion and Recommendations

5.1. Conclusion

Findings from Section 4 reveal that even within listed companies that have established an IA function as required by regulations, EM behavior persists. This indicates that listed companies need to prioritize enhancing the quality of their internal audit to effectively support control efforts and prevent managers' EM practices. The quantitative analysis, through the proposed regression model, yielded the results presented in the previous section. These results consistently show that the factors measuring the IAF negatively influence EM behavior.

This study was conducted in a period following the effective date of Government Decree No. 05/2019/ND-CP, a period for which no prior research had been undertaken. Drawing upon the comprehensive literature review and the findings of this study, it can be affirmed that the IA function, as measured by professional competence, independence and objectivity, IA function size, and IA function quality control, has a negative impact on EM behaviors. Therefore, improving the quality of the IA function is synonymous with enhancing these specific factors. Consequently, to provide practical support for improving IA quality, the following section of this chapter will propose several recommendations from the perspectives of corporate governance, auditing, and regulatory bodies.

5.2. Recommendations

5.2.1. Independence and objectivity

For the IAF to be effective, thus minimizing earnings management behavior, internal auditors must ensure their independence and objectivity. To guarantee this attribute, IA must have direct, unrestricted access when reporting control results to senior management, the Board of Directors, or the Supervisory Board. However, in some smaller listed joint-stock companies, this department still reports directly to the General Director. To maintain and further enhance the independence and objectivity of the IA department, the following suggestions can be implemented:

- To enhance independence and objectivity, ideally, the IA department should be a separate unit from other functional departments within the company.

- A rational organizational structure is necessary to ensure the independence and objectivity of internal auditors. The IA department should be positioned as high as possible in the organizational hierarchy, preferably reporting directly to the Board of Directors rather than the Board of Management. This structure would ensure internal auditors are free from any interference,

human or otherwise, that could compromise their independence and objectivity during audits.

- The appointment, dismissal, and remuneration determination for the IA department must be entirely at the discretion of the Board of Directors. If this is the case, the IA department will be able to maintain objectivity, without any “reservations” regarding managerial misconduct, and will significantly contribute to detecting and preventing earnings management behaviors aimed at personal gain.

5.2.2. Professional Competence

In this study, the professional competence of the IA function is measured by experience, professional certifications, and annual training hours, and it is found to have a negative impact on earnings management behavior.

To enhance the IAF, it is crucial to strengthen professional competence by improving the knowledge, skills, and professional experience in internal audit work. To achieve this, companies need to establish regulations regarding the qualifications and professional capabilities of staff from the recruitment phase and maintain these through continuous training.

According to the guidelines of Decree No. 05/2019, internal auditors must hold a university degree in economics, finance, accounting, or business administration; possess at least 5 years of practical experience in financial management or accounting, with at least 3 years working as an auditor within the assigned company; and have completed training in audit methodology and standards according to the unified program of the Ministry of Finance and obtained a certificate.

In the long term, companies need to develop a specialized and in-depth training program to ensure and maintain IA staffs’ professional competence and skills at an optimal level, enabling them to fully complete audit tasks. For internal auditors who already meet the requirements for training and audit experience, companies should still focus on continuous training for these individuals.

In addition to developing the professional competence of the internal audit team, companies also need to establish appropriate compensation policies for internal auditors to attract and retain a highly competent IA team. Reasonable compensation policies will motivate internal auditors to perform their assigned duties effectively. Therefore, beyond salaries, bonus schemes and allowances also need to be clearly structured, commensurate with individual responsibilities, qualifications, and contributions.

5.2.3. Size of the internal audit department

Building a quality IA department not only requires ensuring that internal auditors possess strong professional knowledge and auditing skills but also requires an adequate number of staffs. Therefore, for the IA department to operate with quality, it needs an appropriate size. However, since each company has different characteristics and operational scales, the decision on what constitutes an appropriate IA size must be carefully considered. Depending on the requirements and the complexity of the operational area, this size may increase or decrease to varying degrees.

5.2.4. Internal audit function evaluation and quality control program

In terms of content, the IA function’s quality evaluation and control program should be designed to include assessments of compliance with regulations, adherence to professional ethics, and identification of areas and aspects for improvement within the IA department.

In terms of scope, to ensure the quality control of IA, the evaluation program for this activity needs to be established and conducted across all aspects of the IA function, without excluding any phase or being limited to evaluating only individual audits. Therefore, the internal assessment level is considered a crucial level that needs to be carried out first to identify weaknesses within the IA function.

Internal assessment typically includes ongoing monitoring and periodic monitoring. In addition to internal assessment, independent assessment is also considered an integral part of the quality control program, aimed at enhancing the program’s effectiveness. Independent assessment is required to be performed at least once every five years by an external expert or an independent competent organization (IIA, 2019)

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FACTORS AFFECTING PROFITABILITY OF LISTED COMPANIES IN THE GARMENT AND TEXTILE INDUSTRY IN VIETNAM

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Abstract: *This study examines factors affecting the profitability of listed companies in the garment and textile industry in Vietnam. The sample consists of 37 listed firms on HNX, HOSE and UpCom over 2014 - 2020. Multiple regression models indicate that firm size, cost management, asset employment and utilization, operating cash flows facilitate the profitability of these companies. In contrast, debt ratio, tangible asset investment and market position hinder profitability. Export value growth of the garment and textile industry shows negative impact on profitability, reflecting the compliance cost burden to ensure the technical and quality regulations of imported markets and the dependence of the Vietnamese garment and textile enterprises on the global market.*

• Keywords: *profitability, garment and textile industry, listed companies, Vietnam.*

Date of receipt: 04th Oct., 2025

Date of delivery revision: 10th Nov., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.24>

Date of receipt revision: 05th Dec., 2025

Date of approval: 21th Jan., 2026

1. Introduction

The garment and textile industry is one of Vietnam's key export sectors, contributing approximately 10-15% to economic growth, creating more than three million jobs annually, and strengthening Vietnam's position in global value chains. As traditional competitive advantages gradually diminish and compliance requirements in importing markets become increasingly stringent, Vietnamese garment and textile firms face mounting pressure to maintain and enhance profitability while ensuring financial sustainability. Therefore, identifying the determinants of profitability in this sector is essential for supporting firm-level financial resilience and sustainable development.

Previous studies on the garment and textile industry include Le and Tran (2024), Phan and Nguyen (2025), Do (2023), Nguyen (2023), and Vu (2025). These studies mainly focus on a limited set of determinants rather than providing a comprehensive assessment of profitability drivers. As most existing research concentrates on firms listed on HNX and HOSE, this study addresses these gaps by expanding the sample to include firms listed on UpCom and by jointly examining internal and industry-specific external determinants of profitability.

2. Hypotheses and research model

Profitability is a key financial indicator

reflecting a firm's ability to generate returns for investors through business operations. It is influenced by internal factors related to firm-specific characteristics and external factors reflecting macroeconomic conditions and market uncertainties. *Regarding internal factors*, primary determinants include firm size, asset structure, operating cash flows, capital structure, liquidity, and working capital management. Firm size is considered as a critical factor for evaluating and determining firm position and potential growth in a particular industry. Larger firms often benefit from easier access to capital, economies of scale, and stronger market access (Dang et al., 2018; Sjahrial, 2012). Investment in fixed assets reflects production capacity (Barney, 1991), particularly in primary industries such as the garment and textile industry. However, excessive investment in fixed assets may reduce asset turnover and operational flexibility, especially in industries suffering from the rapid changes in technology and market needs such as the garment and textile industry.

Asset utilization efficiency and cost management practices have a positive impact on firm profitability. Effective cost management enables firms to optimize their cost structure and eliminate non-value-adding activities, thereby directly enhancing profitability (Hansen & Mowen, 2014). Sound control of operating costs allows firms to achieve higher returns on assets

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(ROA) and returns on equity (ROE), even in the absence of strong revenue growth (Banker et al., 2011).

The impact of capital structure on profitability has been extensively examined within the framework of Modigliani and Miller's capital structure theory (1963). In emerging markets, where borrowing costs and credit risk premiums are relatively high, empirical evidence largely indicates a negative relationship between financial leverage and profitability (Shubita & Alsawalhah, 2012; Arega et al., 2020). Firms that rely excessively on debt financing may face liquidity constraints and reduce operational flexibility. This argument is particularly relevant to Vietnam's garment and textile industry, which is highly dependent on short-term borrowing and is strongly exposed to fluctuations in interest rates and exchange rates.

In terms of liquidity, firms that maintain a high level of liquidity are better able to meet short-term obligations, thereby ensuring financial stability and potentially enhancing profitability (Makori & Jagongo, 2013). However, excessively high liquidity may adversely affect profitability, as a portion of working capital remains idle and is not efficiently utilized in business operations. The inherent trade-off between liquidity and profitability therefore gives rise to a negative relationship between liquidity and firm profitability (Ehi-Oshio et al., 2013).

Working capital management plays a crucial role in labor-intensive and low-margin industries such as the garment sector, as it enables firms to manage receivables, payables, and inventories in a manner that maximizes operating cash flows (Shin and Soenen, 1998; Deloof, 2003; García-Teruel and Martínez-Solano, 2007). However, empirical evidence on the impact of working capital management on profitability remains inconclusive. Studies by García et al. (2014) and Kasozi (2017) find no statistically significant relationship between working capital management and firm profitability.

Regarding the role of operating cash flows, firm life-cycle theory (Adizes, 1979; Dickinson, 2011) suggests that firms with abundant cash flows from operating activities are typically in a strong growth phase and exhibit higher profitability. Operating cash flow (CFO) also serves as an indicator of a

firm's liquidity position and managerial capability (Etim et al., 2022; Christian and Dewi, 2024). Accordingly, higher CFO is expected to enhance firm profitability.

Market position is another key determinant of firm profitability. According to Porter (1980), a strong market position enables firms to reduce competitive pressure and improve financial performance through bargaining power and product differentiation. De and Eeckhout (2017) further demonstrate that firms with greater market power achieve superior profit margins. Given the characteristics of Vietnam's garment supply chain, market position is therefore expected to contribute positively to firm profitability.

Regarding external factors, trade agreements play a critical role in shaping firm performance in the garment and textile industry. Garment firms may experience short-term declines in profitability following trade liberalization due to increased compliance costs related to rules of origin, labor standards, and environmental regulations (Nabeshima et al. 2021). In the context of Vietnam's garment and textile industry, free trade agreements (FTAs) are therefore likely to exert upward pressure on production costs in the short run, while being expected to support export growth and deeper integration into global value chains in the long run.

The research hypotheses are formulated as follows:

H1: Firm size has a positive effect on the profitability of listed garment and textile firms in Vietnam.

H2: Fixed asset investment structure has a significant impact on the profitability of listed garment and textile firms in Vietnam.

H3: Operating cash flow (CFO) has a significant impact on the profitability of listed garment and textile firms in Vietnam.

H4: Capital structure has a negative effect on the profitability of listed garment and textile firms in Vietnam.

H5: Liquidity has a positive effect on the profitability of listed garment and textile firms in Vietnam.

H6: Working capital management has a positive effect on the profitability of listed garment and textile firms in Vietnam.

H7: Asset utilization efficiency and cost management have a positive effect on the profitability of listed garment and textile firms in Vietnam.

H8: Market position has a positive effect on the profitability of listed garment and textile firms in Vietnam.

H9: Trade agreements have a significant impact on the profitability of listed garment and textile firms in Vietnam.

3. Data and Methodology

This study employs secondary data compiled from the consolidated financial statements of 37 garment and textile firms listed on the HNX, HOSE, and UpCom over the period 2014-2020. Industry-level trade data for Vietnam's garment and textile sector are obtained from the World Bank.

The proposed hypotheses are empirically examined using the following econometric models:

$$\text{Profitability}_{i,t} = \beta_{01} + B_1 * X + \varepsilon_1 \quad (1)$$

Where:

Profitability is the dependent variable and measured by BEP, ROA và ROE.

B1, B2, B3 denote the parameter vectors; X represents the vector of independent variables described in Table 1, và $\varepsilon_1, \varepsilon_2, \varepsilon_3$ are the error terms of models (1), (2), and (3), respectively.

Table 1: Explanation of variables in empirical models

Variable	Meaning	Formula
Dependent variables		
ROA	Profitability ratio measuring how efficiently a company uses its assets to generate profit	$ROA = \frac{\text{Net Income}}{\text{Total Assets}}$
BEP	Basic earning power, ability to generate earnings from its assets before interest and taxes	$BEP = \frac{\text{EBIT}}{\text{Total assets}}$
ROE	Profitability ratio measures how efficiently a company uses its equity to generate profit	$ROE = \frac{\text{Net Income}}{\text{Equity}}$
Explanatory variables		
Tang _{per}	Measuring the % of tangible asset (tangibility) over total asset	$Tang_{per} = \frac{\text{Tangible Assets}}{\text{Total assets}}$
CFO	Capability of cash flow generating from operating activities	CFO = Inflow from OA - Outflow from OA
Hd	Reflecting the capital structure of a company	$Hd = \frac{\text{Total Liabilities}}{\text{Total Assets}}$
NWC	Reflecting the net working capital management of business	NWC = (Long-term debts + Equity) - Long-term assets
Liquid	The ability to repay short-term obligation based on liquidating current assets	$Liquid = \frac{\text{Current Assets}}{\text{Current Liabilities}}$
ROS	Measuring the cost management efficiency of a company	$ROS = \frac{\text{Net Income}}{\text{Net Revenue}}$
Aturn	Asset utilization efficiency	$Aturn = \frac{\text{Net Revenue}}{\text{Total assets}}$
MSize	Firm Size	$Msize = \ln(\text{Net Revenue})$
Market	Indicating market position/market share of a company	$Market = \frac{\text{Net Revenue of Firm } i \text{ at Year } T}{\text{Total Revenues of Firm } i \text{ at Year } T}$
Trade	The growth rate of export value of the garment and textile industry	$Trade = \frac{\text{Export Value}_T - \text{Export Value}_{T-1}}{\text{Export Value}_T}$
G	Denoting where a firm is listed	$\begin{cases} = 1 \text{ for listed firms on HNX or HOSE} \\ = 0 \text{ for listed firms on UpCom} \end{cases}$

4. Results and discussion

4.1. Overview of profitability of listed companies in the garment and textile industry

Table 2: Description of the variables in empirical models

Variables	Mean	Std. deviation	Min	Max
ROA	.0631297	.0892324	-.7923179	.3923648
BEP	.0612393	.0808261	-.777653	.2592433
ROE	.1482311	.1818565	-.1.19179	.5700387
Tang_per	.2005875	.1394164	0	.7428897
CFO	5.86e+10	1.41e+11	-4.89e+11	7.67e+11
Hd	.5332343	.2439131	0	1.03134
NWC	1.44e+11	3.68e+11	-2.40e+11	2.73e+12
Liquid	1.788865	1.597616	.2073008	10.38259
ROS	.0666279	.1138467	-.4520098	.5957017
Aturn	1.555672	.8245883	.064094	4.566988
MSize	21.07263	1.41189	23.35807	29.90439
Market	.0323214	.0419385	.0003167	.2505434
Trade	.1036392	.1525205	10.13622	10.58213

The average return on assets (ROA) of listed garment and textile firms in Vietnam during the period 2014-2020 is 6.31%. The economic profitability of assets (BEP) fluctuates around 6.1%, with a standard deviation of 8.082%. The average return on equity (ROE) reaches 14.82%, accompanied by a relatively high standard deviation of 18.18%. Over the study period, listed garment firms exhibit higher returns on equity than returns on assets; however, the substantial dispersion of ROE indicates considerable heterogeneity in profitability across firms.

Fixed asset investment accounts for approximately 20% of total assets, reflecting an asset structure that relies heavily on working capital. The average operating cash flow (CFO) of listed garment firms amounts to VND 58.6 billion, although the range of variation is wide. The highest observed CFO reaches VND 767 billion, whereas the lowest value is -VND 489 billion. The average debt-to-total-assets ratio in the industry is 53.32%. Firms maintain relatively sound liquidity positions, with an average current ratio of 1.788.

The average return on sales (ROS) is 6.66%. Several firms demonstrate strong cost management efficiency, with the highest ROS reaching 59.5%, in sharp contrast to the most severe losses, which correspond to a ROS of -45.2%. In addition, there is substantial variation in asset turnover among listed garment and textile firms in Vietnam, with the highest asset turnover reaching 456% and the lowest only 6.4%.

Firm size also exhibits considerable heterogeneity. The largest firm records net revenue of VND 9,669 billion, nearly 735 times higher than that of the smallest firm (VND 13.15 billion). In terms of market position, the largest firm accounts for approximately 25% of total market revenue, whereas the smallest firm holds only 0.03% market share. Meanwhile, Vietnam's garment and textile exports continue to expand, with an average annual growth rate of approximately 10.3% over the study period.

4.2. Factors affecting profitability of listed companies in the garment and textile industry in Vietnam

Table 4: Results of GLS Regression (1), (2) and (3)

Variables	ROA (1)	BEP (2)	ROE (3)
Tang_per	-.0880338 (***)	-.0198657	-.1410239 (**)
Hd	-.137212 (***)	-.0826303 (**)	-.2709709 (***)
Aturn	.0207006 (***)	.0253037 (***)	.04299 (***)
ROS	.77217 (***)	.3759875 (***)	1.10043 (***)
MSize	.0378324 (***)	.0478561 (***)	.1006652 (***)
Liquid	-.0044761	.0069262 (*)	-.0062202
NWC	-1.02e-13 (***)	-8.31e-14 (***)	-2.29e-13 (***)
CFO	8.44e-14 (***)	7.71e-14 (**)	7.20e-14
Market	-.4906104 (***)	-.6722374 (***)	-.4452299
Trade	-.042681 (*)	-.086791 (***)	-.0797162
G	-.0168249 (*)	.0076081	-.0599234 (**)
_cons	-.4649971 (*)	-.3311011	-1.63595

Note:

(***), (**), (*) denote p-value at 1%, 5%, 10% respectively.

The Hausman test results indicate that the random effects model (REM) is the most appropriate specification for the dataset; however, the presence of heteroskedasticity is detected. Accordingly, the study employs the generalized least squares (GLS) estimator to obtain robust and efficient estimates.

Table 4 reports the results of hypothesis testing. Overall, the explanatory variables are statistically significant; however, the direction and magnitude of their effects vary across different profitability measures. The regression results indicate that firm size, operating cash flows, asset turnover, and cost management efficiency exert positive effects on profitability. In contrast, leverage, working capital management, market position, and free trade agreements (FTAs) have negative effects on firm profitability. In addition, garment firms listed on the UpCom market exhibit lower profitability than those listed on the HNX and HOSE exchanges.

More specifically, leverage has a negative and statistically significant effect on profitability at p-value < 5% level, suggesting that excessive reliance on debt financing increases interest

expenses and financial risk, thereby reducing operational efficiency. Working capital management also shows a strong negative effect on profitability (p-value < 1%), reflecting that excessive investment in short-term assets raises opportunity costs, leads to inefficiencies in working capital allocation, and ultimately weakens firm profitability. These findings are consistent with empirical evidence on working capital management in developing economies.

By contrast, asset turnover has a positive effect on profitability, particularly on ROE, underscoring the critical role of asset utilization efficiency in the garment industry. This result is consistent with the current investment structure of Vietnamese garment firms. Both return on sales (ROS) and firm size exert positive effects on profitability at the 1% significance level, indicating that firms with effective cost control and larger scale are better able to exploit economies of scale, thereby enhancing profitability and shareholder value. Net operating cash flow also exhibits a positive association with profitability, highlighting the importance of stable cash flows in supporting growth and improving financial performance among Vietnamese garment firms.

Conversely, market position has a negative effect on ROA and BEP, suggesting that market expansion does not necessarily translate into higher profitability. Large firms may face challenges in managing diversified market segments, which can increase operating costs and reduce efficiency. Similarly, free trade agreements (FTAs) are found to have a negative impact on profitability in the short run, as stringent requirements related to rules of origin, labor standards, and environmental regulations raise compliance costs, thereby reducing the profits of listed garment and textile firms.

5. Policy implications for improving the profitability of Vietnamese garment and textile firms

Based on the empirical findings, this study proposes several policy implications to enhance the profitability of Vietnamese garment and textile firms in the context of intensifying competition and increasingly stringent environmental and carbon standards imposed by key export markets.

First, policies should encourage firms to shift their strategic focus from scale and

market share expansion toward improving asset utilization efficiency and the quality of growth. Support measures should prioritize productivity enhancement, operational management, and supply chain efficiency rather than promoting extensive growth.

Second, given that free trade agreements (FTAs) do not immediately translate into higher profitability, government policies should aim to reduce firms' compliance costs. Requirements related to emissions control, cross-border carbon mechanisms, and green labeling substantially increase production costs in the garment industry. Accordingly, green financial support schemes, such as preferential credit, tax incentives, or subsidies for clean technology, energy efficiency, and emissions management, are essential to help firms meet international standards at reasonable cost.

Third, policies promoting the development of domestic supporting industries and supply chains should be strengthened to reduce dependence on imported inputs, which undermines the benefits of FTAs. Establishing an integrated domestic ecosystem for textiles, dyeing, and finishing would not only facilitate compliance with rules of origin but also improve profit margins by shortening production cycles and reducing logistics costs.

Fourth, policies should support firms in strengthening financial resilience and improving capital structure efficiency. Given the negative impact of high leverage on profitability, regulatory frameworks and financial institutions should encourage longer-term financing instruments, reduce excessive reliance on short-term debt, and promote access to stable funding sources. Developing specialized credit products tailored to the cash-flow characteristics of garment firms, along with enhanced risk-sharing mechanisms, would help mitigate liquidity constraints and financial vulnerability.

Fifth, policies should promote digital transformation and data-driven management practices within garment and textile firms. Investments in digital technologies such as enterprise resource planning (ERP) systems, supply chain tracking, and data analytics can improve working capital management, cost control, and operational efficiency. Supporting digital adoption through training programs,

technology grants, and public-private partnerships would enable firms to enhance productivity and profitability while adapting to increasingly complex global supply chains.

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THE IMPACT OF BRAND IDENTITY ON MARKET DEVELOPMENT OF ELECTRICAL EQUIPMENT MANUFACTURING SMEs IN VIETNAM: A CLUSTER SEM ANALYSIS

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Abstract: *This study examines the impact of brand identity on market development among small and medium-sized enterprises (SMEs) in Vietnam's electrical equipment industry. The model includes four components of brand identity: Brand-as-Product Identity (BP), Brand-as-Organization Identity (BO), Brand-as-Person Identity (BI) and Brand-as-Symbol Identity (BS), which affect market development (MD). Data were collected using a clustered structure and estimated through Structural Equation Modeling (SEM) in R using the packages lavaan and lavaan.survey. The results indicate that all path coefficients are positive and statistically significant. BO exerts the strongest effect on MD ($\beta=0.310$), followed by BI ($\beta=0.295$), BS ($\beta=0.228$) and BP ($\beta=0.224$). The model explains 47.0% of the variance in MD ($R^2=0.470$). Managerial implications suggest that firms should prioritize brand orientation, strengthen brand identity, standardize brand recognition systems and enhance operational efficiency to expand their markets.*

• Keywords: *brand identity; market development; small and medium-sized enterprises (SMEs); cluster-robust SEM.*

Date of receipt: 25th Oct., 2025

Date of delivery revision: 04th Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.25>

Date of receipt revision: 20th Dec., 2025

Date of approval: 26th Jan., 2026

1. Introduction

In recent years, small and medium-sized enterprises (SMEs) in Vietnam's electrical equipment manufacturing industry have been operating in a highly competitive environment where products are easily commoditized, while customers, particularly in the B2B market, are becoming increasingly demanding regarding product quality, supplier reliability and responsiveness. Therefore, market development, including the expansion of consumption areas, channels or partners and the increase of customers and orders, cannot rely solely on price advantages or production capacity. It requires intangible resources that create differentiation and reduce uncertainty in purchasing decisions.

According to the resource-based view, sustainable competitive advantage is formed from resources that are valuable, rare and difficult to imitate. Consequently, intangible assets such as brand identity can become an important foundation that helps enterprises maintain their position and expand their markets (Barney, 1991). From the customer behavior perspective, brand value is created from brand knowledge and associations, which influence marketing

responses and purchasing choices (Keller, 1993). In the B2B context, the brand still plays a significant role, although the level of influence may vary among buyer groups and purchasing contexts (Mudambi, 2002). Several studies have shown that brand value in B2B markets is related to supplier selection and competitive advantages that extend beyond tangible criteria (Bendixen et al., 2004). At the same time, brand image and corporate reputation can affect perceived quality, value and loyalty, which are mechanisms leading to market performance (Cretu & Brodie, 2007).

Based on this foundation, this study examines the impact of brand identity through four dimensions: Brand-as-Product Identity (BP), Brand-as-Organization Identity (BO), Brand-as-Person Identity (BI) and Brand-as-Symbol Identity (BS), on market development (MD) of SMEs producing electrical equipment in Vietnam. The study applies clustered Structural Equation Modeling (SEM) with a multi-respondent design within each enterprise to properly reflect the nested data structure and enhance the robustness of the estimates when testing the hypotheses among latent constructs.

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2. Theoretical framework, literature review and hypothesis development

In the B2B context, branding and brand identity are increasingly regarded as mechanisms that create differentiation, reduce perceived risks and enhance credibility when customers must make decisions under conditions of incomplete information and constraints related to quality, timelines and service. Recent reviews indicate that B2B branding research is shifting from a “traditional-awareness” approach to a more “systemic” approach, emphasizing the role of brand identity, brand value and relationship management in driving market outcomes (Marvi et al., 2024). At the same time, managing brand identity in B2B enterprises is considered a multi-level challenge (brand organizational and stakeholder levels), requiring consistency between “what the firm aspires to be” and “how the market or customers perceive it,” which in turn affects market expansion and competitive effectiveness (Amoozad Mahdiraji et al., 2024).

For small and medium-sized enterprises, recent systematic reviews provide evidence that brand building is positively associated with business growth and performance, with brand identity serving as a central “building block” that connects brand orientation, marketing activities and outcomes (Fluhrer & Brahm, 2025). More broadly, emerging approaches to brand management emphasize the need to clarify the concept of brand identity, update managerial practices and measure impacts according to value creation logic in dynamic environments (Baumgarth et al., 2020). Furthermore, reviews of brand equity in industrial markets suggest that brand assets can serve as strategic resources that enhance market performance indicators such as supplier selection, relationship engagement and expansion, thereby supporting business growth (Castillo, 2025).

In this study, brand identity is conceptualized through four components:

- (i) Brand-as-Product Identity (BP), which emphasizes quality, relevance to customer needs and product portfolio orientation;
- (ii) Brand-as-Organization Identity (BO), which focuses on core values, reputation and the fulfillment of commitments;
- (iii) Brand-as-Person Identity (BI), which highlights reliability, professionalism, responsibility and ease of collaboration; and

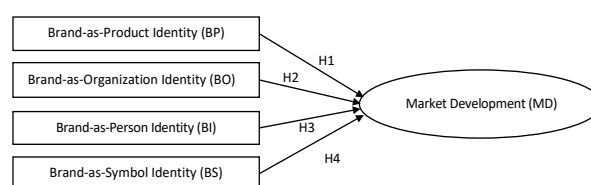
(iv) Brand-as-Symbol Identity (BS), which emphasizes recognizability, consistency and distinctiveness.

The integrated argument is that when these four components are effectively managed, enterprises can generate credible signals, reduce uncertainty in B2B purchasing decisions, enhance their ability to penetrate distribution channels and partnerships, expand their customer base and consequently promote market development (MD).

3. Research model and hypotheses

The proposed research model is presented in Figure 1.

Figure 1. Research model



Based on the theoretical foundations of the resource-based view and brand equity, this study proposes that market development (MD) is influenced by four components of brand identity, including Brand-as-Product Identity (BP), Brand-as-Organization Identity (BO), Brand-as-Person Identity (BI) and Brand-as-Symbol Identity (BS) (Barney, 1991; Keller, 1993). Recent studies in B2B and SME contexts have also acknowledged the positive role of brand identity in driving market outcomes (Marvi et al., 2024; Fluhrer & Brahm, 2025).

Accordingly, the study develops the following hypotheses:

- H1: BP has a positive effect on MD.
- H2: BO has a positive effect on MD.
- H3: BI has a positive effect on MD.
- H4: BS has a positive effect on MD.

4. Research methodology

4.1. Research design

This study applies a quantitative research method and tests the proposed model using Structural Equation Modeling (SEM). Because data were collected from several respondents within the same enterprise, the study uses cluster-robust SEM based on enterprise codes to accurately reflect the nested data structure and improve the robustness of standard errors.

4.2. Data and sample

The survey sample consists of 200 observations from 40 enterprises, with each cluster including approximately 4 to 6 respondents per enterprise. The respondents are business leaders and managers, which is appropriate for evaluating aspects related to brand identity and market development performance at the enterprise level.

4.3. Measurement scales and research variables

The model includes four independent variables: Brand-as-Product Identity (BP), Brand-as-Organization Identity (BO), Brand-as-Person Identity (BI) and Brand-as-Symbol Identity (BS). The dependent variable is market development (MD). Each independent variable is measured by four observed indicators, while market development is measured by three observed indicators. All observed variables are evaluated using a Likert scale.

Table 1. Constructs, number of observed variables and scale sources

Factor / Variable Code	Number of Observed Variables	Description	Scale Source
Brand-as-Product Identity (BP),	4	Brand personality: stable quality, meeting the needs of target customers, reflecting core values and maintaining consistent brand orientation.	Aaker (1996); Burmann et al. (2009); Coleman et al. (2011)
Brand-as-Organization Identity (BO), (MD)	4	Organizational identity: implementing core values, maintaining market reputation, ensuring employees act in line with brand orientation and keeping commitments to customers and partners.	Aaker (1996); Burmann et al. (2009); Coleman et al. (2011)
Brand-as-Person Identity (BI)	4	Brand personality: reliable, professional, responsible and easy to cooperate with.	Aaker (1996); Burmann et al. (2009); Coleman et al. (2011)
and Brand-as-Symbol Identity (BS)	4	Brand symbolism: memorable name/logo, cross-channel consistency, distinctive design and accurate message delivery.	J. L. Aaker (1997); Geuens et al. (2009)
Market Development (MD)	3	Market development (in recent years): expansion of markets or regions, growth in channels, agents or partners and increase in customers or orders.	Vorhies & Morgan (2005); Morgan et al. (2009)

Source: Compiled by the authors

4.4. Data analysis procedure

Data were analyzed in the following sequence:

- (i) Testing the reliability of the measurement scales using Cronbach's Alpha;
- (ii) Conducting Confirmatory Factor Analysis (CFA) to assess the measurement model;
- (iii) Evaluating Composite Reliability (CR) and Average Variance Extracted (AVE) for convergent validity and HTMT ratios for discriminant validity;

(iv) Estimating the structural model and testing hypotheses H1-H4 using cluster-robust SEM (clustered by COM_ID). Missing data were handled using the Full Information Maximum Likelihood (FIML) method within the SEM framework to minimize bias caused by case deletion.

5. Research results

5.1. Descriptive statistics of enterprises

Table 2. Enterprise Profile (n = 40)

Variable	Frequency	Percentage (%)
Type of Enterprise		
Private enterprise	7	17.5
Limited liability company	18	45
Joint-stock company	15	37.5
Years of Operation		
Less than 5 years	8	20
From 5 to 10 years	11	27.5
More than 10 years	21	52.5
Number of Employees		
Fewer than 50 employees	12	30
From 50 to 200 employees	17	42.5
More than 200 employees	11	27.5
Main Products		
Household electrical equipment	19	47.5
Industrial electrical equipment	12	30
Basic home appliances	9	22.5
Main Distribution Channels		
Traditional channels	13	32.5
E-commerce	16	40
Direct sales to consumers	7	17.5
Export	4	10

Source: Compiled by the authors

Table 2 shows that the survey sample includes 40 enterprises with a diverse structure in terms of business type: limited liability companies account for 45%, followed by joint-stock companies with 37.5% and private enterprises with 17.5%. Regarding years of operation, enterprises with over 10 years account for 52.5%, indicating that most have accumulated considerable experience, while those operating for 5 -10 years make up 27.5% and those under 5 years account for 20%.

In terms of workforce size, the sample is mainly concentrated in the group of 50-200 employees (42.5%), followed by enterprises with fewer than 50 employees (30%) and those with more than 200 employees (27.5%), reflecting the characteristics of SMEs while still including a proportion of larger firms. Regarding product type, household electrical equipment represents 47.5%, followed by industrial electrical equipment (30%) and basic home appliances (22.5%).

Notably, the distribution channels show a digitalization trend: e-commerce accounts for 40%, higher than traditional channels (32.5%);

other channels include direct sales to consumers (17.5%) and export (10%). This structure is suitable for analyzing the role of brand identity in market development within a multichannel competitive environment.

5.2. Descriptive statistical analysis of factors

Table 3. Descriptive statistics and correlation matrix

Construct	Mean	Standard Deviation (SD)	BP	BO	BI	BS	MD
BP	3.55	0.62					
BO	3.62	0.72	0.167*				
BI	3.45	0.71	0.123	0.356**			
BS	3.47	0.70	-0.060	0.141*	0.192**		
MD	3.51	0.53	0.266**	0.472**	0.475**	0.306**	

* $p < 0.05$; ** $p < 0.01$

Source: Compiled by the authors

Table 3 shows that the mean values of the factors range from 3.45 to 3.62, reflecting relatively favorable evaluations. The highest mean belongs to BO (Mean = 3.62) and the lowest to BI (Mean = 3.45). The standard deviations range from 0.53 to 0.72, indicating moderate dispersion; MD has the lowest SD (0.53), suggesting relatively consistent responses.

Regarding correlations with MD, all four factors are positively and significantly related ($p < 0.01$), with the strongest correlations being BI-MD ($r = 0.475$) and BO-MD ($r = 0.472$), followed by BS-MD ($r = 0.306$) and BP-MD ($r = 0.266$). Among the independent variables, correlations are generally low (the highest being BO-BI = 0.356), implying a low risk of multicollinearity. The correlation between BP and BS ($r = -0.060$) is not significant, suggesting that these two aspects are relatively independent in respondents' perceptions.

5.3. Reliability and convergent validity of constructs

Table 4. Reliability and convergent validity

Construct	Number of Observed Variables	Cronbach's α	CR	AVE
BP	4	0.800	0.803	0.508
BO	4	0.824	0.827	0.542
BI	4	0.852	0.853	0.597
BS	4	0.838	0.836	0.571
MD	3	0.924	0.924	0.801

Note: $\alpha \geq 0.70$ indicates acceptable internal consistency; $CR \geq 0.70$ and $AVE \geq 0.50$ indicate that the measurement scale achieves convergent validity.

Source: Compiled by the authors

Table 4 shows that all measurement scales demonstrate good reliability, with Cronbach's α values ranging from 0.800 to 0.924, exceeding the acceptable threshold of 0.70. The Composite Reliability (CR) coefficients range from 0.803 to 0.924, confirming that the constructs meet the required level of composite reliability. The

Average Variance Extracted (AVE) values, ranging from 0.508 to 0.801, are all greater than 0.50, indicating that convergent validity is ensured. Among them, MD shows the highest reliability and convergence ($\alpha = CR = 0.924$; $AVE = 0.801$), reflecting strong consistency among the observed variables measuring market development. Overall, the measurement model meets the standards necessary for further CFA/SEM analysis and hypothesis testing.

5.4. Discriminant validity

Table 5. Discriminant validity

	BP	BO	BI	BS	MD
BP	1.000	0.208	0.151	0.084	0.310
BO	0.208	1.000	0.425	0.185	0.541
BI	0.151	0.425	1.000	0.239	0.535
BS	0.084	0.185	0.239	1.000	0.350
MD	0.310	0.541	0.535	0.350	1.000

Note: The diagonal elements (in bold) are equal to 1.000; the off-diagonal elements represent HTMT ratios. All HTMT values are below 0.85, indicating that the measurement scales achieve discriminant validity.

Source: Compiled by the authors

Table 5 shows that all HTMT ratios are below 0.85, indicating that the measurement scales achieve discriminant validity according to the recommended threshold. The two highest values are BO-MD=0.541 and BI-MD=0.535, suggesting that MD is relatively strongly associated with BO and BI but still within the acceptable limit. The remaining pairs are mostly at low to moderate levels (for example, BO-BI = 0.425, BS-MD = 0.350), implying that the constructs are related but not overlapping. Notably, BP-BS = 0.084 is very low, reflecting a clear distinction between these two components in the data. Overall, the HTMT results confirm that BP, BO, BI, BS and MD are distinct constructs, qualifying the model for subsequent SEM analysis.

5.5. Model fit indices of confirmatory factor analysis (CFA)

Table 6. CFA model fit indices

Fit Index	Value	Recommended Threshold	Evaluation
$\chi^2(df)$	149.640(142)	$p > 0.05$	Good
p-value	0.314	> 0.05	Good
CFI	0.996	≥ 0.90	Very good
TLI	0.995	≥ 0.90	Very good
RMSEA	0.016	≤ 0.08	Very good
SRMR	0.041	≤ 0.08	Very good

Note: The CFA model fully meets the recommended thresholds, indicating a very good level of model fit.

Source: Compiled by the authors

Table 6 shows that the CFA model demonstrates an excellent fit with the data. The chi-square test is not statistically significant ($p =$

0.314 > 0.05), indicating that the model does not differ substantially from the observed data. The incremental fit indices are all very high (CFI = 0.996; TLI = 0.995), well above the recommended threshold (≥ 0.90). The approximation and standardized errors are low (RMSEA = 0.016; SRMR = 0.041), both below the 0.08 threshold. Overall, the measurement model meets the required standards and is suitable for proceeding to SEM estimation and hypothesis testing.

5.6. Structural model and hypothesis testing

Table 7. Structural model results (Flat SEM vs. Clustered SEM)

Hypothesis	Path	β (Flat SEM)	β (Clustered SEM)	S.E.	p-value	Conclusion
H1	BP $\rightarrow$ MD	0.224	0.224	0.054	<0.001	Supported
H2	BO $\rightarrow$ MD	0.310	0.310	0.064	<0.001	Supported
H3	BI $\rightarrow$ MD	0.295	0.295	0.046	<0.001	Supported
H4	BS $\rightarrow$ MD	0.228	0.228	0.052	<0.001	Supported
	R^2 (MD) = 0.47					

Note: All path coefficients are statistically significant ($p < 0.05$). $R^2 = 0.470$ indicates that BP, BO, BI and BS explain approximately 47% of the variance in MD.

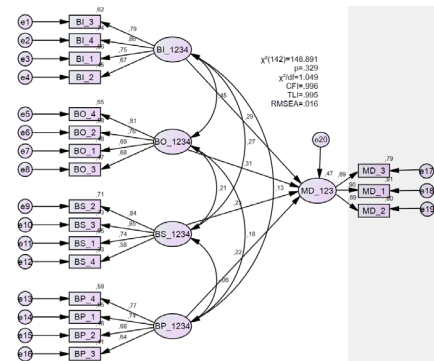
Source: Compiled by the authors

Table 7 shows that all four hypotheses (H1-H4) are supported with a high level of significance ($p < 0.001$), confirming that all components of brand identity have a positive effect on market development (MD). Among them, BO has the strongest impact on MD ($\beta = 0.310$), followed by BI ($\beta = 0.295$), BS ($\beta = 0.228$) and BP ($\beta = 0.224$). The standardized coefficients of the flat SEM and the clustered SEM are identical, indicating robust results after adjusting standard errors for the cluster structure (COM_ID). The value of $R^2(\text{MD}) = 0.47$ shows that the model explains approximately 47% of the variance in market development, which represents a fairly strong explanatory power in behavioral and management research. Overall, the structural model demonstrates good fit and the findings support the significant role of brand identity in promoting market development among enterprises.

The SEM model shows an excellent fit with the data ($\chi^2(142) = 148.891$, $p = 0.329$; $\chi^2/\text{df} = 1.049$; CFI = 0.996; TLI = 0.995; RMSEA = 0.016), confirming that the model structure is consistent with both theoretical and empirical expectations. The observed variables of BI, BO, BS, BP and MD have relatively high standardized loadings, reflecting stable measurement scales. In the structural model, the four factors BI, BO, BS and BP all have positive effects on MD, with standardized coefficients ranging from approximately 0.13 to 0.31. Among them, the

strongest effects are 0.31 and 0.29, while the remaining effects are at moderate levels (0.27, 0.22, 0.18, 0.13). Estimation using clustered SEM enhances the reliability of the results, indicating that the model is robust and stable in the context of data with a clustered structure.

Figure 2: Structural equation model (SEM) with standardized path coefficients



Note: The structural model was estimated using clustered SEM in R (packages lavaan and lavaan.survey), while the diagram was visualized using IBM SPSS AMOS to enhance clarity in presentation.

6. Discussion

The SEM results indicate that the model explains 47.0% of the variance in market development ($R^2 = 0.470$), reflecting the significant role of brand identity in the context of small and medium-sized enterprises (SMEs). This finding aligns with recent reviews on SME branding, which emphasize the logical chain of brand orientation $\rightarrow$ brand identity $\rightarrow$ market outcomes/performance, while recommending the integration of complementary capabilities (digital communication, channel management, marketing capabilities) to enhance the explanatory power of the model (Fluhrer & Brahm, 2025).

Regarding the magnitude of effects, all four hypotheses are supported and statistically significant, with the following order: BO $\rightarrow$ MD is the strongest ($\beta = 0.310$), followed by BI $\rightarrow$ MD ($\beta = 0.295$), BS $\rightarrow$ MD ($\beta = 0.228$) and BP $\rightarrow$ MD ($\beta = 0.224$). The prominent effect of BO is consistent with current B2B branding research: in B2B environments, brands often function as mechanisms to reduce uncertainty, reinforce trust and standardize value propositions. Therefore, the “strategic/oriented” components tend to dominate market outcomes more than purely internal foundational elements (Marvi et al., 2024). Recent studies also emphasize the multi-level challenge of managing B2B brand identity

(enterprise-brand-stakeholders), suggesting that the strong impact of BO/BI may reflect the degree of “implementation discipline” and the ability to maintain identity consistency in market practice (Amoozad Mahdiraji et al., 2024).

The significant effect of BI ($\beta = 0.295$) also aligns with trends in research on co-creating brand meaning in B2B, where content, storytelling and interaction with partners or suppliers help “materialize” brand identity and support market growth (Bansal & Sisodia, 2024). Moreover, the B2B context requires mechanisms to protect brand identity from impersonation/confusion and reputational risk; therefore, firms with a strong BI are generally more capable of signaling trust and reducing perceived risk, thereby improving market outcomes (Shankar et al., 2024).

In terms of managerial implications, enterprises should prioritize translating BO into objectives-operational standards-brand KPIs, while concretizing BI/BS/BP into value messages, B2B sales behavior standards and a “brand code of conduct” to enhance implementation consistency. This approach is also consistent with evidence that professional brand management practices positively relate to SME performance in competitive and internationalizing contexts (Kusi et al., 2022).

7. Conclusion and Implications

The SEM results indicate that all four components of brand identity, including Brand-as-Product Identity (BP), Brand-as-Organization Identity (BO), Brand-as-Person Identity (BI) and Brand-as-Symbol Identity (BS), have positive effects on Market Development (MD) and all are statistically significant ($p < 0.001$). Therefore, hypotheses H1 to H4 are supported. Regarding the magnitude of influence, BO has the strongest effect ($\beta = 0.310$), followed by BI ($\beta = 0.295$), BS ($\beta = 0.228$) and BP ($\beta = 0.224$). The model explains approximately 47% of the variance in MD ($R^2 = 0.47$), indicating fairly strong explanatory power. In addition, the estimated coefficients between flat SEM and clustered SEM are consistent, implying that the results are robust when considering the clustered data structure (COM_ID).

Managerial implications: (1) Because BO has the strongest impact, enterprises should prioritize standardizing organizational identity through core values, quality commitments,

execution capability and operational consistency; (2) Strengthen BI by clearly defining the brand’s personality as reliable, professional and responsible, while ensuring consistent messaging across all customer and partner touchpoints; (3) Reinforce BS through a unified brand identity system, including name, logo, colors, packaging and digital display standards, to improve brand recall and support channel expansion, particularly on digital platforms; (4) Continuously improve BP by emphasizing the core and differentiating benefits of products, aligned with target market needs, to support sales performance and customer expansion.

Limitations and future research directions: This study used a sample of 40 enterprises with 200 individual observations, so caution is needed when generalizing the findings to other industries or sectors. Future studies could expand the sample size, include mediating variables such as brand trust and perceived quality or moderating variables such as firm size and distribution channels, to clarify the mechanisms through which brand identity influences market development.

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THE CHOICE BETWEEN BOND ISSUANCE AND OTHER CAPITAL STRUCTURE DECISIONS: EVIDENCE FROM LISTED COMPANIES IN VIETNAM

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Abstract: *This study examines the factors influencing firms' decisions to issue bonds versus other capital structure options, based on a panel of 325 firms and 1,662 firm-year observations from 2016 to 2024. Results show that firms with negative return on assets (ROA), but strong liquidity, large size, and high leverage are more likely to issue bonds. These traits suggest that large, debt-experienced firms with stable liquidity prefer bond financing. Regression analysis also highlights the role of macroeconomic conditions. GDP growth positively affects the likelihood of bond issuance, while inflation has a negative effect; both are significant at the 10% level. Additionally, bond market development, measured by the bond market size-to-GDP ratio, positively influences bond issuance at the 1% level. In contrast, the long-term domestic credit balance has a significant negative impact at the 1% level. The findings offer policy implications for firms seeking financing strategies and for policymakers promoting capital market development.*

• Keywords: corporate bond, capital structure decision, pecking order theory, firm characteristics, macroeconomic development.

Date of receipt: 25th Oct., 2025

Date of delivery revision: 04th Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.26>

Date of receipt revision: 20th Dec., 2025

Date of approval: 23th Jan., 2026

Introduction

Corporate bonds constitute an important financing channel for firms to meet strategic funding needs, including business expansion, debt refinancing as an alternative to bank loans, and project financing. Bond issuance enables firms to diversify funding sources without diluting existing ownership. From an investor perspective, corporate bonds offer relatively predictable income through periodic interest payments and principal repayment at maturity. Compared to shareholders, bondholders are creditors rather than owners and therefore enjoy higher priority claims on firm assets in the event of bankruptcy.

Despite the growing relevance of corporate bonds, empirical evidence on the determinants of corporate bond issuance in Vietnam remains limited. This study is grounded in the pecking order theory, trade-off theory, and institutional theory. According to Myers and Majluf (1984), firms prioritize internal financing, followed by debt issuance, and resort to equity issuance only as a last option due to adverse selection concerns. The trade-off theory further suggests that firms choose an optimal capital structure by balancing the benefits of debt against

its associated costs (Myers, 1984), implying that bond issuance depends critically on firms' financial capacity to manage risk. In addition, institutional theory emphasizes that financing decisions are also shaped by institutional constraints and legitimacy considerations rather than purely by economic optimization.

Accordingly, this paper examines both firm-level and macroeconomic determinants of corporate bond issuance relative to other capital structure choices, such as bank loans and equity financing. Empirical results indicate that firms with weak operating performance, reflected by negative return on assets (ROA), but strong liquidity, large size, and high leverage are more likely to issue corporate bonds.

This study contributes to the literature by extending research on capital structure decisions in Vietnam, an emerging market where the corporate bond market remains underdeveloped and faces limited investor and policy attention. The findings provide practical implications for corporate managers in selecting financing strategies and for regulators seeking to promote the development of the domestic capital market.

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The remainder of the paper is organized as follows. Section 2 presents the theoretical framework and hypothesis development. Section 3 describes the research design and data. Section 4 reports and discusses the empirical results. Section 5 concludes the study and outlines policy implications.

1. Literature review and hypothesis development

1.1. Theoretical background and related literature

Capital structure decisions have been extensively explained by several theoretical frameworks, notably the pecking order theory, trade-off theory, and institutional theory. According to the pecking order theory, firms do not pursue an optimal capital structure but instead follow a financing hierarchy driven by information asymmetry (Myers and Majluf, 1984). Firms prioritize internal funds, such as retained earnings, and resort to debt financing only when internal resources are insufficient, while external equity is avoided due to adverse selection concerns and negative market signals. Consequently, firms with higher profitability tend to rely less on external financing, whereas debt issuance may signal financial discipline, particularly when supported by collateral.

The trade-off theory provides an alternative explanation by emphasizing the existence of an optimal capital structure achieved through balancing the marginal benefits and costs of debt (Myers, 1984). Within this framework, debt financing, including corporate bond issuance, allows firms to exploit interest tax shields. Firms with strong profitability, tangible assets, and stable cash flows are therefore more likely to use debt instruments such as bank loans or corporate bonds. In contrast, firms with high earnings volatility, excessive leverage, or limited access to capital markets may restrain bond issuance due to elevated financial distress costs. Moreover, firms are expected to consider macroeconomic conditions when committing to long-term debt instruments (Lemmon, Roberts, and Zender, 2008).

Beyond firm-level optimization, institutional theory highlights the role of the institutional environment in shaping corporate bond issuance decisions. Prior studies argue that the development of corporate bond markets depends critically on legal quality, investor protection, contract enforcement,

and information transparency (La Porta et al., 1997, 1998). In countries with effective legal systems and transparent information disclosure, investor confidence is enhanced, facilitating bond market participation and expansion. Conversely, weak institutional frameworks, information asymmetry, and distorted credit assessments raise financing costs and reduce the attractiveness of bond issuance relative to bank lending. Empirical evidence further suggests that institutional characteristics play a particularly important role in emerging economies, where policy biases and state ownership may influence firms' financing behavior (Claessens et al., 2007).

1.2. Macroeconomic and firm-specific determinants

Macroeconomic conditions exert a significant influence on corporate bond issuance by shaping firms' financing needs, risk perceptions, and investor demand. Economic growth reflects the scale of economic activity and supports the establishment of market infrastructure necessary for bond market development (Mu et al., 2013). Inflation, by contrast, is commonly associated with macroeconomic instability. Lower inflation environments tend to support bond market development, while high inflation reduces the attractiveness of bond issuance and alters government financing behavior (Claessens et al., 2007).

At the firm level, empirical studies identify several key characteristics influencing bond issuance decisions, including firm size, profitability, leverage, liquidity, and asset structure (Mizen et al., 2008). Larger firms are more likely to issue bonds due to their greater financing needs, lower information asymmetry, and better access to capital markets (Datta et al., 2000; Dennis and Mihov, 2003). Higher leverage is often associated with increased bond issuance, reflecting rollover needs and refinancing demand (Mizen et al., 2008). Liquidity also plays a positive role, as firms tend to accumulate liquid assets prior to issuing bonds to signal repayment capacity. In contrast, consistent with the pecking order theory, highly profitable firms are less inclined to issue bonds, relying instead on internal funds for operational and investment activities.

1.3. Hypothesis development

Based on the theoretical arguments and prior empirical evidence, this study proposes the following hypotheses:

H1: Firm-specific financial characteristics significantly influence firms' decisions to issue corporate bonds within their capital structure choices.

H2: Macroeconomic conditions significantly affect firms' decisions to issue corporate bonds relative to other financing options.

2. Methodology

Data collection

This study analyzes data from listed firms on the HoChiMinh Stock Exchange (HOSE) between 2016 and 2024. With factors affecting the decision to issue bonds of enterprises in capital structure decisions, data for each year will be collected for each enterprise with decisions and activities related to capital structure decisions including: issuing additional bonds, issuing additional shares, borrowing additional capital from banks. The results from data collection show that there are 325 company codes with data, corresponding to 1662 observations.

Data related to internal factors (firm characteristics) and firm decisions were manually collected from financial statements and annual reports available on the HOSE websites, along with data from the FIINGROUP Vietnam source. Data on external factors were sourced from the annual the Vietnam Statistical Yearbook published by the General Statistics Office and Vietnam Bond Market Association.

Research model

$$\begin{aligned} \text{Choice of Bond}_{i,t} = & \alpha_0 + \alpha_1 * \text{ROA}_{i,t} + \alpha_2 * \text{Lev}_{i,t} + \alpha_3 * \text{Liq}_{i,t} \\ & + \alpha_4 * \text{Fixasset}_{i,t} + \alpha_5 * \text{FirmSize}_{i,t} + \alpha_6 * \text{Shares}_{i,t} \\ & + \alpha_7 * \text{GDP}_t + \alpha_8 * \text{Inf}_t + \alpha_9 * \text{MC_Growth}_t + \alpha_{10} * \text{LTOCredit}_t \\ & + \alpha_{11} * \text{Bondmarket}_t + \alpha_{12} * \text{AvgInterestRate}_t \end{aligned}$$

Where:

Choice of Bond _{i,t}	is a binary variable equal to 1 if the company issues bonds, 0 otherwise
ROA _{i,t}	Return on total assets of firm i in year t
Liq _{i,t}	the value of current assets of firm i divided by current liabilities in year t
Lev _{i,t}	Total liabilities to total assets of firm i in year t
Fixasset _{i,t}	The proportion of fixed assets to total assets of company i in year t, calculated by the original price of fixed assets to total assets
FirmSize _{i,t}	Logarithm of total assets of firm i in year t
Shares _{i,t}	The size of the listed company of company i in year t, corresponding to the natural logarithm of the number of outstanding shares of company i in year t
GDP _t	GDP growth in year t
Inf _t	Inflation in year t
MC_Growth _t	Growth rate of stock market capitalization value in year t
LTOCredit _t	Long-term domestic credit balance, corresponding to the natural logarithm of the long-term domestic credit balance (measured in trillions)
Bondmarket _t	Bond market size relative to gross domestic product year t
AvgInterestRate _t	Average interbank lending interest rate for medium and long term in year t

3. Results

3.1. Descriptive statistics

Table 1. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
Choice of Bond	0.174	0.380	0	1
ROA	0.059	0.064	(0.364)	0.508
LEV	0.511	0.194	0.001	1.294
LIQ	2.829	24.252	0.131	982.486
Fixasset	0.214	0.215	0.000	0.949
FirmSize	12.547	0.635	10.402	14.923
Shares	7.925	0.593	5	9.639
GDP (%)	0.060	0.069	0.026	0.081
Inf (%)	3.068	3.221	1.835	3.621
MC_Growth (%)	12.558	13	(32.7)	46.710
LTOCredit	8.273	8.274	7.741	8.728
AvgInterestRate	0.101	0.101	0.092	0.110
Bondmarket	0.109	0.110	0.050	0.170

Source: Authors data

Table 1 reports the descriptive statistics of the variables used in the empirical analysis. The mean value of the bond issuance dummy is 0.174, indicating that approximately 17.4% of firm-year observations involve bond issuance, suggesting a relatively low propensity for firms to choose bonds as a financing instrument.

Regarding firm-specific characteristics, return on assets (ROA) has a mean of 0.059 and exhibits substantial dispersion, ranging from -0.364 to 0.508, reflecting considerable heterogeneity in firm profitability. Financial leverage (LEV) shows a right-skewed distribution, with a mean of 0.511 and a maximum value exceeding unity, indicating that a subset of firms operates with high debt levels. Liquidity (LIQ) displays extremely high dispersion, with large maximum values observed in the sample; these values were verified against audited financial statements. Firm size, measured as the logarithm of assets, shows moderate variation across firms, while the fixed asset ratio averages 0.214, indicating differences in asset structure among sample firms.

Macroeconomic variables over the 2016-2024 period exhibit relative stability. GDP growth averages around 6%, and inflation remains low and stable. In contrast, stock market capitalization growth is highly volatile, reflecting fluctuations in market conditions. Long-term domestic credit and interest rates show limited variation, while the bond market size-to-GDP ratio averages approximately 11%, indicating a moderate level of corporate bond market development in Vietnam.

Overall, the descriptive statistics suggest a stable macroeconomic environment, alongside substantial heterogeneity in firm-level financial conditions.

Table 2. Collinearity diagnostics

Variable	VIF	SQRT VIF	Tolerance
Choice of Bond	1.19	1.09	0.8425
ROA	1.29	1.14	0.7725
LEV	1.69	1.3	0.5917
LIQ	1.02	1.01	0.9782
Fixasset	1.03	1.01	0.9728
Firmsize	4.69	2.17	0.2131
Shares	4.23	2.06	0.2363
GDP (%)	5.64	2.37	0.1773
Inf (%)	1.76	1.33	0.5688
MC_Growth (%)	5.08	2.25	0.1967
LTOCredit	2.4	1.55	0.4174
AvgInterestRate	2.54	1.59	0.3938
Bondmarket	4.55	2.13	0.2197
Mean VIF	2.85		

Source: Authors data

Table 2 shows all values of collinearity Diagnostics, having VIF less than 10 (O'Brien, 2007). Hence, the conclusion is that multicollinearity is not a significant concern in the research model.

3.2. Regression results

Outliers can heavily influence statistical analyses by distorting estimates and potentially leading to inaccurate conclusions (Cousineau and Chartier, 2010). To ensure the robustness of our findings, we perform analyses on both the complete dataset and a version with handling outliers. This dual approach helps confirm the stability of the results and safeguards against the influence of extreme values. To handle outliers, we applied a winsorization method. Winsorization replaces the smallest and/or largest values in a dataset with the nearest value within a certain percentile threshold, to reduce the distortion caused by outliers in regression and other statistical analyses. The model was then re-estimated based on the adjusted dataset..

Table 3. Regression results of the choice between bond issuance and capital structure decisions

Variables	Full model (Marginal effect)	Model robustcheck(Winsorization) (marginal effect)
ROA	-0.6120*** [0.1229]	-0.7361*** [0.1011]
LEV	0.1494* [0.0823]	0.1448* [0.0798]
LIQ	0.0003** [0.0001]	0.0003** [0.0001]
Fixasset	-0.2571*** [0.0428]	-0.2586*** [0.0427]
Firmsize	0.1143*** [0.0381]	0.1120*** [0.0385]
Shares	0.0651 [0.0415]	0.0687 [0.0420]
GDP	1.5142* [0.8521]	1.5944* [0.8277]
Inf	-0.0276* [0.0157]	-0.0282* [0.0158]

Variables	Full model (Marginal effect)	Model robustcheck(Winsorization) (marginal effect)
MC_Growth	0.0009 [0.0006]	0.0009 [0.0006]
LTOCredit	-0.1596*** [0.0423]	-0.1634*** [0.0413]
Bondmarket	1.7903*** [0.4040]	1.8295*** [0.3930]
AvgInterestRate	-1.4213 [2.3486]	-1.5228 [2.3657]
N	1662	1662
Pseudo R2	0.1817	0.1833
Prob > chi2	0.0000	0.0000
Likelihood-ratio test	LR chi2(12) = 279.64	LR chi2(12) = 282.09
Goodness-of-fit test	Hosmer-Lemeshow chi2(8) = 9.79	Hosmer-Lemeshow chi2(8) = 7.97
Correctly classified	84.78%	84.78%

Source: Authors data

Table 3 reports the Logit regression results examining the determinants of corporate bond issuance relative to other capital structure choices. The results remain consistent and robust when the model is re-estimated using the Winsorization method.

Regarding firm-specific characteristics, return on assets (ROA) has a negative and statistically significant effect at the 1% level, indicating that firms with higher profitability are less likely to issue bonds. This result supports the pecking order theory, suggesting that firms with sufficient internal funds tend to rely less on external debt financing. The fixed asset ratio (Fixasset) also negatively affects the probability of bond issuance, implying that firms with asset structures concentrated in fixed assets may prefer bank loans over bond financing.

In contrast, financial leverage (LEV), liquidity (LIQ), and firm size (Firmsize) exhibit positive and significant effects on bond issuance decisions. Highly leveraged firms are more likely to issue bonds, possibly reflecting refinancing needs or accumulated experience in debt financing. Firms with stronger liquidity positions are also more inclined to access the bond market, as adequate liquidity enhances investor confidence in repayment capacity. Firm size has a strong positive impact, consistent with lower information asymmetry, better governance, and reduced issuance costs for larger firms. The variable Shares does not show a statistically significant effect.

With respect to macroeconomic factors, GDP growth positively influences the likelihood of corporate bond issuance, while inflation has a negative effect; both are significant at the 10% level. These findings suggest that favorable economic conditions encourage long-term financing through bonds, whereas higher inflation increases

borrowing costs and reduces the attractiveness of bond issuance.

At the market level, bond market development, measured by the bond market size-to-GDP ratio, has a positive and highly significant impact on bond issuance decisions. Conversely, long-term domestic credit availability exerts a negative effect, indicating that easier access to bank credit reduces firms' reliance on bond financing. The average interest rate is not statistically significant.

Overall, the results underscore the combined influence of firm financial characteristics, macroeconomic conditions, and financial market development on corporate bond issuance decisions.

4. Conclusion

This study investigates the determinants influencing firms' choices between corporate bond issuance and other capital structure decisions, using a panel dataset of 325 firms with 1,662 firm-year observations over the period 2016-2024.

The empirical findings support the threshold effects documented by Mizen and Tsoukas (2014) and Pham et al. (2020). Firms with weak operating performance, reflected by negative ROA, but possessing strong liquidity, large size, and high leverage are more likely to issue corporate bonds. This suggests that access to the bond market depends not only on financing needs arising from low profitability but also on firms' capacity to satisfy issuance requirements and investors' expectations regarding financial stability. The results are consistent with the pecking order theory, indicating that highly profitable firms tend to rely on internal financing rather than external debt. Moreover, firms with greater size, higher leverage, and stronger liquidity appear to have better access to bond financing, reflecting accumulated debt experience and lower information asymmetry. The analysis also highlights the important role of macroeconomic conditions in shaping corporate bond issuance decisions. In line with institutional and agency theories, favorable economic growth enhances business and investor confidence, thereby encouraging long-term financing through bonds. This finding is consistent with evidence from emerging markets reported by Bae (2012). In contrast, inflation exerts a negative effect on bond issuance by increasing borrowing costs and amplifying information asymmetry, as suggested by the expectation theory of interest rates and

the framework of Bernanke and Gertler (1989). Furthermore, the ratio of long-term domestic credit to GDP negatively affects the likelihood of bond issuance, indicating that in bank-dominated financial systems, firms tend to prefer bank financing due to its procedural simplicity and lower disclosure requirements. Conversely, the size of the corporate bond market relative to GDP has a positive influence, underscoring the importance of well-developed capital market infrastructure in supporting long-term financing in emerging economies. This study offers several policy implications for firms and policymakers in Vietnam. From a corporate perspective, bond issuance provides an effective means to diversify funding sources and reduce reliance on bank credit, which often involves collateral requirements, lengthy appraisal processes, and exposure to credit tightening. Firms are therefore encouraged to enhance financial transparency, strengthen credibility, and take advantage of favorable macroeconomic conditions to access the bond market. From a policy perspective, maintaining stable economic growth and controlling inflation are crucial for fostering a supportive environment for corporate bond issuance. In addition, policymakers should promote institutional mechanisms, such as credit guarantee schemes and financial intermediaries, to facilitate firms' access to the corporate bond market and support the sustainable development of Vietnam's capital market.

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ADVANCING GREEN LOGISTICS IN VIETNAM IN THE DIGITAL ERA: CHALLENGES AND OPPORTUNITIES

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Abstract: *Green logistics has become a central pillar of sustainable development strategies as countries seek to balance economic growth with environmental protection amid increasing trade volumes and climate change pressures. In Vietnam, the rapid expansion of manufacturing, international trade, and e-commerce has intensified logistics activities, leading to rising energy consumption, greenhouse gas emissions, and environmental externalities. Digital technologies are increasingly regarded as critical enablers for the development of green logistics systems. The study adopts a qualitative, mechanism-based approach, synthesizing secondary data from policy documents, academic literature, industry reports, and international comparative evidence. The analysis focuses on key mechanisms through which digitalization supports green logistics, including transportation optimization, real-time monitoring of emissions and energy use, enhanced coordination across supply chain actors, and improved transparency for environmental governance. The findings indicate that digital technologies such as big data analytics, Internet of Things (IoT) applications, digital logistics platforms, and intelligent transport systems facilitate green logistics development by reducing fuel consumption, lowering emissions, and improving logistics efficiency (Blanco et al., 2017; Bartsch et al., 2021). However, the effectiveness of digitalization depends substantially on institutional readiness, data standardization, regulatory incentives, and human resource capacity. By providing insights from an emerging economy context, this study contributes to the literature on green logistics and offers policy-relevant implications for promoting sustainable logistics development in Vietnam.*

• Keywords: green logistics; digitalization; sustainable supply chains; institutional capacity; public policy.

Date of receipt: 25th Oct., 2025

Date of receipt revision: 20th Dec., 2025

Date of delivery revision: 04th Dec., 2025

Date of approval: 23th Jan., 2026

DOI: <https://doi.org/10.71374/jfar.v26.i1.27>

1. Introduction

Logistics plays a critical role in supporting economic growth, international trade, and regional integration. Efficient logistics systems reduce transaction costs, enhance supply chain reliability, and improve national competitiveness. However, logistics activities are also a major source of environmental externalities, including greenhouse gas emissions, air pollution, noise, and excessive energy consumption. Globally, the transportation and logistics sector accounts for a significant share of carbon emissions, making it a focal point in national and international climate policies.

Vietnam has experienced rapid economic growth and deep integration into global value chains over the past two decades. Export-oriented manufacturing, urbanization, and the rapid expansion of e-commerce have significantly increased demand for logistics services. While logistics has become an important driver of economic development, its environmental footprint has also expanded. Heavy reliance on road transport, fragmented logistics networks, and limited coordination among logistics actors contribute to high fuel consumption and emissions, posing challenges to Vietnam's sustainable development objectives (World Bank, 2023).

Green logistics has emerged as a strategic direction in Vietnam's logistics development agenda. Green logistics refers to the incorporation of environmental

considerations into logistics planning, operations, and governance, with the aim of minimizing negative environmental impacts while maintaining operational efficiency and service quality. Achieving green logistics, however, requires more than the adoption of isolated green technologies; it demands systemic changes in logistics management, coordination, and governance.

Digitalization is increasingly viewed as a key enabler of green logistics development. Digital technologies enable real-time data collection, information sharing, and analytical capabilities that support more efficient and environmentally friendly logistics operations. Technologies such as big data analytics, Internet of Things (IoT), and digital logistics platforms can optimize transportation routes, reduce empty runs, improve energy efficiency, and enhance transparency in logistics activities.

Despite growing policy attention to digital transformation and green growth, academic research systematically analyzing how digitalization supports green logistics development in Vietnam remains limited. This study seeks to address this gap by examining green logistics development in Vietnam in the digital era, emphasizing the mechanisms through which digital technologies contribute to environmental and operational improvements and the institutional factors shaping these processes.

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2. Theoretical Background

2.1. *Green logistics and sustainable supply chain management*

Green logistics is an integral component of sustainable supply chain management, which seeks to balance economic efficiency, environmental protection, and social responsibility. In logistics, environmental performance is commonly associated with reducing fuel consumption, minimizing greenhouse gas emissions, improving resource efficiency, and mitigating negative externalities related to transportation and warehousing activities.

Traditional logistics systems have typically prioritized cost reduction and delivery speed, often neglecting environmental considerations. Such systems are frequently characterized by fragmented information flows, inefficient routing, low vehicle utilization rates, and limited coordination among supply chain actors. These inefficiencies lead to unnecessary fuel consumption, higher emissions, and increased environmental costs (Cantarelli et al., 2010).

Green logistics addresses these shortcomings by integrating environmental objectives into logistics decision-making and adopting practices such as route optimization, modal shift, cargo consolidation, energy-efficient warehousing, and environmentally responsible packaging. Effective implementation requires timely, accurate information and close coordination among multiple actors in the logistics network.

2.2. *Digitalization as an enabler of green logistics*

Digitalization enhances green logistics by improving information visibility, coordination, and decision-making quality. Big data analytics enables the processing of large volumes of logistics data to support demand forecasting, route optimization, and capacity planning, thereby reducing empty runs and fuel consumption. IoT technologies provide real-time tracking of vehicles, cargo, and energy use, enabling continuous monitoring and control.

Digital logistics platforms facilitate information sharing and coordination among shippers, carriers, warehouses, and customers. By connecting multiple actors within logistics networks, these platforms enable resource sharing, cargo consolidation, and collaborative transport solutions, which contribute to both cost efficiency and environmental performance.

From a governance perspective, digitalization enhances transparency and accountability. Digital data on logistics operations, energy consumption, and emissions provide a basis for environmental reporting, performance benchmarking, and evidence-based policymaking. This transparency is particularly important for promoting green logistics at the sectoral and national levels.

2.3. *Institutional capacity and green logistics development*

The effectiveness of digital technologies in promoting green logistics depends heavily on institutional capacity, which includes regulatory frameworks, data standards, organizational capabilities, and human resources. Clear environmental regulations, standardized data protocols, and skilled personnel are essential to ensure that digital solutions are effectively integrated into logistics systems.

In emerging economies, institutional constraints often limit the scalability and effectiveness of digital-enabled green logistics initiatives. Fragmented regulations, limited data interoperability, and shortages of skilled labor can hinder the adoption and effective use of digital technologies. Understanding green logistics development thus requires an institutional perspective that considers both technological capabilities and governance structures (Abbasnejad et al., 2021).

3. Methodology

This study adopts a qualitative, mechanism-based research approach to examine green logistics development in Vietnam in the digital era. Rather than measuring causal impacts quantitatively, the approach focuses on explaining how digitalization contributes to green logistics outcomes under specific institutional conditions.

The analysis draws on secondary data from national strategies on logistics development and green growth, policy documents related to digital transformation, reports from international organizations, academic studies, and industry publications. International experiences from selected countries provide comparative references to contextualize Vietnam's progress.

Qualitative content analysis was employed to identify key mechanisms linking digitalization to green logistics outcomes, analyzed in relation to Vietnam's institutional context, allowing for analytical generalization while acknowledging limitations in standardized quantitative data availability.

4. Results

4.1. *Transportation optimization and emission reduction:* Digital technologies optimize transportation, the largest contributor to logistics-related emissions. Route planning software, real-time traffic information, and freight-matching platforms reduce empty runs, improve vehicle utilization, and select more efficient routes, directly lowering fuel consumption and emissions.

4.2. *Real-time monitoring of energy use and emissions:* IoT-based tracking systems allow firms to monitor fuel consumption, vehicle performance, and emissions in real time. This visibility supports preventive maintenance, eco-driving, and corrective actions, enhancing energy efficiency and compliance with environmental standards.

4.3. *Enhanced coordination through digital platforms:* Digital logistics platforms improve coordination and information sharing among shippers, carriers, warehouses, and customers. Enhanced

coordination reduces redundant trips and improves overall efficiency, contributing to green logistics outcomes.

4.4. Transparency and environmental governance

Digitalization strengthens transparency in logistics by providing reliable data on energy use and emissions, supporting environmental reporting, policy evaluation, and incentive design.

Table 1. Digitalization and Green Logistics Performance (Vietnam)

Digitalization Level	Logistics Cost (% GDP)	Fuel Consumption (MJ/t-km)	CO ₂ Emissions (g/t-km)	Supply Chain Coordination
Low	20-22	1.4-1.6	110-130	Low
Medium	16-18	1.0-1.2	80-100	Medium
High	12-14	0.6-0.8	50-70	High

Source: Author's compilation based on trends extracted from World Bank (2023) and OECD (2023).

Note: Figures for logistics costs and emissions are estimated ranges representing typical performance levels in Vietnam's logistics sector under different digitalization scenarios. They are for illustrative purposes to demonstrate the correlation between digital maturity and operational efficiency.

Table 2. Comparative Logistics Costs and Emissions

Country / Region	Logistics Cost (% GDP)	Transport CO ₂ Emissions (% of total)
Vietnam	16-20	18-20
ASEAN-4	13-15	15-17
OECD	8-10	14-15

Source: World Bank (2023); OECD (2023); UNCTAD (2022).

5. Discussion

The analysis demonstrates a positive relationship between logistics digitalization and green logistics outcomes in Vietnam. Digital technologies facilitate route optimization, reduce empty runs, and improve vehicle utilization, leading to lower fuel consumption and emissions. IoT-based tracking and energy monitoring systems enhance real-time visibility, enabling preventive maintenance, eco-driving, and corrective actions. Digital logistics platforms improve coordination among shippers, carriers, warehouses, and customers, reducing redundant trips and promoting efficient resource utilization.

Tables 1 and 2 provide empirical evidence of the relationship between logistics digitalization and green logistics performance in Vietnam. Higher digitalization levels are associated with lower logistics costs, reduced fuel consumption, and lower CO₂ emissions, without implying absolute causality. Table 1 highlights significant differences between low and high digitalization systems in Vietnam, where low digitalization corresponds to high costs (20-22% GDP), high fuel consumption, and high CO₂ emissions due to inefficient routing, empty runs, and limited coordination.

High digitalization systems show marked improvements: costs decrease to 12-14% GDP, fuel consumption and emissions drop, and supply chain coordination improves. Mechanisms include route optimization, real-time monitoring, and digital platforms enhancing coordination. Table 2 situates Vietnam in the regional and global context: while improving, logistics costs and emissions remain higher than OECD benchmarks, illustrating the potential of digital technologies to narrow performance gaps.

Nevertheless, digitalization alone is insufficient for green logistics. Its effectiveness depends on institutional readiness, including regulatory frameworks, data standardization, and human resource capacity. Small and medium enterprises, in particular, face challenges in adopting advanced digital solutions. Policy measures must combine digital investment incentives with capacity building and data standardization to fully realize green logistics benefits.

6. Current practices of green logistics in Vietnam:

Representative practices in e-commerce and industrial zones demonstrate digital-enabled green logistics. Route optimization, warehouse management systems, and real-time vehicle tracking improve efficiency and reduce environmental impacts. Last-mile delivery optimization reduces distances and fuel use; warehouse management supports inventory and energy-efficient operations; real-time tracking enables monitoring of emissions and eco-driving practices. Diffusion remains uneven, highlighting the need for policy support and training programs.

7. Policy implications

Establish standardized digital and environmental data frameworks to ensure interoperability, transparency, and effective monitoring of logistics activities.

Provide incentives and technical support for small and medium-sized logistics enterprises to adopt digital technologies, including route optimization, IoT monitoring, and warehouse management systems.

Invest in human resource development and institutional capacity to enable logistics stakeholders to fully leverage digitalization for sustainable outcomes.

Encourage knowledge sharing and collaboration among public agencies, private companies, and research institutions to scale successful green logistics practices across sectors.

8. Conclusion: Digital technologies significantly support green logistics development in Vietnam by improving transportation efficiency, reducing fuel consumption and emissions, and enhancing supply chain coordination and transparency. However, their effectiveness is contingent on institutional readiness, data standardization, and human resource capacity. This study demonstrates that integrating digitalization with strategic policies and governance structures is essential to achieve environmentally sustainable and operationally efficient logistics systems in emerging economies.

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DETERMINANTS OF FDI ATTRACTION IN HAI DUONG PROVINCE: EVIDENCE FROM A CLUSTERED SEM APPROACH

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Abstract: *This study analyzes key determinants of foreign direct investment (FDI) attraction in Hai Duong province using clustered structural equation modeling. Using 250 observations from 50 FDI enterprises, the study evaluates five factors: infrastructure and logistics (INF), human resource quality (HRQ), investment costs and incentives (INC), market procedures and transparency (PRO), and supporting industries and linkages (SCL). All factors positively and significantly affect FDI attraction ($p < 0.01$). INF has the strongest impact ($\beta = 0.323$), followed by HRQ ($\beta = 0.247$) and PRO ($\beta = 0.231$), while INC ($\beta = 0.192$) and SCL ($\beta = 0.185$) show smaller effects. The model explains 56.6% of the variance ($R^2 = 0.566$), confirming the robustness of the clustered SEM. Findings underscore the need to improve infrastructure, strengthen human resources, enhance transparency, and foster industrial linkages to increase investment competitiveness.*

• Keywords: FDI, clustered SEM, human resource quality, policy environment, SEM, Hai Duong.

Date of receipt: 25th Oct., 2025

Date of delivery revision: 04th Dec., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.28>

Date of receipt revision: 20th Dec., 2025

Date of approval: 20th Jan., 2026

1. Introduction

Foreign direct investment (FDI) is a key driver of economic growth and technology transfer (Dao, 2023). At the local level, provinces increasingly compete through infrastructure development and preferential policies (Le, 2024). Strategically located between Hanoi and Hai Phong, Hai Duong holds strong potential but has recently faced unstable capital inflows. It encounters intense competition from neighbors like Bac Ninh and Quang Ninh, which offer superior infrastructure and procedures (Nguyen, 2024). Therefore, identifying internal factors influencing Hai Duong's competitiveness is essential. While numerous Vietnamese studies examine FDI determinants, most rely on linear or panel models (Minh, 2019; Le, 2024). Very few employ structural equation modeling (SEM), and almost none apply clustered SEM, which is crucial for nested data to avoid biased estimates.

This study addresses that gap by incorporating clustered SEM to account for within-firm correlation, yielding more reliable statistical inference. The findings aim to support evidence-based investment promotion strategies for the province. Hai Duong officially merged into Hai Phong on July 1, 2025; however, all data used in this study were collected prior to the merger, when Hai Duong remained an independent administrative unit. Therefore, retaining the place name "Hai Duong province" accurately reflects the research context and conditions at the time of data collection. Nevertheless,

the findings also provide meaningful policy insights for the post-merger period, particularly in designing FDI attraction strategies within the broader Hai Phong region. Accordingly, this study investigates the determinants of FDI attraction in Hai Duong using a clustered SEM approach, with four objectives: (1) Identifying and quantifying key factors affecting FDI attraction; (2) Examining the interrelationships among determinants at the enterprise level; (3) Proposing policy recommendations to enhance investment competitiveness; and (4) Strengthening provincial policy effectiveness through evidence-based analysis.

2. Literature Review

Attracting foreign direct investment (FDI) is vital for economic development, facilitating technology transfer and employment growth (Dao, 2023). Multinational enterprises' investment decisions are influenced by the host environment, specifically five key factors: infrastructure, human resource quality, institutions, incentives, and supporting industries.

2.1. Infrastructure & Logistics (INF)

Infrastructure is a fundamental determinant of FDI competitiveness. Synchronized infrastructure reduces logistics costs and improves market accessibility (Cuong & Huong, 2025). Lee et al. (2020) and Atangana (2021) confirm strong positive correlations between infrastructure development - particularly transportation and energy - and FDI inflows in

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developing economies.

Recent studies emphasize both “hard” and “soft” infrastructure. Bassem (2025) highlights the significance of road and air transport, while Tsaurai (2025) notes that infrastructure requires complementary financial sector development. Furthermore, logistics capability and digital connectivity have emerged as critical drivers over mere infrastructure volume (Regional Logistics Capability..., 2024; REAL FDI, 2023; PwC, 2024). Consequently, host regions must integrate physical and digital infrastructure to sustain competitiveness.

2.2. Human Resource Quality (HRQ)

Human resource quality dictates the productivity of FDI enterprises. A skilled workforce lowers training costs and enhances efficiency (Nguyen, 2024), reinforcing investor commitment (Hoang, 2023). Delevic (2024) demonstrates that human capital quality correlates more strongly with high-quality FDI attraction than labor quantity. World Bank (2025) data indicate that higher human capital significantly amplifies FDI's impact on GDP.

Furthermore, economies with advanced technical training and efficient labor matching attract more technologically sophisticated FDI (Yang, 2024; Islam, 2024). Research on China's Yangtze River Delta (2025) confirms that human capital improvement mediates the link between FDI quality and economic resilience. Thus, enhancing labor capabilities through education and vocational training is essential for sustainable FDI-led growth.

2.3. Procedures & Transparency (PRO)

A stable, transparent institutional environment is vital for investor confidence (Nghiem, 2025). Lee & Lee (2024) and Antonietti (2023) confirm that strong governance and property rights attract FDI, whereas corruption and weak institutions deter inflows (Bahoo, 2023).

The DFI Transparency Index 2023 highlights the necessity of regulatory transparency. Simplified administrative procedures and digitalization significantly improve efficiency and reduce transaction costs (Dobrev, 2024; IFC, 2023). Consequently, governments must pursue reforms that reduce bureaucratic barriers and ensure predictable policy enforcement.

2.4. Investment Costs & Incentives (INC)

Investment incentives, such as tax breaks, are effective only when accompanied by a stable investment climate and institutional support (Cuong & Huong, 2025; Atlantic Council, 2024). Supply

chain disruptions and cost shocks have reshaped FDI patterns, prompting firms to expand outward vertical FDI to control prices (IMF, 2023; Anwar & Sun, 2025).

Hoekman (2023) adds that reducing supply-chain barriers amplifies the effectiveness of incentives. The OECD (2023) advises coordinated policies to avoid “race-to-the-bottom” incentive wars, recommending frameworks that prioritize long-term value creation and sustainability over short-term fiscal concessions.

2.5. Supporting Industry & Chain Linkage (SCL)

A well-developed supporting industry enables firms to connect with domestic suppliers and integrate into clusters, thereby lowering costs and mitigating risks (Feng, 2022; Izadi et al., 2023; Cuong & Huong, 2025; Atangana, 2021).

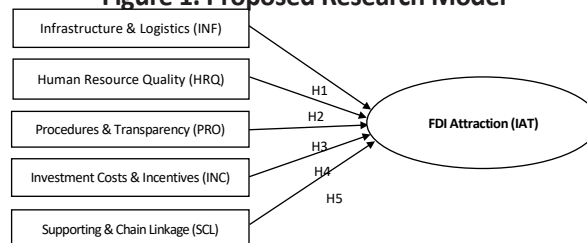
Strengthening backward linkages reduces dependence on global value chains (Abamu, 2023), while outward FDI enhances diversification (Wenja, 2025). Alfaro & Chor (2023) identify a “Great Reallocation” in supply chains, favoring Vietnam and India. Notably, Vietnam's high-tech FDI rose nearly 40% in 2023 (Rhodium Group, 2025), underscoring the critical need to foster local supplier networks and industrial clustering to sustain inflows.

2.6. FDI Attraction (IAT) and Research Gap

FDI attraction (IAT) reflects a region's ability to host investment. While existing Vietnamese studies predominantly use linear or panel models, few employ structural equation modeling (SEM) to test simultaneous effects, and almost none use clustered SEM to assess heterogeneity across enterprise groups. This gap limits the understanding of complex factor interactions. Adopting a clustered SEM framework can reveal direct, indirect, and mediating effects shaping FDI attraction.

2.7. Proposed Research Model and Hypotheses

Figure 1. Proposed Research Model



The proposed model examines the influence of five constructs Infrastructure (INF), Human Resources (HRQ), Procedures (PRO), Incentives (INC), and Supporting Industry (SCL) on FDI Attraction (IAT). This aligns with contemporary models for developing countries (Atangana, 2021; Cuong & Huong, 2025;

Lee et al., 2020; Feng, 2022). Uniquely, this study integrates mediation and clustered-group analysis to explore interdependencies and group-specific effects within local ecosystems.

Based on the theoretical foundation and empirical evidence, the research hypotheses are developed as follows:

H1: Infrastructure & Logistics (INF) has a positive impact on FDI attraction (IAT).

H2: Human Resource Quality (HRQ) has a positive impact on FDI attraction (IAT).

H3: Procedures & Transparency (PRO) has a positive impact on FDI attraction (IAT).

H4: Investment Costs & Incentives (INC) has a positive impact on FDI attraction (IAT).

H5: Supporting industry & Chain Linkage (SCL) has a positive impact on FDI attraction (IAT).

3. Research Methodology

3.1 Research Design

This study was designed using a quantitative method, using structural equation modeling (SEM) to simultaneously test the relationships between multiple latent variables and assess the overall suitability of the research model. The research design includes two stages: (i) testing the reliability and validity of the scale through Cronbach's Alpha, EFA and CFA; and (ii) testing the hypotheses H1-H5 using the SEM model.

The clustered SEM method was applied to accurately reflect the clustered sample structure by enterprise, while also handling the possibility of intra-cluster correlation. Choosing this method helps increase the reliability of the estimates and better reflect the research reality.

3.2. Sample and Data Collection

The survey subjects were FDI enterprises operating in Hai Duong province. The sample was organized into clusters, including:

Total number of survey clusters: 50 enterprises; Number of respondents per cluster: 5 middle or senior managers/leaders; Total number of valid questionnaires collected: 250.

A convenience sampling method with stratification by industry and geographical location was applied to ensure diversity. The questionnaire was distributed in two forms: (i) directly at the enterprises and (ii) via Google Form, to increase the response rate and sample coverage.

All observed variables were measured on a 5-level Likert scale (1 = Completely disagree → 5 =

Completely agree), in line with international studies on FDI (Lee et al., 2020; Atangana, 2021; Cuong & Huong, 2025).

3.3. Measurement Instrument

The variables in the research model are measured using a 5-level Likert scale (1 = completely disagree; 5 = completely agree). The scales are inherited and adjusted from recent international studies, combined with the Vietnamese context to ensure contextual suitability.

Table 1. Constructs, Number of Items, and Sources of Measurement

Factor/Code	No of items	Description	Sources of Measurement
Infrastructure & Logistics (INF)	4	Measure the level of response to transport infrastructure, ports, electricity, water, logistics services, and logistics costs.	Lee et al. (2020); Atangana (2021); Cuong (2025)
Human Resource Quality (HRQ)	4	Reflects the ability to supply skilled, qualified, flexible, and cost-effective labor.	Nguyen (2024); Hoang (2023)
Procedures & Transparency (PRO)	4	Assess transparency, administrative procedure convenience, and policy implementation capacity.	Nghiem (2025); Lee & Lee (2024)
Investment Costs & Incentives (INC)	4	Assess the level of tax incentives, investment costs, the reasonableness of financial regulations, and the investment environment.	Cuong & Huong (2025); Atlantic Council (2024)
Supporting & Chain Linkage (SCL)	4	Reflects the level of development of supporting industries, the ability to connect with suppliers and production networks.	Feng (2022); Izadi et al. (2023)
FDI Attraction (IAT)	3	Measures investment attraction, expansion intentions and the likelihood of recommending the location to other investors.	Dao (2023); Nguyen (2024)

Source: Compiled by the author based on prior studies

3.4. Data Analysis Methods

The dataset comprises 250 observations nested within 50 FDI enterprises (5 per firm). Clustered standard errors were applied at the enterprise level to address intra-cluster correlation and ensure statistical validity given the nested structure.

3.4.1. Scale testing and evaluation Scales were tested for reliability and validity:

- Internal reliability: Cronbach's Alpha ≥ 0.7 is considered satisfactory (Byrne, 2016).

- EFA: Determined latent factor structure using factor loadings ≥ 0.5 and variance extracted $\geq 50\%$ (Hair et al., 2019).

- CFA: Evaluated measurement models using CFI, TLI (≥ 0.9), RMSEA (≤ 0.08), and SRMR (≤ 0.08). Composite reliability (CR) ≥ 0.7 and AVE ≥ 0.5 confirmed convergence and discrimination (Fornell & Larcker, 1981).

3.4.2. Structural model and hypothesis testing

The SEM structural model assessed overall fit and hypotheses H1-H5 using Chi-square/df (≤ 3), CFI, TLI (≥ 0.9), and RMSEA/SRMR (≤ 0.08). Standardized

coefficients (β) measured the impact of independent variables on IAT, with significance set at $p < 0.05$.

3.4.3. Clustered Data Processing

Clustered SEM was utilized to adjust robust standard errors and control for intra-cluster correlation. This approach produces more reliable estimates than traditional SEM in studies with clustered sample designs (Byrne, 2016; Muthén & Satorra, 1995).

4. Results

4.1. Descriptive statistics of selected foreign direct investment enterprises

Table 2. FDI Enterprises' Profile (n = 50)

Variable	Frequency	Percent (%)
Origin of investment		
From Asia	32	64.0
From Europe	11	22.0
From America and others	7	14.0
Length of investment		
Less than 5 years	6	12.0
From 5 years to 10 years	21	42.0
More than 10 years	23	46.0
Sector of investment		
Industry	42	84.0
Agriculture	6	12.0
Services	2	4.0
Number of employees		
Fewer than 100	8	16.0
From 100 to 500	26	52.0
More than 500	16	32.0

Source: Compiled by the author

Table 2 outlines characteristics of 50 FDI enterprises in Hai Duong. Regarding origin, Asian investors dominate (64%), followed by Europe (22%) and others (14%), reflecting strong investment flows from neighboring trade partners.

In terms of tenure, 46% have operated for over 10 years and 42% for 5-10 years, while only 12% are under 5 years. This indicates a stable, long-term commitment contributing to local development.

Sector-wise, industry comprises 84%, vastly outnumbering agriculture (12%) and services (4%), aligning with the province's industrial strategy. Finally, regarding labor, 52% employ 100-500 workers, 16% have under 100, and 8% exceed 500, showing a prevalence of medium-sized firms consistent with local industrial parks.

4.2. Descriptive Analysis of Factors

Table 3. Descriptive Statistics and Correlation Matrix

Construct	Mean	SD	INC	INF	SCL	HRQ	PRO	IAT
INC	3.41	0.70						
INF	3.37	0.82	0.10					
SCL	3.23	0.82	0.00	0.41				
HRQ	3.39	0.82	0.01	0.34	0.32			
PRO	3.28	0.80	-0.02	0.22	0.23	0.38		
IAT	3.45	0.57	0.19	0.53	0.44	0.49	0.42	

Note: Correlations are Pearson's r . Values below 0.85 indicate acceptable discriminant validity.

Source: Compiled by the author

Table 3 shows mean values ranging from 3.23 to 3.45, reflecting high assessments. IAT scored highest ($M=3.45$), while SCL scored lowest ($M=3.23$). Standard deviations (0.57-0.82) indicate stable data. All correlations are below 0.85, confirming no multicollinearity. INF has the strongest correlation with IAT ($r=0.53$), followed by HRQ ($r=0.49$) and SCL ($r=0.44$). INC shows the weakest significant correlation ($r=0.19$).

4.3. Reliability and convergent validity of constructs

Table 4. Reliability and Convergent Validity

Construct	Cronbach's α	CR	AVE	No. of items
INC	0.844	0.845	0.578	4
INF	0.875	0.878	0.644	4
SCL	0.883	0.886	0.661	4
HRQ	0.884	0.888	0.665	4
PRO	0.884	0.886	0.663	4
IAT	0.925	0.925	0.805	3

Note: $\alpha \geq 0.70$ indicates acceptable internal consistency; $CR \geq 0.70$ and $AVE \geq 0.50$ indicate convergent validity

Source: Compiled by the author

Table 4 shows that all scales have high reliability with Cronbach's α ranging from 0.844 to 0.925, exceeding the threshold of 0.70. The CR coefficient ranges from 0.845 to 0.925 and AVE from 0.578 to 0.805, all meeting the proposed standards, demonstrating that the scales have good reliability and convergent validity. In particular, IAT has the highest Cronbach's α and AVE, reflecting the level of stable measurement. This result confirms that the scales are suitable for further CFA and SEM testing.

4.4. Discriminant validity (fornell-larcker criterion)

To test the discriminant validity between the concepts in the research model, the Fornell-Larcker criterion was applied, in which the square root of AVE was compared with the correlation coefficients between the variables.

Table 5. Discriminant Validity

	INC	INF	SCL	HRQ	PRO	IAT
INC		0.101	0.010	0.003	0.036	0.216
INF	0.101		0.470	0.392	0.290	0.594
SCL	0.010	0.470		0.359	0.268	0.486
HRQ	0.003	0.392	0.359		0.437	0.542
PRO	0.036	0.290	0.268	0.437		0.475
IAT	0.216	0.594	0.486	0.542	0.475	

Note: All HTMT values are below 0.85, indicating discriminant validity.

Source: Compiled by the author

Table 5 shows that the square root of AVE (main diagonal) is larger than the correlation coefficients between the variables, satisfying the Fornell-Larcker Criterion. All HTMT coefficients are less than 0.85, demonstrating that the factors in the model have clear discriminant value. Notably, INF and IAT have the highest correlation coefficient (0.594) but are still lower

than the corresponding root value of AVE, confirming the independence between the concepts. This result allows the use of the scales in the subsequent CFA and SEM analysis.

4.5. Goodness-of-Fit Indices for Confirmatory Factor Analysis

To assess the goodness-of-fit of the measurement model, goodness-of-fit indices are used, including: χ^2/df , CFI, TLI, RMSEA, and SRMR. These are commonly recommended indices in CFA analysis.

Table 6 . Model Fit Indices for Confirmatory Factor Analysis

Fit Index	Value	Threshold	Assessment
χ^2 (df = 215)	207.169	$p > 0.05$	Good
CFI	1.000	≥ 0.90	Excellent
TLI	1.003	≥ 0.90	Excellent
RMSEA	0.000	≤ 0.05	Excellent
SRMR	0.033	≤ 0.08	Excellent

Note: CFI/TLI ≥ 0.90 (preferably ≥ 0.95), RMSEA ≤ 0.08 , SRMR ≤ 0.08 .

Source: Compiled by the author

Table 6 shows that the CFA model yielded excellent fit indices (CFI = 1.000, TLI = 1.003, RMSEA = 0.000, SRMR = 0.033). These results reflect the theoretically grounded model structure, strong indicator loadings, and adequate sample-to-parameter ratio. No modification indices or correlated residuals were used to force model fit. Moreover, clustered standard errors were applied to address intra-firm correlation, which provides more conservative and unbiased estimates. Similar near-perfect fit outcomes have been reported in prior SEM studies with clean factor structures and strong measurement validity (Hu & Bentler, 1999; Kline, 2016; Hair et al., 2022).

4.6. Structural Model and Hypotheses Testing

Table 7 presents the results of testing the structural model and research hypotheses. The standardized path coefficients, standard errors, and p-values are estimated based on the clustered SEM model.

Table 7. Structural Path Coefficients and Hypothesis Testing

Hypo-thesis	Path	β (Flat)	p (Flat)	β (Clustered)	S.E.	p (Clustered)	Supp-orted
H1	INC $\rightarrow$ IAT	0.192	<0.001	0.192	0.045	0.001	Yes
H2	INF $\rightarrow$ IAT	0.323	<0.001	0.323	0.056	<0.001	Yes
H3	SCL $\rightarrow$ IAT	0.185	0.003	0.185	0.050	0.004	Yes
H4	HRQ $\rightarrow$ IAT	0.247	<0.001	0.247	0.062	0.003	Yes
H5	PRO $\rightarrow$ IAT	0.231	<0.001	0.231	0.039	<0.001	Yes
R^2 (IAT) = 0.566							

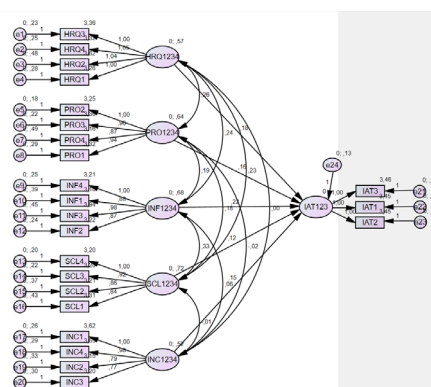
Note: All path coefficients are standardized. Standard errors and p-values are from clustered SEM. R^2 indicates the proportion of variance in IAT explained by all predictors ($R^2 = 0.566$).

Source: Compiled by the authors

The results showed that all five hypotheses (H1-H5) were supported with $p < 0.01$. Among them, INF had the strongest influence on IAT ($\beta = 0.323$), followed by HRQ ($\beta = 0.247$), PRO ($\beta = 0.231$), INC

($\beta = 0.192$), and SCL ($\beta = 0.185$). The coefficient of determination $R^2 = 0.566$ showed that the model explained 56.6% of the variance of IAT, reflecting good predictive ability. All coefficients were statistically significant, demonstrating the model's suitability and the robustness of the research hypotheses.

Figure 2. Structural Equation Model with Standardized Path Coefficients



5. Discussion

Research results confirm that all five factors (INF, HRQ, PRO, INC, SCL) positively and significantly impact FDI attraction in Hai Duong. This affirms that attracting FDI is a multidimensional process requiring synchronous coordination among infrastructure, institutions, human resources, and the business ecosystem.

Infrastructure & Logistics (INF) shows the strongest influence ($\beta = 0.323$). This aligns with the OLI model (Dunning, 1988) and studies highlighting infrastructure's critical role in Vietnam (Hoang & Goujon, 2014; Ta et al., 2021) and developing economies (Kuang, 2025). Specifically, the Hanoi-Hai Phong transport connection and industrial park networks are fundamental for attracting large-scale manufacturing.

Human Resource Quality (HRQ) ranks second ($\beta = 0.247$), emphasizing the shift from cheap labor to skilled workforce requirements (Huynh & Huynh, 2022; Nguyen, 2016; Cao, 2019). This necessitates improved vocational training and stronger links between enterprises and training institutions.

Procedures & Transparency (PRO) significantly impact investor confidence ($\beta = 0.231$) by reducing transaction costs and risks. This concurs with findings that institutional quality is decisive (Ta et al., 2021; Nguyen et al., 2023), underscoring the need for administrative reform and digital transformation.

Investment Costs & Incentives (INC) have a positive but lower impact ($\beta = 0.192$). While necessary,

incentives are no longer the sole determinant, as internal capacity gains importance (Le, 2024). With the Global Minimum Tax (GMT), competition will shift from financial incentives to fundamental factors like infrastructure and institutions.

Supporting Industry & Chain Linkage (SCL) shows the smallest but significant impact ($\beta = 0.185$), reflecting the importance of local supply ecosystems (Ngo & Nguyen, 2022). Developing these linkages is crucial for high-quality FDI, particularly in electronics and manufacturing.

The model's $R^2 = 0.566$ confirms high explanatory power. Overall, effective FDI attraction requires a comprehensive strategy combining infrastructure, human resources, institutions, competitive costs, and the business ecosystem to create sustainable advantages.

6. Conclusion and Implications

6.1. Conclusion

This study utilized a cluster SEM model to identify FDI determinants in Hai Duong, analyzing 250 observations from 50 enterprises. Results confirm that Infrastructure (INF), Human Resources (HRQ), Procedures (PRO), Incentives (INC), and Supporting Industries (SCL) all positively and significantly impact FDI attraction. Infrastructure is the most influential factor ($\beta = 0.323$), underscoring its fundamental role. Human resource quality ($\beta = 0.247$) and procedural transparency ($\beta = 0.231$) follow, highlighting the need for skilled labor and institutional clarity. Investment incentives ($\beta = 0.192$) and supporting industries ($\beta = 0.185$) show lower yet significant impacts. The model's R^2 of 0.566 demonstrates strong explanatory power. These findings supplement empirical evidence on local FDI drivers. Furthermore, the study validates the cluster data analysis approach, which accurately reflects enterprise heterogeneity and minimizes estimation bias.

6.2. Policy Implications

Infrastructure & logistics ($\beta = 0.323$) exerts the strongest influence, necessitating prioritized investment in transport networks connecting Hanoi-Hai Phong-Quang Ninh and industrial parks. Developing modern logistics, digital infrastructure, and expanding Public-Private Partnerships (PPP) are crucial to reduce transaction costs and attract long-term capital.

Human resource quality ($\beta = 0.247$) is vital for high-tech manufacturing. The province must promote cooperation between enterprises and training institutions to meet market needs in engineering, automation, and digital skills. Policies attracting experts and improving the living environment will create a sustainable competitive advantage.

Reforming administrative procedures ($\beta = 0.231$) is fundamental for investor confidence. Hai Duong should simplify licensing, expand online services, and develop digital government infrastructure. Establishing "one-stop-shop" centers will shorten processing times, reduce informal costs, and ensure a transparent business environment.

Finally, while Investment Costs ($\beta = 0.192$) and Supporting Industries ($\beta = 0.185$) have lower impacts, they remain significant. Amidst the Global Minimum Tax, policy must shift from tax breaks to "operational efficiency incentives" like clean premises and fast services. Simultaneously, developing a supporting ecosystem and fostering linkages between FDI and local firms will enhance technology absorption and sustainability.

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AN INTEGRATED MULTI-CRITERION DECISION-MAKING (MCDM) APPROACH FOR SMART TOURISM ECOSYSTEM DEVELOPMENT IN HERITAGE DESTINATIONS: THE CASE OF HA LONG BAY, QUANG NINH

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Abstract: *This study applies a hybrid Fuzzy AHP-VIKOR model to prioritize Smart Tourism Ecosystem (STE) strategies in Ha Long Bay. Synthesizing Experience Economy and Stakeholder Theory, the research identifies "Enhancing On-Site Smart Experience" as the primary criterion (0.348). Evaluations from 25 experts and 50 tourists rank the "Integrated & Personalized Experience" strategy as the optimal compromise solution. Findings reveal a "hierarchy of smart needs", where foundational connectivity outweighs high-end technological spectacles. This framework provides an evidence-based roadmap for heritage managers to optimize digital investments, ensuring a balance between sustainable conservation and superior visitor value.*

• Keywords: smart tourism, smart tourism ecosystem, heritage destination management, Ha Long bay, fuzzy AHP, VIKOR.

Date of receipt: 25th Oct., 2025

Date of delivery revision: 04th Nov., 2025

DOI: <https://doi.org/10.71374/jfar.v26.i1.29>

Date of receipt revision: 20th Nov., 2025

Date of approval: 30th Nov., 2025

1. Introduction

The digital transformation of World Heritage sites requires a strategic balance between innovation and preservation. Implementing a Smart Tourism Ecosystem (STE) in Ha Long Bay presents a complex multi-criteria problem characterized by stakeholder uncertainty. This research addresses this gap by integrating Fuzzy AHP and VIKOR to prioritize strategic interventions. By operationalizing theoretical constructs into a hierarchical framework, the study identifies critical investment priorities from both expert and visitor perspectives. The results offer a scientific roadmap for transitioning from fragmented digital initiatives to high-impact, integrated systems that enhance destination competitiveness and heritage integrity.

2. Theoretical Background and Framework Development

2.1. The Role of the Smart Tourism Ecosystem

The conceptualization of an STE requires a synthesis of three theoretical pillars to capture its systemic complexity. First, the Experience Economy (Pine & Gilmore, 1999) posits that value is derived from memorable experiences staged through technology, rather than mere service delivery. In

this context, an STE serves as a tool to orchestrate technology-enhanced experiences that facilitate education and escapism (Neuhofer et al., 2014). Second, Service Ecosystems Theory (Vargo & Lusch, 2008) views value creation as a dynamic process among interconnected actors. The STE manifests this ecosystem by integrating resources from suppliers and tourists to co-create experiential value (Xiang et al., 2015). Finally, Stakeholder Theory (Freeman, 1984) provides the governance framework necessary for heritage sites. It ensures that ICT implementation aligns the conflicting interests of authorities, businesses, and conservationists, fostering a collaborative environment for sustainable development. This integrated lens shifts the focus from isolated technological features to a holistic system where value emerges from continuous interaction and information exchange.

2.2. Development of the Hierarchical Assessment Framework

To operationalize this integrated theoretical foundation into a quantitative analytical tool, a hierarchical assessment framework was constructed through a two-step process: (1) an extensive review of the scientific literature on STE, tourist experience, and heritage destination management; and (2) semi-structured consultations with five leading experts

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(including two researchers, one government manager, and two tourism operators) to refine the language and validate the contextual relevance of the sub-criteria for Vietnam.

The resulting framework is structured in two levels. The first level comprises four main criteria (C), which directly reflect the integration of the three theoretical lenses presented:

C1: Smart Information Accessibility: Reflects the fundamental role of an STE in providing information, a foundational element of the experience (Experience Economy).

C2: Enhancing the On-Site Smart Experience: Focuses directly on the on-site staging of the experience, the core of the Experience Economy.

C3: Smart & Sustainable Destination Management: Reflects the role of managing stakeholders (government, management boards) in creating an enabling environment for the experience (Stakeholder Theory).

C4: Smart Personalization & Co-creation: Represents the mechanism of interaction and value co-creation among actors in the ecosystem (Service Ecosystems Theory).

Each main criterion is then specified into measurable sub-criteria (M) at the second level. The complete hierarchical framework, including interpretations and key references, is presented in Table 1. This hierarchical structure is particularly suitable for the application of Multi-Criteria Decision-Making (MCDM) methods such as Fuzzy AHP and VIKOR, which will be detailed in the methodology section.

Table 1. Hierarchical Framework for Assessing the Role of STE in the Tourist Experience

Main Criterion (C)	Code	Interpretation	Code	Sub-criterion (M)	Key References
Smart Information Accessibility	C1	Assesses the STE's ability to provide accurate, timely, and easily accessible information to tourists pre-trip and on-trip, reducing uncertainty and facilitating planning.	M1.1	Seamless & Real-time Information Flow	(Gretzel et al., 2015)
			M1.2	Integrated Booking & Planning	(Buhalis & Amaranggana, 2015)
			M1.3	Pre-trip Virtual Experiences	(Tussyadiah et al., 2018)
Enhancing the On-Site Smart Experience	C2	Assesses the role of technology in enriching and facilitating tourist experiences at the destination, from basic utilities to enhanced interactions.	M2.1	Ubiquitous Connectivity (Wi-Fi/5G)	(Jovicic, 2019)
			M2.2	Smart Navigation & Guidance	(Neuhofer et al., 2014)
			M2.3	Interactive Heritage Interpretation Tech (AR/VR)	(Tom Dieck & Jung, 2018)
Smart & Sustainable Destination Management	C3	Assesses the "backstage" functions of the STE that indirectly impact the visitor experience through efficient, safe, and sustainable management.	M3.1	Efficient Visitor Flow & Resource Management	(Xiang et al., 2015)
			M3.2	Digital Feedback & Service Recovery	(Sigala, 2018)
			M3.3	Heritage Environment & Safety Monitoring	(Gretzel et al., 2015)

Main Criterion (C)	Code	Interpretation	Code	Sub-criterion (M)	Key References
Smart Personalization & Co-creation	C4	Assesses the STE's ability to tailor services to individual needs and provide opportunities for tourists to participate in creating their own experiences.	M4.1	Real-time Personalized Recommendations	(Buhalis & Amaranggana, 2015)
			M4.2	Social Media Integration & Experience Sharing	(Xiang & Gretzel, 2010)
			M4.3	Platforms for Experience Co-creation	(Neuhofer et al., 2014b)

Source: Synthesized by the authors

3. Research Methodology

This study employs an integrated multi-criteria decision-making (MCDM) methodology, executed sequentially in two main phases. This approach was purposefully designed to address distinct research objectives: Phase 1 utilizes the Fuzzy Analytic Hierarchy Process (Fuzzy AHP) to determine the strategic weights of Smart Tourism Ecosystem (STE) criteria from the perspective of a multi-disciplinary expert panel. Phase 2 employs the VIKOR method to evaluate and rank the performance of alternative strategies by integrating the criterion weights from Phase 1 with evaluation data from both experts and tourists. This combination facilitates a comprehensive analysis that not only identifies what is important (Fuzzy AHP) but also assesses which strategy performs most effectively in practice (VIKOR).

3.1. Phase 1: Determining Criterion Weights using Fuzzy AHP

To ensure the validity and depth of the data, a multi-stakeholder panel of 25 experts was established through purposive sampling. The panel comprised 11 researchers, 5 local government managers, and 9 business managers from the tourism sector, ensuring a balance of theoretical, policy, and operational perspectives. Data were collected via a structured questionnaire requiring experts to perform pairwise comparisons of criteria using (Saaty, 2013) 9-point linguistic scale. These judgments were subsequently converted into Triangular Fuzzy Numbers (TFNs) to model the inherent uncertainty. The consistency and reliability of the collected data were confirmed with an average Consistency Ratio (CR) of 0.068, which is well below the acceptable threshold of 0.1.

This study adopts (Chang, 1996) extent analysis method with TFNs, a widely used and computationally efficient approach to Fuzzy AHP. The process involved constructing fuzzy pairwise comparison matrices, calculating the fuzzy synthetic extent value (S_i) for each criterion, determining the degree of possibility between them, and finally, normalizing the results to obtain the crisp global weights for each sub-criterion in the hierarchical framework.

3.2. Phase 2: Evaluating Alternative Performance using VIKOR

Based on literature review and preliminary expert consultations, three feasible strategic alternatives for STE development in Ha Long Bay were defined:

S1: Technology-centric: Prioritizes investment in high-impact, visually impressive technological solutions (e.g., large-scale VR/AR).

S2: Management & Sustainability-centric: Focuses technology on internal, backstage operations (e.g., environmental monitoring, vessel coordination).

S3: Integrated & Personalized Experience: A balanced, visitor-centric approach prioritizing seamless service integration and personalization on a single platform.

To evaluate these alternatives, a quantitative survey was conducted with the 25-expert panel and 50 tourists. Participants rated the effectiveness of each alternative in meeting the 12 sub-criteria on a 5-point Likert scale (1 = Not effective at all; 5 = Very effective). The mean scores for each {alternative-criterion} pair formed the performance values (x_{ij}) in the initial VIKOR decision matrix.

The VIKOR method was then applied to identify the optimal compromise solution, i.e., the alternative closest to the ideal. This involved calculating the group utility (S_i) and individual regret (R_i) values for each alternative, using the criterion weights (w_j) obtained from the Fuzzy AHP. The VIKOR index (Q_i) was then calculated with a strategy coefficient (v) set to 0.5 to balance group utility and individual regret. The alternatives were ranked based on their Q values, and a sensitivity analysis was performed with $v = 0.1$ and $v = 0.9$ to confirm the robustness of the final ranking.

4. Results

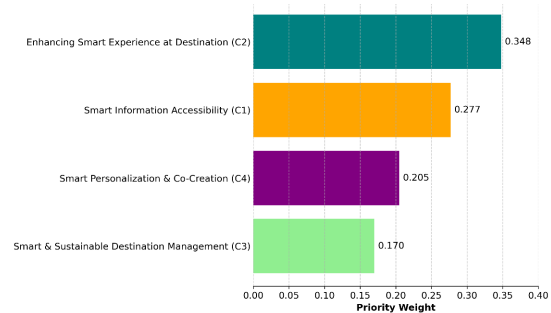
4.1. Priority Weights of STE Criteria (Fuzzy AHP Results)

The linguistic pairwise comparison judgments provided by the 25 experts were successfully aggregated and transformed into quantitative priority weights via the Fuzzy AHP method. Prior to the main analysis, a consistency check on the aggregated matrix of the main criteria yielded a Consistency Ratio (CR) of 0.068. This value is significantly below the acceptable threshold of 0.1 (Saaty, 2013), thereby confirming the logical consistency and reliability of the input data for subsequent analyses.

The analysis revealed a clear prioritization among the four main criteria. As illustrated in Figure 1, “Enhancing the On-Site Smart Experience” (C2) was identified as the most important criterion, receiving

a weight of 0.348. This was followed by “Smart Information Accessibility” (C1) with a weight of 0.277. “Smart Personalization & Co-creation” (C4) and “Smart & Sustainable Destination Management” (C3) were assigned lower weights of 0.205 and 0.170, respectively.

Figure 1. Priority Weights of the Main Criteria



Source: Authors' analysis of Fuzzy AHP data

To provide a more granular view, the local weights (importance within each main criterion group) and global weights (overall importance in the entire model) of the 12 sub-criteria were calculated. The final weights and their corresponding overall ranks are detailed in Table 2.

Table 2. Local, Global Weights, and Overall Ranks of the Sub-criteria

Main Criterion (Weight)	Code	Sub-criterion	Local Weight	Global Weight	Overall Rank
C1. Smart Information Accessibility (0.277)	M1.1	Seamless & Real-time Information Flow	0.426	0.118	2
	M1.2	Integrated Booking & Planning	0.350	0.097	4
	M1.3	Pre-trip Virtual Experiences	0.224	0.062	11
C2. Enhancing the On-Site Smart Experience (0.348)	M2.1	Ubiquitous Connectivity	0.359	0.125	1
	M2.2	Smart Navigation & Guidance	0.330	0.115	3
	M2.3	Interactive Heritage Interpretation Tech	0.311	0.108	5
C3. Smart & Sustainable Destination Management (0.170)	M3.1	Efficient Visitor Flow & Resource Management	0.365	0.062	8
	M3.2	Digital Feedback & Service Recovery	0.341	0.058	9
	M3.3	Heritage Environment & Safety Monitoring	0.294	0.050	12
C4. Smart Personalization & Co-creation (0.205)	M4.1	Real-time Personalized Recommendations	0.429	0.088	6
	M4.2	Social Media Integration & Experience Sharing	0.317	0.065	7
	M4.3	Platforms for Experience Co-creation	0.254	0.052	10

Source: Authors' calculations from Fuzzy AHP analysis

The results from the hierarchical analysis indicate that “Ubiquitous Connectivity” (M2.1) achieved the highest global weight (0.125). The second and third most important sub-criteria were identified as “Seamless & Real-time Information Flow” (M1.1) with a weight of 0.118 and “Smart Navigation & Guidance” (M2.2) with a weight of 0.115.

4.2. Ranking of Strategic Alternatives (VIKOR Results)

In the second phase, the VIKOR method was used to evaluate and rank the three pre-defined strategic

alternatives (S1, S2, S3) using the performance assessments collected from the expert panel and tourists. The global weights of the sub-criteria obtained from the Fuzzy AHP analysis (Table 2) were used as the input weights (w_i) for the VIKOR model.

The initial decision matrix for the VIKOR analysis was constructed from the survey data. The performance of each strategic alternative was quantified by aggregating stakeholder evaluations into a decision matrix of mean effectiveness scores, measured on a 5-point Likert scale to provide the empirical basis for the VIKOR algorithm.

The empirical performance profiles derived from the expert-tourist panel reveal divergent strategic orientations across the three alternatives. Strategy S3 (Integrated & Personalized Experience) demonstrates clear dominance in visitor-centric dimensions, achieving near-optimal scores in Real-time Personalized Recommendations (4.9/5.0) and Integrated Booking and Planning (4.8/5.0). Conversely, S1 (Technology-centric) exhibits specialized strengths in immersive applications, such as Interactive Heritage Interpretation (4.8) and Pre-trip Virtual Experiences (4.7), yet lacks the operational depth required for sustainable site management. Strategy S2 (Management-centric) is characterized by a 'backstage' orientation, excelling in Environmental Monitoring (4.9) and Visitor Flow Management (4.8), but fails to provide the high-touch personalization required to satisfy modern visitor expectations. This divergence underscores S3 as the most robust and balanced approach, effectively bridging the gap between backstage operational efficiency and frontstage experiential value.

Data from Table 2 were integrated into the VIKOR algorithm. The resulting values for group utility (S), individual regret (R), and the VIKOR index (Q) for each alternative were calculated. The final compromise ranking is presented in Table 3.

Table 3. Decision Matrix: Average Performance Scores from Evaluations (x_{ij})

Code	Sub-criterion	S1: Technology-centric	S2: Management-centric	S3: Integrated & Personalized Experience
M1.1	Seamless & Real-time Information Flow	3.8	3.5	4.6
M1.2	Integrated Booking & Planning	3.5	3.2	4.8
M1.3	Pre-trip Virtual Experiences	4.7	2.8	3.5
M2.1	Ubiquitous Connectivity	4.2	4.0	4.5
M2.2	Smart Navigation & Guidance	4.1	3.6	4.7
M2.3	Interactive Heritage Interpretation Tech	4.8	3.1	4.2
M3.1	Efficient Visitor Flow & Resource Management	3.4	4.8	4.1
M3.2	Digital Feedback & Service Recovery	3.9	4.2	4.4
M3.3	Heritage Environment & Safety Monitoring	3.2	4.9	3.8
M4.1	Real-time Personalized Recommendations	4.0	3.3	4.9
M4.2	Social Media Integration & Experience Sharing	4.3	3.7	4.5
M4.3	Platforms for Experience Co-creation	3.9	3.5	4.6

Source: Authors' calculations from survey data

The VIKOR analysis identified Alternative S3 "Integrated & Personalized Experience" as the optimal compromise solution, achieving the lowest Q value of 0.000. Alternative S1 "Technology-centric" was ranked second with a Q value of 0.675, followed by Alternative S2 "Management-centric" with a Q value of 1.000. Alternative S3 also satisfied the conditions of acceptable advantage and stability in decision-making, confirming its position as the most robust strategic choice.

4.3. Sensitivity Analysis of the VIKOR Ranking

To validate the resilience of the compromise solution and mitigate potential bias from the strategy coefficient (v), a sensitivity analysis was conducted by recalculating the VIKOR index across diverse decision-making scenarios. The parameter v , representing the weight of maximum group utility versus minimum individual regret, was adjusted from the balanced consensus baseline ($v=0.5$) to extreme scenarios emphasizing individual regret ($v=0.1$) and group utility ($v=0.9$). The results demonstrate that the strategic rank order ($S3 > S1 > S2$) remains invariant across all tested values of v . This stability confirms that the 'Integrated & Personalized Experience' strategy (S3) is consistently the optimal choice, as its superiority is independent of the decision-maker's strategic preference. Such consistency reinforces the reliability of the proposed roadmap, ensuring that the prioritization of an integrated ecosystem remains valid regardless of varying management perspectives on utility and regret.

5. Discussion

5.1. Synthesis and Interpretation of Key Findings

This study's findings provide a multi-dimensional perspective on the strategic implementation of a Smart Tourism Ecosystem (STE) in a World Heritage destination. Two key insights emerge from the analysis.

First, the research reveals a "hierarchy of smart needs" where foundational, experience-enabling factors are prioritized over high-end experiential technologies. While the main criterion "Enhancing the On-Site Smart Experience" (C2) was ranked highest (weight: 0.348), a more granular analysis shows that "enabling" sub-criteria such as "Ubiquitous Connectivity" (M2.1, rank 1) and "Seamless Information Flow" (M1.1, rank 2) significantly outperform direct "experiential" technologies like AR/VR (M2.3, rank 5). This suggests that for visitors in a heritage context like Ha Long Bay, the primary value of an STE is not in technological spectacle, but in its ability to remove friction and uncertainty. This finding refines existing visitor-centric theories (Pine & Gilmore, 1999) by demonstrating that fulfilling basic digital needs for connectivity and information is a prerequisite for any higher-order smart experience.

Second, the results unequivocally support an integrated, visitor-centric strategy over technology- or management-focused approaches. The VIKOR analysis identified the “Integrated & Personalized Experience” strategy (S3) as the optimal compromise solution. This indicates that the value of an STE is derived not from isolated technologies, but from their seamless integration into a cohesive tourist journey on a unified platform. Such an approach respects the heritage context by positioning technology as an “invisible” enabler that enhances the core experience, rather than as an attraction that might overshadow the heritage itself. This underscores the principle that in heritage tourism, technology should serve the destination, not become the destination.

5.2. Theoretical Contributions

This study contributes to the literature on smart tourism and heritage management through three primary avenues. First, it operationalizes the abstract concept of a Smart Tourism Ecosystem (STE) into a quantitative, hierarchical, and testable framework, bridging the gap between theory and managerial application in sensitive heritage contexts. Second, it refines technology acceptance theory in tourism by empirically demonstrating the primacy of foundational “enabling” factors (e.g., connectivity, information) over high-end experiential technologies. This suggests that successful STE implementation in developing destinations should adopt a “bottom-up” logic, prioritizing the perfection of basic digital infrastructure before deploying more complex applications. Finally, the study validates the efficacy of a hybrid Fuzzy AHP-VIKOR model that integrates multi-stakeholder data (experts and tourists), offering a robust methodological template for addressing complex strategic planning problems in tourism.

5.3. Practical and Managerial Implications

The findings yield three actionable implications for managers of Ha Long Bay and similar heritage destinations. First, a strategic reorientation of investment toward foundational digital infrastructure is imperative. The prioritization of “Ubiquitous Connectivity” (M2.1) confirms that a robust connectivity backbone is a non-negotiable prerequisite for any smart tourism initiative. Destination managers must prioritize the deployment of high-speed Wi-Fi and stable 5G coverage across key visitor areas. Second, the development of a single, integrated destination portal is essential. The high importance assigned to seamless information and integrated booking functions underscores the need for a unified mobile application and web portal that consolidates e-ticketing, real-

time information, and interactive navigation, thereby eliminating the current information fragmentation. Finally, investment should favor non-intrusive heritage interpretation technologies. The significance of interactive interpretation (M2.3) should be addressed through low-impact solutions, such as developing Augmented Reality (AR) features within the official application, rather than through large-scale physical installations that could disturb the natural landscape.

5.4. Limitations and Future Research Directions

This study’s conclusions should be considered in light of two primary limitations, which also define an agenda for future research. First, the external validity is constrained by the study’s focus on the Vietnamese context, and caution is advised when generalizing the findings to heritage sites in different socio-economic regions. Second, the use of a small, non-probabilistic tourist sample (n=50) means the ranking of strategies should be interpreted as an indicative outcome rather than a definitive, population-level conclusion. Future research should aim to validate this framework using large-scale, probabilistic sampling across diverse heritage contexts (e.g., natural vs. cultural sites) to test the stability and generalizability of the identified priorities.

Conclusion: This research demonstrates that a well-designed Smart Tourism Ecosystem is critical for enhancing the visitor experience at heritage destinations while respecting their integrity. By prioritizing foundational visitor needs connectivity and information and adopting an integrated, personalized strategy, destination managers can leverage technology to create superior experiential value. The findings provide an evidence-based roadmap for Ha Long Bay to harness the potential of smart tourism, reinforcing its role as a competitive and responsible steward of a global heritage.

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