



e-ISSN: 2550-1895

Available online at
<https://mar.uitm.edu.my/index.php>

Management And Accounting Review 25 (2) 2026, 659-687

Management And Accounting Review

A Multidimensional Intellectual Capital and Financing Decision: The Mediating Role of Firm Performance

Harmono¹, Nurhidayah Yahya^{2*} and Yusuf³

¹Universitas Merdeka Malang, Kota Malang, Indonesia

²Accounting Research Institute, Universiti Teknologi MARA, Selangor, Malaysia

³STAI Salahuddin Pasuruan, Indonesia

ARTICLE INFO

Article history:

Received 3 November 2025

Revised 16 July 2026

Accepted 30 July 2026

Published 1 August 2026

Keywords:

Multidimensional Intellectual
Capital
Firm Performance
Financing Decision
Banking Industry in Indonesia
Generalized Method of Moments

DOI:

10.24191/MAR.V25i02-17

ABSTRACT

This research examines the impact of Multidimensional Intellectual Capital on financing decisions and their relationship with firm performance. Modified IC variables (M-VAIC) include: Capital Employee Efficiency (CEE), Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), Relational Capital Efficiency (RCE), Innovation Capital Efficiency (InoCE), tested the consistency of influence on firm performance using: Return on Assets (ROA); Return on Investment (ROI) and Return on Equity (ROE), as well as Debt to Equity (DER) and Debt to Assets Ratio (DAR). The research design was an explanatory study based on robustness testing of the model using the Generalized Method of Moments (GMM). It used panel data for 42 banking industries in Indonesia, with N samples of 378 from 2015 to 2023. Novelty, methodologically, produced a robust model regarding the nexus between multi-dimensional IC and financial decisions through firm performance ROA, ROI, and ROE. The research findings, SCE, and InoCE, were fully mediated by firm performance (ROI and ROE). This supported the pecking order theory, and RCE influenced financial decisions in line with the optimum capital structure theory. This research model robustly contributes to strengthening the concept of multidimensional intellectual capital, pecking order, and optimal capital structure theory. It is recommended for future research to be developed by comparing the banking and manufacturing industries and the development of multidimensional intellectual capital

^{1*}Corresponding author. *E-mail address:* harmono@unmer.ac.id

1. INTRODUCTION

The research motivation, first, was based on the dynamic data pattern of the capital structure of Indonesia's banking industry, indicating an interesting phenomenon to study. The dynamic conditions of DER and DAR illustrated that the funding policy (third-party funds such as savings, current accounts, deposits, and other liabilities) was a central issue in banking management. Therefore, the bank's ability to manage its capital structure refers to the capital structure theory (Modigliani and Miller, 1958; 1963; Myers, 1984), become one of the main determinants of the sustainability of the banking business.

Second, the motivation for this research was to see that banking sustainability was insufficient if it only emphasizes the funding aspect. This study considers the crucial role of human capital, using intellectual capital measurements, in determining funding policies. Based on a review of several previous studies, there were still research gaps and inconsistencies in the research results (Soewarno and Tjahjadi, 2020; Bhattacharjee and Akter, 2022; Rosita *et al.*, 2020). Third, this study was motivated to develop an integrated model of multidimensional IC and funding decision (Pulic, 2000; 2004; 2008; Edvinsson, 1997; Sveiby, 1997; Kim, Kim and Lee, 2011).

This research aimed to investigate the multidimensional Intellectual Capital (IC) in influencing financing decisions through firm performance, focusing on the banking industry in Indonesia. The uniqueness of this research was it analyzed the funding policy of the banking industry sector for empirical conditions in Indonesia, which was characterized by a dynamic funding policy, considering the weighted average cost of debt and equity (Miller, 1958; 1963; Myers, 1984; Harmono *et al.*, 2023b; Musa *et al.*, 2025).

The average debt-to-equity ratio (DER) of the Indonesian banking industry for the 2018-2023 period was 5,311, and the composition of the debt-to-assets ratio (DAR) was 0.785, indicating that debt funding policy was a central issue in the banking industry management. The main focus that must be observed is the characteristics of optimal capital structure. It is a major component of the banking service products that collect funds from third parties. There are savings, current accounts, and deposits from customers, trade liabilities, and other debts, divided by equity, generally used for the manufacturing industry. In this case, the banking industry had implemented a targeted funding policy (Salvi *et al.*, 2020; Xu, 2012; Harmono and Insiyroh, 2024; Harmono *et al.*, 2023b; Kim, Kim, and Lee, 2011; Halid *et al.*, 2021).

On the other hand, the determination of banking funding policies is very much determined by the managerial capabilities of banks, both from internal organizational activities and external organizational activities, to efficiently increase the company's added value, or what is known as intellectual capital performance (IC) (Soewarno and Tjahjadi, 2020; Bhattacharjee and Akter, 2022; Rosita *et al.*, 2020). Recent studies have also confirmed that intellectual capital remained important in strengthening financial performance, banking resilience, and value creation, particularly as banks increasingly depended on knowledge-based resources, digital capability, customer relationships, and innovation capacity (Wahyudi, Mahsina and Nawawi, 2026; Wijayanti *et al.*, 2026).

According to Pulic (2000; 2004; 2008) the existence of a traditional accounting information system that treated humans as part of production costs was much debated, so it needed to be developed using modern measurements, namely, human resource capabilities were treated as intellectual capital (Sveiby, 2001;

Edvinsson *et al.*, 2022). The future challenge, managing intellectual capital using the VAIC model, which consisted of capital employee efficiency (CEE), human capital efficiency (HCE), and structural capital efficiency (SCE), required the development of an Intellectual Capital (IC) measurement model (Bakhsha, Afrazeh, and Esfahanipour, 2017; Iazzolino and Laise, 2013). Modification of the VAIC measurement needs to be linked to all levels of managerial activity, both internal and external to the organization, tending towards the development of multidimensional intellectual capital, both related to the efficiency of company performance activities and funding policy strategies, and the efficiency of activities in establishing relations with external parties (Bhattacharjee and Akter, 2022; Harmono, Harmono, 2024; Soewarno and Tjahjadi, 2020; Kim, Kim, and Lee, 2011; Salvi *et al.*, 2020).

Pulic's idea, $VAIC = CEE + HCE + SCE$, then $SCE = (VA - HC) / VA$, in this case, intellectual capital efficiency, in addition to human capital, included physical and non-physical capital. Physical capital of the company, fixed assets (CEE), including land, buildings, machinery, and equipment, in the context of a banking company, an Automatic Teller Machine (ATM) was a tangible fixed asset, as it provided the best service to the community in creating added value. Meanwhile, non-physical measures of structural capital efficiency (SCE) had experienced developments, including computer information systems, internal business processes, customer database management, and organizational structures and governance, including intangible fixed assets such as patents, trademarks and franchises can support the creation of added value (Pulic, 2000; 2004; 2008; Edvinsson, 1997; Sveiby, 1997; Kim, Kim and Lee, 2011).

The latest development, SCE, is related to internal organizations, one of which is innovations resulting from research and development to create added value for the company using the measurement of innovation capital efficiency (InoCE) (Kim, Kim, and Lee, 2011; Vale, Vale, and Lopes, 2022; Cardorel, Appiah, and Majumder, 2021). Meanwhile, external activities can be developed related to customer service or business strategies to anticipate competitors' strategies. Therefore, the development of multidimensional intellectual capital was a crucial factor, including relational capital efficiency (RCE) and innovation capital efficiency (InoCE) (Edvinsson, 1997; Sveiby, 1997; Vale, Vale and Lopes, 2022; Cardorel, Appiah and Majumder, 2021; Soewarno and Tjahjadi, 2020).

The urgency of this research, based on a series of previous studies, was the influence of Intellectual Capital Components (VAIC) on company performance, the most influential factor on firm performance, although some were inconsistent (Smriti and Das, 2018; Zéghal and Maaloul, 2010; Haque and Weqar, 2021; Tripathy, Gil-Alana, and Sahoo, 2015). In addition, according to scholars, there was still not much research on the multidimensional components of intellectual capital in relation to funding policies (Harmono *et al.*, 2023; Liu and Wong, 2011; Kim, Kim, and Lee, 2011; Kayo and Kimura, 2011). In summary, the track record of previous research is presented in Table 1.

Table 1: Previous research

Scholar(s)	IC element	Financial Performance			Financing Decision	
		ROA	ROI	ROE	DER	DAR
1. Smriti and Das (2018)	Capital Employee	S+	-	-	-	-
	Human Capital	NS	-	-	-	-
	Structural Capital	NS	-	-	-	-
2. Soewarno and Tjahjadi (2020)	Capital Employee	S+	-	S+	-	-
	Human Capital	S+	-	S+	-	-
	Structural Capital	S+	-	S+	-	-
	Innovation Capital	S+	-	S+	-	-
3. Harmono and Insiyroh, 2024)	Capital Employee	S+	S+	S	S+	S+
	Human Capital	S+	S+	NS	S+	NS
	Structural Capital	NS	NS	NS	NS	NS
4. Bhattacharjee and Akter (2022)	Capital Employee	S+	-	-	-	-
	Human Capital	S+	-	-	-	-
	Structural Capital	NS	-	-	-	-
5. Zéghal and Maaloul (2010)	Capital Employee	S+	-	-	-	-
	Human Capital	S+	-	-	-	-
	Structural Capital	S+	-	-	-	-
6. (Bayraktaroglu, Calisir and Baskak, 2019)	Capital Employee	S+	-	S+	-	-
	Human Capital	-	-	-	-	-
	Structural Capital	S+	-	S+	-	-
	Innovation Capital	S+		S+	-	-
7. Chowdhury, Rana, and Azim (2019)	Capital Employee	NS	-	NS	-	-
	Human Capital	S+	-	NS	-	-
	Structural Capital	NS	-	NS	-	-
8. Wang et al., (2021)	Capital Employee	S+	-	-	-	-
	Human Capital	S+	-	-	-	-
	Structural Capital	S+	-	-	-	-
	Relational Employed	S+	-	-	-	-

Scholar(s)	IC element	Financial Performance			Financing Decision	
		ROA	ROI	ROE	DER	DAR
9 Liu and Wong (2011)	Innovation Capital	-	-	-	S+	-
10 Kweh <i>et al.</i> (2019)	Capital Employee	S+	-	-	-	-
	Human Capital	S+	-	-	-	-
	Structural Capital	NS	-	-	-	-
11 Tripathy, Gil-Alana, and Sahoo (2015)	Capital Employee	S+	-	S+		
	Human Capital	NS	-	NS		
	Structural Capital	S+	-	S+		
	Relational Capital	NS	-	S+		
12 (Bayraktaroglu, Calisir and Baskak, 2019)	Capital Employee	S+	-	-	-	-
	Human Capital	S+	-	-	-	-
	Structural Capital	S+	-	-		-
13 (Alipour, 2012)	Capital Employee	S+	-	-	-	-
	Human Capital	S+	-	-	-	-
	Structural Capital	S+	-	-	-	-
14 (Maji and Goswami, 2020)	Capital Employee	S+	-	-	-	-
	Human Capital	S+	-	-	-	-
	Structural Capital	NS	-	-	-	-

Sources: Author's compilation

Referring to a series of previous studies, the novelty of this research was the integrated analysis of IC multidimensional influence on funding decisions through company performance, which had not been widely studied before (Liu and Wong, 2011; Kim, Kim, and Lee, 2011; Kayo and Kimura, 2011). In addition, methodologically, the results of previous studies on the relationship between intellectual capital and company performance had shown inconsistent results, caused by the specific effect of unobserved lag1 variables that had not been analyzed in determining the model. Therefore, this study improved it, using the Generalized Method of Moment (GMM) approach, by testing the model through panel regression between the common effect model (CEM), fixed effect model (FEM), first different generalized method of moment (FDGMM), and system generalized method of moment (SysGMM), to determine a robust and unbiased model that could explain the research hypotheses (Bond *et al.*, 2001; Ebrahim *et al.*, 2014).

Based on the background of thinking about developing a model of the influence of IC-multidimensional on funding decisions through firm performance, the discussion stages in this article include: (1) introduction;

(2) literature review and hypothesis development; (3) research methods; (4) results and discussion, including robustness tests; (5) conclusions and implications of research.

2. LITERATURE REVIEW AND HYPOTHESIS

2.1 Relationship of Intellectual Capital and Optimum Capital Structure

Funding decisions are theoretically based on the formation of an optimal weighted average cost of capital, which is the weighted average of the cost of debt and equity capital (Miller, 1958; 1963; Myers, 1984). While firms with high intellectual capital frequently operate under the pecking order theory namely capital accumulation through retained earnings (Myers & Majluf, 1984). On the other hand, Modigliani and Miller's (MM) 1958 proposition, updated in 1963, was subsequently referenced in many studies examining factors that influence leverage, thereby theoretically supporting the trade-off theory. At a certain optimal point, the company will attempt to sell shares to increase its equity capital. On the other hand, when there are taxes, company management will utilize debt to increase production capacity and reduce taxable profits towards optimal capital structure formation (Xu, 2012; Miller, 1958; 1963; Kayo and Kimura, 2011; Mazur, 2007; Myers, 1977; Chen and Chou, 2015; Kim, Kim and Lee, 2011; Salvi *et al.*, 2020).

The phenomenon of optimal capital structure formation has become an interesting issue as many subsequent studies have examined the relationship between company performance, optimal capital structure and firm value (wais *et al.*, 2016; Hirdinis, 2019; Aggarwal and Padhan, 2017; Li-Ju Chen, 2011; Awais *et al.*, 2016). In addition, there were several studies that had investigated the influence of intellectual capital value creation on capital structure (Liu and Wong, 2011; Kayo and Kimura, 2011; Kim, Kim, and Lee, 2011). Dealing with a sequence of research on intellectual capital, Iazzolino and Laise (2013) criticized the measurement of Pulic's intellectual capital model (VAIC), which required multi-criteria measurements such as the dimensions of the Balanced Scorecard, Skandia Navigator, and multi-dimensional intellectual index (Edvinsson, 1997; Sulanjaku, 2014; Iazzolino and Laise, 2013). Therefore, this research investigated the relationship pattern of modified Intellectual Capital (M-VAIC) consisting of (HCE, CEE, SCE) plus Relational Capital (RC), Innovation Capital (InC), with capital structure. Another theory, which showed that when management raised capital, it tended to retain profits, and support the pecking order theory (Mazur, 2007; Adair and Adaskou, 2015). Based on the arguments of several research results above regarding the relationship between multi-criteria of Intellectual Capital (IC) dimensions and optimal capital structure, the research hypothesis formulated were:

Ha1: Human Capital Efficiency is associated with a Capital Structure.

Ha2: Capital Employee Efficiency is associated with a Capital Structure.

Ha3: Structural Capital Efficiency is associated with a Capital Structure.

Ha4: Relational Capital Efficiency is associated with a Capital Structure.

Ha5: Innovation Capital Efficiency is associated with a Capital Structure.

2.2 Intellectual Capital and Firm Performance

Pulic's Model (2000) fundamentally showed that the Intellectual Capital Efficiency (ICE), is a measurement model consisting of Capital Employee Efficiency (CEE), Human Capital Efficiency (HCE), and Structural Capital Efficiency (SCE) (Pulic, 2000; 2004; 2008). In a sequence of studies, the relationship

between intellectual capital and firm performance has shown inconsistent results, which occurred in various countries (Smriti and Das, 2018; Soewarno and Tjahjadi, 2020; Maji and Goswami, 2020; Tripathy, Gil-Alana, Zakaria, 2009; and Sahoo, 2015; Gebisa, 2023). Recent evidence further supports the role of intellectual capital in firm performance, showing that human capital, structural capital, and relational capital can enhance profitability and organisational value, although innovation and R&D-related benefits may take time to materialise (Wahyudi, Mahsina and Nawawi, 2026; Rady and Otake, 2026). On the other hand, many researchers believed that Pulic's (2004) proposition regarding ICE measurement still provided benefits as a basis for assessing IC performance, although there were still many who criticized the weaknesses of VAIC, requiring more complex measurements using M-VAIC, which led to multi-criteria. The explanation of the Pulic VAIC model into M-VAIC developed in this research can be described chronologically as follows:

$$VA = OUT - IN$$

OUT = Total Sales, and IN = Cost

Value-Added can be determined as follows:

$$VA = OP + EC + D + A$$

In this case, OP = operating profit; EC = employee costs; D = Depreciation; and A = amortization. Factor capital depended on human capital in creating the added value of the company. Therefore, it can be formulated: $VA = HC + SC$. Based on this equation, it can be broken down to $HCE = VA/HC$, where HCE = human capital efficiency coefficient; HC = salary and wage. Next, SCE (structural capital efficiency) can be determined: $SCE = SC/VA$. Thus, $ICE = HCE + SCE$. Pulic's model showed that value-added was not only the result of the human capital factor. To achieve a level of efficiency in the company's operations requires financial and physical capital, namely a capital employee efficiency coefficient (CEE), which can be calculated as $CEE = VA/CE$, in this case, CE = book value of net assets. The explanation of the formula is as follows:

Dividing the two sides by VA is the same as:

Dividing the two sides by VA is the same as:

$$VAIC = ICE + CEE = \left(\frac{VA}{HC} + \frac{SC}{VA} + \frac{VA}{CE} \right), \text{ next} \quad (1)$$

$$VA = HC + SC$$

$$1 = \frac{HC}{VA} + \frac{SC}{VA} \text{ and then:}$$

$$1 = \frac{1}{\frac{VA}{HC}} + \frac{SC}{VA} \quad (2)$$

By replacing

$$HCE = \frac{VA}{HC} \text{ (HCE reflects labor productivity based on salary and wages)}$$

$$SCE = \frac{SC}{VA} \text{ (Structural Capital Efficiency)}$$

Equation (2) becomes:

$$SCE = 1 - \frac{1}{HCE} \quad (3)$$

In equation (3) HCE shows the level of productivity of knowledge workers in creating added value cannot stand alone. It requires physical capital (CEE) and structural capital (SCE) related to organizational philosophy and strategy to leverage organizational capabilities, process capital includes techniques, procedures, programs implemented to achieve the distribution of goods and services, including relational capital and innovation capital variables, become multi-criteria IC components (Bakhsha, Afrazeh and Esfahanipour, 2017; Iazzolino, Laise and Migliano, 2014; Edvinsson, 1997) Likewise, it can be developed using primary data (Chen, Cheng and Hwang, 2005; Jamal and Irene, 2007).

Pulic 2000 Contribution The traditional monocriteria VAIC model in calculus, SC as part of VA, can be formulated as follows: $\frac{\delta SCE}{\delta HCE} = \frac{1}{HCE^2} > 0$ (4)

The relationship between SCE and HCE is empirically linear, as shown in Figure 1. In this case, HCE = 1, the value of creation is in a break-even state. Before the break-even point, the value distribution is in the zone (SCE<0), and the value creation will be created at (SCE>0). Thus, SCE contributes to VA with the equation (VA = HCE + SCE). Therefore, SCE can be developed using multiple criteria, including RCE, development of organizational costs, Innovation Capital, Intangible Capital, and others outside HC. In detail, when knowledge worker value creation (HCE<1) shows VA is unable to pay for salaries and wages (VA<HC), then SCE is automatically in the negative or loss zone. Empirically, a graph of the relationship between SCE and HCE can be shown as follows:

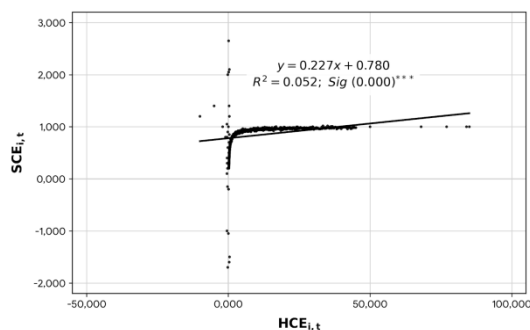


Figure 1. Relationship between HCE and SCE in creating VAIC, empirical evidence of manufacturing companies in Indonesia for the period 2018-2023.

On the other hand, the relationship between IC components and firm performance has shown inconsistent results. Based on previous research that criticized the VAIC model, it led to multi-criteria IC measurements (Iazzolino and Laise, 2013). Therefore, this research conceptually developed the VAIC model into a modified VAIC (M-VAIC) to investigate the validity of the relationship between the M-VAIC components and funding decisions through firm performance.

- (1) When $HCE = 1$, or $SCE = 0$, VA can only pay labor costs. It means not creating added value creations.
- (2) When $HCE > 1$, or $SCE > 0$, there is a possibility that VA can exceed labor costs. Notes that the company must be a profit-oriented, the $HCE > 1$ condition. If the condition $0 < HCE < 1$, the company has

$$ICE = HCE + SCE \quad (5)$$

The relationship between ICE and HCE productivity can be broken down from equation (3) into equation (5), and it was obtained:

$$SCE = 1 - \frac{1}{HCE}$$

$$ICE = HCE + SCE = HCE + \left(1 - \frac{1}{HCE}\right) \text{ or The two sides were divided by their equal HCE into,} \quad (6)$$

$$\frac{ICE}{HCE} = \frac{\left(HCE + \left(1 - \frac{1}{HCE}\right)\right)}{HCE} \text{ or can be simplified,}$$

$$ICE = \frac{HCE^2 + HCE - 1}{HCE} \quad (7)$$

Based on equation (7), the equation of the linear function ICE f(HCE) can be derived

$$\frac{\delta ICE^2}{\delta HCE} = \text{standardized coefficient} = \sqrt{\frac{\sum_{t=0}^t (ICE - \overline{ICE})^2}{\sum_{t=0}^t (HCE - \overline{HCE})^2}} > 0 \quad (8)$$

Empirically, the correlation between ICE and HCE for manufacturing conditions in Indonesia for the years 2016-2019 period can describe the HCE linearity function curve, with ICE as shown in Figure 2.

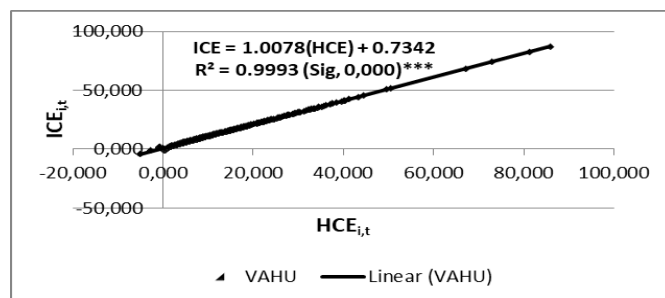


Figure 2. The relationship between HCE and ICE is the empirical evidence from Indonesia for the 2018-2023 period

Referring to equation (8), the SCE function concerning ICE was derived as follows:

$$\frac{\delta ICE^2}{\delta SCE} = \text{standardized correlation coefficient base} = \sqrt{\frac{\sum_{t=0}^i (ICE - \underline{ICE})^2}{\sum_{t=0}^i (SCE - \underline{SCE})}} > 0 \quad (9)$$

Furthermore, M-VAIC development using multi-dimensionality can be described as follows: ICE = HCE + SCE, Next SCE = VA – HC. Thus, a component can be developed in a multi-criterion with the equation M-VAIC = Operating Profit (OP) + Salary and Wages + Human and Development Training and Motivation (HDC) + Marketing Expense (RC) + Research and Development (R&D) + Depreciation (D) + Amortization (A). In detail, the multi-criteria M-VAIC calculation developed is shown in Table 1.

Table 1: The Description of Multi-Dimensional IC (M-VAIC)

Sales (Revenue)	OUT
- Cost	IN
= VA	VA
- Salary and Wages (Human Capital)	HC
= Structural Capital Mono-Dimensional	SC
- Marketing Expenses (Relational Capital)	RC
- Research and Development (Innovation Capital)	InC
- Intangible Assets Capital	IAC
= Structural Capital Multi-dimensional	SCMd
+ Amortization & Depreciation	A+D
= Operating Profit + A + D	VAIC (EBITDA)

The multi-criteria M-VAIC description can be developed into $SC = VA - HC - HDC - RC - InC - IAC$.

Based on the description of the M-VAIC model, and previous research the following research hypotheses were formulated:

Ha7: Human Capital Efficiency is associated with a Firm's Performance.

Ha8: Capital Employee Efficiency is associated with a Firm's Performance.

Ha9: Structural Capital Efficiency is associated with a Firm's Performance.

Ha10: Relational Capital Efficiency is associated with a Firm's Performance.

Ha11: Innovation Capital Efficiency is associated with a Firm's Performance.

Intellectual Capital on Capital Structure through Firm Performance

The role of firm performance as an intervening variable in the relationship between IC and Capital Structure, in line with agency theory (Liow, 2010; Michael and Meckling, 1976). In this case, company performance, in relation to funding decisions, managers will determine the optimum capital structure through debt or by selling shares and/or retaining earnings. Empirically, management in carrying out funding strategies will report the company's performance according to financial reporting standards, both to creditors and potential investors, as a manifestation of the relationship between the principal and the agent, leading to optimal funding decisions. (Miller, 1958; Anderson, Prezas and Anderson, 1998; Chen and Chou, 2015b; Mazur, 2007; Liu and Wong, 2011). This supported the argument that firm performance can act as an important channel through which intellectual capital influenced financing decisions, as knowledge-based resources improve operational capability, investor confidence, and financial flexibility (Wijayanti et al., 2026; Rady and Otake, 2026). In an integrated manner, the role of financial performance in mediating the relationship between multi-dimensional IC and funding decisions can be illustrated by the research model in **Figure 3** and the formulation of the research hypothesis as follows:

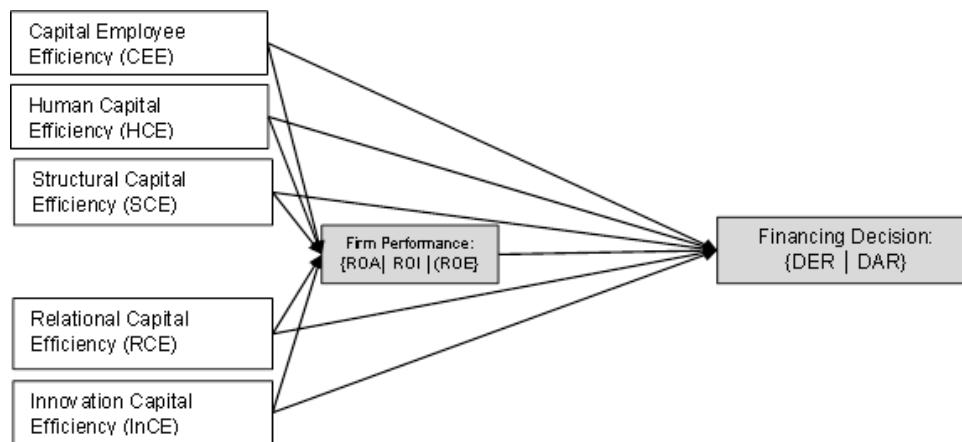


Figure 3. IC-Multidimensional enhancing a financing decision through firm performance based on the Generalized Method of Moments (GMM).

Research Hypothesis:

- Ha₁₂**. Human Capital Efficiency is associated with a Capital Structure through Firm Performance.
- Ha₁₃**. Capital Employee Efficiency is associated with a Capital Structure through Firm Performance.
- Ha₁₄**. Structural Capital Efficiency is associated with a Capital Structure through Firm Performance.
- Ha₁₅**. Relational Capital Efficiency is associated with a Capital Structure through Firm Performance.
- Ha₁₆**. Innovation Capital Efficiency is associated with a Capital Structure through Firm Performance.

3. DATA AND RESEARCH DESIGN

3.1 Sample and Data

Using panel data from 42 listed Indonesian banks (2015–2023), this study combines a two-step Generalized Method of Moments (GMM) with path analysis to examine how firm performance mediates the relationship between multidimensional intellectual capital and financing decisions. Comparing CEM, FEM, FDGMM, and SysGMM in STATA yielded the most robust specification. GMM effectively controls for endogeneity, autocorrelation, and unobserved firm-specific effects (Arellano and Bover, 1995; Bond et al., 2001; Ebrahim et al., 2014). As the dataset is exclusive to Indonesia, findings reflect its specific institutional framework and may not fully generalize to other financial systems. The two-way fixed-effects GMM model is formulated as follows:

3.2 Methodological framework

Leverage ratio dynamic debt-to equity ratio (DER) leading to an optimal capital structure Y^*_{it} , for the i firm at time t was formulated as follows:

$$Y^*_{it} = \alpha_0 + \sum_j \beta_j X_{jit} + \alpha_i + \alpha_t + e_{it} \quad (1)$$

In this case, i represented individual company data from 1 to N ; t represented time series data from 1 to T ; while X represented (J) the diversity of company characteristics and time volatility; α_i dan α_t represented the unobserved variable, firm and time specific effect, as well as ε_{it} is the error term of the panel data dynamic model (i, t), $\varepsilon_{it} = N(0, \sigma^2)$. According to the proposition of Miller (1963), the leverage ratio can achieve the optimal capital structure (DER) target, namely, $Y_{it} = Y^*_{it}$. The optimal change in leverage can be expressed in a mathematical model: $Y_{it} - Y_{it-1} = Y^*_{it} - Y_{it-1}$. In this case, it showed an unrealistic assumption that described the instant adjustment of changes in the cost of capital to reach the optimal capital structure (Ebrahim *et al.*, 2014; Areliano and Boverb, 1995; Bond *et al.*, 2001). Therefore, to partially accommodate dynamic changes in capital structure, a parameter λ was required. Dynamic changes in λ will adjust the weighted average cost of debt and equity capital to range from 0 to 1 toward the optimal capital structure composition. Thus, dynamic changes were formulated into the following model:

$$Y_{it} - Y_{it-1} = \lambda_{it} (Y^*_{it} - Y_{it-1}) \quad (2)$$

$$Y_{it} = (1 - \lambda_{it}) Y_{it-1} + \lambda_{it} Y^*_{it} \quad (3)$$

To eliminate the unobserved optimal leverage variable, Y^*_{it} , by substituting equation (1) into equation (3) to produce equation model (4) and dynamic model (5) as described below:

$$Y_{it} = (1 - \lambda_{it}) Y_{it-1} + Y_{it} \left(\alpha_0 + \sum_j \beta_j X_{jit} + \alpha_i + \alpha_t + \varepsilon_{it} \right) \quad (4)$$

$$Y_{it} = \varphi_0 + \theta_0 Y_{it-1} + \sum_j \theta_0 X_{jit} + \eta_i + \eta_t + \mu_{it} \quad (5)$$

This was then simplified into equation 5. In this case,

$$\varphi_0 = \lambda_{it} \alpha_0, \theta_0 = (1 - \lambda_{it}), \theta_j = \lambda_{it} \beta_j, \eta_i = \lambda_{it} \alpha_i, \eta_t = \lambda_{it} \alpha_t, \text{ and } \mu_{it} = \lambda_{it} \varepsilon_{it}.$$

Table 2. Variable definition

Variables	Description	Measuring variables
Dependent variables		
Financial decision (y1)		
Debt to equity ratio (y1.1)	DERit	$\frac{Debt}{Equity} \times 100\%$
Debt to asset ratio (y1.2)	DARit	$\frac{Debt}{Assets} \times 100\%$
Independent variables		
IC-Multidimensional		
VAIC	Sum of HCE, SCE, and CEE	VA = value-added
	VA = OP + EC + D + A	OP = operating profit
	VAIC = ICE + CEE	EC = employee costs
	ICE = HCE + SCE	D = depreciation
		A = amortization
Capital employee efficiency (x1.1)	CEEit	$\frac{VA}{CE} = \frac{Value\ added}{Capital\ equity}$
Human capital efficiency (x1.2)	HCEit	$\frac{VA}{HC} = \frac{Value - added}{Employee\ cost}$
Structural capital efficiency (x1.3)	SCEit	$\frac{VA - HC}{VA} = \frac{Value\ added - HC}{Value\ added}$
Relational Capital Efficiency (x1.4)	RCEit	$\frac{Sales}{Marketing\ expenses}$
Innovation capital efficiency (x1.5)	InoCEit	$\frac{Sales}{Research, and\ Development}$
φ_0		

Variables	Description	Measuring variables
	ϕ_i	(constant value in GMM model)
γ	γ_{it}	(Lagged dependent variable)
B	$\beta_1 \dots \beta_n$	Regression coefficient
η_i	η_{it}	Unobserved individual-specific effects, two-way firm and time
η_t	η_{it}	Unobserved individual-specific effects, two-way firm and time
μ_{it}	$\lambda + \varepsilon_{it}$	
	λ	the individual-specific effect
	ε_{it}	Disturbance(error) $_{it}$

Notation: Generalized method of moments (GMM)

4. RESULT AND DISCUSSION

4.1 Descriptive statistics

The results of descriptive statistics showed that the number of N valid samples was 378 from 42 banking industries that were publicly listed on the Indonesian Capital Market, in the period 2015-2023. The CEE_{it} variable was the result of a comparison of Value Added divided by Equity, with a minimum value of -0.194 and a maximum of 0.129; then the average value and standard deviation were 0.008 and 0.029, indicating high variation in the data. The next, HCE_{it} , which described the amount of human capital that was measured using salaries and wages in producing an average VA of 0.990 with a minimum value of -14.220 and a maximum of 8.441 with a standard deviation of 2.779, illustrated the high variation between banking companies.

According to previous research, this research used multi-criteria by adding RCE_{it} and $InCE_{it}$ to reveal more complete SCE_{it} information. In this case, SCE_{it} had an average value of -0.260 with a standard deviation of 5.326, which showed high data variation. The average RCE_{it} value was 144.442, the minimum is -35.450, and the maximum value was 325.333 with a high standard deviation of 5.443. RCE_{it} showing the dynamics of sales trends compared to marketing expenses can rationally influence the decision-making behavior of investors and creditors and the condition of the capital structure (DER_{it}) (Kim, Kim, and Lee, 2011; Myers, 1977; Ebrahim *et al.*, 2014; Modigliani and Miller, 1963). Next, the average value of Innovation Capital Efficiency ($InCE_{it}$) had the highest value among the SCE_{it} components, namely 279.113, with a standard deviation of 449.295. On the other hand, the dependent variables consisting of ROA_{it} , ROI_{it} , ROE_{it} , and DAR_{it} had almost the same average value and low variation. In detail, the descriptive statistics is shown in Table 3.

Table 3. Descriptive Statistics

Variables	N	Mean	Min	Max	Std. Deviation
CEE	378	0.008	- 0.194	0.129	0.029
HCE	378	0.990	-14.220	8.441	2.779
SCE	378	-0.260	-57.496	8.959	5.326
RCE	378	144.422	-35.450	925.333	220.172
InoCE	378	279.113	-3.303	921.978	449.295
ROA	378	0.014	-0.089	0.181	0.022
ROE	378	0.084	-0.089	1.239	0.116
ROI	378	0.019	-0.084	0.196	0.027
DAR	378	0.785	0.050	0.932	0.164
DER	378	5.311	0.193	16.079	2.965

4.2 Robustness Test and GMM Analysis Model

Model robustness was tested by adding a lagged DER variable to the GMM specification. Diagnostic testing—including Sargan (instrument validity), Arellano-Bond (consistency), and model unbiasedness tests—was conducted across four specifications (CEM, FEM, FDGMM, and SysGMM) to select the best-fitting model. Results for Equation 6 are as follows:

$$DER_{it} = \varphi_0 + \gamma_0 DER_{it-1} + \beta_1 CEE_{it} + \beta_2 HCE_{it} + \beta_3 SCE_{it} + \beta_4 RCE_{it} + \beta_5 InoCE_{it} + \beta_6 ROA_{it} + \beta_7 ROI_{it} + \beta_8 ROE_{it} + \eta_i + \eta_t + \mu_{it} \quad (6)$$

Robustness and unbiasedness tests establish FDGMM as the optimal model. The lagged DER coefficient for FDGMM ($\beta_0 = 0.566, p = 0.000$) exceeds those of CEM ($\beta_{it} = 0.524, p = 0.000$) and FEM ($\beta_{it} = 0.374, p = 0.000$). Furthermore, Sargan test results indicate that SysGMM is invalid due to significant overidentifying restrictions ($\text{stat} = 51.254, p = 0.0291$), whereas FDGMM satisfies instrument validity ($\text{stat} = 31.647, p = 0.2454$). Thus, FDGMM is confirmed as an unbiased and valid basis for empirical interpretation of hypothesis (Ebrahim *et al.*, 2014).

Based on the FDGMM model, ROE_{it} significantly influences leverage (DER_{it}) ($\beta_{it} = 17.488, p < 0.001$), whereas ROA_{it} ($\beta_{it} = -45.378, p = 0.365$) and ROI ($\beta_{it} = -30.763, p = 0.467$) show no significant effect. This indicates that equity-based profitability is the primary driver of capital structure decisions in Indonesian banking, as higher ROE_{it} signals financial strength to creditors and investors. Aligning with optimal capital structure theory (Modigliani and Miller, 1963; Myers, 1984; Liow, 2010; Soewarno &

Tjahjadi, 2020), these results demonstrate that banks with stronger equity returns are better positioned to manage debt and attract external financing.

The novelty of this study lies in demonstrating that ROE is the primary performance metric explaining bank funding strategies (DER_{it}). Empirically, this finding supports proprietary theory by emphasizing shareholder wealth maximization—specifically, how effectively banks leverage equity capital to generate net income after tax.

Beyond ROE_{it} , Relational Capital Efficiency (RCE_{it}) significantly and negatively affects leverage (DER_{it}) ($\beta_{it} = -0.004$, $p < 0.001$). Lower RCE_{it} values reflect intensive marketing investments aimed at customer acquisition and retention. Effective marketing programs successfully attract third-party funds and expand customer deposits, which ultimately increases the bank's DER funding structure.

These findings reinforce the multidimensional intellectual capital framework, highlighting relational capital as a primary driver of value creation in banking. Strong customer relationships, reputation, and public trust enhance deposit mobilization and investor confidence, directly shaping financing decisions (Edvinsson, 1997; Pulic, 2000; Kim, Kim and Lee, 2011). Consistent with recent literature (Wijayanti et al., 2026; Rady and Otake, 2026), this demonstrates that knowledge-based resources fundamentally drive firm performance, financial resilience, and capital structure strategies.

The novelty of research, methodologically, discovered a robust model when IC used multi-criteria M-VAIC, and firm performance used ROA_{it} based on Generalized Method of Moments, which can show a robust research model in line with research (Iazzolino and Laise, 2013; Smriti and Das, 2018). The findings of this research model can explain the inconsistency of previous research results, which tended to use the Pulic 2000 VAIC model with a single IC criterion, which produced a VAIC measurement model that was still biased in relation to firm performance with different measurements (Bakhsha, Afrazeh, and Esfahanipour, 2017; Soewarno and Tjahjadi, 2020; Iazzolino and Laise, 2013; Smriti and Das, 2018; Rosita et al., 2020).

Table 4. Structure I-a

			Model 1	Model 2	Model 3	Model 4
			(CEM)	(FEM)	(FDGMM)	(SYSGMM)
Variable			$y_2: DER_{it}$	$y_2: DER_{it}$	$y_2: DER_{it} (Fit)^*$	$y_2: DER_{it}$
φ_{DERL1} (specific effect unobsurb)	$\gamma_0 L1.Y_2DER$		0.5249937	0.3740922	0.566177	0.6025988
			(0.000)***	(0.000)***	(0.000)***	(0.000)***
$Y_{1,1}ROA_{it}$	β_1		-46.24612	-42.13579	-45.37788	-46.44289
			(0,138)	(0,215)	(0,365)	(0,345)
$Y_{1,2}ROI_{it}$	β_2		-21.8805	-24.89543	-30.76292	-26.47752
			(0.302)	(0.289)	(0.467)	(0.519)
$Y_{1,3}ROE_{it}$	β_3		15.78917	14.93002	17.48775	16.89367
			(0.000)***	(0.000)***	(0.000)***	(0.000)***
$X_{1,1}: CEE_{it}$	β_4		3.148244	1.686802	15.68194	-4.631226
			(0,657)	(0,831)	(0,276)	(0,443)
$X_{1,2}: HCE_{it}$	β_5		0.067243	0.0322452	-0.0264728	-0.022092
			(0,309)	(0,660)	(0,803)	(0,672)

Variable		Model 1 (CEM)	Model 2 (FEM)	Model 3 (FDGMM)	Model 4 (SYSGMM)
		y ₂ : DER _{it}	y ₂ : DER _{it}	y ₂ : DER _{it} (Fit)*	y ₂ : DER _{it}
X _{1,3} : SCE _{it}	β_6	-0.0202617 (0,325)	-0.0240183 (0,265)	0.0054667 (0,472)	0.0196744 (0,016)**
X _{1,4} : RCE _{it}		-0.0018993 (0,000)***	-0.0027658 (0,000)***	-0.0039728 (0,000)***	-0.0045425 (0,000)***
X _{1,5} : InoCE _{it}	β_7	0.0006041 (0,241)	0.0003327 (0,571)	0.001724 (0,001)***	.0019207 (0,001)***
Constant (φ_0)	φ_0	0.000*** 0.5356	(0,000)*** 0.3791	(0,000)***	(0,000)***
Adj R ² -square		(0,000)***	(0,000)***		
Instrument Validity, Sargan-test				31.64745 (0,2454)*** <i>valid</i>	51.25365 (0,0291) <i>not valid</i>
Arellano-Bond Test, order 2 (Prob > Z). (Consistency test)				-0.19794 (0.8431)*** no <i>autocorrelation</i>	1,0411 (0,2978)*** no <i>autocorrelation</i>
Bias-test of the Model, LI.der		0.52499366***	0.3740921***	0.56617703*** (fit model)	0.60259883*** 204.03 61,01
Wald chi ² , (Prob > chi ²)				(0,000)***	(0,000)***

legend: * p<0.05; ** p<0.01; *** p<0.001

Fit* : selected as a robust model

Discussion of the results of the Second model research, placing funding measurements using the Debt to Asset Ratio (DAR_{it}) with the following equation model:

$$DAR_{it} = \varphi_0 + \gamma_0 ROA_{it-1} + \beta_1 CEE_{it} + \beta_2 HCE_{it} + \beta_3 SCE_{it} + \beta_4 RCE_{it} + \beta_5 InoCE_{it} + \eta_i + \eta_t + \mu_{it} \quad (7)$$

Model 7 (FDGMM) supports the research hypothesis, showing that bank performance directly influences the Debt to Assets Ratio (DAR). Specifically, ROI has a significant negative effect (beta = -2.871, $p = 0.0050$), while ROE has a significant positive effect (beta = 0.324, $p = 0.000$). These results confirm that creditors and investors base their funding decisions on operational profit and equity capital efficiency (Mazur, 2007; Xu, 2012; Thomas, Kiptanui, Chenuos, and Biwott, 2014) see Tables 4 and 5).

Table 5. Structural Equation Model Ib

		Model 5 (CEM)	Model 6 (FEM)	Model 7 (FDGMM) y2: DAR _{it} (Fit)*	Model 8 (SYSGMM) y2: DAR _{it}
Variable		y2: DAR _{it}	y2: DAR _{it}		
αDARL1. (specific effect unobserved)	γ ₀ L1.Y ₂ DAR	0.5777178 (0.000)***	0.4212766 (0.000)***	0.5930593 (0,000)***	0,6392159 (0,000)***
		0.3390335	-1.1227764	0.2001441	-0.1881301
Y _{1,1} ROA _{it}	β ₁	(0,829) -2.927267	(0,941) -2.716428	(0,908) -2.870891	(0,345) -2.361793
Y _{1,2} ROI _{it}	β ₂	(0.006)*** 0.4412055	(0.0019)** 0.406757	(0.005)*** 0.3237974	(0.066)* 0.3223277
Y _{1,3} ROE _{it}	β ₃	(0.000)*** -1.159859	(0.001)*** -1.323999	(0.000)*** -1.541951	(0.025)** -1.224412
X _{1,1} : CEE _{it}	β ₄	(0,001)*** 0.0120972	(0,001)*** 0.0128756	(0.008)*** 0.0162295	(0,004)*** 0.0148295
X _{1,2} : HCE _{it}	β ₅	(0,000)*** 0.000952	(0,000)*** 0.0011293	(0,008)*** 0.0007376	(0,001)*** 0.000842
X _{1,3} : SCE _{it}	β ₆	(0,357) -0.0000708	(0,282) -0.0001387	(0,216) -0.0002079	(0,484) -0.000205
X _{1,4} : RCE _{it}	β ₇	(0.007)*** 0.0000208	(0,000)*** 0.0000288	(0,000)*** 0.0001068	(0,000)*** .000106
X _{1,5} : InoCE _{it}		(0,432) 347.5751	(0,510) 486.6169	(0,001)*** 348.9809	(0,004)*** 307.4224
Constant (α ₀)	α ₀	0,000*** 0.6000	(0,000)*** 0.4610	(0.003)***	(0,000)***
Adj R ² -square		(0,000)***	(0,000)***	49.48164 (0,0052) not valid 0.59193	51.25365 (0,0020) not valid 0.93343
Instrument Validity, Sargan- test				(0.5539)*** no autocorrelation 0.59305934***	(0.3506)*** no autocorrelation
Arellano-Bond Test, order 2 (Prob >Z). (Consistency test)					
Bias-test of the Model, L1.dar		0.5777178***	0.4212766***	(fit model) 589.41	0.63921594*** 682.95
Wald chi ² , (Prob > chi ²)				(0,000)***	(0,000)***

legend: * p<0.05; ** p<0.01; *** p<0.001

Fit*: selected as a robust model

Discussion of the research results of the third model, placing the measurement of company performance using ROA with the following equation model:

$$ROA_{it} = \varphi_0 + \gamma_0 ROA_{it-1} + \beta_1 CEE_{it} + \beta_2 HCE_{it} + \beta_3 SCE_{it} + \beta_4 RCE_{it} + \beta_5 InoCE_{it} + \eta_i + \mu_{it} \quad (8)$$

Diagnostic tests (Sargan, Arellano-Bond, unbiasedness) establish SysGMM as the robust specification for Model 8. Results show that Structural Capital Efficiency (SCE_{it}) positively impacts bank performance ($\beta_{it} = 0.00028, p < 0.005$), whereas Innovation Capital Efficiency ($InnCE_{it}$) exerts a negative effect ($\beta_{it} = -0.000024, p = 0.020$). High SCE β_{it} reflects effective managerial capability to leverage assets, generating value through fee-based income and net interest margin (Soewarno and Tjahjadi, 2020; Bhattacharjee and Akter, 2022). Conversely, InnCE captures heavy R&D spending on digital banking systems and physical infrastructure, which can temporarily compress short-term performance.

On the other hand, the high expenditures—with sales averaging 279.11% of marketing costs—banks maintain strategic marketing and R&D outlays to preserve corporate reputation and public trust. Although these outlays exert a slight negative impact on immediate profitability (ROA: $\beta_{it} = -0.0000241, p = 0.020$), overall financial health across Indonesian banks remains robust, with annual ROA ranging between 1.4% and 18.0% (see Table 6 for complete SysGMM Model 12 estimates).

Table 6. Structure IIa

		Model 9 (CEM)	Model 10 (FEM)	Model 11 (FDGMM)	Model 12 (SYSGMM)
Variable		$y_{1,1}: ROA_{it}$	$y_{1,1}: ROA_{it}$	$y_{1,1}: ROA_{it}$	$y_{1,1}: ROA_{it} \text{ (Fit)*}$
φ ROAL1. (specific effect unobserved)	γ_0 L1.	0.286827	0.1260894	0.2589501	0.2509746
	ROA	(0,000)***	(0,015)**	(0,000)***	(0,006)***
		-0.0573927	-0.1112476	-0.1763355	-0.1100843
$X_{1,1}: CEE_{it}$	β_1	(0,370)	(0,112)	(0,036)**	(0,758)
		-0.0003495	0.0002777		
$X_{1,2}: HCE_{it}$	β_2	(0,577)	(0,681)	0.0007442 (0,384)	0.0003292 (0,896)
		0.0004088	0.0004004		0.0002788
$X_{1,3}: SCE_{it}$	β_3	(0,034)**	(0,042)**	0.00026 (0,269)	(0,005)***
		0.000000145	-0.0000071		
$X_{1,4}: RCE_{it}$	β_4	(0,977)	(0,445)	-0.000013 (0,125)	-0.0000122 (107)
		-0.00000508	-0.000013	-0.0000236	-0.0000241
$X_{1,5}: InoCE_{it}$	β_5	(0,295)	(0,014)**	(0,001)***	(0,020)**
		11.75053	16.0937	17.47944	17.41303
Constant (φ_0)	φ_0	(0,000)***	(0,000)***	(0,000)***	(0,000)***
		0,1163	0,0778		
Adj R ² -square		(0,000)***	(0,0006)***		
Instrument Validity Sargan-test				33.09563 (0,1939)	42.17433 (0.1584)
Arellano-Bond Test, order 2 (Prob >Z). (Consistency test)				-0,9587 (0,3377)	-1,0822 (0,2792)
Wald chi ² , (Prob > chi ²)				no autocorrelation	no autocorrelation
				39,72 (0,000)***	44,20 (0,000)***

legend: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Fit*: selected as a robust model

Discussion of research results in the third model places the measurement of company performance using ROI_{it} (operating profit divided by total investment) with the following equation model:

$$ROI_{it} = \varphi_0 + \gamma_0 ROI_{it-1} + \beta_1 CEE_{it} + \beta_2 HCE_{it} + \beta_3 SCE_{it} + \beta_4 RCE_{it} + \beta_5 InoCE_{it} + \eta_i + \eta_t + \mu_{it} \quad (9)$$

FDGMM estimations confirm that Structural Capital Efficiency (SCE_{it}) positively affects ROI ($\beta_{it} = 0.00027, p = 0.007$), whereas Innovation Capital Efficiency ($InoCE_{it}$) a negative effect ($\beta_{it} = -0.000025, p = 0.031$). Crucially, the GMM framework demonstrates consistent intellectual capital (IC) effects across all profitability metrics (ROA_{it} , ROE_{it} , and ROI_{it}). This offers a unified empirical perspective that resolves prior inconsistencies in the literature regarding variable performance measures (Hoang *et al.*, 2020; Maditinos *et al.*, 2011).

The significant positive effect of Structural Capital Efficiency (SCE) demonstrates that robust internal systems, organizational processes, and governance drive bank performance, supporting Intellectual Capital Theory (Edvinsson, 1997; Sveiby, 1997; Pulic, 2000; 2004). Conversely, the negative effect of Innovation Capital Efficiency (InoCE) reflects initial cost burdens from R&D and digital transformation, which temporarily compress accounting returns before yielding long-term competitive advantages (Iazzolino and Laise, 2013; Soewarno and Tjahjadi, 2020; Bhattacharjee and Akter, 2022). These results corroborate recent evidence indicating that structural capital provides immediate operational capabilities, while innovation-related investment may have delayed financial effects due to its initial cost burden (Wahyudi, Mahsina and Nawawi, 2026; Rady and Otake, 2026).

Furthermore, increased research and development spending to innovate various banking product strategies can lower the $InoCE_{it}$ value and, inversely, increase ROI_{it} profitability. Increasing research and development costs, even at a greater proportion than sales, can lower the $InoCE_{it}$ ratio and negatively increase ROI_{it} profitability, with a regression coefficient of -0.000026 ($p < 0.019$). Details can be seen in Table 6.

Table 6. Structure IIb

		Model 13 (CEM)	Model 14 (FEM)	Model 15 (FDGMM)	model 16 (SYSGMM)
Variable		$y_{1,2}: ROI_{it}$	$y_{1,2}: ROI_{it}$	$y_{1,2}: ROI_{it}$ (Fit)*	$y_{1,2}: ROI_{it}$
φ_{ROIL1} . (specific effect un- obsurb)	γ_0 L1.ROI	0.3656554 (0.000)***	0.1908579 (0.000)***	0.3374164 (0.002)***	0.3445085 (0.008)***
		-0.0568663	-0.1297496	-0.0959616	-0.0073486
$X_{1,1}: CEE_{it}$	β_1	(0.468)	(0.131)	(0.827)	(0.986)
		-0.0005931	0.000094	0.0000848	-0.0005521
$X_{1,2}: HCE_{it}$	β_2	(0.440)	(0.910)	(0.977)	(0.844)
		0.0004806	0.0004851	0.0002722	0.0002997
$X_{1,3}: SCE_{it}$	β_3	(0.042)**	(0.045)**	(0.007)***	(0.007)***

		Model 13 (CEM)	Model 14 (FEM)	Model 15 (FDGMM)	model 16 (SYSGMM)
Variable		$y_{1,2}: ROI_{it}$	$y_{1,2}: ROI_{it}$	$y_{1,2}: ROI_{it}$ (Fit)*	$y_{1,2}ROI_{it}$
		-0.000000697	-0.0000562	-0.0000136	-0.0000172
$X_{1,4}: RCE_{it}$	β_4	(0.909)	(0.457)	(0.114)	(0.048)**
		-0.00000630	-0.0000155	-0.000026	-0.0000253
$X_{1,5}: InoCE_{it}$	β_5	(0.289)	(0.018)**	(0.019)**	(0.031)**
		13.9968	19.67511	19.74575	19.8949
Constant (φ_0)	φ_0	(0.000)***	(0.000)***	(0.000)***	(0.000)***
		0.1718	0.1067		
Adj R ² -square		(0.000)***	(0.000)***		
				48.52109	58.10711
				(0.0067) Not	(0.0062) Not
Instrument Validity-Sargan test				Valid	Valid
				-1.3291	-1.3579
				(0.1838)	(0.1745)
Arellano-Bond Test, order 2				no	no
(Prob > Z). (Consistency test)				autocorrelation	autocorrelation
				48.27	35.73
Wald chi ² , (Prob > chi ²)				(0.000)***	(0.000)***

legend: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Fit*: selected as a robust model

The discussion of the fourth model is the influence of multidimensional IC on company performance (ROE) with the following 10 regression equation models:

$$ROE_{it} = \varphi_0 + \gamma_0 ROE_{it-1} + \beta_1 CEE_{it} + \beta_2 HCE_{it} + \beta_3 SCE_{it} + \beta_4 RCE_{it} + \beta_5 InoCE_{it} + \eta_i + \eta_t + \mu_{it} \quad (10)$$

Based on the measurement of profitability performance using Return on Equity (ROE_{it}) and the FDGMM equation model, it showed consistent results with the Third and Second models when measuring company performance using ROI_{it} and ROA_{it} . In this case, the IC_{it} variables that influenced ROE_{it} were consistent, namely SCE_{it} and $InoCE_{it}$, each having a regression coefficient of 0.00129 ($p < 0.017$) and -0.0000847 ($p < 0.05$). In this case, it explained that managerial innovation led to the utilization of organizational capacity, information systems, managerial, administrative, and general information databases in creating company added value (SCE_{it}), which positively and significantly affected the company's ROE_{it} performance.

Innovation Capital Efficiency ($InoCE_{it}$)—measured as sales relative to R&D expenditure—reflects managerial capability in driving commercial innovation. Model diagnostic comparisons (CEM, FEM, FDGMM, and SysGMM) reveal that Structural Capital Efficiency (SCE) and InoCE exert a consistent effect across all profitability metrics (ROA_{it} , ROI_{it} , and ROE_{it}). By resolving the inconsistencies of prior studies relying on static panel estimators (CEM and FEM), the dynamic GMM framework (FDGMM and SysGMM) establishes the robust empirical influence of SCE_{it} and $InoCE_{it}$ on profitability in the Indonesian

banking sector. Detailed results of the multidimensional IC influence on profitability can be seen in the FDGMM model in Table 7.

Table 7: Structure IIc

Variable	Coeff.	Model 17 (CEM)	Model 18 (FEM)	Model 19 (FDGMM)	model 20 (SYSGMM)
		y _{1,3} : ROE _{it}	y _{1,3} : ROE _{it}	y _{1,3} : ROE _{it} (Fit)*	y _{1,3} : ROE _{it}
Y _{1,3} : ROEL1. (specific effect unobsurb)	$\gamma_{0L1,y}$ ROE _{1,3}	0.1912099 (0.000)*** -1.145642	0.0565346 (0.218) -1.270684	0.1220364 (0.000)*** -2.045393	0.1246188 (0.000)***
X _{1,1} : CEE _{it}	β_1	(0.000)*** -0.0008285	(0.000)*** -0.0008639	(0.308) 0.0022442	-1.860722 (0.361)
X _{1,2} : HCE _{it}	β_2	(0.782) 0.0026204	(0.785) 0.0024096	(0.861) 0.001292	0.0006984 (0.958) 0.0013721
X _{1,3} : SCE _{it}	β_3	(0.005)*** -0.0000173	(0.009)*** -0.0000349	(0.017)** -0.0000723	(0.013)** -0.0000498
X _{1,4} : RCE _{it}	β_4	(0.466) -0.00000196	(0.227) -0.0000447	(0.101) -0.0000847	(0.224) -0.0000919
X _{1,5} : InoCE _{it}	β_5	(0.933) 80.99597	(0.074)* 104.0037	(0.059)* 114.7648	(0.067)* 112.5978
Constant (φ_0)	φ_0	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Adj R ² -square		0.1575 (0.000)***	0.1799 (0.000)***	37.45106	
Instrument Validity-Sargan- test				(0.0870) valid	51.25365 (0.0291) not valid
Arellano-Bond Test, order 2 (Prob >Z). (Consistency test)				0.86606 (0.3865) no autocorrelation	1.0411 (0.2978) no autocorrelation
Wald chi ² , (Prob > chi ²)				66.74 (0.000)***	61.01 (0.000)***

legend: * p<0.05; ** p<0.01; *** p<0.001

Fit*: the robust model

Based on the structured equation model stage I, a path analysis equation model stage II can be formed for variables that indirectly affect DER as follows:

$$\begin{aligned}
 DER_{it} &= \alpha + \beta' SCE_t + \beta' InoCE_t + e_{it} \\
 \beta' &= \beta_3 SCE_t * \beta_8 ROE_t \\
 \beta' &= \beta_5 InoCE_t * \beta_8 ROE_t
 \end{aligned}
 \tag{11}$$

GMM path analysis evaluates the direct and indirect impacts of multidimensional intellectual capital on financing decisions (DER_{it} , DAR_{it}) through bank performance (ROA_{it} , ROI_{it} , ROE_{it}). Estimation results confirm that SCE positively affects—while InoCE negatively affects—ROA ($\beta_{it} = 0.00028$, $p = 0.005$; $\beta_{it} = -0.000024$, $p = 0.020$), ROI ($\beta_{it} = 0.00027$, $p = 0.007$) ($\beta_{it} = -0.000026$, $p = 0.019$), and ROE ($\beta_{it} = 0.00113$, $p = 0.017$; $\beta_{it} = -0.00085$, $p = 0.059$). Crucially, among all performance metrics, only ROE directly drives leverage (DER) ($\beta_{it} = 17.488$, $p < 0.001$). This underscores equity-based profitability as the primary criterion for creditors and management when balancing WACC within optimal capital structure theory DER (Miller, 1958; Miller, 1963; MYERS, 1984; Liu and Wong, 2011).

Direct path analysis demonstrates that Relational Capital Efficiency ($\beta_{it} = -0.004$, $p < 0.001$) and Innovation Capital Efficiency ($\beta_{it} = 0.00172$, $p = 0.001$) directly drive debt-to-equity choices (DER_{it}), supporting (Kim, Kim, and Lee, 2011). Among performance metrics, only ROE_{it} significantly impacts DER_{it} , while ROA_{it} and ROI_{it} show no significant effect. This reflects the banking sector's financial intermediary function, where public deposit mobilization and credit allocation rely heavily on equity-based profitability. Thus, optimizing ROE_{it} is paramount for Indonesian banks when designing capital structure strategies to achieve an optimal DER_{it} (Adair and Adaskou, 2015; Miller, 1958; Miller, 1963; MYERS, 1984. The detailed research results can be seen in Table 8.

ROE_{it} reflects managerial efficiency in generating net profits from equity, attracting customer deposits and positively influencing leverage choices (DER_{it}). Path analysis confirms that ROE_{it} partially mediates the indirect impacts of Structural Capital Efficiency (SCE_{it} ; indirect $\beta_{it} = 0.0225$, $p < 0.001$) and Innovation Capital Efficiency ($InoCE_{it}$; indirect $\beta_{it} = -0.00148$, $p < 0.001$) on DER_{it} . While SCE_{it} captures value-adding organizational infrastructure, processes, and systems (Pulic, 2000; Jamal and Irene, 2007), InoCE represents R&D-driven commercial capabilities that together shape bank profitability and funding decisions (Riahi-Belkaoui, 2003; Alipour, 2012; Liu and Wong, 2011). Details can be seen in Table 8. Results of the structural path analysis IIIa.

$$\begin{aligned}
 DAR_{it} &= \alpha + \beta' SCE_{it} + \beta' InoCE_{it} + e_{it} & (12) \\
 \beta' &= \beta_3 SCE_{it} * \beta_6 ROA_{it} \\
 \beta' &= \beta_5 InoCE_{it} * \beta_6 ROA_{it} \\
 \beta' &= \beta_3 SCE_{it} * \beta_7 ROI_{it}
 \end{aligned}$$

Using a dynamic GMM approach, Structural Capital Efficiency (SCE_{it}) and Innovation Capital Efficiency ($InoCE_{it}$) consistently determine Indonesian bank performance across all metrics (ROA_{it} , ROI_{it} , ROE_{it}). This robust outcome resolves widespread empirical inconsistencies and theoretical criticisms surrounding Pulic (2000) conventional VAIC model in emerging markets (e.g., Iazzolino and Laise, 2013; Smriti and Das, 2018; Hoang, Thi Hai, Ngan Hoang, Quach and Hong, 2020; Jamal and Irene, 2007; Bhattacharjee and Akter, 2022). Regarding asset leverage (DAR_{it}), $InoCE_{it}$ exerts a direct effect, whereas SCE_{it} shows no direct impact. Path analysis further reveals that ROI_{it} ($\beta_{it} = -2.870$, $p = 0.005$) and ROE_{it} ($\beta_{it} = 0.324$, $p < 0.001$) significantly affect DAR_{it} , while ROA_{it} remains non-significant.

Consequently, ROA_{it} does not mediator. Conversely, ROI_{it} and ROE_{it} fully mediate the SCE_{it} - DAR_{it} relationship and partially mediate the $InoCE_{it}$ - DAR_{it} . This condition was in line with research (Kim, Kim, and Lee, 2011; Bhattacharjee and Akter, 2022; Soewarno and Tjahjadi, 2020; Liu and Wong, 2011). The detailed research results are shown in Table 9.

Table 8. Structural path analysis IIIa

Indirect effect	direct effect of IC: $X_{1,1}:CEE_{it}$, $X_{1,2}:HCE_{it}$, $X_{1,3}:SCE_{it}$, $X_{1,4}:RCE_{it}$, $X_{1,5}:InoCE_{it}$ on Profitability ($y_{1,1}:ROA_{it}$, $y_{1,2}:ROI_{it}$, $y_{1,3}:ROE_{it}$)	direct effect Profitability ($y_{1,1}:ROA_{it}$, $y_{1,2}:ROI_{it}$, $y_{1,3}:ROE_{it}$) on $y_{2,1}:DER_{it}$ [FDGMM]	Direct effect of IC: $X_{1,1}:CEE_{it}$, $X_{1,2}:HCE_{it}$, $X_{1,3}:SCE_{it}$, $X_{1,4}:RCE_{it}$, $X_{1,5}:InoCE_{it}$ on $y_{2,1}:DER_{it}$	Indirect effect	Description
$X_{1,1} \rightarrow y_{1,1} \rightarrow Y_{2,1}$	$X_{1,1} \rightarrow y_{1,1} = -0.1100843$ (0,758)	$y_{1,1} \rightarrow y_{2,1} = -45.37788$ (0.365)	$X_{1,1} \rightarrow y_{2,1} = 15.68194$ (0.276)	7.98650688	Not mediating
$X_{1,2} \rightarrow y_{1,1} \rightarrow Y_{2,1}$	$X_{1,2} \rightarrow y_{1,1} = 0.0003292$ (0,896)	$y_{1,1} \rightarrow y_{2,1} = -45.37788$ (0.365)	$X_{1,2} \rightarrow y_{2,1} = -0.0264728$ (0.803)	-0.031764516	Not mediating
$X_{1,3} \rightarrow y_{1,1} \rightarrow Y_{2,1}$	$X_{1,3} \rightarrow y_{1,1} = \mathbf{0.0002788}$ (0,005)	$y_{1,1} \rightarrow y_{2,1} = -45.37788$ (0.365)	$X_{1,3} \rightarrow y_{2,1} = 0.0054667$ (0,472)	-0.011798249	Not mediating
$X_{1,4} \rightarrow y_{1,1} \rightarrow Y_{2,1}$	$X_{1,4} \rightarrow y_{1,1} = -0.0000122$ (107)	$y_{1,1} \rightarrow y_{2,1} = -45.37788$ (0.365)	$X_{1,4} \rightarrow y_{2,1} = \mathbf{-0.0039728}$ (0,000)***	0.000589912	Not mediating
$X_{1,5} \rightarrow y_{1,1} \rightarrow Y_{2,1}$	$X_{1,5} \rightarrow y_{1,1} = \mathbf{-0.0000241}$ (0,020)**	$y_{1,1} \rightarrow y_{2,1} = -45.37788$ (0.365)	$X_{1,5} \rightarrow y_{2,1} = \mathbf{0.001724}$ (0,001)***	0.001070918	Not mediating
$X_{1,1} \rightarrow y_{1,2} \rightarrow Y_{2,1}$	$X_{1,1} \rightarrow y_{1,2} = -0.0959$ (0.827)	$y_{1,2} \rightarrow y_{2,1} = -30.76292$ (0.467)	$X_{1,1} \rightarrow y_{2,1} = 15.68194$ (0.276)	2.950164028	Not mediating
$X_{1,2} \rightarrow y_{1,2} \rightarrow Y_{2,1}$	$X_{1,2} \rightarrow y_{1,2} = 0.00008$ (0.977)	$y_{1,2} \rightarrow y_{2,1} = -30.76292$ (0.467)	$X_{1,2} \rightarrow y_{2,1} = -0.0264728$ (0.803)	-0.002461034	Not mediating
$X_{1,3} \rightarrow y_{1,2} \rightarrow Y_{2,1}$	$X_{1,3} \rightarrow y_{1,2} = \mathbf{0.00027}$ (0,007)***	$y_{1,2} \rightarrow y_{2,1} = -30.76292$ (0.467)	$X_{1,3} \rightarrow y_{2,1} = 0.0054667$ (0,472)	-0.008305988	Not mediating
$X_{1,4} \rightarrow y_{1,2} \rightarrow Y_{2,1}$	$X_{1,4} \rightarrow y_{1,2} = -0.0000136$ (0.114)	$y_{1,2} \rightarrow y_{2,1} = -30.76292$ (0.467)	$X_{1,4} \rightarrow y_{2,1} = \mathbf{-0.0039728}$ (0,000)***	0.000418376	Not mediating
$X_{1,5} \rightarrow y_{1,2} \rightarrow Y_{2,1}$	$X_{1,5} \rightarrow y_{1,2} = \mathbf{-0.000026}$ (0,019)**	$y_{1,2} \rightarrow y_{2,1} = -30.76292$ (0.467)	$X_{1,5} \rightarrow y_{2,1} = \mathbf{0.001724}$ (0,001)***	0.000799836	Not mediating
$X_{1,1} \rightarrow y_{1,3} \rightarrow Y_{2,1}$	$X_{1,1} \rightarrow y_{1,3} = -2.045393$ (0.308)	$y_{1,3} \rightarrow y_{2,1} = \mathbf{17.48775}$ (0,000)***	$X_{1,1} \rightarrow y_{2,1} = 15.68194$ (0.276)	-35.76932144	Not mediating
$X_{1,2} \rightarrow y_{1,3} \rightarrow Y_{2,1}$	$X_{1,2} \rightarrow y_{1,3} = 0.0022442$ (0.861)	$y_{1,3} \rightarrow y_{2,1} = \mathbf{17.48775}$ (0,000)***	$X_{1,2} \rightarrow y_{2,1} = -0.0264728$ (0.803)	0.039246009	Not mediating
$X_{1,3} \rightarrow y_{1,3} \rightarrow Y_{2,1}$	$X_{1,3} \rightarrow y_{1,3} = \mathbf{0.00129}$ (0,017)**	$y_{1,3} \rightarrow y_{2,1} = \mathbf{17.48775}$ (0,000)***	$X_{1,3} \rightarrow y_{2,1} = 0.0054667$ (0,472)	$\mathbf{0.022559198}$ ***	S + (fully mediating)
$X_{1,4} \rightarrow y_{1,3} \rightarrow Y_{2,1}$	$X_{1,4} \rightarrow y_{1,3} = -0.0000723$ (0.101)	$y_{1,3} \rightarrow y_{2,1} = \mathbf{17.48775}$ (0,000)***	$X_{1,4} \rightarrow y_{2,1} = \mathbf{-0.0039728}$ (0,000)***	-0.001264364	Not mediating
$X_{1,5} \rightarrow y_{1,3} \rightarrow Y_{2,1}$	$X_{1,5} \rightarrow y_{1,3} = \mathbf{-0.0000847}$ (0,059)*	$y_{1,3} \rightarrow y_{2,1} = \mathbf{17.48775}$ (0,000)***	$X_{1,5} \rightarrow y_{2,1} = \mathbf{0.001724}$ (0,001)***	$\mathbf{-0.001481212}$ ***	S - (partial mediating)

*, **, and *** Indicate the level of significance of bold values at 0.10, 0.05, and 0.01, respectively

Table 9. Path analysis of structure IIIb

Indirect effect	direct effect of IC: $X_{1,1}:CEE_{it}$, $X_{1,2}:HCE_{it}$, $X_{1,3}:SCE_{it}$, $X_{1,4}:RCE_{it}$, $X_{1,5}:InoCE_{it}$ on Profitability ($y_{1,1}:ROA_{it}$, $y_{1,2}:ROI_{it}$, $y_{1,3}:ROE_{it}$)	direct effect Profitability ($y_{1,1}:ROA_{it}$, $y_{1,2}:ROI_{it}$, $y_{1,3}:ROE_{it}$) on $y_{2,2}:DAR_{it}$	Direct effect of IC: $X_{1,1}:CEE_{it}$, $X_{1,2}:HCE_{it}$, $X_{1,3}:SCE_{it}$, $X_{1,4}:RCE_{it}$, $X_{1,5}:InoCE_{it}$ on $y_{2,2}:DAR_{it}$	Indirect effect	Description
$X_{1,1} \rightarrow y_{1,1} \rightarrow Y_{2,2}$	$X_{1,1} \rightarrow y_{1,1} = -0.1100843$ (0,758)	$y_{1,1} \rightarrow y_{2,2} = 0.2001441$ (0.908)	$X_{1,1} \rightarrow y_{2,2} = \mathbf{-1.541951}$ (0,008)***	-0.03529	Not mediating
$X_{1,2} \rightarrow y_{1,1} \rightarrow Y_{2,2}$	$X_{1,2} \rightarrow y_{1,1} = 0.0003292$ (0,896)	$y_{1,1} \rightarrow y_{2,2} = 0.2001441$ (0.908)	$X_{1,2} \rightarrow y_{2,2} = \mathbf{0.0162295}$ (0,008)***	0.000149	Not mediating
$X_{1,3} \rightarrow y_{1,1} \rightarrow Y_{2,2}$	$X_{1,3} \rightarrow y_{1,1} = \mathbf{0.0002788}$ (0,005)***	$y_{1,1} \rightarrow y_{2,2} = 0.2001441$ (0.908)	$X_{1,3} \rightarrow y_{2,2} = 0.0007376$ (0,216)	0.000052	Not mediating
$X_{1,4} \rightarrow y_{1,1} \rightarrow Y_{2,2}$	$X_{1,4} \rightarrow y_{1,1} = -0.0000122$ (107)	$y_{1,1} \rightarrow y_{2,2} = 0.2001441$ (0.908)	$X_{1,4} \rightarrow y_{2,2} = \mathbf{-0.0002079}$ (0,000)***	-0.000003	Not mediating
$X_{1,5} \rightarrow y_{1,1} \rightarrow Y_{2,2}$	$X_{1,5} \rightarrow y_{1,1} = \mathbf{-0.0000241}$ (0,020)**	$y_{1,1} \rightarrow y_{2,2} = 0.2001441$ (0.908)	$X_{1,5} \rightarrow y_{2,2} = \mathbf{0.0001068}$ (0,001)***	-0.000005	Not mediating
$X_{1,1} \rightarrow y_{1,2} \rightarrow Y_{2,2}$	$X_{1,1} \rightarrow y_{1,2} = -0.0959$ (0.827)	$y_{1,2} \rightarrow y_{2,2} = \mathbf{-2.870891}$ (0,005)***	$X_{1,1} \rightarrow y_{2,2} = \mathbf{-1.541951}$ (0,008)***	275318.447	Not mediating
$X_{1,2} \rightarrow y_{1,2} \rightarrow Y_{2,2}$	$X_{1,2} \rightarrow y_{1,2} = 0.00008$ (0.977)	$y_{1,2} \rightarrow y_{2,2} = \mathbf{-2.870891}$ (0,005)***	$X_{1,2} \rightarrow y_{2,2} = \mathbf{0.0162295}$ (0,008)***	-229.67128	Not mediating
$X_{1,3} \rightarrow y_{1,2} \rightarrow Y_{2,2}$	$X_{1,3} \rightarrow y_{1,2} = \mathbf{0.00027}$ (0,007)***	$y_{1,2} \rightarrow y_{2,2} = \mathbf{-2.870891}$ (0,005)***	$X_{1,3} \rightarrow y_{2,2} = 0.0007376$ (0,216)	$\mathbf{-775.14057}$	S-(Fully mediating)
$X_{1,4} \rightarrow y_{1,2} \rightarrow Y_{2,2}$	$X_{1,4} \rightarrow y_{1,2} = -0.0000136$ (0.114)	$y_{1,2} \rightarrow y_{2,2} = \mathbf{-2.870891}$ (0,005)***	$X_{1,4} \rightarrow y_{2,2} = \mathbf{-0.0002079}$ (0,000)***	39.0441176	Not mediating
$X_{1,5} \rightarrow y_{1,2} \rightarrow Y_{2,2}$	$X_{1,5} \rightarrow y_{1,2} = \mathbf{-0.000026}$ (0,019)**	$y_{1,2} \rightarrow y_{2,2} = \mathbf{-2.870891}$ (0,005)***	$X_{1,5} \rightarrow y_{2,2} = \mathbf{0.0001068}$ (0,001)***	$\mathbf{74.643166}$	S+(partial mediating)
$X_{1,1} \rightarrow y_{1,3} \rightarrow Y_{2,2}$	$X_{1,1} \rightarrow y_{1,3} = -0.045393$ (0.308)	$y_{1,3} \rightarrow y_{2,2} = \mathbf{0.323797}$ (0,000)***	$X_{1,1} \rightarrow y_{2,2} = \mathbf{-1.541951}$ (0,008)***	-0.01469811	Not mediating
$X_{1,2} \rightarrow y_{1,3} \rightarrow Y_{2,2}$	$X_{1,2} \rightarrow y_{1,3} = 0.0022442$ (0.861)	$y_{1,3} \rightarrow y_{2,2} = \mathbf{0.323797}$ (0,000)***	$X_{1,2} \rightarrow y_{2,2} = \mathbf{0.0162295}$ (0,008)***	0.00072666	Not mediating
$X_{1,3} \rightarrow y_{1,3} \rightarrow Y_{2,2}$	$X_{1,3} \rightarrow y_{1,3} = \mathbf{0.00129}$ (0,017)**	$y_{1,3} \rightarrow y_{2,2} = \mathbf{0.323797}$ (0,000)***	$X_{1,3} \rightarrow y_{2,2} = 0.0007376$ (0,216)	$\mathbf{0.0004176}$ ***	S+(fully mediating)
$X_{1,4} \rightarrow y_{1,3} \rightarrow Y_{2,2}$	$X_{1,4} \rightarrow y_{1,3} = -0.0000723$ (0.101)	$y_{1,3} \rightarrow y_{2,2} = \mathbf{0.323797}$ (0,000)***	$X_{1,4} \rightarrow y_{2,2} = \mathbf{-0.0002079}$ (0,000)***	-0.00002341	Not mediating
$X_{1,5} \rightarrow y_{1,3} \rightarrow Y_{2,2}$	$X_{1,5} \rightarrow y_{1,3} = \mathbf{-0.0000847}$ (0,059)*	$y_{1,3} \rightarrow y_{2,2} = \mathbf{0.323797}$ (0,000)***	$X_{1,5} \rightarrow y_{2,2} = \mathbf{0.0001068}$ (0,001)***	$\mathbf{-0.0000274}$ ***	S-(partial mediating)

*, **, and *** Indicate the level of significance of bold values at 0.10, 0.05, and 0.01, respectively.

Overall, the empirical findings were aligned with the objective of this study, which was to examine the effect of multidimensional intellectual capital on financing decisions through firm performance. The results showed that SCE and InoCE were important determinants of firm performance, while ROE, ROI, and RCE explained financing decisions. These findings supported the intellectual capital theory, pecking order theory, and optimum capital structure theory by showing that knowledge-based resources, profitability, and relational capability jointly influenced financing behaviour in Indonesian banks (Pulic, 2000; Myers, 1984; Modigliani and Miller, 1963).

5. CONCLUSION

By examining the relationship between the $VAIC_{it}$ component and the DAR_{it} funding policy through the financial performance of ROA_{it} , ROI_{it} , and ROE_{it} , using the GMM model approach for banking conditions in Indonesia, a robust analytical model could be produced and the basis for formulating the following conclusions: When funding policy was analyzed based on the Debt to Equity Ratio (DER_{it}), information on banking ROE_{it} performance became a consideration for investors and creditors, including management, in determining funding policies that considered the optimum point of the weighted average cost of debt and equity capital (DER_{it}). This research finding supported the existence of the optimal capital structure theory of DER_{it} (Kayo and Kimura, 2011; Kim, Kim, and Lee, 2011; Miller, 1958; Miller, 1963; Vo, Truong, and Huynh, 2022).

The results were also consistent with the intellectual capital theory, which explains that value is created through the effective use of knowledge-based resources, internal systems, innovation capability, and relational capital (Pulic, 2000; 2004; Edvinsson, 1997; Sveiby, 1997). In addition, the mediating role of firm performance supported the pecking order theory, as profitability becomes an important consideration before banks adjust their external financing structure (Myers, 1984; Adair and Adaskou, 2015).

In this case, ROE_{it} had the meaning of the Company's managerial ability to manage its own capital to generate net profit after tax, could fully mediate the relationship between SCE_{it} and DER_{it} , and partially mediate the relationship between $InoCE_{it}$ and DER_{it} funding policy. The findings showed that SCE and InoCE were important intellectual capital components that influenced firm performance, while ROE and ROI played an important role in linking intellectual capital to financing decisions. Specifically, ROE explained financing decisions measured by DER, while ROI and ROE explained financing decisions measured by DAR. These findings indicated that firm performance served as an important mediating mechanism between multidimensional intellectual capital and financing decisions.

Important information: When funding policy used the DAR_{it} measurement, which reflected the proportion of third-party funds plus long-term debt and other debt to the company's total assets, the performance of banking operating profit relative to assets (ROI_{it}) was fully mediated by the performance of banking operating profit compared to assets (ROI_{it}). This was indirectly influenced by SCE_{it} (VA-HC). This represented managerial capability in managing the efficiency of organizational structures, information systems, appropriate database management, and corporate governance, which can support operational performance achievement, ultimately influencing DAR_{it} funding policy through ROI_{it} .

On the other hand, the financial performance of banking operating profit (ROI_{it}) partially mediated the relationship between $InoCE_{it}$ and DAR_{it} funding policy. This condition represented the consideration of funding policy by considering the extent of banking management's ability to produce innovative banking product services, based on research and development programs to create economic added value that can increase operating profit (ROI_{it}).

This study aimed to examine the effect of multidimensional intellectual capital on financing decisions through firm performance in the Indonesian banking industry. Consistent with the title and research objective, the analysis focused on five components of multidimensional intellectual capital, namely CEE, HCE, SCE, RCE, and InoCE; three firm performance indicators, namely ROA, ROI, and ROE; and two financing decision indicators, namely DER and DAR.

The research implications for academics can robustly show the relationship between multi-dimensional IC and company performance using ROA_{it} . For practitioners and policymakers in Indonesia, multi-dimensional IC information is important as a basis for assessing the performance of banking companies in relation to leverage funding policies.

Research limitations: The development of multidimensional aspects of intellectual capital is still limited to $InoCE_{it}$ and RCE_{it} . Suggestions for future research include exploring other intellectual capital variables related to green intellectual capital sustainability.

Suggestions for future research: The scope of this research was limited to the banking industry in Indonesia. To increase the generalizability of the model, it is recommended that it be extended to several countries and can be extended to include the characteristics of non-banking industries. Nevertheless, future studies may replicate this model in other countries, particularly ASEAN and other emerging economies, to enhance external validity. Cross-country and cross-industry comparisons would further validate the applicability of the multidimensional intellectual capital model across different institutional, regulatory, and financial settings.

6. CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

7. REFERENCES

- Adair, P. and Adaskou, M. (2015). Trade-off theory vs. Pecking order theory and the determinants of corporate leverage: Evidence from a panel data analysis upon French SMEs (2002–2010). *Cogent Economics and Finance*, 3(1), pp. 1–12. <https://doi.org/10.1080/23322039.2015.1006477>.
- Aggarwal, D. and Padhan, P.C. (2017). Impact of Capital Structure on Firm Value: Evidence from Indian Hospitality Industry. *Theoretical Economics Letters*, 07(04), pp. 982–1000. <https://doi.org/10.4236/tel.2017.74067>.
- Alipour, M. (2012). The effect of intellectual capital on firm performance: An investigation of Iranian insurance companies. *Measuring Business Excellence*, 16(1), pp. 53–66. <https://doi.org/10.1108/13683041211204671>.
- Anderson, H., Prezas, P. and Anderson, M.H. (1998). The Interaction Financing of Investment Under and Decisions Moral. *International Review of Economics & Finance*, 7(4), pp. 379–392.
- Arelano, M. and Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 68(August 1990), pp. 29–51.
- Awais, M. et al. (2016). Impact of Capital Structure on the Firm Performance: Comprehensive Study of Karachi Stock Exchange. *Science International*, 28(1), pp. 501–507.
- Bakhsha, A., Afrazeh, A. and Esfahanipour, A. (2017). A Criticism on Value Added Intellectual Coefficient (VAIC) Model. *IJCSNS International Journal of Computer Science and Network Security*, 17(6), p. 59.
- Bayraktaroglu, A.E., Calisir, F. and Baskak, M. (2019). Intellectual capital and firm performance: an extended VAIC model. *Journal of Intellectual Capital*, 20(3), pp. 406–425. <https://doi.org/10.1108/JIC-12-2017-0184>.
- Bhattacharjee, S. and Akter, R. (2022). Intellectual capital efficiency and firm performance: Evidence from an emerging knowledge-economy. *International Journal of Learning and Intellectual Capital*, 19(1), pp. 30–52. <https://doi.org/10.1504/IJLIC.2022.119284>.
- Bond, S.R., Hoeffler, A., & Temple, J. (2001). GMM Estimation of Empirical Growth Models. *Fiscal Studies*, November(3048), pp. 1–33. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=290522
- Cardorel, O.C., Appiah, B.K. and Majumder, S.C. (2021). Determinants of market to book value and financial performance of Chinese listed firms: implication of MVAIC model. *International Journal of Learning and Intellectual Capital*, 1(1), p. 1. <https://doi.org/10.1504/ijlic.2021.10034909>.

- Chen, M.C., Cheng, S.J. and Hwang, Y. (2005). An empirical investigation of the relationship between intellectual capital and firms' market value and financial performance. *Journal of Intellectual Capital*, 6(2), pp. 159–176. <https://doi.org/10.1108/14691930510592771>.
- Chen, Y. and Chou, R.K. (2015). *The Effect of EPS on Capital Structure*, *Journal of National Chengchi University*. National Chengchi University.
- Chowdhury, L.A.M., Rana, T. and Azim, M.I. (2019). Intellectual capital efficiency and organisational performance: In the context of the pharmaceutical industry in Bangladesh. *Journal of Intellectual Capital*, 20(6), pp. 784–806. <https://doi.org/10.1108/JIC-10-2018-0171>.
- Ebrahim, M.S. et al. (2014). Dynamic capital structure and political patronage: The case of Malaysia. *International Review of Financial Analysis*, 31, pp. 117–128. <https://doi.org/10.1016/j.irfa.2013.11.004>.
- Edvinsson, L. (1997). Developing intellectual capital at Skandia. *Long Range Planning*, 30(3), pp. 366–373. [https://doi.org/10.1016/s0024-6301\(97\)90248-x](https://doi.org/10.1016/s0024-6301(97)90248-x).
- Edvinsson, L. et al. (2022). From a value-based knowledge economy to a worth economy. New reflections and perspectives on intellectual capital research. *International Journal of Learning and Intellectual Capital*, 19(1), pp. 83–101. <https://doi.org/10.1504/IJLIC.2022.119282>.
- Gebisa, D. (2023). The Impact of Information Sharing and Inventory Management Practices on Firms' Performance in Supply Chain Practices. *Gadjah Mada International Journal of Business*, 25(2), pp. 199–225. <https://doi.org/10.22146/gamaijb.69616>.
- Halid, S., Mahmud, R., Zakaria, N. B., & Rahman, R. A. (2021). Does board monitoring affect integrated reporting disclosure for better transparency and sustainability. *Universal Journal of Accounting and Finance*, 9(5), pp. 1049–1057. doi.org/10.13189/ujaf.2021.090515
- Haque, S.M.I. and Weqar, F. (2021). The influence of intellectual capital on the Indian firms' financial performance. *International Journal of Learning and Intellectual Capital*, 19(2), pp. 169–188. <https://doi.org/10.1504/ijlic.2021.10039514>.
- Harmono, H. et al. (2023b). Financial Performance and Ownership Structure: Influence on Firm Value Through Leverage', in W.A. Barnett and B.S. Sergi (eds) *Macroeconomic Risk and Growth in the Southeast Asian Countries: Insight from SEA*. Emerald Publishing Limited (International Symposia in Economic Theory and Econometrics). pp. 63–85. <https://doi.org/10.1108/S1571-03862023000033B005>.
- Harmono, Harmono, and Insyiroh, I. (2024). Information content disclosure of VAIC : influence on firm value through firm performance and leverage. *International Journal of Learning and Intellectual Capital*, 21(4). pp. 407–430. <https://doi.org/10.1504/IJLIC.2024.142382>.
- Hirdinis, M. (2019). Capital structure and firm size on firm value moderated by profitability. *International Journal of Economics and Business Administration*, 7(1), pp. 174–191. <https://doi.org/10.35808/ijeba/204>.
- Hoang, H.T. et al. (2020). Intellectual capital and firm performance in Vietnam 2012–2016. *International Journal of Learning and Intellectual Capital*, 17(1), pp. 27–46. <https://doi.org/10.1504/IJLIC.2020.105325>.
- Iazzolino, G. and Laise, D. (2013). Value added intellectual coefficient (VAIC): A methodological and critical review. *Journal of Intellectual Capital*, 14(4), pp. 547–563. <https://doi.org/10.1108/JIC-12-2012-0107>.
- Iazzolino, G., Laise, D. and Migliano, G. (2014). Measuring value creation: VAIC and EVA. *Measuring Business Excellence*, 18(1), pp. 8–21. <https://doi.org/10.1108/MBE-10-2013-0052>.
- Jamal, A.N. and Irene, M.H. (2007). Extended VAIC model: measuring intellectual capital components. *Journal of Intellectual Capital*, 8(4), pp. 595–609. <http://search.ebscohost.com/login.aspx?direct=true&db=lih&AN=27312425&lang=pt-br&site=ehost-live>.
- Kayo, E.K. and Kimura, H. (2011). Hierarchical determinants of capital structure. *Journal of Banking and Finance*, 35(2), pp. 358–371. <https://doi.org/10.1016/j.jbankfin.2010.08.015>.
- Kim, J., Kim, S. and Lee, H. (2011). An effect of technology innovation activity on firm value and a mediation effect of leverage: Evidence from Korean firms. *Asian Journal of Technology Innovation*, 19(1), pp. 37–51. <https://doi.org/10.1080/19761597.2011.578430>.
- Kweh, Q.L., Ting, I.W.K., Hanh, L.T.M. and Zhang, C. (2019). Intellectual capital, governmental presence, and firm

- performance of publicly listed companies in Malaysia. *International Journal of Learning and Intellectual Capital*, 16(2), pp. 193–211. <https://doi.org/10.1504/IJLIC.2019.098944>.
- Li-Ju Chen, S.-Y.C. (2011). Imfi_2011_8_3_13 (1). *Investment Management and Financial Innovations*, 8(3), pp. 121–129.
- Liow, K.H. (2010). Firm value, growth, profitability and capital structure of listed real estate companies: An international perspective. *Journal of Property Research*, 27(2), pp. 119–146. <https://doi.org/10.1080/09599916.2010.500459>.
- Liu, Q. and Wong, K.P. (2011). Intellectual capital and financing decisions: Evidence from the U.S. patent data. *Management Science*, 57(10), pp. 1861–1878. <https://doi.org/10.1287/mnsc.1110.1380>.
- Maditinos, D. et al. (2011). The impact of intellectual capital on firms' market value and financial performance. *Journal of Intellectual Capital*, 12(1), pp. 132–151. <https://doi.org/10.1108/1469193111097944>.
- Maji, S.G. and Goswami, M. (2020). Is the influence of intellectual capital on firm performance homogeneous? Evidence from India employing a quantile regression model. *International Journal of Learning and Intellectual Capital*, 17(2), pp. 187–211. <https://doi.org/10.1504/ijlic.2020.108897>.
- Mazur, K. (2007). The determinants of capital structure choice: Evidence from Polish companies. *International Advances in Economic Research*, 13(4), pp. 495–514. <https://doi.org/10.1007/s11294-007-9114-y>.
- Michael and Meckling, C.J. and W.H. (1976). Theory of the Firm: Managerial Behaviour, Agency Costs and Ownership Structure. *Human Relations*, 3, pp. 305–360.
- Miller, F.M. and M.H (1963). Corporate Income Taxes and the Cost of Capital: A Correction Author (s): Franco Modigliani and Merton H. Miller. *The American Economic Review*, 53(3), pp. 433–443.
- Miller, F.M. and M.H. (1958). The Cost of Capital, Corporation Finance and the Theory of Investment. *American Economic Review*, XLVIII(June), pp. 261–297. <https://doi.org/10.1257/aer.91.1.i>.
- Modigliani F. and Miller M. (1963). Corporate income taxes and the cost of c. *The American Economic Review*, pp. 433–443.
- Musa, K., Janssen, M., Said, J., Zakaria, N. B., and Erum, N. (2025). The impact of public debt and quality of governance on economic growth in high-income countries. *Journal of the Knowledge Economy*, 16(1), pp. 2817–2843. <https://doi.org/10.1007/s13132-024-02073-x>
- Myers, S.C. (1977). Determinants of corporate borrowing. *Journal of Financial Economics*, 5(2), pp. 147–175. [https://doi.org/10.1016/0304-405X\(77\)90015-0](https://doi.org/10.1016/0304-405X(77)90015-0).
- Myers, S.C. (1984). The Capital Structure Puzzle. *The Journal of Finance*, 39(3), pp. 574–592. <https://doi.org/10.1111/j.1540-6261.1984.tb03646.x>.
- Ni, Y., Cheng, Y.R., and Huang, P. (2020). Do intellectual capitals matter to firm value enhancement? Evidence from Taiwan. *Journal of Intellectual Capital*, 22(4), pp. 725–743. <https://doi.org/10.1108/JIC-10-2019-0235>.
- Piekkola, H. (2020). Intangibles and innovation-labor-biased technical change. *Journal of Intellectual Capital*, 21(5), pp. 649–669. <https://doi.org/10.1108/JIC-10-2019-0241>.
- Pulic, A. (2000). VAIC™ – An Accounting Tool for Intellectual Capital Management. *International Journal of Technology Management*, 20(5/6/7/8), pp. 702–714. <https://www.inderscienceonline.com/doi/epdf/10.1504/IJTM.2000.002891>.
- Pulic, A. (2004). Intellectual capital – does it create or destroy value? *Measuring Business Excellence*, 8(1), pp. 62–68. <https://doi.org/10.1108/13683040410524757>.
- Pulić, A. (2008). The Principles of Intellectual Capital Efficiency - A Brief Description. *Croatian Intellectual Capital Center*, (76), pp. 1–24. <https://www.scinapse.io/papers/2371185822>.
- Rady, A.M. and Otake, T. (2026). The impact of intellectual capital efficiency on firm performance in the MENAT region: Does R&D intensity matter? *Journal of Financial Reporting and Accounting*, Vol. ahead-of-print No. ahead-of-print.
- Riahi-Belkaoui, A. (2003). Intellectual capital and firm performance of US multinational firms: A study of the resource-based and stakeholder views. *Journal of Intellectual Capital*, 4(2), pp. 215–226. <https://doi.org/10.1108/14691930310472839>.
- Rosita, Ghazali, I., Harto, P., Susanto, H. and Zainuddin, F. (2020). Intellectual capital and financial performance of state-owned banking: Evidence from Indonesia. *International Journal of Learning and Intellectual Capital*, 17(1), pp. 47–60. <https://doi.org/10.1504/IJLIC.2020.105322>.

- Salvi, A., Vitolla, F. and Raimo, N. (2020). Does intellectual capital disclosure affect the cost of equity capital? An empirical analysis in the integrated reporting context. *Journal of Intellectual Capital*, 21(6), pp. 985–1007. <https://doi.org/10.1108/JIC-12-2019-0283>.
- Smriti, N. and Das, N. (2018). The impact of intellectual capital on firm performance: a study of Indian firms listed in COSPI. *Journal of Intellectual Capital*, 19(5), pp. 935–964. <https://doi.org/10.1108/JIC-11-2017-0156>.
- Soewarno, N. and Tjahjadi, B. (2020). Measures that matter: an empirical investigation of intellectual capital and financial performance of banking firms in Indonesia. *Journal of Intellectual Capital*, 21(6), pp. 1085–1106. <https://doi.org/10.1108/JIC-09-2019-0225>.
- Sulanjaku, M. (2014). The Contribution of Skandia Navigator in Intangibles Measurements. *SSRN Electronic Journal*, II(11), pp. 1–10. <https://doi.org/10.2139/ssrn.2527891>.
- Sveiby, K.E. (1997). The Intangible Assets Monitor. *Journal of Human Resource Costing & Accounting*, 2(1), pp. 73–97.
- Sveiby, K.E. (2001). A knowledge-based theory of the firm to guide in strategy formulation. *Journal of Intellectual Capital*, 2(4), pp. 344–358. <https://doi.org/10.1108/14691930110409651>.
- Thomas, Kiptanui, T., Chenuos, N. and Biwott, G. (2014). Do Profitability, Firm Size and Liquidity Affect Capital Structure ? Evidence from Kenyan Listed Firms. *European Journal of Business and Management*, 6(28), pp. 119–124.
- Tripathy, T., Gil-Alana, L.A. and Sahoo, D. (2015). The effect of intellectual capital on firms' financial performance: An empirical investigation in India. *International Journal of Learning and Intellectual Capital*, 12(4), pp. 342–371. <https://doi.org/10.1504/IJLIC.2015.072197>.
- Vale, J.A.F.L.O., Vale, V.C.F.T. and Lopes, V.S.C. (2022). Intellectual capital efficiency and financial performance in the hotel sector. *International Journal of Learning and Intellectual Capital*, 19(1), pp. 53–71. <https://doi.org/10.1504/IJLIC.2022.119276>.
- Vo, A.H.K., Truong, T.T.T. and Huynh, K.D. (2022). The impact of COVID-19 on financing decisions of SMEs in Vietnam. *Asian Academy of Management Journal*, 27(2), pp. 163–187. <https://doi.org/10.21315/aamj2022.27.2.8>.
- Wahyudi, T., Mahsina, M. and Nawawi, M. (2026). Corporate governance and intellectual capital: its impact on Islamic banking performance in OIC countries. *Journal of Islamic Accounting and Business Research*, Vol. ahead-of-print No. ahead-of-print.
- Wang, Z. et al. (2021). Intellectual capital and firm performance: the mediating role of innovation speed and quality. *International Journal of Human Resource Management*, 32(6), pp. 1222–1250. <https://doi.org/10.1080/09585192.2018.1511611>.
- Wijayanti, R., Masron, T.A., Azizah, Z.N., Nurmasari, N.D. and Jawo, M. (2026). The evolving landscape of intellectual capital and sustainable finance practices and their role in enhancing dynamic financial performance. *SAM Advanced Management Journal*, 91(2), pp. 184–206.
- Xu, J. (2012). Profitability and capital structure: Evidence from import penetration. *Journal of Financial Economics*, 106(2), pp. 427–446. <https://doi.org/10.1016/j.jfineco.2012.05.015>.
- Zakaria, N. B. (2009). Dynamic and static corporate liquidity measurement: a case of Malaysian Small and Medium Enterprises. *International Journal of Management and Enterprise Development*, 6(4), pp. 479–493. <https://doi.org/10.1504/IJMED.2009.024237>.
- Zéghal, D. and Maaloul, A. (2010). Analysing value added as an indicator of intellectual capital and its consequences on company performance. *Journal of Intellectual Capital*, 11(1), pp. 39–60. <https://doi.org/10.1108/14691931011013325>.



© 2026 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY-NC-ND) license (<http://creativecommons.org/licenses/by/4.0/>).