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The Effect of Value-Added Intellectual Coefficient on Commercial Banks' Financial Performance in Cambodia

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Abstract

This study investigates the impact of the value-added intellectual coefficient (VAIC) on the financial performance of commercial banks in Cambodia, specifically focusing on return on assets (ROA). Panel data models, such as Pooled OLS, random effect, and fixed effect models, are utilized to analyze the data. The empirical results indicate that VAIC has a positive and statistically significant influence on asset utilization efficiency, as measured by ROA. Furthermore, the study reveals that each component of VAIC (human capital efficiency, structural capital efficiency, and capital employed efficiency) contributes significantly to banks' financial performance. The size of banks, measured by the logarithm of their aggregate assets, has a significant impact on ROA, while the physical capital of banks does not demonstrate a significant effect. These findings have practical implications for commercial banks in Cambodia, suggesting that they should prioritize enhancing VAIC by improving the efficiency of human, structural, and employed capital. This can be achieved through investments in training and development programs, optimization of organizational structures and processes, and effective utilization of capital resources. Nonetheless, it is important to acknowledge the limitations of this study, as it solely focuses on data from commercial banks in Cambodia, and the findings may not be applicable to other countries or types of financial institutions. Future research could employ different methodologies and extend the analysis to include a larger sample of banks from multiple countries, to enhance the generalizability of the findings.

Keywords: *Value-Added Intellectual Coefficient, Human Capital Efficiency, Structural Capital Efficiency, Capital Employed Efficiency, Panel Data Models.*

Introduction

Accounting metrics such as return on assets (ROA) and return on equity (ROE) provide valuable insights into the factors that influence the performance of banks. The manner in which banks employ and oversee their resources, encompassing both tangible and intangible assets, has a substantial influence on the level of competition and profitability within the banking sector. One crucial intangible asset is intellectual capital (IC), encompassing the knowledge, processes, databases, strategies, experience, and skills of employees. In today's business world, having a strong foundation of knowledge is essential for the success and competitiveness of industries, including banking. IC is a highly regarded resource for accomplishing these objectives (Faruq et al., 2023).

However, there is a notable research gap when it comes to examining the influence of VAIC on the financial performance of commercial banks in Cambodia. Although there has been extensive research on performance measurement in different industries, there is a lack of empirical studies specifically focused on Cambodia's banking sector. Therefore, this study aims to address this knowledge gap by examining the relationship between VAIC and financial performance, specifically

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ROA, in commercial banks in Cambodia.

In order to accomplish its research objectives, this study will utilize panel data models including Pooled OLS, random effect (RE), and fixed effect (FE) models. These models will facilitate a thorough examination of the impact of VAIC on bank financial performance. The VAIC measurement method, developed by Pulic (2008), will be utilized to evaluate IC. While typically utilized in manufacturing companies, this study seeks to broaden its application to the banking sector. The coefficients for the three components of VAIC (human capital efficiency, structural capital efficiency, and capital employed efficiency) will be determined using Marzo's (2022) method.

The findings of this study will provide valuable insights for Cambodian commercial banks in making informed decisions regarding their IC investments. In addition, this research will enhance our understanding of the importance of intellectual capital in the banking sector by examining the correlation between VAIC and financial performance indicators. The study's findings will also have practical implications for Cambodian banks, assisting them in making well-informed decisions regarding the utilization and management of their IC resources.

This study is structured into five chapters. The initial chapter serves as an introduction, while the subsequent chapter delves into the review of relevant literature. Chapters three and four delve into the methodology and empirical findings of the study, respectively. Lastly, chapter five concludes the research by summarizing the findings and offering recommendations.

Literature Review

Several studies have examined the relationship between value-added intellectual capital (VAIC) and bank performance, specifically ROA, ROE, and net interest margin (NIM). Akhter (2020) conducted a study on Malaysian banks from 1999 to 2008, focusing on capital employed efficiency (CEE), human capital efficiency (HCE), and structural capital efficiency (SCE). Using non-parametric data envelopment analysis, the study found a positive association between VAIC and bank performance. Poh et al. (2018) further explored the impact of VAIC on financial performance in ten local Malaysian banks over a span of ten years. The study found that both SCE and HCE significantly influenced financial performance, as measured by ROA, ROE, and leverage. However, the small sample size and lack of assessment of assumptions raised concerns about the reliability of the findings. Nawaz & Haniffa (2017) investigated the impact of VAIC on Islamic Financial Institutions (IFIs) and found that all components of VAIC had a significant effect on these institutions, which aligns with previous studies. Marsintauli et al. (2023) examined the influence of intellectual capital (IC) on the financial performance of banks listed on the Indonesian Stock Exchange. The empirical findings indicated that IC influenced ROA and NIM, but not the capital adequacy ratio.

Recent research has provided evidence of the significant contribution of HCE to financial performance. For instance, Sardo et al. (2018) emphasized the importance of skilled and efficient employees in enhancing organizations' productivity and effectiveness. Xu & Liu (2020) conducted

study on manufacturing companies in South Korea and found that firms' performance relies heavily on human capital. This is consistent with the findings of Smriti and Das (2018), who observed that higher levels of human capital within firms correspond to increased productivity. Furthermore, research conducted by Amin (2020) assessed the financial performance of banks in Bangladesh and discovered a positive correlation between investment in human capital and overall financial performance, particularly for publicly traded banks. These findings emphasize the importance of human capital for organizational performance, including in the banking sector. Moreover, Kondoy & Soewignyo (2023) examined the connection between IC and company performance in the banking sector. They found that HCE and CEE have a significant

positive effect on company performance. In contrast, SCE had a significant negative effect, indicating that increased investment in structural capital may lower a company's performance. Tariq et al. (2023) investigated the relationship between IC and the performance of banks in the Pakistani banking sector. They found that IC significantly and favorably affects banks' financial performance, as measured by ROA. This highlights the positive contribution of IC to the banking sector and underscores its importance for overall economic functioning.

CEE also positively impacts bank performance, indicating effective utilization of financial resources (Kweh et al., 2019; Soewarno & Tjahjadi, 2020; Pilatin et al., 2023; Asutay & Ubaidillah, 2023). Researchers have found that efficient utilization of financial resources contributes to better bank performance, as measured by metrics like ROA and ROE. These findings highlight the importance of CEE in enhancing the overall financial performance of banks. In the context of Turkey, it has been observed that IC, particularly CEE and HCE, has a positive and significant influence on bank performance (Pilatin et al., 2023). This further strengthens the link between CEE and financial performance in the banking sector. Furthermore, a study by Asutay & Ubaidillah (2023) focused on Islamic banks and their IC performance. They found that IC has a favorable impact on financial performance, primarily in terms of profitability. When examining the individual components of IC, CEE and HCE emerged as the most influential factors, while SCE did not significantly impact financial performance. Mollah & Rouf (2022) explored the impact of IC on the financial performance of listed commercial banks in Bangladesh. Their findings indicate that HCE and CEE have a significant positive influence on bank performance, suggesting that investment in these areas can lead to higher returns. However, the study also points out the limitations of the IC measurement model employed and recommends further research on the entire banking sector for comprehensive results.

Several studies have examined the impact SCE on financial performance. Rusmawan et al. (2023) specifically focused on Islamic banks in Indonesia and found that IC had a significant positive impact on financial performance. However, they discovered contrasting roles for HCE and SCE, with HCE positively influencing performance and SCE negatively impacting performance. This suggests that effective management of IC is crucial for Islamic banks. Poh et al. (2018) conducted a study on Malaysian banks and found that both HCE and SCE significantly influenced financial performance. However, the small sample size and lack of robustness tests raise concerns about the reliability of the findings. Future studies should consider larger sample sizes and conduct thorough assessments to strengthen the validity of their results. Thaha & Sulaiman (2022) examined IC efficiency in Indonesian banks using the VAIC model. Their findings indicated that HCE and CEE positively contribute to value creation and efficiency in banks. This suggests that IC plays a significant role in determining the efficiency and ranking of banks in Indonesia.

Regional studies provide valuable insights into the influence of IC on bank performance in diverse contexts. For example, in Turkey, the IC of banks, specifically CEE and HCE, had a positive and significant influence on bank performance (Pilatin et al., 2023). Similar findings were observed for Turkish banks in a study that utilized a panel vector autoregressive model (Vuslat, 2020). Onumah & Duho (2019) focused on the effect of IC on the financial performance and stability of banks in Ghana. Their findings reveal that the VAIC has a positive and significant impact on financial performance and stability. Among the components of VAIC, HCE behaves similarly, while SCE negatively affects financial performance and stability. CEE has a positive impact on financial performance but a negative impact on financial stability. The evaluation of Kuwaiti Islamic Banks also indicated that the efficiency of capital employed had a significant impact on bank performance (Nawaz & Haniffa, 2017; Ozkan et al., 2017; Buallay, 2019). The financial performance of Gulf Cooperation Council (GCC) Islamic banks was greatly affected by VAIC, as highlighted in the study conducted by Ousama et al. (2020). This finding is consistent with the research conducted by Akkas

and Asutay (2022). These studies contribute to the understanding of the relationship between VAIC and financial performance in Islamic banks.

Family businesses might benefit more from efficient IC. Acuña-Opazo & Gonzalez (2019) focused on the impact of IC on the financial performance and value-added production of manufacturing businesses in an emerging economy. They found that the efficiency of IC positively affects financial performance, with family businesses experiencing a greater impact than non-family businesses, especially SMEs. This suggests that effective management of IC can enhance competitiveness, efficiency, and growth in businesses.

While previous studies have employed panel data analysis to examine the relationship between VAIC and financial performance, most of them utilized pooled OLS analysis. However, it is important to consider the specific effects of individual banks, which can be evaluated through the implementation of random and fixed effect models (Faruq et al., 2023). These models provide a more comprehensive understanding of the relationship between VAIC and financial performance, taking into account the unique characteristics of each individual bank.

The mediating role of competitive advantage in the relationship between IC and financial performance requires further exploration. Awwad & Qtaishat (2022) examined the impact of IC on the financial performance of Jordanian commercial banks, with the mediating role of competitive advantage. They found that intellectual capital and competitive advantage positively influence financial performance. Furthermore, competitive advantage mediates the relationship between IC and financial performance, highlighting the importance of IC in creating value and developing a competitive edge in the banking sector.

The existing literature have examined the impact of VAIC, including CEE, HCE, and SCE, on banks' financial performance indicators such as ROA and ROE. The findings suggest that both HCE and SCE play a significant role in determining the financial performance of banks, although there may be variations depending on the specific context and region. However, there are limitations to consider, including small sample sizes, the omission of certain statistical tests and assessments, and the use of pooled OLS analysis without considering individual bank effects. By utilizing panel data regression models and considering specific bank effects, this study aims to contribute to the existing literature on the relationship between VAIC and financial performance in commercial banks in Cambodia.

Methodology

This study employs panel data models, including Pooled OLS, random effect (RE), and fixed effect (FE) models, to investigate the impact of VAIC on the performance of banks. The performance is evaluated using the accounting-based indicator, ROA. The VAIC measurement method, initially developed by Public (2008), has been predominantly applied in the context of manufacturing companies. However, this study focuses on analyzing the performance of commercial banks. To calculate the three components of VAIC, namely human capital efficiency (HCE), structural capital efficiency (SCE), and capital employed efficiency (CEE) coefficients, the Marzo's (2022) method is utilized.

$$ROA_{jt} = \alpha_0 + \theta_1 VAIC_{jt} + \theta_2 PC_{jt} + \theta_3 SIZE_{jt} + \varepsilon_{jt} \quad (1)$$

$$ROA_{jt} = \omega_0 + \delta_1 HCE_{jt} + \delta_2 SCE_{jt} + \delta_3 CEE_{jt} + \delta_4 PC_{jt} + \delta_5 SIZE_{jt} + \epsilon_{jt} \quad (2)$$

Equation (1) assesses the performance of banks using the VAIC measure, specifically by looking at the ROA. Equation (2) is then used to analyze the impact of the three components of VAIC on the ROA. Both models include two control variables: banks' physical capital (PC), measured by total

assets minus intangible assets, and banks' size (SIZE), measured by the logarithm of banks' total assets. In Equation (1), the parameters to be estimated are $\alpha_0, \theta_1, \theta_2,$ and θ_3, while in Equation (2), the coefficients to be estimated are $\omega_0, \delta_1, \delta_3, \delta_4,$ and δ_5. The residual terms of Equation (1) and Equation (2) are represented by ε and ϵ, respectively. In addition, j indicates individual bank, $j = 1,2,3,\cdots,23$ and t represents time period, $t = 2011,2012,2013,\cdots,2022$.

To assess the relationships, three different panel data models – Pooled OLS, RE, and FE models – will be applied to each equation. The comparison between Pooled OLS and FE models will be conducted using the FE test, specifically the F-statistic. The null hypotheses for the FE test of Equation (1) and (2) are as follows:

Equation (1),

$$H_0: \alpha_{01} = \alpha_{02} = \alpha_{03} = \cdots = \alpha_{0N}$$

Equation (2),

$$H_0: \omega_{01} = \omega_{02} = \omega_{03} = \cdots = \omega_{0N}$$

Rejection of the null hypothesis indicates the presence of a unique bank-specific effect, suggesting that the FE model is more suitable than the Pooled OLS model. Furthermore, the selection between RE and FE models will be determined by conducting the Hausman test. If the null hypothesis is rejected, the FE model will be chosen; otherwise, the RE model will be selected.

Table 1 illustrates the process of determining the variables under investigation and the sources from which the data is collected. To standardize the dataset, SCE takes the cube, whereas CEE equips the square root (Marzo, 2022).

Table 1: Measurement of Variables.

Names	Variables	Measurement	Data Sources
Return on Assets	ROA	$ROA = \frac{Net\ Income}{Total\ Assets}$	National Bank of Cambodia
Net Value Added	VA	$VA = i + t + ni + w$ Where, $i: Interest\ Expense$ $t: Taxes$ $ni: Net\ Income$ $w: Salaries\ and\ Wages\ Expense$	Data related to $i, t,$ and ni are collected from the National Bank of Cambodia, while w is collected from Commercial Banks' Annual Reports
Human Capital Efficiency	HCE	$HCE = \frac{VA}{Salaries\ and\ Wages\ Expense}$	National Bank of Cambodia and Commercial Banks' Annual Reports
Structural Capital Efficiency	SCE	$SCE = \frac{VA - Human\ Capital\ Employed}{VA}$	National Bank of Cambodia and Commercial Banks' Annual Reports
Capital Employed Efficiency	CEE	$CEE = \frac{VA}{Total\ Assets - Intangible\ Assets}$	National Bank of Cambodia and Commercial Banks' Annual Reports
Value-Added Intellectual Coefficient	VAIC	$VAIC = HCE + SCE + CEE$	National Bank of Cambodia and Commercial Banks' Annual Reports
Physical Capital	PC	$PC = \frac{Fixed\ Assets}{Total\ Assets}$	National Bank of Cambodia
Banks' Size	SIZE	$SIZE = Log(Total\ Assets)$	National Bank of Cambodia

Empirical Results

This section has been divided into three distinct parts. The first section presents descriptive statistics for all variables investigated in the study. Parts two and three elaborate on the research's empirical

findings. The second section includes an analysis and interpretation of the estimated results from panel data models. These models investigate the effect of the value-added intellectual coefficient on asset utilization efficiency, as measured by return on assets. The value-added intellectual coefficient is calculated by taking into account the efficiency of human, structural, and employed capital. An empirical investigation using panel data models is conducted to assess the impact of these indicators on asset return. The third part of this section presents the findings of this analysis.

The study ran from 2011 to 2022, which was a span of 12 years. Throughout this period, a total of 23 commercial banks provided comprehensive datasets. Time series data from 2011 to 2022 were combined with cross-sectional data from these 23 commercial banks, yielding a total of 276 observations. The empirical examination is conducted using seven variables: return on asset, value-added intellectual coefficient, human capital efficiency, structural capital efficiency, capital employed efficiency, physical capital, and commercial bank size. The statistical summary is shown in Table 2.

Table 2: Summary Statistics.

Variables	Observation	Mean	Standard Deviation	Minimum	Maximum
ROA	276	1.3703	1.3360	-7.9240	4.3729
VAIC	276	8.6803	6.1303	1.5228	41.0189
HCE	276	7.3909	6.1546	-2.0050	39.7927
SCE	276	0.9834	0.0221	0.8560	1.1215
CEE	276	0.2017	0.0425	0.0591	0.3377
PC	276	0.0246	0.0337	0.0009	0.2454
SIZE	276	6.2758	0.5416	5.1746	7.5688

This study examines two models. The initial model, represented by equation (1), aims to assess the influence of the value-added intellectual coefficient on ROA. This influence is determined by two factors: banks' physical capital and size. Equation (2), on the other hand, is designed to evaluate the impact of the value-added intellectual capital coefficient's three components (human capital, structural capital, and capital employed efficiency coefficients) on asset return. This model is further governed by two variables: physical capital and bank size. As a result, prior to running any regression models, it is critical to assess the correlation between independent variables to avoid multicollinearity. Multicollinearity occurs when there is a high or perfect correlation between independent variables in the model, reducing the statistical significance of an independent variable. The correlation coefficients between VAIC and PC (-0.2173) and VAIC and SIZE (0.2128) are both low, indicating that the independent variables in equation (1) do not exhibit high or perfect multicollinearity. In equation (2), all of the correlation coefficients between the independent variables (HCE, SCE, CEE, PC, and SIZE) are less than $|0.5|$, indicating that there is no high or perfect collinearity among these variables. It should be noted that there is a perfect positive correlation between VAIC and HCE, as the correlation coefficient is equal to 1. This underscores the rationale for not implementing the model that combines VAIC and its three components to assess the influence of banks' ROA.

Table 3: Correlation Matrix.

Variables	VAIC	HCE	SCE	CEE	PC	SIZE
VAIC	1					
HCE	1	1				
SCE	0.3771	0.3727	1			
CEE	0.2724	0.2653	0.3258	1		
PC	-0.2173	-0.2175	-0.1604	0.013	1	
SIZE	0.2128	0.2091	0.2745	0.4988	-0.0744	1

There will be three distinct panel data models, specifically pooled OLS, random effect, and fixed

effect models, based on either equation (1) or (2). The three models will produce empirical outcomes, and an evaluation of their suitability will also be performed. This assessment involves assessing the choice between pooled OLS and fixed effect models using a fixed effect test. The null hypothesis of the fixed effect test indicates the lack of any distinct effect specific to individual banks. The fixed effect test, as displayed in Table 4, decisively rejects the null hypothesis with a high level of significance at 1%. Consequently, the fixed effect model is more appropriate than the pooled OLS model. In addition, it is important to mention that the Hausman test indicates a preference for the fixed effect model over the random effect model. The statistical significance of the calculated chi(3) value of 27.35 is evident at the 1% level. The empirical results obtained from the fixed effect model indicate that the estimated parameter of VAIC is 0.0951. The positive value is also statistically significant in explaining the return on asset at a significance level of 1%. Therefore, it can be inferred that a rise in the value-added intellectual coefficient would improve the efficiency of asset utilization in commercial banks. Furthermore, while the estimated parameters of the two control variables, banks' physical capital and size, do not show statistical significance in explaining return on asset, the joint test reveals a calculated F-statistic of F(3,238) = 18.01. Given a test probability of 0.0000, which falls below the 1% level of significance, it can be inferred that all independent variables in the fixed effect model collectively account for the variation in return on asset.

In order to improve the comprehensiveness of evaluating the influence of the value-added capital coefficient on asset utilization efficiency, the three distinct components of one of the significant independent variables in the three panel data models are replaced. The components encompassed in this context are human capital, structural capital, and the capital employed efficiency coefficient. However, the models continue to include the two control variables, specifically banks' physical capital and size.

Table 4: VAIC and ROA.

Explanatory Variables		Pooled OLS	Random Effect	Fixed Effect
VAIC		0.0863***	0.0891***	0.0951***
		(0.0099)	(0.0122)	(0.0142)
PC		-5.4723***	-1.3770	-0.3237
		(1.7348)	(1.8596)	(2.0441)
SIZE		0.2054*	-0.0390	-0.2344
		(0.1103)	(0.1503)	(0.1925)
CONSTANT		-0.4476	0.9646	2.1175*
		(0.6885)	(0.9386)	(1.1948)
Observation		276	276	276
No. of banks		23	23	23
Joint test		F(3, 260) = 2.23	Wald chi2(3) = 69.60	F(3,238) = 18.01
		Prof > F = 0.0000	Prob > chi2 = 0.0000	Prof > F = 0.0000
Fixed Effect test	F(22, 238) = 7.12			
	Prof > F = 0.0000			
Hausman test	chi2(3) = 27.35			
	Prob > chi2 = 0.0000			
***, **, * significant at 1%, 5%, 10%, respectively. Standard error in parenthesis.				

Table 5 presents the results of the fixed effect test, F(22, 238) = 7.12, which indicate the presence of an individual bank specific effect. The null hypothesis of the test is decisively rejected with a high level of confidence at a significance level of 1%. Hence, it can be inferred that the fixed effect model is more appropriate than the pooled OLS model. In addition, the Hausman test produces a chi-square value of 27.35 with a very low probability, suggesting that the fixed effect model is more suitable than the random effect model. Based on the outcomes of the fixed effect and Hausman

tests, it can be inferred that the fixed effect model is the most suitable model.

The empirical results of the fixed effect model are shown in Table 5. The estimated coefficients for HCE, SCE, and CEE are 0.0397, 13.2298, and 15.0004, respectively. Significantly, each coefficient demonstrates statistical significance in explaining banks' return on assets at a 1% level. Moreover, in the fixed effect model, only one of the two control variables exhibits a substantial impact on ROA. This variable represents the magnitude of banks, quantified by the logarithm of their aggregate assets.

However, the physical capital of banks, as measured by the ratio of fixed assets to total assets, does not have a notable impact. Significantly, all variables in the fixed effect model, including HCE, SCE, CEE, PC, and SIZE, except for the constant term, collectively exhibit substantial explanatory capability in relation to banks' return on asset. This is apparent from the computed F-statistic ($F(5,236) = 67.15$), which demonstrates a probability that is nearly zero and unquestionably below the 1% level of significance.

Table 5: HCE, SCE, CEE and ROA.

Explanatory Variables		Pooled OLS	Random Effect	Fixed Effect
HCE		0.0532***	0.0434***	0.0397***
		(0.0081)	(0.0096)	(0.0111)
SCE		13.9975***	13.8178***	13.2298***
		(2.5350)	(2.6827)	(3.0148)
CEE		14.2435***	14.6613***	15.0004***
		(1.2825)	(1.3324)	(1.4820)
PC		-6.4054***	-2.8328**	-2.1983
		(1.3495)	(1.3723)	(1.4772)
SIZE		-0.4101***	-0.6089***	-0.7038***
		(0.0969)	(0.1190)	(0.1467)
CONSTANT		-12.8452***	-11.5217***	-10.3990***
		(2.4226)	(2.4864)	(2.6515)
Observation		276	276	276
No. of banks		23	23	23
Joint test		F(5, 258) = 76.00	Wald chi2(5) = 355.38	F(5,236) = 67.15
		Prof > F = 0.0000	Prob > chi2 = 0.0000	Prof > F = 0.0000
Fixed Effect test	F(22, 238) = 7.12			
	Prof > F = 0.0000			
Hausman test	chi2(5) = 171.50			
	Prob > chi2 = 0.0000			
***, **, * significant at 1%, 5%, 10%, respectively. Standard error in parenthesis.				

Conclusion

In this study, the impact of VAIC on the financial performance of commercial banks in Cambodia was examined. VAIC was determined by considering the efficiencies of human capital, structural capital, and capital employed. To address multicollinearity issues, two distinct regression equations were employed to achieve the research objectives.

Panel data from 23 commercial banks over a 12-year period were utilized for the study. Three panel data models, namely pooled OLS, random effect, and fixed effect models, were employed. The fixed effect model was found to be the most suitable, revealing the presence of individual bank-specific effects.

The empirical findings of this study demonstrated a significant positive impact of VAIC and its three components on the ROA of commercial banks. This emphasizes the importance of effectively managing intellectual capital alongside physical assets in generating profit.

These findings have practical implications for Cambodian commercial banks, indicating the need to prioritize the improvement of VAIC by enhancing the efficiency of human, structural, and employed capital. This can be accomplished through investment in employee training and development programs, improvement of organizational structures and processes, and optimization of capital resource allocation. By doing so, banks can enhance asset utilization efficiency and consequently improve their financial performance.

It is important to acknowledge the limitations of this study. The analysis focused solely on data from commercial banks in Cambodia, thus limiting the applicability of the results to other countries or types of financial institutions. Additionally, the study utilized panel data models, which come with their own assumptions and limitations. Future research could explore the relationship between VAIC and financial performance using different methodologies or expand the analysis to include a larger sample of banks from multiple countries. Moreover, incorporating dynamic panel data models, specifically the generalized method of moments (GMM) estimation method, may provide further insights into the dynamic relationship between VAIC and ROA.

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