Capital Structure and Technology Investment on Profit Growth: The Moderating Role of Operational Efficiency in ASEAN Islamic Banks

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Abstract

This study examines the effect of capital structure and technology investment, proxied by non-interest expenses, on profit growth, with operational efficiency serving as a moderating variable in ASEAN Islamic banks. Unlike previous studies that primarily examine operational efficiency as a direct determinant of financial performance, this study evaluates its moderating role while employing non-interest expenses as an operational proxy for technology investment in the ASEAN Islamic banking context. Panel data from 26 Islamic banks during 2020–2024 were analyzed using the Random Effects Model (REM) and Moderated Regression Analysis (MRA). The results indicate that capital structure has no significant effect on profit growth (β = –28.942; p = 0.454), whereas technology investment has a positive and significant effect (β = 75.824; p = 0.004). Operational efficiency does not significantly moderate the relationship between capital structure and profit growth (β = 13.701; p = 0.173), but it significantly moderates the relationship between technology investment and profit growth through a negative interaction effect (β = –51.815; p = 0.037), indicating that the profitability benefits of technology investment depend on efficient operational cost management. These findings provide empirical evidence that technology investment contributes to sustainable profit growth only when supported by operational efficiency, thereby extending the application of X-Efficiency Theory in explaining financial performance within ASEAN Islamic banks.

Keywords: *Capital Structure; Technology Investment; Operational Efficiency; Profit Growth; Asean Islamic Banks; Panel Data; Moderating Effect.*

Abstrak

Studi ini meneliti pengaruh struktur modal dan investasi teknologi yang diwakili oleh pengeluaran non-bunga, terhadap pertumbuhan laba, dengan efisiensi operasional sebagai variabel moderasi di bank-bank Islam ASEAN. Berbeda dengan studi sebelumnya yang terutama meneliti efisiensi operasional sebagai penentu langsung kinerja keuangan, studi ini mengevaluasi peran moderasinya sambil menggunakan pengeluaran non-bunga sebagai proksi operasional untuk investasi teknologi dalam konteks perbankan Islam ASEAN. Data panel dari 26 Bank Islam selama tahun 2020–2024 dianalisis menggunakan Model Efek Acak (REM) dan Analisis Regresi Moderasi (MRA). Hasil menunjukkan bahwa struktur modal tidak memiliki pengaruh signifikan terhadap pertumbuhan laba (β = –28,942; p = 0,454), sedangkan investasi teknologi memiliki pengaruh positif dan signifikan (β = 75,824; p = 0,004). Efisiensi operasional tidak secara signifikan memoderasi hubungan antara struktur modal dan pertumbuhan laba (β = 13,701; p = 0,173), tetapi secara signifikan memoderasi hubungan antara investasi teknologi dan pertumbuhan laba melalui efek interaksi negatif (β = –51,815; p = 0,037), menunjukkan bahwa

manfaat profitabilitas dari investasi teknologi bergantung pada manajemen biaya operasional yang efisien. Temuan ini memberikan bukti empiris bahwa investasi teknologi berkontribusi pada pertumbuhan laba berkelanjutan hanya jika didukung oleh efisiensi operasional, sehingga memperluas penerapan Teori Efisiensi-X dalam menjelaskan kinerja keuangan di bank-bank Islam ASEAN.

Kata Kunci: *Struktur Modal; Investasi Teknologi; Efisiensi Operasional; Pertumbuhan Laba; Bank Syariah Asean; Data Panel; Efek Moderasi.*

INTRODUCTION

Islamic banking in the ASEAN region has experienced significant asset growth over the past two decades, reflecting its increasing role in the regional financial system (Sabila, 2025). Supported by ASEAN's strong economic development and large Muslim population, particularly in Indonesia and Malaysia, the Islamic banking industry continues to expand despite differences in market maturity among member countries (Rivaldi & Dompak, 2024; Nurmaulidia *et al*., 2024; Fadhil et al., 2024). However, the penetration of Islamic banking remains relatively low compared to conventional banking, indicating that substantial growth potential has yet to be fully realized (Putri *et al*., 2024). Pursuant to the Islamic Financial Services Board (IFSB) report, Islamic banking profits fluctuated from 2020 to 2024, with growth of around 14.9% in 2020–2021, a 50% jump in 2022, a 20% increase in 2023, and a further 23% increase in 2024 (IFSB 2025) . Since profit growth reflects a bank's ability to sustain its financial performance and enhance firm value, understanding the factors that influence profit growth has become increasingly important for both researchers and practitioners (Azizzah & Susanti, 2023) . Therefore, identifying the determinants of profit growth in ASEAN Islamic banks remains a relevant issue that warrants further empirical investigation.

Capital structure is considered one of the internal factors that may influence profit growth (Abraham & Sukartaatmadja, 2021). In the banking sector, capital adequacy is commonly measured by the Capital Adequacy Ratio (CAR), which represents a bank's ability to absorb potential risks while supporting business expansion (Jinggili *et al.*, 2022); (Lestari et al., 2025). Adequate capital enables banks to expand financing activities, strengthen financial resilience, and potentially improve profitability (Uran & Wuryani, 2019). Empirical evidence generally suggests that capital structure positively affects profit growth (Samosir *et al., (*2022); Febriyanti & Aini (2022). (Samosir et al.,

2022; Febriyanti & Aini, 2022). Moreover, previous studies have primarily focused on the direct relationship between capital structure and financial performance, while giving limited attention to the role of operational efficiency in determining how effectively capital contributes to profit growth, particularly within ASEAN Islamic banks. These limitations indicate that the relationship between capital structure and profit growth warrants further empirical investigation.

The development of Islamic banking assets continues to increase in line with global trends toward sustainable finance and service digitalization (Wirandana & Manda, 2024). Following the COVID-19 pandemic, Islamic banks have accelerated the adoption of digital services, automated operational processes, and technology-based financial innovations to improve customer experience and operational performance (Ronggo et al., 2022). This trend is evident across ASEAN, particularly in Indonesia and Malaysia, and is increasingly observed in emerging Islamic banking markets such as Brunei Darussalam, the Philippines, and Thailand (Nafiah, 2023; Wahyudi *et al.*, 2021). In this study, technology investment is proxied by non-interest expenses, reflecting expenditures that support digital infrastructure, technology-enabled operations, and banking innovation. Such investments are expected to reduce operational costs, improve service efficiency, and expand market reach, thereby contributing to higher profit growth (Sibarani *et al* ., 2025). Previous studies by Dibie and Nworie (2025) and Alshehadeh and Al-Khawaja (2022) reported that technology invesment positively influences profitability. Nevertheless, Keliuotytė-Staniulėnienė and Smolskytė (2019) suggested that technology investment may increase operational costs and financial risks when it is not supported by effective management. Furthermore, previous studies have primarily examined the direct effect of technology investment on financial performance, while limited attention has been given to the role of operational efficiency in determining whether technology investment can effectively enhance profit growth, particularly in the context of ASEAN Islamic banks. These limitations suggest that the relationship between technology investment and profit growth requires further empirical investigation.

Although previous studies have examined the effects of capital structure, technology investment, and operational efficiency on banking performance, most have treated operational efficiency as an independent variable that directly influences financial

performance. Consequently, limited attention has been given to its potential role as a contextual factor that may strengthen or weaken the relationship between strategic resources and profit growth, particularly within Islamic banks operating in the ASEAN region.

Based on these theoretical and empirical considerations, this study investigates the effects of capital structure and technology investment on profit growth, with operational efficiency serving as a moderating variable in Islamic banks across the ASEAN region during the 2020–2024 period. Grounded in X-Efficiency Theory, this study extends previous research by positioning operational efficiency not merely as a direct determinant of financial performance, but as a moderating mechanism that influences the effectiveness of capital utilization and technology investment in generating profit growth. By focusing on the ASEAN Islamic banking sector, this study contributes to the literature by providing empirical evidence from a regional context characterized by diverse banking systems and digital transformation while offering practical insights for bank managers in developing integrated strategies that combine capital management, technology investment, and operational efficiency to achieve sustainable financial performance.

RESEARCH METHODS

X-Efficiency Theory

Leibenstein (1979) X-Efficiency Theory explains that differences in company performance are determined not only by the amount of resources owned, but also by management's ability to manage those resources efficiently. In the context of Islamic banking, this theory is highly relevant because banks are not only required to achieve optimal financial performance but also to manage resources in accordance with Islamic principles, such as trustworthiness, fairness, and the avoidance of waste (israf). Therefore, the presence of substantial capital and sophisticated technology will not have a maximum impact on profit growth if not balanced by an adequate level of operational efficiency. Research of Kurniawati et al (2025) used the Cost Income Ratio (CIR) as the main reference for assessing bank productivity and efficiency on an international scale. In this study, operational efficiency is conceptualized as a moderating variable rather than a direct determinant of profit growth. This perspective is based on X-Efficiency Theory,

Capital adequacy and technology investment may provide strategic advantages; however, their effectiveness in generating profit growth is contingent upon the bank's capability to manage operational costs efficiently. Therefore, operational efficiency is expected to strengthen or weaken the relationship between capital structure, technology investment, and profit growth, making it a relevant contextual variable for explaining differences in financial performance among Islamic banks in the ASEAN region. Islamic banks that are able to maintain high levels of efficiency will more optimally utilize capital and technology to boost profitability (Sibarani *et al* ., 2025) .

Effect of Capital Structure and Profit Growth

Capital structure can be seen from the capital adequacy ratio (CAR) (Jinggili *et al.*, 2022). Banks that optimally carry out business activities thus make a positive contribution to profit growth (Wulandari & Rofiuddin, 2022) . Research by Samosir *et al.*, (2022) and Febriyanti and Aini (2022) suggests that the structure calculated from the CAR ratio influences profit growth. However, other studies by Faisal (2018) that excess capital can lead to inefficiency because funds are not used productively for financing activities. Based on previous research results, the alternative hypothesis in this study is:

H1: Capital Structure Has a Significant Effect on Profit Growth.

Effect of Technology Invesment and Profit Growth

Technology investment in this study is proxied by non-interest expenses, which represent banks' expenditures on information technology infrastructure, digital platforms, software development, system maintenance, employee training, and other operational activities supporting digital transformation (Hamdan et al., 2021). Although non-interest expenses may include various operational costs, previous banking studies suggest that increasing expenditures outside interest-related activities largely reflect investments aimed at improving technological capabilities and service innovation. Therefore, non-interest expenses are considered an appropriate proxy for technology investment, particularly in the context of Islamic banking, where digital transformation requires substantial operational spending to enhance efficiency, customer experience, and long-term competitiveness (Siswati & Hermansyah, 2025). Digital transformation can reduce

operational costs, increase service speed, and expand market reach, which in turn has the potential to increase profits (Sibarani *et al* ., 2025) . Previous research by Dibie and Nworie (2025) and Alshehadeh and Al-Khawaja (2022) suggests that technology invesment influences profitability, which in turn influences profit growth. Increasing profitability can lead to increased profit growth. Based on the results of previous research, the alternative hypothesis in this research is:

H2: Technology investment Has a Significant Influence on Profit Growth.

Operational Efficiency Moderates The Effect of Capital Structure on Profit Growth

A healthy capital structure reflects a bank's ability to manage capital to minimize risk while optimizing financial performance (Uran & Wuryani, 2019). Islamic banks able to maintain a high level of efficiency will be more optimal in utilizing capital and technology to drive profitability (Sibarani *et al* ., 2025) . Efficiency reflects the bank's ability to manage operational costs to generate optimal income (Putri *et al*., 2024). Research by Amalia *et al* . (2024) and Ayinuola and Gumel (2023) revealed that operational efficiency influences profitability. As a result, it also suggests that the impact of capital structure on profit growth in Islamic banks is moderated by operational efficiency. The disparities in study findings show that bank management's capacity to distribute capital effectively has a significant impact on how capital structure affects profit growth. In the context of Islamic banking in ASEAN, differences in bank size and market characteristics further underscore the critical role of operational efficiency as a moderating variable. Based on the results of previous research, the alternative hypothesis in this study is:

H3: Operational Efficiency Moderates the Effect of Capital Structure on Profit Growth.

Operational Efficiency Moderates The Effect of Technology Invesment on Profit Growth

Investment in digital banking technology enables Islamic banks to increase efficiency, expand service reach, and strengthen customer satisfaction (Siuwandy & Wibowo, 2020). A high level of efficiency will strengthen the positive influence of technology on profit growth, as advanced technology will not deliver optimal results if it is accompanied by wasteful costs. Conversely, even when technology is not fully optimized, banks can still

achieve profit growth if they are able to efficiently reduce operational costs. Therefore, operational efficiency is believed to either strengthen or weaken the influence of technology on profit growth. Based on previous research results, the alternative hypothesis in this study is:

H4: Operational Efficiency Moderates the Effect of Technology investment on Profit Growth.

Based on this description, the conceptual framework in this study is presented as follows:

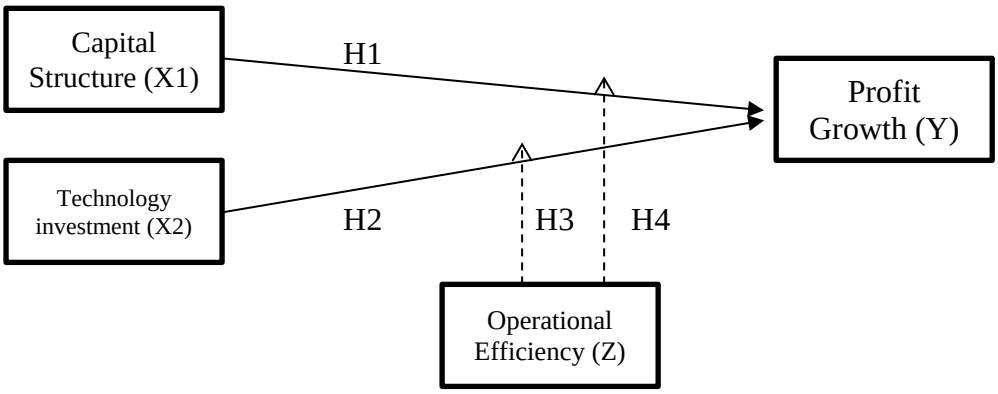

Figure 1. Research Framework

This research employs a quantitative descriptive design aimed at testing hypotheses related to the relationships and causal effects among the examined variables (Barlian, 2018) . The subject of this research is Islamic banks in the ASEAN region. The ASEAN region is known as one of the world's centers of economic growth, which has also encouraged increased banking activities, including Islamic banking (Rivaldi & Dompak, 2024). ASEAN is the region with the largest muslim population, especially Malaysia and Indonesia, which makes the Islamic banking market very potential (Nurmaulidia et al., 2024). This study employed secondary data obtained from the annual financial reports of Islamic banks operating in the ASEAN region during the 2020–2024 period. The observation period was deliberately selected to capture the dynamics of Islamic banking performance during and after the COVID-19 pandemic, a period characterized by accelerated digital transformation, increased adoption of financial technology, and significant changes in banking operations across ASEAN countries. During this period, Islamic banks intensified investments in digital banking services, automation systems,

and technology-enabled operations to maintain business continuity and enhance competitiveness. Consequently, the selected timeframe provides an appropriate context for examining how capital structure and technology investment influence profit growth under evolving operational conditions.

The population of this study consisted of 33 Islamic banks operating across ASEAN countries. To ensure data consistency and comparability throughout the observation period, a purposive sampling technique was employed. The sample selection was based on the criterion that Islamic banks consistently published complete annual financial reports during the 2020–2024 period. Banks that did not consistently publish annual reports were excluded because incomplete financial information would not allow the measurement of all research variables consistently across the observation period.

Table 1. Sample Slection Process

No.	Sampling Criteria	Number of Banks
1	**Islamic Banks Operating in ASEAN**	**33**
2	**Banks that did not consistently publish annual financial reports during 2020–2024**	**(7)**
	Final research sample	**26**
	Bank-year observations (26 × 5 years)	**130**

The data analysis was conducted using descriptive statistics and panel data regression analysis with the assistance of EViews 12 software. Descriptive analysis was employed to provide an overview of the characteristics of the research variables, while panel data regression was used because it combines cross-sectional and time-series observations, enabling more efficient estimation and better control of unobserved heterogeneity. Panel data estimation was performed using three alternative models, namely the Common Effects Model (CEM), Fixed Effects Model (FEM), and Random Effects Model (REM) (Dirna et al., 2025). (Dirna et al., 2025). Prior to hypothesis testing, the panel regression model was evaluated through the relevant diagnostic tests to ensure that the estimation results satisfied the required statistical assumptions. Hypothesis testing was subsequently conducted using the t-test to evaluate the significance of individual regression coefficients and the coefficient of determination (R^2) to assess the explanatory power of the model (

Sugiyono, 2020) . To examine the moderating role of operational efficiency, this study employed Moderated Regression Analysis (MRA). This approach enables the estimation of interaction effects between operational efficiency and the independent variables, thereby assessing whether operational efficiency strengthens or weakens the effects of capital structure and technology investment on profit growth (Ghozali, 2018). The following is the attachment of the model regression equation with interactions :

$$\mathbf{Y = \alpha + \beta\ 1X1 + \beta\ 2X2 + e}$$

$$\mathbf{Y = \alpha + \beta\ 1X1 + \beta\ 2X2 + \beta\ 3Z + \beta\ 4X1Z1 + \beta\ 5X2Z2 + e}$$

Information:

Y = Profit Growth

α = Costant

β = Reggresion Coefisient

X1 = CAR

X2 = NIE

Z = CIR

E = Error

DISCUSSION

Descriptive Analysis

This study applies descriptive statistical analysis to assess the overall characteristics and distribution of the collected data (Barlian, 2018). The condition of the data is described using statistical indicators, including the median, mean, minimum value, maximum value, and standard deviation. This study examines profit growth (Y) as the dependent variable, capital structure as measured by the Capital Adequacy Ratio (CAR) (X1) and technology investment as proxied by non-interest expenses (X2) as independent variables, with operational efficiency measured by the Cost-to-Income Ratio (CIR) (Z) serving as the moderating variable.

Table 1. Descriptive Anlysis

Variables	Profit Growth (Y)	CAR (X1)	Technology Invesment (X2)	CIR (Z)
Mean	**-0.151469**	**24.34269**	**17530.96**	**75.56482**
Median	**0.039500**	**19.95500**	**956,0000**	**59.11500**
Maximum	**118,5900**	**149.6800**	**189420.0**	**560,3000**
Minimum	**-117.2000**	**3.260000**	**17.63000**	**25,80000**
Std. Dev.	**16.10121**	**14.92361**	**37026.22**	**71.49461**
Skewness	**-0.364010**	**5.130305**	**2.487187**	**4.589599**
Kurtosis	**47.02179**	**40.32271**	**8.866496**	**26.47732**

Source: Output Eviews 12 (2025)

Table. 1 explain the Profit Growth (Y) shows that mark *minimum* amounting to -117.2000 and the value *maximum value* is 118.5900. Meanwhile, the *mean value* is -0.151469 with *a standard deviation* of 16.10121. This *standard deviation* is relatively large compared to the average value. It means condition variable Y varies greatly between One observation with observation other. Variables independent (X1) Capital Structure (CAR) show that mark *minimum* amounting to 3,260000 and the value *maximum* 149.6800. while the value *mean* amounting to 24.34269 with *standard deviation* of 14.92361. The relative *standard deviation* small compared to with *mean* show that CAR tends to nature homogeneous. Variables independent (X2) Technology show that mark *minimum* amounting to 17,63000 and the value *maximum* amounting to 189420.0. while mark *mean* amounting to 17530.96 with *standard deviation* of 37026.22. The relative *standard deviation* small compared to with *mean* show that Technology tend nature heterogeneous. variables moderation (Z) Efficiency Operational show that mark *minimum* amounting to 25,80000 and the value *maximum* 560,3000. whereas mark *mean* as big as 75.56482 with *standard deviation* 71.49461. *Standard deviation* 71.49 indicates existence difference efficiency sufficient bank operations significant, from the scale small up to the very large ones.

Model Determination

This study uses panel data regression, a development of OLS designed for time series and cross-sectional data. According to Dirna *et al.,* (2025) , there are three approaches to estimating the model parameters: *the Fixed Effects Model* (FEM), *the Common Effects Model* (CEM), and *the Random Effects Model* (REM).

Chow Test

The best panel data model between the Common Effect Model (CEM) and the Fixed Effect Model (FEM) is chosen using the Chow test (Dirna et al., 2025). The retrieval choice for Cross-Section F with see mark probability. The Common Effect Model (CEM) is adopted if the p-value is greater than 0.05. On the other hand, the Fixed Effect Model (FEM) is chosen if the p-value is less than 0.05.

Table 2. Chow Test Result

Effects Test	Statistic	d.f.	Prob.
Cross-section F	0,145765	(25,102)	1,0000
Cross-section Chi-square	4,563424	25	1,0000

Source: Eviews 12 (2025)

Based on table above, explained that second mark *Cross Section F and Chi Square* probability is higher big from mark probability 0.05 with the *probability value* is 1.0000 > 0.05, then the selected one is the *CEM Model*. Then the next test is the LM test.

Lagrange Multiplier (LM) Test

The retrieval choice for Cross-Section F with see mark probability. The Common Effect Model (CEM) is chosen if the p-value is greater than 0.05. On the other hand, the Fixed Effect Model (FEM) is chosen if the p-value is less than 0.05. The following results from LM test:

Table 3. LM Test Result

	Cross-section	Time	Both
Breusch-Pagan	**1.271.041**	**2.803.157**	**1.551.357**
	(0,0004)	**(0,0941)**	**(0,0001)**

Source: Eviews 12 (2025)

Based LM test results, *Breusch-Pagan* test results show mark *p-value* is 0.0001 < 0.05, so show that the right model namely the REM Model. Because the selected regression model is a REM model, then No need assumption testing was carried out classic because the random effect model is method trusted *generalized least squares* (GLS) estimation can overcome existence autocorrelation sequence time (*time series*) and correlation between observation (*cross section*) (Tambun & Sitorus, 2025) .

Hypothesis Test

Testing hypothesis is one of the the goal to be achieved proven in research. The t-statistic test, the F-statistic test, and the coefficient of determination are used in this study's hypothesis testing.

Partial Significance Test (t-statistic Test)

The Partial Test is conducted to assess the individual impact of each independent variable on the dependent variable (Sugiyono, 2020) . Variable X does not have a statistically significant impact on variable Y if the p-value is greater than 0.05. However, if the p-value is less than 0.05, it means that variable X has a statistically significant impact on variable Y. The results of the t-test in study This shown in table. 4 as following:

Table 4. Partial t-test Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17,23912	82,70152	2.084499	0,0392
CAR (X1)	-28,94239	38,5359	-0,7510500	0,4540
Technology (X2)	75,82400	26,0162	2,9145000	0,0044

Source: Eviews 12 (2025)

The t-test findings on variable X1 obtained a calculated t-value of -0.7510500, smaller than the t-table value of 2.084, and a sig-value of 0.4540 > 0.05, hence H1 is rejected. It might be read as the capital structure variable does not have a statistically significant effect on profit growth. The computed t-value for variable X2 was 2.9145000, which was higher than the t-table value of 2.084, and the sig-value was 0.0044 < 0.05. H2 is therefore approved. Therefore, it may be concluded that the technological variable affects profit growth in a statistically meaningful way.

Correlation and Determination Coefficient (R^2)

The Coefficient of Determination (R^2) represents the proportion of variance in the dependent variable that can be explained by all independent variables, both individually (partially) and collectively (simultaneously) (Sugiyono, 2020) . The coefficient of determination value ($0< R^2 < 1$). The following is a table. 5 of the R^2 test results:

Table 5. R^2 Test Result

Adjusted R-squared	0.410871

Source: Eviews 12 (2025)

An R-squared score of 0.410871 shows that the independent variables account for 41.1% of the variation in the dependent variable, while the remaining 58.9% is explained by factors outside the model.

Moderate Regression Analysis (MRA)

The degree to which moderating variables enhance or diminish the link between the independent and dependent variables is evaluated using Moderated Regression Analysis (MRA). Probability values are used in hypothesis testing; if a probability value is less than 0.05, H0 is rejected. Conversely, if the *probability value* is > 0.05, then H0 is accepted. The following is the panel data regression equation in this study:

Table 6. MRA Test Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CAR (X1) > CIR (Z) > Profit Growth (Y)	-32,61284	2,3790	-1.370854	0,1729

Technology (X2) > CIR (Z) > Profit Growth (Y)	-51,81510	2,4564	-2.109392	0,0369

Souce: Eviews 12 (2025)

The interaction of operational efficiency with capital structure on profit growth. The probability value of the CAR*CIR variable is 0.1729, or greater than 0.05, so H3 is rejected. This indicates that operational efficiency is unable to moderate the effect of capital structure. The profit growth in Sharia Commercial Banks in the ASEAN region. The interaction of operational efficiency with technology on profit growth. Mark probability from variables CIR*Technology that is of 0.0369 or is less than 0.05, then H4 is accepted. This shows that operational efficiency is able to moderate the influence of technology. on profit growth in Sharia commercial Banks in the ASEAN region.

Effect of Capital Structure and Profit Growth

Based on Table 4, the results of the partial (t-test) indicate that capital structure has no statistically significant effect on profit growth. This is evidenced by a calculated t-value of −0.751050, which is lower than the critical t-value of 2.084, and a significance level of 0.4540 (> 0.05). These findings suggest that maintaining a high level of capital adequacy alone is insufficient to generate higher profit growth. Although adequate capital strengthens financial stability and enhances banks' resilience against potential risks, it does not automatically translate into productive financing activities capable of increasing profitability (Qothrunnada & Wardana, 2021). Capital adequacy primarily functions as a prudential safeguard to absorb unexpected losses and satisfy regulatory requirements rather than as a direct source of income generation. Consequently, banks with relatively high capital ratios may adopt more conservative financing and investment policies to preserve financial stability instead of expanding productive financing aggressively (Subekti & Wardana, 2022). (Subekti & Wardana, 2022). As a result, excess capital may remain underutilized, limiting its contribution to sustainable profit growth.

These findings are consistent with Faisal (2018) as well as Syifa and Binastuti, (2024), who concluded that the Capital Adequacy Ratio (CAR) does not significantly influence profit growth. Similar results may occur because banks frequently prioritize regulatory compliance and risk mitigation over expanding financing portfolios, thereby

reducing the immediate financial benefits of higher capital adequacy. From the perspective of X-Efficiency Theory, this finding demonstrates that the availability of financial resources alone is insufficient to improve organizational performance. Rather, management's capability to allocate available capital efficiently toward productive financing and investment activities determines whether capital can generate sustainable profit growth. Therefore, the insignificant relationship identified in this study indicates that resource utilization is more important than resource availability in explaining financial performance among Islamic banks in the ASEAN region. These findings further suggest that even when banks possess adequate capital, profit growth may remain limited if those resources are not transformed into productive assets capable of generating sustainable returns (Lestari et al., 2025).

Effect of Technology Invesment and Profit Growth

Based on Table 4, the results of the partial (t-test) indicate that technology investment has a positive and statistically significant effect on profit growth. This is evidenced by a calculated t-value of 2.914500, which exceeds the critical t-value of 2.084, and a significance level of 0.0044 (< 0.05). These findings indicate that technology investment contributes positively to the profit growth of Islamic banks in the ASEAN region. The rapid adoption of digital banking services across ASEAN has intensified competition within the banking industry, encouraging Islamic banks to modernize operational processes and customer service channels (Ronggo et al., 2022). Investments in mobile banking, digital onboarding, automated transaction systems, and financial technology improve service quality, reduce transaction costs, accelerate business processes, and expand customer access (Singh et al., 2024). These improvements enable banks to increase operational productivity, strengthen customer satisfaction and loyalty, and ultimately generate sustainable profit growth. Furthermore, digital transformation creates competitive advantages by improving operational efficiency and expanding market reach, thereby enhancing banks' long-term financial performance (Sibarani *et al* ., 2025) .

These results are consistent with Dibie and Nworie (2025) and Alshehadeh and Al-Khawaja (2022), who reported that technology investment positively influences banking profitability. The present study extends these findings by demonstrating that the benefits

of technology investment are reflected not only in profitability but also in sustainable profit growth. From the perspective of X-Efficiency Theory, technology investment represents a strategic organizational resource whose economic value depends on management's ability to utilize it efficiently. Investments in digital infrastructure alone are insufficient to improve financial performance unless they are accompanied by effective implementation, integration into banking operations, and efficient resource management. Therefore, the positive relationship identified in this study suggests that Islamic banks in the ASEAN region have increasingly succeeded in transforming technology investments into operational improvements that support sustainable profit growth. From a managerial perspective, these findings imply that technology investment should not be viewed merely as an operational expenditure but as a long-term strategic investment. Accordingly, Islamic banks should continue strengthening digital transformation initiatives while simultaneously enhancing employee capabilities, technology integration, and operational governance to maximize the long-term financial benefits of digital innovation.

Operational Efficiency Moderates the Effect of Capital Structure on Profit Growth

Based on table 6. The result of MRA test, it shows that the probability value of the technology variable on growth profit Which moderated operational efficiency, obtained mark t-statistic as big as -2,109392 with probability the coefficient of return (R) is 0.0369, which is smaller than 0.05. This indicates that operational efficiency can moderate the influence of technology on profit growth in Islamic banks in ASEAN. The interaction coefficient is negative, indicating that increasing operational costs may reduce the marginal contribution of technology investment to profit growth. One possible explanation is that capital adequacy primarily functions as a prudential safeguard intended to maintain financial stability, absorb unexpected losses, and comply with regulatory requirements rather than directly generating income. Consequently, regardless of whether operational efficiency is relatively high or low, maintaining excess capital alone is unlikely to improve profit growth unless those financial resources are effectively allocated to productive financing and investment activities (Dwinanda & Sulistyowati,

2021). This finding suggests that the effectiveness of capital adequacy depends more on strategic capital allocation than on operational efficiency.

Although these findings differ from the expectations of Leibenstein 's (1979) *X-Efficiency Theory*, Leibenstein's (1979) X-Efficiency Theory, they do not necessarily contradict its fundamental proposition. X-Efficiency Theory emphasizes that organizational performance depends on the efficient utilization of resources; however, capital adequacy differs from operational resources because its primary objective is to ensure financial resilience and regulatory compliance. Therefore, improvements in operational efficiency alone may not be sufficient to enhance the contribution of capital adequacy to profit growth. Instead, other organizational factors, such as asset quality, financing quality, risk management practices, and strategic financing decisions, are likely to play a more influential role in determining how capital contributes to financial performance in Islamic banks across the ASEAN region (Sibarani *et al* ., 2025).

Operational Efficiency Moderates the Effect of Technology Invesment on Profit Growth

Analysis (MRA) indicate that the interaction between technology investment and operational efficiency has a statistically significant effect on profit growth. This is evidenced by a t-statistic of −2.109392 and a significance value of 0.0369, which is below the 0.05 significance level. The negative interaction coefficient indicates that operational efficiency significantly moderates the relationship between technology investment and profit growth. More specifically, although technology investment contributes positively to profit growth, its marginal contribution becomes weaker when technology-related expenditures are not accompanied by efficient operational management. This finding suggests that technology investment alone is insufficient to generate sustainable financial benefits. Investments in digital infrastructure, financial technology, cybersecurity systems, software maintenance, and employee capability development generally require substantial financial resources. During the early stages of digital transformation, these investments often increase operational expenses before productivity gains can be fully realized. Consequently, banks with inefficient operational management may experience diminishing returns from technology investment because additional technology-related

expenditures are not immediately translated into higher operational productivity or financial performance. In contrast, banks with better operational efficiency are more capable of integrating technological resources into their business processes, optimizing cost structures, and improving service quality, thereby maximizing the financial benefits of digital transformation (Siuwandy & Wibowo, 2020) This finding is also consistent with Staniulėnienė and Smolskytė (2019), who argued that technology investment may initially increase operational costs and financial risk when it is not supported by effective managerial capabilities.

This result Is consistent with Leibenstein (1979) *X-Efficiency Theory*, these findings reinforce the argument that organizational performance depends not only on the availability of strategic resources but also on management's capability to utilize those resources efficiently. Technology investment represents a valuable organizational resource; however, its economic value can only be realized when accompanied by efficient operational processes, effective cost control, and appropriate managerial practices. Accordingly, this study extends the application of X-Efficiency Theory by demonstrating that operational efficiency functions as an important organizational mechanism through which technology investment is translated into sustainable profit growth in Islamic banks operating across the ASEAN region.

Overall, the findings demonstrate that sustainable profit growth in Islamic banks across the ASEAN region depends not only on the availability of financial resources but, more importantly, on how effectively those resources are managed and utilized. While capital adequacy contributes to financial stability, it does not automatically enhance profit growth unless it is translated into productive financing and investment activities. Conversely, technology investment contributes positively to profit growth, although its effectiveness depends on the bank's ability to maintain high operational efficiency. These findings suggest that operational efficiency plays a critical role in determining whether strategic resources can be transformed into superior financial performance.

The study also provides empirical support for Leibenstein's X-Efficiency Theory by demonstrating that managerial capability in utilizing available resources is more important than resource ownership itself. In particular, operational efficiency emerges as a key organizational mechanism that determines the effectiveness of technology

investment in generating sustainable profit growth. Therefore, Islamic banks should adopt integrated strategies that combine prudent capital management, technology investment, and continuous improvements in operational efficiency to strengthen long-term competitiveness and financial sustainability within the increasingly digitalized ASEAN banking industry.

CONCLUSION

This study examined the effects of capital structure and technology investment on profit growth, with operational efficiency serving as a moderating variable in Islamic banks across the ASEAN region during the 2020–2024 period. The findings reveal that capital structure does not significantly influence profit growth, indicating that capital adequacy alone is insufficient to improve financial performance unless it is effectively allocated to productive financing activities. Conversely, technology investment has a positive and significant effect on profit growth, highlighting the important role of digital transformation in strengthening the financial performance of Islamic banks. Furthermore, operational efficiency does not significantly moderate the relationship between capital structure and profit growth but significantly moderates the relationship between technology investment and profit growth. These findings demonstrate that the effectiveness of technology investment depends not only on the amount of investment but also on the efficiency with which organizational resources are managed.

Theoretical and Practical Implications

This study contributes to the Islamic banking literature by extending the application of Leibenstein's X-Efficiency Theory within the context of ASEAN Islamic banks. Unlike previous studies that primarily considered operational efficiency as an independent determinant of financial performance, this research demonstrates its role as a moderating mechanism influencing the effectiveness of technology investment in generating profit growth. Accordingly, this study provides empirical evidence that operational efficiency should be considered not only as a direct determinant of financial performance but also as a contextual mechanism that influences the effectiveness of strategic resource utilization in Islamic banking.

From a practical perspective, the findings suggest that Islamic bank management should not rely solely on strengthening capital adequacy but should integrate digital transformation initiatives with continuous improvements in operational efficiency, effective resource allocation, and cost management to achieve sustainable financial performance and enhance long-term competitiveness.

Limitations

This study has several limitations. First, the analysis is limited to 26 Islamic banks operating in the ASEAN region during the 2020–2024 observation period, which may limit the generalizability of the findings to other regions or longer periods. Second, technology investment is measured using Non-Interest Expenses as an indirect proxy, which may not fully capture the actual level of digital investment undertaken by Islamic banks.

Future Research

Future studies are encouraged to employ more direct measures of technology investment, such as digital banking expenditure, information technology investment, fintech adoption, or digital innovation indices. In addition, future research may incorporate other explanatory variables, including corporate governance, asset quality, risk management, bank size, and macroeconomic conditions, to provide a more comprehensive understanding of the determinants of profit growth in Islamic banking institutions

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