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Efficiency of Islamic Rural Banks in Indonesia: A Non-Parametric Analysis

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Abstract
This research examines the technical efficiency of prominent Islamic microfinance working in Indonesia as the Islamic Rural Banks (IRBs) not only play their role in poverty alleviation but also become an essential stakeholder that becomes a cause of generating income activities in Indonesia through the provision of micro-financing to unbanked people. A non-parametric approach (Data Envelopment Analysis Techniques) was applied to observe the efficiency of 144 Decision-making Units (DMUs) in 21 provinces from 2012-2021. The results show only 12 exhibited notably high-efficiency levels. Those with lower efficiency levels demonstrated reduced Technical Efficiency (TE) and Pure Technical Efficiency (PTE), often attributed to deficient management, inadequate human resource quality, and insufficient funding. Geographic conditions highlight varying efficiency scores across provinces, with higher concentrations of IRBs in cities correlating with greater utilization potential and improved institutional performance.
Keywords: Islamic Microfinance, Islamic Rural Banks, Technical Efficiency, Data Envelopment Analysis, Indonesia

Introduction

Microfinance has emerged as a promising solution to the economic problem of poverty in recent decades. It has been found to strengthen the economy at the local level, especially in developing countries (Rokhman, 2013; Ben & Abdelkader, 2013; Tammili et al., 2017). Yunus (2004), introduced this idea by establishing the Grameen Bank in Bangladesh, which provided loans to rural populations, primarily to women. Implementing this strategy has significantly enhanced the economic well-being of the local population and reduced poverty in Bangladesh, serving as a successful example of promoting financial inclusion through microfinance.

The efficiency scores of microfinance banks are equally important for all stakeholders, including clients, bank employees, bank shareholders, investors, and regulators. This is because microfinance banks play a crucial role in poverty reduction and generate economic activity (Iqbal et al., 2018). Microfinance poses a dilemma for Muslim countries and populations due to the ethical and moral conflicts arising from the practice of interest (*riba*) (Rahman, 2010). The prohibition of interest in Islam has presented a significant challenge within the microfinance sphere. In response, Dr. Ahmad El-Naggar pioneered Islamic microfinance as an alternative solution. Notably, he established the Mit Ghamr Savings Bank in Egypt in 1963 and introduced a local bank model based on profit-sharing principles, marking the inception of Islamic banks worldwide (Rokhman, 2013b)

Islamic Microfinance Institutions (IMFI) are categorized in many ways in Indonesia. The principles define the two types of MFIs—Islamic and conventional MFIs. Indonesia established Islamic Rural Banks (IRB), also known as *Bank Pembiayaan Rakyat Shariah* (BPRS) (Bank Indonesia Regulation No. 10 of 1998). This project started due to worries expressed by Muslim economists in Indonesia about how Islamic banks were not doing their part to promote socioeconomic fairness (Akbar & Siti-Nabiha, 2022).

The Indonesian Islamic financial system is indistinguishable from its Islamic rural banks. Despite making up only around 2.5% of all Islamic banking assets in the nation Trinugroho et al. (2018), their contribution to the national Islamic finance industry is relatively minor. Still, because they mostly service small businesses, they are significant to the Indonesian economy. Interestingly, according to Shaban et al (2014), 99% of Indonesian enterprises fall under the small and micro business category, and their presence has contributed to 42% of the nation's Gross Domestic Product.

It should be mentioned that Indonesia has hundreds of Islamic rural banks spread throughout its areas or provinces, a distinct situation not found in other nations. In this context, we can take advantage of time and area heterogeneity and apply panel data analysis to examine the performance of Islamic rural banks. Furthermore, there is a shortage of empirical studies conducted in Islamic rural bank contexts. There are just a few studies that mainly address Islamic rural banks, including Trinugroho et al (2017), Trinugroho et al (2018), Wasiaturrahma et al (2020), and Risfandy & Pratiwi (2022). Meanwhile, none particularly address how decomposing banks efficiencies according to provinces in Indonesia over the last decades. As a result, the research's findings will significantly advance the body of literature.

Literature Review

The microfinance literature often discusses the performance of MFIs. One method of assessing performance is using a productivity ratio, which is the ratio of outputs to inputs. Technical efficiency refers to a firm's capacity to stay close to the ideal production frontier without deviating from it (Haq et al., 2010). Firms operating at the frontier are considered technically efficient, while those operating below the barrier are classified as inefficient. Efficiency can be assessed using many approaches.

Wijesiri et al (2015), state that the predominant techniques for assessing efficiency are ratio indicators, parametric approaches, and non-parametric methods. The last two methods are referred to as frontier methods. According to Berger and Humphrey (1997), frontier approaches offer a sophisticated and powerful approach to comparing organizations. Non-parametric approaches encompass data envelopment analysis (DEA) and free-disposal hull.

The parametric methods encompass stochastic frontier analysis (SFA), thick frontier, and distribution-free approaches. Non-parametric approaches involve calculating efficiency scores by measuring the distance between an observation and the best-performing observations, also known as the frontier (Abbas et al., 2016). The frontier is a collection of production possibilities that includes input-output correspondences, allowing for many inputs and outputs. This contrasts parametric techniques, allowing only a single input or output.

Data Envelopment Analysis (DEA) is a mathematical programming method used to assess the efficiency of a decision-making unit (DMU) in comparison to other similar DMUs. The critical constraint is that all DMUs must be on or below the efficiency frontier (Seiford & Thrall, 1990). The DEA also determines the origins and extent of inefficiency for each input and output of inefficient DMUs (Charnes et al., 1994). The CCR model assumes no significant correlation exists between the size of operations and efficiency (Charnes et al., 1978). It does this by assuming constant returns to scale (CRS) and provides an overall measure of technical efficiency. The assumption of constant returns to scale (CRS) is valid only when all decision-making units (DMUs) work at their optimal scale. Banker et al. (1984) expanded the CCR model by loosening the CRS assumption. The BCC model was utilized to evaluate the efficiency of DMUs that exhibit variable returns to scale (VRS). The VRS assumption allows for assessing pure technical efficiency (PTE), which explicitly measures technical efficiency without considering the effects of scale efficiency (SE).

Berg et al. (1993) employed the notion of Technical Efficiency (TE) and Scale Efficiency (SE) to assess the efficiency scores of various companies. Favero & Papi (1995) identified Charnes, Cooper, and Rhodes (CCR) and BCC as the fundamental models of Data Envelopment Analysis (DEA). These techniques are employed to assess the efficiency score of banking sectors and other financial institutions. The CCR model measures efficiency based on constant returns to scale, while the BCC model considers variable returns to scale. Matthews et al. (2006) state that the DEA model operates on the notion of a "Black Box," where inputs generate outputs, but the specific production process is implicit and unknown. Bader et al. (2008) emphasized that prior research can be categorized into two groups. One group assessed the efficiency of the banking sector using ratio analysis, whereas the second group evaluated the performance of banks using DEA, explicitly focusing on TE, PTE, and SE. They also stated that the frontier method is superior to regular financial ratio analysis techniques. This is because frontier analysis techniques eliminate the variations in input and output prices, as well as other external market factors that affect the standard performance of enterprises.

Several recent research have focused on productivity and performance analysis with an input-output relationship (Gidwani & Dangayach, 2017; Abdelalim et al., 2019; Granadillo et al., 2019). The application of DEA has arisen as a key research stream for analyzing financial institution efficiency across time (Berger & Humphrey, 1997; Chen, 2002; Saljoughian et al., 2019). The efficiency of Islamic banks utilizing DEA has been studied in some studies, however, the results from a global perspective are almost nil. However, examining the effectiveness of expanding Islamic banking is critical because it is now acknowledged by Muslims and non-Muslims globally (Kumru & Sarntisart, 2016).

Method

The process of selecting financial institutions as Decision-Making Units (DMUs) began with assembling a roster of MFI financial statements under the oversight of the Indonesian Financial Services Authority. This step is crucial as one of the principal aims of this study is to scrutinize the performance of IMFIs. The initial requirement involved classifying and confirming the accuracy of financial data spanning from 2012 to 2021. Following the collection of financial information covering the past decade, 144 Islamic rural banks, out of the 165 registered by December 2021 across 24 provinces, were found to have complete data distributed amongst 21 provinces.

Islamic rural banks dispersed across 21 provinces in Indonesia (see table 1): Aceh (9), Sumatera Utara (7), Sumatera Barat (7), Riau (2), Sumatera Selatan (1), Bengkulu (1), Lampung (9), Bangka Belitung (1), Kepulauan Riau (1), Jawa Barat (26), Jawa Tengah (26), Yogyakarta (11), Jawa Timur (21), Banten (8), Bali (1), Nusa Tenggara Barat (1), Kalimantan Tengah (3), Kalimantan Selatan (1), Kalimantan Timur (1), Sulawesi Selatan (6), Maluku Utara (1). The bank-level dataset is extracted from the Indonesia Financial Authority/*Otoritas Jasa Keuangan*—OJK.

Two fundamental DEA models were employed in this paper. In these models, inputs and outputs for specific DMUs are linearly combined in the following manner:

$$\text{Virtual Input} = V_1 X_1 + \ldots\ldots + V_1 X_1 = i{=}1mV_1 X_1 \quad (1)$$

$$\text{Virtual Output} = U_1 Y_1 + \ldots\ldots + U_r Y_r = i{=}1sU_r Y_r \quad (2)$$

$$\text{Efficiency} = \frac{V_1 X_1 + \ldots\ldots + V_1 X_1 = i{=}1mV_1 X_1}{U_1 Y_1 + \ldots\ldots + U_r Y_r = i{=}1sU_r Y_r} \quad (3)$$

The efficiency score for each DMU is determined by maximizing the weighted output-to-weighted input ratio, where V_1 represents the weighting for input and Ur signifies the weighting for output measurement. In DEA, two approaches are applied: the input-oriented model, which maximizes proportional input reduction while keeping output constant, and the output-oriented model, which maximizes proportional output increase while maintaining input constant. While the BCC model assumes an unequal ratio between new input and output (VRS), the CCR model assumes similarity in this ratio (CRS) or the operating of DMUs at their optimal scale (VRS). Additionally, the BCC model considers Technical Efficiency (TE), whereas the CCR model factors in both Scale Efficiency (SE) and Pure Technical Efficiency (PTE).

TE denotes a business unit's ability to either maximize output given a set quantity of inputs or minimize inputs given outputs. As defined by Hassan and Sanchez (2009), PTE indicates a firm's ability to minimize waste by producing as much output as input allows or utilizing as little input as output production permits. Scale Efficiency (SE) refers to the firm's ability to operate at its optimal scale, reflecting a proportional reduction if the firm attains a consistent return to scale (CRS).

TE can be dissected into two components: PTE and SE by employing a production technology with VRS. PTE measures a DMU's capability to convert inputs into outputs without the influence of SE. By using the VRS specification, this assessment eradicates the impact of scale efficiency when determining pure technical efficiency (Coelli et al., 1998). The VRS model typically generates technical efficiency scores that are either equal to or higher than those produced by the CRS model as it encompasses data points more closely.

Table 1
DMUs Per Region and Province

Region	Province	Total Per Province	Total Per Region
Sumatera Island	Aceh	9	38
	Sumatera Utara	7	
	Sumatera Barat	7	
	Riau	2	
	Sumatera Selatan	1	
	Bengkulu	1	
	Lampung	9	
	Kep. Bangka Belitung	1	
	Kep. Riau	1	
Java Island	Jawa Barat	26	92
	Jawa Tengah	26	
	Di Yogyakarta	11	
	Jawa Timur	21	
	Banten	8	
Bali and Nusa Tenggara	Bali	1	4
	Nusa Tenggara Barat	3	
Kalimantan Island	Kalimantan Tengah	1	3
	Kalimantan Selatan	1	
	Kalimantan Timur	1	
Sulawesi Island	Maluku Utara	1	7
	Sulawesi Selatan	6	
		144	144

For this research, the chosen measure is the input-oriented approach. This decision stems from the idea that variables used as inputs can be more readily adjusted by the DMU managers, giving them greater control over these variables than output variables. In a separate study (Widiarto & Emrouznejad, 2015), both input- and output-oriented CCR and BCC models were utilized in DEA analyses. Microfinance units, facing limited available inputs, naturally seek to maximize outputs, given their dual mission. Consequently, input-oriented models are preferred. However, this study incorporates an input-oriented model to examine scenarios whereby MFIs cannot boost outputs due to geographical, demographic or regulatory constraints and instead need to reduce inputs to enhance efficiencies. Since operational size variations might affect efficiency, the BCC model, considering the VRS assumption, seems more logically suitable for evaluating MFI performance. Nevertheless, the CCR model also estimates SE and compares efficiency against optimal size.

The selected variables for this study are outlined in Table 1 and are linked to the primary functions of IMF. Input variables provide insights into the attributes utilized by financial institutions for their operations and service creation. Conversely, output variables are associated with the revenue generation of financial institutions through financing and the range of services offered to customers seeking comprehensive financing. Once again, DEA was employed to conduct a detailed TE analysis, aiming to demonstrate the efficiency of financial institutions in managing their financing portfolios and generating profits.

Table 2
List of Variables' Efficiency

Variables	Symbol	Definition	References
Input			
Operational Expenses (IDR)	X1	Includes costs like staff, depreciation, amortisation, and administrative costs	Sakti and Mohamad (2018), Hafez and Halim (2019), Wanke et al. (2019), Samad (2019)
Total Assets (IDR)	X2	Total amount of assets Islamic Rural Banks	
Output			
Income Financing (IDR)	Y1	Total revenue from finance activities (profit sharing and margin)	Sakti and Mohamad (2018), Hafez and Halim (2019), Wanke et al. (2019), Samad (2019)
Financing (IDR)	Z1	Total amount of client funds received. Total allocation of funds to borrowers or other entities based on Shariah principles	Sakti and Mohamad (2018), Hafez and Halim (2019), Wanke et al. (2019), Samad (2019)

MaxDEA Ultra 8, developed by Cheng (2014), serves as the software utilised for calculating the efficiency scores of the DMUs. This DEA program is well-regarded for its user-friendly interface, robust functionality, and expert-level capabilities within the current DEA models. It stands out for its comprehensive range of options and ease of use. The software does not require installation and boasts simplicity in dataset preparation. Individual fields or unique data arrangements do not require explicit declaration of input and output names. The dataset, software, and DEA model settings are all consolidated into a single access database file (.mdb), ensuring straightforward backup processes.

Notably, when restarting MaxDEA Ultra 8 after closure, the database and model settings remain intact. The software imposes no limitations on the number of DMUs or the depth of DEA models, allowing simultaneous execution of multiple models. Users have the freedom to duplicate or rename the MaxDEA Ultra file, and each copy retains a DEA model with saved data and preferences. It optimises the utilisation of multi-core CPUs, enabling concurrent processing of numerous files, which proves beneficial for intricate analyses like bootstrapping. Overall, MaxDEA Ultra 8 provides a comprehensive array of current DEA models, offering versatility and efficiency in DEA analyses.

Result

The main objective of this research is to dissect the efficiency scores of IMFIs by using two orientations: input and output. The measurement outcomes included TE scores assuming CRS and PTE under VRS. The latter comprised managerial efficiency and SE, which are mutually exclusive and non-additive. SE can manifest in three forms: CRS, Increasing Returns to Scale (IRS), and Decreasing Returns to Scale (DRS). The overall efficiency scores were derived from two input and two output variables.

Table (see appendix 1) showcases empirical estimates of the overall efficiency, TE, PTE, and SE in Indonesian IMFIs. Notably, 12 IRBs, – namely Bahari Berkesan, Bangka Belitung, Berkah Gemadana, BPRS Gajah Tongga Kota Piliang, BPRS Mitra Amanah, Haji Miskin, Harta Insan Karimah, Hasanah, Untungsyariah, Muamalat Harkat, Syariat Fajar Sejahtera Bali and Vitka Central – maintain efficiency across TE, PTE and SE scores. Employing an input-oriented approach, the average TE, PTE, and SE scores were observed at 90.67%, 95.20%, and 95.21%, respectively.

In contrast, employing output-oriented measurements yielded efficiency scores of 90.67%, 94.82%, and 95.60%, respectively. TE estimates suggested that input-oriented interventions could reduce inputs by 4.79% without affecting output levels. Conversely, with output-oriented policies, IMFIs could enhance their loan portfolio by 5.17% at current input levels. Additionally, IMFIs utilizing both approaches had an overall TE of 90.67%, signifying the potential for either a 9.32% output increase or a 9.32% input reduction while maintaining the same input-output ratio.

Table (see appendix 1) illustrates that the total TE of IMF was inferior to its PTE. This outcome implied that scale inefficiencies, rather than just technical or managerial inefficiencies, were often the primary cause of technical shortcomings in MFIs. SE ranged between zero and one or from 0% to 100%. An IMFI was deemed scale efficient and operating at its optimal size if its SE ratio was 100%. If the SE fell below 100%, it indicated that the IMFI suffered from a small-scale inadequacy.

Table 3
TE, PTE and SE scores for the Period of 2012–2021

Year	Input-Oriented			Output-Oriented		
	TE	**PTE**	**SE**	**TE**	**PTE**	**SE**
2012	0.894	0.949	0.942	0.894	0.946	0.946
2013	0.909	0.950	0.957	0.909	0.945	0.961
2014	0.924	0.956	0.967	0.924	0.954	0.969
2015	0.924	0.963	0.959	0.924	0.957	0.965
2016	0.894	0.950	0.941	0.894	0.946	0.945
2017	0.888	0.950	0.933	0.888	0.947	0.937
2018	0.912	0.953	0.956	0.912	0.950	0.959
2019	0.911	0.951	0.959	0.911	0.948	0.962
2020	0.903	0.948	0.952	0.903	0.942	0.958
2021	0.908	0.950	0.956	0.908	0.948	0.958
Average	0.907	0.952	0.952	0.907	0.948	0.956

In Table 3, the TE, PTE and SE scores were presented for the research period (2012–2021). The efficiency scores for both input and output orientations exhibited nearly identical values. The average financial efficiency of IMFIs fluctuated over the research period, ranging from 89.40% in 2012 to 90.80% in 2021, while the overall average TE score for IMFI was

90.70%. The trend in scores displayed an uptick from 2012 to 2015, followed by a slight decrease, a subsequent rise and a minor dip during the COVID-19 pandemic. Nonetheless, the research findings indicated that MFIs can curtail their inputs by approximately 9.33% while maintaining the same output level through efficient input utilisation. Furthermore, for the years 2012 through 2021, MFIs could respectively reduce their inputs by 10.59%, 9.14%, 7.55%, 7.63%, 10.61%, 11.17%, 8.80%, 8.89%, 9.69% and 9.22% without squandering any resources.

The subsequent phase involved analysing the efficiency scores across various provinces to evaluate the performance of IMFIs in Indonesia. The outcomes are detailed in Table 4.

Table 4
TE, PTE and SE Scores for IMFIs at Provincial Level

Province	Input-Oriented			Output-Oriented		
	TE	PTE	SE	TE	PTE	SE
Aceh	0.917	0.963	0.953	0.917	0.963	0.952
Sumatera Utara	0.940	0.963	0.976	0.940	0.961	0.977
Sumatera Barat	0.934	0.959	0.974	0.934	0.964	0.969
Riau	0.987	1.000	0.987	0.987	1.000	0.987
Sumatera Selatan	1.000	1.000	1.000	1.000	1.000	1.000
Bengkulu	1.000	1.000	1.000	1.000	1.000	1.000
Lampung	0.900	0.951	0.947	0.900	0.951	0.947
Bangka Belitung	1.000	1.000	1.000	1.000	1.000	1.000
Kepulauan Riau	1.000	1.000	1.000	1.000	1.000	1.000
Jawa Barat	0.870	0.926	0.940	0.870	0.920	0.947
Jawa Tengah	0.891	0.946	0.943	0.891	0.941	0.948
Yogyakarta	0.931	0.958	0.972	0.931	0.956	0.973
Jawa Timur	0.869	0.934	0.930	0.869	0.929	0.936
Banten	0.920	0.959	0.959	0.920	0.952	0.966
Bali	1.000	1.000	1.000	1.000	1.000	1.000
Nusa Tenggara Barat	0.975	0.997	0.978	0.975	0.999	0.976
Kalimantan Tengah	1.000	1.000	1.000	1.000	1.000	1.000
Kalimantan Selatan	1.000	1.000	1.000	1.000	1.000	1.000
Kalimantan Timur	1.000	1.000	1.000	1.000	1.000	1.000
Maluku Utara	1.000	1.000	1.000	1.000	1.000	1.000
Sulawesi Selatan	0.922	0.985	0.932	0.922	0.970	0.949
Average	0.907	0.952	0.952	0.907	0.948	0.956

Table 4 presents the overall TE score under CRS, PTE considering VRS, and SE. At the provincial level, the scores for input and output orientation were nearly identical. Specifically, the average minimum efficiency amongst all IMFIs in the province, namely Jawa Timur, stood at CRS 86.90%, while Jawa Barat exhibited a VRS efficiency of 92.60%. Conversely, the average maximum efficiency scores (100%) for both CRS and VRS were observed in several provinces, such as Sumatera Selatan, Bengkulu, Bangka Belitung, Kepulauan Riau, Bali, Kalimantan Tengah, Kalimantan Selatan, Kalimantan Timur, and Maluku Utara.

The performance of IMFI has notably risen in the past decade, averaging a PTE of 94.42%. Contrasting the average VRS value (PTE) with SE, Table 4 highlights the predominant influence of PTE over SE in determining the province's TE. Additionally, various IMFIs at the provincial level in regions outside Java displayed complete efficiency scores compared to those within the Java region.

Table 5
TE, PTE and SE Scores for IMFIs at Regional Level

Region	Input-Oriented			Output-Oriented		
	TE	PTE	SE	TE	PTE	SE
Sumatera	0.964	0.982	0.982	0.964	0.982	0.981
Jawa	0.896	0.945	0.949	0.896	0.940	0.954
Bali and Nusa Tenggara	0.988	0.998	0.989	0.988	0.999	0.988
Kalimantan	1.000	1.000	1.000	1.000	1.000	1.000
Sulawesi	0.961	0.993	0.966	0.961	0.985	0.975
Average	0.962	0.984	0.977	0.962	0.981	0.980

Drawing from the initial description of the research object in this chapter, the TE, PTE and SE scores were presented at the regional level. This data aligned with the division of Indonesia's provinces into six regions by the Central Bank of Indonesia in its annual financial report: Sumatra, Java, Kalimantan, Sulawesi, Bali Nusa Tenggara and Papua (Papua was excluded due to the absence of IMFIs). For this study, only five regions were considered.

Table 5 showcases the comparison between the average VRS (PTE) and SE values, revealing an evident predominance of PTE over SE in determining technical efficiency at the regional level. Notably, regions outside Java exhibited higher average SE scores, notably Kalimantan (100%), in contrast to the Java region's average score of 89.60%. The average TE score across all regions, as depicted in Table 4.6 over the entire research period, stood at 96.20%. This finding indicated that IMFIs in the region could generate an output equivalent to 96.20% while experiencing only a 3.8% loss in resources utilised as inputs.

Discussion

The research findings indicated that the average TE observed in IMFIs primarily stemmed from technical inefficiencies alone. This outcome pointed to suboptimal output production, including a deficit in fundraising efforts. Amongst the 144 IMFIs scrutinised in this study, only 12 exhibited notably high-efficiency levels. Those with lower efficiency levels demonstrated reduced TE and PTE, often attributed to deficient management, inadequate human resource quality, and insufficient funding. As a recommendation, optimising inputs and increasing outputs in IMFIs with lower efficiency levels is advised. This effort could involve acquiring additional capital from external sources to enhance profitability. The study also holds significance by offering insights into how IMFIs can strive for financial independence and sustainability, particularly by optimising efficiency levels.

Most research emphasised that IMFIs operate on a framework that provides interest-free loans to their target audience, with repayments made within stipulated periods without interest charges. Sharpe (1995), underscored the primary objectives of IMFIs, focusing on poverty alleviation and the enhancement of social well-being amongst underprivileged communities. These institutions play a pivotal role in fostering job creation and supporting project development. Additionally, Obaidullah (2008), highlighted the importance of incorporating *zakat* and *sadaqah* contributions to bolster funding sources and amplify social impact on impoverished communities.

Moreover, the findings indicated that inefficiencies within Indonesian IMFIs primarily stemmed from technical inadequacies, encompassing deficiencies in management, insufficient resources and workforce quality, rather than inefficiencies associated with scale. This outcome holds substantial policy implications for enhancing the overall efficiency of these IMFIs. Addressing inefficiencies within IMFIs should prioritise enhancements in management practices, technological capabilities, and workforce competencies, especially for units operating in contexts characterised by IRS. This perspective resonates with the findings of a study conducted by Soulama (2008), which similarly identified both technical efficiency and inefficiency within MFIs in Burkina Faso.

Multiple studies conducted by Wasiaturrahma et al (2020), and Risfandy and Pratiwi (2022) suggested that MFIs still exhibit some degree of inefficiency when assuming CRS. Furthermore, certain effective MFIs do not operate with constant technology returns, expecting variable returns instead. This finding indicated inefficiencies at the scale and posed a significant issue of size for certain organisations, negatively impacting their effectiveness and subsequently impeding their capacity to alleviate poverty.

Conclusion

In conclusion, the calculation of TE by using the DEA approach in IMFIs revealed their ongoing inefficient performance in the production approach, as identified by Widiarto and Emrouznejad (2015) and (Risfandy et al., 2016). Institutions need to secure funding to enhance production efficiency. Across all provinces in this study, varying efficiency scores were observed, notwithstanding their geographical locations, as it has been demonstrated that a higher concentration of IMFIs in a city corresponded to greater potential utilisation. Enhanced city infrastructure contributed to improved institutional performance. Moreover, variations in efficiency scores were linked to the number of IMFIs in a province. In comparison to Java, IMFI showed greater effectiveness in provinces outside Java, which was associated with concentration and competition from similar institutions (Trinugroho et al., 2018).

This study contributes significantly to the existing body of knowledge on Islamic microfinance, particularly regarding the efficiency of Islamic Rural Banks (IRBs) in Indonesia. Theoretically, the research enriches the discourse on efficiency analysis in Islamic finance by applying non-parametric methods such as Data Envelopment Analysis (DEA) to a unique dataset of Islamic microfinance institutions. It highlights the importance of considering both technical and scale efficiencies in evaluating financial institutions, particularly in regions with diverse socio-economic conditions. Additionally, the study offers insights into the challenges and opportunities for Islamic microfinance institutions in balancing their dual mission of achieving financial sustainability while adhering to Shariah principles. Contextually, the research emphasizes the role of IRBs in Indonesia's microfinance landscape, especially in provinces with varying levels of infrastructure and financial inclusion. The findings underscore the critical need for strategic management and resource optimization in these banks to enhance their impact on poverty alleviation and economic empowerment. By addressing these issues, the study provides valuable implications for policymakers, practitioners, and academics aiming to improve the efficiency and effectiveness of Islamic microfinance in Indonesia and other developing economies.

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No.	Islamic Rural Banks	Input-Oriented			Output-Oriented		
		TE	PTE	SE	TE	PTE	SE
1	Adeco	0.989	0.989	1.000	0.989	0.989	1.000
2	Al Barokah	0.931	0.994	0.937	0.931	0.994	0.937
3	Al Falah	1	1	1	1	1	1
4	Al Hijrah Amanah	0.894	0.987	0.906	0.894	0.986	0.907
5	Al Ihsan	0.840	0.977	0.862	0.840	0.975	0.864
6	Al Mabrur	0.869	0.968	0.899	0.869	0.963	0.903
7	Al Mabrur Babadan	0.931	0.951	0.979	0.931	0.952	0.978
8	Al Madinah Tasikmalaya	0.917	0.948	0.967	0.917	0.943	0.972
9	Al Makmur	0.920	0.938	0.980	0.920	0.947	0.971
10	Al Ma'soem Syariah	0.922	0.950	0.970	0.922	0.951	0.970
11	Al Salaam Aman Salman	0.886	0.940	0.944	0.886	0.944	0.940
12	Al Wadi'ah	0.924	0.950	0.973	0.924	0.951	0.971
13	Al Washliyah	0.714	0.771	0.933	0.714	0.759	0.940
14	Alyaqin	0.966	1.000	0.966	0.966	1.000	0.966
15	Amanah Bangsa	0.993	1.000	0.993	0.993	1.000	0.993
16	Amanah Insan Cita	0.982	0.999	0.983	0.982	0.999	0.983
17	Amanah Insani	0.759	0.801	0.954	0.759	0.800	0.956
18	Amanah Rabbaniah	0.901	0.912	0.988	0.901	0.911	0.989
19	Amanah Sejahtera	0.834	0.945	0.880	0.834	0.953	0.873
20	Amanah Ummah	0.833	0.866	0.961	0.833	0.872	0.955
21	Ampek Angkek Candung	0.858	0.893	0.963	0.858	0.925	0.927
22	Annisa Mukti	0.948	0.971	0.974	0.948	0.966	0.980
23	Arta Leksana	0.740	0.788	0.939	0.740	0.761	0.973
24	Artha Amanah Ummat	0.901	0.975	0.924	0.901	0.966	0.933
25	Artha Fisabilillah	0.832	0.930	0.893	0.832	0.909	0.915
26	Artha Madani	0.883	0.888	0.994	0.883	0.890	0.992
27	Artha Mas Abadi	0.970	0.988	0.981	0.970	0.987	0.982
28	Artha Pamenang	0.967	0.993	0.974	0.967	0.993	0.974
29	Artha Surya Barokah	0.805	0.823	0.979	0.805	0.830	0.970
30	Asad Alif	0.910	0.949	0.959	0.910	0.942	0.966
31	Asri Madani Nusantara	0.962	0.991	0.971	0.962	0.990	0.972
32	Attaqwa Garuda Utama	0.945	0.969	0.974	0.945	0.963	0.981
33	Bahari Berkesan	1.000	1.000	1.000	1.000	1.000	1.000
32	Attaqwa Garuda Utama	0.945	0.969	0.974	0.945	0.963	0.981
33	Bahari Berkesan	1.000	1.000	1.000	1.000	1.000	1.000
34	Baiturrahman	0.790	0.812	0.975	0.790	0.839	0.938
35	Baktimakmur Indah	0.955	0.992	0.962	0.955	0.993	0.961
36	Bandar Lampung	0.975	1.000	0.975	0.975	1.000	0.975
37	Bangka Belitung	1.000	1.000	1.000	1.000	1.000	1.000
38	Bangun Drajat Warga	0.878	0.935	0.943	0.878	0.942	0.934
39	Barakah Nawaitul Ikhlas	0.943	1.000	0.943	0.943	1.000	0.943
40	Barkah Gemadana	1.000	1.000	1.000	1.000	1.000	1.000
45	Bhakti Haji	0.774	0.997	0.776	0.774	0.973	0.794
46	Bhakti Sumekar	0.952	1.000	0.952	0.952	1.000	0.952
47	Bina Amanah Satria	0.845	0.858	0.985	0.845	0.861	0.981
48	Bina Amwalul Hasanah	0.932	0.984	0.946	0.932	0.973	0.957
No.	**Islamic Rural Banks**	**Input-Oriented**			**Output-Oriented**		
		TE	**PTE**	**SE**	**TE**	**PTE**	**SE**
49	Bina Finansia	0.926	0.953	0.971	0.926	0.946	0.979

50	Bina Rahmah	0.847	0.885	0.947	0.847	0.867	0.973
51	BPR Syariah Magetan	0.800	0.873	0.921	0.800	0.864	0.930
52	BPRS Aman Syariah	0.880	1.000	0.880	0.880	1.000	0.880
53	BPRS Bakti Artha Sejahtera Sampang	0.929	0.941	0.986	0.929	0.943	0.984
54	BPRS Gajah Tongga Kota Piliang	1.000	1.000	1.000	1.000	1.000	1.000
55	BPRS Gotong Royong	0.894	0.936	0.955	0.894	0.931	0.960
56	BPRS Harta Insan Karimah Kota Tegal	0.999	1.000	0.999	0.999	1.000	0.999
57	BPRS Harta Insan Karimah Makassar	0.817	0.942	0.854	0.817	0.882	0.923
58	BPRS Harta Insan Karimah Surakarta	0.970	0.987	0.982	0.970	0.986	0.984
59	BPRS Kota Bekasi	0.748	0.791	0.953	0.748	0.790	0.956
60	BPRS Kota Mojokerto	0.895	0.917	0.975	0.895	0.923	0.968
61	BPRS Lantabur Tebuireng	0.963	0.970	0.993	0.963	0.970	0.993
62	BPRS Mitra Amanah	1.000	1.000	1.000	1.000	1.000	1.000
63	BPRS Mitra Harmoni Kota Bandung	0.821	0.910	0.902	0.821	0.891	0.920
64	BPRS Rahma Syariah	0.713	0.871	0.818	0.713	0.818	0.871
65	BPRS Rahmania Dana Sejahtera	0.980	0.997	0.982	0.980	0.997	0.983
66	Buana Mitra Perwira	0.852	0.872	0.976	0.852	0.879	0.968
67	Bumi Artha Sampang	0.866	0.886	0.977	0.866	0.882	0.981
68	Cahaya Hidup	0.984	1.000	0.984	0.984	1.000	0.984
69	Carana Kiat Andalas	0.863	0.898	0.962	0.863	0.890	0.971
70	Central Syariah Utama	0.882	0.944	0.932	0.882	0.925	0.952
71	Cilegon Mandiri	0.914	0.920	0.993	0.914	0.920	0.994
72	Daarul Hayat	0.652	0.901	0.738	0.652	0.859	0.779
73	Dana Amanah	0.923	0.988	0.935	0.923	0.983	0.940
74	Dana Hidayatullah	0.945	0.974	0.971	0.945	0.971	0.973
75	Dana Moneter	0.984	1.000	0.984	0.984	1.000	0.984
76	Dana Mulia	0.903	0.923	0.977	0.903	0.919	0.982
77	Danagung Syariah	0.920	0.939	0.978	0.920	0.933	0.986
78	Daya Artha Mentari	0.791	0.824	0.957	0.791	0.816	0.971
79	Dharma Kuwera	0.937	0.962	0.974	0.937	0.960	0.977
80	Dinar Ashri	0.953	1.000	0.953	0.953	1.000	0.953
81	Formes	0.816	0.848	0.962	0.816	0.835	0.977
82	Gala Mitra Abadi	0.922	0.994	0.927	0.922	0.992	0.929
83	Gayo Perseroda	0.971	0.981	0.990	0.971	0.982	0.989
84	Gebu Prima	0.942	0.969	0.971	0.942	0.968	0.971
85	Gowata	0.847	1.000	0.847	0.847	1.000	0.847
86	Gunung Slamet	0.986	0.990	0.996	0.986	0.991	0.995
87	Haji Miskin	1.000	1.000	1.000	1.000	1.000	1.000
88	Harta Insan Karimah	1.000	1.000	1.000	1.000	1.000	1.000
89	Harta Insan Karimah Bekasi	0.953	0.976	0.977	0.953	0.976	0.976
90	Harta Insan Karimah Parahyangan	0.998	1.000	0.998	0.998	1.000	0.998
91	Harum Hikmahnugraha	0.842	0.865	0.973	0.842	0.859	0.980
92	Hasanah	1.000	1.000	1.000	1.000	1.000	1.000
93	Hikmah Wakilah	0.976	0.994	0.981	0.976	0.995	0.981
94	Ikhsanul Amal	0.833	0.935	0.891	0.833	0.912	0.913

No.	IMFIs	Input-Oriented			Output-Oriented		
		TE	PTE	SE	TE	PTE	SE
95	Insan Cita Jaya Artha	0.855	0.891	0.955	0.855	0.877	0.972
96	Insan Madani	0.960	0.977	0.982	0.960	0.977	0.982
97	Investama Mega Bakti	0.975	0.979	0.996	0.975	0.981	0.993
98	Karya Mugi Sentosa	0.841	0.904	0.926	0.841	0.909	0.924
99	Khasanah Ummat	0.852	0.970	0.881	0.852	0.966	0.884
100	Kota Juang	0.972	1.000	0.972	0.972	1.000	0.972
101	Kotabumi	0.938	0.980	0.957	0.938	0.981	0.956
102	Lampung Timur	0.958	0.985	0.973	0.958	0.983	0.975
103	Madina Mandiri Sejahtera	0.950	0.950	0.999	0.950	0.961	0.981
104	Mandiri Mitra Sukses	0.896	0.955	0.938	0.896	0.958	0.935
105	Manfaatsyariah	1.000	1.000	1.000	1.000	1.000	1.000
106	Margirizki Bahagia	0.923	0.935	0.988	0.923	0.939	0.983
107	Mentari	0.986	0.990	0.996	0.986	0.990	0.996
108	Mentari Pasaman Saiyo	0.954	0.986	0.967	0.954	0.985	0.968
109	Meru Sankara	0.756	0.969	0.784	0.756	0.964	0.789
110	Metro Madani	0.830	0.880	0.945	0.830	0.897	0.925
111	Mitra Amal Mulia	0.987	0.989	0.998	0.987	0.988	0.998
112	Mitra Cahaya Indonesia	0.918	0.994	0.923	0.918	0.968	0.944
113	Mitra Harmoni Kota Malang	0.877	0.912	0.957	0.877	0.902	0.970
114	Mitra Harmoni Kota Semarang	0.936	0.971	0.964	0.936	0.968	0.967
115	Mitra Harmoni Yogyakarta	0.994	0.996	0.999	0.994	0.995	0.999
116	Muamalah Cilegon	0.838	0.894	0.937	0.838	0.878	0.955
117	Muamalat Harkat	1.000	1.000	1.000	1.000	1.000	1.000
118	Mulia Berkah Abadi	0.945	0.984	0.960	0.945	0.983	0.961
119	Musyarakah Ummat Indonesia	0.963	1.000	0.963	0.963	1.000	0.963
120	Niaga Madani	0.990	1.000	0.990	0.990	1.000	0.990
121	Patuh Beramal	0.973	0.991	0.982	0.973	0.996	0.977
122	PT BPRS Lampung Barat	0.842	0.970	0.868	0.842	0.964	0.875
123	Puduarta Insani	0.999	1.000	0.999	0.999	1.000	0.999
124	Rahman Hijrah Agung	0.926	0.974	0.949	0.926	0.977	0.947
125	Rajasa	0.930	0.956	0.971	0.930	0.951	0.977
126	Rifatul Ummah	0.773	0.970	0.797	0.773	0.948	0.818
127	Riyal Irsyadi	0.829	0.851	0.972	0.829	0.845	0.979
128	Saka Dana Mulia	0.737	0.966	0.767	0.737	0.939	0.794
129	Sarana Prima Mandiri	0.905	0.913	0.991	0.905	0.915	0.989
130	Sindanglaya Katonapan	0.988	1.000	0.988	0.988	1.000	0.988
131	Sukowati Sragen	0.979	1.000	0.979	0.979	1.000	0.979
132	Suriyah	0.915	0.967	0.947	0.915	0.972	0.941
133	Surya Sejati	0.916	0.992	0.923	0.916	0.957	0.957
134	Syariat Fajar Sejahtera Bali	1.000	1.000	1.000	1.000	1.000	1.000
135	Taman Indah Darussalam	0.779	0.954	0.821	0.779	0.941	0.834
136	Tanggamus	0.871	0.885	0.984	0.871	0.881	0.989
137	Tanmiya Artha	0.902	0.981	0.920	0.902	0.979	0.921
138	Tengku Chiek Dipante	0.870	0.965	0.904	0.870	0.946	0.924
139	Tulen Amanah	0.999	1.000	0.999	0.999	1.000	0.999

140	Ummu	0.680	0.718	0.941	0.680	0.696	0.974

No.	IMFIs	Input-Oriented			Output-Oriented		
		TE	PTE	SE	TE	PTE	SE
141	Unawi Barokah	0.745	0.996	0.748	0.745	0.993	0.750
142	Vitka Central	1.000	1.000	1.000	1.000	1.000	1.000
143	Wakalumi	0.837	0.970	0.866	0.837	0.938	0.895
144	Way Kanan	0.878	0.903	0.971	0.878	0.903	0.973
	Average	0.907	0.952	0.952	0.907	0.948	0.956