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The Effect of Value-Added Intellectual Coefficient (VAIC) on Return on Assets (ROA) with Physical Capitals (PC) as a Moderating Variable in Banking Companies Listed on the Indonesia Stock Exchange 2020-2024

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ABSTRACT

This study aims to analyze the effect of the Value-Added Intellectual Coefficient (VAIC) on Return on Assets (ROA), with Physical Capital (PC) serving as a moderating variable in banking companies listed on the Indonesia Stock Exchange during the period 2020-2024. This research employs a quantitative approach using secondary data over a five-year period. The population of this study consists of banking companies listed on the Indonesia Stock Exchange, with samples selected through purposive sampling, resulting in a total sample of 47 companies. Panel data regression analysis was utilized as the analytical technique.

The results of this study indicate the Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), and Capital Employed Efficiency (CEE) have a significant negative effect on Return on Assets (ROA), while the Value-Added Intellectual Coefficient (VAIC) has a significant positive effect on ROA. Furthermore, Physical Capital (PC) partially moderates the effect of Human Capital Efficiency (HCE) and Value-Added Intellectual Coefficient (VAIC) on ROA by strengthening their influence on ROA. Conversely, Physical Capital (PC) partially moderates the effect of Structural Capital Efficiency (SCE) on ROA by weakening its influence. Meanwhile, Physical Capital (PC) is not able to moderate the effect of Capital Employed Efficiency (CEE) on ROA.

Keywords: *Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), Capital Employed Efficiency (CEE), Value-Added Intellectual Coefficient (VAIC), Return on Assets (ROA), Physical Capital (PC), Intellectual Capital.*

INTRODUCTION

In Indonesia, the banking sector is one of several highly competitive industries that continually adapts to changes in the business landscape, regulations, and market expectations. The financial performance of banking companies is a crucial indicator for measuring operational efficiency and a company's ability to generate profits. One ratio often used to measure a company's profitability is the Return on Assets (ROA), which reflects how effectively a company uses its assets to generate profits.

Recent developments indicate that the Indonesian banking sector is facing complex challenges and opportunities. Following the COVID-19 pandemic, a massive acceleration of digital transformation has occurred,

forcing banks to invest more in information technology and develop digital banking services.

In this knowledge-based economy, intangible assets are increasingly recognized as key drivers of company value. Unlike easily measurable physical assets, intangible assets such as knowledge, innovation, brands, and customer relationships often determine long-term competitiveness. The concept of Intellectual Capital (IC) has emerged as a framework for identifying, measuring, and managing these intangible assets. IC is grouped into three main components: Human Capital, Structural Capital, and Relational Capital. A company's ability to manage and utilize IC effectively is believed to be positively correlated with financial performance.

Improving company performance requires not only physical capital but also intellectual capital (IC), which is crucial for creating wealth and achieving competitive advantage. In the modern era, evaluation of an organization's efficiency and effectiveness is based on the utilization of its intangible resources (Barak & Sharma, 2024). The knowledge-based economy is characterized by its focus on the effective and innovative use of intangible resources (Tiwari & Vidyarthi, 2018). In today's digital and knowledge-based economy, the primary factors driving organizational efficiency, performance, and value creation have shifted significantly. In the past, physical assets were largely recognized as the primary determinant. However, today, according to Leon (2017), when companies maximize the use of knowledge and technology, this will result in more economical and efficient resource utilization.

According to Stewart (1997), IC encompasses knowledge, information, intellectual property, and experience, which can generate wealth value for a company. The difference between a company's market value and book value has also been categorized as IC (Maditinos et al., 2011). Intellectual capital (IC) is the stock of knowledge capital owned and available to an organization (Dierickx & Cool, 1989).

The Value-Added Intellectual Coefficient (VAIC) is a method for measuring IC performance, introduced by Pulic (1998). This method is widely used in IC studies across many business sectors. The Value-Added Intellectual Coefficient (VAIC) is considered a standard and logical measurement method. This method uses financial statement data to calculate a company's value-creation efficiency, enabling comparisons with other companies. In its original form, VAIC assessed IC solely through Human Capital (HC) and Structural Capital (SC). Human Capital (HC) refers to the skills and knowledge that enable workers to succeed in various situations, including values and motivation (Sveiby, 1997). Structural Capital (SC), on the other hand, refers to the procedures, processes, and systems that workers use to utilize their existing skills and expertise to generate wealth (Hsu & Wang, 2010). Over time, Capital Employed (CE) was also considered as an IC component.

According to the Financial Services Authority (OJK), a good ROA (Return on Assets) standard for banking is above 1.5%. A high ROA indicates a bank's ability to generate profits from its assets. It aligns with Bank Indonesia Circular Letter No. 13/24/DPNP, which states that a bank is considered healthy if its ROA is above 1.21%.

Based on the financial reports of banking companies listed on the Indonesia Stock Exchange, company profitability, as measured by the Return on Assets (ROA) ratio, fluctuated between 2020 and 2024. Significant changes in the average ROA of banking companies listed on the Indonesia Stock Exchange affected the average Human Capital Efficiency (HCE), Capital Employed Efficiency (CEE), Structural Capital Efficiency (SCE), and Value-Added Intellectual Coefficient (VAIC) during 2020-2024.

Table 1. Average ROA, HCE, SCE, CEE, and VAIC for Banks on the IDX

Years	Average Value of Banking Companies Listed on the Indonesia Stock Exchange during 2020-2024				
	ROA	HCE	SCE	CEE	VAIC = (HCE + SCE + CEE)
2020	0,56	4,29	0,80	0,27	5,36
2021	-0,07	5,51	0,72	0,33	6,84
2022	0,87	3,98	0,64	0,22	4,84
2023	1,34	3,90	0,45	0,21	4,56
2024	1,39	4,43	0,65	0,25	5,33

Table 1 above shows changes in the average values of Return on Assets (ROA), Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), Capital Employed Efficiency (CEE), and Value-Added Intellectual Coefficient (VAIC) for banking companies listed on the Indonesia Stock Exchange during 2020-2024. In 2023 and 2024, ROA was at an ideal level, which influenced increases in HCE, SCE, CEE, and VAIC, indicating a positive relationship among the variables.

The positive relationship between ROA, HCE, SCE, CEE, and VAIC can be seen in several banking companies listed on the Indonesia Stock Exchange that experienced increases in ROA, HCE, SCE, CEE, and VAIC during the 2023-2024 period, as shown in Table 2 below:

Table 2. List of Banks on the IDX with Increases in ROA, HCE, SCE, CEE and VAIC

No.	Banks	Years	ROA	HCE	SCE	CEE	VAIC
1	BSI	2023	2,35	1,97	0,50	0,37	2,84
		2024	2,49	2,16	0,54	0,38	3,08
3	Panin	2023	1,57	4,95	0,80	1,80	5,93
		2024	1,57	4,97	0,80	1,80	5,95
4	Amar Bank	2023	4,06	3,22	0,69	0,24	4,15
		2024	4,42	4,30	0,77	0,32	5,39
5	Neo Commerce Bank	2023	-2,99	14,43	0,93	1,18	16,54
		2024	0,11	15,18	0,94	1,24	17,36
6	KB Bank	2023	-7,71	20,50	0,95	1,18	22,63
		2024	-7,55	20,96	0,96	2,17	24,09
7	Bank National Nobu	2023	0,79	2,74	0,63	0,27	3,64
		2024	1,38	3,90	0,74	0,39	5,03
8	Bank Mestika	2023	3,26	0,25	-2,94	0,05	-2,67
		2024	3,97	1,32	0,24	0,08	1,64
9	Mayapada	2023	0,04	9,38	0,89	0,50	10,77
		2024	0,04	12,31	0,92	0,61	13,84
10	IBK	2023	0,92	4,00	1,14	0,75	5,89
		2024	1,40	4,02	1,15	0,76	5,93
11	Artha Graha	2023	0,60	4,37	0,29	0,77	5,43
		2024	0,60	4,92	0,33	0,80	6,05
12	Bank Banten	2023	0,72	2,20	0,55	0,16	2,91
		2024	1,02	2,23	0,56	0,17	2,96
13	Bank of India Indonesia	2023	0,96	4,47	0,63	0,80	5,90
		2024	1,52	4,72	0,71	0,78	6,21
14	China Construction Bank	2023	1,22	2,30	0,57	0,10	2,97
		2024	1,23	4,00	0,75	0,18	4,93
15	Victoria Bank	2023	0,48	10,70	0,90	0,44	12,04
		2024	0,51	12,31	0,92	0,56	13,99
16	Aladin Syariah	2023	-4,22	3,21	0,83	0,69	4,73
		2024	-0,90	3,54	0,72	0,86	5,12
17	OCBC NISP	2023	2,14	0,44	0,30	0,10	0,84
		2024	2,24	0,45	3,36	0,11	3,92
18	SMBC	2023	1,70	3,00	0,26	0,66	3,92
		2024	1,80	3,10	0,27	0,67	4,04

The positive relationship between variables is reinforced by previous research. Previous studies have shown a significant positive relationship between Human Capital Efficiency (HCE) and company performance, as measured by Return on Assets (ROA) (Xu & Zhang, 2021), (Xu & Li, 2022), (Nazir, et al., 2021), (Lu, et al., 2021), and (Ramírez, et al., 2021). Meanwhile, Nazir et al. (2021) and Tariq et al. (2023) found that HCE had a significant negative effect on a company's ROA. Structural Capital Efficiency (SCE) is said to have a significant positive effect on ROA (Duho & Agomor, 2021; Xu & Li, 2022; Lu et al., 2021; Ramírez et al., 2021; Majumdar et al., 2021). This statement is inconsistent with the results of previous studies that stated SCE had a significant negative effect on ROA (Olarewaju & Msomi, 2021; Nazir et al., 2021; Majumdar et al., 2021), (Barak & Sharma, 2024) and (Mustafa et al., 2024).

Previous research indicates that Capital Employed Efficiency (CEE) has a significant positive effect (Xu & Zhang, 2021; Duho & Agomor, 2021; Olarewaju & Msomi, 2021), (Xu & Li, 2022), (Nazir et al., 2021). This statement differs from previous research findings that CEE has a significant negative effect on ROA (Olarewaju & Msomi, 2021; Ayinaddis et al., 2024; Barak & Sharma, 2024).

The VAIC variable has a significant positive effect on ROA (Nazir et al., 2021; Ramírez et al., 2021; Olarewaju & Msomi, 2021; Tariq et al., 2023; Lim, Ky, & Flores, 2024), and (Setyadi et al., 2024). In contrast, the results of research by Duho and Agomor (2021) indicated that VAIC had no significant relationship with ROA.

Deegan (2004) stated that stakeholder theory emphasizes organizational accountability far beyond financial performance, where physical assets are considered capable of creating added value for a company. In his research, the three VAIC components (HCE, SCE, and CEE) showed a positive impact on ROA, with this impact moderated by Physical Assets (PC). However, in that study, Physical Assets (PC) did not have a significant effect on ROA. Furthermore, another study by Xu and Zhang (2021) found that PC had a significant positive effect on ROA.

The inconsistent research findings regarding the relationship between ROA and Physical Assets (PC) are also supported by data in Table 3, which shows inconsistent changes in the average values of ROA and Physical Assets (PC) for banking companies during the 2020-2025 period. The table shows how the relationship between ROA and Physical Assets (PC) fluctuates from year to year.

Table 3. Average ROA and PC of Banks Listed on the IDX (2020–2024)

Years	ROA	*Physical Capital* (PC)
2020	0,56	1,90
2021	-0,07	1,49
2022	0,87	1,43
2023	1,34	1,41
2024	1,39	1,31

Then, company performance, measured by Return on Assets (ROA), was chosen because ROA reflects how effectively management utilizes all resources listed on the balance sheet to generate profits.

Based on the phenomenon and the varying results of previous research regarding the influence of the Value-Added Intellectual Coefficient (VAIC) and its components, the author was motivated to conduct a study entitled "The Effect of Value-Added Intellectual Coefficient (VAIC) on Return on Assets (ROA) with Physical Capital (PC) as a Moderating Variable in Banking Companies Listed on the Indonesia Stock Exchange 2020-2024."

LITERATURE REVIEW

Firm Value

One important benchmark in assessing a company's performance is profit (Efriyanti et al., 2012). In this study, company performance is reflected through the profitability ratio Return on Assets (ROA). ROA is the ratio of net profit to total assets. ROA can be formulated as follows (Tariq et al., 2023):

$$\text{ROA} = \frac{Net\ Income\ After\ Tax}{Total\ Assets}$$

Intellectual Capital

From each existing definition of IC, it can be explained that IC is the total that can be collected from 3 main elements in an organization (human capital, structural capital, customer capital) that intersect with knowledge and technology that can produce more points for the company, such as excelling when there is competition between organizations (Sawarjuwono & Kadir, 2004). IC is an intangible asset that is not easy to assess or report.

1. Value-Added Intellectual Coefficient (VAIC)

VAIC is the sum of three efficiency elements: capital employed efficiency (CEE), human capital efficiency (HCE), and structural capital efficiency (SCE). The calculation of VAIC is stated as follows:

VAIC = HCE + SCE + CEE

2. Human Capital Efficiency (HCE)

Human Capital (HC) is the skills and knowledge that enable workers to succeed in various circumstances, including values and motivation (Sveiby, 1997). HCE shows the efficiency of value added by human resources by treating staff expenditures as investments (Al-Musali & Ismail, 2016). According to Sudibya et al (2014), Human Capital Efficiency (HCE) can be formulated as follows:

$$\textbf{HCE} = \frac{\boldsymbol{VA}}{\boldsymbol{HC}}$$

VA = Output – Input

Description:
Output = Total sales and other income
Input = Expenses and costs (excluding employee expenses)
VA (Value Added) = Value Added (Difference between Output and Input)
HC (Human Capital) = Employee Expenses (Allowances, salaries, incentives, etc.)

3. Structural Capital Efficiency (SCE)

Structural capital (SC) refers to the knowledge embedded in an organization's processes, databases, manuals, strategies, and organizational charts (Poh et al., 2018).
SCE is what remains after accounting for human capital, reflecting the efficiency of an organization's processes and infrastructure in creating value (Watson & Stanworth, 2006). According to Thalia and Hutabarat (2022), Structural Capital Efficiency (SCE) can be formulated as follows:

$$\textbf{SCE} = \frac{SC}{VA}$$
$$\textbf{SC} = \textbf{VA} - \textbf{HC}$$

Description:
SC (Structural Capital) = Difference between VA and HC
VA (Value Added) = Added Value (Difference between Output and Input)
HC (Human Capital) = Employee Expenses (Allowances, salaries, incentives, etc.)

4. Capital Employed Efficiency (CEE)
In general, CE is a form of financial capital, commonly defined as the sum of capital employed in fixed and current assets. Capital efficiency refers to the finances invested in an organization (Duho & Agomor, 2021). It is seen as a benefit that enables a company to increase sales.
In the VAIC model, Capital Employed Efficiency (CEE) measures the value created per unit of invested financial and physical capital (Pulic, 1998).
According to Tariq et al. (2023), Capital Employed Efficiency (CEE) can be formulated as follows:

$$\textbf{CEE} = \frac{VA}{CE}$$
$$\textbf{CE} = \textbf{Total Assets} - \textbf{Total Liabilities}$$

Description:
CE (Capital Employed) = Difference between Total Assets and Total Liabilities
VA (Value Added) = Value Added (Difference between Output and Input)

Physical Capital (PC)
Physical capital is all tangible assets used in the production process. These assets include machinery, equipment, buildings, and infrastructure that help produce goods and services. Pulic (1998) considers the efficiency of physical capital use as an indicator of a company's ability to utilize intellectual capital better. If a unit of physical capital generates greater value added, the company is considered more effective in utilizing it. Flores and Lim (2024) note the importance of effectively managing intellectual capital (IC) alongside physical assets in generating profits.
According to Flores and Lim (2024), physical capital (PC) is defined as follows:

$$\textbf{PC} = \frac{\textbf{Fixed Assets}}{\textbf{Total Assets}}$$

Framework

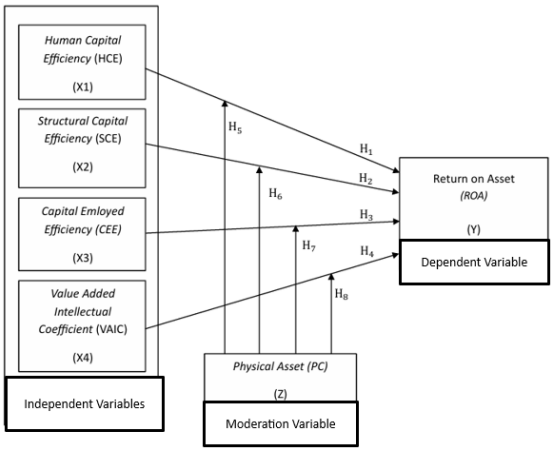

Figure 1. Conceptual Framework

H1: Human Capital Efficiency (HCE) has a significant positive effect on Return on Assets (ROA).
H2: Structural Capital Efficiency (SCE) has a significant positive effect on Return on Assets (ROA).
H3: Capital Employed Efficiency (CEE) has a significant positive effect on Return on Assets (ROA).

H4: Value-Added Intellectual Capital (VAIC) has a significant positive effect on Return on Assets (ROA).
H5: Physical Capital (PC) moderates the effect of Human Capital Efficiency (HCE) on Return on Assets (ROA).
H6: Physical Capital (PC) moderates the effect of Structural Capital Efficiency (SCE) on Return on Assets (ROA).
H7: Physical Capital (PC) moderates the effect of Capital Employed Efficiency (CEE) on Return on Assets (ROA).
H8: Physical Capital (PC) moderates the effect of Value-Added Intellectual Coefficient (VAIC) on Return on Assets (ROA).

MATERIALS & METHODS

The research design is descriptive quantitative. Descriptive quantitative research seeks to explain solutions to existing problems based on data. Therefore, descriptive quantitative research presents, analyzes, and interprets data (Cholid & Abu, 2012). The data used in this study are secondary, namely, data published by banking companies listed on the Indonesia Stock Exchange. The data used is time series data from 2020 to 2024. The data were sourced from the Indonesia Stock Exchange (IDX) website and the websites of each banking company.
The population in this study is banking companies listed on the Indonesia Stock Exchange for the period 2020-2024. In this study, the population sampled was 47 companies listed on the Indonesia Stock Exchange.
The sample used in this study was financial report data for the period 2020-2024. The sampling technique used was purposive sampling, in which the sample was selected and tailored to the research objectives or research problem being developed. Based on the sample selection results, 47 companies were selected as research objects, as all met the criteria. The sample criteria used were:

1. Banking companies consecutively listed on the Indonesia Stock Exchange for the 2020-2024 period.
2. Banking companies that presented complete financial reports as of December 31 for the 2020-2024 period.

Therefore, the observation sample obtained in this study was 47 samples x 5-year observation period = 235 observations.
The data analysis technique used was quantitative, expressed as numbers, calculated using statistical methods assisted by the data program EViews.

RESULT

Descriptive Statistical Analysis

Table 4. Descriptive Statistical Analysis

	HCE	SCE	CEE	VAIC	PC	ROA
Mean	4.476894	0.651783	0.254787	5.383447	1.508072	0.613157
Median	3.014000	0.726000	0.162000	3.898000	0.036000	0.757000
Maximum	48.76200	4.106000	3.118000	50.87700	42.86300	8.431000
Minimum	-4.254000	-2.941000	-0.296000	-3.316000	0.001000	-18.20100
Std. Dev.	6.127574	0.627433	0.351430	6.517019	4.553853	2.583733
Sum	1052.070	153.1690	59.87500	1265.110	354.3970	144.0920
Sum Sq. Dev.	8786.035	92.11930	28.89966	9938.340	4852.594	1562.108
Observations	235	235	235	235	235	235

Source: EViews 10 Software Processing Results

Based on Table 4, the results can be interpreted as follows:

1. The minimum HCE value is -4.254, representing Bank Mega's HCE value, and the maximum DER value is 48.762, representing Bank Capital Indonesia's DER value. The average HCE value is 4.476 with a standard deviation of 6.127.
2. The minimum SCE value is -2.941, representing Bank Mestika's HCE value, and the maximum SCE value is 4.106, representing Bank BCA's HCE value. The average SCE value is 0.651, with a standard deviation of 0.627.
3. The minimum CEE value is -0.296, representing Bank Mega's HCE value, and the maximum CEE value is Bank Raya's HCE value. The average CEE value is 0.254, with a standard deviation of 0.351.

4. The minimum VAIC value is -3.316 for Bank Mega, and the maximum value is 50.877 for Bank Capital Indonesia. The average VAIC value is 5.383, with a standard deviation of 6.517019.
5. The minimum PC value is 0.001 for Amar Bank, and the maximum value is 42.863 for Bank Maspion. The average PC value is 1.508, with a standard deviation of 4.553.
6. The minimum ROA value is -18.201 for Bank Raya, and the maximum value is 8.431 for Bank BTPN Syariah. The average ROA value is 0.613, with a standard deviation of 2.583.

Selecting a Panel Data Regression Model

Before conducting a regression analysis to determine the appropriate regression model (CEM), the common effects model (CEM), the fixed effects model (FEM), or the random effects model (REM), the Chow test, the Hausman test, and the Lagrange multiplier test are performed.

a. Chow Test

To determine whether the CEM or FEM estimation model is appropriate for forming a regression model, the Chow test is used. The decision rule for selecting the model is: if the cross-section Chi-square probability value is <0.05, then the FEM model is accepted. If the cross-section Chi-square probability value is >0.05, then the CEM model is accepted.

Table 5. Chow Test Results

Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	4.439189	(46,184)	0.0000
Cross-section Chi-square	175.449077	46	**0.0000**

Source: EViews 10 Software Processing Results

Based on the results of the Chow test in Table 5, the probability value is 0.0000. Since the chi-square probability value is 0.0000 < 0.05, the accepted estimation model is the Fixed Effects Model (FEM).

b. Hausman Test

This test determines whether the FEM or REM is the appropriate regression model for developing a regression model. The Hausman test is used to determine which model to use: if the cross-section probability value is > 0.05, then the REM is accepted. If the cross-section probability value is < 0.05, then the FEM model is accepted.

Table 6. Hausman Test Results

Correlated Random Effects - Hausman Test
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	6.829882	4	**0.1452**

Source: EViews 10 Software Processing Results

Based on the results of the Hausman test in Table 6, the probability value is 0.145 > 0.05, so the accepted estimation model is the Random Effect Model (REM).

c. Lagrange Multiplier Test

Because the Chow test selected the FEM model and the Hausman test selected the REM model, the next test, the Breusch-Pagan Lagrange Multiplier test, was performed. This test determines whether the CEM or REM estimation model will be used. The basis for decision-making is that if the cross-section probability value is > 0.05, the CEM model is accepted. If the cross-section probability value is < 0.05, the REM model is accepted.

Table 7. Lagrange Multiplier Test Results

Lagrange multiplier (LM) test for panel data

Null (no rand. effect) Alternative	Cross-section One-sided	Period One-sided	Both
Breusch-Pagan	66.88850 (**0.0000**)	0.022714 (0.8802)	66.91122 (0.0000)

Source: EViews 10 Software Processing Results

Based on the results of the Lagrange Multiplier test in Table 7, the probability value is 0.0000. Since the probability value is 0.000 < 0.05, the estimation model used is the Random Effects Model (REM).

Because the Breusch-Pagan Lagrange Multiplier test selected the REM, the Random Effects Model (REM) will be used in this study. Since the Random Effects

Model (REM) has been selected, there is no need to conduct a classical assumption test, as described in the previous chapter.

Panel Data Regression Analysis

Regression analysis is used to determine the extent to which independent variables influence the dependent variable. In this study, the independent variables are Human Capital Efficiency, Structural Capital Efficiency, Capital Employed Efficiency, and Value-Added Intellectual Coefficient. The dependent variable is Profitability (Return on Assets). The following are the results of the regression test using panel data with the Random Effects Model (REM):

Table 8. Multiple linear regression test using the REM model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.179678	0.242466	8.989612	0.0000
HCE	-403.0483	181.4290	-2.221521	0.0273
SCE	-407.8527	181.4995	-2.247128	0.0256
CEE	-403.0718	181.4218	-2.221738	0.0273
VAIC	402.9888	181.4318	2.221159	0.0273

Effects Specification			
		S.D.	Rho
Cross-section random		1.154656	0.4063
Idiosyncratic random		1.395654	0.5937

Weighted Statistics			
R-squared	0.512740	Mean dependent var	0.291573
Adjusted R-squared	0.504266	S.D. dependent var	1.998508
S.E. of regression	1.407118	Sum squared resid	455.3955
F-statistic	60.50673	Durbin-Watson stat	1.837714
Prob(F-statistic)	0.000000		

Source: EViews 10 Software Processing Results

Based on Table 8, the multiple linear regression equation is obtained as follows:

Y = 2.1796 (C) - 403.0483 X1 - 407.8527 X2 - 403.0718 X3 + 402.9888 X4 +e

Hypothesis Testing

1. Partial Significance Test (T-Test)

The partial test is used to determine the effect of each independent variable on the dependent variable. An independent variable is said to affect the dependent variable if its significance value (sig) is below 0.05. Based on Table 8, the results of the moderation test can be interpreted as follows:

1. The regression coefficient for the HCE variable is -403.0483. The p-value is 0.027, which is <0.05. Therefore, it is concluded that HCE has a negative and significant effect on ROA.
2. The regression coefficient for the SCE variable is -407.8527. The p-value is 0.025, which is <0.05. Therefore, it is concluded that SCE has a negative and significant effect on ROA.
3. The regression coefficient for the CEE variable is -403.0718. The p-value is 0.027, which is <0.05. Therefore, it is concluded that CEE has a negative and significant effect on ROA.
4. The regression coefficient for the VAIC variable is 402.9888. The p-value is 0.027, which is <0.05. So it is concluded that VAIC has a positive and significant effect on ROA.

Moderating Test

The Moderated Regression Analysis interaction test was conducted by adding a product variable for the independent variable and its moderator.

Table 9. Results of the Moderating Test of HCE on ROA Moderated by PC

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.067536	0.254008	8.139661	0.0000
X1	-0.224306	0.026001	-8.626861	0.0000
Z	-0.067126	0.042688	-1.572507	0.1172
X1XZ	**0.069794**	0.010078	6.925675	**0.0000**

Source: EViews 10 Software Processing Results

Based on Table 9, the coefficient of the HCE and PC interaction variable (X1*Z) is 0.069 and is positive. The Prob. value is 0.0000, which is less than the sig. value of 0.05, indicating a significant effect. Therefore, it can be concluded that the PC variable is significant and moderates the effect of HCE on ROA, strengthening that effect.

Table 10. Results of the SCE Moderating Test on ROA Moderated by PC

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.319980	0.340575	3.875740	0.0001
X2	-2.290109	0.565942	-4.046541	0.0001
Z	0.084350	0.058666	1.437803	0.1518
X2*XZ	**-0.537308**	0.143641	-3.740623	**0.0002**

Source: EViews 10 Software Processing Results

Based on Table 10, the coefficient value of the interaction variable between SCE and PC

(X2*Z) is -0.537 and is negative. The Prob. value is 0.0000, which is < the sig. value of 0.05, indicating a significant influence. Therefore, it can be concluded that the PC variable is significant and can moderate the influence of SCE on ROA, with the direction of the moderation weakening the influence of SCE on ROA.

Table 11. Results of the Moderating Test of CEE on ROA Moderated by PC

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.999379	0.221154	9.040676	0.0000
X3	-4.996393	0.554527	-9.010193	0.0000
Z	-0.015427	0.039824	-0.387392	0.6988
X3XZ	**0.199731**	0.159961	1.248625	**0.2131**

Source: EViews 10 Software Processing Results

Based on Table 11, the coefficient value of the interaction variable between CEE and PC (X3*Z) is 0.199 with a positive direction. The Prob. value is 0.2131, which is greater than the sig. value of 0.05. It means it has no significant effect. Therefore, it can be concluded that the PC variable is unable to moderate the effect of CEE on ROA.

Table 12. Results of the VAIC Moderating Test on ROA Moderated by PC

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.287169	0.260534	8.778764	0.0000
X4	-0.220427	0.024540	-8.982451	0.0000
Z	-0.068319	0.043011	-1.588403	0.1136
X4XZ	**0.057565**	0.009101	6.325131	**0.0000**

Source: EViews 10 Software Processing Results

Based on Table 12, the coefficient for the interaction term between VAIC and PC (X4*Z) is 0.057 and is positive. The Prob. Value of the interaction variable between VAIC and PC (X4*Z) is 0.0000, which is < the sig. value of 0.05, indicating a significant influence. Therefore, it can be concluded that the PC variable is significant and moderates the influence of VAIC on ROA, with the direction of moderation strengthening the influence of VAIC on ROA.

DISCUSSION

The Effect of HCE on ROA

The research results revealed that, based on a partial t-test, the regression coefficient for the HCE variable was -403.0483. The p-value was 0.027, which is <0.05. Therefore, it was concluded that HCE had a negative and significant effect on ROA. Therefore, Hypothesis 1, which stated that HCE had a positive and significant effect on ROA, was rejected.

Based on descriptive analysis, the average Human Capital Efficiency (HCE) score was 4.476, with a minimum of -4.254 and a maximum of 48.762. This average score indicates that, in general, human capital efficiency in the banks studied is still relatively low and varies across banks. It means that banks' ability to leverage their human resources to create value and increase productivity is uneven. Some banks have very negative HCE scores, while others have excessively high or inefficient ones. A negative HCE value indicates that the bank is unable to convert human resource expenditures into optimal productivity or profits. In this situation, labor and training costs become a burden that does not generate additional revenue, directly impacting the company's bottom line and reducing profitability or Return on Assets (ROA).

Meanwhile, an excessively high HCE value does not always indicate an ideal condition. An excessively high HCE can indicate an imbalance between human resource costs and the results obtained. It means that a very high HCE indicates overutilization of the workforce, a condition in which employees work beyond their ideal capacity, which, in the long term, can reduce efficiency and service quality.

The Effect of SCE on ROA

The research results revealed that, based on a partial t-test, the regression coefficient for the SCE variable was -407.8527. The p-value was 0.025, i.e., <0.05. Therefore, it was concluded that SCE negatively and significantly affected ROA. Therefore, Hypothesis 2, which stated that SCE had a positive and significant effect on ROA, was rejected.

Based on the descriptive statistics, the minimum Structural Capital Efficiency (SCE) score was 2.941 for Bank Mestika, the maximum was 4.106 for Bank BCA, and the average was 0.651 with a standard deviation of 0.627. These average scores indicate that the banking sector's overall ability to manage structural capital remains relatively low. It means that organizational structures, work systems, procedures, and productivity-supporting infrastructure have not been optimally utilized to support financial performance. Meanwhile, a standard deviation close to the mean indicates significant variation between banks, suggesting differences in each bank's ability to leverage its internal systems and structures to achieve efficiency and profitability.

A low SCE value indicates that most banks have not been able to transform their organizational structure and internal systems into advantages that increase the company's added value. The short timeframe of the research data also influences the results. Pulic (2000) also stated that structural capital can negatively impact short-term performance due to implementation costs. Conversely, banks with large core capital have the most stable ROA. A negative SCE, as demonstrated by Bank Mestika, a bank with KBMI (Bank Group Based on Core Capital) II, indicates structural inefficiencies, such as excessive bureaucracy and administration, slow operational processes, or work systems that are not adaptive to current developments, particularly in the banking sector.

The Effect of CEE on ROA

The research results revealed that, based on a partial t-test, the regression coefficient for the CEE variable was -403.0718. The p-value was 0.027, which is <0.05. Therefore, it was concluded that CEE had a negative and significant effect on ROA. Therefore, Hypothesis 3, which stated that CEE had a positive and significant effect on ROA, was rejected.

Based on the descriptive analysis, Bank Mega had the lowest Capital Employed Efficiency (CEE) of -0.296, while Bank Raya (Putra Rajawali Kencana Tbk.) had the highest CEE of 4.106, with an average of 0.254 and a standard deviation of 0.351. These average values indicate that the banks in the study sample generally have low capital efficiency. It indicates that the banks' ability to utilize their capital, whether in the form of physical assets, working capital, or productive investments, to generate profits is not yet optimal. The relatively high standard deviation relative to the average also indicates significant variation between banks, suggesting that not all can efficiently manage capital to create added value and improve profitability.

Meanwhile, based on a descriptive analysis of the Return on Assets (ROA) variable, the minimum value was -18.201 for Bank Raya, the maximum was 8.431 for Bank BTPN Syariah, and the average was 0.613, with a standard deviation of 2.583. The relatively low average ROA indicates that banks' profitability is generally weak, and their ability to convert total assets into profits is suboptimal. Furthermore, the significant difference between the minimum and maximum values, along with the high standard deviation, indicates substantial disparities in financial performance between banks, with some experiencing losses while others achieving substantial profits.

The Effect of VAIC on ROA

The research results revealed that, based on a partial t-test, the regression coefficient of the VAIC variable was 402.9888. The p-value was 0.0027, which is <0.05. Therefore, it was concluded that VAIC has a positive and significant effect on ROA. Therefore, Hypothesis 4, which states that HCE has a positive and significant effect on ROA, was accepted.

Based on the descriptive analysis, the average HCE (4.476) indicates that HR efficiency is still variable and unstable (some are very high, others are negative).

The average SCE (0.651) indicates that the organizational structure does not optimally support added value. The average CEE (0.254) indicates that physical capital efficiency is still low. However, when these three components are combined, VAIC provides a comprehensive overview of the efficiency of the company's value-added creation process. It demonstrates that although each component still has weaknesses, the combination of the three can show a positive trend, as the added value in one aspect can offset the shortcomings of the others. For example, a good organizational structure (SCE) can minimize HR (HCE) or capital (CEE) inefficiencies, thereby increasing VAIC and positively impacting ROA.

Physical Capital Moderates the Effect of Human Capital (HCE) on ROA

The results of the research revealed that, based on the moderation regression test, the interaction between HCE and PC (X1*Z) was 0.069 and positive. The Prob. value was 0.0000, which is less than the sig. 0.05, indicating a significant effect. Therefore, it can be concluded that the PC variable significantly moderates the effect of HCE on ROA, strengthening that effect.

The results showed that partially, HCE had a negative effect on ROA, but after being moderated by Physical Capital (PC), the effect became positive and significant. This moderation test indicates a complementary or mutually reinforcing role between human capital and physical capital in creating added value for the company. It means that although human capital efficiency alone cannot increase asset profitability (ROA), the presence and effective use of a company's physical capital can shift the relationship to a positive one.

Physical Capital Moderates the Effect of SCE on ROA

The results of the study revealed that, based on the moderation test, the coefficient for the interaction term between SCE and PC (X2*Z) was -0.537, indicating a negative effect. The Prob. value is 0.0000, which is less than the sig. 0.05, indicating a significant effect. Therefore, it can be concluded that the PC variable significantly moderates the effect of SCE on ROA, weakening that effect.

The results indicate that Physical Capital (PC) negatively and significantly moderates the relationship between Structural Capital Efficiency (SCE) and Return on Assets (ROA). It suggests that the presence of physical capital actually weakens the relationship between structural capital efficiency and bank profitability. Logically, this condition indicates that when banks increase investment in physical assets, such as buildings, equipment, and technological infrastructure, this is not always accompanied by increased efficiency in internal systems and procedures. Conversely, excessive increases in physical capital can lead to increased operating costs and asset depreciation, resulting in a relative decline in net profit. Consequently, even if SCE increases, its impact on ROA is suboptimal.

Physical Capital Moderates the Effect of CEE on ROA

The results of the research revealed that, based on the moderation regression test, the coefficient for the interaction variable between CEE and PC (X3*Z) was 0.199, with a positive sign. The Prob. The value of 0.2131 is less than the sig. 0.05, indicating no significant effect. Therefore, it can be concluded that the PC variable is unable to moderate the effect of CEE on ROA.

The results showed that Physical Capital (PC) did not significantly moderate the relationship between Capital Employed Efficiency (CEE) and Return on Assets (ROA). This result indicates that the presence of physical capital neither strengthens nor weakens the relationship between the efficiency of invested capital use and the level of company profitability. In the banking industry, CEE growth is not

always determined by the number or size of physical assets, but rather by management's ability to optimize existing assets to generate interest and non-interest income. Ulum (2013) stated that physical capital efficiency does not always impact bank profitability. If management is unable to utilize assets productively, increasing physical capital will actually increase depreciation and operating costs without directly improving capital efficiency. Therefore, PC cannot act as a moderator of the effect of CEE on ROA.

Physical Capital Moderates the Effect of VAIC on ROA

The results of the research revealed that, based on the moderation regression test, the coefficient for the interaction term between VAIC and PC (X4*Z) was 0.057, which was positive. The Prob. value of the interaction variable between VAIC and PC (X4*Z) was 0.0000, which is less than the sig. 0.05, indicating a significant effect. Therefore, it can be concluded that PC significantly moderates the effect of VAIC on ROA, strengthening that effect.

The results of the study, which show a partial positive and significant effect of VAIC on ROA, confirm that the efficiency and combination of intellectual capital management, consisting of HCE, SCE, and CEE, play a crucial role in increasing the profitability of banking companies. When this relationship is moderated by Physical Capital (PC) and produces a positive, significant effect, it indicates that the presence of strong, adequate physical capital supporting human resources/employees' operational activities can strengthen the company's ability to utilize intellectual capital more productively and efficiently. In other words, PC acts as a reinforcing factor, enhancing the influence of VAIC on ROA.

CONCLUSION

1. HCE has a negative and significant effect on ROA in banking companies and those listed on the IDX for the 2020-2024 period.
2. SCE has a negative and significant effect on ROA in banking companies and those listed on the IDX for the 2020-2024 period.
3. CEE has a negative and significant effect on ROA in banking companies and those listed on the IDX for the 2020-2024 period.
4. VAIC has a positive and significant effect on ROA in banking companies and those listed on the IDX for the 2020-2024 period.
5. Physical Capital moderates and strengthens the effect of HCE on ROA in banking companies and those listed on the IDX for the 2020-2024 period.
6. Physical Capital moderates and weakens the effect of SCE on ROA in banking companies and those listed on the IDX for the 2020-2024 period.
7. Physical Capital does not moderate the effect of the CEE variable on ROA in banking companies listed on the IDX during the 2020-2024 period.
8. Physical Capital moderates and strengthens the effect of the VAIC variable on ROA in banking companies listed on the IDX during the 2020-2024 period.

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