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# EXPLORING THE IMPACT OF GREEN FINANCING ON BANK STABILITY: INSIGHTS FROM INDONESIAN ISLAMIC AND CONVENTIONAL BANKS

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***Abstract***

*This study examines the influence of green financing on the efficiency of Islamic and conventional banks in Indonesia between 2016 and 2022. Employing the Data Envelopment Analysis (DEA) method to compute efficiency scores and Tobit regression to evaluate the impact of green financing, the findings reveal that conventional banks outperform their Islamic counterparts in terms of efficiency. This disparity is attributed to superior risk management practices and the benefits of operational scale. Notably, green financing enhances the efficiency of both banking types, with its effects being more pronounced in smaller banks. These insights underscore the potential of green financing to advance sustainability without undermining banking efficiency. The study advocates for robust policy frameworks to incentivize green financing initiatives, particularly targeting smaller banks, to maximize their role in fostering sustainable development.*

**Keywords***: Bank Stability; Green Financing, Efficiency; Data Envelopment Analysis (DEA); Tobit regression*

**Abstrak**

Penelitian ini mengkaji pengaruh pembiayaan hijau (green financing) terhadap efisiensi bank syariah dan konvensional di Indonesia pada periode 2016 hingga 2022. Dengan menggunakan metode Data Envelopment Analysis (DEA) untuk menghitung skor efisiensi serta regresi Tobit untuk mengevaluasi dampak pembiayaan hijau, temuan menunjukkan bahwa bank konvensional memiliki efisiensi yang lebih tinggi dibandingkan bank syariah. Perbedaan ini disebabkan oleh praktik manajemen risiko yang lebih unggul dan manfaat dari skala operasional. Secara khusus, pembiayaan hijau meningkatkan efisiensi kedua jenis bank, dengan dampak yang lebih signifikan pada bank-bank berukuran kecil. Temuan ini menegaskan potensi pembiayaan hijau dalam mendorong keberlanjutan tanpa mengorbankan efisiensi perbankan. Penelitian ini mendorong adanya kerangka kebijakan yang kuat untuk menginisiasi

pembiayaan hijau, terutama pada bank-bank kecil, guna mengoptimalkan peran mereka dalam mendukung pembangunan berkelanjutan.

**Kata kunci**: Stabilitas Bank; Pembiayaan Hijau; Efisiensi; Data Envelopment Analysis (DEA); Regresi Tobit

## INTRODUCTION

Bank efficiency has become an increasingly critical issue, particularly within modern banking systems that must navigate dynamic economic, technological, and environmental challenges. Efficient banks are capable of optimizing resource allocation, minimizing operational costs, and sustaining competitive advantages, all while adhering to stringent regulatory requirements. In the current era of sustainable development, bank efficiency is not only a measure of operational effectiveness but also an indicator of how well banks incorporate Environmental, Social, and Governance (ESG) principles into their practices. This shift prompts an essential question: how can banks, both Islamic and conventional, harmonize economic and environmental objectives without compromising operational efficiency?

Social and economic activities have long been recognized as significant contributors to global environmental degradation (Puteh et al., 2018). These activities exacerbate the adverse effects of climate change, which arise from global warming and disrupt sustainable development efforts. Acknowledging these challenges, Indonesia's National Medium-Term Development Plan (RPJMN) 2020–2024 underscores the importance of environmental sustainability. The plan marks a strategic policy shift toward fostering sustainable development through green economic activities aimed at achieving net-zero emissions.

Green financing has emerged as a key mechanism for translating such green initiatives into actionable outcomes. Defined as financial activities that enhance resource flows from the public sector to sustainability-focused priorities, green financing aims to better manage social and environmental risks, seize opportunities offering economic and ecological benefits, and ensure heightened accountability (UNEP, 2023). This financing approach also serves as a practical framework for implementing ESG principles, particularly those related to environmental stewardship.

Credit or financing remains the cornerstone of green financing, representing the financial services sector's support in driving global sustainable development initiatives. Such initiatives include ozone preservation, food security, and other green explorations (UNEP, 2023). Agricultural and forestry activities, which play an integral role in ensuring food security, are vital components of green financing efforts. The distribution of

working capital loans to these sectors exemplifies the banking industry's commitment to fostering sustainable development while simultaneously contributing to national economic growth. This illustrates the pivotal role of banks in mobilizing and distributing public funds to support green initiatives.

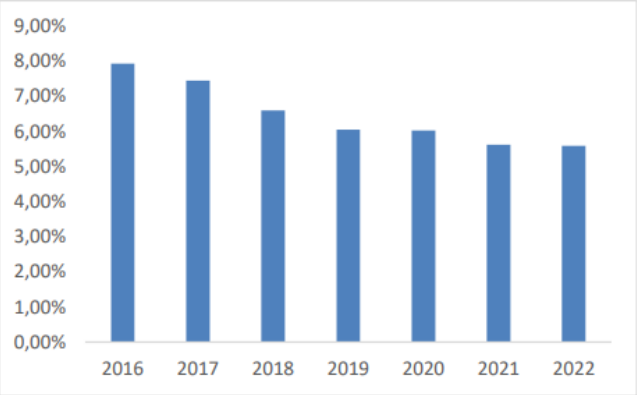


Figure 1 Contribution of banking working capital credit to the agricultural sector (BPS, 2023)

The extension of working capital credit to the agricultural sector (Figure 1) further highlights the indispensable role of banking in facilitating national development through its dual functions as a collector and distributor of public funds (OJK, 2017a). The banking sector is fundamental to maintaining economic stability (Istinfarani and Azmi, 2020). At regional, national, and international levels, banks fulfill critical socio-economic functions as the cornerstone of the financial system, primarily through their role as financial intermediaries. They mobilize funds by collecting deposits and disbursing loans directly to customers or indirectly via capital market investments in debt securities. Moreover, banks significantly influence the efficient allocation of financial resources within the economy. While providing these services, banks generate profits by managing risks. Over time, the banking sector has expanded its portfolio, encompassing personal, corporate, and investment banking, as well as trading activities in currencies, commodities, and financial securities within stock markets (Ouenniche and Carrales, 2018).

The banking sector is a cornerstone of the economy, playing a pivotal role in regulating the money supply, managing financial risks, and ensuring the efficient allocation of resources. In providing these services, including risk management, banks generate profits as compensation for their critical functions. With increasingly diversified operations—ranging from personal and corporate banking to investment banking and trading activities in stock markets—the importance of operational efficiency in banking has grown substantially. Inefficiencies can expose banks to significant risks, such as insolvency, and lead to adverse economic and social consequences (Ouenniche

& Carrales, 2018). Consequently, managing operational costs efficiently is a fundamental metric for evaluating banking performance (Istinfarani & Azmi, 2020). Notably, Islamic banks have demonstrated superior cost efficiency but lag behind conventional banks in terms of revenue efficiency, reflecting differences in their operational frameworks and business models (Safiullah & Shamsuddin, 2019).

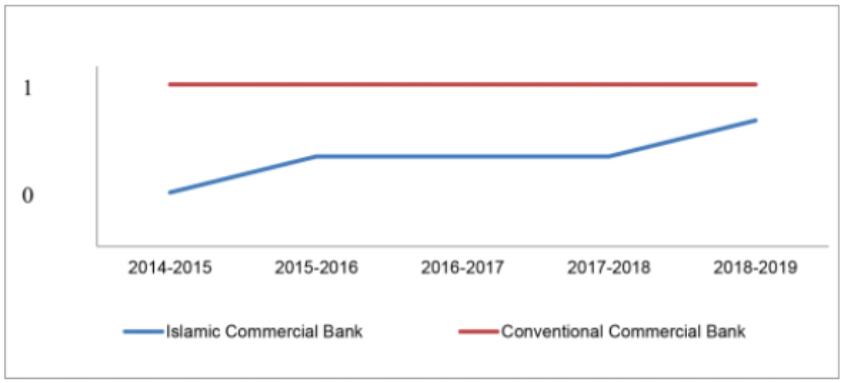


Figure 2 Efficiency of Islamic and conventional banks in Indonesia during 2014-2019 (Yusuf et al. (2021)

Islamic banks often engage in activities that positively impact environmental sustainability, as they align with the principles of maqashid al-sharia (Qoyum et al., 2022). One such activity is the reduction of carbon emissions, which can be achieved through green financing in sectors like agriculture (Mo et al., 2023). Green financing plays a pivotal role in integrating ESG principles within industries, serving as a key variable for implementing sustainable practices. Research has shown that these activities provide a sustainable solution for addressing environmental challenges at a national level (Yang et al., 2022).

Over the past decade, ESG-related green financing activities have been linked to enhanced banking efficiency (Cao et al., 2024). Implementing green financing can improve banks' ESG reputation, which is well-received by investors and aligns with Freeman's stakeholder theory (1984) (Alam et al., 2022). Evidence suggests that green financing enhances the efficiency of both conventional and Islamic banks, with Islamic banks deriving even greater benefits (Alam et al., 2022). Additionally, studies on environmental activities conducted by companies in Indonesia and Malaysia indicate that Islamic firms tend to outperform their conventional counterparts in these initiatives (Qoyum et al., 2022).

Green financing aligns closely with the United Nations Environment Programme's sustainable development goals, which emphasize collaboration

among countries, financial regulators, and the financial sector to promote sustainability. As the financial market represents the core of the global economy, banks and investors allocate capital to various sectors to shape future production and consumption patterns (UNEP, 2023). However, the concept of market efficiency suggests that resources should ideally flow to their most productive uses. However, the push for environmental investments can disrupt this flow, leading to potential inefficiencies (Pekkala, 2016)

This perspective is supported by Duque-Grisales and Aguilera-Caracuel (2021), who found that environmental activities negatively affect company performance. Conversely, research by Nizam et al. (2019) presents an opposing view, noting that environmental financing positively impacts return on equity. These contrasting findings underscore the need for further investigation into whether green financing enhances bank efficiency or contributes to inefficiency. This study aims to examine the influence of green financing on banking efficiency in Indonesia. Specifically, the objectives are twofold: first, to analyze the efficiency levels of Islamic and conventional banks in Indonesia from 2016 to 2022; and second, to evaluate the relationship between green financing and the efficiency levels of these banks.

Understanding this relationship is essential for optimizing banking operations while contributing to environmental sustainability. By investigating both Islamic and conventional banks, this study seeks to provide nuanced insights into how different financial models respond to green financing initiatives. The urgency of this research is driven by the critical role banks play in financing sustainable development, which is increasingly recognized as essential for addressing global climate challenges. Green financing not only facilitates sustainable development but also aligns with Indonesia's strategic goals, as outlined in the RPJMN, which prioritizes sustainability and the achievement of net-zero emissions.

## LITERATURE REVIEW

### Efficiency Theory and Factors Influencing Bank Efficiency

Efficiency in banking refers to the optimal utilization of inputs to maximize outputs, serving as a critical performance metric where a higher output-to-input ratio signifies greater efficiency (Bhatia et. Al 2018). In the banking sector, technical efficiency focuses on a bank's ability to maximize outputs with minimal inputs, highlighting areas for resource optimization (Arkdeniz, 2024; Nashim et al. 2024). Scale efficiency assesses whether a bank operates at its optimal size, which can enhance profitability through growth or consolidation (Assaf et al. 2019). Price efficiency evaluates the bank's capability to minimize input costs while maintaining output quality, ensuring

competitive pricing strategies (Ullah et al. 2023). Lastly, allocative efficiency examines how effectively resources are distributed to achieve the best output mix, which is essential for maximizing profitability (Brissimis et al. 2022).

The Economies of Scale Theory (Berger & Mester, 1997) is particularly pertinent to banking efficiency. This theory suggests that as a bank's size increases, it can achieve cost savings and efficiency gains. Larger banks tend to be more efficient due to their ability to diversify and mitigate liquidity risks (Barth et al., 2013; Beck et al., 2013; Alam et al., 2022; Nizam et al., 2019). Liquidity, commonly measured by the ratio of short-term deposits to total assets, enhances efficiency by enabling banks to meet immediate demands without compromising long-term investments (Bitar et al., 2020). Supporting this, the Liquidity Management Theory (Bhattacharya & Thakor, 1993) posits that efficient liquidity management enables banks to balance maintaining sufficient cash reserves for withdrawals while investing in income-generating opportunities. Indicators such as the Financing to Deposit Ratio (FDR) and Loan to Deposit Ratio (LDR) are positively associated with efficiency, as they reflect the banks' intermediation capabilities (Sulaeman et al., 2019).

Moreover, the Capital Adequacy Theory highlights the role of capital reserves in ensuring risk management and enhancing efficiency. The Capital Adequacy Ratio (CAR) provides banks with the resilience needed to absorb economic shocks, particularly in conventional banks where CAR significantly impacts operational efficiency (Khan, 2022; Bitar et al., 2020). Externally, macroeconomic factors such as GDP growth and inflation also influence banking efficiency. GDP growth promotes efficiency by expanding financial activities and increasing profitability, while inflation can adversely affect efficiency by narrowing profit margins and reducing returns (Mirzaei et al., 2013; Buallay, 2019; Nizam et al., 2019; Bitar et al., 2020).

In summary, a bank's efficiency is shaped by a combination of internal factors, such as liquidity management, capital adequacy, and operational scale, and external macroeconomic conditions. These determinants collectively influence a bank's ability to allocate resources effectively and sustain optimal performance.

### *Green Financing and Its Impact on Bank Efficiency*

Green financing refers to financial investments aimed at supporting environmentally sustainable projects, such as renewable energy, agriculture, and forestry, with the goal of reducing emissions and fostering a low-carbon economy. It aligns with Sustainable Development Goal (SDG) 13, which emphasizes climate action (Glomsrod & Wei, 2016; Debrah et al. 2022). Green financing has emerged as a critical mechanism for channeling capital towards

sustainability, simultaneously driving economic growth and environmental benefits (Huang & Zhang, 2021). In Indonesia, it aligns with the government's sustainability objectives outlined in the RPJMN, supported by the Financial Services Authority (OJK) through initiatives like the Sustainable Finance Roadmap and the Indonesian Green Taxonomy (Kemenkeu, 2022). These frameworks encourage banks and financial institutions to prioritize investments in sustainable activities, aiding the country's emissions reduction goals and promoting long-term environmental sustainability.

The Resource-Based View (RBV) Theory (Barney, 1991) provides a theoretical lens for examining green financing's contribution to bank efficiency. According to RBV, green financing acts as a strategic resource, enabling banks to gain a competitive advantage by positioning themselves as leaders in sustainability. By incorporating Environmental, Social, and Governance (ESG) principles, banks can attract environmentally conscious investors, enhance their reputation, and strengthen long-term performance, all while adhering to regulatory requirements related to climate change mitigation (Sachs et al., 2019). Moreover, green financing facilitates the adoption of sustainable business practices through funding mechanisms like working capital loans for green projects, which enhance operational efficiency by mitigating environmental risks (Falcone et al., 2018).

The relationship between green financing and bank performance, however, presents mixed findings. While RBV posits that green financing boosts bank efficiency by creating a distinct competitive edge, the Capital Adequacy Theory suggests that capital allocated to green initiatives may affect banks' risk management capabilities. For example, Alam et al. (2022) found that green financing enhanced efficiency by elevating banks' ESG reputation, particularly among conventional banks. In contrast, Islamic banks exhibited smaller efficiency gains, potentially due to ethical investment guidelines that influence their decision-making processes. Meanwhile, Shair et al. (2021) and observed that although banking development supports energy-saving technologies, it may also introduce new challenges to operational efficiency.

Despite extensive research on green financing and bank efficiency, notable gaps remain, particularly in understanding the mechanisms through which green financing influences efficiency across different banking models (Alam et al., 2022). For example, the role of financial ratios, such as Liquidity and CAR, in mediating this relationship remains underexplored. Additionally, macroeconomic factors, including GDP growth and inflation, may shape the effectiveness of green financing in promoting efficiency, especially in emerging markets like Indonesia, where economic conditions differ significantly from those of developed nations. Many studies rely on cross-sectional data, which

may fail to capture the long-term impacts of green financing on efficiency, highlighting the need for longitudinal panel data approaches (Nizam et al., 2019; Bitar et al., 2020). Furthermore, regulatory frameworks play a pivotal role in determining green financing's impact on bank efficiency, yet they remain inadequately addressed in existing literature. Future research should investigate how policies influence the outcomes of green financing, particularly in relation to bank stability and sustainable practices.

H1: The efficiency level of conventional banks is higher than that of Islamic banks.

H2: Green financing activities negatively affect the efficiency of conventional and Islamic banks..

## METHOD

This study employs secondary data collected from the official websites of the relevant banks and other credible sources. The data is categorized into four main groups: green financing scores, banking efficiency, bank-specific data, and macroeconomic variables. Green financing scores are calculated using the natural logarithm of financing allocated to green sectors such as agriculture and forestry, while banking efficiency is assessed through individual bank reports. The bank-specific data includes variables such as bank size, liquidity, Loan-to-Deposit Ratio (LDR) or Financing-to-Deposit Ratio (FDR), and Capital Adequacy Ratio (CAR). Additionally, macroeconomic variables such as GDP growth rate and inflation are obtained from the World Bank and Indonesia's Central Statistics Agency (Badan Pusat Statistik).

The research sample comprises Shariah and conventional commercial banks registered with Bank Indonesia during the 2016–2022 period. The sample is selected using purposive sampling, based on criteria that include banks operating continuously from 2016 to 2022, the top 12 Shariah commercial banks with the highest assets, and the top 11 conventional commercial banks with the highest assets. Additionally, the selected banks must publish annual financial reports that detail financing for green sectors. According to data from the Financial Services Authority (OJK), as of 2022, there are 15 Shariah commercial banks and 106 conventional commercial banks. However, only those meeting the specified criteria are included in the sample for this research.

The data analysis method used in this study is descriptive and inferential statistics, adopting a quantitative approach. Following Alam et al. (2022), Tobit regression is employed to estimate the linear relationship between the dependent and independent variables. The dependent variable is the efficiency

score, which is derived from Data Envelopment Analysis (DEA) processing. Tobit regression is suitable for data with values ranging from 0 to 1, and the study uses non-dynamic panel data, as efficiency scores fall within this range. Furthermore, the publication timelines of banks' sustainability reports differ, resulting in variations in the annual data available for each bank. Therefore, the DEA method is applied to measure efficiency based on the availability of bank data each year. Unlike the parametric DEA method, this non-parametric approach (Equation 1) does not require the data to satisfy specific assumptions, making it adaptable to the diverse nature of the data.

$$Efficiency = \frac{Output}{Input} \quad (1)$$

However, this equation only partially demonstrates efficiency because, in general, the input used will produce multiple types of output, resulting in equations (2) with many inputs and many outputs (Ullah et al. 2023).

$$Efficiency = \frac{weighted\ sum\ of\ output}{weighted\ sum\ of\ input} \quad (2)$$

The Data Envelopment Analysis (DEA) method is designed to evaluate the efficiency of decision-making units (DMUs) within a sample of organizations, such as banks or hospitals. Due to its suitability for scenarios with a limited number of DMUs, DEA is considered one of the most reliable techniques for measuring bank efficiency (Chen and Wang, 2022). Initially introduced in 1984 as a tool for assessing bank performance, this method has since become widely adopted in the banking industry for evaluating operational efficiency. DEA is particularly advantageous because it can handle a variety of inputs and outputs, enabling the accurate calculation of efficiency across numerous decision-making units (Ullah et al. 2023).

To calculate the maximum efficiency of a decision-making unit, DEA employs a weighted input-output efficiency calculation, which is mathematically represented in Equation (3). In this study, the determination of inputs and outputs for each bank is guided by the asset approach, where deposits are positioned as the primary input variable. This approach ensures that the efficiency analysis is aligned with the operational characteristics of the banking sector.

$$\max = \frac{\sum_{j=1}^{I} V_{mj} y_{nj}}{\sum_{i=1}^{I} u_{mi} x_{mi}} \quad (3)$$

with,

$$0 \leq \frac{\sum_{j=1}^{I} V_{mj} y_{nj}}{\sum_{i=1}^{I} u_{mi} x_{mi}} \leq 1; n = 1,2,\dots,N$$

$$v_{mj,} u_{mi} \geq 0; i = 1,2,\dots,I; J = 1,2,\dots,J$$

where:

N : Number of decision-making units
J : Total weighted output
I : Total weighted input
M : Basic decision-making unit (count the $m^{th}$ decision making unit)
N : Decision-making unit
I : Input
J : Output
$v_{mj}$: weighted output
$u_{mi}$: weighted input

The next step involves running a Tobit regression analysis on efficiency, green financing, and other dependent variables. This regression analysis is conducted in two stages. The first stage regresses overall bank efficiency on the dependent variable, which is the green financing activity score, along with control variables comprising bank-specific and macroeconomic factors. In the second stage, the sample is divided into three categories: Islamic banks, conventional banks, and bank size groups. Separate regressions are then performed for each category to provide a more nuanced understanding of the relationships.

The Tobit regression model was first introduced by Tobin, who extended his research on probit analysis to develop the Tobit model (Tobin probit) (Zhou et al., 2021). This method is particularly effective for analyzing data that incorporates both discrete and continuous components. The dependent variable in this study combines a discrete scale, representing values that equal zero, and a continuous scale for non-zero values. This dual nature makes the Tobit regression model suitable for capturing the unique characteristics of the dataset. The data used in Tobit regression is censored data with a censored normal distribution pattern that follows the assumption $N\ (\mu, \sigma^2)$ (Greene 2008). Tobit regression employs a random effect model (REM) that employs Generalized Least Square (GLS) assumptions to overcome heteroscedasticity and autocorrelation, eliminating the need for a post-estimation test (Gujarati et al., 2017). The general formulation of the Tobit model, according to Tobin (1958) in Greene (2003) is as follows:

$$y_i = \begin{cases} y_i^*, for\ y_i^* > 0 \\ 0, for\ y_i^* \leq 0 \end{cases}$$

Where, $i = 1,2, \dots, T$ dan $Y_i^*$ is the dependent variable with the equation:

$$y_i^* = x_i^T \beta + u_i$$

With:

$y_i^*$ : the true value of the dependent variable
$x_i^T$ : $[1, x_i^1, x_i^2, \dots, x_i^p]$ is a vector of independent variables
$\beta$ : $[\beta_0, \beta_1, \dots, \beta_p]^T$ is the parameter vector, $p$ is the number of variables
$u_i$ : model residuals that follow a censored normal distribution

The primary dependent variable in this study is the number of green financing activities undertaken by banks, measured using the natural logarithm of financing allocated to green sectors. To ensure a comprehensive analysis, the study incorporates several bank control variables. These include bank size, represented by the natural logarithm of total assets, and bank liquidity, calculated as the ratio of total deposits and short-term loans to total assets. Additional control variables are the Loan-to-Deposit Ratio (LDR) or Financing-to-Deposit Ratio (FDR), which is defined as the ratio of total loans to total deposits and long-term loans, and the Capital Adequacy Ratio (CAR), which indicates the bank's financial stability. Based on these variables, the following models were developed:

$$Efficiency_{i,t} = \alpha_i + \beta_1 GF_{i,t} + \beta_2 BANK_{i,t} + \beta_3 MAKRO_{i,t} + \varepsilon_{i,t}$$

The $GF_{i,t}$ variable is the value of implementing green financing activities from each bank each year. The $BANK_{i,t}$ variable consists of several bank-specific control variables including bank size, liquidity, CAR, and LDR/FDR. The $MAKRO_{i,t}$ variable is a macroeconomic variable consisting of GDP and inflation. Meanwhile, $\varepsilon_{i,t}$ is the error value from the regression.

To gain a comprehensive understanding of the effect of green financing on bank efficiency, the study employs five different models based on the capital core grouping (*Kelompok Bank berdasarkan Modal Inti,* or KBMI) of the banks. The models are designed to account for variations in core capital among banks, which can influence the results due to significant differences in bank size and assets (OJK, 2021). The models are as follows: (1) Overall Model: This model includes all sampled banks, both Shariah and conventional, to provide a general overview of the relationship between green financing and efficiency across the banking sector; (2) KBMI 1 Model: This model focuses on banks with core capital up to 6 trillion rupiahs. It aims to analyze the impact of green financing on smaller banks with limited core capital. This model including Bank Aceh, Bang BCA Syariah, Bank BJB Syariah, Bank BTPN Syariah, Bank Bukopin Syariah, Bank Muamalat, Bank NTB, Bank Panin Syariah, and Bank Victoria; (3) KBMI 2 Model: This model examines banks with core capital ranging from 6 trillion to 14 trillion rupiahs. It is designed to explore how medium-sized banks are influenced by green financing activities. This model

including Bank Syariah Mandiri, BNI Syariah, BRI Syariah, and Bukopin; (4) KBMI 3 Model: This model targets banks with core capital between 14 trillion and 70 trillion rupiahs. The goal is to assess the efficiency of larger banks with substantial assets. This model including Bank Syariah Indonesia, BTPN, CIMB Niaga, Bank Mega, OCBC NISP, and Bank Panin; (5) KBMI 4 Model: This model analyzes banks with core capital exceeding 70 trillion rupiahs, aiming to understand how the largest banks, often with significant resources and influence, are affected by green financing initiatives. This model including BCA, BNI, BRI, and Bank Mandiri.

The segmentation into these five models facilitates a more detailed and nuanced analysis of the data by accounting for variations in core capital and their impact on bank efficiency. By analyzing each model independently, the study aims to identify specific patterns and insights unique to different categories of banks. This approach provides a deeper understanding of how green financing contributes to enhancing bank efficiency, offering valuable implications for both theoretical and practical applications in the banking sector.

## RESULTS AND DISCUSSION

### Efficiency of Islamic and Conventional Banks

Data processing using the Data Envelopment Analysis (DEA) method was employed to calculate the efficiency of both conventional and Islamic banks from 2016 to 2022. The input variables include total deposits, short-term financing, fixed assets, and employee costs, while the output variables consist of bank loans, other productive assets, and other operating income. Table 1 presents the average efficiency values for each conventional and Islamic bank.

Bank Victoria achieved the highest efficiency score among conventional banks, with a value of 0.990484. In contrast, BCA Syariah Bank received the highest score for Islamic banks, at 0.976749. Bank BTPN recorded the lowest efficiency value among conventional banks, with a score of 0.730256. Meanwhile, Bank Aceh Syariah had the lowest efficiency score for Islamic banks, at 0.20943, making it the least efficient bank among both categories. According to the data in Table 4.4, conventional banks demonstrated higher efficiency than Islamic banks, with a difference of 0.282154. These findings support the acceptance of H1.

**Table 1: Average efficiency of each conventional and Islamic bank in 2016-2022**

| Conventional Banks | | Islamic Banks | |
|---|---|---|---|
| Banks | Efficiency | Banks | Efficiency |
| Bank BCA | 0.962767 | Bank Aceh Syariah | 0.209430 |
| Bank BNI | 0.856826 | Bank BCA Syariah | 0.976749 |
| Bank BRI | 0.947329 | Bank BJB Syariah | 0.310920 |
| Bank BTPN | 0.730256 | Bank BTPN Syariah | 0.780083 |
| Bank Bukopin | 0.958608 | Bank Bukopin Syariah | 0.790352 |
| Bank Cimb Niaga | 0.949409 | Bank Muamalat | 0.836265 |
| Bank Mandiri | 0.949826 | Bank NTB Syariah | 0.438187 |
| Bank Mega | 0.853028 | Bank Panin Syariah | 0.905708 |
| Bank OCBC NISP | 0.930004 | Bank Syariah Mandiri | 0.503207 |
| Bank Panin | 0.911274 | BNI Syariah | 0.795846 |
| Bank Victoria | 0.990484 | BRI Syariah | 0.462853 |
| | | BSI | 0.551059 |
| **Average** | 0.912710 | **Average** | 0.630055 |

**Source: Data processed by researchers (2023)**

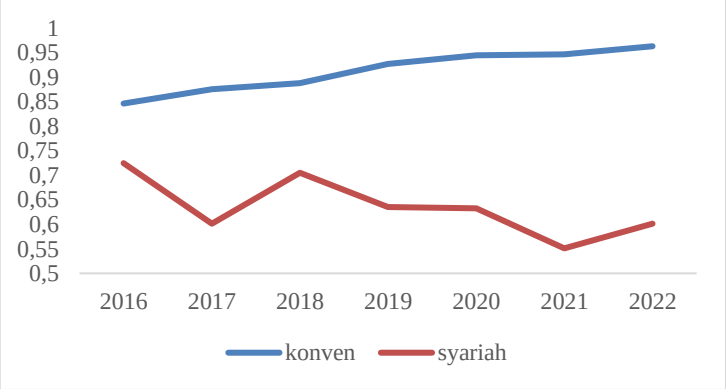


**Figure 1: Average efficiency of conventional and Islamic banks during 2016-2022**
**Source: Data Processed (2023)**

As shown in Figure 1, there are noticeable differences in the efficiency patterns between conventional and Islamic banks. Conventional banks exhibit consistently higher efficiency, with significant improvements observed each year. In contrast, the efficiency of Islamic banks fluctuates, experiencing a sharp decline from 2016 to 2017, followed by an increase in 2018. However, Islamic banks saw another significant drop in efficiency between 2020 and 2021, before rising again in 2022.

## The Effect of Implementing Green Financing Activities on the Efficiency of Islamic and Conventional Banks

In this study, the Tobit panel regression method was employed to analyze the impact of green financing activities on the efficiency of Islamic and conventional banks from 2016 to 2022. The results of the Tobit regression, detailing the impact of green financing activities on the efficiency of both Islamic and conventional banks, are presented in Table 2.

**Table 2. Tobit regression results**

| Variables | Overall | Islamic Banks | | Conventional Banks | |
|---|---|---|---|---|---|
| | | KBMI 1 | KBMI 2 | KBMI 3 | KBMI 4 |
| GF | 0.064*** | 0.106** | -0.210 | 0.001 | -0.051 |
| | (0.022) | (0.042) | (0.141) | (0.006) | (0.054) |
| SIZE | -0.005 | 0.040 | -0.132 | 0.734*** | 0.119 |
| | (0.040) | (0.129) | (0.256) | (0.062) | (0.125) |
| CAR | 0.683* | 2.034*** | -3.282*** | 0.714* | 1.407 |
| | (0.385) | (0.704) | (0.840) | (0.382) | (0.875) |
| FDR(LDR) | 0.240* | 0.488* | 0.739 | -0.116** | 0.461 |
| | (0.132) | (0.277) | (0.773) | (0.056) | (0.309) |
| LIQ | 0.211** | 0.272** | 0.458** | -0.080 | 0.384** |
| | (0.067) | (0.113) | (0.201) | (0.056) | (0.179) |
| GDP | 0.023 | 0.719 | 2.959** | -0.080 | -3.383 |
| | (0.579) | (1.367) | (1.266) | (0.220) | (0.500) |
| INF | -0.599 | -4.571 | -2.584 | -1.443** | 1.339 |
| | (1.437) | (3.488) | (2.784) | (0.670) | (1.297) |
| CONS | 2.415 | 9.523 | -32.785*** | -2.063** | -1.679 |
| | (3.123) | (6.929) | (9.424) | (1.011) | (2.490) |
| SIGMA | 0.208*** | 0.233*** | 0.065 | 0.194*** | 1.851 |
| | (0.037) | (0.075) | 0.039 | (0.633) | (0.015) |
| N | 150 | 54 | 17 | 35 | 28 |

**Source: Data processed by researchers (2023)**

The results of the Tobit panel regression, examining the impact of green financing activities on the efficiency of conventional and Islamic banks, are presented in Table 2. The regression analysis was conducted on the entire sample as well as by bank size, in accordance with Financial Services Authority Regulation Number 12/03/2021. Since most conventional banks fall into the larger size categories, the regression results for conventional banks are limited to those classified as KBMI 3 and 4. Regression analysis was not performed for conventional banks in KBMI 1 and 2 due to a lack of sufficient sample size. Similarly, the regression for Islamic banks was only conducted for those classified as KBMI 1 and 2, as KBMI 3 consists only of Indonesian Islamic banks, preventing regression analysis for that group.

According to the Tobit regression results, the impact of green financing varies by bank size. Overall, the implementation of green financing positively influences bank efficiency. The coefficient estimation results indicate a value of 0.064, suggesting that for every one percent increase in green financing activities, bank efficiency increases by 0.064 percent, all else being equal. The same effect is observed in KBMI 1 banks, where the estimated coefficient is 0.106, implying that a 1 percent increase in green financing results in a 0.106 percent increase in efficiency. This finding aligns with Yang's (2023) research, which demonstrated a positive impact of green financing on regional energy efficiency in China. Based on these results, hypothesis (H2) is rejected. In contrast, the regression results for banks classified as KBMI 2, 3, and 4 show no significant effect of green financing on bank efficiency.

## Discussion

The results of this study reveal a positive impact of green financing on the efficiency of Islamic banks, particularly for smaller banks (KBMI 1). This finding aligns with the Resource-Based View (RBV) theory, which asserts that firms possessing unique and valuable resources can achieve competitive advantages (Barney, 1991). In this context, green financing represents an intangible resource that can enhance efficiency by attracting a customer base increasingly conscious of sustainability. Furthermore, green financing can mitigate the risks associated with future environmental regulations and reduce operational risks linked to climate change. These strategic advantages, particularly for smaller banks with more focused operations, allow them to achieve higher efficiency compared to larger, more diversified institutions. This finding is consistent with Azmi et al. (2021) and Nizam et al. (2019), who also observed that green financing positively impacts financial performance and operational efficiency, especially in banks focusing on niche sectors such as agriculture, forestry, or renewable energy. In these sectors, smaller Islamic banks can allocate their resources more effectively, aligning themselves with green initiatives and realizing immediate efficiency gains from the adoption of environmentally sustainable practices.

However, for larger banks (KBMI 2, 3, and 4), the positive effect of green financing is less pronounced. This can be explained by the Economies of Scale theory, which suggests that as organizations grow, the marginal benefits from specific investments, such as green financing, may diminish (Berger & Mester, 1997). Larger banks often have diversified portfolios, and green financing initiatives may not contribute significantly to overall efficiency unless integrated into broader strategies involving technology and operational management. This is supported by Miralles-Quirós et al. (2019), who found

that while environmental, social, and governance (ESG) factors generally enhance performance, their impact is more substantial in smaller entities that focus on specific sectors.

In conventional banks, the lack of a significant impact of green financing on efficiency, particularly in KBMI 3 and 4 banks, indicates that other factors—such as technological advancements and broader operational management strategies—play a more dominant role in enhancing efficiency. Sulaeman et al. (2019) emphasized that, in larger banks, efficiency gains are often driven by comprehensive management systems and technology upgrades, suggesting that green financing alone may not be sufficient to improve efficiency. This finding is crucial for policymakers and bank managers as it underscores the importance of integrating green initiatives into a broader strategic framework, especially in larger institutions.

The results also show that the Capital Adequacy Ratio (CAR) significantly influences the efficiency of Islamic banks, particularly those in KBMI 1 and KBMI 3. This aligns with Capital Adequacy Theory, which suggests that banks with higher capital buffers are better positioned to absorb risks and, therefore, operate more efficiently (Widiarti et al., 2015). Additional capital allows banks to undertake more profitable ventures without exposing themselves to excessive risk, thereby boosting their efficiency. Smaller Islamic banks (KBMI 1), which may face higher operational risk, especially benefit from stronger capital adequacy, as it stabilizes their operations amidst market fluctuations.

However, the negative impact of CAR on the efficiency of KBMI 2 Islamic banks suggests a potential Risk-Return Trade-Off (Stiroh, 2004), where holding excessive capital might limit opportunities for more profitable investments. Excessive capital allocations in these banks may result in underutilization of assets, leading to lower efficiency—a pattern commonly observed in banks that adopt conservative risk management practices at the expense of profitability.

The Financing-to-Deposit Ratio (FDR), which reflects the proportion of customer deposits allocated to financing, is a critical indicator of bank efficiency. The positive relationship between FDR and efficiency, particularly in Islamic banks classified as KBMI 1, supports the findings of Alam et al. (2022), who suggest that banks with optimal levels of credit provisioning and liquidity management are able to achieve higher efficiency. Islamic banks that maintain effective liquidity provision without overextending into risky ventures tend to maximize their operational efficiency, reflecting a balance between credit expansion and risk management.

Conversely, the negative impact of FDR on the efficiency of KBMI 3 banks could indicate challenges related to credit risk management. Larger banks,

which typically handle a more diverse portfolio of loans, may struggle with higher levels of non-performing loans (NPLs), reducing the efficiency gains from their financing activities. This is consistent with findings from the Bank for International Settlements (BIS, 2019), which highlight the importance of robust credit risk management systems in maintaining operational efficiency across banking institutions, particularly in larger banks handling more complex portfolios.

Liquidity (LIQ) plays a significant role in driving bank efficiency across different bank sizes. The positive and significant impact of liquidity in Islamic banks (KBMI 1) aligns with Liquidity Management Theory, which posits that banks with better liquidity management are more efficient as they can respond quickly to short-term funding needs without incurring additional costs (Bhattacharya & Thakor, 1993). Efficient liquidity management ensures that banks can meet their obligations while minimizing the costs of maintaining excess reserves.

On the macroeconomic front, Gross Domestic Product (GDP) growth was found to have a positive but non-significant effect on bank efficiency in most cases. However, in conventional banks (KBMI 3), GDP growth had a significant positive impact, suggesting that macroeconomic growth contributes to operational improvements in these larger banks. This finding aligns with Dietrich & Wanzenried (2011), who noted that economic growth generally supports bank performance by expanding the customer base and increasing loan demand. The effect of Inflation (INF) was generally negative across bank sizes, although not statistically significant in most cases. This outcome may reflect the adverse impact of inflation on banks' real interest income, increasing costs and reducing profitability (Boyd & Champ, 2006). Particularly for Islamic banks, which avoid interest-based income, inflationary pressures may further constrain their operational efficiency.

These findings have important implications for both policymakers and bank managers. First, the positive impact of green financing on smaller Islamic banks suggests that targeted policies promoting green financing in this segment can lead to tangible efficiency gains. Governments and regulatory bodies should consider providing additional incentives or subsidies to encourage green financing initiatives, particularly among smaller institutions that can benefit most from these practices.

For larger banks, the results indicate that green financing alone may not significantly improve efficiency. Instead, these banks may need to integrate green financing with broader strategic initiatives, such as technological innovation, cost management, and diversification of income sources, to achieve similar benefits. Regulatory frameworks should also encourage a

comprehensive approach to green finance, ensuring that it becomes part of a broader sustainability strategy, rather than a standalone initiative.

## CONCLUSION

This study examines the impact of green financing on the efficiency of conventional and Islamic banks, exploring whether it positively influences bank efficiency or causes a trade-off that reduces it. The findings indicate that green financing does indeed have a positive effect on bank efficiency. Specifically, green financing has a significant impact on the efficiency of smaller Islamic banks, while its effect is minimal in larger banks. Based on these results, it is evident that while green financing has a relatively minor impact on the efficiency of larger banks, other variables, beyond green financing, play a more substantial role in influencing the efficiency of both Indonesian Islamic and conventional banks.

Nevertheless, the study demonstrates that banks need not be concerned about a trade-off between environmental sustainability and operational efficiency. Green financing can support both objectives simultaneously. However, to fully leverage these benefits, the government must establish clear regulations and enforce green financing initiatives, potentially incorporating penalties for non-compliance. This regulatory framework would encourage broader adoption among banks, fostering sustainable development while simultaneously improving bank efficiency.

At the managerial level, bank executives should integrate green financing into their long-term strategies, viewing it not merely as a regulatory requirement but as a strategic tool that provides a competitive edge. By enhancing risk management, optimizing resource allocation, and bolstering reputational value, green financing can become a valuable asset for banks. Additionally, promoting collaboration between financial institutions and sustainable projects, coupled with training staff on green finance mechanisms, can further enhance the effectiveness of these initiatives, improving overall banking performance in alignment with sustainability goals.

This study employs static panel data analysis without accounting for potential dynamic effects. Future research could benefit from utilizing dynamic panel methods, such as the Generalized Method of Moments (GMM), to capture temporal effects in the relationship between green financing and bank efficiency. Moreover, expanding the scope to include comparative analyses across different countries or regions would offer deeper insights into how regulatory environments and market conditions impact the effectiveness of green financing. Further investigation into the impact of green financing on

additional performance indicators—such as financial stability, risk management, and profitability—would provide a more comprehensive understanding of its broader effects on the banking sector.

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