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KÜRESEL FİNANS SİSTEMİNDE FAALİYET GÖSTEREN SEÇİLMİŞ İSLAMİ VE KONVANSİYONEL BANKALARIN FİNANSAL ETKİNLİK ANALİZİ: 2017-2021[a]

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ÖZ

Bu çalışmanın amacı, uluslararası finansal sistemde faaliyet gösteren İslami ve konvansiyonel bankaların finansal etkinlik düzeylerini analiz etmek, rekabet seviyelerini belirlemek ve bulgulara dayalı olarak banka yöneticilerine ve politika yapıcılarına öneriler sunmaktır. Çalışmada, "The Banker" dergisinin "Dünya'nın En İyi 1000 Bankası" raporuna dayanarak seçilen 2017-2021 dönemine ait 9 İslami ve 9 geleneksel bankanın finansal verimliliği, Veri Zarflama Analizi (VZA) yöntemi kullanılarak değerlendirilmiştir. Ayrıca, girdi-odaklı BCC-I modeli ile teknik verimlilik ölçülmüştür. Bu beş yıllık dönem örneğinde, İslami ve konvansiyonel bankaların verimliliklerinin benzer sonuçlar verdiği gözlemlenmiştir. Çalışma, finansal sektörde İslami ve konvansiyonel bankalar arasında derinlemesine bir karşılaştırma ve kapsamlı bir değerlendirme sunmaktadır. Analiz döneminde etkin olmayan dört bankadan, ikisinin İslami ve diğer ikisinin ise konvansiyonel banka olduğu belirlenmiştir. Bu bankaların etkinsizliğinin temel nedeni, kaynakları etkili bir şekilde kullanamamalarıdır. Finansal verimliliği artırmak için, etkin olamayan bankaların kaynak israfını belirlemeleri ve girdilerini üretim sınırında faaliyet gösteren örnek bankalara göre ayarlamaları son derece önemlidir. Ayrıca, küresel finans sisteminde faaliyet gösteren İslami ve konvansiyonel bankaların ölçek büyüklüklerine de dikkat etmeleri gerekmektedir.

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FINANCIAL EFFICIENCY ANALYSIS OF SELECTED ISLAMIC AND CONVENTIONAL BANKS OPERATING IN THE GLOBAL FINANCIAL SYSTEM: 2017-2021[a]

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ABSTRACT

The aim of this research is to evaluate the financial performance levels of both Islamic and conventional banking institutions operating within the global financial system, analyze their competitiveness, and offer recommendations to bank executives and policymakers based on the results.This research examines the financial performance of 9 Islamic and 9 conventional banks, selected from *The Banker* magazine's *Top 1000 Banks in the World* report for the years 2017-2021, and assesses it through the application of the Data Envelopment Analysis (DEA) technique. In addition, technical efficiency was evaluated utilizing the input-oriented BCC-I model. In the case of this five-year period, it is observed that the efficiency of Islamic and conventional banks yield similar results. This study provides an in-depth comparison and comprehensive evaluation of Islamic and conventional banks in the financial sector. The analysis revealed that two of the four banks found to be inefficient during the study period were Islamic, while the other two were conventional banks. The primary cause of the inefficiency observed in these banks is their failure to optimize resource utilization. In order to increase financial efficiency, it is crucial for inefficient banks to identify resource wastage and adjust their inputs relative to benchmark banks operating at the production frontier. Additionally, Islamic and conventional banks in the global financial system should also pay attention to their scale sizes.

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INTRODUCTION

The banking sector is a fundamental component of the economic framework, crucial for the operation of national economies. Banks are recognized as crucial commercial entities with special significance in ensuring sustainable and robust economic development (Fukuyama and Tan, 2020:954; Rehman and Niazi, 2010:24). They serve as financial intermediaries facilitating liquidity flows between units with surplus and deficit funds. These units contribute to economic development by facilitating the mobilization of funds for productive purposes (Balcerzak et al., 2017:52).

In recent years, heightened competition within the banking industry has placed growing pressure on bank profitability. Leading financial institutions strategically expand into new markets to bolster their asset base and improve profitability by diversifying their range of products and services. Islamic banking has emerged as one of the products resulting from the quest for new products within the financial system (Ariss, 2010:101). Islamic banks have developed as a viable substitute for conventional banks, offering profit-sharing and risk-sharing services based on Islamic principles, in contrast to traditional banks that provide interest-based services (OICU-IOSCO, 2004:17; Abdul-Rahman, 2017:421-425; Görmüş and Yabanlı, 2021:105; Özsoy, 2012:71). Additionally, Islamic banks follow an equity-based approach in deposit-taking and lending operations (Siraj and Pillai, 2012:124; Ariss, 2010:101; Dinç, 2017:68).

Islamic banks, despite catering to a distinct customer segment from traditional banks, operate under the same market conditions. This situation leads to competition between the two types of banking institutions (Dilbildirici Çalık, 2016:122-126). While Sharia-compliant and traditional financial institutions provide comparable banking solutions to their clientele, they operate based on distinct principles and ethical frameworks. Both categories of institutions employ various promotional tactics and financial products to grow their customer base and enhance their market position. Nevertheless, the market share and competitive landscape of Islamic finance may differ depending on the country or region (Ülev et al., 2018; Novickytė and Droždz, 2018).

Enhanced financial efficiency is desired for banks to increase their competitiveness. Financial efficiency refers to a financial institution's ability to utilize its existing resources efficiently. This term is commonly used to assess the effectiveness of financial organizations and helps determine the efficiency with which an organization utilizes its resources. In other words, financial efficiency reflects how effectively a financial institution balances its revenues and expenses, utilizes its resources, and achieves its financial goals. An efficient financial institution can maximize its profits by increasing revenues and reducing costs while minimizing risks (Aydın and Kök, 2013:2).

Efficiency signifies a bank's ability to achieve its objectives (Arslan, 2002:79; Novickytė and Droždz, 2018). Furthermore, efficiency is also expressed as the ratio between valuable inputs and outputs. From this perspective, efficiency is concerned with demonstrating what more businesses can do by considering the ratio between inputs and outputs. Banks must effectively utilize human capital, skills, and technology to be efficient and reduce transaction costs (Chakrabarty, 2013:7, as cited in Torun and Özdemir, 2015:130).

Efficiency measurements help assess the health and sustainability of financial institutions and provide information to managers and regulatory authorities for making financial economic decisions (Yükçü and Atağan, 2009; Rehman and Niazi, 2010:24). Measuring the efficiency of banking institutions serves two essential purposes. Firstly, it facilitates benchmarking against the bank(s) that have demonstrated outstanding efficiency. Secondly, it supports the adoption of various strategies and enables the assessment of their influence on the performance, productivity, and overall results of these institutions (Das et al., 2005:1190).

The performance of banking institutions is essential for the smooth operation of capital markets and the overall economy. High-performing banks contribute to ensuring financial stability, fostering economic growth, and enhancing customer satisfaction. As a result, the performance of banks is a key determinant for the stable and sustainable development of financial markets and the broader economy. Well-managed banks can secure capital at reduced costs, whereas less efficient banks tend to assume greater risks. As a result, lower capital costs and enhanced profitability are linked to higher efficiency, which in turn indicates improved financial performance (Seyrek and Ata, 2010:68).

Over time, numerous studies have been conducted to assess performance in the banking sector. In literature reviews regarding performance evaluation in the banking industry, it is seen that DEA developed by Charnes et al., (1978a) is extensively applied. In this context, the financial efficiencies of 9 Islamic and 9 conventional banks were comparatively evaluated using the DEA method between 2017-2021 in this study.

Research Problem

Technical efficiency in the banking sector aims to achieve higher outputs at lower costs, thereby reducing credit costs, lowering product and service costs, and positively impacting investments in the real sector by increasing competition (Çelik and Kaplan, 2016:2). This study analyzes the performance levels within the banking sector, the factors leading to inefficiencies in financial institutions, and the identification of appropriate reference points. Recognizing banks' financial and technical efficiency as critical indicators for economic development and competitiveness, determining the efficiency level is essential for sustainable economic growth and economic stability. In this context, the operational effectiveness of both Islamic and conventional banks worldwide is regarded as a key issue, and analyzing them is of great importance for the sustainable economic growth and financial stability of banks.

Research Aim

Increasing the number of banks with high efficiency is crucial for achieving stable economic growth in all countries. In this regard, banks need to identify the reasons for inefficiency and improve these areas to enhance their efficiency. Additionally, determining other Decision-Making Units (DMUs) that inefficient DMUs should reference is critical for an inefficient DMU to become efficient. Accordingly, the primary goals of this research are to assess the financial performance of Islamic and conventional banks within the global economic system, analyze their market competitiveness, and offer recommendations to banking executives and policymakers based on the results.

Significance of the Research

This research is crucial for evaluating the financial performance of Islamic and conventional banking institutions operating within the global economic structure. This research seeks to pinpoint best practices by referencing efficient banks, recognize risks and opportunities, and offer a comprehensive perspective on policies and regulations. Moreover, comparing Islamic and conventional banks with similar banks on an international level is crucial for understanding financial trends and determining international competitiveness. The study provides an in-depth comparison and comprehensive evaluation of Islamic and conventional banks in the financial sector. It is expected that the study will provide important insights to policymakers, regulatory institutions, and stakeholders in the financial industry.

Limitations of the Study

The primary limitations of this research are the limited number of observations and the challenges in acquiring input and output data for the decision-making units (DMUs). Given the involvement of Islamic and conventional banks in global financial markets, accessing a single database is not feasible. Therefore, the gathered information was obtained from the banks' yearly performance reports and official websites. Restrictions on accessing international banks and new bank openings necessitated limiting the analyzed period of the study to 5 years. Attempts were made to establish direct communication for unavailable data, but some received negative responses or remained unanswered. In this context, the variables representing total personnel and the number of branches, initially intended to be included as input and output factors, were ultimately excluded from the analysis. Consequently, in light of these restrictions, total deposits, total assets, and total equity capital were designated as input variables, while total loans and net income were categorized as output variables.

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

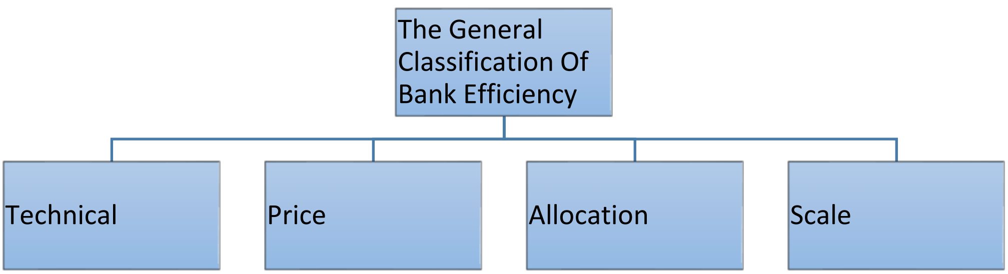
Over time, different approaches have been utilized to assess performance in the banking industry. In addition to DEA, methods such as regression analysis, ratio analysis, and simulation are commonly preferred in the literature. For instance, Dinç (2017), utilized simple linear regression to examine the role of specific current accounts as independent variables in modeling the performance of participation banks across the years 2010-2016. This study marked the first evaluation of the ratio of current accounts to total participation funds as an independent variable among the effective predictors of performance for participation banks. Bumin (2009), on the other hand, conducted a ratio analysis covering the period 2002-2008 to evaluate the profitability trends of the Turkish banking industry, concluding an overall increase in profitability during this period. Arıcan and Çetin (2018), applied Monte Carlo Simulation in their study, which spanned from January 2005 to December 2015, with the aim of examining the mean interest rates and profit-sharing ratios between conventional banking institutions and Sharia-compliant financial organizations. The results revealed no considerable statistical disparity across the two banking categories.

Effectiveness within the banking industry involves maximizing output while minimizing resource input. Bank performance is described as the gap between actual input and output values and the optimal levels of these variables. A fully functioning bank can achieve a score of one, whereas an underperforming bank may lower this value to zero(Rehman and Niazi, 2010:25). In the banking sector, efficiency is fundamentally linked to the capacity of banks to leverage inputs to produce output levels. Considering the production processes in the banking industry, a bank is considered to operate at optimal efficiency if it cannot decrease its resources without also diminishing its output. However, if a bank achieves the same output level by using more inputs than other banks in the sector, it is considered to be inefficient in resource utilization (Çelik and Kaplan, 2010:12). Indeed, substantial challenges faced by financial institutions in the late 1980s raised concerns regarding the performance and effectiveness of banks (Miller and Noulas, 1996:496).

Debreu and Farrell, developed a metric for evaluating technical efficiency. The metrics, expressed as a negative value, represent the greatest feasible decrease in all inputs while continuing to produce the specified outputs. A value of one indicates optimal technical efficiency, as no further input reduction is possible, whereas a score below one reflects the degree of technical inefficiency (Farrell, 1957; Debreu, 1951). Technical inefficiency can arise from various reasons such as poor management of the bank, mismatch with firm size, and external factors (Lovell, 1993:12). Berger and Humphrey (1997:175) argued, "Evaluating the effectiveness of a financial entity can guide governmental policy by examining deregulation, mergers, and the influence of market composition on performance." At the level of individual institutions, it can contribute to improving managerial effectiveness by identifying exemplary and suboptimal practices associated with different degrees of efficiency.

Efficiency is understood as a state in which it is impossible to generate one more unit of a good without decreasing the output of another good, given existing resources. This concept may be linked to the microeconomic production frontier. Consequently, under these circumstances, a firm operates at its maximum production capacity. Evaluating efficiency is a crucial element of the strategic behavior of production units aiming to thrive in a competitive market over the long term (Balcerzak et al., 2017:53). From this perspective, efficiency in the banking sector is divided into four categories. The classification of efficiency in banking is illustrated in Figure I.

Figure I. Efficiency Classification in the Banking Sector



Source: (Othman et al., 2016:912).

DATA SET AND METHODOLOGY

This study utilizes the DEA method to assess the financial performance of 9 Islamic and 9 conventional banking institutions, selected from the "Top 1000 Banks in the World" report by *The Banker* magazine, covering the period from 2017 to 2021. The data is obtained from the banks' annual reports and official websites. DEA comprehensively assesses banks' efficiency over time by considering various input and output variables. This method aims to measure both the current efficiency of banks and identify the potential for improvement in inefficient banks. Additionally, technical efficiency is calculated using the BCC-I model, which is an input-oriented model based on a non-parametric programming approach. This method, widely used in the banking industry, enables an objective evaluation of banks' efficiency.

The aforementioned limitations have resulted in the use of more sophisticated methods to evaluate the comparative efficiency of individual banks in relation to the top performers within the analyzed group or to examine the performance of single banks or whole banking systems. In the absence of a theoretical "best" bank model, there is an objective challenge in identifying the "best" bank for empirical comparison. However, the analysis of the production frontier allows for the determination of comprehensive bank performance and subsequent categorization into efficient and inefficient groups, enabling the exploration of the reasons for inefficiency. Moreover, the method provides specific recommendations to guide inefficient banks toward efficiency (Balcerzak et al., 2017:53). Emrouznejad and Yang (2017:8) noted that DEA analysis is widely applied in industries such as agriculture, financial services, logistics, transportation, and government policy.

Although the DEA approach was initially developed to assess the effectiveness of non-profit organizations, it has since become widely applied to evaluate commercial entities, including financial institutions. Sherman and Gold (1985) were the first to investigate the feasibility of evaluating banks' performance using DEA. Berger and Humphrey's (1992) study analyzing the efficiency of 14,000 U.S. banks can be considered pioneering in measuring bank efficiency. Initially, the efficiency of bank branches was analyzed (Camanho and Dyson, 1999).

A key characteristic of DEA is its capability to be applied in production settings where multiple inputs are used to generate various outputs, without requiring any predefined analytical production function, as is the case with parametric methods. By employing DEA, it is possible to identify the causes and degree of inefficiency for each DMU, providing managers with guidance on the necessary reductions in inputs or increases in outputs to improve the performance of inefficient DMUs (Charnes et al., 1978).

The non-parametric modeling method employed in this research is grounded in Farrell's (1957) framework and its subsequent developments.

It involves building a non-parametric boundary and calculating an input-focused metric of technical efficiency (Rangan et al., 1988:170). Initially introduced by Farrell in 1957, this technique was later enhanced by Charnes, Cooper, and Rhodes (CCR) in 1978. It is a non-parametric technique that employs linear optimization to evaluate the performance of similar DMUs with several inputs and outcomes (Klimberg et al., 2009:136). Initially, it was grounded in basic production theory that considered a single input-output relationship, such as 'output per labor unit,' as suggested by Farrell (Ayadi et al., 1998:10; Cooper et al., 2007).

Efficiency = Output/Input

Effectiveness = Standard Quantity/Actual (Utilized) Quantity

The basic CCR DEA original model developed by CCR in 1978 has been expanded by modifying the equation as follows (Ayadi et al., 1998:10; Othman et al., 2016:912).

Efficiency = Weighted sum of outputs / Weighted sum of inputs

Methods for measuring the effectiveness of DMUs in the DEA, such as banks, hospitals, etc., are used in the literature. DEA is the most accurate technique for measuring efficiency when a limited number of DMUs, such as banks, are given (Klimberg et al., 2009:135; Hassan et al., 2009:48; Ahmad and Luo, 2010:379-380). DEA measures relative efficiency in two stages; it identifies the most successful units in a random sample and determines the efficiency frontier, and then measures the distances of inefficient units to this frontier radially using the identified efficiency level as a reference (Yolalan, 1993:27-28).

DEA was initially based on Farrell's work in 1957. Although Farrell used multiple inputs and one output in his study, the linear equation system Farrell established for efficiency measurement also formed the basis for calculating efficiency for a couple of outputs (Farrell, 1957). Sherman first adapted the DEA model in 1984 to assess bank performance, and it has since become extensively utilized across the global banking industry to evaluate operational efficiency. DEA allows for measuring efficiency using numerous inputs and outputs in multiple DMUs (Othman et al., 2016:912).

Therefore, the mathematical expression for determining the optimal performance of DMUs based on the weighted input-output efficiency measure is presented as Model I (Ramanathan, 2007:139; Chen et al., 2008:527).

Model I:

$$max \frac{\sum_{j=1}^{J} V_{mj} Y_{mj}}{\sum_{i=1}^{J} U_{mi} X_{mi}}$$

$$Based\ on\ this\ formula$$

$$0 \leq \frac{\sum_{j=1}^{J} V_{mj} Y_{nj}}{\sum_{i=1}^{J} U_{mi} X_{ni}} \leq 1; n = 1,2, \dots \dots \dots \dots, N$$

$$V_{mj} U_{mi} \geq 0; i = 1,2, \dots., I; J = 1,2, \dots., J$$

N: Total number of Decision Making Units (DMUs)

J: Weighted sum of outputs

I: Weighted sum of inputs

M: Primary DMU (calculation of the mth DMU)

N: DMUs

I: Inputs

$$V_{mj}: The\ weights\ for\ outputs$$

$$U_{mi}: The\ weights\ for\ inputs$$

Because the equation above is a fractional function, its computation is not straightforward. Therefore, CCR (1978) simplified it by fixing the ratio's denominator to one, facilitating easier computation. Consequently, the equation was transformed into a linear programming equation, creating an equivalent linear programming equation (Model II). This output maximization is known as the CCR model (Ramanathan, 2007:139; Chen et al., 2008:527).

Model II:

$$max \sum_{j=1}^{J} V_{mj} Y_{mj}$$

$$Based\ on\ this\ formula$$

$$\sum_{i=1}^{I} U_{mi}\, X_{mi} = 1;$$

$$\sum_{j=1}^{J} V_{mj}\, Y_{nj} - \sum_{i=1}^{I} U_{mi} X_{ni \leq 0;} \qquad n = 1,2, \dots, N$$

$$V_{mj,} U_{mi} \geq 0; \;\; i = 1,2, \dots, I; \;\; j = 1,2, \dots, j$$

When DEA is applied to evaluate the efficiency of a group of DMUs, such as banks, the linear programming method compares the weighted outputs to the weighted inputs (derived from the most efficient DMUs) and other units. As a result, this process places the best-performing DMUs along the efficient frontier. This indicates that the top-performing units are considered relatively efficient, with an efficiency score of 100% based on the DEA efficiency measure (efficiency = 1) (Othman et al., 2016:693).

Charnes et al. (1978) introduced non-negative constraints to guarantee that the coefficients allocated to inputs and outputs remain positive. As a result, the calculated efficiency measure falls within a range of 0 to 1. Therefore, no efficiency metric can exceed a value of one. This threshold reflects the extent of inefficiency relative to other units (Charnes et al., 1978a:437).

Determination of the Dataset

The determination of the dataset for the study involves several stages. In this regard, selecting the most suitable decision-making units for the study, identifying a sufficient number of input and output variables with the best representativeness for the selected DMUs, obtaining, processing, and interpreting the data related to these variables constitute significant portions of the study. The steps followed in creating the dataset for the study are detailed below.

Selection of Decision-Making Unit

Determining DMUs to be used in the analysis is the first and most crucial step. DMUs should be economic entities capable of transforming inputs into outputs. Furthermore, as DEA is a comparative approach, the validity of the analysis is contingent upon the homogeneity of the decision-making units (Golany and Yaakov, 1989):239). In this context, institutions responsible for producing similar outputs using similar inputs, such as companies, banks, hospitals, libraries, sports clubs, are referred to as DMUs and abbreviated as DMUs (Budak, 2011:96). Therefore, the DMUs to be selected for the study should be chosen according to the content of the study topic. Another important consideration is that the quantity of DMUs in the sample must be adequate for a meaningful estimation of the efficient production frontier. Thus, besides the principle of homogeneity, determining the number of DMUs is also vital when selecting DMUs.

It has been recommended that the number of DMUs should be at least double the total of the inputs and outputs (Dyson et al., 2001:248). Another perspective proposes that the number of DMUs should exceed three times the combined count of inputs and outputs (Cooper et al., 2001:219). On the other hand, Norman and Stoker (1992), emphasize that at least twenty DMUs should be included in the analysis.

Considering the opinions mentioned above, the constraints to be taken into account in DMU selection, and the most commonly used ones in the literature, are illustrated in Figure II.

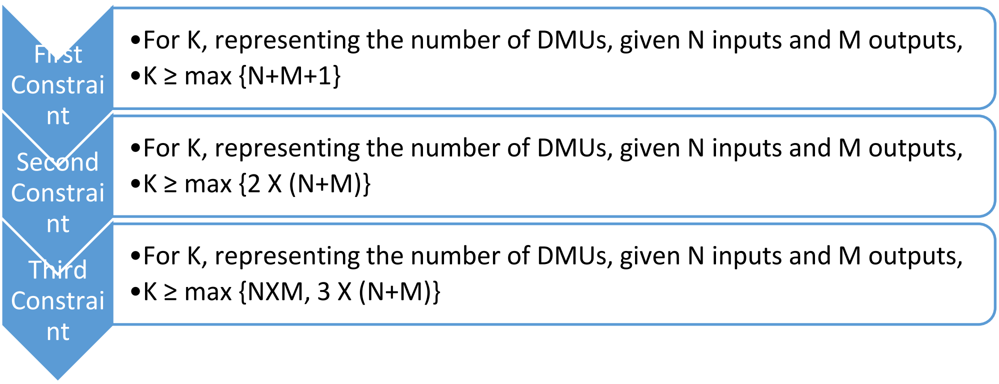


Figure II. Constraints Used in DMU Selection

Source: (Dyson et al., 2001:245-259).

In the research model, 3 inputs and 2 outputs are used. Accordingly;

Under the first constraint,

Input amount + Output Amount + 1 = 3 + 2 + 1 = 6,

Under the second constraint,

X (Input + Output) = 2X (3 + 2) = 10,

Under the third constraint,

Input X Output, 3 X (Input + Output) = 3 X 2, 3 X (3+2) = 15.

The DMUs considered in the study are determined as the top 9 Islamic and 9 conventional banks based on their total assets, according to "The Banker" magazine's "World's Top 1000 Banks" report.

Table I: Decision-Making Units Included in The Analysis

Period	**2017-2021**
Islamic Banks	**Conventional Banks**
1. CIMB Islamic Bank (BNKI), 2. Abu Dhabi Islamic Bank (BNKII), 3. Qatar Islamic Bank (BNKIII), 4. Dubai Islamic Bank (BNKIV), 5. Masraf Al Rayan (BNKV), 6. Alinma Bank (BNKVI), 7. Al Rajhi Bank (BNKVII), 8. Maybank Islamic (BNKVIII), 9. Kuwait Finance House (BNKIX),	1. Industrial & Commercial Bank of China Ltd. (BNKX), 2. China Construction Bank Corp. (BNKXI), 3. Agricultural Bank of China Ltd. (BNKXII), 4. Bank of China Ltd. (BNKXIII), 5. Mitsubishi UFJ Financial Group Inc. (BNKXIV), 6. JPMorgan Chase & Co. (BNKXV), 7. BNP Paribas SA. (BNKXVI), 8. HSBC Holding PLC. (BNKXVII), 9. Bank of America Corp. (BNKXVIII).
Total DMUs	**18**

Selection of Input and Output Variables

The second phase in applying DEA involves choosing the variables for inputs and outputs to be analyzed. Since DEA is a method based on data for measuring efficiency, the precision of the results depends on how meaningful the selected input and output variables are. Various measurement units can be applied to both inputs and outputs within the DEA framework. In order to assess the performance of DMUs, the input and output characteristics of these units must be identified. Expanding the number of input and output variables is anticipated to improve the DEA model's ability to break down the data. Therefore, it is advisable to include as many input and output variables as feasible; however, these selected variables must be applicable to all DMUs. If the desired count of input variables is represented by 'm' and the output variables by 's', a minimum of m+s+1 DMUs is required to ensure the validity of the analysis.

Defining the inputs and outputs for bank branches is a complex task, which has led to ongoing discussions in academic literature and the development of various alternative methods. Many studies in banking tend to follow either a production-based or an intermediation-based framework. Establishing inputs and outputs is typically regarded as one of the most difficult aspects of building a DEA model. The classification of inputs and outputs is generally rooted in three key banking models: (i) the intermediation approach, (ii) the production approach, and (iii) the asset approach. Additionally, it is important to recognize other potential models, such as the user cost approach or the value-added approach.

Table II: Input and Output Parameters for the Analysis

	Variables	**Source**	**DMUs**
Input Variables	Total Deposits Total Equity Total Assets	Annual Reports, Official Bank Websites, World Bank Database.	18
Output Variables	Net Profit Total Loans		

In selecting the input and output variables, a combined approach of production and intermediation (hybrid approach) was employed. Considering the scope of the study sample, incorporating a wide range of factors into the analysis has a significant impact on the outcomes;

therefore, three input variables and two output variables were deemed appropriate. An excessive number of variables can artificially inflate the effective count of DMUs, which, in turn, diminishes the model's ability to distinguish between units and reduces the explanatory power of the analysis (Balcerzak et al., 2017:63). As a result, it is advisable that the number of variables does not exceed one-third of the total range of the sample. In this study, the selected input variables were total deposits, equity, and assets, while the output variables were defined as net profit and total loans.

The number of selected DMUs in the study exceeds the values determined under all three constraints of 6, 10, and 15. Moreover, it is observed that the relationship between the selected DMUs and input-output variables maintains its validity in terms of the perspectives shown in Figure II.

Data Availability and Reliability

For DEA analyses to generate reliable and meaningful results, it is essential to obtain data in a complete and trustworthy manner. The absence of such data for decision-making units (DMUs) can render efficiency scores contentious. In such cases, the respective DMU or data should be excluded from the analysis (Telli, 2021:90).

Construction of the Research Model

There are two fundamental approaches to determining the DEA model. The first is input-oriented, where a decision-making unit is considered adequate if there is no decrease in input quantity without reducing any output variable. The second approach is output-oriented, where a decision-making unit is considered effective if there is no increase in input or decrease in output without increasing the output variable. The choice between these approaches varies depending on the situation (Öztürk and Gezer, 2021:1145). DEA models can be constructed differently depending on their areas of application and assumptions. Any of the mentioned models can be used in the analysis. Determining which model to use in the study relies on the verifiability of inputs and outputs (Gasimov, 2019:12).

This research evaluates the data for the chosen input and output variables from 2017 to 2021, assuming variable returns to scale, using the BCC-I model to assess technical efficiency scores. In these evaluations, the input-oriented BCC-I DEA model was employed to identify the optimal combination of inputs required to achieve a specific level of output in the most efficient manner (Behdioğlu and Özcan, 2009:308). The primary goal of the input-oriented BCC-I model is to determine the ideal input level necessary to produce a given output. This model is derived by introducing a convexity constraint into the input-oriented CCR model (Yun et al., 2004:91).

The DEA Solver application, a specialized tool for data envelopment analysis, was employed for data processing. The variables for input and output used to assess the performance of banks are briefly outlined below:

Inputs: I = Total deposits, Total equity, Total assets.

Outputs: O = Net profit, Total loans.

Minimizing input variables, which are essential cost factors for banks, to increase profitability and competitive strength holds significant importance. Banks seek the optimal input combination to obtain a specific output most efficiently. Therefore, our study adopts an input-oriented approach. At the same time, this model assists banks in determining how efficiently and effectively they utilize resources and identify areas of waste. This is crucial for banks to manage their resources more effectively.

In the model used in DEA, all decision-making units in the study are not collected. Regardless of whether each DMU is efficient or inefficient, the degree of efficiency is determined. In other words, all DMUs included in the analysis exist within a structure as efficient or inefficient. This is a result of the envelopment property of data envelopment analysis. Additionally, each unit is compared with another unit, and a reference is assigned to each unit. Optimal input components for DMUs are obtained, and a reference is provided in the most suitable output combination. Efficacious banks operating at the same scale are paired with inefficient banks to serve as a reference. Thus, the references are matched according to the scale.

In this context, the study examined 9 Islamic and 9 conventional banks ranked in the top 10 in the global banking sector by asset size. Thus, a broad DMU comprising 18 banks was determined, and a comparative technical and financial efficiency measurement was conducted collectively using the DEA method for the period 2017-2021.

IMPLEMENTATION OF THE RESEARCH

Table III: Summary Statistics of Efficiency Values for Islamic and Conventional Banks (2017-2021)

	2017	2018	2019	2020	2021
Number of Efficient Banks	13	11	14	14	14
Number of Inefficient Banks	5	7	4	4	4
Total Number of Banks	18	18	18	18	18
Average Efficiency of All Banks	0,9501	0,9589	0,9652	0,9478	0,9689
Minimum Efficiency Value of All Banks	0,7239	0,7337	0,7096	0,626	0,7841
Maximum Efficiency Value of All Banks	1	1	1	1	1

Standard Deviation of Efficiency for All Banks	0,0978	0,0724	0,0751	0,1096	0,0635
Average Efficiency of Inefficient Banks	0,781	0,844	0,8501 75	0,7700 5	0,8709 75
Maximum Efficiency Value of Inefficient Banks	0,8848	0,9085	0,9199	0,9058	0,9409
Number of Banks with Increasing Returns to Scale	3	1	3	1	2
Number of Banks with Decreasing Returns to Scale	10	14	12	13	12
Number of Banks with Constant Returns to Scale	5	3	3	4	4

According to Table III;

This analysis presents an evaluation covering five years and involving 18 financial institutions. Fluctuations in the count of high-performing banks were observed throughout the analyzed timeframe. Remarkably, 2018 marked the lowest efficiency level, whereas efficiency levels were higher in 2019, 2020, and 2021. The average efficiency of banks remained generally stable and above 95%, indicating that inefficient banks have efficiency levels close to others. The highest efficiency average, around 97%, belongs to the years 2019 and 2021, but the lowest average was reached in 2020 due to lower efficiency scores of inefficient banks compared to other years. The proportion of banks operating under conditions of diminishing returns to scale grew over the period, suggesting a need for banks to enhance their operational efficiency. Without action, banks operating with decreasing returns to scale may lose efficiency, and inefficient banks may worsen further. Therefore, banks need to take strategic measures to consider this trend.

Table IV: Efficiency Scores of Islamic and Conventional Banks (2017-2021)

DMUs	2017	2018	2019	2020	2021	Avarege
BNKX	1	1	1	1	1	1
BNKXI	1	1	1	1	1	1
BNKXII	1	1	1	1	1	1
BNKXIII	1	1	1	1	1	1
BNKXV	1	1	1	1	1	1
BNKXVI	1	1	1	1	1	1
BNKVII	1	1	1	1	1	1
BNKVIII	1	1	1	1	1	1
BNKI	1	1	1	1	1	1
BNKXIV	1	1	1	1	0,9876	0,99752
BNKIV	1	0,9718	1	1	1	0,99436
BNKV	1	1	1	1	0,9686	0,99372
BNKIII	1	0,9595	1	0,9802	1	0,98794

BNKVI	0,9786	0,9535	0,9738	1	1	0,98118
BNKII	0,8848	0,862	0,9199	0,9058	0,9409	0,90268
BNKXVII	0,7608	0,9085	0,8786	0,8076	0,7841	0,82792
BNKXVIII	0,7239	0,8718	0,8926	0,626	0,8267	0,7882
BNKIX	0,7545	0,7337	0,7096	0,7408	0,9322	0,77416

According to Table IV:

In 2017, the banks demonstrating the highest levels of efficiency, achieving maximum output with minimal input, as determined by the weighted combination of their inputs and outputs, include BNKX, BNKXI, BNKXII, BNKXVIII, BNKXIV, BNKXV, BNKXVI, BNKVII, BNKIV, BNKVIII, BNKIII, BNKV, and BNKI. Furthermore, Alinma Bank, with an approximate deviation of 2%, is also regarded as efficient. These efficient banks generally exhibit superior efficiency scores compared to BNKII, BNKXVII, BNKIX, and BNKXVIII, considering the inputs and outputs utilized in 2017.

In 2018, the banks demonstrating the highest efficiency, achieving maximum output with minimum input, as determined by the weighted combination of their inputs and outputs, include BNKX, BNKXI, BNKXII, BNKXIII, BNKXIV, BNKXV, BNKXVI, BNKVII, BNKVIII, BNKV, and BNKI. Additionally, BNKIV, with a deviation of 3%, BNKIII, with a deviation of 4%, and BNKVI, with a deviation of 5%, are considered efficient. These banks generally exhibit superior efficiency relative to BNKII, BNKXVII, BNKIX, and BNKXVIII.

In 2019, the banks with the highest efficiency and achieving maximum output with minimum input, based on the weighting of banks' inputs and outputs, are again BNKX, BNKXI, BNKXII, BNKXIII, BNKXIV, BNKXV, BNKXVI, BNKVII, BNKIV, BNKVIII, BNKIII, BNKV, and BNKI. Additionally, BNKVI, with a deviation of 3%, is considered efficient. These banks generally have a higher efficiency score compared to BNKII, BNKXVIII, BNKXVII, and BNKIX.

In 2020, the banks with the highest efficiency and achieving maximum output with minimum input, based on the weighting of banks' inputs and outputs, are again BNKX, BNKXI, BNKXII, BNKXIII, BNKXIV, BNKXV, BNKXVI, BNKVII, BNKIV, BNKVIII, BNKVI, BNKV, and BNKI. Additionally, BNKIII, with a deviation of 2%, is considered efficient. These banks generally have a higher efficiency score compared to BNKII, BNKXVIII, BNKXVII, and BNKIX.

In 2021, the banks with the highest efficiency and achieving maximum output with minimum input, based on the weighting of banks' inputs and outputs, are again BNKX, BNKXI, BNKXII, BNKXIII, BNKXV, BNKXVI, BNKVII, BNKIV, BNKVIII, BNKIII, BNKVI, and BNKI. Additionally, BNKXIV, with a deviation of 1%, and BNKV, with a deviation of 3%, are considered efficient. These banks generally have a higher efficiency score compared to BNKII, BNKXVIII, BNKXVII, and BNKIX.

CONCLUSION AND RECOMMENDATIONS

In the financial efficiency evaluation conducted in this resarch, the performance of both Sharia-compliant and conventional banking institutions within the international financial system over the past five years was analyzed. As a result of these evaluations, it was found that banks such as BNKX, BNKXI, BNKXII, BNKXIII, BNKXV, BNKXVI, BNKVII, BNKVIII, and BNKI have consistently operated at optimal efficiency levels, with VRS=1, throughout the five-year period. These institutions appear to hold a competitive edge in the financial industry. Alongside these high-performing banks, institutions such as BNKXIV, BNKIV, and BNKV, with an overall average of VRS=0.995, as well as BNKIII and BNKVI, with an average of VRS=0.985, have demonstrated only slight variations in their efficiency scores. However, it has been observed that banks like BNKII, BNKXVII, BNKXVIII, and BNKIX have shown relatively low levels of financial efficiency. Notably, these banks have failed to attain the expected level of productivity throughout the entire analysis period.

Moreover, it has been observed that the proportion of banks functioning under conditions of diminishing returns to scale has notably risen, while the number of efficient banks has declined over time. These institutions must enhance their operational processes and optimize resource utilization. Failing to do so may result in a decline or deterioration of their efficiency.

When examined on a country-by-country basis using the selected performance indicators employed in the evaluation, it was found that four conventional banks (BNKX, BNKXI, BNKXII, and BNKXIII), headquartered in China, operated at full efficiency throughout the entire five-year period. Based on the data analyzed during the review period, it can be argued that China is a leading force in the global traditional banking sector. In Islamic banking, institutions such as BNKVIII and BNKI from Malaysia, BNKVI and BNKVII from Saudi Arabia, and BNKIII and BNKV from Qatar demonstrated consistent efficiency throughout the analysis period. Considering the literature review, it is reasonable to assert that these countries are at the forefront of Islamic banking. BNKXVI from France and BNKXIV from Japan were found to be efficient throughout all years, while BNKIX, BNKII, BNKIV, BNKXVII, and BNKXV exhibited efficiency for the entire period under review, except for Bank of America Corp., which was inefficient during the analysis period.

Proportionally, Islamic and conventional banks provided parallel results in the efficiency comparison over the 5-year period. It was found that out of the four banks that were inefficient throughout the analysis period, 2 were Islamic banks (BNKII and BNKIX) and 2 were conventional banks (BNKXVII and BNKXVIII). The primary cause of inefficiency in these banks is the misallocation of resources (inputs). In terms of the number of efficient and inefficient banks, the distribution between Islamic and conventional banks was proportionate across all years. Based on this finding, it can be inferred that no substantial difference exists in the financial performance between

Islamic and conventional banks within the global economic system during the period under review.

In addition, it can be said that the financial inefficiency of some banks in each year examined in the analysis is due to the waste of resources. These banks should determine to what extent resources are wasted and should use their inputs compared to the reference banks operating at the production frontier and reduce resource wastage. In addition to the findings, both Sharia-compliant and conventional banking institutions within the international financial system should also take their scale sizes into consideration.

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ARAŞTIRMACILARIN KATKI ORANI

Yazarların mevcut araştırmaya katkı oranları aşağıda belirtildiği gibidir:

1. Yazar ve 2. Yazar'ın katkı oranları sırasıyla %50 ve %50'dir.

1. Yazar: Saha araştırması, veri toplama, analize hazırlık, veri analizi, araştırma tasarımı, model geliştirme, literatür taraması, yazım.

2. Yazar: Saha araştırması, veri analizi, analizlerin yorumlanması, araştırma tasarımı, model geliştirme, literatür taraması, yazım kontrolü.

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AUTHORS' PERCENTAGE-BASED CONTRIBUTIONS

The contributions of the author to the study by percentages are as follows: The percentage-based contributions of the 1st author and 2nd author are 50% and 50%, respectively.

1st Author: Field research, data collection, data preparation for analysis, data analysis, research design, model development, literature review, writing.

2nd Author: Field research, data analysis, interpretation of analysis, research design, model development, literature review, proofreading.

DECLARATION OF COMPETING INTERESTS

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ETHICAL APPROVAL OF THE STUDY

All rules within the scope of “Instruction on Research and Publication Ethics for the Higher Education Institutions” were observed throughout the study. No actions mentioned in the Instruction’s second chapter titled “Actions Against to Scientific Research and Publication Ethics” were taken in the study.

PEER REVIEW

Reviewed by at least two external referees / Double-Blind Review.