

ARTICLE

Exploring Human Resource Contributions to Bank Performance in Vietnam

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Abstract

This study investigates the role of human resources in enhancing bank performance in the digital era and examines whether technology strengthens the contribution of human capital within a developing economy. As automation and digital transformation continue to reshape banking operations, leading to reductions in branch networks and workforce size, concerns have emerged regarding the continuing importance of human resources in driving organizational performance. The study utilizes panel data from 22 Vietnamese commercial banks over the period 2011–2023, drawing information from audited annual reports, the General Statistics Office of Vietnam, and the World Bank. The analysis employs the Feasible Generalized Least Squares (FGLS) method and incorporates several human resource indicators. The findings demonstrate that human resources remain a significant determinant of bank performance despite increasing levels of digitalization. Results from both the baseline and extended models reveal a positive and statistically significant relationship between human resource factors and bank performance. However, the interaction between human resources and technological advancement does not generate a synergistic effect that further improves performance in highly digitalized banks. A key limitation of this study is the use of the ICT Index as a proxy for technological development, which may not fully capture the complexity of automation and digital transformation. Nevertheless, the study provides empirical evidence that human resources continue to play a vital role in the banking sector even as technological solutions become more prevalent. These findings offer important implications, bank managers, and other stakeholders seeking to balance technological investment with human capital development.

Keywords: Human resources; bank performance; digitalization; automation; ICT.

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1. Introduction

Traditionally, the banking industry has depended extensively on human resources as a strategic asset. Employees not only act as the public face of banking institutions but also play essential roles in customer relationship management, financial advisory services, and operational execution. Through their contributions, they influence service quality, mitigate operational risks, and support the profitability and long-term sustainability of banks. Consequently, human resources have long been recognized as a key organizational resource for achieving strategic objectives and maintaining competitive advantage (Armenta, 2007).

The emergence of the Fourth Industrial Revolution has significantly transformed the operating environment of commercial banks. To remain competitive, financial institutions have increasingly adopted digital technologies, including artificial intelligence (AI), big data analytics, automation systems, digital platforms, and smart branches with minimal human intervention. As technological capabilities continue to advance, numerous conventional banking functions are being automated, resulting in substantial changes to organizational processes and workforce responsibilities (Kreger, 2023). These developments are reshaping the traditional role of employees and redefining how value is created within the banking sector.

Existing empirical evidence provides inconsistent conclusions regarding the contribution of human resources to organizational performance, particularly in highly digitalized environments. Studies conducted in manufacturing and technology-intensive industries suggest that human resources continue to deliver unique and irreplaceable value despite rapid technological advancement (Romero et al., 2016; Wan & Leirimo, 2023). Similarly, within the banking sector, intellectual capital has been identified as a critical source of competitive advantage and enhanced organizational performance (Le & Nguyen, 2020b; Tran & Vo, 2022). However, research focusing on specific human resource dimensions, such as employee competence and human capital, has produced mixed findings. While some studies report a positive relationship between employee competence and organizational performance (Wanyama & Mutsotso, 2010; Yusuf et al., 2021), others reveal weak or statistically insignificant effects (Munjuri et al., 2015; Rusianto & Khasmir, 2023).

A review of the literature highlights several important research gaps. First, although substantial attention has been devoted to understanding how digital technologies improve banking performance, limited research has explored the continued contribution of human resources alongside digital transformation initiatives. Much of the existing literature implicitly treats digitalization as a substitute for labor, often neglecting the possibility that human expertise and digital technologies may operate in a complementary manner (Zhang et al., 2025). Consequently, the mechanisms through which human capabilities interact with digitalization to influence bank performance remain insufficiently understood. This raises an important question regarding whether digital transformation enhances, rather than replaces, the value generated by human resources (Mutuku & Nyaribo, 2015; Xinyue & Macerlo, 2024).

Second, previous studies have frequently relied on broad proxies such as intellectual capital or human capital when examining human resource contributions. While useful, these measures may not adequately capture the multidimensional nature of human resources in contemporary digital organizations (Marimuthu et al., 2009; Masuluke & Ngwakwe, 2018; Munjuri et al., 2015; Rahman & Akhter, 2021). A more comprehensive assessment is therefore needed to understand how different aspects of human resources contribute to organizational performance in the era of digital banking.

To address these limitations, the present study investigates the relationship between human resources and bank performance within a digital transformation context. Rather than relying on aggregate measures, this study employs a broader set of indicators that

capture multiple dimensions of human resource contributions, including employee numbers, employee growth rates, personnel expenditures, business productivity per employee, and revenue productivity per employee. This approach enables a more detailed evaluation of the role of human resources in shaping banking performance. In addition, the study examines how varying levels of digitalization interact with human resource factors in influencing organizational outcomes.

The empirical analysis utilizes a balanced panel dataset comprising 22 major commercial banks in Vietnam during the period 2011–2023. Several econometric techniques are employed, including ordinary least squares (OLS), fixed-effects models, random-effects models, and feasible generalized least squares (FGLS), to ensure the robustness of the findings. Vietnam provides an appropriate setting for this investigation due to the rapid digital transformation occurring within its banking industry, where institutions increasingly leverage technology to improve employee productivity and operational effectiveness.

The findings contribute to the literature by extending the application of resource-based theory and human capital theory within the context of digital banking transformation. The results demonstrate that human resources continue to represent a crucial source of competitive differentiation despite increasing levels of automation and technological integration. From a managerial perspective, the study offers valuable insights for banking executives and policymakers by clarifying how human resources influence performance in a digitally evolving environment. Such insights can support strategic decisions related to talent development, workforce planning, and technology investment. Furthermore, the results highlight the importance of regulatory policies that strengthen workforce capabilities and human resource resilience as essential components of sustainable growth in the banking sector.

2. Literature Review

This study is grounded in two prominent theoretical perspectives: resource-based theory and human capital theory. Resource-based theory posits that organizational performance depends on the effective utilization of valuable, rare, inimitable, and well-organized resources (Barney, 1991). These resources include physical, organizational, and human resources. In increasingly competitive and dynamic business environments, human resources have emerged as one of the most strategic assets for sustaining competitive advantage and improving organizational outcomes (Subramanian, 2005). Within the banking industry, employees possess valuable knowledge, expertise, and experience that contribute directly to service quality, operational efficiency, and profitability.

Human capital theory further explains the importance of investing in employee capabilities. Originally proposed by Schultz (1961) and later expanded by Becker (2009), the theory argues that education, training, and skill development enhance employee productivity and ultimately improve organizational performance. Human capital, including knowledge, experience, education, and professional skills, serves as a key driver of organizational growth and competitiveness (Gidado et al., 2014). Consequently, investments in employee development can generate substantial returns that are comparable to, or even exceed, investments in physical assets.

Prior empirical studies consistently identify human resources as a critical source of competitive advantage and organizational performance (Gidado et al., 2014; Hitt et al., 2001; Moon & Kym, 2009; Sharma, 2012). Evidence from the banking sector suggests that human capital, employee development, and intellectual capital positively contribute to profitability and operational performance (Agbiogwu et al., 2016; Gidado et al., 2014; Le & Nguyen, 2020b; Pavlović et al., 2024; Rahman & Akhter, 2021; Tran & Vo, 2022; Zeghal & Maaloul, 2010). Survey-based studies similarly demonstrate that employee quality and

competence positively affect organizational outcomes (Mukherjee et al., 2003; Rusianto & Khasmir, 2023). Nevertheless, previous findings are not entirely consistent. Several studies report insignificant or even negative effects of human capital on financial performance (Chu et al., 2020; Gidado et al., 2014; Munjuri et al., 2015; Rahman & Akhter, 2021). Furthermore, Le and Nguyen (2020b) identified a non-linear relationship between intellectual capital and risk-adjusted returns, suggesting that the contribution of human resources may vary across contexts and organizational environments.

At the same time, digital transformation has become an increasingly important factor influencing bank performance. Digital transformation refers to the integration of digital technologies into business operations and processes to improve productivity and organizational outcomes (Microsoft, 2022). Within the banking industry, digitalization has evolved from a competitive advantage into a strategic necessity (Balkan, 2021; Nicoletti, 2021). Existing studies indicate that digital technologies enhance profitability by increasing revenue generation and reducing operating costs (Do et al., 2022; Guo & Xu, 2021; Imran et al., 2014; Nguyen et al., 2025; Zhai et al., 2022). In addition, digital transformation contributes to lower operational and credit risks, thereby strengthening institutional resilience (Balkan, 2021; Yang & Masron, 2023). However, some studies report that digital transformation may generate short-term costs that outweigh immediate benefits (Putra, 2022), while others find no significant relationship between digitalization and profitability (Martín-Oliver & Salas-Fumás, 2008).

Digitalization also substantially influences workforce structures within banking institutions. Technologies such as artificial intelligence, robotic process automation, and machine learning increasingly perform tasks that were previously executed by employees (Nicoletti, 2021). While automation improves efficiency and reallocates employees toward higher-value activities, including customer relationship management and financial advisory services (Meena & Parimalarani, 2020; Mutuku & Nyaribo, 2015), it may simultaneously reduce labor demand. Research suggests that automation could eliminate a significant proportion of banking jobs (Meena & Parimalarani, 2020). Nevertheless, recent studies indicate that the relationship between digitalization and employment is more complex than simple labor substitution. Digital transformation may initially increase labor redundancy, but as organizations mature digitally, technology and human resources can evolve into complementary assets that jointly improve performance (Gao et al., 2025; Zhang et al., 2025). Evidence from the banking sector also remains mixed. While Khams (2022) found no significant reduction in banking employment due to digitalization, Hazarika (2020) reported differing impacts across employee categories, highlighting the context-specific nature of digital transformation outcomes.

Drawing upon resource-based theory and human capital theory, this study investigates whether human resources continue to contribute to bank performance in the digital era and whether a synergistic relationship exists between human resources and technology. The empirical analysis focuses on Vietnam's banking industry, which has experienced substantial digital transformation in recent years. Digital transactions account for a significant proportion of banking activities, making Vietnam an appropriate context for examining the interaction between human resources and digitalization (Nguyen, 2023).

3. Research Methods

The study utilizes a balanced panel dataset comprising 22 major Vietnamese commercial banks over the period 2011–2023. Financial and human resource data were manually collected from audited annual reports, while macroeconomic indicators were obtained from the General Statistics Office of Vietnam and the World Bank. The selected banks represent the largest and most systemically important institutions in the

Vietnamese banking sector, providing a suitable sample for investigating the effects of digitalization and human resources on performance.

Bank performance is measured using return on average assets (ROA) and return on average equity (ROE), following previous banking studies (Athanasoglou et al., 2008; Kodan et al., 2011; Pasiouras & Kosmidou, 2007). Human resources are captured through five direct indicators: number of employees, employee growth rate, employee expenditure, business productivity per employee, and revenue productivity per employee. Unlike prior studies that rely on indirect measures such as intellectual capital or human capital indices (Marimuthu et al., 2009; Masuluke & Ngwakwe, 2018; Munjuri et al., 2015; Rahman & Akhter, 2021), this study employs direct human resource indicators to provide a more detailed assessment of workforce contributions.

Table 1. Definitions and Sources of Variables

Variables	Notations	Definitions	References
Dependent Variable			
Return on Assets	ROA	Return on assets, i.e. net income/total assets	Athanasoglou et al. (2008); Kodan et al. (2011)
Return on Equity	ROE	Return on equity, i.e. net income/total equity	Pasiouras and Kosmidou (2007)
Main Independent Variables			
Total Number of Employees	EMP_Nu	Total number of employees	Authors' suggestion
Employee Growth Rate	EMP_Gr	$EMP_t - EMP(t-1) / EMP(t-1)$	Gidado et al. (2014)
Employee Expense	EMP_Ex	Employee expenses / total number of employees	Agbigwo et al. (2016)
Employee Business Productivity	BU_Pro	Total assets / total number of employees	Kodan et al. (2011)
Employee Revenue Productivity	RE_Pro	Operating income / total number of employees	Vaydande and Adwani (2022)
Bank-Specific Control Variables			
Bank Equity	EQUI	Equity / total assets	Athanasoglou et al. (2008); Jadah et al. (2020)
Credit Risk	LLP	Provision for loan loss / total loan outstanding	Pasiouras and Kosmidou (2007); Rehman et al. (2018)
Customer Deposits	DEPO	Customer deposits / total assets	—
Loan Outstanding	LOAN	Lending / total assets	—
Operating Costs	CIR	Operating costs / operating revenue	—
Digitalisation Index	ICTIndex	Technology infrastructure	Le and Pham (2022); Nguyen (2021)
Macroeconomic Control Variables			
Gross Domestic Product	GDP	Annual GDP growth rate	Bilalli and Sadiku (2023); Le and Ngo (2020)

Variables	Notations	Definitions	References
Inflation	INF	CPI Index	Pasiouras and Kosmidou (2007); Shair et al. (2019); Uralov (2020)

Digitalization is represented by the Information and Communication Technology (ICT) Index, which measures the readiness of banks to adopt and utilize technology. The index, published by the Ministry of Information and Communications of Vietnam, evaluates technological infrastructure, human resource infrastructure, information technology applications, and online service delivery capabilities. Additional control variables include customer deposits, loan outstanding, credit risk, cost-to-income ratio, equity-to-total-assets ratio, inflation, and gross domestic product growth.

Following Athanasoglou et al. (2008), Kodan et al. (2011), and Pasiouras and Kosmidou (2007), the study estimates baseline regression models in which bank performance is explained by human resource variables, bank-specific characteristics, macroeconomic factors, and the ICT Index. To minimize potential reverse causality, human resource variables and bank-specific variables are lagged by one period. Additional models are estimated to examine the interaction between human resources and digitalization, thereby assessing the potential synergy between human capital and technology in enhancing bank performance. Furthermore, adjusted models incorporating squared terms of the main independent variables are employed to explore potential non-linear relationships and the robustness of the results.

4. Results

4.1 Descriptive Statistics

Descriptive statistics for all variables included in the analysis are presented in Table 2. The results indicate substantial variation in the financial performance of Vietnamese commercial banks throughout the study period. Both return on assets (ROA) and return on equity (ROE) exhibit considerable dispersion, with ROE showing a greater degree of variability across the sampled banks. Regarding human resource characteristics, the average number of employees was 8,635. The smallest bank employed 1,273 staff members, whereas the largest institution had a workforce of 24,480 employees. These figures reflect notable differences in organizational size and human resource capacity among Vietnamese commercial banks.

Table 2 .Descriptive Statistics

Variables	Mean	SD	Min.	Max.
Independent Variables				
ROA	0.0193	0.0104	0.0038	0.0434
ROE	0.2361	0.1215	0.0541	0.4515
Human Resource Variables				
EMP_Nu	8.635	7.281	1.273	24.480
EMP_Gr	0.0328	0.0499	-0.0199	0.1668
EMP_Ex	0.2546	0.0912	0.1333	0.4570
BU_Pro	31.2801	12.8530	14.4780	62.3890
RE_Pro	1.1582	0.6556	0.4495	2.7510

Variables	Mean	SD	Min.	Max.
Bank-Specific Variables				
DEPO	0.6703	0.1057	0.4600	0.8490
LOAN	0.5919	0.1060	0.3716	0.7300
EQUI	0.0863	0.0293	0.0505	0.1617
LLP	0.0131	0.0041	0.0087	0.0233
CIR	0.5055	0.1392	0.2909	0.8016
ICT Index	0.5391	0.1104	0.3629	0.7565
Macroeconomic variables				
GDP	5.7610	1.5370	2.5800	8.0200
INF	4.8570	4.4810	0.6300	18.6780

4.2 Diagnostic Tests

Prior to estimating the regression models, several diagnostic tests were conducted to ensure the reliability of the empirical results. Pearson correlation analysis was first employed to examine potential multicollinearity among the explanatory variables. The correlation matrix presented in Table 3 shows that the highest correlation coefficient among the independent variables was 0.74, observed between employee business productivity and employee expenditure. However, this relationship was not statistically significant. Moreover, all pairwise correlation coefficients remained below the threshold of 0.80, suggesting that multicollinearity is not a serious concern in the dataset (Gujarati, 2009). This conclusion was further supported by the variance inflation factor (VIF) results.

The Hausman specification test was subsequently performed to determine the most appropriate panel estimation approach. The results favored the fixed-effects model over the random-effects model. Nevertheless, additional diagnostic procedures, including the Breusch–Pagan Lagrange Multiplier test and the Wooldridge test, revealed the presence of heteroskedasticity and serial correlation. To address these issues and improve estimation efficiency, the Feasible Generalized Least Squares (FGLS) approach proposed by Hansen (2007) was adopted for the final analysis.

Table 3 .Correlation Matrix and Diagnostic Test

Variables	EMP_N	EMP_Gr	EMP_Ex	BU_Pr	BU_Re	DEPO	LOAN	EQUI	LLP	CIR	ICT	GDP	INF
EMP_N	1												
EMP_Gr	-0.439***	1											
EMP_Ex	0.573***	-0.235***	1										
BU_Pr	0.378***	-0.120**	0.747***	1									
BU_Re	0.508***	-0.306***	0.726***	0.612***	1								
DEPO	0.058	0.075	0.090	0.144**	-0.052	1							
LOAN	0.486***	-0.069	0.470***	0.291***	0.281***	0.423***	1						
EQUI	-0.221***	0.020	-0.166***	-	-0.026	-0.31***	-	1					
LLP	-0.353***	-0.242***	0.270***	0.347***	0.367***	-0.005	0.170***	-0.017	1				
CIR	-0.520***	0.336***	-0.525***	-	-	0.257***	0.196***	-0.083	-	1			
ICT	0.367***	-0.133*	0.366***	0.422***	0.629***	0.151**	0.108	-0.109	0.324***	-	1		
										0.458***			

Variables	EMP_N	EMP_Gr	EMP_Ex	BU_Pr	BU_Re	DEPO	LOAN	EQUI	LLP	CIR	ICT	GDP	INF
GDP	-0.043	0.084	-0.147**	-0.123**	-0.126**	-0.006	-0.033	-0.021	-0.102*	0.119**	-	1	
											0.113		
INF	-0.189***	-0.068	-0.352***	-	-	-	-	0.222***	0.0402	-0.136**	0.069	0.059	1
				0.254***	0.178***	0.454***	0.445***						

4.3 Empirical Results

The effects of human resource factors on bank performance in the context of digital transformation are reported in Table 4. The analysis focuses on five dimensions of human resources, namely employee number, employee growth rate, employee expenditure, employee business productivity, and employee revenue productivity.

4.3.1 Baseline Model

The baseline estimation results indicate that the number of employees has a significant positive relationship with both ROA and ROE. Likewise, employee growth and employee expenditure are positively associated with bank performance, with coefficients of similar magnitude. Employee revenue productivity also exhibits a positive and statistically significant effect on performance, whereas employee business productivity is negatively related to both performance indicators. Both relationships are significant at the 1% level.

Among the control variables, loan outstanding demonstrates a positive and significant association with bank performance, while customer deposits show a significant negative relationship. In addition, the cost-to-income ratio is negatively associated with performance, whereas loan loss provisions display a positive effect, with both variables achieving statistical significance. Although the ICT Index carries a positive coefficient, its effect is not statistically significant. At the macroeconomic level, both GDP growth and inflation are positively related to bank performance, and the estimated coefficients are statistically significant.

Table 4. Human Resource and Bank Performance – The Baseline Model

Variables	Panel A – ROA	Panel B – ROE
EMP_N	0.0019*** [3.48]	0.0314*** [4.73]
EMP_Gr	0.0122** [1.83]	0.1750** [2.32]
EMP_Ex	0.0192** [2.55]	0.1450 [1.41]
BU_Pr	-0.0002*** [-5.76]	-0.0023*** [-3.74]
RE_Pr	0.0049*** [3.82]	0.0657*** [3.40]
DEPO	-0.016*** [-4.51]	-0.2520*** [-5.75]
LOAN	0.0080 [0.20]	0.1390*** [2.61]
EQUI	0.1370*** [9.80]	2.5800*** [2.81]
LLP	0.2000*** [2.57]	-2.4200*** [-3.17]
CIR	-0.0302*** [-8.16]	-0.3930*** [-7.86]
ICT Index	0.0032 [1.10]	0.0519 [1.2]
GDP	0.0006*** [3.15]	0.0066** [2.54]
INF	0.0002*** [2.89]	0.0039*** [3.88]
_cons	0.0046 [0.6]	0.1350 [1.60]

4.3.2 Extended Models

To further investigate the interaction between human resources and digitalization, an additional variable representing the interaction between the ICT Index and employee

number ($ICT \times EMP_N$) was incorporated into the model. The ICT Index was transformed into a dummy variable, taking a value of one for banks belonging to the upper 50% of the ICT Index distribution and zero otherwise. This specification was designed to assess whether the contribution of human resources to bank performance differs across banks with varying levels of digital readiness.

The results presented in Table 5 reveal a significant but negative interaction effect between human resources and digitalization. Specifically, for banks with relatively high ICT readiness, increases in employee numbers do not translate into superior performance outcomes. One possible explanation is the existence of workforce redundancy in certain large Vietnamese banks, where a portion of employees may not possess the digital competencies required to effectively support technological transformation initiatives (Pham et al., 2022; Pham et al., 2024). These findings suggest that merely increasing workforce size may not enhance performance in highly digitalized banking environments unless accompanied by appropriate skill development and workforce restructuring strategies.

Table 5. Extended Model Results and Human Resource Digitalization Interaction Effects

Variables	Panel A – ROA	Panel B – ROE
EMP_N	0.0032*** [7.08]	0.0424*** [7.77]
DEPO	-0.0165*** [-4.31]	-0.2260*** [-2.52]
LOAN	-0.0018 [-0.44]	0.1304* [2.27]
EQUI	0.1979*** [16.67]	-0.1060 [-0.64]
LLP	0.0893*** [3.84]	-3.1530*** [-3.68]
CIR	-0.0304*** [-13.00]	0.0460 [0.11]
ICT Index	0.0098** [1.97]	0.1370** [2.20]
GDP	0.0005** [2.62]	0.0061* [2.43]
INF	0.0000 [0.96]	0.0025** [2.64]
$ICT \times EMP_N$	-0.0002* [-1.80]	-0.0023* [-1.68]

5. Discussion

The findings of this study provide strong evidence that human resources remain a critical determinant of bank performance, even in an era characterized by rapid digital transformation. This result extends the resource-based theory by demonstrating that human resources continue to function as strategic assets capable of generating sustainable competitive advantages within increasingly digitalized banking environments (Subramanian, 2005). While previous studies suggest that digitalization and automation reduce the need for human labor in banking operations (Bernini et al., 2022; Meena & Parimalarani, 2020; Nicoletti, 2021), the present findings indicate that workforce size continues to positively influence bank performance in emerging markets. Although many routine banking services have become automated and standardized through digital platforms, employees still play an indispensable role in customer relationship management, financial consulting, cross-selling activities, and the development of long-term client relationships. This finding supports the argument of Fasano and La Rocca (2024), who emphasize that technological solutions cannot fully substitute the expertise and interpersonal capabilities of banking professionals, particularly in serving business customers.

The results also reinforce the propositions of human capital theory by highlighting the positive contribution of employee-related expenditures to organizational performance. Investments in employee compensation, training, and professional development generate measurable returns in terms of improved bank outcomes. Higher

personnel expenditures often reflect superior employee competencies and greater organizational commitment to workforce development. Consistent with Becker (2009), Pavlović et al. (2024), and Rahman and Akhter (2021), the findings suggest that investments in knowledge, skills, and employee capabilities should be viewed as strategic investments rather than operational costs. In the context of digital transformation, continuous learning becomes increasingly important because technological advancements frequently alter the competencies required for effective job performance. Consequently, banks must invest in both employee development and talent retention through competitive compensation systems and targeted training initiatives (Bernini et al., 2022; Pham et al., 2024).

Another noteworthy finding concerns the contrasting effects of employee business productivity and employee revenue productivity on bank performance. Employee business productivity exhibits a negative relationship with performance, whereas employee revenue productivity contributes positively. This result suggests that excessive emphasis on asset growth or business volume per employee may create operational pressures that do not necessarily translate into higher profitability. In contrast, focusing on revenue generation and value creation appears to be more closely aligned with improved organizational performance. These findings imply that banks should carefully evaluate the design of employee performance indicators and avoid relying solely on volume-based measures when assessing workforce effectiveness.

The analysis further reveals that the contribution of human resources varies according to the level of digitalization. While the number of employees positively affects performance across the full sample, the interaction analysis indicates a negative relationship between workforce size and performance among banks with higher ICT readiness. This finding suggests that the marginal benefit of adding employees declines as digital capabilities increase. In highly digitalized banks, excessive staffing may reduce efficiency and hinder performance, particularly when employees lack the digital competencies necessary to support technology-driven operations. This result is consistent with the findings of Bernini et al. (2022), who argue that digital transformation changes the optimal balance between labor and technology. Therefore, workforce quality and digital readiness may become more important than workforce quantity in technologically advanced banking institutions.

Regarding the control variables, the results indicate that loan outstanding positively influences bank performance, whereas customer deposits do not generate a similarly positive effect. This finding aligns with the structure of the Vietnamese banking industry, where lending activities remain the primary source of revenue generation (Nguyen, 2019). Furthermore, operating expenses exhibit a significant negative relationship with performance, which is consistent with previous studies emphasizing the importance of cost efficiency in banking operations (Al-Homaidi et al., 2020; Supriyono & Herdhayinta, 2019). Interestingly, loan loss provisions are positively associated with bank performance. Although previous research often reports a negative relationship due to increased provisioning costs (Vong & Chan, 2009), the Vietnamese banking context may provide a different explanation. Higher loan loss provisions may reflect prudent risk management practices and stronger regulatory compliance, both of which contribute to long-term financial stability (Nguyễn & Đặng, 2025).

The macroeconomic variables also produce expected results. Both GDP growth and inflation are positively related to bank performance, indicating that favorable economic conditions create opportunities for banks to expand lending activities and increase profitability. These findings are consistent with previous studies showing that economic expansion enhances banking sector performance through increased financial activity and credit demand (Aburime, 2008; Akbaş et al., 2012; Pasiouras & Kosmidou, 2007).

Although the ICT Index exhibits a positive coefficient, its impact on bank performance is not statistically significant. This finding suggests that technological

readiness alone may be insufficient to generate superior performance outcomes. The benefits of digitalization may depend on complementary organizational resources, particularly human capital and managerial capabilities. While investments in information and communication technologies create opportunities for efficiency improvement and business expansion, their effectiveness ultimately depends on how well these technologies are integrated into organizational processes and supported by a skilled workforce (Do et al., 2022; Nguyen, 2021).

Overall, the findings emphasize that human resources remain an essential component of banking success despite the increasing adoption of digital technologies. During the past decade, Vietnamese banks have significantly expanded technology-based operations and reduced reliance on traditional banking models (Omet, 2019). Nevertheless, the empirical evidence indicates that employees continue to play a fundamental role in generating organizational value. Even in highly digitalized environments, banks require skilled professionals capable of managing complex financial activities, delivering specialized services, and supporting technological innovation (Adesina, 2021; Kuchciak & Warwas, 2021).

From a practical perspective, several recommendations emerge from the findings. First, bank executives should exercise caution when implementing workforce reduction strategies. Although digital transformation may eventually decrease labor requirements, such effects may not yet be fully realized in emerging economies due to technological, institutional, and organizational constraints. Second, banks should continue investing in employee development through targeted training, reskilling initiatives, and competency enhancement programs. Human capital remains a valuable strategic resource that can complement technological investments. Third, performance evaluation systems should move beyond volume-based indicators and place greater emphasis on efficiency, innovation, and value creation. Finally, policymakers and regulatory authorities should establish frameworks that support workforce protection, continuous upskilling, and digital competency development. Such measures can help ensure that the banking workforce remains resilient and capable of adapting to the evolving demands of a digitally transformed financial sector.

6. Conclusions

The findings of this study demonstrate that, despite the rapid advancement of digital technologies and the increasing automation of banking operations, human resources continue to play a crucial role in determining bank performance. Although digital transformation has become an unavoidable strategic direction for the banking industry, the evidence from Vietnam suggests that banking remains fundamentally dependent on human capabilities. The results indicate that technological development alone is insufficient to generate superior performance outcomes. Instead, the successful implementation of digital transformation relies heavily on the quality, competence, and productivity of the workforce. Human resources remain essential for supporting innovation, facilitating customer engagement, and ensuring the effective utilization of digital technologies within banking institutions.

The study further highlights that investments in both technology and human capital are equally important for achieving sustainable organizational performance. Rather than viewing technology as a substitute for labor, banks should recognize its role as a complementary resource that enhances employee productivity, efficiency, and decision-making capabilities. Consequently, banking institutions should focus not only on technological investments but also on recruiting digitally skilled employees and providing continuous training programs that strengthen workforce competencies. Such initiatives will enable employees to adapt to evolving technological requirements and contribute more effectively to organizational objectives.

The findings also suggest that the relationship between human resources and technology is more complex than often assumed. The interaction between workforce productivity and digitalization may be influenced by organizational culture, managerial practices, and implementation challenges. Therefore, achieving the full benefits of digital transformation requires effective alignment between human resource strategies and technological initiatives. Banks that successfully integrate human expertise with digital capabilities are more likely to achieve superior performance and long-term competitiveness.

Despite its contributions, this study has several limitations. The most important limitation relates to the measurement of digitalization. Specifically, the ICT Index used in this study primarily reflects technological readiness and adoption capability, but it may not fully capture the broader dimensions of automation, digital transformation, and the interaction between technology and human resources. Future research should consider developing more comprehensive measures of digitalization and technological integration to better understand how technology and human capital jointly influence organizational performance. In addition, further studies may explore the moderating roles of organizational culture, leadership, and innovation capabilities to provide a deeper understanding of the mechanisms through which digital transformation affects banking performance.

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