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Determinants of Information Technology Investment Expenditure

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Abstract: Amid globalization, financial deregulation, and market volatility, banks aggressively adapt to maintain long-term competitive advantages. While digital transformation is non-negotiable, heavy capital allocations for Information Technology (IT) often face the "productivity paradox," where extensive spending does not automatically translate into immediate efficiency or output returns. Objective: This study aims to analyze the critical internal and external determinants of IT Investment Expenditure in the Indonesian banking industry. Methodology: Drawing upon the Resource-Based View (RBV) and Dynamic Capabilities Theory, this study utilizes panel data from commercial banks listed on the Indonesia Stock Exchange (IDX) and registered with the Financial Services Authority (OJK) from 2010 to 2023. The empirical framework corrects prior model discrepancies by formally treating Bank Risk as an independent control variable. Model selection was rigorously evaluated using the Chow, Hausman, and Lagrange Multiplier (LM) tests, validating the Fixed Effect Model (FEM) as the most robust specification. Results: The empirical findings demonstrate that Leadership and Efficiency (BOPO) have a statistically significant positive impact on IT Investment Expenditure. Conversely, Bank Size exhibits a statistically significant negative effect. Client-Based variables, Bank Risk (NPL), and the COVID-19 pandemic dummy do not show a statistically significant direct impact on IT expenditures. Conclusion: The findings suggest that smaller banking institutions bear a disproportionately higher financial burden relative to their asset size to keep pace with technological changes, whereas larger banks successfully exploit structural economies of scale in their IT infrastructure deployment.

Keyword: IT Cost, Leadership, Efficiency, Bank Size, Resource-Base View, Dynamic Capabilities.

INTRODUCTION

Amidst the maelstrom of globalization, deregulation, the onslaught of non-bank financial institutions, and volatile market dynamics, banks continue to adapt to maintain their profitability. Understanding and continually updating knowledge regarding the determinants of banking profitability are key to effective bank management, ensuring the existence and stability of banks as financial drivers and contributing to the nation's economic development.

Bank profitability, like the pulse of the financial system, serves as an indicator of the health and resilience of banking institutions. Consequently, the underlying factors are increasingly complex and can be divided into three groups: bank-specific determinants, industry-specific determinants, and the macroeconomic environment. Traditionally, banking profitability and financial resilience have been evaluated through a combination of bank-specific indicators, industry concentrations, and macroeconomic shifts. However, the contemporary financial landscape is undergoing an aggressive digital paradigm shift. Modern bank survival and performance are heavily dictated by the strategic and effective implementation of information technology (IT). Advanced digital products and services ranging from cloud-based systems and automated mobile processing to artificial intelligence (AI) have restructured how consumer satisfaction and operational networks are delivered. However, today, the banking landscape is undergoing a drastic transformation. Bank performance is determined not only by the traditional factors mentioned above but also by the effective implementation of information technology. Information technology has become a crucial element in supporting operations and improving banking performance.

Many banking products and services have used information and communication technology (ICT), now called digital technology (DT) in the production and delivery process to achieve effective and efficient ways of generating satisfaction and experience for customers. (Beccalli, 2007). The costs required to implement information technology are quite large and require skilled and trained human resources. The problem lies in the fact that there are still human resources who are not yet aware of information technology. This has resulted in the phenomenon of the "productivity paradox". Solow (1987) stated that "you can see computers everywhere except in productivity statistics". According to Roach (1994), the productivity paradox as a phenomenon of mismatch between the amount of investment spent on information technology needs and the total size of output produced. And currently, with digitalization, we are still in the cycle of the Solow productivity paradox. The development of information technology, such as cloud, e-commerce, mobile internet, Artificial Intelligence, Machine Learning, and the Internet of Things, has gone beyond process optimization to fundamentally transform business models, changing the value chain, especially in the banking world. Research on information technology investment spending. To address this paradox, academic attention must shift from merely evaluating IT outputs to uncovering the systematic internal drivers that compel corporate managers to allocate capital budgets into IT infrastructure in the first place.

Leadership plays a significant role in a company's success. Creative leaders are key to achieving profitability and sustaining their business. Madanchian dan Taherdoost (2019). He stated that leadership effectiveness is the key to a company's success. With all their strengths, leaders play a central role in allocating a company's budget. (Firmansyah, 2019). This study will use leadership as an independent variable influencing information technology investment spending. Visionary and results-oriented leaders will encourage companies to invest in information technology that can help them achieve their strategic goals.

This study will use bank size as an independent variable influencing information technology investment spending. Lullah et al. (2020) explains that bank size has a positive influence on information technology investment spending. Larger banks tend to invest more in information technology than smaller banks. This is because larger banks have more

resources to invest in technology and have a greater need to use technology to improve efficiency, productivity, and customer service.

Another independent variable included in this study is bank efficiency. Hamdani et al. (2018) stated that the BOPO (Operating Cost to Operating Income) ratio significantly influences ROA. A more efficient bank indicates its ability to effectively reduce operational costs. Greater efficiency allows the bank to allocate funds for information technology investment.

Client-based is another independent variable included in this study. Bank Indonesia Regulation No. 3/10/PBI/2001 concerning the Implementation of Know Your Customer Principles requires banks to know their customers, from identifying them to monitoring and reporting suspicious transactions. This is due to the client-centric banking philosophy, which strives to understand client needs. The more clients an organization has, the more data it needs to store and process. This can lead to a greater need for more robust hardware and software, such as servers, software, and data storage.

This study covers the period from 2010 to 2023, during which the COVID-19 pandemic has generally impacted business activities. Therefore, the study includes a dummy variable as an independent variable representing the COVID-19 period. Several experts have demonstrated the significant impact of COVID-19 on company performance (Ciotti et al., 2020; Ngo & Duong, 2024; Shen et al., 2020; Shaharuddin, 2021). Furthermore, Daryanto et al. (2023) also noted the significant impact of COVID-19 on company performance in the construction sector. Furthermore, Alsamhi et al. (2022) also found a significant impact of COVID-19 on company performance in India.

After seeing this phenomenon, the researcher conducted research on the Determinants of Information Technology Investment Expenditure.

While a vast body of literature focuses on how IT adoption improves overall bank performance, empirical research exploring what internal firm characteristics determine the scale of a bank's IT spending remains remarkably scarce—particularly within emerging markets like Indonesia that are undergoing state-mandated digital transformations. Prior studies often suffer from model specification issues, treating operational risks and systemic shocks in isolation. The novelty of this study lies in its multi-dimensional structural approach: It uncovers the core drivers of IT capital allocation by examining internal organizational capabilities: strategic Leadership compensation, structural operational Efficiency (BOPO), and asset Scale economies. It explicitly models how banks adjust their technological budgeting in response to internal financial vulnerabilities (Bank Risk) and severe external macroeconomic shocks (the COVID-19 pandemic).

METHOD

Model Panel Data

This research utilizes a panel data model to estimate the relationship between several independent variables to determine profitability as the dependent variable. These variables include IT costs, leadership, efficiency, bank size, client base, and the COVID-19 pandemic period, all of which serve as independent variables. The panel data model is suitable for small data sets with short time series and small companies as samples. Furthermore, the panel data model also includes both time and cross-sectional data. Gujarati (2003), Wooldridge (2002), Greene (2008), Biorn (2017), Sul (2019), and Manurung (2024b) state that the panel data model is as follows:

a. Pooled Data Model

Pooled Data Model is a model that combines all data and its models, as follows:

$$Y_{i,t} = \beta_1 + \beta_2 X_{2i,t} + \beta_3 X_{3i,t} + \mu_{i,t} \quad (7)$$

$i = 1, 2, \dots, k; t = 1, 2, \dots, n$

X's is non-stochastic and $E(\mu_{it}) \sim N(0, \sigma^2)$

b. Fixed Effect Model

FEM is a model that assumes μ_i with X's correlation.

$$Y_{i,t} = \beta_{1i} + \beta_2 X_{1i,t} + \beta_3 X_{2i,t} + \mu_{i,t} \quad (8)$$

$i = 1, 2, \dots, k; t = 1, 2, \dots, n$

c. Random Effects Model (REM)

REM is a model that assumes ϵ_i and Xs are uncorrelated.

$$Y_{i,t} = \beta_{1i} + \beta_2 X_{1i,t} + \beta_3 X_{2i,t} + \mu_{i,t} \quad (9)$$

$$\beta_{1i} = \beta_1 + \epsilon_i$$

$i = 1, 2, \dots, k; t = 1, 2, \dots, n$

μ_i is a random error with a mean score of zero and variants σ_ϵ^2 .

Judge (1982), Wooldridge (2002), Biorn (2017), Sul (2019) and Manurung (2024b) states that how we choose FEM or REM is as follows:

1. If T (total time series data) is larger and N (total cross-sectional units) is smaller, FEM is probably better.
2. If N is larger and T is smaller, if we are confident that the individual units or cross-sectional units in our sample are not random samples from the larger sample, FEM is the appropriate choice. If the cross-sectional units in the sample are considered random samples, then REM is the appropriate choice.
3. If the individual error components ϵ_i and one or more regressors are correlated, FEM is an unbiased estimator.
4. The REM estimator is more efficient than the FEM estimator when N is larger and T is smaller and when the assumptions underlying REM hold.

This study analyzes panel data comprising both cross-sectional bank units (i) and sequential time series (t) from 2010 to 2023. To justify the selection of the estimation technique among Pooled OLS (Common Effect Model), Fixed Effect Model (FEM), or Random Effect Model (REM), three formal diagnostic tests were executed: Chow Test: Evaluates whether cross-sectional intercepts are redundant (H_0 : Pooled OLS vs. H_1 : FEM). Hausman Test: Evaluates the correlation between individual error components and the regressors (H_0 : REM vs. H_1 : FEM). Lagrange Multiplier (LM) Test: Validates the presence of random individual effects (H_0 : Pooled OLS vs. H_1 : REM). Given the long time horizon ($T = 14$ years) relative to specific listing criteria constraints, the Fixed Effect Model (FEM) was statistically selected. It provides consistent and unbiased estimators when internal corporate individual errors correlate with organizational regressors.

Data Sources

This research uses annual data for the Information Technology Investment Expenditure variable as the dependent variable, Leadership, Efficiency, Bank Size, and Client-Based as the independent variables, and Bank Risk as the moderate variable. The data were collected from bank company data, the Indonesia Stock Exchange, and the Financial Services Authority. The research period is 2010-2023.

RESULT AND DISCUSSION

The discussion is divided into two main sections. The discussion begins with descriptive statistical analysis, followed by correlation analysis between variables, and then continues with causality analysis.

Descriptive Statistics

This sub-chapter will discuss the descriptive statistics of the variables studied. The descriptive statistics are shown in Table 1 below.

This sub-chapter will discuss the descriptive statistics used in the research data. The variables analyzed are as described previously.

Table 1. Descriptive Statistics of Research Variables

	LDE	EFF	SIZE	CLIENT	TI	RISK
Mean	0.000853	0.858841	0.239874	0.044764	0.002072	0.427300
Median	0.000669	0.833450	0.176973	0.004168	0.001807	0.377392
Maximum	0.003228	2.878600	2.439870	0.451221	0.007908	2.132856
Minimum	0.000130	0.437600	0.024443	5.74E-05	1.22E-05	0.126231
Std. Dev.	0.000589	0.246081	0.237593	0.096898	0.001624	0.219325
Skewness	1.896516	4.293665	4.060071	2.985122	1.268714	2.990900
Kurtosis	6.922916	30.17138	33.19902	11.30430	4.865338	19.20556
Jarque-Bera	295.2822	8052.591	9697.681	1037.334	98.35378	2959.153

Source: Eviews Panel Data Regression Output

The average information technology (IT) investment expenditure was 0.2072% with a standard deviation of 0.1624%. In 2015, PT Bank Sinarmas Tbk achieved a high score of 0.7908%. In 2021, the minimum score for PT Bank Negara Indonesia (Persero) Tbk was 0.00122%. These figures indicate a small variation in IT Investment Expenditures. This ratio has a normal distribution using the Jarque Bera test.

The average leadership coefficient (LDE) was 0.0853% with a standard deviation of 0.0589%. In 2010, PT Bank Mayapada Tbk achieved a maximum score of 0.3228%. In 2010, the minimum score for PT Bank Rakyat Indonesia (Persero) Tbk was 0.0130%. These figures indicate a very small variation in Banking Management Fees. This occurs because banking management salary and benefit costs are standardized, so there is little variation. This ratio has a normal distribution using the Jarque Bera test.

The average efficiency ratio (EFF) was 85.884% with a standard deviation of 24.608%. In 2021, PT Bank Raya Indonesia Tbk recorded a maximum value of 287.86%. The lowest value was held by PT Bank Central Asia Tbk at 43.76% in 2010. These figures indicate significant variation in the Efficiency Ratio (BOPO). This indicates that the BOPO ratio remains a concern for the banking industry. This ratio exhibits a normal distribution using the Jarque Bera test.

The average bank size was 23.987% with a standard deviation of 23.759%. In 2021, PT Bank Raya Indonesia Tbk had a maximum value of 243.987%. In 2019, PT Bank Victoria International Tbk recorded a minimum value of 2.443%. These figures demonstrate significant variation in the bank size ratio. This indicates varying bank capitalization due to differences in bank share prices and the number of shares outstanding. This ratio has a normal distribution using the Jarque Bera test.

The client-based mean is 4.476%, with a standard deviation of 9.689%. In 2010, PT Bank Rakyat Indonesia (Persero) Tbk reached a maximum value of 45.122%. In 2023, PT Bank Bumi Arta Tbk recorded a minimum value of 0.005743%. These figures indicate significant client-based variation. This reflects the differences in the total number of customer accounts held by each different bank. This ratio has a normal distribution using the Jarque Bera test.

The average risk is 42.73% with a standard deviation of 21.9325%. In 2010, PT Bank Sinarmas Tbk achieved a high value of 213.2856%. In 2020, PT Bank MNC Internasional Tbk recorded a minimum value of 12.6231%. These figures indicate significant bank risk variation. This indicates that the banking sector faces high risks. This ratio has a normal distribution using the Jarque Bera test.

IT Causality Analysis

As previously described, this study aims to analyze the factors influencing information technology. The model developed using Eviews-13 with data from 2010 to 2023 is as follows:

$$\begin{aligned}
 TI_{i,t} = & 0.001580 + 0.000863 \text{ Client}_{i,t} + 0.000364 \text{ Eff}_{i,t} - 0.000250 \text{ Size}_{i,t} \\
 & (0,4031) \quad (2,8061) \quad (-1,955) \\
 & + 0.265276 \text{ LDE}_{i,t} - 0.00005790 \text{ Risk}_{i,t} - 0.00000585 \text{ PDM}_t \\
 & (4,8186) \quad (-0,4661) \quad (-0,14004)
 \end{aligned}$$

R-squared = 93.81%; Ftest = 148.1728, numbers in brackets are T-test (10)

This model has a determination of 93.81%. This indicates that the independent variables Leadership, Efficiency, Bank Size, Client-Based, and Bank Risk have a 93.81% influence on the dependent variable, IT, as measured by IT Cost. The remaining 6.19% is influenced by other factors not included in the model. It can be concluded that there is a strong relationship between the independent variables Leadership, Efficiency, Bank Size, Client-Based, and Bank Risk and the dependent variable, IT, as measured by IT Cost.

This model also performs well as a financial model. Furthermore, a goodness-of-fit test was conducted using the F-test. This test confirmed that Equation (10) is an appropriate model for estimating IT Cost for the banking industry. As previously mentioned, this study aims to explore the determinants of Information Technology Investment Expenditures (IT Cost).

Efficiency is crucial for banking companies to support their financial performance. The more efficient a company is, the better its sustainability. Efficiency is also included as an independent variable influencing information technology investment expenditures. The efficiency variable is measured by operating costs divided by operating income. The Efficiency variable (EFF) significantly positively influences IT investment expenditure at the 5% significance level. The greater the variable expenditure, the higher the IT investment expenditure. The Efficiency variable has a coefficient of 0.0364 on the IT variable. A 1-unit increase in efficiency will result in a 0.0364 unit increase in IT investment expenditure. This research supports previous studies such as Mumin et al. (2014), Ackermann et al. (2007), Chen et al. (2006), Martínez et al. (2014), and Ginsberg and Venkatraman (1992).

In the banking industry, bank size is a crucial indicator of competitiveness and stability. Bank size is included as an independent variable to influence information technology investment spending. Bank size in this study is measured by multiplying the number of outstanding shares by the year-end share price, divided by the bank's total assets. Bank size significantly negatively influences technology investment spending at the 10% significance level. These results indicate that a smaller bank size will increase information technology investment spending. The Bank Size variable has a coefficient of -0.0250 on the IT variable. A decrease in bank size by one unit will result in a decrease in information technology expenditure by 0.0250 units. This study supports previous research by Shih et al. (2007), Ou et al. (2009), Hannan and McDowell (1984), Turner (1983), and Shevlin (2019).

Leadership is the managerial ability possessed by management to manage the bank in which they work. The Leadership variable is included as a variable projecting operational cost. The Leadership variable has a coefficient of 0.2653 on the IT variable. This means that if the Leadership variable increases by 1 unit, the TI variable increases by 0.2653 units. The

Leadership variable significantly influences TI at the 5% significance level. The results of this study are consistent with previous research by Sollosy and Weible (2020), Banker et al. (2011), Khallaf et al. (2017), Adigwe et al. (2023), and Gotcheva et al. (2013).

This study also included variables such as bank risk, client base, and the COVID-19 pandemic, all of which did not impact information technology investment spending. These variables were not significant at the 10% level.

Based on this description, bank owners are not concerned about spending large sums on leadership skills to ensure they obtain high-quality IT. Good management will manage the company effectively, so IT expenditure will require high-quality IT. The larger the company, the smaller the bank's IT expenditures, indicating that the larger the scale, the more sophisticated IT with a low cost is needed.

CONCLUSION

Based on the previous description, this study provides the following conclusions:

1. Leadership significantly influences banks' IT investment expenditures.

The empirical results reveal that Leadership compensation has a highly significant positive impact on IT expenditure. This finding strongly aligns with Dynamic Capabilities Theory. Top-tier executive management teams commanding competitive compensation packages are inherently linked to advanced IT governance strategies. Visionary leaders actively allocate substantial investment budgets toward digital architectures, cloud transformations, and algorithmic systems to secure the long-term survivability of the bank rather than prioritizing short-term cost reductions.

2. Efficiency, as measured by BOPO, significantly influences banks' IT investment expenditures.

The positive coefficient of the BOPO ratio indicates that as operational inefficiency increases, the proportion of capital allocated to IT investment expenditure relative to total assets also rises. This uncovers an institutional phenomenon: Indonesian commercial banks facing elevated operational stress (high BOPO) intentionally inject capital into IT networks as a strategic correction mechanism. Management uses IT investments to automate manual processes, digitize redundant brick-and-mortar operations, and reduce long-term transactional overhead costs.

3. Bank size, as measured by market capitalization, significantly influences banks' IT investment expenditures.

Bank Size proximity by market capitalization exhibits a significant negative relationship with the IT spending ratio. This finding provides clear evidence of structural economies of scale in banking digital infrastructure:

Larger Banking Conglomerates: Large institutions have already established and fully amortized their core digital banking architecture. As their total assets grow exponentially, their marginal IT maintenance expenditure shrinks as a percentage of total assets. While the **Smaller Banking Institutions:** Smaller or digital-native banks face steep entry barriers. To compete with dominant financial conglomerates and FinTech disruptors, these institutions must allocate a disproportionately larger percentage of their total asset capital to fund essential IT infrastructure.

4. The F-Test indicates that the variables Leadership, Efficiency, Bank Size, Client-Based, Risk, and the Covid-19 period collectively influence banks' IT investment expenditures.

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