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

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**Abstract**

This study explores the dual nature of intellectual capital (IC) and its components—human capital efficiency (HCE), structural capital efficiency (SCE), capital employed efficiency (CEE), and relational capital efficiency (RCE)—in influencing Vietnamese banks' technical efficiency. Utilizing data from 30 commercial banks from 2011 to 2018, we employ econometric models including truncated regression, fractional regression, and Tobit models to uncover the intricate relationships between IC and bank performance. Our findings reveal a compelling dichotomy: while human capital consistently drives efficiency, capital employed inversely affects performance, challenging conventional wisdom. Structural and relational capitals exhibit varying impacts across different bank types, with state-owned banks benefiting from relational capital due to government support, unlike foreign and joint-stock banks. Robustness checks via system generalized method of moments (SGMM) and two-staged least squares (2SLS) confirm our results' resilience. This study underscores the critical importance of IC in enhancing bank efficiency and calls for a strategic reevaluation of capital utilization practices. Our insights suggest that balancing human and financial capital management can yield significant efficiency gains, advocating for targeted training programs while advising caution in capital allocation strategies. This analysis contributes to the broader discourse on resource-based theory, offering fresh perspectives on the interplay between tangible and intangible assets in driving sustainable competitive advantage within the banking industry.

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

## 1. Introduction

The financial services sector relies heavily on both physical and knowledge-based resources. Recent literature, however, highlights the superior importance of knowledge-based resources (Singh et al., 2021). Intellectual capital (IC)—investments in human resources, brand development, systems, and processes—is essential for the banking industry to deliver high-quality customer services. This shift signifies IC's growing role in replacing traditional production components. Additionally, IC distinguishes firms in their value creation processes and drives economic progress within the banking sector (Rahim et al., 2021).

To leverage the benefits of IC, researchers have examined its theoretical foundations, developed effective methods for measuring IC outputs, and investigated its relationships with various business, industry, and regional characteristics. Banks utilize IC to enhance efficiency and achieve a competitive advantage. Studying the relationship between efficiency and IC in the Vietnamese banking sector is crucial due to their significant impact on performance.

Since the early 2000s, Vietnam's economic landscape has transformed significantly, marked by a trade agreement with the United States in 2001 and accession to the World Trade Organization in 2007. These milestones presented both opportunities and challenges for the Vietnamese banking sector, a critical pillar of the nation's financial framework. To support socio-political lending and promote banking sector liberalization, Vietnam implemented a two-tier banking

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*Preprint* *July 24, 2024*

https://doi.org/10.32388/54S3QD

system. In this framework, the State Bank of Vietnam (SBV) serves as the central bank, while state-owned and private commercial banks conduct commercial operations. This strategy has piqued international interest, encouraging foreign banks to enter the Vietnamese market (Huy et al., 2021).

Deregulation has radically transformed Vietnam's banking sector, shifting from near-monopolistic state-owned banks to a market allowing 100 percent foreign ownership. The financial market in Vietnam is still in its early stages (Martens, 2024), emphasizing the need for efficient management in Vietnamese banks. Recent reforms underscore the growing importance of IC, particularly as banking is widely regarded as a highly knowledge-intensive service industry (Desmarchelier et al., 2013). Furthermore, Vietnam's service sector is expected to outpace the broader economy in growth (Giam, 2021). The financial sector's contribution to employment and economic output underscores its critical importance, with the service sector expected to constitute 60% of GDP by 2030 and the financial industry employing nearly 500,000 people and contributing about 5.37% to Vietnam's GDP (Sta). Therefore, investigating the relationship between IC and technical efficiency (TE) within the banking sector is essential, especially given the limited research in this area.

This study aims to bridge these gaps and enrich the bank IC and efficiency literature. 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.

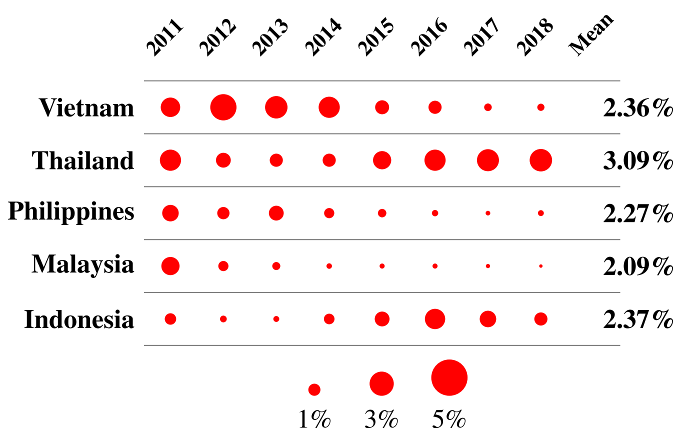
## 2. Vietnamese Banking: Historical Context, Research, Theoretical Framework, and Hypotheses

### *2.1. 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 (CEIC, 2020), and the poverty rate fell from about 70% in 2002 to less than 6% (at US\$3.2 per day) as of 2019 (Quyen, 2019). Banking grew with the economy, and as of 2020, the banking sector had \$521 billion in assets, surpassing the GDP (Le et al., 2020). Despite its development, financial asset bubbles and intra-bank lending threatened the system's collapse in the second half of 2009. To stabilize the financial sector and address both short-term and long-term issues, the government adopted three major restructuring initiatives from 2011 to 2019 (To and Le, 2020). The first approach was to enhance financial capacity to resolve non-performing loans (NPLs), which severely damage bank productivity and health (Rachman et al., 2018). 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%, SBV created VAMC and required banks to sell NPLs for SBV bonds (Ha, 2020). 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.

Efficiency is pivotal for the economic advancement of transition economies, yet the impact of bank ownership type on efficiency remains uncertain (Le et al., 2019). 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.

Table 1: Non-performing loans as a percentage of gross loans



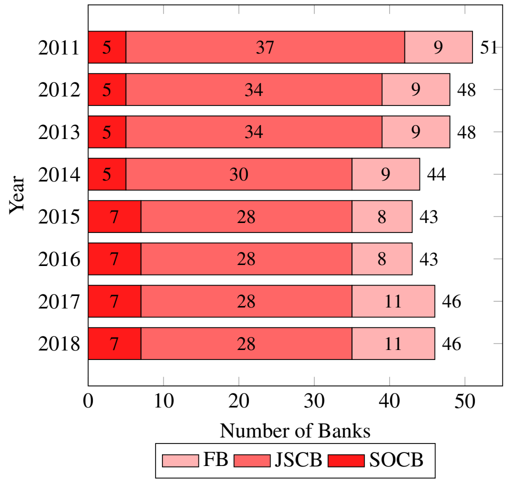




Figure 1: Banks by type and year

### *2.2. Bank Efficiency*

The concept of 'productive efficiency' was first introduced by Farrell (1957), 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, while 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; Nguyen and Pham (2020) argues it better suits banks' production functions with less variability than Data Envelopment Analysis, another commonly used model.

#### *2.2.1. Vietnamese Bank Efficiency*

The research on the effectiveness of Vietnamese financial institutions is primarily centered around efficiency. From 1999 to 2008, the Vietnamese government implemented restructuring programs. However, these efforts were hindered by financial crises and economic downturns Vo and Nguyen (2018). According to a study byLe and Ho (2020), the liberalization of the banking sector in Vietnam resulted in private banks experiencing benefits, but it also led to a decline in the efficiency of the deposit and loan divisions within the sector from 2008 to 2018. Nguyen and Nghiem (2020) 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 domestic banks in emerging countries. Nahm and Vu (2008) observed that state-owned commercial banks (SOCBs) in Vietnam exhibited superior profit efficiency compared to foreign banks (FBs). However, Vu and Turnell (2010) conducted a study using various assessment methods and did not find any significant differences.

### *2.3. Intellectual Capital*

Intellectual capital (IC) encompasses intangible assets that provide organizations with unique competitive advantages, including knowledge, information, intellectual property, and experience (Xu et al., 2020; Martens, 2023). IC measurement models vary, with the VAIC$^{TM}$ model by Pulić (1998) being widely adopted for its simplicity, allowing effective comparison across enterprises and countries. This model highlights three major efficiency components: human capital efficiencies (HCE), capital employed efficiencies (CEE), and structural capital efficiencies (SCE). To address VAIC model limitations, Ulum et al. (2014) incorporated relational capital efficiency (RCE), resulting in the modified VAIC (MVAIC) method.

HCE, defined by Tran and Vo (2020), consists of an organization's knowledge embodied in its employees, fostering innovation and aligning with the Resource-Based View (RBV), which posits that high-quality human resources are essential for competitiveness. SCE includes inventions, processes, copyrights, patents, technologies, strategies, and systems, creating a supportive culture for experimentation and learning (Beltramino et al., 2020). CEE quantifies the value created by a firm from its capital, crucial for efficient use and derived from business budgeting processes (Corrado et al., 2022).

RCE encompasses consumer and brand loyalty, market image, goodwill, bargaining power, strategic alliances, and coalitions, and is vital due to the complexity of organizational interactions with external entities (Laghi et al., 2020). These robust relationships with stakeholders positively influence an organization's competitiveness. Consequently, they significantly enhance the organization's performance potential (Corvino et al., 2019).

Given IC's positive impact on a firm's financial performance and the benefits associated with its components, we propose the following hypotheses:

**H1:** *IC correlates with improved bank performance.*

**H2a:** *Increased HCE correlates with improved bank performance.*

**H2b:** *Increased SCE correlates with improved bank performance.*

**H2c:** *Increased CEE correlates with improved bank performance.*

**H2d:** *Increased RCE correlates with improved bank performance.*

### *2.4. Conceptual Schema*

Scholars and experts in economics and management have long been fascinated by the development of a theoretical framework to comprehend firms' operations and identify performance determinants. The notion that a firm's resources are crucial to its long-term success stems from the belief that these resources and skills provide strategic direction and are the primary source of profit (Vu et al., 2022). According to Porter and Advantage (1985), the ability to generate returns above the cost of capital hinges on the attractiveness of a firm's industry and its capacity to secure a competitive advantage over its competitors. These concepts align with the resource-based view (RBV), which emphasizes the importance of knowledge management and organizational learning, recognizing knowledge as a vital resource. RBV posits that the ownership and control of strategic tangible and intangible assets are foundational for achieving sustainable competitive advantage and, consequently, determining performance (Dubey et al., 2019). In a knowledge-driven economy, knowledge and intellectual capital (IC) are key production variables and critical drivers of enduring competitive advantage, supplementing RBV and IC management. Managing IC is a fundamental managerial duty, with strategic attributes like scarcity, value, and the impossibility of replication or substitution being essential for sustained competitive advantage. Numerous studies have examined the relationship between IC and firm performance through the RBV lens, suggesting that strategic resources enable firms to compete more effectively, whereas resource heterogeneity can lead to firm failure. A firm's value is gauged by its ability to effectively organize its resources and capabilities. RBV underscores the importance of conceptualizing and leveraging both tangible and intangible assets, including administrative capabilities, routines, organizational processes, and the knowledge within its control. To explore the institutional potential of IC, this study extends existing research by examining IC and efficiency through the RBV framework, which serves as the core competency embedded in each IC dimension. Figure 2 depicts the study's hypothesis and its association with RBV, with the intangible components encompassing HCE, SCE, and RCE, and CEE representing the tangible component.

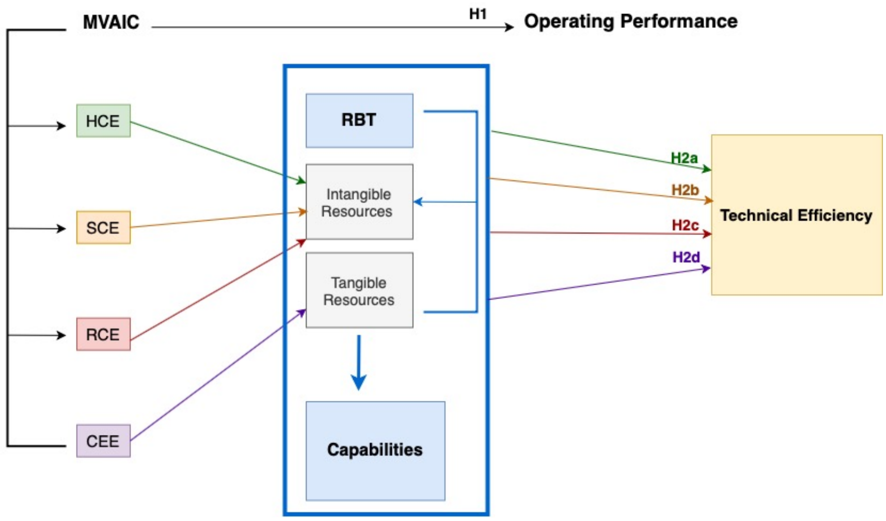



Figure 2: Theoretical Framework

## 3. Research Design and Data Collection

### *3.1. Measurement of Variables*

#### *3.1.1. Measurement of Intellectual Capital*

This study adopts the MVAIC model as an IC proxy, following the methodologies of Tran et al. (2020). The MVAIC is the independent variable (IV) calculated by summing HCE, SCE, CEE, and RCE, as shown in Eq.1.

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

The four components of MVAIC are measured as follows: HCE is proxied by the funds spent on compensating employees for their skills, experience, knowledge, and productivity. SCE is derived by subtracting HCE from value added (VA). CEE is calculated as the net of total assets minus total liabilities. RCE is proxied by expenditures related to maintaining relationships with customers, suppliers, shareholders, and the government, such as marketing and sales expenses. VA is determined by subtracting inputs from outputs (see Eq. 2). Higher CEE, HCE, SCE, and RCE values indicate greater IC value creation.

$$VA_{it} = \text{Output - Input}_{it} \qquad (Eq.\ 2)$$

In this context, *Output* refers to total bank revenue, which includes interest and non-interest income, fees, and commissions. *Input* encompasses operational costs, such as interest, administration, and other expenses, excluding personnel costs like salaries, wages, and benefits.

*3.1.2. Measurement of Bank Efficiency*

To quantify efficiency, this study employs the Stochastic Frontier Analysis (SFA) method, as suggested by Martens et al. (2021b); Martens (2021) and Anwar (2019). 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 labour and capital. The fundamental concept of SFA technical efficiency (TE) is expressed as the ratio of realized output to maximum attainable output, as defined by the relevant literature. 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 (Kea et al., 2016). 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, while a value close to zero implies inefficiency, suggesting that random factors do not control SFA output. Following Ding and Sickles (2018), we specify a cost frontier model with two-output ($\gamma$) and three-input ($w$) parameters via the translog functional form. The SFA inputs and outputs are detailed in Table 3 under Stochastic Frontier arguments.

*3.2. 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. To address this issue, we follow (Simar and Wilson, 2007) and utilize bootstrapped truncated regression models. This approach, which uses 5000 simulated observations, ensures the model's goodness of fit and provides bootstrap confidence intervals for the parameter estimates $\widehat{\beta}_1 - \widehat{\beta}_3$.

For additional robustness, Tobit and fractional regression analyses are also employed, as these methods impose the necessary constraints on the dependent variables (JS Ramalho and da Silva, 2009). Two models are tested in this study: Eq.3 examines the impact of intellectual capital (IC) as a composite measure on bank efficiency, while Eq.4 investigates the effects of individual components of IC on bank efficiency.

$$Eff_{i,t} = \beta_0 + \beta_1 \text{MVAIC}_{i,t} + \text{BC}_{i,t} + \text{IC}_{i,t} + \text{CC}_{i,t} + \text{Year}_i + e_{i,t} \qquad (Eq.\ 3)$$

$$\begin{aligned} Eff_{i,t} = \beta_0 + \beta_1 \text{HCE}_{i,t} + \beta_2 \text{SCE}_{i,t} + \beta_3 \text{CEE}_{i,t} + \beta_4 \text{RCE}_{i,t} \\ + \text{BC}_{i,t} + \text{IC}_{i,t} + \text{CC}_{i,t} + \text{Year}_i + e_{i,t} \end{aligned} \qquad (Eq.\ 4)$$

In this context, $Eff_{i,t}$ represents the technical efficiency scores of the bank $i$ at time $t$. The value of *Eff* ranges from zero, indicating no efficiency, to one, denoting perfect efficiency. To account for the impact of various confounding factors on bank performance, the models include bank controls (BC), industry controls (IC), and country controls (CC), as outlined in Table 3. Additionally, individual year dummy variables are incorporated to control for year-specific effects.

*3.3. Descriptive Data Analysis*

The data was sourced from BankFocus and encompasses the timeframe of 2011 to 2018, specifically focusing on thirty commercial banks in Vietnam. The sample includes both historical and contemporary commercial banks to mitigate the risk of survivorship bias. However, financial institutions that lacked sufficient financial data for SFA or IC, or had less than two years of data, negative equity, interest expenses, or total revenue, were excluded. The efficiency scores are displayed in Table 2, categorized by bank and year. Throughout the specified time frame, the efficiency scores experienced an average decline of 0.95 percent. None of the banks were able to attain complete efficiency. The efficiency score of PVCom, which was 0.89, set a new record for the highest score ever recorded. On the other hand, VPB received the lowest score of 0.70. Based on the sample, the average efficiency score is 0.818, suggesting that the average bank has the ability to boost output by 18.2 percent without needing any 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. The table 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 that were fully owned by foreign entities were prohibited until 2008, and they were not granted complete national treatment until 2011.

Table 2: Efficiency scores by banks by years

| | | | Year | | | | | | | | CAGR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Size** | **Name of Bank** | **Abbreviation** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | |
| **SOCB** | | | | | | | | | | | |
| 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 3. The mean MVAIC score is 3.81, which closely matches Hoang et al. (2020) findings. The values of HCE, SCE, CEE, and RCE 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 3 shows that the average total assets (SIZE) of Vietnamese banks 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 4 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 does not perform well with small sample sizes, typically between 100 and 10,000 observations (Cheung and Lai, 1997). Using the Augmented Dickey-Fuller (ADF) test, we find that all variables are stationary. The VIF test results indicate that all VIF values are below 10, suggesting no multicollinearity

Table 3: 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 labour. 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 (Eq 1) | 3.811 | 1.056 | 1.651 | 6.894 |
| HCE | Human capital efficiency is calculated as VA / HCE | 2.763 | 0.894 | 0.927 | 5.488 |
| SCE | Structure capital efficiency is calculated as SC / VA | 0.592 | 0.161 | -0.079 | 0.818 |
| CEE | Capital employed efficiency is calculated as VA / CE | 0.283 | 0.156 | 0.019 | 0.795 |
| RCE | Relational capital efficiency is calculated as RC / VA | 0.174 | 0.162 | -0.003 | 1.078 |
| VA | Value added (Eq 6) | 253596.600 | 344997.200 | 5885.200 | 1920939.000 |
| **Bank Specific Arguments** | | | | | |
| 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** | | | | | |
| INDcon | Industry Concentration. Total assets of largest 5 banks / Total assets | 0.5961 | 0.0625 | 0.5460 | 0.7973 |
| **Country Specific Arguments** | | | | | |
| GDP | Real GDP annual growth rate | 6.2859 | 0.5821 | 5.2500 | 7.0800 |
| INFL | Inflation, average consumer price (percentage change) | 4.8361 | 3.8365 | 0.9000 | 18.7000 |

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

among the independent variables. Table 4 (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 associated 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 findings of Vidyarthi (2019). 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 (Zeghal and Maaloul, 2010).

## 4. Findings and Analysis

### *4.1. 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 5, 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 Adesina (2019) and Meles et al. (2016) 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 coefficient being strongly negative. The positive relationship between HCE and efficiency supports *Hypothesis 2a*,

Table 4: Unit Root Tests, VIF, and Correlation Heatmap

| Panel A | | | Panel B | | | | Panel C: Correlation Heatmap | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit Root Tests | | | VIF | | | | Variable | MVAIC | HCE | SCE | CEE | RCE | ROA |
| Variable | ADF Test | PP Test | VIF | 1/VIF | VIF | 1/VIF | MVAIC | | | | | | |
| HCE | 140.210*** | 248.099*** | 6.36 | 0.16 | - | - | HCE | ↑↑ | | | | | |
| SCE | 126.726*** | 215.105*** | 6.24 | 0.16 | - | - | SCE | ↑↑ | ↑↑ | | | | |
| CEE | 91.526*** | 137.484*** | 3.01 | 0.33 | - | - | CEE | ↑ | ↑ | ↑ | | | |
| RCE | 153.916*** | 277.953*** | 1.56 | 0.64 | - | - | RCE | ↓ | ↓ | ↓ | ↓ | | |
| ROA | 108.592*** | 243.830*** | 2.90 | 0.35 | 2.40 | 0.42 | ROA | ↑↑ | ↑↑ | ↑↑ | ↑ | ↓ | |
| Mean VIF | | | 4.01 | | 2.44 | | | | | | | | |

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).

underscoring the crucial role of human capital in boosting efficiency through an enhanced knowledge base. Without the academic knowledge and practical experience provided by HCE, 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 Adesina (2019) and Chen et al. (2005), 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 (Brewer Iii et al., 2008). The State Bank of Vietnam mandates banks to maintain a capital adequacy ratio (CAR) 1% higher than required by the Basel II accord. While reducing capital levels might improve efficiency, it can complicate risk management. Consequently, banks must carefully evaluate this trade-off to enhance efficiency. The finding that greater capital employed decreases efficiency is supported by Van Dang (2019)'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 Ozkan et al. (2017), who also found no significant relationship between SCE and performance. Similarly, Corvino et al. (2019) 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 (Huang and Sun, 2017; Martens et al., 2020). 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. This conclusion is supported by Peng et al. (2017). 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 (Berger and Hannan, 1998). 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 (Martens et al., 2021a). 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.

### *4.2. 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 6 (Panel A) shows that despite lower efficiency scores for FB, MVAIC

Table 5: 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 | yes | yes | yes | yes | yes | yes |
| Industry | yes | yes | yes | yes | yes | yes |
| Country | yes | yes | yes | yes | yes | yes |
| Obs | 143 | 143 | 143 | 143 | 143 | 143 |
| Wald $\chi^2$ | 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.

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 (Rahman and Ahmed, 2012). 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.

### *4.3. Robustness Check*

Due to omitted variables and reverse causality, MVAIC and its components may be endogenous econometrically. The financial 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 efficiency. System generalized method of moments (SGMM) testing can address endogeneity concerns. For small sample sizes and short time periods, the SGMM method is the most accurate estimator. 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 instrumental variables (IVs) because econometrics often uses lagged variables. Table 6 (Panel B) summarizes the study's findings.

Endogeneity tests generally confirm previous findings, except for SCE. SCE preliminary results are positive but insignificant. 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 6: 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 | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Obs | 11 | 20 | 112 | 11 | 20 | 112 | 176 | 176 | 173 | 173 |
| Wald $\chi^2$ | 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.

The hypotheses testing results, summarized in Table 7, reveal significant insights into the relationship between IC and bank efficiency. IC (H1) consistently shows a positive association with bank efficiency across all models, including Truncated, Fractional, Tobit, 2SLS, and SGMM, underscoring its critical role. HCE (H2a) also maintains a consistently positive impact on efficiency, highlighting the importance of human resources. However, SCE (H2b) presents a more complex picture, with positive associations in Truncated and Fractional models, but negative in 2SLS and SGMM models, indicating variability based on the analytical approach. Both CEE (H2c) and RCE (H2d) predominantly exhibit negative associations with bank efficiency, suggesting potential inefficiencies in their utilization. As detailed in Table 8, these results vary by bank type. For Foreign Banks (FB), IC (H1) and CEE (H2c) positively influence efficiency, whereas HCE (H2a) and RCE (H2d) have adverse effects. SOCB show positive correlations with HCE (H2a) and RCE (H2d), but negative with IC (H1), SCE (H2b), and CEE (H2c). JSCB display positive associations with IC (H1) and HCE (H2a), but negative impacts from SCE (H2b), CEE (H2c), and RCE (H2d). These findings underscore the specific impact of different forms of IC on bank efficiency across various banking models.

Table 7: Summary of Hypotheses Testing Results

| | Hypothesis | Truncated | Fractional | Tobit | 2SLS | SGMM |
|---|---|---|---|---|---|---|
| Intellectual Capital | (H1) | ++ | ++ | ++ | ++ | ++ |
| Human Capital Efficiency | (H2a) | ++ | ++ | ++ | ++ | ++ |
| Structural Capital Efficiency | (H2b) | + | + | + | – | – |
| Capital Employed Efficiency | (H2c) | – | – | – | – | – |
| Relational Capital Efficiency | (H2d) | - | - | - | – | - |

Note: The ++ (–) indicates a positive (negative) association with bank efficiency.

Table 8: Summary of Hypotheses Testing Results for FB, SOCB, and JSCB

| | Hypothesis | FB | SOCB | JSCB |
|---|---|---|---|---|
| Intellectual Capital | (H1) | ++ | – | ++ |
| Human Capital Efficiency | (H2a) | – | ++ | ++ |
| Structural Capital Efficiency | (H2b) | ++ | – | – |
| Capital Employed Efficiency | (H2c) | ++ | – | – |
| Relational Capital Efficiency | (H2d) | – | ++ | – |

Note: The ++ (–) indicates positive (negative) association with efficiency.

## 5. Conclusion

This study is the first to examine the linkages between IC and its components—HCE, SCE, CEE, and RCE—on performance as measured by technical efficiency in the Vietnamese banking sector. This investigation provides a unique opportunity to analyze the association of IC with technical efficiency after accounting for bank type, industry, and country-specific factors. Given the crucial role of a robust banking sector in financial stability and economic growth, understanding the efficiency trend and the IC factors influencing it is essential for long-term stability. This examination identifies the fundamental drivers of organizational performance, emphasizing the importance of both tangible and intangible resources according to resource-based theory.

Analyzing IC and its components using various regression methods on Vietnamese bank data from 2011 to 2018 reveals that not all resources enhance efficiency. Increases in relational capital are ineffective at boosting efficiency, except in State-owned banks, where monopolistic power, increased government support, and early entry restrictions on foreign competition have contributed to greater brand loyalty. FB and JSCB banks in Vietnam have struggled to implement relational capital effectively for long-term growth, indicating that indirect relationship capital may require further examination. Employing more capital generally reduces efficiency, though reducing capital could negatively impact risk management. Throughout the study, human capital consistently demonstrated a favourable impact on efficiency, except in foreign-owned banks, suggesting that these banks have not fully prioritized human resource development. The data clearly shows that human capital positively affects technical efficiency, highlighting the importance of staff training for increased productivity.

The insights from this study have practical implications for the broader corporate sector and regulatory bodies. Banks should prioritize human capital within IC, as other IC components show limited efficiency-enhancing characteristics. Regulators should review IC components aligning with national objectives and allocate investment funding to areas benefiting long-term economic trends. Banks can improve performance and competitive edge by identifying and addressing inefficient inputs, such as capital employed, to avoid increased risk. Stakeholders may benefit from creating IC development programs prioritising human capital through training and education.

In a knowledge-based economy, strategic management of resources is essential. The RBV framework links value, strategy, and IC in the quest for a deeper understanding of the value creation process. The focus on developing and conserving valuable resources, as examined through Vietnamese banks, reveals that intangible resources play a more significant role in value creation than tangible resources. This finding aligns with Firer and Williams (2003), suggesting a theoretical disconnect where some valuable resources may actually destroy value. Transitioning to a knowledge-based economy requires new strategic management perspectives on value creation and sustained competitive advantage (Duarte Alonso et al., 2022).

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