

## Intellectual Capital and Bank Productivity: The Moderating Role of Risk Management in Indonesia and Malaysia

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### Abstract

This study aims to analyze the effect of intellectual capital on bank productivity and the role of risk management as a moderating variable in the banking industry in Indonesia and Malaysia. The components of intellectual capital examined include human capital, structural capital, and physical capital (capital employed), with a total sample of 162 data from 59 banks selected using purposive sampling techniques during the period 2021-2023. The results indicate that human capital has a positive influence on bank productivity, while structural capital and physical capital show a negative influence. Additionally, risk management was found to have a negative influence on bank productivity, suggesting that overly stringent risk management approaches may hinder the optimal utilization of resources. These findings have important implications for the management of intellectual resources and risk in improving the competitiveness and performance of the banking sector, for example in the ASEAN region, such as Indonesia and Malaysia.

**Keyword:** *Intellectual capital; Bank productivity; Risk management*

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### Introduction

The banking industry is now facing intense pressure to maintain sustainable productivity growth, in line with digital transformation and financial globalization. Productivity not only reflects the operational efficiency of banks, but also serves as a key benchmark for the competitiveness and resilience of the national financial system (Wu & Cheng, 2024). One approach that is gaining increasing attention in driving productivity is the optimization of intellectual capital (IC), which consists of human capital (HC), structural capital (SC), and physical capital (PC). Intellectual capital plays a strategic role in creating added value and enhancing the competitiveness of banks, as elements such as employee competencies, organizational structure, and external relationships are core resources that can drive productivity and long-term performance in the banking sector (Rizky Ramdani et al., 2022). Contemporary studies indicate that IC significantly contributes to bank performance and efficiency, particularly in developing countries adapting to global market demands (Ul Rehman et al., 2023).

Effective utilization of intellectual capital, particularly in the form of HC and SC, plays an important role in creating competitive advantage and supporting increased bank productivity. However, the success of this influence can be further optimized if accompanied by a risk management system that is capable of identifying and managing potential operational obstacles early on (Shabrina et al., 2021). Nevertheless, the effective utilization of IC is significantly influenced by the quality of risk management implemented by banking institutions. Adaptive risk management acts as an element that can strengthen the relationship between IC and productivity by minimizing potential losses due to

uncertainty and strengthening operational stability (Farhad Ahmed Bhatti et al., 2023). Conversely, risk management that is too strict and bureaucratic can hinder innovation and limit the role of HC and SC (Ali et al., 2022).

Banks in Indonesia and Malaysia still face challenges in terms of asset quality, as reflected in the Non-Performing Loan (NPL) ratio. NPL is an important indicator in assessing asset quality and credit risk management by companies, in this case banks (Pratama et al., 2024). One factor closely related to NPL is the Loan to Deposit Ratio (LDR), as this ratio shows the extent to which third-party funds are channeled back as credit (Nurkhin et al., 2024). When the LDR is too high, banks tend to be more aggressive in channeling credit, thereby increasing the risk of customer default and raising NPL. Conversely, an LDR that is too low can indeed reduce credit risk, but it also reduces the effectiveness of the bank's intermediary function, thereby impacting productivity. Thus, NPL can be used as an early indication of why liquidity risk management through LDR is an important factor to consider as a proxy for risk management (Eltweri et al., 2024).

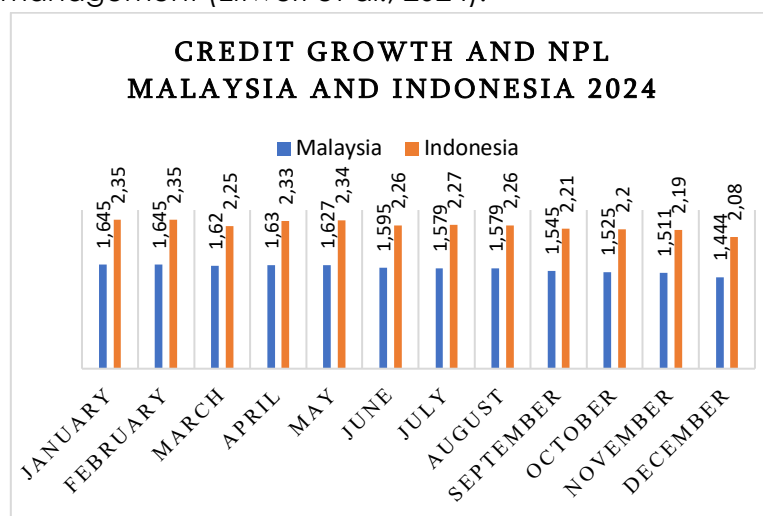


Figure 1 Figure of Credit Growth and NPLs in Malaysia and Indonesia in 2024

Source : Statistik Perbankan Indonesia - Desember 2024 & CEIC data Malaysia Non Performing Loans Ratio

Based on data from graphs showing credit growth and NPL (Non-Performing Loan) ratios in Indonesia and Malaysia throughout 2024, there are dynamics that reflect challenges and opportunities in the banking sectors of both countries. As shown in Graph 1, there are differences in credit growth and NPL between Indonesia and Malaysia throughout 2024. Indonesia recorded consistently higher credit growth compared to Malaysia, but this was accompanied by a relatively stable NPL rate above Malaysia's. Meanwhile, Malaysia showed a decline in credit growth from 1.645% in January to 1.444% in December 2024. These differences indicate that risk management and the efficiency of intellectual capital management can have varying impacts on bank productivity, depending on macroeconomic conditions and each country's managerial approach (Statistik Perbankan Indonesia, 2024 & CEIC data Malaysia, 2024).

Intellectual capital contributes positively to bank productivity growth, particularly through human and structural capital efficiency (Alhassan & Asare, 2016). However, without good risk management, the potential of intellectual capital will not be optimally achieved. Effective risk management of credit and liquidity risks greatly affects bank financial performance (Harb et al., 2023). High credit disbursement, reflected in an increasing LDR value, means that banks capable of effectively managing credit risk through an integrated risk management system have the potential to strengthen the positive impact of intellectual capital on productivity, as well as maintain asset quality and financial

performance stability (Annisa & Inayati, 2022). Therefore, this study examines the influence of intellectual capital on bank productivity, considering the moderating role of risk management, which is highly relevant for understanding how banks can sustainably enhance their competitiveness amid fluctuating market conditions.

This study aims to analyze how risk management moderates the influence of IC on bank productivity in Indonesia and Malaysia. IC is considered a strategic asset of a company because it plays an important role in creating added value and improving operational efficiency. However, in order to maximize its contribution to productivity, a risk management system is needed that can guide the appropriate and sustainable use of intellectual resources (Wahyuantika et al., 2023). According to Fakhruddin & Purwanti (2015) the health or productivity of a bank, as reflected in financial ratios such as operational efficiency, capital adequacy, and loan quality, plays a significant role in banking productivity. This indicates that a robust risk management system is a key factor in ensuring the optimal utilization of intellectual resources to support sustainable performance. Using a quantitative approach, this study aims to fill the literature gap and provide strategic policy recommendations for the banking sector in effectively managing intellectual resources and adapting to risks. This study also addresses the limited availability of comparative literature across countries within the ASEAN regional context (UI Rehman et al., 2023).

### **Resource-Based View (RBV)**

The Resource-Based View (RBV) theory emphasizes that sustainable competitive advantage can be achieved through the utilization of unique and difficult-to-imitate internal resources, such as intellectual capital, which includes human capital, structural capital, and physical capital. In the context of banking in Indonesia and Malaysia, these are considered strategic assets for improving financial performance and organizational productivity (Ur Rehman et al., 2022). Studies show that intellectual capital efficiency, measured through VAIC, is positively associated with the financial outcomes of ASEAN banks (UI Rehman et al., 2023), while bank efficiency moderates the relationship between intellectual capital and market performance, highlighting the importance of intellectual capital management for operational efficiency and market success (Rachmah et al., 2023).

Optimal utilization of intellectual capital has been proven to improve the financial performance of Islamic banks in Indonesia, reflecting that the management of intangible assets such as knowledge and human resource expertise contributes to bank productivity, especially when supported by an efficient internal management system (Depriska Lailatul Aroof et al., 2023). However, in the highly regulated and high-risk banking industry, risk management capabilities are a critical factor that can moderate this relationship, as without adequate risk management, the potential of intellectual capital can be hindered by external uncertainties such as liquidity risk, credit risk, or policy changes (Smriti & Das, 2018).

Previous research has shown that unaddressed operational risks can disrupt the process of transforming intellectual capital into superior organizational performance (Smriti & Das, 2018), and therefore, solid risk management is key to optimizing the role of intellectual capital. In this context, integrating the RBV approach with risk management practices creates a more comprehensive framework for understanding organizational performance, as demonstrated by (Khaliq et al., 2015) in their study of the Pakistani banking sector, which found that the contribution of intellectual capital to performance becomes more significant when combined with effective risk management practices. This is highly relevant

for banks in Indonesia and Malaysia, which are currently facing pressure from strict regulations and competitive digital transformation, where excellence in intellectual assets and risk mitigation capabilities simultaneously become the primary determinants of long-term productivity and competitiveness in the regional market (Khalique et al., 2015).

### **The Relationship Between Human Capital (HC) and Bank Productivity**

Based on the Resource-Based View, a business achieves competitiveness by utilizing internal resources that hold value, are rare, difficult to copy, and efficiently arranged (Barney, 1991). In the context of the banking industry, human capital (HC), which includes employees' knowledge, skills, and experience, is considered a strategic asset that meets these criteria, where investment in HC development through training and education has been proven to enhance organizational capabilities and bank productivity (Rahman & Akhter, 2021). The effectiveness of HC management is also supported by findings Vo et al. (2024) showing that HC efficiency has a positive impact on bank productivity in ASEAN countries. Furthermore, Hermawan et al. (2021) identified that bank efficiency moderates the relationship between human capital and market performance, confirming that human capital management is an important factor in strengthening banking efficiency and competitiveness. Therefore, the utilization of HC as a strategic resource, as explained by RBV, is the main driver of sustainable competitive advantage in the banking sector.

***H<sub>1</sub>: Human capital (HC) has a positive effect on bank productivity.***

### **The relationship between structural capital (SC) and bank productivity**

The RBV theory emphasizes that sustainable competitive advantage can be achieved through the management of valuable, rare, difficult-to-imitate, and well-organized internal resources, including structural capital that encompasses systems, procedures, organizational culture, and information technology that support efficiency and innovation (Barney, 1991). In this context, structural capital (SC) becomes an intangible asset that can drive overall bank productivity and performance, especially when effectively managed to support digital transformation and the provision of innovative financial services (Zuo et al., 2021). A study conducted by (Zuo et al., 2021), the financial performance of banks in ASEAN nations is positively and significantly impacted by SC efficiency, highlighting the significance of SC development in raising the banking industry's level of competition. Additionally, research by (Melsia & Dewi, 2021) also confirms that structural capital efficiency has a positive impact on corporate financial performance, as measured by Return on Assets (ROA), reinforcing the argument that optimal management of structural capital contributes significantly to sustainable competitive advantage, as explained in the RBV framework.

***H<sub>2</sub> : Structural Capital (SC) has a positive effect on bank productivity.***

### **The relationship between physical capital (PC) and bank productivity**

According to the Resource-Based View (RBV) approach, which highlights the significance of managing internal resources to achieve competitive advantage, Physical Capital (PC) is a critical indicator in evaluating how well banks use their financial and physical capital to create added value. The efficiency of capital utilization has been proven to have a positive impact on bank productivity, as explained by (Khairiyansyah & Vebtasvili, 2018) in the context of the Indonesian banking sector through the asset turnover ratio, and reinforced by the findings of (Asutay & Ubaidillah, 2024) which show that the efficiency of capital employed as a proxy for physical capital contributes to increases in earnings per share (EPS) and return on assets (ROA) in banks across the ASEAN region. They also stress

how crucial it is to make investments in infrastructure and systems to promote operational effectiveness. It is anticipated that this study's high CEE value, which represents the efficiency of capital employed, will enhance business performance (Pratama et al., 2019). Thus, efficiency in the management of physical and financial capital is a key strategy in improving the productivity and competitiveness of banks (Asutay & Ubaidillah, 2024).

**H<sub>3</sub> : Physical Capital (PC) has a positive effect on bank productivity.**

#### **The relationship between risk management and bank productivity**

Effective risk management is an internal control mechanism that supports operational efficiency and strategic decision-making, thereby contributing to increased bank productivity. The comprehensive implementation of enterprise risk management reflects good governance and strengthens the role of intellectual capital in creating value (Pratama et al., 2020). Risk management has a significant impact on productivity through a reduction in non-performing loans (NPL) and an improvement in credit quality (Wulandari et al., 2021). From the Resource-Based View (RBV) perspective, Internal resources that are rare, precious, unique, and well-organized are essential for maintaining a competitive edge over the long run (Barney, 1991). Managerial ability to identify and manage risk is part of dynamic capabilities, which are strategic assets because they are not easily replicated by competitors and can adapt to changes in the environment.

One indicator of risk management effectiveness is the loan to debt ratio (LDR), which reflects efficiency in channeling third-party funds-based credit. An optimal LDR indicates good credit risk management and efficient resource utilization, which directly has a positive impact on bank productivity and competitiveness (Landry et al., 2024). In other contexts, such as institutional growth, Islamic microfinance studies show that enhancing the operational capacity of financial institutions can boost profit margins, underscoring the importance of internal factors like efficiency and risk management. In the context of conventional banking, these factors can be represented by the LDR indicator (Pratama & Inayati, 2018). Therefore, banks that successfully integrate risk management into all operational lines have the potential to enhance productivity while maintaining the stability and sustainability of their financial performance amid external environmental uncertainty (Ngo & Trinh, 2025).

**H<sub>4</sub> : Risk management has a positive effect on bank productivity.**

#### **Risk management moderates the relationship between human capital (HC) and bank productivity**

Risk management serves as a strategic resource within the RBV framework, strengthening the relationship between HC efficiency and bank productivity by creating an internal environment that supports the development of staff skills, knowledge, and capabilities (Collins, 2021). Empirical studies in Islamic banks show that HC efficiency and intellectual capital significantly improve banking operational and financial performance, especially when combined with a good risk management system to detect and manage potential productivity barriers (Hidayati & Nandiroh, 2023). Furthermore, research in Bangladesh proves that a combination of human resource management practices, including risk-related training, and corporate risk management positively moderates the impact of human capital efficiency on bank performance, as it strengthens a risk-aware organizational culture and supports the achievement of sustainable competitive advantage (Amin et al., 2024).



**H<sub>5</sub> : Risk management positively moderates the relationship between human capital (HC) and bank productivity.**

**Risk management moderates the relationship between Structural Capital (SC) and bank productivity**

Banks that implement effective risk management are able to moderate the influence of structural capital (SC) efficiency, which includes efficiency in organizational structure, systems, and technological infrastructure, on productivity and financial results such as EPS, ROA, and ROE. This concept aligns with the Resource-Based View (RBV) theory, which views risk management as a unique and difficult-to-imitate strategic resource, thereby enhancing the value and utilization of structural capital efficiency to achieve competitive advantage (Dewi et al., 2025). Research on ASEAN banks reveals that the positive influence of SC on bank performance is reinforced by risk management practices that can identify and mitigate potential productivity barriers (Asutay & Ubaidillah, 2023). Empirical studies also show that SC, in addition to improving ROA and ROE, also improves asset quality and reduces credit risk, especially when supported by strong risk management (Hasan & Cheung, 2023). By integrating risk management into internal strategies, banks can combine SC and risk as mutually reinforcing resources, thereby emphasizing the importance of investing in the development of internal structures and risk control systems for sustainable and stable bank performance.

**H<sub>6</sub> : Risk management positively moderates the relationship between Structural Capital (SC) and bank productivity.**

**Risk management moderates the relationship between physical capital (PC) and bank productivity**

Effective risk management capabilities play a strategic role in strengthening the relationship between capital efficiency, in this case capital employed efficiency as a proxy for physical capital, and bank productivity. In the context of modern banking, risk management not only serves to minimize potential losses but also acts as a valuable and difficult-to-replicate internal resource, as emphasized by the Resource-Based View (RBV) theory (Barney, 1991). Studies in the Indonesian banking sector indicate that the implementation of Enterprise Risk Management (ERM) integrated with digital technology, such as mobile banking, significantly improves capital efficiency and financial performance, including EPS, ROA, and ROE ratios (Yoewono & Ananto, 2024). These findings are reinforced by research on global financial institutions, which shows that proactive risk management through the identification, evaluation, and mitigation of risks can enhance the overall stability and productivity of an organization (Adam et al., 2023). Thus, banks that develop risk management capabilities as part of a resource-based strategy have the potential to achieve sustainable competitive advantage through the optimization of capital efficiency and increased productivity.

**H<sub>7</sub> : Risk management positively moderates the relationship between physical capital (PC) and bank productivity.**

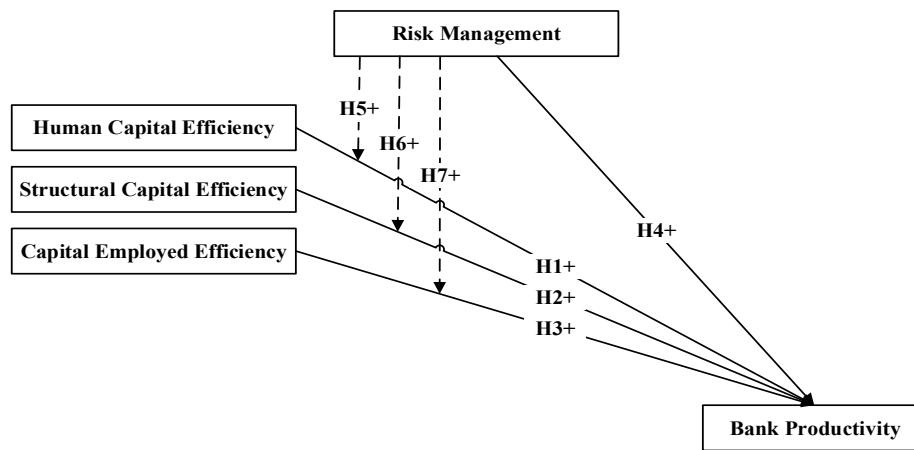


Figure 2 Conceptual Framework

## Research Methods

The analysis uses a panel data regression model and is processed using Stata 17 statistical software. The population in this study is all banks operating in Indonesia and Malaysia. The sample used consists of 162 data points from 59 companies for the period 2021-2023, and the sample was selected using purposive sampling, a method of selecting samples based on specific criteria (Memon et al., 2025). The sampling criteria require banks to publish financial reports on their official platforms or the Indonesia Stock Exchange/Bank Negara Malaysia, have reports for 2021–2023, and provide data on intellectual capital, risk management, and productivity while reporting positive profits.

Table 1 Input and Output Bank Productivity Variables

	Mean	Standard deviation	Minimum value	Maximum value
Input variables				
Deposits	1.30	2.24	740	1.29
Fixed Assets	2.49	7.46	2.25	5.80
Staff expenses	3.13	8.37	483	6.58
Output variables				
Investment	1.10	1.66	168	6.77
Loans	9.24	1.48	780	7.99
Fees and commission	2.75	1.98	-9.11	1.74

Source : Research Data, 2025

To obtain bank productivity measurements in this study, the method used refers to the Malmquist Productivity Index (MPI), which is identical to Total Factor Productivity Change (TFPCH). Based on Alhassan & Asare (2016), bank productivity is measured using the Malmquist Productivity Index (MPI), which is identical to Total Factor Productivity Change (TFPCH), calculated from the multiplication of Efficiency Change (EFFCH) and Technical Change (TECHCH) (Amirteimoori et al., 2024). EFFCH shows the ability of banks to catch up with the best efficiency (catch-up effect), while TECHCH reflects shifts in the efficiency frontier due to innovation or technological advances. The measurement is carried out by placing banks as institutions with inputs in the form of customer deposits, fixed assets, and staff costs to be utilized to obtain the best efficiency (EFFCH) and outputs in the form of investments, loans, provision income, and commissions by increasing innovation or technological advances.

Table 2 Definition and Measurement

Variable	Definition	Measurement
Bank productivity (Y)	Productivity in the context of banks is defined as the efficiency of banks in converting inputs into outputs. The input factors (x) considered are customer deposits, fixed assets, and staff costs, while the outputs (y) are loans and provision and commission income, which are measured using the Malmquist Productivity Index (MPI) with the distance function relative to technology at time t ( $d^t$ ). MPI is a statistical tool used to calculate Total Factor Productivity Change (TFPCH). (Alhassan & Asare, 2016)	$TFPCH = \left( \frac{d^{t+1}(x^{t+1}, y^{t+1})}{d^t(x^t, y^t)} \right) \left[ \frac{d^t(x^{t+1}, y^{t+1})}{d^{t+1}(x^{t+1}, y^{t+1})} \times \frac{d^t(x^t, y^t)}{d^{t+1}(x^t, y^t)} \right]^{0.5}$ (Alhassan & Asare, 2016)
Intellectual capital (X)	Intellectual capital is an intangible asset used to create value, achieve high performance, and realize corporate goals. (AlQershi et al., 2023)	VAIC = HCE + SCE + CEE (Pulic, 2004)
Human Capital (X1)	HC is measured by Human Capital Efficiency (HCE), which is the ratio between the company's value added (VA) and human capital costs such as salaries, training, and benefits. (Ousama et al., 2020)	$HCE = \frac{VA}{HC}$ (Pulic, 2004)
Structural Capital (X2)	SC is measured using the Structural Capital Efficiency (SCE) proxy, calculated by dividing structural capital (the difference between value added and human capital) by total value added. (Cenciarelli et al., 2018)	$SCE = \frac{SC}{VA}$ (Pulic, 2004)
Physical Capital (X3)	PC is measured using Capital Employed Efficiency (CEE), which is calculated by dividing value added (VA) by capital employed (CE), where CE is usually defined as total assets minus intangible assets. (Tran et al., 2022).	$CEE = \frac{VA}{CE}$ (Pulic, 2004)
Risk management (Z)	Liquidity risk management is measured using the Loan to Deposit Ratio (LDR), which is the ratio between total loans and total deposits. (Harb et al., 2022)	$LDR = \frac{Total\ Loans}{Total\ Deposits} \times 100\%$ (Harb et al., 2022)
Firm Size	This study uses Company Size as a control variable, with the Natural Logarithm of total company assets used as a proxy to measure Company Size (Suryani & Purbohastuti, 2020)	Size = Ln (Total Assets) (Suryani & Purbohastuti, 2020)
Leverage	Leverage is the ratio of a bank's total	$Leverage = \frac{Total\ Liabilities}{Total\ Equity}$



assets to its equity, where a lower equity-to-asset ratio indicates higher leverage.  
(Yu, 2024)

(Yu, 2024)

Source : Research Data, 2025

This study uses Model (1) to examine the effect of HCE, SCE, and CEE on bank productivity. Meanwhile, Model (2) is used to examine the moderating effect of risk management on the relationship between HCE, SCE, CEE, and bank productivity. The following are the regression equation models used in this study:

$$(1) \text{TFPCH} = \alpha + \beta_1\text{HCE} + \beta_2\text{SCE} + \beta_3\text{CEE} + \beta_4\text{LDR} + \beta_5\text{SIZE} + \beta_6\text{Lev} + \varepsilon + \mu$$

$$(2) \text{TFPCH} = \alpha + \beta_1\text{HCE} + \beta_2\text{SCE} + \beta_3\text{CEE} + \beta_4\text{LDR} + \beta_5\text{HCE}*\text{LDR} + \beta_6\text{SCE}*\text{LDR} + \beta_7\text{CEE}*\text{LDR} + \beta_8\text{Lev} + \beta_9\text{SIZE} + \varepsilon + \mu$$

Where:

TFPCH = Total Factor Productivity Change

$\alpha$  = Constant

$\beta_1 - \beta_9$  = Regression coefficient in each variable

HCE = Human Capital Efficiency

SCE = Structural Capital Efficiency

CEE = Capital Employed Efficiency

Lev = Leverage

SIZE = Company Size

LDR = Loan to Deposit Ratio

$\varepsilon$  = Error term

$\mu$  = Disturbance term

## Result and Discussion

Descriptive statistical analysis was conducted to provide an overview of data characteristics, such as mean, maximum, minimum, and standard deviation, so that patterns, trends, and data distribution could be identified before further analysis was performed.

Table 3 Descriptive Statistics of variables

Variable name	Number of observations	Mean	Standard deviation	Minimum value	Maximum value
VAIC	162	3.761	2.552	1.30	20.1
HCE	162	2.988	2.43	1.04	19.1
SCE	162	0.572	0.161	0.04	0.95
CEE	162	0.200	0.127	0	0.99
LDR	162	1.193	1.369	-1.39	9.349
TFPCH	162	1.026	0.252	0.33	1.946

Source : Research Data, 2025

The Total Factor Productivity Change (TFPCH) indicator stood at a mean of 1.0260, indicating positive growth in the overall operational efficiency of banks. although there are some banks that have experienced a decline in productivity, this figure is higher than the 2013–2018 period, which had a mean TFPCH for banks in Southeast Asia of 0.7682 during the 2013–2018 period, indicating significant productivity growth in the banking sector (Chowdhury & Haron, 2021).

VAIC values can be categorized based on their mean : if the VAIC value is  $\geq 3.00$ , it is considered very good, (2.00–2.99) is in the good category, (1.50–1.99) is in the fair category, and if the VAIC value is ( $< 1.50$ ), it is in the poor category (Sahari & Jais, 2021). Based on

Table 1, the mean VAIC value is 3.76 or  $\geq 3.00$ , which is in the very good (top) category, meaning that banks in Indonesia and Malaysia are highly efficient in managing their intellectual capital.

LDR has a mean of 1.1930 or 119%, which falls into the overloaning category, meaning there is a potential for a liquidity crisis. LDR values are divided into several categories: if the value is  $<70\%$ , the bank is considered conservative, meaning that funds are not being utilized to their full potential. A healthy LDR is between 70% and 90%, where funds are being used efficiently. If it is above 90%, it is classified as aggressive, meaning that funds are used to their full potential, but this increases liquidity risk. Furthermore, based on the results of the descriptive analysis, an LDR value of  $119\% > 100\%$  falls into the overloaning category (Idris et al., 2025). After conducting the descriptive analysis, the next step is the Hausman test.

Table 4 Hausman Result

Hausman Test	Chi2	Prob > Chi2	Result
Model 1	15.65	0.0079	FE
Model 2	0.00	0.0029	FE

Source : Research Data, 2025

Based on the Hausman test results, the probability value in model 1 is 0.0079 and in model 2 is 0.0029, indicating that the fixed effect is more appropriate than the random effect. This value ( $<0.05$ ) means that differences between banks in Indonesia and Malaysia significantly affect bank productivity. Thus, the fixed effect is able to capture the specific variations of each bank that cannot be explained by the random effect model. Therefore, further analysis should use the fixed effect model to produce more accurate estimates.

Table 5 Heterocedastisity dan Autokorelasi Result

Model 1		Model 2	
Full Sample	162	Full Sample	162
Heteroscedasticity		Heteroscedasticity	
Chi2	2499.65	Chi2	77022.99
Prob > Chi2	0.0000	Prob > Chi2	0.0000
Serial Correlation		Serial Correlation	
F	52.889	F	45.514
Prob > F	0.0000	Prob > F	0.0000

Source : Research Data, 2025

Based on the results of the heteroscedasticity test for the fixed effect regression model, the P value (Prob > Chi2) was below (0.05) in models 1 and 2, as indicated by a P value of  $0.0000 < 0.05$ . Furthermore, the P value (Prob > F) was also below (0.05), indicating the presence of autocorrelation. Table 4 shows significant serial correlation with a P-value (Prob > F) of  $0.006 < 0.05$  in Model 1 and  $0.0000 < 0.05$  in Model 2. Thus, it can be concluded that this indicates that the error variance varies among banking entities, so the model needs to be adjusted using robust SE methods to produce reliable estimates and corrections such as Driscoll-Kraay SE.

Table 6 Hypothesis Test Result (Model 1)

Driscoll-Kraay Standard Errors					
Hypothesis	Path	Coefficient	T value	P> t	Result
H1	HC→TFPCH	0.100	41.07	0.001***	Accepted
H2	SC→TFPCH	-1.076	-9.22	0.012**	Rejected
H3	PC→TFPCH	-0.171	-1.08	0.392	Rejected
H4	LDR→TFPCH	-0.136	-16.99	0.003***	Rejected
R-Squared		0.278			
F		44.64			

Prob > F	0.022
*10% Sign	
**5% Sign	
***1% Sign	

Source : Research Data, 2025

Table 7 Hypothesis Test Result (Model 2)

Driscoll-Kraay Standard Errors					
Hypothesis	Path	Coefficient	T value	P> t	Result
H5	HC*LDR→TFPCH	- 0.007	-0.60	0.611	Rejected
H6	SC*LDR→TFPCH	- 0.131	-2.75	0.111	Rejected
H7	PC*LDR→TFPCH	0.855	12.51	0.006***	Accepted
R-Squared		0.361			
F		104.88			
Prob > F		0.009			
*10% Sign					
**5% Sign					
***1% Sign					

Source : Research Data, 2025

The results of this study provide a diverse picture of the influence of intellectual components and risk management on bank productivity, particularly in Indonesia and Malaysia, as measured using Total Factor Productivity Change (TFPCH). In general, these results are in line with the Resource-Based View (RBV) theoretical framework, which emphasizes the importance of unique and difficult-to-imitate internal resources as the basis for long-term competitive advantage.

The first hypothesis in this study was accepted. The finding that human capital (HC) has a positive and significant effect at a significance level of 1% on bank productivity reinforces the argument that the quality of human resources is a strategic asset that greatly determines efficiency and innovation in the banking sector. This aligns with the Resource-Based View (RBV), which views knowledge and skills as the primary drivers of competitive advantage (Flayyih Hamzah & Dahham Tanai, 2024). Investments in training, competency development, and strengthening organizational culture have proven to effectively enhance Total Factor Productivity (TFPCH), consistent with previous findings in the literature supporting the contribution of HC to organizational performance (Testa et al., 2024).

Conversely, structural capital (SC) shows a significant negative and significant effect at a significance level of 5% relationship with productivity. These results contradict the initial hypothesis and most of the literature that emphasizes the important role of systems, processes, and organizational structures in supporting performance. However, this negative result can be explained by the context of SC implementation, which may not yet be optimal, such as systems and procedures that are not adaptive or bureaucratic. This finding is in line with studies such as (Istikamah & Wulandari, 2023), which found that the effectiveness of SC is highly dependent on the suitability of the context and its execution within the organization. Therefore, the second hypothesis in this study is rejected.

Meanwhile, physical capital (PC) as a proxy with capital employed does not show a significant effect on productivity. Although it has a positive coefficient, its significance is low, indicating that an increase in tangible assets does not necessarily improve efficiency or productivity. This aligns with the findings of (Dragomir, 2024) dan (Sardo et al., 2018), which show that in the service industry, the accumulation of physical assets without effective utilization can actually lead to operational burdens. The Resource-Based View (RBV) theory

also emphasizes that physical assets have low flexibility and are easily imitated, making them not the primary source of sustainable competitive advantage. Thus, the third hypothesis in this study is rejected.

These findings indicate that risk management, in some cases, significant negatively moderates the relationship between intellectual capital and productivity, and significant effect at a significance level of 1% meaning that the fourth hypothesis in this study is rejected. These results show a negative relationship, meaning that the higher the LDR ratio, the more likely it is to decrease bank productivity. An excessively high LDR ratio may indicate that the bank is extending too much credit relative to its third-party funds (Sari et al., 2022). This situation poses risks to the bank's liquidity and increases the potential for non-performing loans, ultimately negatively impacting the bank's operational efficiency and productivity. Banks that are overly focused on pursuing productivity through credit expansion without proper risk management fail to utilize resources strategically and may potentially trigger a crisis (Ashik-Uz-Zaman et al., 2025). The relationship between productivity and bank financial performance, considering indicators such as customer deposits, fixed assets, and staff costs (Haris et al., 2024).

In the relationship between risk management and HC and SC, moderation shows a negative and insignificant direction. This indicates that a risk management approach that is too rigid or standardized can hinder the creativity and flexibility needed by human resources and internal systems to drive productivity. This is supported by the research of Riani et al. (2023) dan Eltweri et al. (2024) which states that restrictive risk management can limit an organization's potential to maximize its intellectual assets. Therefore, the fifth and sixth hypotheses in this study are rejected.

Risk management moderates the influence of physical capital on banking productivity shows a significant and significant effect at a significance level of 1%. Effective risk management has been shown to strengthen this relationship, indicating that with good risk management, tangible assets can be used more efficiently and productively. This finding is in line with the views of Tan et al. (2022) and Malik et al. (2020), who highlight the importance of risk control systems in ensuring the optimal utilization of physical capital to support productivity. Thus, the seventh hypothesis is accepted.

Overall, the results of this study confirm that contributions to bank productivity do not only depend on the availability of resources, but also on how those resources are managed and integrated into organizational strategies. Intellectual capital components, especially human capital, have been proven to be the main drivers of productivity, while the roles of physical capital and structural capital are highly dependent on context and implementation. Risk management plays an ambivalent role, as it can either support or hinder productivity depending on its flexibility and alignment with the company's internal needs. Therefore, strategies to enhance banking productivity in Indonesia and Malaysia must consider a balance between strengthening internal resources and implementing adaptive risk management. (Chowdhury & Haron, 2022).

## **Conclusions and Recommendations**

This study concludes that intellectual capital, particularly human capital plays an important role in increasing bank productivity in Indonesia and Malaysia. Risk management has been proven to play a moderating role in strengthening the relationship between intellectual capital and bank productivity. These findings indicate that effective intellectual resource management, when accompanied by adequate risk management, can support the achievement of optimal productivity in the banking industry.

This study offers a novel approach by measuring bank performance through Total Factor Productivity Change (TFPCH), which is more comprehensive than traditional financial indicators such as ROA or ROE, thereby providing a realistic picture of bank productivity. Furthermore, this research is conducted across countries in the banking sectors of Indonesia and Malaysia, enabling a comparative perspective on how intellectual capital affects productivity in two financial systems that are similar yet have different characteristics. Another novelty lies in the use of the Loan to Deposit Ratio (LDR) as a proxy for liquidity risk management, which is more proactive than Non-Performing Loans (NPL), which tend to be reactive, thereby revealing the role of risk management in strengthening or weakening the influence of human capital, structural capital, and capital employed efficiency on bank productivity. Thus, this study presents a new integration between intellectual capital, risk management, and bank productivity that has been rarely explored in previous literature.

Theoretically, this study contributes to the development of research within the Resource-Based View (RBV) framework by highlighting the importance of synergy between internal resources that are not easily imitated. From a practical perspective, these results provide input for banking management to not only focus on financial efficiency but also strengthen human resource development strategies and risk management as part of intellectual capital management. This underscores the originality of this research in examining the integrated relationship between intellectual capital and risk management on bank productivity in two countries with different economic contexts.

The limitations of this study lie in its quantitative approach, which is not yet fully capable of capturing the practical dynamics of intellectual capital management and risk management in the field. Risk management measurements are also still limited to financial indicators, without considering qualitative dimensions such as risk culture or management orientation. Therefore, further research is recommended to use a more holistic mixed-method approach and consider external factors such as regulations, market conditions, and technological developments. This will allow for a more comprehensive understanding of the relationship between intellectual capital, risk management, and productivity.

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