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HOW DOES INTELLECTUAL CAPITAL AFFECT FIRM PERFORMANCE ACROSS DIFFERENT LEVELS? A QUANTILE REGRESSION APPROACH

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Abstract

This study aims to examine the effect of intellectual capital on firm performance. Intellectual capital is evaluated using the Value-Added Intellectual Coefficient (VAIC), which covers human, structural, and capital efficiency. Using quantile regression and three different performance measures, the study analyzes how the effect of intellectual capital changes across different performance levels. The sample is 358 Indonesian non-financial companies (1,074 firm-year observations) from 2018 to 2020. The results show a positive relationship between intellectual capital and firm performance, which supports the resource-based theory (RBT). However, the effect varies between high-performing and low-performing companies, showing that intellectual capital has a different influence depending on the firm's performance level.

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INTRODUCTION

The rapid change and more competitive business condition compel companies to face bigger challenges and risks. Therefore, it is crucial for companies to adapt quickly to survive and win business competition (Bataineh et al., 2022). Nowadays, knowledge has become an important element in fostering business development. To gain a competitive advantage, companies need to shift from a business model based on the workforce (labor-based business) to one based on knowledge (knowledge-based business) (Chen et al., 2012). While a labor-based business relies on many workers for high productivity, a knowledge-based business focuses more on the knowledge, skills, and expertise of its human resources. This shift has led many companies to prioritize knowledge-related resources for growth, with intellectual capital being a key part of this focus.

Intellectual capital encompasses all the knowledge within company that contributes in creating value and gaining firm competitive advantage in the era of global competition (Nuryaman, 2015). The resource-based theory (RBT) asserts that organizations should explore their internal resources to identify their competitive advantage, and intellectual capital is one of the internal resources (Barney, 1991). According to this theory, a firm achieves competitive advantage when its assets possess characteristics of being valuable, rare, imperfectly imitable and lack equivalent substitutes. This strategic advantage not only helps mitigate threats in the firm's environment but also ensures that competitors cannot easily replicate the unique assets. Therefore, based on RBT, companies who own high intellectual capital will have higher performance.

However, the relationship between intellectual capital and firm performance remains a subject of question with several previous researches showing inconsistent result. Sofian et al. (2020), Pratama and Innayah (2019), Yousaf (2022), Gamayuni (2015) and Restuti et al. (2019) demonstrate that intellectual capital has positive effect on firm performance. In contrast, Mukaro et al. (2023) and Saifi et al. (2022) present opposite findings suggesting that intellectual capital affects firm performance negatively. In addition, previous studies conducted by Rahayu and Ramadhanti (2019) and Crisnandani et al. (2021)

exhibits no significant relationship between intellectual capital and firm performance. To address this gap, this study will examine the effect of intellectual capital on firm performance using quantile regression. Unlike most prior studies employing ordinary least square (OLS) method, this research use quantile regression (QR) as a more suitable method. The OLS may not capture the full picture, especially when the firm performance is extremely high or low, because it only estimates the mean relationship between variables (Chi et al., 2015). In contrast, QR allows for a more refined analysis by examining the relationship across various quantiles of the dependent variable. This enables us to capture how the relationship between variables might differ across different levels of firm performance. Hence, QR is preferred over OLS, as it allows for a more detailed analysis of these relationships at different levels of dependent variables.

Based on the preceding phemonena and gaps, this study will investigate the effect of intellectual capital on firm performance of 358 Indonesian companies over the period of 2018-2020 (1,074 firm-year observations). According to Sutisna et al. (2023), the selection of Indonesian companies as the research sample is due to the fact that the practical implementation of intellectual capital in Indonesia remains insufficient. Several essential components, such as the skills of the workforce and integration with technology, which are integral to intellectual capital do not receive the necessary emphasis. If intellectual capital is indeed crucial to increase the firm performance, the companies must exert extra effort to increase its intellectual capital. As the references, the idea of intellectual capital in Indonesia has grown due to Financial Accounting Standards (PSAK) rules number 19 in 2000 (Yateno, 2020). These rules specifically address that intellectual capital is non-monetary assets, such as: ideas and knowledge used for various purposes such as producing goods or services, leasing to other, and administrative needs (Puspita, 2016).

The novelty of this study is employing the quantile regression method to estimate the intellectual capital and firm performance regression. To the best of the author's knowledge, there has been no previous research that examines this relationship using quantile regression. Quantile regression enables us to assess the impact of explanatory variables across the entire spectrum of the dependent variable distribution. While OLS regression estimates intellectual capital contributions solely at the average performance level, quantile regression allows us to explore that contributions at every performance level (Francis & Nwakuya, 2022). The findings of this study make a valuable contribution to expand the application of financial theories related to intellectual capital. Furthermore, these results can inform businesses on how to develop plans for improving their performance by recognizing the strategic value of intellectual capital as a vital resource in today's competitive market environment.

This paper is organized into several parts. Section 2 provides literature review, theories related to intellectual capital and hypothesis building. Section 3 explains about the data, variables and research methods. Section 4 demonstrate the study's findings and discusses the results. The last section covers conclusion, limitations and future implications.

THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

Resource-Based Theory (RBT)

Resource-Based Theory (RBT), introduced by Barney (1991), analyzes companies achieve sustained competitive advantage if they have excellent resources (Pratama & Innayah, 2019). These resources, that include assets, capabilities, and organizational processes, empower companies to make strategic choices in the external business environment. This theory challenges the assumptions of resource homogeneity and high resource mobility. It emphasizes enduring resource heterogeneity and immobility as key factors for sustained competitive advantage.

The essence of RBT lies in resources that meets VRIN criteria: valuable, rare, imperfectly imitable, and non-substitutable (Barney, 1991; Kamaluddin & Rahman, 2013). Valuable resources contribute to effectiveness and efficiency in strategy implementation. Rarity ensures competitors lack similar resources, making strategy replication difficult. Imperfect imitability arises from unique historical conditions, causal ambiguity, and complex social systems. Non-substitutability means competitors cannot replace these resources with equivalents, solidifying a company's competitive advantage. Intellectual capital aligns with VRIN criteria that serves as a resource for competitive advantage by enhancing company value (Astuti & Chariri, 2019).

Hypothesis Development: Intellectual Capital and Firm Performance

Resource based theory posits that organizations will perform better when they own distinctive resources. Barney (1991) states that firm resources consist of several elements such as assets, capabilities, organizational process, attributes, information and knowledge which intellectual capital is in. Utilizing these resources effectively should be able to enhance firm efficiency and effectiveness in the implementation of strategies that can contribute to the success (Handoyo et al., 2023).

Intellectual capital as a strategic resource holds an important role in enabling organizations to attain competitive advantage (Radjenovic & Krstic, 2017). The advantage stems from the unique knowledge, expertise and innovative capabilities possessed by human resources that are embedded within the organization (Wahyuni et al., 2023). It allows the firms to differentiate itself in the market and offer product or services that are not easily replicable by the competitors. In addition, intellectual capital can create innovation that enables firms to navigate changing market dynamics (Karchegani et al., 2013). As a result, this innovation capacity can foster resilience and the position of the firm in the industry that contributes to sustained superior performance. Furthermore, several previous studies supported the positive effect of intellectual capital on firm performance (Gamayuni, 2015; Pratama & Innayah, 2019; Restuti et al., 2019; Sofian et al., 2020).

However, the strength of this positive effect can vary between firms with high performance and low performance. This research categorizes companies as high or low performing based on their position within performance quantiles. Firms in the upper quantiles are classified as high-performing, while those in the lower quantiles are considered low-performing. High performance firms needs to sustain their excellence and constantly strive for improvement (Waal, 2012). They need to employ more innovative strategies to further enhance their performance as they have already had elevated standard. On the other hand, low-performing firms needs fundamental improvements in core business operations (Handoyo et al., 2023). These firms will allocate fewer resources for intellectual capital development and focus more on addressing performance challenges. Hence, the positive effect of intellectual capital on firm performance will be more pronounced in high-performing firms.

Based on above explanation, we propose this following hypothesis.

H1: Intellectual capital has positive effect on firm performance

H2: The relationship between intellectual capital on firm performance is heterogeneous

RESEARCH METHOD

Data and Variables

This study uses firm performance (PERF) as the dependent variable. This variable is assessed through three variables that are commonly used: return on assets (ROA), return on equity (ROE) and stock return (SR). We employ three measurements for firm performance to ascertain whether the findings are robust in response to the changes in the performance measurement. ROA is measured by dividing the net income earned to total assets, whereas ROE is determined by dividing the net income to total equity (Egbunike & Okerekeoti, 2018). Stock return that represents market performance is calculated by dividing the difference between the closing price and opening price of the year by the opening price (Permatasari & Nugroho, 2023).

The independent variable as the variable of interest is intellectual capital (IC). Intellectual capital is assessed through value added intellectual coefficient (VAIC) (Hartono & Hashim, 2023; Pulic, 2000). VAIC is the sum of three components: human capital efficiency (HCE), structural capital efficiency (SCE) and capital employed efficiency (CEE) (Bayraktaroglu et al., 2019; Yusup & Susilawati, 2023). HCE represents the amount of value generated per unit of money allocated to employees. It is calculated by dividing value added by labor expenses (salary and wage expenditure). Value added itself is measured by finding the difference between gross margin and operating expense, excluding labor expenses. On the other hand, SCE illustrates the proportion of structural capital on value added. Structural capital (SC) encompasses software systems, distribution network, management process, trademarks, etc. Hence, SC is computed by substracting human capital from value added. CEE portrays how effectively an organization generates value through the utilization of its financial capital. It is quantified as the ratio of total value added to book value of net assets. The formula for VAIC is written as follows:

$$\mathbf{VAIC = HCE + SCE + CEE} \quad (1)$$

We incorporate several control variables to account for additional factors, especially firm-specific effects, that may affect the estimation results. Therefore, the findings will provide more accurate understanding of the impact of the variables under investigation (Nielsen & Raswant, 2018). The control variables used are firm size, firm age, sales growth, leverage and ownership concentration. Firm size is calculated using natural logarithm of total assets (Dang et al., 2018). Firm age is the difference between the year in the research period and the year when companies went public (Yusup et al., 2022). Sales growth is measured using the percentage increase of sales over previous year (Kayani et al., 2023). Leverage is calculated using debt ratio that divides total debt with total assets (Danso et al., 2021). Ownership concentration is measured using the sum of holdings of two largest shareholders (Vintilă & Gherghina, 2014).

The final sample of this study is 358 non-financial firms listed on the Indonesia Stock Exchange (IDX) from 2019-2021 (1078 firm-year

observations). Several samples with uncomplete variable data have been excluded from the research. The data is collected manually from firm's annual report and annual financial statement from the official site of Indonesia Stock Exchange. We winsorized the data at 5th and 95th percentiles to minimize outlier effects (Galvani & Li, 2023).

Methodology

This study uses two methodologies. They are fixed-effect model and quantile regression. Fixed effect model is used to examine the effect of intellectual capital on firm performance. We performed panel data model tests: Chow Test, Hausman Test and Lagrange Multiplier Test and the result showed that fixed effect model is the appropriate model to use in this study. The regression equation is as follows:

$$\mathbf{PERF_{it}} = \boldsymbol{\alpha_{10}} + \boldsymbol{\beta_1}\mathbf{IC_{it}} + \boldsymbol{\beta_2}\mathbf{SIZE_{it}} + \boldsymbol{\beta_3}\mathbf{AGE_{it}} + \boldsymbol{\beta_4}\mathbf{SGR_{it}} + \boldsymbol{\gamma_5}\mathbf{LEV_{it}} + \boldsymbol{\gamma_6}\mathbf{OWC_{it}} + \mathbf{Industry_{it}} + \mathbf{Year_{it}} + \boldsymbol{\varepsilon_i} + \boldsymbol{\varepsilon_t} + \boldsymbol{\varepsilon_{it}} \quad (2)$$

Prior to regression analysis, we conducted multicollinearity, heteroscedasticity and autocorrelation test. We did not perform normality test since the sample size are large. Gujarati and Porter (2009) explained that large sample size can be assumed to follow a normal distribution pattern.

On the other hand, quantile regression (QR) is used to examine whether the relationship between intellectual capital and firm performance is heterogenous (Ghardallou, 2023). We will obtain several coefficients estimates that elucidate the relationship between intellectual capital and firm performance at a certain quantile of firm performance (Chi et al., 2015; Koenker & Bassett, 1978). This analytical approach has been proven to be more robust than simple ordinary least square (OLS) as it is effectively mitigating significant outliers that can influence the impact of regression findings (Ullah et al., 2023). Specifically, we will utilize panel quantile regression via moments (MMQR), as proposed by Machado and Silva (2019) since our sample involves panel data. This study will particularly use 25th, 50th and 75th percent quantile. The model spesification is as follows (Iorember et al., 2022):

$$\boldsymbol{Q}\mathbf{PERF_{it}}(\boldsymbol{\tau}|\boldsymbol{\alpha_i}, \boldsymbol{\varepsilon_{it}}, \boldsymbol{X_{i,t}}) = \boldsymbol{\alpha_{it}} + \boldsymbol{\varphi_{1\tau}}\mathbf{IC_{it}} + \boldsymbol{\varphi_{2\tau}}\mathbf{SIZE_{it}} + \boldsymbol{\varphi_{3\tau}}\mathbf{AGE_{it}} + \boldsymbol{\varphi_{4\tau}}\mathbf{SGR_{it}} + \boldsymbol{\varphi_{5\tau}}\mathbf{LEV_{it}} + \boldsymbol{\varphi_{6\tau}}\mathbf{OWC_{it}} + \boldsymbol{\varepsilon_{it}} \quad (3)$$

where $\mathrm{QPERF_{it}}(\boldsymbol{\tau}|\boldsymbol{\alpha_i}, \boldsymbol{\varepsilon_{it}}, \boldsymbol{X_{i,t}})$ is the conditional quantile of $\mathrm{QPERF_{it}}$ with the scalar coefficient ($\boldsymbol{\alpha_i}(\boldsymbol{\tau})$) for the distributional effect at $\boldsymbol{\tau}$. $\boldsymbol{\tau}$ varies between 0 and 1. In this study, $\boldsymbol{\tau}$ is set 0.25, 0.5 and 0.75.

RESULT AND DISCUSSION

Descriptive Statistics and Correlation

Table 1 presents the descriptive statistics of the variables used in this study. The average (median) level of intellectual capital as the variable of interest is 1.8812 (1.9250). Higher value of VAIC indicates the company utilizes its intellectual capital assets more efficiently. However, it is worth noting that several companies have negative VAIC score. Three firm performance indicators show relatively low average value. The average of ROA, ROE and stock return are consecutively 1.47%, 3.30% and 0.33%. Among these three indicators, stock return exhibits the highest fluctuation ranging from -51.38% to 86.78%. In addition, over 50% of stock return are negative.

Table 2 exhibits the correlation between the dependent and independent variables. The result shows intellectual capital has positive correlation with ROA, ROE and stock return. The correlation table also shows that the variables are free of multicollinearity. All VIF values are less than 10 and the tolerance is more than 0.1.

Table 1. Descriptive Statistics

Variable	Obs.	Mean	Std. dev.	Min	Max	Q25	Q50	Q75
Intellectual Capital (IC)	1.074	1.8812	2.6009	-4.8095	7.3094	1.1011	1.9250	2.9933
Size (SIZE)	1.074	3.5214	0.7384	0.7117	5.4956	3.0223	3.5297	4.0342
Age (AGE)	1.074	18.0866	9.2793	2.0000	43.0000	9.0000	18.0000	26.0000
Sales Growth (SGR)	1.074	-0.0127	0.2383	-0.4944	0.4515	-0.1624	0.0081	0.1355
Leverage (LEV)	1.074	0.5011	0.2306	0.1311	0.9599	0.3134	0.5036	0.6580

Ownership Concentration (OWC)	1.074	0.5356	0.2126	0.1890	0.9062	0.3583	0.5230	0.7010
Return on Asset (ROA)	1.074	0.0147	0.0727	-0.1540	0.1535	-0.0174	0.0163	0.0565
Return on Equity (ROE)	1.074	0.0330	0.1605	-0.3942	0.3224	-0.0252	0.0419	0.1248
Stock Return	1.074	0.0033	0.3381	-0.5138	0.8678	-0.2180	-0.0317	0.1290

Table 2. Correlation

	IC	**SIZE**	**AGE**	**SGR**	**OC**	**LEV**	**ROA**	**ROE**	**SR**	**VIF**	**Tolerance**
IC	1									1.22	0.8217
SIZE	0.2562	1								1.11	0.898
AGE	-0.0020	0.0094	1							1.01	0.993
SGR	0.2524	0.1092	-0.0690	1						1.08	0.9273
OC	0.0352	-0.0350	-0.0240	0.0345	1					1.01	0.9937
LEV	-0.2170	0.1193	-0.0360	-0.0070	0.0264	1				1.09	0.9157
ROA	0.6823	0.2722	0.0453	0.3483	0.0258	-0.3710	1				
ROE	0.4957	0.1890	0.0488	0.2731	0.0214	-0.1920	0.7374	1			
SR	0.1393	0.0242	0.0088	0.1561	0.0159	-0.0520	0.1910	0.2042	1		

Table 3. Regression Analysis

Variables	**Dependent: ROA**	**Dependent: ROE**	**Dependent: Stock Return**
Intellectual Capital	0.0104***	0.0146***	0.0162**
	(7.61)	(2.82)	(2.30)
Size	0.0492*	0.0599	0.1103
	(1.81)	(0.58)	(0.58)
Age	-0.0016	-0.0041	0.0294*
	(-0.98)	(-0.79)	(1.69)
Sales Growth	0.0578***	0.1074***	0.1790**
	(6.49)	(3.76)	(2.26)
Leverage	-0.0827**	-0.3079***	0.1044
	(-2.23)	(-5.06)	(0.57)
Ownership Concentration	0.0148	0.1955**	0.2040
	(0.59)	(1.98)	(0.52)
Constant	-0.1006	-0.0493	-1.4156*
	(-1.08)	(-0.16)	(1.72)
Industry	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	1074	1074	1074
Adjusted R-square	57.44%	28.38%	30.70%
F-value	42.56***	70.46***	6.66***

Note: Robust t-statistics are in brackets and based on robust standard error. ***, **, and * indicate significance at the 1 percent, 5 percent and 10 percent levels, respectively.

Table 4. Panel Data Quantile Regression Analysis using Machado and Santos Silva Method

Variables	Dependent Variables: ROA			Dependent Variables: ROE			Dependent Variables: Stock Return		
	Q25	Q50	Q75	Q25	Q50	Q75	Q25	Q50	Q75
Intellectual Capital	0.0098***	0.0105***	0.0109***	0.0126**	0.0149***	0.0162***	0.0107	0.0153**	0.0228**
	(5.61)	(10.93)	(9.20)	(2.07)	(4.25)	(3.68)	(1.34)	(2.47)	(2.15)
Size	0.0552	0.0484**	0.0446*	0.1210	0.0483	0.0097	0.0465	0.0999	0.1859
	(1.54)	(2.47)	(1.84)	(0.80)	(0.55)	(0.09)	(0.22)	(0.61)	(0.66)
Age	-0.0025	-0.0015	-0.0009	-0.0072	-0.0036	-0.0017	0.0252	0.0287**	0.0344
	(-1.02)	(-1.09)	(-0.54)	(-1.00)	(-0.86)	(-0.32)	(1.31)	(1.93)	(1.34)
Sales Growth	0.0621***	0.0573***	0.0545***	0.1095***	0.1069***	0.1056***	0.1580**	0.1756***	0.2040*
	(4.82)	(8.08)	(6.24)	(2.61)	(4.44)	(3.47)	(1.90)	(2.71)	(1.83)
Leverage	-0.0961**	-0.0809***	-0.0724**	-0.4145***	-0.2877***	-0.2202***	0.0699	0.0988	0.1452
	(-2.1)	(-3.22)	(-2.33)	(-3.94)	(-4.41)	(-2.87)	(0.34)	(0.62)	(0.53)
Ownership Concentration	0.0175	0.0144	0.0126	0.2115	0.1925**	0.1823*	0.1298	0.1919	0.2920
	(0.30)	(0.45)	(0.32)	(1.46)	(2.32)	(1.74)	(0.28)	(0.54)	(0.48)

Note: Robust t-statistics are in brackets and based on robust standard error. ***, **, and * indicate significance at the 1 percent, 5 percent and 10 percent levels, respectively.

Hypothesis Testing Result

Table 3 presents the result of regression analysis using fixed effect model. Before conducting the regression analysis, we tested both heteroscedasticity and autocorrelation and the result indicated that the model encountered both issues. Therefore, we applied robust standard errors in the regression analysis to address these problems (Mansournia et al., 2021). The results show that intellectual capital has a positive effect on firm performance, as measured by ROA, ROE, and stock returns. The consistent qualitative results across the three firm performance metrics demonstrate the robustness of our findings. Hence, the first hypothesis (H1) was accepted.

Table 4 presents the results of the panel data quantile regression using the Machado and Santos Silva method. Across the three measures of firm performance, the results indicate that intellectual capital affects firm performance positively in all three quartiles. As firm performance increases, the coefficient of intellectual capital also increases, showing the heterogeneity of the intellectual capital effect. Therefore, the second hypothesis (H2) is accepted.

Discussion

The finding shows that intellectual capital can increase firm performance. This result aligns with those of several previous studies conducted by Halim (2024), Putri et al. (2023), and Sofian et al. (2020). Intellectual capital plays an important role in improving firm performance in Indonesia by helping companies adapt quickly and differentiate themselves in competitive and rapidly changing market (Angela & Budidarma, 2024). This is particularly important as Indonesia's economy evolves, with technological advancements and changing consumer preferences requiring companies to agile.

Intellectual capital, through skilled employees, efficient processes, and strong business relationships, supports better decision-making and fosters innovation (Mehralian et al., 2024). This concept aligns with Resource-Based Theory (RBT), which emphasizes the value of unique and hard-to-replicate resources for competitive advantage (Barney, 1991). Investing in human capital provides strategic insights, while strong relational networks boost customer loyalty and stakeholder support. These elements boost current performance and support long-term success, assisting Indonesia's shift towards a knowledge-driven economy. By prioritizing intellectual capital, businesses can enhance their present operations and secure a sustainable future by utilizing their internal resources to gain a competitive advantage.

The result also shows that the relationship between intellectual capital on firm performance is heterogeneous because different firms have varying capacities to utilize and integrate IC into their business strategies. This heterogeneity is influenced by factors, such as firm size, resources, industry, and stage of development. For instance, companies that are larger and more established typically possess well-developed mechanisms for efficiently managing and utilizing intellectual capital, which results in a more significant impact on their performance (Muftiasa et al., 2023). These organizations have the financial means to invest in advanced human capital training, cutting-edge technologies for structural capital, and extensive networks for relational capital. Such investments allow them to fully exploit the advantages of intellectual capital, leading to a more pronounced positive effect on their overall performance. In contrast, smaller or newer firms may not have the same resources or systems in place, which limits their ability to fully benefit from intellectual capital. They may have fewer

skilled employees, less-developed processes, and weaker business relationships (Belgraver & Verwaal, 2018). They also need fundamental improvements in their core business operations (Handoyo et al., 2023). This makes it harder for them to use intellectual capital to improve their performance.

CONCLUSION

The findings confirmed that intellectual capital positively affects firm performance, consistent with the Resource-Based Theory (RBT) which highlights the significance of unique internal resources for competitive advantage. Quantile regression analysis also revealed that this positive relationship varies across different performance levels, showing that intellectual capital exerts a greater influence on high-performing firms than on low-performing ones. This finding suggests that high-performing companies can more effectively leverage intellectual capital, whereas low-performing firms may struggle. Thus, firms prioritizing intellectual capital are likely to see enhanced performance, especially if they have a strong foundation to integrate and utilize these intangible resources.

This study provides several theoretical and practical insights for the body of knowledge, businesses, investors, and policymakers. Theoretically, the use of quantile regression enhances the understanding of how intellectual capital influences firm performance across various levels, supporting resource-based theory by showing its significant impact, especially on high-performing companies. For businesses, the study emphasizes the strategic importance of investing in human, structural, and relational capital to stay competitive. Investors can benefit from these findings by identifying companies that excel in managing intellectual capital, as it is closely tied to stronger financial performance and long-term investment potential. Policymakers are encouraged to support the development of intellectual capital through initiatives in education, training, and technology, creating an environment that fosters innovation and sustainable economic growth.

However, this study has several limitations. This study uses VAIC to measure intellectual capital, a widely accepted method, but it may not capture qualitative factors like innovation capacity or relational assets. Future research could explore alternative methods, such as the balanced scorecard or qualitative assessments, for a more complete measurement. Qualitative evaluation methods offer a more nuanced understanding of knowledge-related resources and their interconnections, revealing aspects that might be overlooked when focusing solely on quantitative metrics. In addition, this study also focuses solely on firms in Indonesia that limits the generalizability of the findings to other countries. Future research could expand to include a broader range of countries or conduct comparative studies in different countries to validate the results.

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