Strategic Insights: The Paradox of Intellectual Capital's Role in Bank Efficiency

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Abstract-**This study investigates the impact of intellectual capital (IC)—the intangible assets and knowledge resources that drive value creation—and its components: human capital efficiency (HCE), structural capital efficiency (SCE), capital em- ployed efficiency (CEE), and relational capital efficiency (RCE), on the technical efficiency of Vietnamese commercial banks, including state-owned, foreign, and joint-stock institutions. While research in developed countries (e.g., USA, EU, Japan) consistently finds that robust IC investments improve bank performance, our analysis of an 8-year dataset from 30 Vietnamese banks reveals significant divergences. Notably, HCE consistently enhances efficiency across all bank types, whereas CEE exhibits an inverse relationship with performance, challenging traditional capital utilization paradigms. Moreover, the effects of SCE and RCE vary markedly by ownership: relational capital notably boosts efficiency in state-owned banks—likely reflecting government support—while its impact is less pronounced in foreign and joint-stock banks. These findings underscore the need for tailored strategies; banks should prioritize human capital investments and adjust capital strategies according to their unique operational contexts, while regulators might improve oversight by incorporating nuanced IC metrics. This research extends resource-based theory in an emerging market context by highlighting how the interplay between tangible and intangible resources, and their effects on efficiency, diverges not only from patterns observed in developed economies but also across different bank types.**

Keywords: Bank Efficiency, Capital Employed Efficiency, Human Capital Efficiency, Intellectual Capital, Resource-Based Theory

JEL Classification: G21, O34, D24

1. INTRODUCTION

In an era where information and expertise define success, the financial services sector increasingly depends on both physical and knowledge-based resources—with a growing dominance of the latter driving bank performance [15, 7]. Intellectual capital (IC), encompassing investments in human resources, brand development, systems, and processes, is crucial not only for achieving efficiency but also for enhancing competitive positioning, optimizing resource utilization, and fostering innovation. IC improves sustainable competitive advantage because competitors cannot easily replicate it [41], with firms increasingly relying on intangible capabilities to withstand external pressures and competition [39, 17].

Extensive studies in developed economies (United States, European Union, Japan) consistently find a positive relation- ship between IC and bank performance, with Human Capital Efficiency (HCE) as the primary driver of profitability [35, 31, 30]. Research using the Value Added Intellectual Coefficient (VAIC) model confirms that banks with strong IC investments experience improved returns, as measured by return on assets (ROA) and return on equity (ROE) [10, 94]. Findings from emerging markets like India, China, Indonesia, and Thailand reveal varying emphasis on IC components depending on country-specific contexts [37, 11, 95].

Despite extensive research, there is limited empirical evidence exploring IC's impact in transitional economies like

Vietnam, a country that has rapidly shifted from a centrally planned to a market-driven economy. Vietnam's banking sector has undergone significant restructuring, including policies to manage non-performing loans and increase capital adequacy requirements [48]. This research investigates how IC components—HCE, SCE, CEE, and Relational Capital Efficiency (RCE)—contribute to Vietnamese bank efficiency in an evolving environment where market mechanisms and regulatory structures are still solidifying.

Grounded in Resource-Based Theory (RBT), this study applies the Modified VAIC (MVAIC) model, which incorpo- rates RCE as a distinct component. Unlike previous studies that predominantly use Data Envelopment Analysis (DEA) [81, 69, 58], this research employs Stochastic Frontier Analysis (SFA) to better account for both internal inefficiencies and external market shocks. Notably, while studies in India and Thailand found positive correlations between Capital Employed Efficiency (CEE) and bank efficiency, this study identifies a negative association in Vietnam, suggesting unique capital allocation patterns in transitional economies.

This research is particularly timely as Vietnam's financial sector continues to evolve, offering insights for enhancing bank efficiency in other emerging markets undergoing similar transitions. The remainder of this paper is structured as follows: Section 2 explores the relationship between IC and efficiency in the Vietnamese context, reviews relevant literature, and formulates hypotheses. Section 3 outlines the data set and research design. Section 4 presents efficiency scores and discusses empirical results concerning the association between IC and efficiency. Finally, Section 5 concludes with practical and theoretical implications, offering valuable insights for policymakers and industry practitioners.

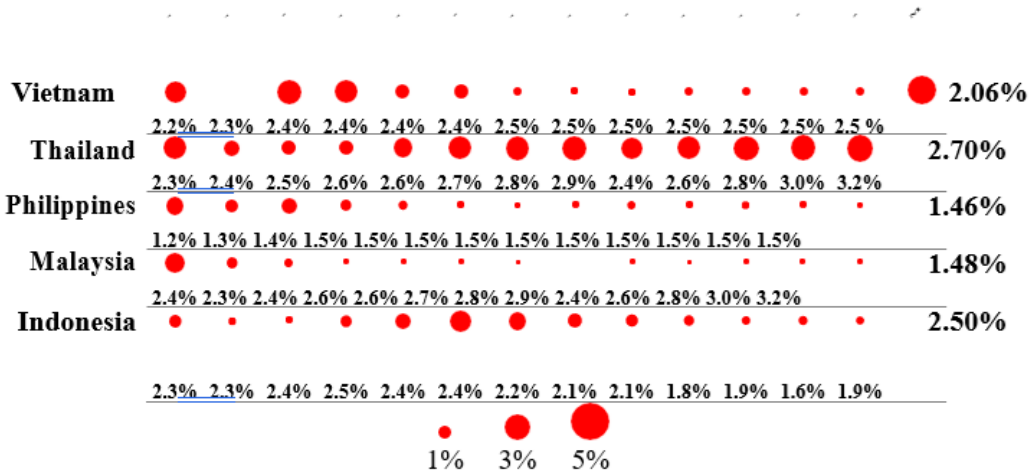
1. Vietnamese Banking: Historical Context, Research, Theoretical Framework, and Hypotheses

1.1. Introduction to Vietnam's Banking Sector

Vietnam, the smallest of the five ASEAN nations, has made significant strides in transitioning from central planning to a market economy. In 1986, political and economic upheavals led to the nation achieving lower-middle-income status. By 2020, per capita income increased from $43 to $2,777 [18], and the poverty rate fell from about 70% in 2002 to less than 6% (at US$3.2 per day) as of 2019 [63]. Banking grew with the economy, and as of 2020, the banking sector had $521 billion in assets, surpassing the GDP [53]. Despite its development, financial asset bubbles and intra-bank lending threatened the system's collapse in the second half of 2009. The government adopted three major restructuring initiatives from 2011 to 2019 [82] to stabilize the financial sector and address both short-term and long-term issues. The first approach was to enhance financial capacity to resolve non-performing loans (NPLs), severely damaging bank productivity and health [75]. Vietnam had the highest NPL rates among core ASEAN countries from 2012 to 2014, mainly due to the 2009 commercial bank real estate collateral devaluation. As shown in Table 1, expanding bubbles represent non-performing loans as a percentage of gross loans, with the legend indicating 1%, 3%, and 5% NPL reference sizes. To keep NPLs below 3%, the State Bank of Vietnam (SBV) created the Vietnam Asset Management Company (VAMC) and required banks to sell NPLs for SBV bonds [36]. Banks had to increase charter capital and revenues to eliminate problematic loans. Management systems were rebuilt to match global standards, including improved internal control, audit systems, strategic planning, managerial competency, and Basel Committee-like risk management. The third method increased minimum equity requirements to improve bank operations, leading to a significant decline in NPLs by 2019. Over the 2019-2023 period, Vietnam's NPL levels remained steady, reflecting the continued effectiveness of these measures and the economy's resilience.

Thailand and Malaysia have seen rising NPLs due to economic slowdowns and sector-specific vulnerabilities exacerbated by the COVID-19 pandemic. In Thailand, vulnerable sectors like tourism saw increased loan defaults as businesses faced prolonged closures and reduced demand [9]. Malaysia experienced a similar rise in NPLs, driven by the pandemic's economic impact, lockdowns, and rising interest rates, further strained borrowers' ability to repay [79]. In contrast, the Philippines, like Vietnam, maintained stable NPL levels from 2019 to 2023, with the Philippine bank- ing sector's resilience, supported by strong regulatory frameworks, helping it weather global challenges. These trends highlight the varying impacts of regional economic pressures, with Vietnam and the Philippines showing resilience while Thailand and Malaysia faced more pronounced challenges.

Table 1: Non-performing loans as a percentage of gross loans (2011-2023)



Efficiency is pivotal for the economic advancement of transition economies, yet the impact of bank ownership type on efficiency remains uncertain [50]. Despite this uncertainty, the liberalization of financial markets enhances access to domestic markets, thereby fostering economic growth. In Vietnam, there are three categories of bank ownership: State- owned commercial banks (SOCBs), which are wholly owned by the government or state sector; Joint-stock commercial banks (JSCBs), which are co-owned by the public and private sectors; and Foreign banks (FBs), which include foreign bank branches with overseas headquarters, and joint-venture banks, with ownership divided equally between foreign and domestic banks. As indicated in the stacked bar chart in Figure 1, the number of SOCBs increased from five to seven over the study period, while the number of FBs rose from nine to eleven. Despite these increases, the total number of banks declined from 51 to 46 over the study period.

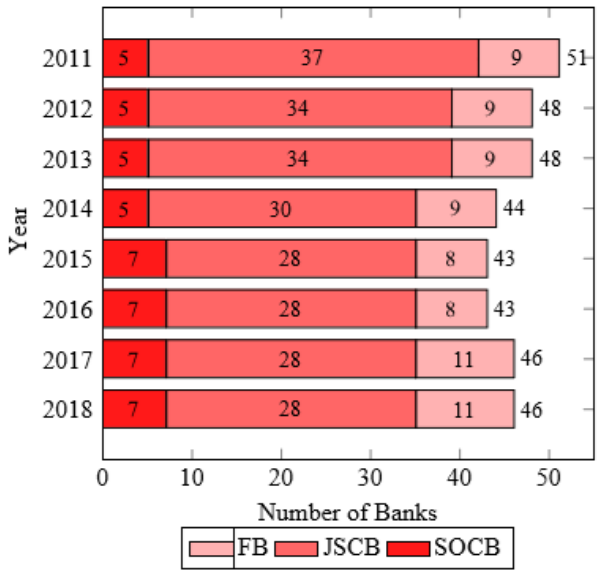


Figure 1: Banks by type and year

1.2. Bank Efficiency

The concept of 'productive efficiency' was first introduced by [28], who further divided it into allocative and technical efficiency. Allocative efficiency measures a firm's ability to produce optimally by aligning marginal input costs with pricing. In contrast, technical efficiency (TE) assesses a business's capability to generate maximum output

from a given set of inputs. In financial terms, TE pertains to an institution's capacity to create diverse financial products or services from various inputs. Since financial institutions operate as intermediaries, achieving efficiency is essential for their success. The performance of commercial banks has been a focal point of extensive research due to the variety of products and services they manage. Researchers frequently employ frontier-based production models to differentiate between high and low-performing institutions, given the strong negative correlation between efficiency and bank failure. Enhanced efficiencies reduce future risks for banks and demonstrate effective management. Stochastic Frontier Analysis (SFA) is a prevalent frontier-based approach; [64] argues it better suits banks' production functions with less variability than Data Envelopment Analysis, another commonly used model.

1.2.1. Vietnamese Bank Efficiency

The research on the effectiveness of Vietnamese financial institutions is primarily centered on efficiency. From 1999 to 2008, the Vietnamese government implemented restructuring programs. However, these efforts were hindered by financial crises and economic downturns [91]. According to a study by [49], the liberalization of the banking sector in Vietnam resulted in private banks experiencing benefits. Still, it also led to a decline in the efficiency of the deposit and loan divisions within the sector from 2008 to 2018. [65] found that Vietnamese banks achieved an average efficiency rate of 92.8% during the period from 2000 to 2014. Studies indicate that international banks perform better than do- mestic banks in emerging countries. [60] observed that state-owned commercial banks (SOCBs) in Vietnam exhibited superior profit efficiency compared to foreign banks (FBs). However, [92] conducted a study using various assessment methods and found no significant differences.

1.3. Intellectual Capital (IC)

IC encompasses intangible assets that provide organizations unique competitive advantages, including knowledge, in- formation, intellectual property, and experience [96]. Competitors can not easily replicate these assets, enhancing sustainable competitive advantage [8]. The VAIC model by [74] is widely adopted for its simplicity and effectiveness in cross-enterprise comparison, highlighting three efficiency components: HCE, CEE, and SCE, as detailed in Table

This comprehensive framework illustrates how each efficiency component contributes to various dimensions of organizational performance, including financial metrics (return on assets, profitability), operational capabilities (adaptability, process efficiency), and innovation capacity, thereby supporting the multifaceted nature of IC's influence on organizational success. IC protects firms during economic turmoil through intangible assets like customer loyalty, patents, and human resource skills [88]. To address VAIC limitations, [86] incorporated RCE in the modified VAIC (MVAIC) method. IC synthesizes and evaluates organizational intangible resources [1], with [33] noting its importance for sustained competitive advantages in knowledge-intensive sectors, particularly banking.

The significance of these efficiency components is supported by extensive empirical research across industries and market conditions. HCE, as defined by [83], represents an organization's collective employee knowledge, fostering innovation and aligning with RBT, while [42] indicates that substantial human capital enables better market disruption adaptation. SCE encompasses organizational capabilities, including inventions, processes, copyrights, patents, technologies, strategies, and systems, supporting experimentation and continuous learning [13], with [4] arguing that robust SCE enhances organizational agility and opportunity capitalization. CEE quantifies value created from tangible capital employment, crucial for efficient resource allocation through strategic planning and budgeting processes [21]. IC creates entry barriers through unique knowledge, patents, and established relationships, preventing easy imitation by new entrants. [51] emphasizes patents' role in protecting innovation, particularly in technology-driven industries, while [61] highlights the competitive edge of strong stakeholder relationships.

Dynamic capabilities are essential in renewing and integrating IC for sustained competitive advantages. Sensing capability involves market opportunity creation and needs estimation, enhancing innovation performance by identifying trends and opportunities, thus moderating relationships between human capital, structural capital, relational capital, and innovation performance [29]. Seizing capability integrates and capitalizes on these opportunities, enabling intangible resource renewal and integration, mainly moderating human and structural capital relationships, though not affecting relational or social capital and innovation performance similarly [59]. Firms integrating IC with strategic foresight improve both short-term performance and long-term sustainability [78], while IC influences competitive advantage, resilience, and societal impact beyond immediate financial gains, with strategic foresight integration enabling organizations to anticipate challenges, develop sustainable practices, and align resources with long-term goals [5], ensuring adaptability and competitive edge maintenance during market disruptions.

1.4. Hypothesis Development

Building upon the literature and the RBT, this study hypothesizes that IC and its components - HCE, SCE, CEE and RCE —have a significant positive impact on bank performance. Given the role of IC in fostering innovation, strategic advantage, and operational efficiency, we expect that higher levels of IC correlate with improved financial performance metrics across Vietnamese banks.

Table 2: Efficiency Components and Their Influence on Organizational Performance

Ac.	Factor	Definition	Key Literature	Influence on Efficiency
HCE	Human Capital Efficiency	Measures how well employees' skills and knowledge are leveraged to produce value.	[66], [89], [46], [71]	Positive impact on Return on Assets, Return on Eq- uity, and Employee Productivity. Enhances organiza- tional performance and sustainability.
SCE	Structural Capital Efficiency	Refers to how effectively structural assets (processes, intellectual prop- erty, etc.) support performance.	[27], [23], [68], [62]	Enhances asset turnover, reduces operating costs, and promotes innovation and adaptability. Important across sectors like ICT and education.
CEE	Capital Employed Efficiency	Measures the effectiveness of cap- ital (equity and debt) in generating revenue and profits.	[66], [34], [2], [52]	Improves ROCE and profitability and optimizes in- vestments, especially in capital-intensive industries like banking and manufacturing.
RCE	Relational Capital Efficiency	Evaluates how well external re- lationships (customers, suppliers, etc.) are leveraged to create value.	[67], [85], [84]	Enhances technical efficiency, reduces transaction costs, and fosters innovation through collaboration. Critical in tech-driven industries.

H1: IC correlates with improved bank performance.

The rationale for **H**1 is rooted in the RBT, which posits that intangible assets such as knowledge, experience, and intellectual property provide a strategic advantage, enabling banks to outperform their competitors. The literature supports that IC plays a pivotal role in enhancing profitability, adaptability, and innovation, which are critical to bank success [96]. By leveraging their intellectual capital, banks can improve operational efficiency, optimize resource allocation, and ultimately increase their financial performance [22].

H2*a*: Increased HCE correlates with improved bank performance.

The rationale for **H**2*a* is that HCE, which refers to the knowledge, skills, and expertise embodied in bank employees, is a key driver of innovation and operational excellence. According to [83], highly skilled employees contribute to more effective problem-solving, better customer service, and innovative financial products. These factors align with RBT principles, where superior human resources give banks a competitive edge, enhancing their profitability and market position.

H2*b*: Increased SCE correlates with improved bank performance.

The rationale for **H**2*b* is that SCE, which encompasses organizational processes, strategies, technologies, and inno- vation capabilities, directly enhances a bank's ability to operate efficiently. As highlighted by [13], well-developed structural capital fosters a culture of innovation and learning, enabling banks to adapt to changing market conditions more effectively. This efficiency in operations and innovation leads to enhanced financial performance, as banks can deliver services more effectively and with lower costs.

H2*c*: Increased CEE correlates with improved bank performance.

The rationale for **H**2*c* is that CEE, which reflects how effectively a bank utilizes its capital to generate value, is a

critical determinant of financial success. Efficient use of capital, as indicated by [21], enables banks to optimize their resource allocation, ensuring higher investment returns. This aligns with the RBT's focus on leveraging valuable, rare, and inimitable resources to achieve superior financial performance.

H2*d*: Increased RCE correlates with improved bank performance. The rationale for **H**2*d* is that RCE, which refers to the quality and strength of a bank's external relationships (e.g., customer loyalty, brand image, and strategic partnerships), has a substantial impact on bank performance. Strong relational capital, as outlined by [47], enhances a bank's market position by fostering trust and loyalty, increasing customer retention and profitability. This is consistent with RBT principles, which emphasize the value of external relationships in maintaining a competitive advantage.

1.5. Conceptual Schema

Resource-based theory (RBT) has emerged as a pivotal framework for understanding how firms leverage their strategic resources, particularly IC, to achieve sustainable competitive advantage. According to RBT, organizations can establish and maintain competitive superiority by strategically deploying resources that exhibit characteristics of value, rarity, and inimitability [98]. This theoretical foundation emphasizes that intellectual capital, encompassing both human and structural dimensions, serves as a strategic asset through which firms can attain superior financial performance and competitive positioning [93]. The distinctive nature of IC, characterized by its imperfect mobility and resistance to substitution, sets it apart from conventional resources such as physical and financial capital, thereby reinforcing its strategic significance in the contemporary business landscape [73].

The application of RBT in understanding firm performance and efficiency has garnered substantial attention in man- agement and economics literature, particularly with IC management. This theoretical framework emphasizes that knowledge and IC represent crucial production variables in a knowledge-driven economy, serving as fundamental drivers of enduring competitive advantage [26]. The management of IC, with its strategic attributes of scarcity, value, and inimitability, has become a critical managerial responsibility, directly influencing organizational success. Through the RBT lens, numerous studies have established that the effective organization and deployment of resources and capabilities, including administrative competencies, routines, and organizational processes, significantly impact a firm's value-creation potential. This study extends existing research by examining the relationship between IC and efficiency through the RBT framework, as illustrated in Figure 2, where intangible components (HCE, SCE, and RCE) and tangible elements (CEE) are analyzed within the context of organizational performance.

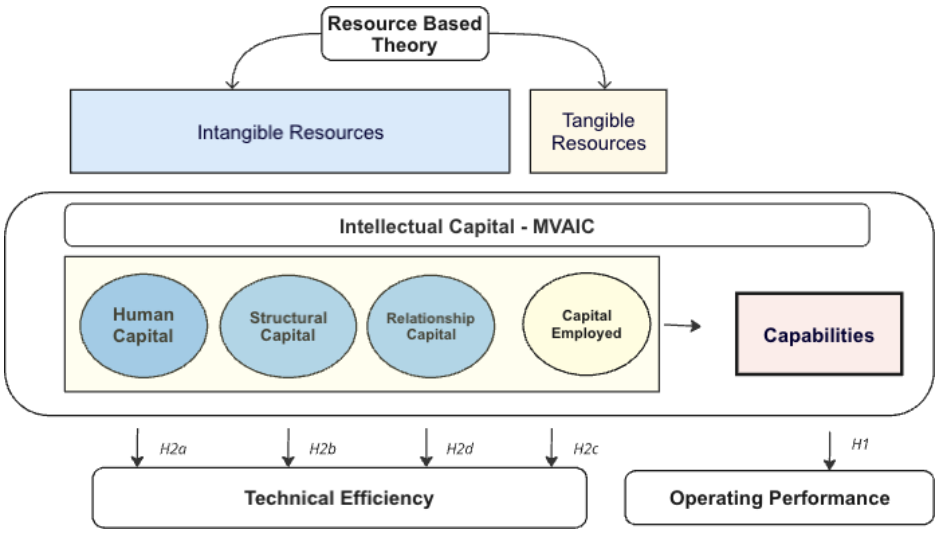


Figure 2: Theoretical Framework

2. Research Design and Data Collection

2.1. Measurement of Intellectual Capital

This study adopts the modified value-added intellectual coefficient (MVAIC) model as an intellectual capital proxy, building on prior methodologies [96]. The MVAIC model measures a firm's intellectual capital efficiency by evaluating value creation through invested monetary units. This approach extends the traditional VAIC model by incorporating relational capital as a distinct and indispensable component of value creation, addressing limitations in prior frameworks [32].

The MVAIC formula is defined as:

$$MVAIC_i = ICE_i(HCE_i + SCE_i + RCE_i) + CEE_i \quad (Eq.\ 1)$$

where ICE_i refers to intellectual capital efficiency, and the components are calculated as follows:

$$HCE_i = \frac{VA_i}{HC_i}, \quad SCE_i = \frac{SC_i}{VA_i}, \quad RCE_i = \frac{RC_i}{VA_i}, \quad CEE_i = \frac{VA_i}{CE_i} \quad (Eq.\ 2)$$

HCE_i represents total investment in salaries and wages, while SCE_i is computed as:

$$SC_i = VA_i - HC_i \quad (Eq.\ 3)$$

RCE_i reflects investments in customer relationships, supplier networks, and external relational assets, and CEE_i repre- sents the book value of net assets.

Value-added (*VA*) is computed as:

$$VA_i = \text{Net Income} + \text{Employee Salaries and Benefits} + \text{Interest} + \text{Tax} \quad (Eq.\ 4)$$

The MVAIC model improves upon the traditional VAIC framework by treating structural capital as a separate compo- nent of IC rather than a residual of human capital. Additionally, the explicit inclusion of relational capital enhances the model's ability to capture the broader spectrum of intangible assets that contribute to firm value creation [45]. This refinement is particularly relevant in knowledge-intensive industries, where firms leverage human, structural, and relational capital to achieve sustainable competitive advantage [57].

2.1.1. Measurement of Bank Efficiency

To quantify efficiency, this study employs the Stochastic Frontier Analysis (SFA) method, as suggested by[6]. While a comprehensive evaluation of a bank's efficiency score considers three dimensions—intermediation, profitability, and production—this research focuses on the intermediation dimension. This dimension assumes that banks collect deposits and convert them into loans and other assets using labor and capital. As the relevant literature defines, the fundamental concept of SFA technical efficiency (TE) is expressed as the ratio of realized output to maximum attainable output. The parameters of the SFA model are estimated using the maximum likelihood estimation method, which calculates the likelihood function in terms of two variance parameters [44]. An efficiency value ranges between zero and one, where a value close to one indicates a smaller gap between actual and maximum possible output, signifying high efficiency. In contrast, a value close to zero implies inefficiency, suggesting that random factors do not control SFA output. Following [24], we specify a cost frontier model with two-output (γ) and three-input (w) parameters via the translog functional form. The SFA inputs and outputs are detailed in Table 4 under Stochastic Frontier arguments.

It is important to note that while regulatory frameworks (e.g., Basel II/III, national capital adequacy guidelines) directly affect aspects such as goodwill and intangible asset valuation, their impact is indirectly captured through our bank-specific control variables (e.g., CAP, SOLV, etc.). Moreover, during the study period, the regulatory environment in Vietnam was relatively stable, with gradual changes, which minimized the need for explicit inclusion. Given our methodological approach focusing on internal drivers of efficiency and the management of IC, the exclusion of explicit regulatory variables maintains the analytical integrity while appropriately capturing their effects through existing controls.

2.2. Empirical Models

Given the truncated distribution of bank efficiency scores, which range between 0 and 1, employing ordinary least squares (OLS) regression may lead to biased coefficient estimates due to its reliance on the assumption of a normal and homoskedastic distribution. We follow [80] and utilize bootstrapped truncated regression models to address this issue. This approach, which uses 5000 simulated observations, ensures the model's goodness of fit and provides bootstrap confidence intervals for the parameter estimates $\beta_1 - \beta_3$.

For additional robustness, Tobit and fractional regression analyses are also employed, as these methods impose the necessary constraints on the dependent variables [43]. Two models are tested in this study: Eq.5 examines the impact of IC as a composite measure on bank efficiency, while Eq.6 investigates the effects of individual components of IC on bank efficiency.

$$Eff_{i,t} = \beta_0 + \beta_1 \mathrm{MVAIC}_{i,t} + \mathrm{BSA}_{i,t} + \mathrm{ISA}_{i,t} + \mathrm{CSA}_{i,t} + \mathrm{Year}_i + e_{i,t} \quad (Eq.\ 5)$$

$$Eff_{i,t} = \beta_0 + \beta_1 \mathrm{HCE}_{i,t} + \beta_2 \mathrm{SCE}_{i,t} + \beta_3 \mathrm{CEE}_{i,t} + \beta_4 \mathrm{RCE}_{i,t} + \mathrm{BSA}_{i,t} + \mathrm{ISA}_{i,t} + \mathrm{CSA}_{i,t} + \mathrm{Year}_i + e_{i,t} \quad (Eq.\ 6)$$

In this context, $Eff_{i,t}$ represents the technical efficiency scores of bank *i* at time *t*, ranging from zero (no efficiency) to one (perfect efficiency). To account for various confounding factors on bank performance, the models include bank-specific arguments (BSA), industry-specific arguments (ISA), and country-specific arguments (CSA), as outlined in Table 4. The BSA includes variables like return on assets (ROA), total equity (CAP), liquidity (LIQ), total assets (SIZE), and capital structure (SOLV), reflecting key financial characteristics and operational aspects of the banks. ISA captures industry-level factors, such as market concentration, which affect a bank's performance with its competitors. CSA incorporates macroeconomic factors like GDP growth and inflation, which are crucial for controlling the broader economic environment's impact on bank efficiency. Individual year dummy variables are also included to control for year-specific effects.

2.3. Descriptive Data Analysis

The data was sourced from BankFocus, encompassing the timeframe of 2011 to 2018 and explicitly focusing on thirty commercial banks in Vietnam - a period that captures a critical phase of structural reform and market liberalization in Vietnam's banking sector with consistent accounting practices and reporting standards. The sample includes historical and contemporary commercial banks to mitigate the risk of survivorship bias. Banks were systematically filtered to exclude those that lacked sufficient financial data for SFA or IC, had less than two consecutive years of data, negative equity, interest expenses, or total revenue. This approach ensures robust analysis without confounding effects from transitional regulatory shifts. The efficiency scores, displayed in Table 3 and categorized by bank and year, experienced an average decline of 0.95 percent throughout the specified time frame. None of the banks could attain complete efficiency, with PVCom achieving the highest recorded efficiency score of 0.89.

In contrast, VPB received the lowest score of 0.70. Based on the sample, the average efficiency score is 0.818, suggest- ing that the average bank can boost output by 18.2 percent without needing extra resources. VBARD held the position of the largest bank based on its total assets, while VIETIN achieved the highest ranking in terms of its mean efficiency score. Table 4 additionally classifies banks based on their magnitude, indicating that VBARD held the top position as the largest bank. Foreign banks (FB) exhibited lower efficiency rankings, placing in the bottom third, in contrast to the outcomes observed in other nations. This could be attributed to market entry constraints that impeded their capacity to adjust to the cultural and trust prerequisites of the local community. Foreign banks wholly owned by foreign entities were prohibited until 2008 and were not granted complete national treatment until 2011.

Table 3: Efficiency scores by banks by years

			Year								CAGR
Size SOCB 1	**Name of Bank**	**Abbreviation**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	
1	Vietnam Bank for Agriculture and Development (Agribank)	VBARD	0.000	0.783	0.763	0.807	0.793	0.784	0.766	0.734	-0.009
2	Vietnam CSJ Bank for Industry and Trade (VietinBank)	VIETIN	0.836	0.829	0.828	0.823	0.822	0.809	0.792	0.782	-0.008
3	CB for Foreign Trade of Vietnam (Vietcombank)	VCB	0.840	0.846	0.842	0.844	0.838	0.825	0.813	0.803	-0.006

JSCB											
4	Sai Gon Joint Stock CB	SCB	0.000	0.000	0.836	0.839	0.838	0.000	0.826	0.794	-1.03%
5	Saigon Thuong Tin JS CB (SACOMBANK)	SBS	0.821	0.805	0.805	0.788	0.798	0.790	0.800	0.743	-1.24%
6	Asia Joint Stock CB	ACB	0.846	0.812	0.818	0.812	0.803	0.791	0.779	0.766	-1.23%
7	Military Joint Stock CB	MBB	0.853	0.842	0.843	0.835	0.826	0.805	0.776	0.748	-1.63%
8	Vietnam Prosperity JS CB	VPB	0.000	0.000	0.817	0.809	0.775	0.758	0.718	0.703	-2.47%
9	Vietnam Technological and JS CB (Techcombank)	TCB	0.850	0.832	0.823	0.817	0.809	0.801	0.793	0.780	-1.07%
10	Saigon - Hanoi JS CB	SHB	0.847	0.836	0.841	0.828	0.821	0.807	0.795	0.803	-0.66%
11	Vietnam Export Import JS CB (EXIMBANK)	EIB	0.859	0.830	0.841	0.838	0.809	0.806	0.793	0.763	-1.47%
12	Ho Chi Minh City Development JS CB	HDB	0.000	0.000	0.850	0.830	0.811	0.809	0.786	0.774	-1.55%
13	Lien Viet Post JS CB	LPB	0.000	0.000	0.834	0.841	0.829	0.816	0.786	0.771	-1.30%
14	Southeast Asia JS CB	SSB	0.000	0.000	0.000	0.000	0.000	0.000	0.835	0.818	-1.02%
15	Vietnam Maritime CS Bank	MSB	0.000	0.000	0.829	0.805	0.791	0.794	0.788	0.782	-0.97%
16	Vietnam Public JS CB	PVCOM	0.000	0.000	0.891	0.000	0.818	0.812	0.000	0.000	-2.29%
17	VietNam International JS CB (VIB)	VIB	0.000	0.000	0.836	0.829	0.824	0.818	0.803	0.783	-1.09%
18	Tien Phong JS CB	TPB	0.000	0.000	0.864	0.860	0.862	0.849	0.815	0.778	-1.73%
19	An Binh JS CB	ABB	0.000	0.000	0.849	0.842	0.825	0.815	0.802	0.793	-1.13%
20	Bac A JS CB	BACA	0.000	0.000	0.842	0.847	0.842	0.834	0.832	0.819	-0.46%
21	National Citizen JS CB	NVB	0.842	0.819	0.835	0.834	0.831	0.806	0.806	0.000	-0.62%
22	Bao Viet JS CB	BVSC	0.000	0.000	0.854	0.000	0.000	0.839	0.838	0.834	-0.59%
23	Nam A JS CB	NAB	0.000	0.000	0.853	0.839	0.825	0.810	0.000	0.000	-1.28%
26	Kien Long JS CB	KLB	0.000	0.000	0.825	0.795	0.795	0.777	0.753	0.728	-2.06%
27	Petrolimex Group JS CB	PGB	0.000	0.000	0.845	0.842	0.834	0.829	0.812	0.796	-0.99%
29	Mekong Development JS CB	MDB	0.000	0.000	0.796	0.823	0.000	0.000	0.000	0.000	1.68%
FB 25	Indovina Bank*	IVB	0.000	0.000	0.847	0.850	0.846	0.854	0.835	0.830	-0.003
24	Standard Chartered Bank (Vietnam)	SCBV	0.000	0.000	0.830	0.830	0.800	0.803	0.787	0.000	-0.011
28	Woori Bank Vietnam	WB	0.000	0.000	0.000	0.000	0.000	0.000	0.855	0.834	-0.012
30	Hong Leong Bank Vietnam Limited	HLBVN	0.000	0.000	0.000	0.827	0.826	0.000	0.000	0.000	-0.001

Note: Colors indicate the minimum (light red) and maximum (dark red) efficiency scores for each bank across the years. Growth rates are estimated as the annual compound growth rate from the first non-zero observation to the last non-zero observation. *Indicates a Joint Venture Bank. The joint-venture partners are Vietnam Joint Stock Commercial Bank for Industry and Trade (Vietinbank) and Cathay United Bank in Taiwan (CUB). Size ranks banks from largest to smallest based on Total Assets, with one being the largest. Commercial Bank are denoted as CB

The values for the IC arguments are presented in Table 4. The mean MVAIC score is 3.81, which closely matches [38] findings. HCE, SCE, CEE, and RCE values are all positive; however, the minimum values for SCE and RCE are negative, suggesting a significant range in value generation. HCE is identified as the primary element of MVAIC. In addition, Table 4 shows that Vietnamese banks' average total assets (SIZE) are around VND 5.04 trillion. This indicates the limited adoption and reach of banking services in Vietnam, with only 21% of adults having a bank account at the beginning of the study period, which increased to 30% in 2017. The table also presents summary statistics on efficiency inputs and factors specific to individual banks, industries, and countries. CB represents Commercial Bank, JS represents Joint Stock

Table 5 presents the results of unit root tests and variance inflation factor (VIF) analysis. The Phillips Perron (PP) test does not provide evidence against the null hypothesis of a unit root for four control variables: liquidity, solvency, income diversity, and inflation. However, the PP test performs poorly with small sample sizes, typically between 100 and 10,000 observations [20]. Using the Augmented Dickey-Fuller (ADF) test, we find that all variables are stationary.

Table 4: Sample descriptive analysis

Variable	Description	Average	SD	Min	Max
Stochastic Frontier Arguments					
y1	Output 1: Total Loans. Net loans (gross loans - reserve for loan loss)	1684145.0	1592669.0	27764.8	7145195.0
y2	Output 2: Total Financial securities. Securities held to maturity + securities held for sale	7108681.0	9281370.0	98868.9	46700000.0
w1	Input 1: Price of deposits. Interest expense / total deposits	431539.0	497166.0	3940.0	2424408.0
w2	Input 2: Price of labor. Salaries / Total Assets	85276.0	111321.0	4684.0	636584.0
w3	Input 3: Price of physical capital. Expenditure on premises + fixed assets / premises + fixed assets	31128.0	43082.0	-42.0	308570.0
TOC	Total Operating Cost	169456.6	200715.6	9452.6	1080252.0
TE	Technical Efficiency	0.8153	0.0296	0.7034	0.8913
Intellectual	**Capital Arguments**				
MVAIC	Modified Value added intellectual capital calculated as per Eq 1	3.811	1.056	1.651	6.894
HCE	Human capital efficiency as per Eq. 2	2.763	0.894	0.927	5.488
SCE	Structure capital efficiency as per Eq. 2	0.592	0.161	-0.079	0.818
CEE	Capital employed efficiency as per Eq. 2	0.283	0.156	0.019	0.795
RCE	Relational capital efficiency as per Eq. 2	0.174	0.162	-0.003	1.078
VA	Value added as per Eq. 4	253596.600	344997.200	5885.200	1920939.000
Bank Specific Arguments (BSA)					
ROA	Net income to average assets ratio	0.007	0.006	-0.010	0.029
CAP	Logarithm of total equity	678614.000	640017.300	134637.600	2843491.000
LIQ	Liquid assets to total assets ratio	0.000	0.000	0.000	0.001
SIZE	Logarithm of total assets	15.517	1.130	12.531	17.844
SOLV	Shareholders' equity to total assets ratio	0.099	0.078	0.033	0.614
IncDiv	Non-interest income to total operating income	-0.156	10.534	-120.043	14.361
OWN	SOCB, JSCB, and FB dummy variable	0.051	0.221	0.000	1.000
Industry Specific Arguments (ISA)					
INDcon	Industry Concentration. Total assets of largest 5 banks / Total assets	0.5961	0.0625	0.5460	0.7973
Country Specific Arguments (CSA)					

Note: All figures in millions of USD except as indicated. Data sourced from BankFocus and World Bank.

The VIF test results indicate that all VIF values are below 10, suggesting no severe multicollinearity among the independent variables. Specifically, HCE and SCE exhibit moderate correlation (VIF < 6), but remain within an acceptable range, ensuring that collinearity does not significantly distort the parameter estimates. These results confirm that the inclusion of all IC components—HCE, SCE, CEE, and RCE—does not introduce problematic multicollinearity in the regression model. The findings support the robustness of the empirical design and are consistent with prior research on IC measurement and its relationship with firm efficiency [12].

Table 5 (Panel C) displays the Pearson correlation coefficients for IC, efficiency, and regression control variables. The correlation figures reveal a positive relationship between MVAIC and efficiency, indicating that increased IC is asso- ciated with higher efficiency. Analyzing the individual IC components, we observe that all the intangible resources bring increased efficiency, except for CEE. The inverse relationship between CEE and efficiency aligns with the find- ings of [90]. Interestingly, while CEE negatively correlates with efficiency, it positively correlates with return on assets (ROA). In many studies, CEE has been found to have a significantly positive association with at least one key performance metric [97].

Table 5: Unit Root Tests, VIF, and Correlation Heatmap

Panel A			**Panel B**		**Panel C: Correlation Heatmap**				
Unit Root Tests			**VIF**		Variable				
Variable	ADF Test	PP Test	VIF	1/VIF	MVAIC	HCE	SCE	CEE	RCE
HCE	140.210***	248.099***	5.14	0.19	HCE	↑↑ 0.89			
SCE	126.726***	215.105***	5.94	0.17	SCE	↑↑ 0.89	↑↑ 0.89		
CEE	91.526***	137.484***	1.30	0.77	CEE	↑ 0.45	↑ 0.44	↑ 0.44	
RCE	153.916***	277.953***	1.52	0.66	RCE	↓ -0.41	↓ -0.54	↓ -0.34	↓ -0.34
Mean VIF			3.64						

Note: *Panel A Note:* ADF and PP are the Augmented Dickey-Fuller unit root and Phillips Perron tests. *Panel B Note:* VIF statistics were generated using truncated regression and are comparable to other models; thus, only this model is shown. *Panel C Note:* Color intensity represents correlation strength. Symbols: (perfect correlation), ↑↑ (strong positive), ↑ (moderate positive), (weak/no correlation), ↓ (moderate negative), ↓↓ (strong negative).

2. Findings and Analysis

2.1. Truncated, Fractional, and Tobit Regression Models

The regression results for the 240 bank-year observations, pooled data of 30 banks over eight years (2011 - 2018), are presented in Table 6, showing the outcomes of truncated, fractional, and Tobit regressions. In the first column of each regression, MVAIC is evaluated against efficiency, controlled by the study's bank, industry, and country-specific variables. The results indicate a significant positive relationship between MVAIC and efficiency, suggesting that IC positively impacts efficiency. This finding is consistent with [3] and [56] and highlights the numerous benefits banks gain from enhancing IC. Improved IC helps banks achieve management and shareholder profit objectives while ensuring financial stability, allowing them to avoid increasing asset risk and maintain profitability.

Only HCE and CEE showed statistical significance when examining the individual IC components, with CEE's co-efficient being strongly negative. The positive relationship between HCE and efficiency supports Hypothesis 2a, underscoring the crucial role of human capital in boosting efficiency through an enhanced knowledge base. Without the academic knowledge and practical experience HCE provides, banks may struggle to manage financial risks and client relations, resulting in decreased efficiency.

The significant negative coefficient for CEE suggests that greater capital resources reduce efficiency. This finding, which aligns with [3] and [19], does not support Hypothesis 2d. The authors have demonstrated a strong positive correlation between all IC components and efficiency, which might be linked to competition incentives. In highly competitive environments, banks strive for higher capital ratios. Still, they must maintain a certain level of capital depending on their asset risk, especially in countries with smaller banking sectors [16]. The State Bank of Vietnam mandates banks to maintain a capital adequacy ratio (CAR) 1% higher than the Basel II accord requires. While reducing capital levels might improve efficiency, it can complicate risk management. Consequently, banks must carefully evaluate this trade-off to enhance efficiency. supports the finding that greater capital employed decreases efficiency [87]'s conclusion that banks with larger capital buffers take fewer risks and are less profitable. This conclusion is further corroborated by the market capitalization control variable, which shows that greater capital reserves are linked to reduced efficiency.

Neither SCE nor RCE significantly impacted technical efficiency levels, providing no support for Hypothesis 2b or Hypothesis 2d. These SCE findings align with [70], who also found no significant relationship between SCE and performance. Similarly, [22] did not find a relationship between RCE and performance in European listed banks.

Analyzing the control variables, we first note the negative association between ROA and efficiency, suggesting that riskier banks are less efficient, as ROA connects abnormal operating activity with performance [40, 54]. Second, when examining individual IC components, the results reveal a positive association between bank size and efficiency, indicating that larger banks are more efficient in allocating expenditures. [72] supports this conclusion. Third, controlling for industry concentration did not influence bank efficiency levels, directly opposing the central tenet of the quiet life hypothesis, which asserts that market power enables businesses to raise prices and generate additional revenue otherwise wasted due to cost inefficiencies [14]. Fourth, the country-specific factors of GDP and inflation were inversely associated with efficiency. This latter finding suggests that a favorable economic environment with increased GDP per capita may lead to increased bank savings and deposits, reduced customer deposit fees, and decreased efficiency due to lower inputs [55]. Inflation, a critical component of economic growth, adversely affects bank profitability, particularly when undetected. Profitability hinges on effective cost control, but rising inflation distorts cost-cutting efforts.

2.2. Results by Bank Type

While the earlier models present our baseline data, we also conduct sensitivity assessments by evaluating a subset of banks by ownership type. We analyze SOCB, JSCB, and FB separately using fractional regression due to the small sample size and conditional mean. Table 7 (Panel A) shows that despite lower efficiency scores for FB, MVAIC reports a positive impact on efficiency, as do SCE and CEE. These results reveal notably different outcomes than

when testing all banks collectively, as HCE showed a significantly negative relationship with efficiency. This finding directly contrasts earlier conclusions, suggesting that structural capital and capital employed were internally transformed to the bank's advantage differently than in other bank ownership types.

For SOCB, all individual IC variables are statistically significant, with SCE and CEE showing an inverse relationship with efficiency. This novelty may be attributed to SOCB's commitment to acquire and retain both internal and external structural capital [77]. In SOCB, MVAIC appears inversely related to efficiency. However, this variable is likely weighed down by the strongly adverse effects of CEE and SCE. The results for JSCB align entirely with the results of the collective analysis.

Table 6: Regression Results

Variable	**Truncated (1)**	**Fractional (1)**	**Tobit (1)**	**Truncated (2)**	**Fractional (2)**	**Tobit (2)**
MVAIC	0.013***	0.049***	0.013***			
	(0.00)	(0.01)	(0.00)			
HCE				0.018***	0.068***	0.018***
				(0.00)	(0.01)	(0.00)
SCE				0.020	0.060	0.020
				(0.03)	(0.07)	(0.03)
CEE				-0.159***	-0.568***	-0.159***
				(0.02)	(0.05)	(0.02)
RCE				-0.015	-0.056	-0.015
				(0.02)	(0.05)	(0.02)
_cons	0.824	1.034	0.824	0.645*	0.434	0.645*
	(0.43)	(1.45)	(0.44)	(0.27)	(0.88)	(0.28)
Controls						
Bank (BSA)	yes	yes	yes	yes	yes	yes
Industry (ISA)	yes	yes	yes	yes	yes	yes
Country (CSA)	yes	yes	yes	yes	yes	yes
Obs	143	143	143	143	143	143
Wald χ^2	1535.00	1628.15	1613.63	2988.46	3817.32	3112.12
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000

Note: Coefficients are displayed in the top line with significance denoted as follows: *$\rho < 0.10$, ** $\rho < 0.05$, ***
$\rho < 0.01$. t-values are presented below the coefficients. Data from 2011 - 2018.

2.3. Robustness Check

Due to omitted variables and reverse causality, MVAIC and its components may be endogenous econometrically. The fi- nancial performance of banks affects MVAIC. If banks are successful, they may increase staff bonuses, which increases high-cost expenditure. They can also reinvest earnings in physical and financial assets to boost capital expenditure ef- ficiency. System generalized method of moments (SGMM) testing can address endogeneity concerns. The SGMM method is the most accurate estimator for small sample sizes and short periods. Additionally, it can analyze internal instruments. A resilient one-step SGMM with independent variables from the previous period is used to recalculate. We also compare using instrument-based two-stage least squares (2SLS). To address endogeneity in the efficiency-IC relationship, instrumental variables (IV) must be correlated with one endogenous variable but not the other. We use year dummy variables as IVs because econometrics often uses lagged variables. Table 7 (Panel B) summarizes the study's findings.

Endogeneity tests generally confirm previous findings, except for SCE. SCE preliminary results are positive but in- significant. The 2SLS method yields a negative SCE without statistical significance. In SGMM, SCE has a negative and statistically significant relationship, suggesting a correlation with other factors. The rejection of a positive SCE-efficiency relationship does not change Hypothesis 2b. Based on baseline results and endogeneity checks, Hypotheses 1 and 2a are supported.

Table 7: Regression Results and Endogeneity Check by Bank Type

	Panel A Results by Bank						Panel B Endogeneity Test			
	(1)			(2)			(1)		(2)	
Bank Type	FB & JV	SOCB	JSCB	FB & JV	SOCB	JSCB	2SLS	SGMM	2SLS	SGMM
MVAIC		0.006*	-0.047*	0.040*				0.018*	0.040**	
		0.00	-0.02	-0.01				-0.01	-0.01	
HCE					-0.211	0.181	0.052			0.050***	0.116**
					0.00	-0.01	-0.01			-0.01	-0.03
SCE					2.913	-0.675	0.061			-0.008	-0.064*
					0.00	-0.16	-0.07			-0.01	-0.03
CEE					0.448	-0.763	-0.521			-0.037***	-0.053*
					0.00	-0.04	-0.03			0.00	-0.02
RCE					-0.501	0.155	-0.056			-0.006**	-0.013
					0.00	-0.01	-0.05			0.00	-0.01
_cons		-1.333	4.924	0.791	8.278	-1.221*	0.243	0.917***	12.151	0.764***	12.095
		0.00	-1.69	-1.41	0.00	-0.25	-0.94	-0.03	-11.8	-0.04	-7.7
Controls (BSA,ISA, CSA)		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Obs		11	20	112	11	20	112	176	176	173	173
Wald χ^2		1,260,000	69067.85	212.54	2,860,000	13,300,000	830.42				
Prob > F		0.00	0.00	0.00	0.00	0.00	0.00				
Sargan / Sargan								0.026	0.000	0.030	0.017
Basmnann / Hansen								0.026	1.000	0.035	1.000
Durbin / AR1								0.000	0.232	0.030	0.505
Wu-Hausman /AR2								0.000	0.064	0.035	0.370

Note: To save space, control variables were not reported. Coefficients are displayed in the top line. AR(1) and AR(2) are Arrelano–Bond tests for first-order and second-order serial correlation, respectively, under the null hypothesis of no serial correlation. The Sargan and Hansen statistics examine the validity of the independent variable. Significance is denoted as *$\rho < 0.10$, ** $\rho < 0.05$, *** $\rho < 0.01$. t-values are presented below the coefficients. Fractional regression is the testing method. Wald chi-square and Prob > F indicate test statistics for the respective models.

2.4. Summary of Hypotheses Testing Results Across Models and Bank Types

As shown in Table 8, our analysis reveals a complex relationship between IC components and bank efficiency across different institutional types. While IC generally enhances bank efficiency, with human capital consistently demon- strating positive performance impacts, other components show more varied effects. Structural capital exhibits mixed influences, proving beneficial in some models while detrimental in others, and both capital employed and relationship capital frequently correlate with decreased efficiency. These effects manifest differently across bank categories: for- eign banks benefit from higher intellectual and capital-employed metrics while struggling with elevated human and relationship measures; state-owned banks demonstrate enhanced performance through stronger human and relation- ship factors but experience negative impacts from increased intellectual, structural, and capital-employed values; and joint-stock banks achieve improved efficiency through robust intellectual and human factors, though their performance tends to decline with higher structural, capital employed, and relationship levels.

3. Conclusion and Implications

This study offers a comprehensive analysis of how IC and its components—HCE, SCE, CEE, and RCE—affect bank performance in Vietnam, measured through technical efficiency. By examining different bank types, this research provides nuanced insights into the role of IC in the banking sector. The findings reveal that IC, particularly HCE, plays a critical role in improving efficiency, aligning with previous research on the importance of human capital in driving organizational success. These results extend the work of [22], highlighting the varying influence of IC components across different banking models and their specific contributions to efficiency.

The study underscores the importance of focusing on targeted IC investments, especially in human capital, to enhance performance. HCE consistently improved efficiency across bank types, supporting the notion that employees are central to innovation and productivity in the banking sector [83, 13]. Conversely, SCE, CEE, and RCE displayed mixed or negative associations with efficiency, particularly in foreign and joint-stock banks. These findings suggest that while human capital remains vital, other IC components require more strategic management to deliver their full potential. Foreign and joint-stock banks, in particular, may need to re-evaluate how they leverage relational capital to

enhance their competitive edge, as suggested by [22].

3.1. Practical Applications

Our findings reveal critical insights that extend beyond Vietnam's banking sector, offering valuable lessons for emerg- ing economies worldwide. The results demonstrate how intelligent management of IC can transform banking efficiency, with implications for institutional practice and policy development. At the institutional level, our research highlights the pivotal role of HCE in driving overall bank performance. Banks across emerging markets can enhance their efficiency by implementing strategic human capital initiatives, including comprehensive employee training programs in critical

Table 8: Comprehensive Analysis of Bank Performance Hypotheses Across Models and Bank Types

H	Factor & Hypothesis	Model Results					Bank Type Results			Key Findings
							FB	SOCB	JSCB	
H1	IC: IC correlates with improved Bank Performance	++ 0.013***	++ 0.049***	++ 0.013***	++ 0.013***	++ 0.013***	○	○	○	**Mixed Alignment** FB & JSCB: IC positively impacts efficiency SOCB: IC negatively correlates with efficiency due to capital constraints
H2a	HCE: Increased HCE correlates with improved bank Performance	++ 0.018***	++ 0.068***	++ 0.018***	++ 0.018***	++ 0.018***	○	○	○	**Mixed Alignment** FB: HCE negatively impacts efficiency, contradicting expectations SOCB & JSCB: HCE positively impacts efficiency
H2b	SCE: Increased SCE correlates with improved bank Performance	+ 0.020	+ 0.060	+ 0.020	– -0.159***	– -0.159***	○	○	○	**Partial Alignment** FB: SCE positively impacts efficiency SOCB & JSCB: SCE negatively impacts efficiency
H2c	CEE: Increased CEE correlates with improved bank Performance	– -0.159***	– -0.568***	– -0.159***	– -0.159***	– -0.159***	○	○	○	**Partial Alignment** FB: CEE positively impacts efficiency SOCB: CEE negatively impacts efficiency due to capital constraints JSCB: CEE negatively impacts efficiency
H2d	RCE: Increased RCE correlates with improved bank Performance	- -0.015	- -0.056	- -0.015	– -0.015	-	○	○	○	**Mixed Alignment** FB & JSCB: RCE negatively impacts efficiency SOCB: RCE positively impacts efficiency

Model Results Legend: ++ Strong positive, + Weak positive, - Weak negative, – Strong negative
Bank Type Results Legend: ○ Positive association, ○ Negative association
Bank Types: FB: Foreign, SOCB: State-Owned Commercial, JSCB: Joint-Stock Commercial

areas such as risk management, digital banking technologies, and customer service excellence. Creating a culture of innovation through internal innovation hubs and formal suggestion programs can further leverage human capital po- tential while implementing competitive compensation packages and clear career advancement pathways, which proves essential for attracting and retaining top talent in competitive markets.

For foreign and joint-stock banks facing particular challenges with RCE and CEE, our findings suggest several strate- gic approaches. Advanced Customer Relationship Management systems, powered by data analytics, can help banks better understand and serve their customers' evolving needs. At the same time, strategic alliances with local businesses and fintech startups can provide access to new markets and technologies, which are particularly valuable in emerging economies where traditional banking infrastructure may be limited. Furthermore, optimizing capital utilization through rigorous investment appraisal techniques like Net Present Value and Internal Rate of Return,

alongside digital transfor- mation initiatives, can significantly improve operational efficiency through streamlined processes and reduced reliance on physical capital.

The regulatory implications of our findings extend far beyond Vietnam's borders, suggesting a comprehensive frame- work for banking regulators in emerging economies to foster sector-wide efficiency improvements. This includes im- plementing incentive structures for human capital development, such as tax benefits for banks investing substantially in employee training programs [76], and promoting industry collaboration through organized forums and workshops to facilitate the exchange of best practices in IC management across the sector. Our research suggests that regulatory bodies should adopt a more comprehensive approach to oversight by incorporating IC metrics into their reporting re- quirements, helping identify areas requiring intervention and support while establishing regulatory frameworks that promote prudent capital utilization through measures such as setting limits on non-performing assets and encouraging transparency in capital investments.

The successful implementation of these strategies can create a virtuous cycle. As banks become more efficient through better IC management, they can better serve their economies, contributing to broader economic development. This demonstrates how micro-level improvements in banking efficiency can cascade into macro-level economic benefits, particularly crucial for emerging economies striving to strengthen their financial sectors and establish more resilient, competitive banking systems that can effectively support economic growth and development. By implementing these specific strategies, banks and regulators can enhance efficiency by effectively managing IC components, ultimately fostering a more robust and sophisticated banking sector capable of meeting the evolving needs of emerging economies.

3.2. Theoretical Implications

This study substantially advances RBT by demonstrating that IC components contribute differentially to technical efficiency in transitional banking sectors, challenging traditional assumptions about universal resource benefits [25, 47]. The consistently positive effect of HCE, contrasted with the inverse relationship of CEE to bank performance, reveals that the ability to leverage human capital proves more critical for sustaining competitive advantage than efficient allocation of tangible capital. This finding particularly resonates in transitional economies, where excessive capital employed may introduce inefficiencies due to regulatory constraints and market imperfections—a phenomenon largely unexplored in previous RBT applications.

The mixed or negative associations of SCE, CEE, and RCE with efficiency underscore a critical refinement to RBT: the mere possession of valuable resources proves insufficient without effective utilization, especially within highly regu- lated financial sectors. This insight necessitates integrating regulatory and market structure considerations into RBT's framework, particularly when assessing how structural constraints—such as capital adequacy requirements and bank- ing regulations—moderate the effectiveness of intangible resource utilization. These findings suggest that theoretical models should prioritize human capital when examining resource contributions to firm performance, particularly in knowledge-intensive industries like banking.

Moreover, our analysis reveals how ownership structures and market conditions significantly influence resource con- tribution to performance, encouraging the development of more nuanced theoretical frameworks. This advancement in RBT particularly benefits emerging economies, where regulatory frameworks continue to evolve and financial liberal- ization remains in progress. The findings demonstrate that RBT must evolve beyond its traditional focus on resource possession to incorporate the complex interplay between regulatory environments, market structures, and resource utilization in shaping organizational performance.

3.3. Limitations and Future Research

Despite its contributions, this study has limitations that suggest directions for future research. Focusing exclusively on Vietnamese banks from 2011 to 2018 may not capture global economic events or long-term trends, limiting generaliz- ability, and expanding the time frame and including banks from other countries could enhance applicability. The use of technical efficiency as the sole performance metric overlooks other dimensions like financial profitability, market share growth, or customer satisfaction, suggesting future research could benefit from incorporating a multi-dimensional performance framework. The negative associations with CEE and RCE indicate underlying factors not

captured in the model, warranting investigation into mediating variables such as corporate governance quality, organizational cul- ture, and technological adoption rates. Additionally, exploring how regulatory compliance frameworks moderate IC efficiency relationships could provide valuable insights, particularly in understanding whether regulatory stringency amplifies or suppresses efficiency gains from IC investments. As fintech and digital banking rapidly advance, future research should examine how technological innovation and regulatory agility interact with IC components, especially in the context of digital banking reforms. Furthermore, qualitative studies involving interviews or case analyses could offer deeper insights into how banks strategize IC management, enriching quantitative findings and providing practical guidance for leveraging IC to enhance bank performance across various contexts

Table 9: Glossary of Acronyms

Acronym	Definition	Acronym	Definition
ADF	Augmented Dickey-Fuller	LIQ	Liquidity
BSA	Bank Specific Arguments	MVAIC	Modified Value Added Intellectual Capital
CAP	Total Equity	NPL	Non-Performing Loan
CAR	Capital Adequacy Ratio	OLS	Ordinary Least Squares
CEE	Capital Employed Efficiency	PP	Phillips-Perron
CORR	Correlation	RBT	Resource-Based Theory
CSA	Country Specific Arguments	RCE	Relational Capital Efficiency
DEA	Data Envelopment Analysis	ROA	Return on Assets
FB	Foreign Bank	ROE	Return on Equity
GDP	Gross Domestic Product	SGMM	System Generalized Method of Moments
HCE	Human Capital Efficiency	SCE	Structural Capital Efficiency
IC	Intellectual Capital	SFA	Stochastic Frontier Analysis
IncDIV	Non-Interest Income to Total Oper. Income	SIZE	Total Assets
INDcon	Industry Concentration	SOLV	Shareholders' Equity to Total Assets Ratio
INFL	Inflation	TE	Technical Efficiency
ISA	Industry Specific Arguments	TOC	Total Operating Cost
JSCB	Joint-Stock Commercial Bank	VAIC	Value Added Intellectual Coefficient
JV	Joint Venture	VIF	Variance Inflation Factor
		2SLS	Two-Stage Least Squares

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