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Intellectual Capital, Digital Transformation, and Firm Value: A Cross-Country Analysis of Indonesian and Malaysian Banks

Aldena Selavi[1], Bima Cinintya Pratama[2*], Suryo Budi Santoso[3], Ira Hapsari[4]

Faculty of Economics and Business/ Accounting, Universitas Muhammadiyah Purwokerto, Indonesia
[*]Corresponding Email: bimacinintyapratama@gmail.com

Abstract

This study aims to examine the effect of intellectual capital components human capital (HC), structural capital (SC), and physical capital (PC) on firm value (FV), with digital transformation (DT) serve as a moderating variable. The research population consists of banking companies listed on the Indonesia Stock Exchange and Bank Negara Malaysia during the periods 2020–2023. A total of 248 observations were obtained using purposive sampling. Employing panel data regression with Stata, the results show that SC have significant positive impact on FV, PC have significant negative impact on FV, whereas HC and DT demonstrate no direct effect. However, DT significantly moderates the relationship between SC and FV, highlighting its role in strengthening organizational structures to enhance firm value in the banking sector. The findings imply that banks should prioritize digital transformation strategies that optimize structural capital such as processes, systems, and knowledge management in order to maximize firm value. Moreover, regulators and policymakers are encouraged to foster digital readiness across the industry to ensure sustainable competitiveness in the era of digital banking

Keywords: Intellectual Capital, Human Capital, Structural Capital, Physical Capital, Digital Transformation, Firm Value.

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INTRODUCTION

Digital transformation has emerged as a critical driver of growth and competitiveness in the digital economy. Companies are required to strategically implement technology to enhance operational efficiency while creating sustainable value Hsiao (2024). Based on RBT, intellectual capital is viewed as an essential intangible resource in building long-term competitive advantage Zhang et al. (2025). Digital transformation, as a dynamic capability, enhances the utilization of intellectual capital, enabling it to be optimized for improving firm value Ellström et al. (2022).

The Global Digitalization Index (GDI), developed by Huawei and the International Data Corporation, provides a comprehensive overview of a country's digital maturity and its impact on the development of the digital economy transformation International Data Corporation (2024). The report assesses various digitalization indicators, including ubiquitous connectivity, digital infrastructure, green energy, and policy & ecosystem, which serve as key enablers in supporting digital transformation International Data Corporation (2024). Maghfiroh et al. (2024) found that investments in technology and the utilization of intellectual capital positively influence firm value in the banking sector. International Data Corporation on 2024 presents the digital readiness ranking of Asian countries in the following chart.

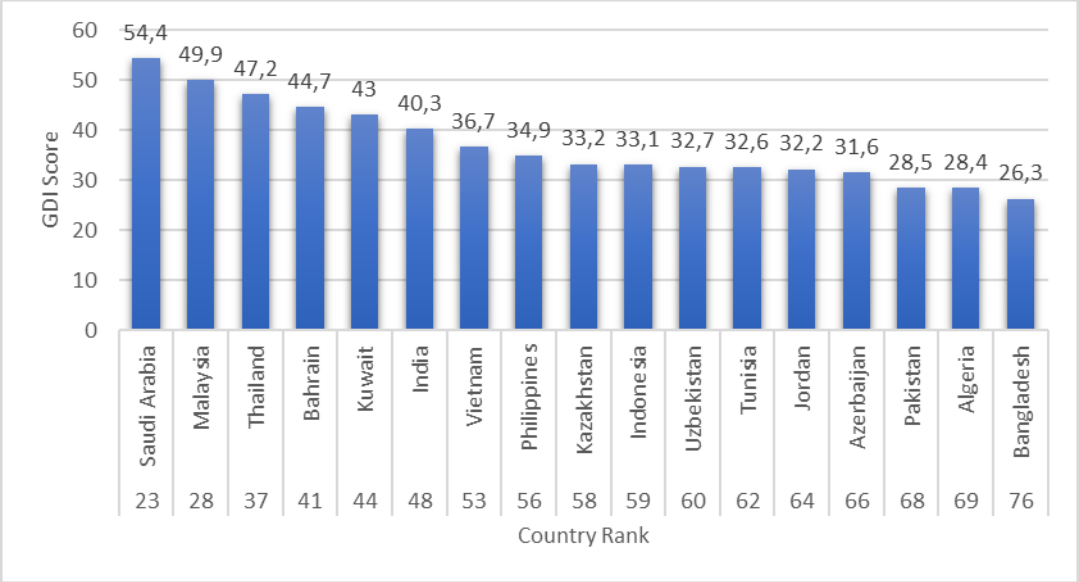


Figure 1. Asia's global digitalization index rank
Source: International Data Corporation (IDC), 2024

The 2024 Global Digitalization Index (GDI) report highlights the digitalization gap in Southeast Asia, with Malaysia classified as an adopter (score 49.9; rank 28), relying on digital infrastructure and financial innovation, while Indonesia is categorized as a starter (score 33.1; rank 59), still focusing on accelerating infrastructure development and regulatory reforms. International Data Corporation, (2024). National data corroborates this finding, indicating that digital banking transaction values in Indonesia reached IDR 87 quadrillion by the end of 2024, representing a 50.6% YoY OJK (2024), while Bank Indonesia recorded over 1.8 billion mobile banking transactions in a single month BI (2025). In comparison, Malaysia reported 11.5 billion e-payment transactions in 2023, amounting to RM 592 billion, with the average per capita transactions rising to 409 in 2024 BNM (2024). This disparity in digital readiness indicates that the banking sectors in the two countries face distinct challenges and opportunities, making the optimization of intellectual capital and the acceleration of digital transformation critical for enhancing competitiveness and firm value sustainably. Brand Finance (2024) shows that global banks with stronger capability to manage

knowledge-based resources and digital strategies generally occupy higher valuation ranks. For instance, Maybank as Malaysian Bank is positioned at rank #61 with a brand value of USD 5.2 billion, while BRI as Indonesian Bank is ranked #67 with a brand value of USD 4.9 billion. This pattern reflects how intellectual capital and digital transformation are linked with stronger firm value outcomes in the banking sector.

IC is an intangible asset comprising human capital, structural capital, and physical capital, which plays a crucial role in firm value creation and the sustainable enhancement of firm value Pulic (2004); Barney (1991). Prior studies provide mixed evidence, while Ni et al. (2020), Priyanto et al. (2024), and Dewi et al. (2022) confirmed positive effects of IC components on profitability and FV, other findings suggest inconsistencies, such as the limited role of HCE Rahman & Akhter (2021); Supian et al. (2025) and insignificant IC effects in Islamic banks Pratama et al. (2020). Evidence also highlights that SC and organizational systems Khin & Ho (2019); Tubara et al. (2024) as well as efficient use of physical assets Hermawan, Rokhmania, et al. (2024); Yahaya et al. (2025) contribute strongly to firm value. Furthermore, technology-driven innovation can strengthen IC's impact Amimakmur et al. (2024), and IC disclosure enhances market perception Salvi et al. (2020). Given these inconsistencies, further testing of IC's role in the Indonesian and Malaysian banking context remains essential.

DT is defined as the use of digital technologies to transform business models, enhance efficiency, and create new value for customers and organizations Vial (2019) As a moderating variable, DT strengthens the relationship between IC and FV is able to improve operational efficiency, strengthen financial performance, and optimize the role of IC in creating firm value Yin & Xu (2025); Veshkurova et al. (2024); Jiang & Li (2024); Pratama et al. (2023). Studies show its role in reinforcing SC Khin & Ho (2019) supporting HC Supian et al. (2025) and optimizing PC Lei & Wang (2023); Zhao et al. (2024). Based on the Global Digitalization Index International Data Corporation (2024), Malaysia is in the adopter category with more stable infrastructure and regulatory support, while Indonesia is still in the start-up stage with great market potential but faces efficiency barriers and accelerated adoption of financial technology BNM (2024); OJK (2024).When compared to Singapore, which is already the frontrunner of digitalization in ASEAN, the level of digital transformation of Indonesia and Malaysia is still growing. This condition confirms the importance of DT in strengthening the influence of IC on FV in the banking sector.

Previous study by Ni et al. (2020) examined the relationship between IC and FV in manufacturing companies listed on the Taiwan Stock Exchange between 2010 and 2013, but it was limited in scope as it did not consider the banking sector, which is a highly digitized knowledge-based industry with different characteristics of IC utilization. This study is an extension of that research, with the research object being companies in the banking sector listed on the Indonesia Stock Exchange and the Malaysia Stock Exchange from 2020 to 2023. The banking sector was chosen because it is the most digitized knowledge-based industry and plays a strategic role in supporting financial stability, economic growth, and global competitiveness. Based on data from the Asia's Global Digitalization Index (GDI) 2024 phenomenon, this study has been updated to describe a more comprehensive relationship between IC and FV by adding DT as a moderating variable. This approach is expected to provide a more complete understanding of how DT strengthens the role of IC in increasing banking FV, while responding to the challenges of global competition in an era of rapid digitalization.

In light of these inconsistencies and the differing levels of digital maturity between Indonesia and Malaysia, this study aims to provide more comprehensive evidence on how Intellectual Capital influences Firm Value in the banking sector and whether Digital Transformation strengthens these relationships. Accordingly, the study addresses three key research questions: (1) To what extent do Human Capital, Structural Capital, and Physical Capital affect Firm Value? (2) Does Digital Transformation moderate these effects? and (3) Do these relationships differ across banking

industries operating in a digitally "starter" market such as Indonesia compared to an "adopter" market such as Malaysia? These questions serve as a conceptual bridge to the hypothesis development presented in the next section.

LITERATURE REVIEW AND HYPOTHESIS FORMULATION

Resource-Based Theory (RBT)

Resource-Based Theory (RBT), based on the conceptual framework of the Resource-Based View developed by Barney (1991), emphasizes that sustainable competitive advantage is achieved through the utilization of internal resources that are Valuable, Rare, Inimitable, and Nonsubstitutable. Intellectual capital (IC) is regarded as an intangible asset of strategic value, instrumental in creating long-term competitive advantage and enhancing firm value Ni et al. (2020); Pratama et al. (2024). DT functioning as a moderating variable and considered part of dynamic capabilities, enables firms to reconfigure and optimize IC, making it more adaptive to technological changes and global competition Vo & Tran (2024) ; Pratama et al. (2023). RBT thus provides a comprehensive theoretical lens to explain how IC, supported by DT, drives higher firm value in highly competitive industries such as banking.

Human Capital on Firm Value

In the Value-Added Intellectual Coefficient (VAIC) model developed by Pulic (2004), human capital represents the knowledge, skills, and competencies of employees that contribute to value creation Adi Pracoyo et al. (2022). This perspective highlights human capital as a strategic resource capable of enhancing innovation, productivity, and decision-making quality in the banking industry Rahman & Akhter (2021). According to RBT, FV can be enhanced through the effective management of internal resources, including IC, which supports operational efficiency and long-term competitive advantage Barney (1991).

Previous research by, Ni et al. (2020) found that human capital has a significant positive effect on profitability and firm value in the banking sector. Priyanto et al. (2024) confirmed that employee competencies can drive financial performance and enhance firm value. Moreover, Amimakmur et al. (2024) indicated that knowledge-based innovation strengthens the contribution of human capital to firm value creation. Based on these findings, the first hypothesis can be formulated as follows:

H_1: Human capital has a significant positive effect on Firm Value

Structural Capital on Firm Value

Risk management systems, information technology, standard operating procedures, and an efficient organizational culture within a company are the scope of the SC. In addition, SC may also be reflected in broader institutional support, such as the synergy of business institutions, religious leaders, and higher education in the development of Islamic banking Santoso & Astuti (2019). A wellmanaged SC can improve operational efficiency, accelerate decision-making, and increase customer satisfaction, thereby contributing to profitability and firm value. SC is an organizational capability that is difficult for competitors to imitate, so it becomes a source of sustainable competitive advantage Barney (1991). In the VAIC model Pulic (2004). SC plays an important role in creating value through efficiency, innovation, and corporate sustainability.

Previous research, Dewi et al. (2022) found that structural capital efficiency (SCE) has a positive effect on firm value. Furthermore, while Tubara et al. (2024), added that the effectiveness of SC contributes to sustainable competitiveness. Based on these findings, the second hypothesis can be formulated as follows:

H_2: Structural capital has a significant positive effect on Firm Value

Physical Capital on Firm Value

Physical Capital refers to tangible assets owned by a company, such as buildings, equipment, branches, and technological infrastructure, which play an important role in supporting operations and service quality in the banking sector. Efficient PC management enables faster, more quality services and increases corporate value for shareholders in line with RBT. PC usage efficiency is measured through Capital Employed Efficiency (CEE), one of the key components in the VAIC model Pulic (2004). Additionally, several studies note that in an increasingly digitalized environment, extensive physical asset ownership may become cost-intensive and reduce organizational flexibility. As a result, physical capital can also impose a potential burden on firm value rather than consistently enhancing it. Research by Tubara et al. (2024) confirms that CEE as a representation of physical capital efficiency contributes positively to financial performance and firm value in various industrial sectors of the company. Similar findings are reinforced by Yahaya et al. (2025) on manufacturing companies in Nigeria, as well as Hermawan et al. (2024) who emphasize the importance of managing physical and intellectual assets simultaneously to improve operational efficiency and firm value.
Based on these findings, the third hypothesis can be formulated as follows:
H_3: Physical capital has a significant positive effect on Firm Value

Digital Transformation on Firm Value

Digital Transformation is defined as the digitization of banking strategies and management aimed at enhancing the health and stability of banks Hu et al. (2025). This involves the integration of digital technologies across all operational, strategic, and service-related aspects of the organization, thereby improving efficiency, innovation, and customer experience Matt et al. (2015). From the perspective of RBT, and dynamic capabilities, a bank's ability to dynamically manage and adapt both internal and external resources enables effective implementation of DT, which in turn can enhance firm value.

Research by Ganawati et al. (2024) indicates that DT strengthens process efficiency and firm value creation. This is further supported by Salvi et al. (2020) who highlight that the optimal adoption of DT enhances operational efficiency, service quality, and customer satisfaction, thereby positively impacting firm value. Based on these findings, the fourth hypothesis can be formulated as follows: *H_4: Digital Transformation has a significant positive effect on Firm Value* The Moderating Effect of Digital Transformation on the Relationship of Human capital and Firm Value

HC reflects the competencies, skills, and creativity of employees that are the main foundation of value creation in organizations Supian et al. (2025). DT plays an important role in optimizing the role of HC through the provision of digital infrastructure, collaborative platforms, and flexible work systems that drive productivity and innovation Veshkurova et al. (2024). In the perspective of Dynamic Capability in RBT Barney (1991); Teece et al. (1997), companies that are able to integrate internal competencies such as HC with digital technology will be more adaptive to external changes and have a high innovative capacity.

Research by Ni et al. (2020) and Priyanto et al. (2024) shows that HC contributes positively to the increase in FV, while Amimakmur et al. (2024) emphasize that knowledge-based innovations strengthen the contribution of HC. Furthermore, Subariyanti et al. (2025) and Veshkurova et al. (2024) highlight that the implementation of digital transformation (DT) through digital infrastructure, collaborative platforms, and flexible work systems can increase productivity, innovation, and the effectiveness of employee roles. This shows that DT has the potential to strengthen the relationship between HC and firm value. Based on these findings, the fifth hypothesis can be formulated as follows:
H_5: Digital Transformation moderates the relationship of Human capital on Firm Value

The Moderating Effect of Digital Transformation on the Relationship of Structural Capital and Firm Value

SC covers organizational routines, information systems, risk management, and operational procedures that enable companies to operate efficiently and maintain competitiveness. DT supports SC optimization through process digitization, information integration, and accelerated decisionmaking, so that Structural Capital can function more effectively in creating value Khin & Ho (2019). RBT explained that DT strengthens SC's usability as a strategic intangible asset that increases organizational agility and operational efficiency.

Previous research by Khin & Ho, (2019) confirms that digitalization strengthens the effectiveness of structural capital (SC) through accelerating decision-making and improving organizational efficiency. In line with that, Dewi et al. (2022) found that structural capital efficiency (SCE) has a positive effect on firm value, while Yahaya et al. 2025 and Hermawan et al. (2024) affirm the role of SC in strengthening the financial performance and valuation of companies. Based on these findings, DT is seen as able to increase the contribution of the SC to the creation of firm value. Based on these findings, the sixth hypothesis can be formulated as follows:

H_6: Digital Transformation moderates the relationship of Structural Capital on Firm Value

The Moderating Effect of Digital Transformation on the Relationship of Physical Capital and Firm Value

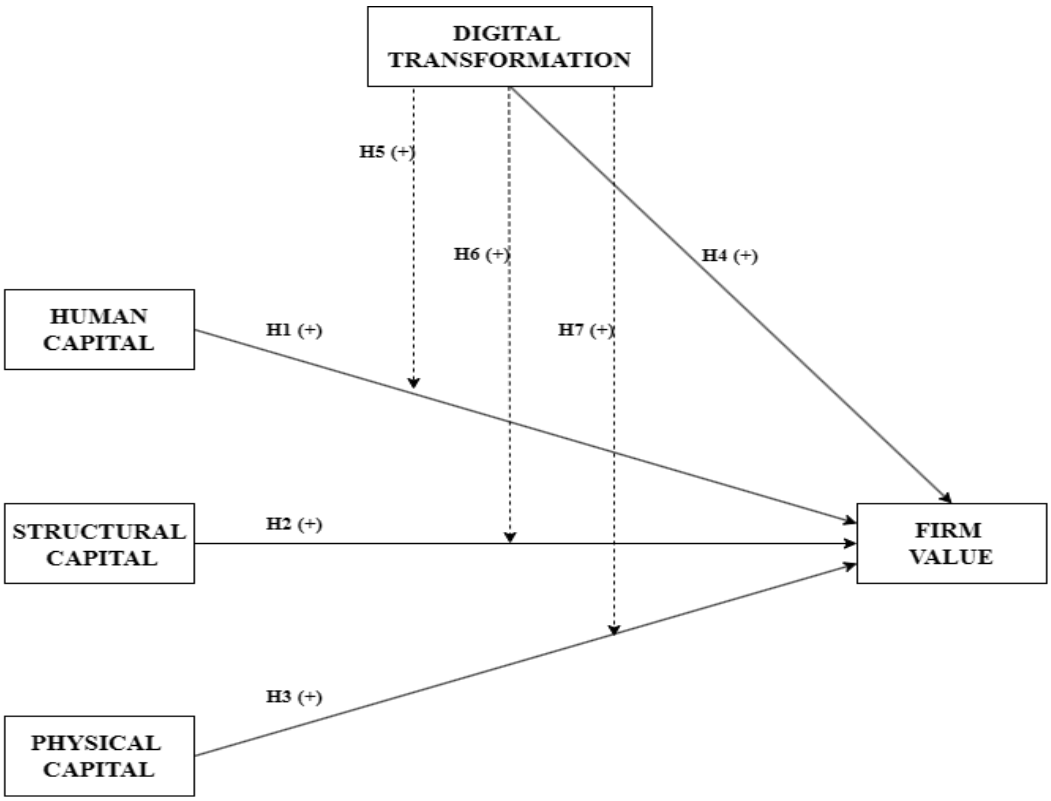
The efficiency of PC management contributes to increased productivity, service quality, and investor confidence. Digital transformation (DT) integration enables process automation, real-time data utilization, and smarter asset management, thereby increasing the effectiveness of PC utilization Lei & Wang (2023); Zhao et al. (2024). RBT, companies that are able to adopt DT to strengthen the use of PCs will have a higher resilience to market disruptions and changes in the external environment Barney (1991).

Previous research by Jiang & Li (2024) found that digitalization significantly increases the productivity of companies through the optimization of capital and resource use. Companies that successfully integrate PCs with digital technology will be more resilient to market disruptions and be able to create sustainable value for stakeholders. Based on these findings, the seventh hypothesis can be formulated as follows:

H_7: Digital Transformation moderates the relationship of Physical Capital on Firm Value

Conceptual Framework

Figure 2. Research Model



RESEARCH METHOD

This quantitative research utilizes secondary data obtained from financial statements and annual reports fully published by companies listed on the Indonesia Stock Exchange, and Bank Negara Malaysia covering the period 2020–2023. The analysis is conducted using a panel data regression model processed with Stata 17. The sampling method employed is purposive sampling, a nonprobabilistic technique in which samples are deliberately selected based on specific criteria relevant to the research objectives. This approach allows the researcher to obtain more focused data and enhance the credibility of the findings, albeit with limitations in generalizability Memon et al. (2025). Based on the study's criteria, 62 companies were examined, yielding a total of 248 firm-year observations for the 2020–2023 period. These companies are listed on the Indonesia Stock Exchange, and Bank Negara Malaysia with data obtained from their published financial statements and annual reports.

Table 1. Operational Definition and Measurement of Variables

Variables	Operational Definition of Variables	Variable Measurement
Firm Value(Y)	Firm Value reflects the market's perception of a company's long-term 's $Tobin$ performance prospects Rr.Supantiningrum (2025)	Q = ($MVCS$ +$RVALVPS$ +BVD) Elali (2007)
Intellectual Capital (X)	Intellectual Capital an intangible resource of strategic value, essential for creating corporate wealth and enhancing long-term firm value. Rehman et al. (2022)	VAIC = HCE + SCE + CEE Pulic (2004)
Human Capital (X1)	Human Capital is measured using Human Capital Efficiency, which assesses the efficiency of human resource expenditures in generating value-added. He et al. (2024)	$HCE = \frac{VA}{HC}$ Pulic (2004)
Structural Capital (X2)	Structural Capital is measured using Structural Capital Efficiency, which evaluates the contribution of internal systems and processes in supporting firm value creation. He et al. (2024)	$SCE = \frac{SC}{VA}$ Pulic (2004)
Physical Capital (X3)	Physical Capital is measured using Capital Employed Efficiency which indicates the efficiency of utilizing physical and financial assets in generating value. Rehman et al. (2022)	$CEE = \frac{VA}{CE}$ Pulic (2004)
Digital Transformation (Z)	Digital transformation is measured using composite index comprising 12 dummy indicators, reflecting the company's digital maturity as a strategic adoption of digital technologies across banking strategy, products, and management Hu et al. (2025)	Dummy: 1 = Yes; 0 = No Based on 12 dummy variables Hu et al. (2025)

Source: Research Data, 2025

Table 2. Framework of indicators digital transformation index

Primary Indicator	Secondary Indicator	Definition of Specific Indicators
Strategy digitalization	Digital technology references	1 if the company's report mentions ≥1 of 124 keywords related to AI, big data, cloud, blockchain, online, and mobile; 0 otherwise
Business digitalization	Digital channels	1 if the company has launched a mobile banking application; 0 otherwise
		1 if the company has introduced digital micro-banking services; 0 otherwise
	Digital products	1 if the company has launched an internet-based financial product; 0 otherwise
		1 if the company provides internet-based credit services; 0 otherwise
		1 if the company operates an e-commerce platform or offers e-commerce services; 0 otherwise
	Digital R&D	1 if the company applied for at least one digital technology-related patent during the year; 0 otherwise.
Management digitization	Digital architecture	1 if the company underwent internal restructuring to support digital transformation; 0 otherwise.
		1 if the company established a dedicated FinTech subsidiary; 0 otherwise
	Directors with IT background	1 if there is at least one board member with an IT-related educational or professional background; 0 otherwise
	Executives with IT background	1 if at least 25% of the executive team members have an IT background; 0 otherwise.
	Digital cooperation	1 if the company formed investment or strategic partnerships with external tech firms during the year; 0 otherwise.

Source: Research Data, 2025

This study employs panel data regression analysis to examine the relationships between HC, SC, PC, and DT on FV, as well as the moderating role of DT. The selection of the optimal model between Fixed Effect (FE) and Random Effect (RE) is conducted using the Hausman test to ensure parameter estimates that are valid, efficient, and accurately reflect the causal relationships among the variables.

Leverage and firm size are included as control variables because capital structure and firm scale have been empirically shown to influence financial risk, investor perception, and firm value. The inclusion of these control variables aims to minimize estimation bias, allowing the effects of Intellectual Capital and Digital Transformation on firm value to be examined more accurately.

Model (1) is employed to test the direct effects of HC, SC, and PC on FV, while Model (2) is used to assess the moderating impact of DT on the relationships between HC, SC, PC, and FV. The regression equations utilized in this study are presented as follows:

(1) $FV = \alpha + \beta1HCE + \beta2SCE + \beta3CEE + \beta4DT + \beta5Leverage + \beta6SZ + e$
(2) $FV = = \alpha + \beta1HCE + \beta2SCE + \beta3CEE + \beta4DT + b5HCE*DT + \beta6SCE*DT + \beta7CEE*DT + \beta8Leverage + \beta9SZ + e$

Description

FV	: Firm Value
α	: Constant
β1 – β9	: Regression coefficient
HCE	: Human Capital Efficiency
SCE	: Structural Employed Efficiency
CEE	: Capital Employed Efficiency
DT	: Digital Transformation
Leverage	: The level of corporate debt utilization
SZ	: Firm Size
e	: Error Term

RESULTS AND DISCUSSION

This analysis aims to characterize the collected data, emphasizing the distribution of primary variables and detecting any potential disparities or variations across the sampled firms.

Table 3. Descriptive Statistical Analysis Test Result

Variable	Mean	Std. Deviation	Min.	Max.
Tobins Q	1.510677	2.325201	0.2978287	21.84963
HCE	2.541286	2.754193	-10.61	19.10
SCE	0.5369694	1.659316	-17.21	16.04
CEE	0.1958318	0.1935573	-1.09	1.20
DT	0.7424099	0.1181444	0.2941176	0.9411765
SIZE	29.88	3.05	23.02	35.31
Lev	-4.13	6.18	-9.71	4.08
Observation	248			

Source: Research Data, 2025

Descriptive statistical analysis is conducted to characterize the distribution of key values. The standard deviation serves as an indicator of data dispersion, with smaller values suggesting that the data points are more closely clustered around the mean. Table 3 presents the descriptive statistics for the variables used in this study, highlighting the distribution and characteristics of the primary values. Tobin's Q variable exhibits a mean of 1.51, with values greater than 1 indicating that, on average, the sampled companies possess market valuations exceeding their book values Tobin (1969); Tambunan (2023). According to the VAIC categorization criteria proposed by Ulum et al. (2014), values of ≥3.00 are classified as very good, 2.00–2.99 as good, 1.50–1.99 as fair, and <1.50 as poor. Based on Table 2, the average VAIC is 3.274087 (≥3.00), falling into the "very good" category, which implies that the sampled companies are highly efficient in managing their intellectual capital to generate added value Pulic (2004). Digital Transformation shows a mean of 0.74 with a standard deviation of 0.12. A mean approaching 1 indicates that the sampled companies have adopted a relatively high level of digital transformation, suggesting that they are in an advanced stage of digital maturity Hu et al. (2025).

Following the descriptive analysis, the Hausman test was conducted to determine whether the Fixed Effects Model or the Random Effects Model is more appropriate.

Table 4. Hausman Test

Hausman Test	Chi2	Prob>Chibar2	Result
Model 1	18.24	0.0027	FE
Model 2	18.52	0.0176	FE

Source: Research Data, 2025

Based on the results of the Hausman test presented in Table 4, the probability values (Prob > Chibar2) for Model 1 (0.0027) and Model 2 (0.0176) are both below 0.05, thereby rejecting the null hypothesis. Consequently, it can be concluded that the Fixed Effects Model is the most appropriate for this study, given the presence of correlation between individual effects and the independent variables.

In panel data regression, the validity of estimation results is more likely to be affected by heteroskedasticity and serial correlation rather than by the normality of residuals. As emphasized by Baltagi (2005) and Gujarati & Porter (2009), residual normality testing is not essential because the consistency of panel data estimators does not rely on normally distributed residuals. Instead, the main concern lies in whether the residuals exhibit constant variance (homoskedasticity) and whether they are free from correlation across time (serial correlation). The presence of heteroskedasticity or serial correlation does not bias the regression coefficients, but it renders the standard errors inconsistent, leading to invalid statistical inference. Therefore, this study focuses its diagnostic testing on heteroskedasticity and serial correlation while omitting residual normality testing.

Heteroskedasticity in the fixed effects model was tested using the Modified Wald Test Baum (2001); Torres-reyna (2007), whereas serial correlation was tested using the Wooldridge Test Drukker (2003). The criterion applied is that if the probability value is below 0.05, the model is considered to suffer from heteroskedasticity or serial correlation.

Table 5. Heteroscedasticity Test and Serial Correlation Test

Model 1		Model 2	
Full Sample	248	Full Sample	248
Heteroscedasticity		Heteroscedasticity	
Chi2	3.4e+07	Chi2	7.2e+07
Prob > Chi2	0.0000	Prob > Chi2	0.0000
Serial Correlation		Serial Correlation	
F	2.613	F	3.928
Prob > F	0.1111	Prob > F	0.0520

Source: Research Data, 2025

Table 5, both models exhibit probability values (Prob > Chi2) of 0.0000, indicating strong evidence of heteroskedasticity. This suggests a violation of the homoskedasticity assumption, implying that the models do not satisfy one of the fundamental classical linear regression assumptions. Meanwhile, the autocorrelation test results reveal that Model 1 does not exhibit autocorrelation (Prob > F = 0.1111), whereas Model 2 shows a slight indication of autocorrelation (Prob > F = 0.0520).

Based on these results, it is necessary to adjust the estimation procedure to obtain robust results. According to Hoechle (2007) and Torres-reyna (2007), when fixed effects models are affected by both heteroskedasticity and serial correlation, the use of Driscoll–Kraay standard errors is recommended. This estimator produces heteroskedasticity- and autocorrelation-consistent (HAC) standard errors, ensuring that despite violations of classical assumptions, the regression coefficients remain consistent and the statistical inference remains valid.

Accordingly, this study employs the Fixed Effects Model with Driscoll–Kraay standard errors for all regression estimations. The hypothesis testing results presented in Tables 6 and 7 have been adjusted using this estimator, ensuring that the research findings are both reliable and robust.

Table 6. Hypothesis Test Model 1

The hypothesis testing results for Model 1 are presented in Table 6, and the regression equation derived from this study is expressed as follows:

Hypothesis	Path	Coefficient	T Value	P > | t |	Result
H1	HC → FV	0.092	0.63	0.533	Rejected
H2	SC → FV	0.124	3.37	0.001***	Accepted
H3	PC → FV	-2.342	-3.43	0.001***	Rejected
H4	DT → FV	-3.783	-1.47	1.148	Rejected
***10% Sign**					
****5% Sign**					
*****1% Sign**					

Source: Research Data, 2025

Table 7. Hypothesis Test Model 2

The hypothesis testing results for Model 2 are presented in Table 7, and the regression equation derived from this study is expressed as follows:

Hypothesis	Path	Coefficient	T Value	P > | t |	Result	
H6	SC * FV → DT	5.649	4.33	0.000***	Accepted	H5
H7	PC * FV → DT	6.096	1.42	0.160	Rejected	HC
***10% Sign**						*
****5% Sign**						FV
*****1% Sign**						→
DT	-0.589	-0.12	0.907	Rejected	Source: Research Data, 2025	

The hypothesis testing results have been adjusted for autocorrelation and heteroskedasticity by employing a fixed effects regression with Driscoll–Kraay standard errors. With this adjustment, the estimation results can be considered reliable and consistent with the initial findings.

The results of the first hypothesis test indicate that human capital (HC) does not have a significant effect on firm value (FV) in the banking sector of Indonesia and Malaysia. This suggests that although employee competencies, knowledge, and skills are important assets, their contribution has not yet been directly reflected in the market valuation of banks in these countries. This implies that the banking industry in both countries remains heavily reliant on systems and technology, leading investors to place greater emphasis on structural capital and physical capital such as risk management systems and branch networks rather than solely on the quality of human resources. From the RBT perspective, HC is categorized as a strategically valuable resource; however, without the support of structural capital and the utilization of digital technologies, its role in enhancing firm value is not optimal.

This divergence in results underscores that the effectiveness of HC is contextual, particularly in markets undergoing digital transformation. For practitioners, this implies that banks in Indonesia and Malaysia need not only to invest in employee development but also to integrate these competencies into organizational systems and digital infrastructure to ensure a more tangible contribution to firm value enhancement. This finding aligns with Dewi et al. (2022) , who also reported that human capital efficiency (HCE) is not always significant, but contrasts with Ni et al. (2020) and Priyanto et al. (2024), who demonstrated a positive effect. This non-significant finding may also reflect the digitalization gap between Indonesia and Malaysia. As the panel model captures average effects, the positive role of human capital in Malaysia as a digital adopter may be offset by its weaker utilization in Indonesia, where digital transformation is still at an early stage. Therefore, the first hypothesis is rejected.

The results of the second hypothesis test indicate that structural capital (SC) has a significant positive effect on firm value (FV). This implies that banks with well-structured risk management systems, information technology, and operational procedures can enhance efficiency and create sustainable competitive advantages. Within the RBT framework, SC can be considered an organizational capability that is difficult for competitors to replicate, thereby contributing to higher market value Pratama (2016). This demonstrates that the more structured a bank's internal systems are, the greater investor confidence in the company's prospects.

These findings are consistent with Tubara et al. (2024),who emphasize the importance of SC in supporting financial performance and firm value, and align with Dewi et al. (2022), who found that SC positively affects FV. However, this result differs from Pratama et al. (2020),who reported that intellectual capital (IC) does not have a significant effect on Islamic banks, indicating a context-specific effectiveness of IC. Banks in Indonesia and Malaysia need to continue strengthening internal systems and technology-based processes to ensure SC functions optimally, while also signaling positively to investors regarding the sustainability of firm value. Therefore, the second hypothesis is accepted.

The results of the third hypothesis test indicate that physical capital (PC) has a significant negative effect on firm value (FV). Statistically, this finding rejects the third hypothesis (H3), which predicted a positive relationship. The regression analysis shows that PC has a significant negative coefficient ($\beta = -2.342$, $p < 0.01$), meaning that an increase in physical and financial assets such as branch networks and technological infrastructure tends to reduce firm value in the banking sector of Indonesia and Malaysia. This outcome suggests that the market interprets excessive or inefficient investment in tangible resources as a sign of declining efficiency and rising operational costs, which consequently undermines investor confidence. In line with the RBT, physical capital may shift from being a potential source of competitive advantage to becoming a liability when it is not strategically managed or effectively integrated with other organizational resources.

This contrasts with the findings of Tubara et al. (2024), Yahaya et al. (2025), and Hermawan et al. (2024), who emphasize the positive role of physical asset management in enhancing performance and value. In line with the present study, however, Rahman & Akhter (2021), Maghfiroh et al. (2024) and Supian et al. (2025) argue that excessive investment in tangible resources can increase costs, reduce efficiency, and act as a liability rather than a strategic advantage. These results suggest that, in the context of Indonesian and Malaysian banks, the market prioritizes efficiency and digital transformation over heavy reliance on physical assets. Therefore, the third hypothesis is rejected.

The results of the fourth hypothesis test indicate that digital transformation (DT) does not have a direct effect on firm value. This suggests that the adoption of digital technologies has not yet been perceived by the market as an independent driver of value, or that its effects may only become evident in the long term. From the perspective of dynamic capabilities, DT functions more as a catalyst that enhances the interaction among resources rather than as a standalone factor. One possible explanation is that the market still views digital investments as short-term costs, so their

positive impact is not yet reflected in firm valuations. Additionally, digitalization in the banking sectors of Indonesia and Malaysia is still in developmental stages, meaning its benefits are more apparent at the operational level rather than directly in capital markets. Within the RBT framework, DT is expected to strengthen the value of organizational resources by reconfiguring and integrating them, however, when these synergies are not yet established, DT alone cannot serve as a direct driver of firm value.

This finding contrasts with Ganawati et al. (2024) who reported a positive effect of DT on firm value, while also confirming that the effectiveness of DT is highly contingent on adoption context and digital maturity. In line with Salvi et al. (2020) digitalization only exerts a significant impact when integrated with the optimal management of intellectual capital. Thus, these results underscore that in Indonesia and Malaysia, DT has not yet become an independent value driver and requires complementary support from human capital, structural capital, and physical capital. Therefore, the fourth hypothesis is rejected.

The results of the fifth hypothesis test indicate that digital transformation (DT) does not moderate the relationship between human capital (HC) and firm value (FV). This suggests that although companies have implemented digitalization, the contribution of employees to market value enhancement has not been fully realized. This condition indicates that DT has not yet functioned optimally as an enhancer of HC, but rather serves primarily as an operational tool. One possible reason is that digitalization in the banking sectors of Indonesia and Malaysia still relies heavily on external technologies, limiting employees' roles to implementation rather than strategic innovation that could increase market valuation. Within the RBT, HC is regarded as a strategically valuable and rare resource; however, without effective integration with DT as a dynamic capability, its potential contribution to firm value cannot be fully leveraged.

This finding aligns with Subariyanti et al. (2025), who emphasize that digitalization must be accompanied by the strengthening of employee competencies to realize HC contributions. In contrast to studies Ni et al. (2020) and Priyanto et al. (2024) which found a significant contribution of HC to firm value, these results suggest that without integrating employee skills with digital transformation, the role of HC is unlikely to be reflected in investor assessments. The implication is that banks in Indonesia and Malaysia need to ensure that digitalization programs are accompanied by human resource development strategies so that digital transformation not only functions at the operational level but also strengthens the strategic value of HC in creating firm value. Therefore, the fifth hypothesis is rejected.

The results of the sixth hypothesis test indicate that digital transformation (DT) significantly moderates the relationship between structural capital (SC) and firm value (FV). The digitalization of internal systems and processes accelerates decision-making, enhances efficiency, and strengthens the effectiveness of SC in creating firm value. Digital transformation reinforces the effectiveness of organizational systems, procedures, and infrastructure in generating value. The implementation of digital services, such as mobile banking and the integration of core banking systems, improves service speed, efficiency, and competitiveness, which is subsequently reflected in increased firm value. From the dynamic capabilities perspective within the RBT framework, this demonstrates that leveraging digital technology enables SC to become more adaptive and contribute tangibly to market value enhancement.

These findings are in line with Khin & Ho (2019), who emphasize that digitalization enhances organizational agility in responding to business dynamics, and support Dewi et al. (2022), who highlight that non-HC components of intellectual capital play a more significant role in influencing firm value. The implication is that banks in Indonesia and Malaysia need to ensure the integration of digital technologies into infrastructure and operational procedures so that the benefits of SC can be maximized and reflected in firm value enhancement. Therefore, the sixth hypothesis is accepted.

The results of the seventh hypothesis test indicate that digital transformation (DT) does not moderate the relationship between physical capital (PC) and firm value (FV). Although companies have integrated digital technologies, the utilization of physical assets has not fully translated into increased market value. Theoretically, the integration of technologies such as automation and realtime data should enhance the efficiency of physical assets. However, in Indonesia and Malaysia, limitations in the integration between physical infrastructure and digital systems, high investment costs, and regulatory constraints mean that the positive effects of digitalization on PC are not yet reflected in firm valuations. Within the RBT, PC is considered a valuable resource that can support firm competitiveness; however, without strategic alignment and effective integration with DT, its potential advantage may not be realized.

This finding contrasts with Lei & Wang (2023) and Zhao et al. (2024).who highlight the role of DT in improving PC efficiency, and underscores that the effectiveness of DT as a moderating factor is highly context-dependent. Banks in Indonesia and Malaysia need to strengthen the integration of physical assets with digital systems and ensure adequate regulatory support so that technology investments not only enhance operational efficiency but also build market confidence. Therefore, the seventh hypothesis is rejected.

CONCLUSION

This study finds that among the three components of intellectual capital, only structural capital (SC) exerts a significant positive effect on the firm value (FV) of banks in Indonesia and Malaysia, while physical capital (PC) shows a significant negative effect and human capital (HC) does not exert a direct impact. Digital transformation (DT) also does not directly affect FV, but it has been shown to strengthen the relationship between SC and FV, indicating that digitalization can enhance the effectiveness of organizational systems, procedures, and infrastructure in value creation. Conversely, DT does not moderate the relationship between HC or PC and FV, suggesting that the integration of digital technologies has not yet fully optimized the contribution of employees or physical assets to market value.

These findings reinforce the RBT perspective that the management of unique and inimitable internal resources can generate long-term competitive advantages and enhance firm value. Practically, the results imply that bank management should prioritize strengthening structural and physical capital, while strategically leveraging digital transformation to maximize their contribution to firm value.

This study has several limitations. First, it relies solely on quantitative secondary data derived from financial statements and annual reports, which may not fully capture the qualitative dimensions of intellectual capital such as employee creativity, innovation culture, or knowledge-sharing practices. Second, intellectual capital is measured only through the VAIC model, which focuses on efficiency ratios; other approaches such as MVAIC or disclosure-based indices might provide a more comprehensive view. Third, the scope of analysis is restricted to the banking sectors of Indonesia and Malaysia over the 2020 – 2023 period, which limits the generalizability of the findings to other industries, countries, or longer time horizons.

Future research is encouraged to adopt mixed-method designs that combine quantitative and qualitative approaches, explore alternative measures of intellectual capital, and expand the scope across industries, regions, or extended periods to strengthen the external validity and applicability of the results.

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