



Balancing resources: Returns and the digital transformation of Vietnam's banking sector

 **Nguyen Thi Lan Anh**¹

 **Duy Van Nguyen**^{2*}

 **Huong Thi Lan Pham**³

¹Department of Science, Technology and International Cooperation, Tay Bac University, Son La, Vietnam.

¹Email: lananhnt@utb.edu.vn

²Faculty of Business Administration, Phenikaa University, Duong Noi, Hanoi 12116, Vietnam.

²Email: duy.nguyenvan1@phenikaa-uni.edu.vn

³Quantitative Analysis Centre, QAglobal, Hanoi, Vietnam.

³Email: lanhuong.pt.neu@gmail.com



(+ Corresponding author)

ABSTRACT

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Research on digital transformation plays a crucial role for enterprises, especially those in emerging economies such as Vietnam. This study aims to examine the impact of digital transformation, measured through the ICT index, on bank performance (ROE, ROA) during the period 2015–2022, involving 26 commercial banks listed on the Vietnam Stock Exchange. The results of the Feasible Generalized Least Squares (FGLS) regression analysis indicate that the ICT index of the previous year has a negative impact on bank performance. This finding suggests that the Resource-Based View (RBV) theory can provide a sound explanation for this relationship. Specifically, while banks make significant investments in digital transformation, the limited availability of resources may generate high costs, thereby negatively affecting bank performance in the short term. Based on these results, the authors also provide several theoretical and practical implications for enhancing bank performance through digital transformation. Establishing a clear roadmap that aligns with current capabilities can help banks avoid unnecessary costs during the digital transformation process. This study will make a significant theoretical contribution by explaining the impact of digital transformation on bank performance in Vietnam. Consequently, banks and relevant agencies can develop appropriate resource-balancing policies to promote the effectiveness of digital transformation.

Contribution/ Originality: This study measures digital transformation using the ICT index and evaluates the effect of ICT on the performance of Vietnamese joint-stock commercial banks. Additionally, it introduces a new measurement of digital transformation through the ICT index.

1. INTRODUCTION

Digital transformation is becoming a core driver of change in global business operations. Recent studies indicate that adopting digital technologies enables firms to redesign their business models, create new value, and enhance sustainable competitiveness (Vial, 2019). At the macro level, digital transformation enhances resource efficiency, optimizes processes, and broadens access to international markets. From an industry perspective, digital technologies assist enterprises in automation and data-driven decision-making, fostering innovation. For example, Bharadwaj, El Sawy, Pavlou, and Venkatraman (2013) emphasize that digital transformation provides the foundation for integrating technology and strategy, enabling firms to adapt to rapidly changing business environments. This is especially critical as competition arises not only from traditional rivals but also from technology-based startups. At the micro level,

digital transformation offers tangible benefits for individual firms, such as improving customer experience, reducing operational costs, and strengthening managerial capabilities. Westerman, Bonnet, and McAfee (2014) argue that digitally mature firms often outperform others in both financial performance and innovation capacity. This evidence highlights that digital transformation is no longer a choice but has become a survival factor, especially in a constantly volatile market environment.

In the banking sector, digital transformation is considered one of the pioneering fields in applying technology to enhance efficiency and service quality. Globally, numerous studies have demonstrated that banks with strong digitalization often achieve higher customer satisfaction and sustainable profitability. Gomber, Kauffman, Parker, and Weber (2018) emphasize that digital technologies such as artificial intelligence, big data, and blockchain have reshaped the entire financial value chain from payments and credit to asset management. At the strategic level, digitalization is not merely about improving transaction systems but also about restructuring business models to adapt to the new competitive environment. In Vietnam, digital transformation in banking has become a key driver promoting financial inclusion and supporting the modernization of the economy. According to Do, Pham, Thalassinou, and Le (2022), Vietnamese commercial banks have begun adopting electronic banking, mobile banking, and e-wallets as primary tools to expand customer access.

There has been extensive research on digital transformation and bank performance (Brynjolfsson & Hitt, 2000; Fethi & Pasiouras, 2010; Melville, Kraemer, & Gurbaxani, 2004; Nguyen-Thi-Huong, Nguyen-Viet, Nguyen-Phuong, & Van Nguyen, 2023). Most studies measure digital transformation by focusing on digitalization in banking through textual analysis (Bellstam, Bhagat, & Cookson, 2021; Li, Zhang, Yan, & Zhang, 2025; Nguyen-Thi-Huong et al., 2023; Verhoef et al., 2021). Some research measures it through total investment in information technology infrastructure (Santorrey, 2024). Certain studies report a negative impact of digital transformation on bank performance (Nguyen-Thi-Huong et al., 2023) while others find a positive relationship (Brynjolfsson & Hitt, 2000; Fethi & Pasiouras, 2010; Melville et al., 2004). This indicates that the measurement and impact of digital transformation on bank performance remain controversial. At the same time, measuring digital transformation through the ICT index has not yet received much attention from researchers. Therefore, this study measures digital transformation using the ICT index and evaluates its effect on the performance of Vietnamese joint-stock commercial banks. The research adopts the Resource-Based View (RBV) to explain this relationship. Additionally, whereas previous studies typically assessed the effect of digital transformation on bank performance within the same year, this study considers the possibility that digital investments may influence performance in the following year.

2. LITERATURE REVIEW

2.1. Digital Transformation

Researchers provide many definitions of digital transformation. Some define digital transformation as the application of information technology (IT), including the measurement and quantification of IT and its benefits and impacts, extending beyond the traditional IT domain (Agarwal, Gao, DesRoches, & Jha, 2010; Kitsios, Giatsidis, & Kamariotou, 2021). Some researchers also indicate digital transformation (DT) as the use of new digital technologies, such as social media, mobile devices, analytics, or embedded systems, to enable significant business improvements. These improvements may include enhancing customer experience, streamlining operations, or creating new business models (Fitzgerald, Kruschwitz, Bonnet, & Welch, 2014). This definition of DT is also consistent with more recent studies, which emphasize adopting digital technologies in operations, business model innovation, or digital strategies to create value for firms (Kane, Palmer, Phillips, Kiron, & Buckley, 2015; Schallmo, Williams, & Boardman, 2017). Our study follows the definition of DT by Fitzgerald et al. (2014), highlighting digital technologies and their role in enabling business improvements. Therefore, in this research, digital transformation is defined as the use of new digital technologies to enable significant business improvements. To better understand digital transformation, it is essential to distinguish it from digitization: digitization refers to converting physical values into digital form. For example,

instead of managing employee records in hard-copy files, HR departments can now input data into Excel files and manage them digitally. By contrast, digital transformation occurs when digitized data are utilized with technologies such as AI and Big Data to analyze, transform, and create new value. In this sense, digital transformation can be considered a higher-level stage of digitization.

It can be observed that the concept of digital transformation is no longer unfamiliar to scientists. Digital transformation is associated with the adoption of new technologies in the business operations of enterprises (Agarwal et al., 2010; Fitzgerald et al., 2014). Accordingly, digitizing operational processes and enhancing customer experience through digital services are considered important business strategies (Fitzgerald et al., 2014). In addition, some authors believe that DT is the application of digital technologies to innovate business models and create greater value for companies (Kane et al., 2015; Schallmo et al., 2017). However, in this study, we apply the perspective of Fitzgerald et al. (2014), defining DT as using new digital technologies to improve business operations.

2.2. Measuring Digital Transformation

To measure and evaluate digital transformation, scientists have implemented many different methods. Some researchers assess digital transformation activities by utilizing digital services within the organization's operating system (Kitsios et al., 2021; Verhoef et al., 2021). In addition, a standard method is textual analysis, which relies on the frequency of digital-related terms appearing in corporate reports and disclosures (Kriebel & Debener, 2019). Specifically, researchers examine the occurrence of keywords associated with digital transformation (Bellstam et al., 2021; Li et al., 2025; Verhoef et al., 2021). Examples of such terms include: digital transformation, digitization, internet, website, ATM, web, computer, online, information system, IT, information technology, bank card, virus, digitalization, online payment services, cloud, email, mobile devices, server, tablet, password, encryption, smartphone, LAN, wireless, among others (Bellstam et al., 2021; Kitsios et al., 2021; Li et al., 2025). This study adopts the first measurement approach, using the ICT Development Index (ICT index) as a proxy for digital transformation in the banking sector.

2.3. Bank Performance

Bank performance has long been regarded as a key indicator for assessing an economy's health and sustainable development capacity. Efficient banks maximize shareholder profits and allocate capital more effectively to firms and individuals, thereby fostering economic growth (Berger & Humphrey, 1997). In practice, efficiency is not merely reflected in end-period profit figures but is also associated with risk management capacity, capital adequacy, liquidity maintenance, and customer trust. An efficiently operating bank is also more resilient to economic shocks, thereby strengthening its regional and international competitive position (Demirgüç-Kunt & Huizinga, 2010). In Vietnam, the trend of digitalization and improvements in cost management processes have yielded encouraging results, as many banks have reported reduced cost ratios and increased levels of customer satisfaction (Nguyen, Le, & Vu, 2022). This demonstrates that bank performance should be viewed from a multidimensional perspective, encompassing financial outcomes, management, and innovation factors.

Bank performance is assessed using financial indicators and should also be evaluated through other non-financial or intermediate indicators. Some commonly used financial indicators by researchers to measure bank performance include Return on Assets (ROA), Return on Equity (ROE), and the Cost-to-Income Ratio (CIR). These indicators are popular due to their simplicity and ease of comparison across different banks and time periods (Athanasoglou, Brissimis, & Delis, 2008). Other analyses are also employed in measuring the technical efficiency of enterprises, such as Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) models (Fethi & Pasiouras, 2010). In addition, many researchers are increasingly interested in non-financial factors such as customer satisfaction and technological adaptability (Molyneux, 2017). Combining these approaches provides a more comprehensive view,

enabling managers to make informed decisions to improve efficiency, while also assisting investors and regulators in accurately assessing the actual performance of the banking system (Nguyen & Vo, 2020).

2.4. The Relationship Between Digital Transformation and Bank Performance

In strategic management research, the Resource-Based View (RBV) emphasizes that a firm’s efficiency and sustainable competitive advantage stem from its ability to possess and exploit resources that are valuable, rare, inimitable, and non-substitutable (Barney, 1991). Information and communication technology (ICT) is increasingly recognized as a strategic resource in the banking sector. ICT serves as a tool for facilitating transactions, enhancing productivity, optimizing costs, and improving risk management (Melville et al., 2004). When ICT is well invested in and integrated, it can create significant advantages in capital allocation and provide faster, more accurate customer services, thereby enhancing overall performance (Brynjolfsson & Hitt, 2000). Banks cannot rely solely on traditional financial resources in the digital competition era but must combine ICT with organizational capabilities to maximize value (Zhang, 2005). Empirical evidence shows that ICT is closely associated with technical and cost efficiency, particularly in emerging markets (Fethi & Pasiouras, 2010). Furthermore, developing digital banking platforms, mobile banking, and big data analytics enhances customer experience while creating new revenue streams (Gomber et al., 2018).

However, when banks invest in digital transformation without sufficient managerial capacity, skilled human resources, and customer readiness, technology resources may act merely as "costs" rather than value drivers (Nguyen-Thi-Huong et al., 2023). Consequently, bank performance may decline in the short term. In the context of Vietnamese joint-stock commercial banks, digital transformation has only gained significant momentum since the COVID-19 period. Therefore, in the short term, digital transformation may not generate superior profits compared to the incurred costs. Based on this reasoning, we propose the following hypothesis.

Hypothesis: Digital transformation has a negative impact on bank performance.

3. METHOD

3.1. Research Model

The research model is presented.

$$Bank\ performance_{it} = \beta_i + \beta_1 ICT_{it-1} + \sum_{k=1}^n \beta_k Control\ variables_{it} + \varepsilon_{it} \quad (1)$$

The variables in Equation 1 are defined in Table 1.

Table 1. Variable’s definition.

Variables	Description	Expected
<i>Alternative dependent variable</i>		
ROA	Return on total assets	
ROE	Return on equity	
<i>Independent variables</i>		
ICT	ICT index	(+)
<i>Control variables</i>		
CAR	Equity/ Total assets	(+)
SIZE	=ln(total assets)	(+)
LOANS	= Total loans/ Total assets	(-)
NII	=Net interest income/Total assets	(+)

In this study, bank performance is measured using two alternative dependent variables: ROA and ROE. Return on Assets (ROA) reflects profitability relative to total assets, indicating a bank’s ability to utilize its resources to generate profits. Return on Equity (ROE) measures profitability from the shareholders’ perspective, capturing the return on invested equity. Both indicators are widely applied in banking performance research to ensure comparability and reliability.

The primary independent variable is ICT – the Information and Communication Technology index. ICT is expected to have a negative effect on bank performance, as digital technologies enable cost optimization, service expansion, and enhanced customer experience.

Four control variables are included in the model to enhance robustness. The Capital Adequacy Ratio (CAR), defined as equity to total assets, reflects capital safety; a positive effect is expected since well-capitalized banks are generally more stable and efficient. Bank size (SIZE), measured as the natural logarithm of total assets, controls for scale effects; larger banks are anticipated to benefit from economies of scale, thus a positive relationship is expected. Loans (LOANS), defined as total loans to total assets, indicate the degree of reliance on credit activities; a negative effect is anticipated because excessive lending may increase credit risk. Finally, Net Interest Income (NII), defined as net interest income to total assets, is expected to have a positive effect, as strong income generation from core activities typically enhances profitability and overall performance.

3.2. Data Collection

Financial indicators were collected from Vietnamese joint-stock commercial banks listed on the Vietnamese stock exchange during the period 2015–2022, using the Refinitiv database by Thomson Reuters. Data on ICT were obtained from the ICT reports published by the Ministry of Science and Technology of Vietnam (available up to 2022). The dataset was cleaned to remove outliers using the STATA command “winsor2” with cut points at 5 and 95. The descriptive statistics provide an overview of the banks' performance and operational characteristics within the sample.

Return on Assets has a mean value of approximately 1.1%, ranging from a minimum of 0.2% to a maximum of 2.5%, indicating variation in asset profitability across banks. Return on Equity (ROE) shows an average of 13.4%, with a standard deviation of 0.07. Regarding the ICT index, the mean is 0.45 with a relatively high dispersion (SD = 0.205): some banks recorded almost no ICT adoption (0.000 in the early years), while others reached as high as 0.727, reflecting substantial heterogeneity in digital transformation. Bank size, measured as the natural logarithm of total assets, ranges from 31.0 to 34.9, capturing the diversity in bank scale. The ratio of loans to total assets averages 64.4%, showing relatively consistent bank lending activity. The capital adequacy ratio (CAR) averages 8.6%, but with significant variation, as the most well-capitalized bank recorded 15.6%. Finally, net interest income to total assets maintains an average of 2.8%, underlining the central role of credit activities in profitability. A summary of these descriptive statistics is presented in Table 2.

Table 2. Summary statistics.

VarName	Mean	Median	SD	Min.	Max.
ROA	0.011	0.009	0.007	0.002	0.025
ROE	0.134	0.136	0.070	0.013	0.295
ICT	0.450	0.490	0.205	0.000	0.727
SIZE	32.928	32.852	1.091	31.009	34.938
LOANS	0.644	0.656	0.065	0.517	0.737
CAR	0.086	0.078	0.029	0.051	0.156
NII	0.028	0.027	0.008	0.017	0.044
N=208					

4. RESULT

The regression analysis employed common panel data models, including fixed effects, random effects, and heteroskedasticity-corrected FGLS. The results, based on a sample of 26 banks, indicate that the lagged ICT variable has a negative effect on ROA ($\beta < 0$, statistically significant at the 1% level). Firm size and NII exert positive effects on ROA ($\beta > 0$, statistically significant at the 1% level). Additionally, loans show a negative effect on ROA ($\beta < 0$, statistically significant at the 10% level). Detailed results are presented in Table 3.

Table 3. Regression with ROA.

Variables	(1)	(2)	(3)
	ROA	ROA	ROA
ICT _{t-1}	-0.00565** (0.00272)	-0.00301 (0.00234)	-0.00685*** (0.00102)
SIZE	0.00393 (0.00236)	0.00106 (0.000835)	0.00614*** (0.000492)
LOANS	-0.0192* (0.0103)	-0.0252*** (0.00709)	-0.0112* (0.00568)
CAR	-0.000607 (0.0378)	0.0531** (0.0218)	0.00201 (0.0213)
NII	0.546*** (0.112)	0.610*** (0.0737)	0.550*** (0.0841)
Constant	-0.121 (0.0786)	-0.0297 (0.0276)	-0.199*** (0.0161)
<i>Observations=208</i>			
<i>Number of groups=26</i>			

Note: Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Similarly, for bank performance measured by ROE, the lagged ICT variable exerts a negative effect on current ROE ($\beta < 0$, statistically significant at the 10% level). Likewise, loans and capital adequacy ratio (CAR) show negative effects on ROE ($\beta < 0$, statistically significant at the 5% and 1% levels, respectively). In contrast, firm size and net interest income (NII) have positive effects on ROE ($\beta > 0$, statistically significant at the 1% level). Detailed results are reported in Table 4.

Table 4. Regression with ROE.

Variables	(1)	(2)	(3)
	ROE	ROE	ROE
ICT _{t-1}	-0.0782** (0.0343)	-0.0465 (0.0293)	-0.0903*** (0.0138)
SIZE	0.0366 (0.0298)	0.0127 (0.0106)	0.0689*** (0.00665)
LOANS	-0.268** (0.130)	-0.314*** (0.0893)	-0.173** (0.0531)
CAR	-1.820*** (0.476)	-1.326*** (0.275)	-1.755*** (0.286)
NII	6.795*** (1.408)	7.150*** (0.929)	6.916*** (0.894)
	(0.991)	(0.350)	(0.224)
<i>Observations=208</i>			
<i>Number of groups=26</i>			

Note: Standard errors in parentheses.
*** p<0.01, ** p<0.05.

The lagged ICT variable negatively affects bank performance (ROA, ROE) among Vietnamese joint-stock commercial banks. According to the statistical results from the final SGMM model, if the ICT index of a bank increases by 1 point, the average ROA next year will decrease by 0.00685 (approximately 0.7%), and the average ROE next year will decrease by 0.0903 (about 9.0%). This result primarily stems from the characteristics of technology investment, where expenditures on infrastructure, software, information security, and staff training increase significantly. In contrast, the benefits from these investments may not materialize immediately in the subsequent period (Do et al., 2022). Higher operating costs reduce net profits, thereby lowering profitability indicators. Additionally, implementing new technological systems often requires testing, adjustments, and adaptations, during which technical risks or operational disruptions may occur, negatively affecting short-term performance (Gomber et al., 2018). Another important factor is the gap between the level of technological investment and the ability of bank

managers and staff to utilize these resources effectively. In many medium- and small-sized banks, ICT investments have not yet translated into a clear competitive advantage due to limitations in risk management and digital product development capabilities (Ozili, 2018). Moreover, customer habits and acceptance of digital services also take time to adjust, meaning that additional revenues from digital channels may not immediately offset the investment costs. Therefore, the negative relationship between lagged ICT and bank performance often reflects the initial investment phase rather than a sustainable decline. In the long term, once systems become stable and effectively utilized, these investments are likely to generate added value, enhance profitability, and strengthen the competitive position of banks (Arner, Barberis, & Buckley, 2015).

The results indicate that bank size and net interest income positively affect profitability, as measured by ROA and ROE. In terms of size, larger banks often possess advantages such as capital, market share, and portfolio diversification, which create favorable conditions for improving operational efficiency. Greater size also allows banks to exploit economies of scale, reduce average costs, and enhance competitiveness in the market (Demirgüç-Kunt & Huizinga, 2010). Moreover, banks with larger total assets generally have easier access to cheaper funding sources, improving credibility and reputation, thereby strengthening profitability (Athanasoglou et al., 2008). Meanwhile, NII the difference between interest income and interest expenses, represents the core source of bank profitability, reflecting the effectiveness of managing earning assets and liabilities. An increase in NII demonstrates efficient credit and investment operations, as well as the bank's ability to adjust interest rate policies (Al-Homaidi, Almaqtari, Yahya, & Khaled, 2020). As NII rises, net profits also improve, boosting both ROA and ROE. This positive relationship is typically stable and sustainable, given that NII accounts for a substantial proportion of banks' income structures in emerging markets such as Vietnam

The results further reveal that LOANS have a negative effect on both ROA and ROE. When banks excessively expand lending activities, the pressure of credit risk increases, leading to a higher probability of non-performing loans and greater loan-loss provisioning expenses, which reduce net profits. This directly affects ROA, as after-tax profits relative to average assets shrink. Similarly, ROE declines because shareholders' equity must absorb the negative impact of lower profits, while capital risk intensifies (Athanasoglou et al., 2008). In addition, under competitive interest rates and tightened credit policies, banks find it difficult to sustain high profit margins from lending activities, thereby weakening overall performance (Demirgüç-Kunt & Huizinga, 2010). Overconcentration on lending may also reduce income diversification. Banks heavily reliant on credit activities often devote less attention to developing non-lending services, which are generally more stable and less risky sources of income. This imbalance makes banks more vulnerable to macroeconomic shocks, such as economic slowdowns or interest rate fluctuations, ultimately leading to a decline in performance. The Vietnamese context also demonstrates this phenomenon: periods of rapid credit growth are often accompanied by rising non-performing loan ratios, forcing banks to increase provisioning, which significantly reduces profitability indicators (Al-Homaidi et al., 2020).

5. CONCLUSION AND IMPLICATIONS

The study provides a theoretical foundation for digital transformation in general and in the banking sector in particular. Several methods can be used to measure the digital transformation index, such as technology investment, attention to digital transformation, and the ICT index of banks. In this study, the ICT index is employed to assess the level of digital transformation in Vietnamese joint-stock commercial banks. To evaluate the impact of digital transformation on banks' performance, data were collected from 26 listed Vietnamese joint-stock commercial banks between 2014 and 2023. The data analysis, conducted using the Feasible Generalized Least Squares (FGLS) model, indicates that the ICT index of the previous year has a negative impact on banks' performance. Consequently, the hypothesis is supported. Additionally, the study examines the influence of control variables on Return on Equity (ROE) and Return on Assets (ROA). Specifically, firm size and Net Interest Income (NII) positively affect ROE and

ROA, whereas loans have a negative impact on these indicators. Based on these findings, the authors propose several theoretical and practical implications for the banking sector and digital transformation strategies.

5.1. Theoretical Implication

This study makes a significant theoretical contribution by demonstrating that investments in digital transformation have a negative impact on banks' performance. This result can be explained through the Resource-Based View (RBV). Specifically, when existing resources cannot immediately accommodate the changes brought about by digital transformation, operating costs increase, while the additional profits generated, although positive, are not yet sufficient to offset the rising costs of digital transformation, particularly in developing countries such as Vietnam. This finding also opens avenues for applying alternative theoretical frameworks to explain the impact of digital transformation on performance in the future, once banks have fundamentally completed their digital transformation processes.

5.2. Practical Implication

In practice, the findings of this study provide valuable insights for banks as well as stakeholders in formulating appropriate policies to enhance performance through digital transformation. First, banks must balance their resources, including human capital, financial capacity, and infrastructure, to carry out digital transformation effectively. Excessive investment may result in redundancy and waste if resources are not fully capable of absorbing the changes. Therefore, developing a clear roadmap and implementing it step by step will help reduce costs and optimize the efficiency of digital transformation initiatives. Second, government authorities should design supportive policies enabling banks to comprehensively implement digital transformation. Such policies would help banks overcome procedural and regulatory obstacles when introducing services related to digital transformation.

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