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Does Intellectual Capital Matter for Bank Stability Efficiency? An Application in Vietnamese Banking

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Abstract. This paper investigates the significance of intellectual capital (IC) on the stability efficiency of Vietnamese banks over the period 2007 – 2020. The study firstly estimates the stability efficiency of Vietnamese banks using stochastic frontier approach and explore the potential correlation between IC and Vietnamese bank stability efficiency in the second stage. Employing the two-step GMM method, the findings reveal that IC enhances the stability efficiency in Vietnamese banks. In terms of IC constituents, the efficiency of human capital and structural capital substantially contribute to the stability efficiency of banks, whereas the efficiency of employed capital has a detrimental effect. These outcomes offer valuable insights regarding the investment in intellectual capital, especially in human capital and structural capital to alleviate the level of risk in Vietnamese banks in long term.

Keywords: intellectual capital, capital employed efficiency, human capital efficiency, structural capital efficiency, bank stability efficiency

1. Introduction

The existence of intellectual capital (IC) in an organization's performance is paramount because it embodies unique attributes that, *ceteris paribus*, can decide the efficacy or failure of an organization in comparison to its rivals (El-Bannany, 2008; Gogan et al., 2016; Chaudhary et al., 2022). This factor contributes value to an organization and thereby determines its level of success, under the theory of resource-based view (RBV) (Toy & Tay, 2022). Consequently, IC is widely recognized as the primary driver of long-term competitive advantage and has garnered considerable interest from both scholars and industry professionals.

Given that banking is one of the most knowledge-intensive industries, this sector provides an optimal environment for IC research due to several reasons. Firstly, the competitive advantages in banking operations are strongly reliant on their clients. Further, bank products are their services, and their value is determined by intellectual capital, as opposed to being tangible goods. Lastly, banks must allocate resources towards human capital, brand recognition, and system and processes to offer the highest quality services to their clients. Therefore, it is compulsory for banks to effectively manage their intellectual capital (Le & Nguyen, 2020; Tran & Vo, 2018).

There has been a significant focus on examining the linkage between IC and firm performance and firm efficiency in the extant literature (El-Bannany, 2008; Meles et al., 2016; Tran & Vo, 2018; Le et al., 2022). However, the substantial research addressing the key role of IC in bank risk management is still limited, and this correlation yields inconsistent results. On the one side, greater IC can potentially assist banks in surviving economic hardship (Al-Shammari, 2022; Nguyen et al., 2021; Onumah & Duho, 2019). Others may argue that IC and its components negatively affect bank stability (Ghosh & Maji, 2014; Zheng et al., 2022). Intriguingly, Dalwai et al. (2021) find that IC does not affect the risk-taking decisions and the soundness of Asian banks, but that its constituent, human capital efficiency, exhibits an unfavorable association with bank risk-taking. Consequently, the degree of consistency regarding the linkage between IC and bank soundness remains a subject of ongoing scholarly discussion.

Otherwise, recent studies use either the nonperforming loans ratio or Z-score to estimate the diverse degrees of risk when evaluating how IC and its constituents influence bank stability. As argued by Tabak et al. (2012), Z-scores does not precisely reflect the prospective stability of institutions. Further, Fang et al. (2019) contend that traditional risk calculations could underestimate the potential stability of individual institutions. Further, none of the research endeavors have accounted for the potential impacts of IC on a bank's stability efficiency. Thus, this paper addresses the deficiency through employing a stochastic frontier method to estimate bank efficiency stability and by reassessing the correlation between IC and bank risk management within the Vietnamese banking industry.

Employing a sample of 24 Vietnamese commercial banks from 2007 to 2020, our research illustrates that the degree of IC efficiency and its elements have a favorable influence on the stability efficiency of Vietnamese banks. The results are still robust during the financial crisis time. Therefore, the improvement in intellectual capital can facilitate Vietnamese banks to adapt in a dynamic environment and achieve their goals.

This paper contributes to extant literature in several ways. First, this is the first attempt to consider how intellectual capital affects bank stability efficiency, using the stochastic frontier technique. Mention and Bontis (2013) assert that despite numerous studies of firms' intellectual capital, empirical evidence on the beneficial impact of IC to firm efficiency has not adequately explored, particularly in certain industries and regions. Thus, our findings significantly contribute to the expanding corpus of contexts for developing economies by providing substantial empirical evidence from a Southeast Asian country. Last but not least, this research also contributes to the unresolved debate surrounding IC and corporate risk and provides long-term implications for bank executives and regulators.

The subsequent sections of this paper are arranged in the following manner. Section 2 presents a comprehensive overview of the related literature, while Section 3 outlines the methodology and data sample employed in this study. Section 4 presents the empirical findings and discussion, while Section 5 includes the concluding remarks.

2. Literature review

2.1. Theoretical background on intellectual capital

Resources are anything that either improves or deteriorates an entity's market position (Wernerfelt, 1984). Stewart (2010) specifies IC as comprising intellectual resources that can be leveraged to generate economic value. Giacosa et al. (2017) contend that IC addresses the issues relating to knowledge in organizations. Thus, the concept of IC is commonly characterized as the cognitive resources that organizations utilize to attain a competitive edge in the marketplace. However, it is worth noting that many companies only acknowledge a portion of these valuable assets (Banker et al., 2019).

The paradigm of resource-based view, proposed by Barney (1991), depicts IC as a vital asset comparable to physical and financial assets. The paradigm suggests that businesses can attain strategic advantage and enhanced performance if they acquire, maintain, and use these assets effectively. Grant (1996) also asserts that IC is the primary strategic asset to enhance business success and profits. Consequently, numerous empirical studies have endeavored to figure out the potential implications of IC on the overall business outcome.

Several conventional metrics for intellectual capital and its constituents have been proposed across various fields of study due to the variety of its definitions and the availability of data (Tayles et al., 2007). Following the majority of earlier research on IC, this paper concentrates on one of the most prevalent measurements, the so-called value-added intellectual coefficient (VAIC), developed by Pulic (2004). This methodology assumes that the efficacy of value creation within organizations is contingent upon the collective contribution of all available resources encompassing the efficiencies of structural capital (SCE), human capital (HCE), and capital employed (CEE).

2.2. The correlation between intellectual capital and bank stability

Numerous studies have endeavored to explore how IC affect the financial performance and the efficacy of corporations, using the VAIC framework (Buallay et al., 2019; Tran & Vo, 2018; Le et al., 2022). Nevertheless, the significance of IC in mitigating bank risk-taking remains inadequately explored, and various studies have yielded conflicting results. Research by Ghosh and Maji (2014) reveals a reciprocal association between IC and Indian bank credit risk. Regarding its constituents, human capital efficiency is the sole significant component that displays an inverse relationship with credit risk in Indian banks. However, this research is unable to confirm the potential effect between IC and the insolvency risk of Indian banks. Curado et al. (2014) illustrate the effects of IC on bank stability from 2005 to 2009. They conclude Portugal banks that exhibit lower scores of IC are at a higher risk of experiencing failure. In the same vein, the enhancement in intellectual capital potentially assists financial banks in withstanding economic adversity and uncertainty (Kaupelytė & Kairytė, 2016; Nguyen et al., 2021; Onumah & Duho, 2019).

Otherwise, others may argue that IC and its constituents are detrimental to bank stability. Research by Onumah and Duho (2019) reveals a noteworthy and affirmative link between IC and financial stability. However, their research also indicates that two of its constituents, namely Structural Capital Efficiency and Employed Efficiency, exert an unfavorable influence on the banks soundness. Similarly, Zheng et al. (2022) also confirm the notion of a favorable correlation between IC and its constituent elements with bank risks in Bangladesh. Surprisingly, Dalwai et al. (2021) discover that IC does not exert any influences on the risk-taking behavior and the soundness of Asian banks, but that human capital efficiency is found to be negatively associated with the risk of bank. None of the former research has examined how IC and its constituents affect a bank's stability efficiency, especially in a developing context. In light of the current discussion, we formulate the below hypotheses:

H1a: There is a positive correlation between IC and Vietnamese banks stability efficiency;

H1b: There is a positive correlation between IC's sub-components and Vietnamese banks stability efficiency;

In addition, the vulnerability of businesses during economic downturns may endanger the stability of banks as a result of risk-shifting processes (Stiglitz & Weiss, 1981). Altunbas et al. (2011) argue that differences in the business model explain why certain banks took more risks than others during the financial crisis. Therefore, we further propose the below hypothesis to observe the significance of IC on bank stability during the time of economic crisis:

H2: The positive association between IC and Vietnamese bank stability efficiency is exacerbated during the financial crisis.

3. Research methods

3.1. Variables definition

3.1.1 Estimation on bank stability efficiency

The most prevalent indicator of bank stability is Z-score, and it is derived from the amalgamation of a bank's return on assets and equity to total assets ratio ((Liu et al., 2013; Liu & Wilson, 2013). This indicator of risk is formulated as follows:

$$Z-score_{i,t} = \frac{ROA_{i,t}+E_{i,t}/\ TA_{i,t}}{\sigma ROA_{i,t}} \quad (01)$$

where $ROA_{i,t}$ is return on assets ratio; the ratio $E_{i,t}/\ TA_{i,t}$ presents the proportion of equity over total assets; $\sigma ROA_{i,t}$ denotes the standard deviation of return on assets and is computed using a rolling window of the three years.

The insufficiencies of the conventional Z-score measure in capturing the potential stability of individual banks have been highlighted by Fang et al. (2019) and Tabak et al. (2012). The Z-score metric solely indicates the achieved financial stability and provides limited insight into the performance of individual banks in achieving optimal levels. In order to resolve this issue, the deviation between the current stability situation of a bank and its utmost stability must be taken into account. Hence, the term "stability inefficiency" has been formulated, denoting the extent to which a specific bank deviates from the optimal Z-score. This study employs a translog specification to estimate the Vietnamese bank stability efficiency and the specification is as follows:

$$\mathrm{Ln}\left(\frac{Z-score_{it}}{W_{3,it}}\right) = \alpha_0 + \alpha_1 lnQ_{it} + \frac{1}{2}\alpha_2 (lnQ_{it})^2 + \sum_{m=1}^{2}\beta_n \ln\left(\frac{W_{mit}}{W_{3,it}}\right) + \sum_{m=1}^{2}\sigma_m lnZ_{mit} +$$
$$\frac{1}{2}\sum_{m=1}^{2}\sum_{j=1}^{2}\gamma_{mj}\ln\left(\frac{W_{mit}}{W_{3,it}}\right) ln\left(\frac{W_{jit}}{W_{3,it}}\right) + \frac{1}{2}\sum_{m=1}^{2}\sum_{j=1}^{2}\pi_{mj}\, lnZ_{mit} lnZ_{jit} +$$
$$\sum_{m=1}^{2}\delta_m lnQ_{it} ln\left(\frac{W_{mit}}{W_{3,it}}\right) + \sum_{m=1}^{2}\varepsilon_m lnQ_{it} lnZ_{mit} + \sum_{m=1}^{2}\sum_{j=1}^{2}\theta_{mj}\ln\left(\frac{W_{mit}}{W_{3,it}}\right) lnZ_{mit} +$$

$$\varphi_1 Trend + \frac{1}{2}\varphi_2(Trend)^2 + \varphi_3 TrendlnQ_{it} + \sum_{m=1}^{2}\mu_m Trend \ln\left(\frac{W_{mit}}{W_{3,it}}\right) +$$
$$\sum_{m=1}^{2}\vartheta_m TrendlnZ_{mit} + \varepsilon_i$$

(02)

Based on the intermediation theory, this study identifies the inputs and outputs of banks, which are regarded as financial intermediaries that convert deposits into loans and other earning assets (Sealey Jr & Lindley, 1977). Thus, Table 1 below defines all variables used in the translog cost function in Eq(02).

The error term is comprised of the one-sided time-varying inefficiency component (u_i) and the time-invariant heterogeneity-capturing random error term. The inefficiency term (u_i) follows a non-negative truncated normal distribution that is independently and identically distributed (Jondrow, Lovell, Materov, & Schmidt, 1982). The bank stability efficiency scores are estimated using the two-step approach (Coelli et al., 2005) by extracting them from the error term. A positive correlation exists between stability efficiency score and bank risk level, whereby a higher score indicates lower risk and conversely.

$$\boldsymbol{Stability\ efficiency\ (ZEFF_i) = E[\exp(-u_i)]} \qquad (03)$$

3.1.2 Estimation on bank intellectual capital and its components

Various techniques for intellectual capital measurement are proposed in the existing VAIC literature. This study employs the conventional VAIC method to estimate intellectual capital and its elements, which is deemed an innovative approach from both theoretical and methodological perspectives. Furthermore, the fundamental tenets of accounting are not modified or contradicted under the employment of this method (Iazzolino & Laise, 2013).

The coefficient of value-added intellectual ($VAIC_{it}$) is computed as follows:

$$VAIC_{it} = CEE_{it} + HCE_{it} + SCE_{it} \qquad (04)$$

where CEE_{it} is the efficiency of capital employed; HCE_{it} denotes the efficiency of human capital; SCE_{it} demonstrates the efficiency of structural capital (Pulic, 2004; Tran & Vo, 2018).

To calculate the VAIC elements, the computation of the total value added is required. This ratio can be measured as follows:

$$VA_{it} = OP_{it} + PC_{it} + A_{it} \qquad (05)$$

where OP_{it} denotes a bank's operating profit; PC_{it} illustrates personnel expenditures (salaries, wages, and additional benefits), and A_{it} is the amortization and depreciation values of the bank.

Then, the VAIC decompositions are subsequently estimated: CEE_{it} = VA_{it}/CE_{it} where CE_{it} is the book value of equity; HCE_{it} = VA_{it}/HC_{it}, where HC_{it} covers personnel expenses; SCE_{it} = SC_{it}/VA_{it}, where SC_{it} denotes structural capital and is calculated as SC_{it}=VA_{it}/HC_{it} (Le et al., 2022).

Table 1: Variables definition utilized in the estimation of bank stability efficiency

Variable	Definition
$Z-score_{i,t}$	The index is obtained from Eq(01)
Q_{it} (output)	Total assets
W_1 (Input price 1)	The proportion of interest expenses to total deposits
W_2 (Input price 2)	The rate of personnel expenses/number of employees
W_3 (Input price 3)	The proportion of other operating cost to fixed assets
Z_1 (Fixed netput 1)	Fixed assets
Z_2 (Fixed netput 2)	Total equity
$Trend$	Technical change, ranges from 1 to 14, for the period 2007 – 2020 respectively
ε_i	Error term

Source: Authors' calculation.

3.1.3 Other control variables

The too-big-to-fail postulation posits that bigger banks are inclined to engage in riskier activities, thereby increasing the likelihood of bank insolvency (Beck et al., 2006). Nevertheless, it is plausible that bigger banks could exhibit greater efficiency and stability due to their reduced financial constraints. Therefore, our study incorporates the bank size variable ($SIZE_{it}$) as the natural logarithm of total assets to regulate the influence of bank size on the efficiency of financial stability in Vietnamese banks. Further, Le (2021) contends that a bank's risk increases in proportion to its liquidity ratio. Consequently, the proportion of liquid assets to total assets (LIQ_{it}) is utilized in this study as a gauge of liquidity risk on Vietnamese bank stability efficiency.

The Herfindahl-Hirschman Index (HHI_{it}) is employed as a metric for bank concentration for market-specific circumstances (García-Herrero et al., 2009). This indicator is calculated by adding up the squared market shares of the assets held by each bank during a specific year. It takes a value of 0 for a perfectly competitive market and 1 for a market with monopoly. A smaller HHI value demonstrates a greater degree of competition, and vice versa. Moreover, the crisis dummy variable (GFC_{it}) taking value 1 if the year is 2007 or 2008 and 0 otherwise, is included as a gauge for the influence of IC on Vietnamese bank stability under a systemic crisis. Finally, our study further includes the annual GDP growth rate (GDP_{it}) and the annual inflation rate (INF_{it}) to investigate the impact of economic expansion and inflation on the efficiency of bank stability in Vietnam (Le & Nguyen, 2020; Perry, 1992).

3.2 Data and sample

Our sample involves 24 commercial banks in Vietnam, covering the timeframe from 2007 to 2020, and representing over 80% of the industry's total assets. The bank-specific variables are derived from bank financial statements and the Vietdata database, adhering to Vietnamese accounting standards. All macroeconomic variables are accumulated from the World Bank Database. Moreover, the selection of solely local commercial banks is intended to ensure homogeneity, as they are the most active participants in the market. Conversely, it is noteworthy that international bank affiliates, entirely overseas-based banks, and joint-venture banks encounter more significant restrictions in their business activities in the Vietnamese market.

3.3 Model specification

This research uses a dynamic panel model, more specifically the two-step system generalized technique of moments (GMM) as the principal method of estimating how IC and its decompositions influence bank stability efficiency. The aforementioned approach, which was formulated by Arellano & Bover (1995) and Blundell & Bond (1998), facilitates the computation of the parameter with a degree of certainty, while simultaneously tackling the challenges associated with undetected heterogeneity and endogeneity.

To empirically test our hypotheses, the following dynamic model is constructed:

$$ZEFF_{it} = \alpha_0 + \alpha_1 ZEFF_{i,t-1} + \alpha_2 VAIC_{it} + \alpha_3 CONVAR_{it} + \mu_i + \varepsilon_{it} \quad (06)$$

where $ZEFF_{it}$ represents the stability efficiency scores of bank *i* at time *t;* $VAIC_{it}$ illustrates the value of IC in each bank; $CONVAR_{it}$ denotes bank-specific and macro variables in section 3.1.3; μ_i is the unobserved fixed effect for bank *i* while ε_{it} indicates the remaining disturbance term; the coefficient $\alpha_0, \alpha_1, \alpha_2, \alpha_3$ are the parameters to be estimated.

Table 2 displays the descriptive statistics pertaining to all variables. Additionally, Table 3 exhibits the correlation matrix of all variables. The outcomes validate the absence of any issues related to multicollinearity.

Table 2. The descriptive statistics of all variables

Variable	N	Mean	S.D.	Min	P25	P50	P75	Max
$ZEFF$	281	0.094	0.117	0.002	0.005	0.017	0.150	0.348
$VAIC$	322	4.662	1.956	0.702	3.509	4.430	5.557	12.846
CEE	322	0. 286	0.131	0.049	0.187	0.266	0.366	0.696
HCE	322	3.715	1.844	0.702	2.685	3.369	4.497	12.846
SCE	322	0.674	0.178	-0.202	0.631	0.704	0.780	1.049
$SIZE$	322	31.850	1.127	28.420	30.944	31.973	32.699	34.522
LIQ	309	0.321	0.132	0.049	0.227	0.315	0.398	0.816
HHI	309	0.001	0.001	-0.000	0.000	0.000	0.001	0.005
GDP	322	0.060	0.011	0.029	0.054	0.062	0.068	0.071
INF	322	0.073	0.061	0.006	0.032	0.053	0.090	0.231
GFC	322	0.214	0.411	0	0	0	0	1

Source: Authors' calculation.

Table 3. The correlation matrix of all variables

	$ZEFF$	$VAIC$	CEE	HCE	SCE	$SIZE$	LIQ	HHI	GDP	INF	GFC
$ZEFF$	1										
$VAIC$	-0.006	1									
CEE	0.358	0.242	1								
HCE	-0.044	0.995	0.157	1							
SCE	0.077	0.817	0.230	0.779	1						
$SIZE$	0.412	-0.178	0.524	-0.225	-0.130	1					
LIQ	0.035	0.261	0.024	0.271	0.158	-0.126	1				
HHI	0.290	0.128	0.402	0.096	0.094	0.611	-0.103	1			
GDP	-0.020	0.087	0.049	0.086	0.039	-0.045	0.008	-0.010	1		
INF	-0.103	0.290	-0.095	0.306	0.216	-0.445	0.248	0.012	-0.101	1	
GFC	-0.145	0.299	-0.008	0.312	0.199	-0.508	0.145	-0.013	-0.036	0.463	1

Source: Authors' calculation.

4. Results and discussion

4.1. Intellectual capital and bank stability efficiency

The results of our baseline models of intellectual capital and its sub-elements are presented in Table 4 below for evaluating the null hypothesis H1. The lagged value of dependent variable is restricted to 1 as a mean of minimizing the quantity of moment conditions (Fosu et al., 2020; Le & Nguyen, 2020). The coefficient of the lagged dependent variables are significant, suggesting that the system GMM estimation is applicable. Further, the null hypothesis cannot be rejected as the p-value obtained from the Hansen test is insignificant. In addition, the AR1 and AR2 test results are also acceptable. Therefore, it can be concluded that our diagnostic procedures are appropriate and there is a lack of substantiated proof regarding the existence of over-identifying constraints due to the usage of valid instruments and the fulfillment of all conditions (Arellano & Bond, 1991).

To begin with, hypothesis H1a is well supported by all model specifications, indicating that the existence of intellectual capital substantially reduces bank risk and enhances the efficiency of stability in Vietnamese banks. In particular, the estimated coefficient for $VAIC$ is 0.002 and exhibits statistical significance at the 1% level of significance. This suggests that there exists a positive correlation between an elevated degree of IC and enhanced stability efficacy of the banks in Vietnam. This finding aligns with the research conducted Curado et al. (2014), Kaupelytė and Kairytė (2016), Nguyen et al. (2021), and Onumah and Duho (2019) which demonstrated that intellectual capital serves as a valuable asset for creating value and enhancing business operations, thereby strengthening their stability. The research outcome is also consistent with the viewpoint of the RBV theory, which posits that intellectual resources hold significant importance in identifying the sustainable efficiency of banks.

To deepen the effects of IC on Vietnamese bank stability efficiency, our analysis is expanded by breaking down $VAIC$ into three distinct constituents: CEE, HCE and SCE. When evaluating VAIC's components, it is evident that HCE and SCE are positively and substantially associated with bank stability efficiency, with the value of coefficients at 0.002 and 0.032 respectively. As expected, the efficacy of human capital and structural capital are the main drivers of the stability efficiency of Vietnamese banks. However, the remaining factor, CEE, exhibits a statistically significant negative correlation with the efficiency of bank stability, indicating that bank risk will increase if banks participate in hazardous projects with excessive confidence, particularly in the short term. The results presented herein are in alignment with prior research performed by Nguyen et al. (2021) and Onumah & Duho (2019) which have established a corroborative correlation between the constituents of VAIC and the resilience of banks.

With respect to bank-specific variables, the coefficient on $SIZE$ in all models indicates a statistically significant and beneficial impact on Vietnamese bank stability efficiency, suggesting that larger banks exhibit greater degree of risk management compared to their smaller counterparts. This argument is consistent with the research outcomes of Tabak et al. (2012). The findings also reveal a significant association between liquidity risk (LIQ) and the stability efficiency of Vietnamese banks, indicating that banks with better levels of liquidity are more likely to attain enhanced stability. In the same vein, Ghenimi et al. (2017) and Özşuca and Akbostancı (2016) corroborate that banks that possess robust financial standing, high liquidity, and substantial capitalization are less susceptible to risk and demonstrate greater stability. Regarding other macroeconomic factors, the results illustrate that an increase in the HHI is positively correlated with bank stability efficiency. This points out that a higher level of concentration in Vietnamese banks may help to alleviate potential risks and improve managerial effectiveness (Mirzaei et al., 2013). Furthermore, the positive correlation between GDP and bank stability indicates a favorable signal for the economy. This reinforces the conventional notion that there is a surge in the need for banking services and products during cyclical upturns, leading to a rise in bank profitability and enhancement in bank stability. Finally, INF correlates negatively with bank stability efficiency, suggesting that banks may face challenges in accurately predicting inflation and making appropriate adjustments to interest rates.

4.2. Intellectual capital and its components impacts on bank stability efficiency during the crisis

Table 5 below presents an analysis of the linkage between IC and the stability of Vietnamese banks during the financial crisis period, in order to assess the validity of hypothesis H2. The coefficient on the interaction of $VAIC$ during the crisis period is statistically positive and significant (0.001), implying that the presence of IC enhances the stability of Vietnamese banks during the turbulent years of 2007-2008. Therefore, the enhancement of IC has the potential to assist financial institutions in withstanding economic adversity and uncertainty during times of crisis. This result is corroborated by research undertaken by Nguyen et al. (2021) and Onumah & Duho (2019). In terms of VAIC's sub-elements, the positive and significant coefficient observed in all models for the interaction of the sub-elements of $VAIC$, namely CEE, HCE, and SCE during the crisis is noteworthy. These findings suggest that investment in capital employed, human capital, and structural capital efficiency can enhance the stability and efficiency of banks during periods of crisis, which are consistent with Nguyen et al. (2021). Additionally, comparable results for additional control variables are likewise achieved.

4.3. Robustness check

To further reinforce the validity of our conclusion, supplementary tests are carried out to evaluate the strength and reliability of our primary results. The outcomes of these tests are performed in Table 6 below.

Firstly, the dependent variable ($ZEFF$) is substituted with the conventional Z-score (*Z-SCORE*) to serve as a direct indicator of bank soundness and an inverse measure of risk. An additional metric for assessing risk, namely the nonperforming loan (*NPL*) ratio, is also taken into account. The findings of the models below demonstrate that the presence of intellectual capital and its constituents exert a noteworthy influence on the specific risk of Vietnamese bank during the sample period. Consequently, the results presented herein validate the aforementioned findings.

Table 4. Baseline results of impacts of IC and its constituents on Vietnamese bank stability efficiency

Dep. variable – ($ZEFF$)	Predicted sign	VAIC	VAIC components		
Panel A – Coefficients estimation					
$VAIC$	+	0.002*** (0.000)			
CEE	+		-0.020*** (0.000)		
HCE	+			0.002*** (0.000)	
SCE	+				0.032*** (0.000)
$SIZE$	+/-	0.002*** (0.000)	0.003*** (0.000)	0.003*** (0.000)	0.002*** (0.000)
LIQ	+	0.054*** (0.000)	0.039*** (0.000)	0.055*** (0.000)	0.045*** (0.000)
HHI	+	1.137*** (0.001)	3.250*** (0.000)	1.110*** (0.001)	0.928*** (0.002)
GDP	+	0.295*** (0.000)	0.288*** (0.000)	0.286*** (0.000)	0. 271*** (0.000)
INF	-	-0.069*** (0.000)	-0.066*** (0.000)	-0.068*** (0.000)	-0.063*** (0.000)
$ZEFF_{t-1}$	+	0.910*** (0.000)	0.921*** (0.000)	0.910*** (0.000)	0.913*** (0.000)
Constant		-0.066*** (0.000)	0.100*** (0.000)	-0.078*** (0.000)	-0.069*** (0.000)
Panel B – Model fit					
AR1 (p-value)		0.005	0.005	0.005	0.006
AR2 (p-value)		0.785	0.779	0.782	0.819
Hansen test (p-value)		0.146	0.162	0.144	0.142
No.of Obs		254	254	254	254

Note: This table presents the results of the main equation. Robust standard errors are in parentheses. *, ** and *** Significant at 10, 5 and 1 % levels, respectively.

Source: Authors' calculation.

Table 5: IC and its decompositions and Vietnamese bank stability efficiency: the impact of financial crisis

Dependent variable – ($ZEFF$)	VAIC	VAIC components		
Panel A – Coefficients estimation				
$VAIC$	0.001***			
	(0.000)			
$VACRIS$	0.001***			
	(0.000)			
CEE		-0.169***		
		(0.000)		
$CECRIS$		0.022***		
		(0.009)		
HCE			0.002***	
			(0.000)	
$HCCRIS$			0.001***	
			(0.000)	
SCE				0.034***
				(0.000)
$SCCRIS$				0.001
				(0.805)
$SIZE$	0.005***	0.021***	0.005***	0.003***
	(0.000)	(0.000)	(0.000)	(0.006)
LIQ	0.049***	0.169***	0.048***	0.049***
	(0.000)	(0.000)	(0.000)	(0.000)
HHI	-3.614***	-9.728***	-3.803***	-4.567***
	(0.000)	(0.000)	(0.000)	(0.000)
GDP	-0.202***	0.141***	-0.201***	-0.275***
	(0.000)	(0.000)	(0.000)	(0.000)
INF	-0.035***	-0.071***	-0.034***	-0.054***
	(0.000)	(0.000)	(0.000)	(0.000)
$ZEFF_{t-1}$	0.924***	0.560***	0.924***	0.948***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.162***	-0.650***	-0.165***	-0.113***
	(0.000)	(0.000)	(0.000)	(0.001)
Panel B – Model fit				
AR1 (p-value)	0.004	0.005	0.004	0.004
AR2 (p-value)	0.808	0. 791	0.809	0.847
Hansen test (p-value)	0.131	0.175	0.131	0.128
No.of Obs	254	254	254	254

Note: This table presents the results of the main equation. Robust standard errors are in parentheses. *, ** and *** Significant at 10, 5 and 1 % levels, respectively.

Source: Authors' calculation.

Table 6: IC and its sub-components and alternative measures of risk

	Dependent variable - ZSCORE				**Dependent variable - NPL**			
	VAIC	**VAIC components**			**VAIC**	**VAIC components**		
Panel A – Coefficients estimation								
$VAIC$	0.176*				-0.130*			
	(0.060)				(0.051)			
CEE		-4.427***				-2.534**		
		(0.000)				(0.011)		
HCE			0.168**				-0.160**	
			(0.019)				(0.016)	
SCE				2.755***				-1.299*
				(0.008)				(0.050)
$SIZE$	0.473***	0.252**	0.433***	0.361***	-0.462***	-0.213	-0.497***	-0.408***
	(0.000)	(0.030)	(0.000)	(0.002)	(0.000)	(0.171)	(0.000)	(0.002)
LIQ	0.357***	1.311**	0.118***	0.920***	-1.803***	-1.452	-1.768***	-2.447***
	(0.068)	(0.046)	(0.001)	(0.000)	(0.000)	(0.150)	(0.000)	(0.000)
HHI	-1.514	3.628	-1.216	-1.134	-3.706	4.985	-1.305	5.897
	(0.517)	(0.300)	(0.572)	(0.558)	(0.851)	(0.967)	(0.949)	(0.816)
GDP	0.982	2.818	0.761	2.086	-7.704***	-5.121*	-7.343***	-7.005**
	(0.638)	(0.302)	(0.632)	(0.189)	(0.001)	(0.085)	(0.007)	(0.026)
INF	1.741***	1.003**	1.363*	1.986***	4.217***	5.334***	4.334***	4.324***
	(0.008)	(0.019)	(0.057)	(0.000)	(0.003)	(0.001)	(0.003)	(0.002)
π_{t-1}	0.289***	0.462***	0.300***	0.275***	0.219***	0.187***	0.218***	0.229***
	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-1.472***	0.796**	-1.333***	-1.211***	1.796***	0.979*	1.896***	1.658***
	(0.000)	(0.027)	(0.000)	(0.001)	(0.000)	(0.054)	(0.000)	(0.001)
Panel B – Model fit								
AR1	0.014	0.006	0.014	0.008	0.007	0.008	0.008	0.013
AR2	0.108	0.158	0.075	0.225	0.098	0.087	0.098	0.091
Hansen test	0.268	0.276	0.254	0.250	0.247	0.256	0.244	0.251
No.of Obs	254	254	254	254	254	254	254	254

Note: This table presents the results of the main equation. Robust standard errors are in parentheses. *, ** and *** Significant at 10, 5 and 1 % levels, respectively.

Source: Authors' calculation.

5. Conclusions

This study offers empirical evidence concerning the significance of IC and its constituents in enhancing Vietnamese banks stability efficiency, using a sample of 24 commercial banks from 2007 to 2020. In contrast to previous research that employed Z-scores as a means of accounting for the diverse levels of risk in assessing the effects of IC and its constituents, our study utilizes a stochastic frontier approach to gauge the bank stability efficiency. Further, intellectual capital efficiency was computed using the conventional VAIC methodology. Overall, our findings validate the significance of intellectual capital for strengthening the stability efficiency of Vietnamese banks. Upon decomposition of the measure of IC, it is evident that the efficiency of human capital and structural capital significantly contribute to the stability of banks. Conversely, the efficiency of capital employed exhibits a negative and significant impact. This study delves deeper into the influences of IC and its constituents on the stability efficiency of banks in Vietnam amidst the financial crisis and we confirm that the research outcomes remain applicable despite the challenging circumstances. In addition, different risk indicators are utilized to reassess the interaction between intellectual capital and bank risk, and the findings remain resilient.

Our analysis could potentially have significant implications for both bank managers and policymakers. While the former normally endeavors to improve the financial performance of banks, our current research objective is to prevent excessive risk-taking by banks, thus enhancing bank stability. The paper's findings indicate that the implementation of efficient knowledge management strategies by banks can facilitate the accumulation of intellectual capital required to tackle a constantly evolving environment. This, in turn, can serve as a viable approach to attaining the objectives of both bank executives and regulators.

This research has some limitations. Firstly, this study solely focuses on commercial banks in Vietnam within a limited timeframe. Additional research should be considered to examine the importance of intellectual capital in other developing countries to gain a better understanding of the context. Moreover, due to the unique nature of banks as an institution, it is imperative to incorporate further control variables, such as bank ownership, innovations, and R&D investments, to distinguish the impact of IC on the soundness of banks.

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