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THE EFFICIENCY OF PARTICIPATION AND CONVENTIONAL BANKING IN TURKIYE: A STOCHASTIC FRONTIER APPROACH

Çağlar HAMARAT[1]

Abstract

The efficiency of conventional and participation banks in Türkiye between 2011 and 2016 is examined in this research using stochastic frontier analysis (SFA). The primary goals of this research are the analysis of the Turkish banking system's cost-effectiveness, a comparison of the efficacy of conventional and participation banks. The empirical research was based on a sample that included panel data for three participation banks and 23 commercial banks that had been in operation continuously. The one-step approach permits control of firm- and country-specific variables as well as Shariah-compliant banking directly in the estimated frontier, allowing any differences in technology and output that are caused by differences in the two banking systems' operational characteristics. According to the SFA statistics, participation banks are less efficient than regular banks overall. According to the findings, inflation and interest rates are statistically significant for the chosen external factors and negatively affect Turkish banks' cost-effectiveness, particularly between 2012 and 2014.

Keywords

Banking
Technical Efficiency
Stochastic Frontier Analysis
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TOPLUM, EKONOMİ VE YÖNETİM DERGİSİ
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TÜRKİYE'DE İSLAMİ VE GELENEKSEL BANKACILIĞIN ETKİNLİĞİ: STOKASTİK SINIR YAKLAŞIMI

Öz

Bu araştırmada 2011-2016 yılları arasında Türkiye'deki konvansiyonel ve katılım bankaların etkinliği stokastik sınır analizi (SFA) kullanılarak incelenmiştir. Bu araştırmanın temel amacı, Türk bankacılık sisteminin maliyet etkinliğinin analizi, konvansiyonel ve katılım bankaların etkinliğinin karşılaştırılmasıdır. Ampirik araştırma, sürekli faaliyette olan üç katılım bankası ve 23 ticari banka için panel verileri içeren bir örneğe dayanmaktadır. Tek adımlı yaklaşım, iki bankacılık sisteminin operasyonel özelliklerindeki farklılıklardan kaynaklanan teknoloji ve çıktı farklılıklarına izin vererek, tahmin edilen sınırda doğrudan Şer'i uyumlu bankacılığın yanı sıra bankaya ve ülkeye özgü değişkenlerin kontrolüne izin vermektedir. SFA analiz sonuçlarına göre, katılım bankaları genel olarak normal bankalardan daha az verimlidir. Bulgulara göre, enflasyon ve faiz oranları seçilen dış faktörler için istatistiksel olarak anlamlıdır ve özellikle 2012-2014 yılları arasında Türk bankalarının maliyet etkinliğini olumsuz etkilemektedir.

Anahtar Kelimeler

Bankacılık
Teknik Etkinlik
Stokastik Sınır Analizi
Panel Veri

Makale Hakkında

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INTRODUCTION

With sustained expansion, the Turkish economy has done well in the recent decade. The Turkish financial system has boosted the economy due to its prominence. The financial crises that Turkey has experienced in recent years show how the financial sector has affected the economy. Before the global financial crisis, the Turkish economy had multiple internal and foreign financial crises, so it knows how important financial markets are and how to avoid collapse.

Effective supervision and the latest reforms and regulations made the banking sector the most dominant sector in the financial system and made it more efficient and profitable than other financial institutions (BAT, 2013, p. 20). Foreign banks were interested, and several new banks joined the industry. The government implemented structural changes to address the growing interest in the financial sector, particularly banks (Saltoğlu, 2012, p. 78). The administration also proposed making Istanbul a financial centre. To achieve this, most stated-owned bank offices were relocated to Istanbul (Dizkırıcı, 2012, p. 74). These innovations have expanded the financial industry, attracting additional institutions (Güner and Yılmaz, 2021, p. 47).

These changes have attracted participation banks. Türkiye has a big Muslim population, although participation banks made up a small portion of the financial sector. People lost faith in traditional banks following the financial crisis. Participation banking gained popularity with conservative clientele and society. Additionally, trade links with Islamic nations, notably the affluent Gulf countries, need this growth. Therefore, the Turkish government has established a plan to raise participation banks' share of sector assets and supply world-class financial products and services to make Türkiye an Islamic financial centre (PBAT, 2015, p. 18).

The rising interest in participation banking in Türkiye necessitates financial players' analysis of its mechanism, efficiency, and drivers. Thus, participation banks' economic and financial efficiency should be compared to conventional banks (Ahmad and Rahim Abdul Rahman, 2012, p. 247). This article compares SFA efficiency with appropriate tests for 2011–2016 Turkish participation and conventional banks to produce valid and accurate findings.

This research makes two literary contributions. First, it compares conventional and participation bank cost efficiency. Turkish conventional bank efficiency analysis is well-researched, whereas participation bank efficiency analysis is not. Second, this is one of the first studies to assess both internal (bank-specific) and external (macroeconomic and structural) determinants of conventional and participation bank efficiency in Türkiye.

Section 1 gives a short review of the Turkish economy and the financial sector, including capital norms and recent changes. Section 2 evaluates current research on the effectiveness of the two banking systems in Türkiye and elsewhere. Data and technique are described in Section 3. Section 4 presents the empirical study's findings and investigates efficiency's causes. Section 5 presents results and concludes.

1. Türkiye's Economy and Finance

The economic recovery and financing incentives have helped banks' balance sheets rise. Banks are resilient to liquidity risk, and they have renewed short-term foreign loans with long-term resources in recent years. The banking industry is more resistant to global liquidity shocks due to longer maturity foreign loans. Banks' liquid assets against worldwide market volatility look robust enough to react to bad eventualities. Including cash and deposits. Long-term bonds and equity-denominated instruments have increased due to positive international market conditions (CBRT, 2017, p. 26).

The banking sector's profitability metrics have continued to grow in the new year, after flattening out in the fourth quarter of 2016. Examining income-expense accounts, net interest income growth, primary expenditure austerity, and securities, foreign exchange, and derivative transaction profitability is favourable.

1.1. Turkish Banking Sector

As of the study period, Türkiye has 52 banks: 34 deposit banks, 13 investment and development banks, and 5 participation banks. Banking Law No. 5411:

Deposit banks: Financial entities that take deposits and lend money in their own names and accounts;

Development and investment banks: Financial entities that focus on completing their unique legislation and making loans;

Participation banks: Financial entities that gather money via participation accounts and issue loans under particular criteria.

The Bank Regulation and Supervision Agency (BRSA) and Central Bank of Republic of Türkiye oversee the Turkish banking sector. BRSA's major responsibility is to supervise, regulate, and manage international standards for financial markets, institutions, and consumers within national criteria and needs. BRSA is a Basel Committee on Banking Supervision and Islamic Financial Services Board member. However, CBRT, the country's monetary authority, prints banknotes and implements monetary and exchange rate policy. The major goal of CBRT is price stability for financial stability.

The Turkish banking system branches declined by 24, although staff climbed by 176, according to the BRSA. As of March 2017, there are 11,723 branches and 211,062 employees. The Turkish economy and banking sector received severe internal and external shocks in 2016, but a strong balance sheet framework, healthy shareholders' equity, and the banking sector management's experience and effective communication and collaboration with the BRSA and Central Bank limited the impact. Banking assets reached TL 2,731 billion (USD 776 billion) in 2016, with fixed exchange rates up 8%. The total assets-to-GDP ratio was roughly 105% (BAT, 2017, p. 19).

Türkiye's banking system accounts for 81% of the financial sector's assets. Loans make up 64% and securities 13%. The highest proportion of liabilities is deposits (53%), followed by bank borrowing (19%) and repo funds (4%). March 2017 non-cash loans were TL 578 billion.

In 2017, the loan was TL 183 trillion and the deposit TL was 152 trillion. The deposit credit conversion rate is 1.21 (BAT, 2017, p. 22).

Non-performing loans (NPL) increased somewhat due to economic issues, with the NPL ratio to total loans rising to 3.3%, namely 2.9% in corporate loans and 4.3% in retail loans. With a 15.6% capital adequacy ratio and a few NPLs, the banking sector was solid. Additionally, banking sector interest income was TL 56 billion and cost was TL 28 billion last year. The Turkish banking industry earned TL 14 billion during this time. The BRSA limits on commissions and fees pressured profitability, yet all banking organisations' net profit improved and return on assets was 1.42% and equity was 13.95% last year (CBRT, 2017, p. 32).

1.1.1. Turkish Participation Banking

To study the history of participation banking in Türkiye, one must first explain the distinctions between participation and conventional banking. Participation banking prohibits interest, financing sectors illegal and unsuitable under Shariah law, such as drugs and alcohol, and risk and uncertainty.

Profit-loss sharing regulations supplement this. All financial transactions must be based on genuine economic activities and physical assets (Beck et al., 2013, p. 436). In practice, Islamic scholars have established dependent payment forms including discounting with fees that replace interest rate payments. The basic components of both systems are similar nowadays (Batır et al., 2017, p. 91).

Participation banking has grown worldwide since the 1960s, although Turkish financial markets are new to it. It has grown because to favourable public attitudes, declining faith in traditional banks following the 2001 and 2008 global financial crisis, and a desire to attract Gulf area cash. Participation banking in Türkiye is new, but government goals and public sensibilities have allowed it to acquire credibility in the previous decade. Despite its rising popularity, participation banking has a modest share of the financial industry due to its low market penetration and severe rivalry with traditional banks. Türkiye's traditional financial capital system is older than other Muslim majority nations' and did not modernise in the recent century. The significance of participation banking in the economy will rise since Türkiye has a significant Muslim population and may attract investors from the affluent Arab Gulf area, who have a lot of liquid cash and are religiously conservative (Hardy, 2012, p. 11).

Participation banks in Türkiye began operations in 1985 to release ‘under the pillow’ financial valuables that cannot be included in the national economy under interest-free financing rules for different reasons. Special financing houses (SFHs) founded participation banks. Al Baraka Türk, the first SFH, was created in 1985 after routine modifications. Later, Kuveyt Türk was created in 1989. Law No.5411 of Banking Law made SFH a participation bank in 2005 (PBAT, 2015, p. 63).

In 2016, the participation banking industry grew despite turbulent and tough micro and macro conditions. Türkiye's participation banks have TL 141.2 billion in assets (PBAT, 2017, p. 72). Participation banks had 14,466 employees and 1005 branches in 2016, accounting for 8% of the banking market. Türkiye has higher participation banking potential than Malaysia, Indonesia, and the Gulf nations, where at least 50 participation banks operate, due

to its population and 6% market share with five participation banks. The Participation Banks Association of Türkiye (PBAT) will work hard to provide participation banks 15% market share by 2025 (PBAT, 2017, p. 58).

1.2. Turkish Banking System Capital Norms

The Turkish banking capital rules framework began in 2006. The prudential framework for all banks was upgraded to reflect Basel II, Basel II.5, and Basel III criteria and enhanced in 2015 and 2016. The BRSA conducted a thorough Basel-standards examination of its domestic rules in early 2015. After submitting the altered self-assessment and updated rules, the assessment team validated them and approved modifications in 2016 with the CBRT and Turkish Ministry of Development.

Basel capital requirements classify equity as tier 1 capital. In 2015, the CET1 ratio was 13.2% and the weighted average capital ratio 15.5%. The analysed period had core tier 1 ratio between 12 and 14%.

The core tier 1 ratio fluctuated between 2011 and 2016 due to rising currency and interest rates. This is because exchange rates raise the risk banks must reserve, while interest rates decrease the value of ready-to-sell assets. Thus, the unanticipated exchange rate and interest rate increases reduced Turkish banking sector capital adequacy. This was also true for the liquidity coverage ratio (LCR), which ensures banks have enough liquidity to survive 30 days of liquidity crisis.

This study used liquid assets to total assets and total deposits with borrowing rates to approximate the LCR. Since 2011, Turkish banks' liquid assets have been substantially influenced by currency rate and interest rate fluctuations. Moreover, the net stable funding ratio (NSFR) encourages banks to keep long-term stable financing resources in proportion to their liquid assets to decrease transformation and maturity risk (Chiaramonte and Casu, 2017, p. 146).

2. Literature Review

Efficiency searches and measurements are done in real economy industries using the institutional approach to corporate microeconomics. In general, efficiency studies investigate deviations from the frontier, which predicts the ‘efficient frontier’ and efficiency loss. The frontier production techniques and assumptions about inefficiency distribution determine the strategies utilised. Frontier studies may overcome financial ratio study limitations. These studies estimate the frontier of best bank practices that other banks may use to improve efficiency (Eisenbeis et al., 1999, p. 111). An efficient frontier separates good and bad producers. In this frontier literature, parametric and non-parametric techniques are important. The most popular parametric technique is stochastic frontier analysis, while the major non-parametric approach is data envelopment analysis (DEA).

Charnes et al. (1978, p. 436) introduced the DEA technique, a linear programming approach that evaluates efficiency without affecting cost, profit, or manufacturing process (Isık and Hassan, 2002, p. 259). Despite this benefit, DEA prevents measurement mistakes and random shocks in inefficient model variables. SFA is for cross-sectional data and has a production function. The key assumption of this model is that adding an error term to the

conventional production or cost function creates two components. This technique enables non-controlled external factors and the inefficiency term to be modelled, which is a major benefit. The frontier analysis literature is led by Farrel (1957, p. 258). Aigner et al. (1977, p. 26), Altunbas et al. (2001, p. 1934), Battese and Coelli (1992, p. 155; 1995, p. 327), Coelli et al. (1998, p. 173), Kumbhakar and Lovell (2000, p. 83) and Meeusen and van den Broeck (1977, p. 439) created, utilised, and tested this approach.

There are several efficiency notions. Technical efficiency assesses a bank's capacity to maximise output with fixed inputs. The ratio of observed output to ideal output shows how much observed output must grow to make the bank 100% technically efficient. Technical efficiency was expanded by Farrel (1957, p. 272), who included allocative efficiency (price efficiency). Banks may choose the optimum technical efficiency input and output vector based on input-output pricing. Leibenstein (1966, p. 405) advocated combining technical and allocative efficiencies to quantify economic efficiency. Based on economic optimisation, economic efficiency considers pricing, competition, cost, profit, and both. Leibenstein (1966) discusses x-inefficiency in cost efficiency. Kwan and Eisenbeis (1997, p. 125) describe this as 'deviations from the production efficient frontier which displays the maximum possible output for a given quantity of input'. Bank efficiency studies concentrate on cost efficiency rather than technical efficiency since cost efficiency is a key step towards long-term profit efficiency (Delis et al., 2009, p. 196).

2.1. Turkish Bank Efficiency Studies

Turkish bank efficiency studies have mostly used DEA rather than SFA. Ertuğrul and Zaim (1999, p. 103) and Öniş (1995, p. 261) use DEA to examine the efficiency impact of deregulation on Turkish banks. The data show that Turkish banks were more efficient post-liberalisation. Financial deregulation in the late 1980s improved bank efficiency. Turkish bank efficiency during 1988–1996 is extensively studied by Isik and Hasan (2002, p. 263). Their research estimates using parametric and non-parametric methods. According to their findings, technical inefficiency in Turkish banking is the fundamental culprit, not diseconomies of scale-induced allocative inefficiency. They find that international banks in Türkiye are more efficient than local ones.

In contrast, Kasman (2002, p. 13) uses a three-input, three-output Fourier flexible cost function specification to study cost efficiency, technological development, and scale economies in the Turkish banking system from 1988 to 1998. The research confirmed that the average yearly inefficiency of Turkish banks improved throughout the analysed period, despite a major inefficiency issue. The analysis also found economies of scale in the sample.

Yildirim (2002, p. 2295) uses the DEA approach to study Turkish commercial banks' size and technical efficiency from 1988 to 1999. They found that scale efficiency was the major cause of inefficiency and technical efficiency was variable owing to the Turkish economy's unpredictability. Efficient banks were more profitable, and bank size was connected to scale and technological efficiency. In another research, Isik and Hasan (2002, p. 268) utilise DEA to examine how market structure, ownership, governance, and control affect Türkiye bank efficiency. They investigate 1988, 1992, and 1996 and validate their 2002 findings that international banks outperform local banks. The report also shows that efficiency, not

technology, has driven productivity growth in all Turkish banks. Increasing efficiency has also relied on improved resource management rather than scaling. Using the model for technical inefficiency effects with SFA, Demir et al. (2005, p. 404) discover critical parameters to establish technical efficiency differentials between Turkish commercial banks pre- and post-liberalisation. They observed that bank size, ownership, loan quality, and profitability positively and significantly affect technical efficiency.

The research by El-Gamal and İnanoğlu (2005, p. 657) examines Turkish bank efficiency from 1990 to 2000. Their findings show that state banks used workers inefficiently. They also say overseas banks are more efficient than local ones. Özkan-Günay and Tektaş (2006, p. 423) analyse bank efficiency before and after the 1994 crisis. Their 1990–2001 analysis includes non-public commercial banks. The analysis indicated a steady decline in bank efficiency. Thus, they showed that the 1994 and late 1990s crises deteriorated bank efficiency. Denizer et al. (2007, p. 186) use DEA to examine bank efficiency pre- and post-liberalization, comparable to Demir et al. (2005, p. 407) and Ertuğrul and Zaim (1999, p. 112). The research found that liberalisation policies decreased bank efficiency and scale difficulties in the Turkish banking sector. The second portion of the analysis shows that this reduction was linked to Türkiye's rising macroeconomic instability.

Aysan and Ceyhan (2008, p. 1598) found that branch count decreases efficiency. Efficiency and bank capitalization in the Turkish banking system from 1990 to 2006 were positively correlated. Fukuyama and Matousek (2011, p. 82) demonstrate that financial restructuring initiatives improved bank efficiency from 2001 to 2004, but they gradually decreased after 2004. Their findings show that the 2000 crisis significantly affected bank efficiency. Similar to Fukuyama and Matousek (2011, p. 88), Özkan-Günay (2012, p. 95) shows that restructuring strategies significantly and gradually improve deposit bank efficiency. They also discover that Türkiye deposit banks' management effectiveness was unaffected by the global crisis. Assaf et al. (2013, p. 511) examine Turkish bank productivity and efficiency from 2002 to 2010. They demonstrate that Turkish banks' productivity increases were positive throughout the sample period, even while efficiency growth was negative, notably following the 2008 global crisis.

2.2. Bank Efficiency Comparisons

Despite the enormous number of bank efficiency studies, few compare conventional and participation banks, notably in Türkiye. Bader et al. (2008, p. 38) used DEA to analyse the income, profit, and cost efficiency of 37 conventional and 43 participation banks in 21 countries between 1990 and 2005. The research found no substantial efficiency differences between participation and conventional banks. Johnes et al. (2009, p. 8) and Srairi (2009, p. 19) find that conventional GCC banks are more efficient than participation banks. Srairi (2009, p. 23) shows superior cost and profit efficiencies utilising SFA, whereas Johnes et al. (2009, p. 11) show excellent technical efficiency in traditional banks using DEA. Hassan et al. (2009, p. 53), like Bader et al. (2008, p. 57), find no substantial differences in overall efficiency between participation and conventional banks.

Ahmad and Luo (2010, p. 364) compare participation bank efficiency to conventional bank efficiency, including the financial crisis. Participation banks are more technically efficient

than normal banks but less allocatively efficient. Technological and managerial efficiency helped conventional banks beat participation banks in all efficiency parameters, according to Ahmad and Rahim Abdul Rahman (2012, p. 250). Johnes et al. (2014, p. 97) used DEA and metafrontier analysis to study 18 nations from 2004–2009. The DEA findings support Bader et al. (2008, p. 62) and Hassan et al. (2009, p. 57), which show that participation and conventional banks have similar overall efficiency. Sillah and Harrathi (2015, p. 145) use DEA to evaluate conventional and participation banks in the six GCC nations from 2006 to 2012. There is no indication of efficiency difference between the two bank types.

In Türkiye, a few academics study conventional and participation bank efficiency. Between 2007 and 2013, Yılmaz and Günes (2015, p. 388) found that participation banks were more technically efficient than conventional banks. Batır et al. (2017, p. 93) found that participation banks had greater efficiency than conventional banks from 2005-2013, according to DEA analysis findings.

All Türkiye investigations show that efficiency comparison study for both banking kinds is insufficient. Thus, this research compares the effectiveness of conventional and participation banks in Türkiye to address this large gap. SFA detects bank-specific and macroeconomic factors that impact bank efficiency.

3. Data and Methods

3.1. Data

This empirical research analyses 2011–2016 consolidated income statements and balance sheets of Turkish participation and conventional banks. A study was conducted between 2011 and 2016 because it was a period in which access to data was possible, participation in banking became widespread, and interest in this type of banking partially increased. When needed, conventional and participation banks export yearly accounting data from the Orbis Bank database, the SNL Financial database, and their annual financial reports. The Orbis database verifies bank categorization with PBAT and the Bank Association of Türkiye. BAT provides industry-specific data for traditional banks, whereas PBAT provides participation bank data.

Performance analysis requires homogeneous production units with equivalent resources and services. Investment and development banks were omitted from this analysis because of their tiny market share, non-depository purposes, and distinct structure (Işık and Hassan, 2002, p. 263). Thus, this analysis comprises 23 continuously running commercial banks (10 privately owned, 3 state owned, and 10 foreign banks) and three participation banks that account for almost 90% of Turkish banking sector assets. 22 of the 27 banks in the sample are publicly listed, which is recommended for analysis. The final data set includes 160 bank observations.

Inflation rate, GDP per capita, GDP price deflator, and GDP growth are the macroeconomic indicators analysed from the World Bank World Development Indicator database and the Central Bank of the Turkish Republic and Turkish Statistical Institute websites. Real interest rate is computed using Fisher equation. The data are then checked for reporting mistakes, inconsistencies, and missing numbers.

3.2. Method

3.2.1. Stochastic Frontier Analysis

The SFA technique of Aigner et al. (1977, p. 32) and Meeusen and Van den Broeck (1977, p. 442) is used to compare the efficiency of two banking systems in this research. SFA offers several benefits over DEA or DFA. Even if a model variable is unrelated, it will have little influence on the efficiency rate computation. SFA permits stochastic shocks and efficient separation of noise and pure inefficiency, unlike DEA, which classifies the whole deviation as inefficiency. Thus, it controls exogenous influences like inefficiency on the cost frontier structure and estimates measurement errors and random events' impacts on the model (Kumbhakara and Lovell, 2000, p. 157).

SFA-based efficiency studies employ two major methods. First, a 'one-step' method analyses the impacts of border and environmental variables on efficiency concurrently using a Battese and Coelli (1995, p. 330) model for inefficiency effects. The second important literary method is a 'two-step' strategy. This method calculates the frontier and then uses regression analysis to determine the link between bank-specific characteristics and inefficiency scores (Altunbas et al., 2001, p. 1939). The two-step technique ignores environmental effects on frontier estimate (Maudos et al., 2002, p. 41). The two-step process has various drawbacks, according to Coelli et al. (1998, p. 273) and it biases efficiency estimations (Abdul-Majid et al., 2010, p. 32). Given the discussion, this study uses the Battese and Coelli (1995, p. 330) model to estimate efficiency using the one-step approach because it allows direct control of country- and firm-specific factors and Shariah-compliant banking in the estimated frontier by allowing technology and output differences due to operating characteristics.

This article uses a one-step cost efficiency analysis because banking cost efficiency estimates reveal an ability to assure services without squandering supplies due to allocative or technological inefficiency (Fethi and Pasiouras, 2010, p. 194). If seen from three angles, it may also indicate financial progress. First, structural, institutional, and state policy-related banking incentives and limitations increase cost efficiency. Second, although cost efficiency may directly boost macroeconomic development, it will encourage the bank to charge the debtor less. Participation banks may compete with traditional banks by reducing their profit-sharing ratio. Third, cost efficiency may be related to other bank performance aspects that affect the economy via more productive lending but are not readily assessed in bank statistics (Zuhroh et al., 2015, p. 1126).

The study's cost function includes country-specific environmental macro variables:

$$TC_{i,t} = f\ (p_{i,t}, y_{i,t}, e_{i,t}) + \varepsilon_{i,t} \quad (1)$$

$TC_{i,t}$ measures the total cost of bank i at time t, $f\,(p_{i,t}, y_{i,t}, e_{i,t})$ represents the cost frontier, and ε_{it} represents the error term. Cost efficiency often uses a trans log cost function (Berger and Mester, 1997, p. 913):

$$\ln TC_{i,t} = \alpha_0 + \sum_{i=1}^{n} a_i \ln y_{it} + \sum_{j=1}^{n} \beta_j \ln p_{jt} + \frac{1}{2}\sum_{i}^{n}\sum_{i}^{k} \sigma_{ik} \ln y_{jt} \ln y_{kt} + \frac{1}{2}\sum_{j}^{m}\sum_{h}^{m} \gamma_{jh} \ln p_{jt} \ln p_{ht} + \sum_{i}^{n}\sum_{j}^{m} \delta_{ij} \ln y_{it} \ln p_{jt} + v_{it} + u_{it} \quad (2)$$

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Where $y_{j,it}$ is the output vector, $p_{j,it}$ is the input price, and β is an unknown parameter vector to estimate. Linear homogeneity limitations are difficult to enforce, according to cost efficiency literature. Pasiouras et al. (2009, p. 298) normalise the dependent variable and all input prices by one. The cost function is restricted to linear homogeneity of second-order parameters, unlike this work (Goddard et al., 2013, p. 356).

The marginal cost of inputs and outputs must be positive, and the well-structured cost function must be non-increasing, convex for constant input levels, non-decreasing, and concave for fluctuating input prices (Goddard et al., 2013, p. 358). Following Yıldırım and Phillippatos (2007, p. 132), input prices are subject to regular constraints of symmetry and linear homogeneity.

$$\gamma_{jh} = \gamma_{hj} \tag{3}$$

$$\sum_{j}^{m} \beta_j = 1 \sum_{j}^{m} \gamma_{jh} = 0 \sum_{j}^{m} \delta_{ij} = 0$$

The parametric model of SFA splits the error term into random noise and inefficiency terms.

$$\varepsilon_{i,t} = v_{i,t} + u_{i,t} \tag{4}$$

$v_{i,t}$ is the independent, identically distributed random error in the error term. The error term is assumed to have $N\ (0,\sigma_v^2)$ and a normal distribution. In contrast, $u_{i,t}$ represents the impacts of non-negative inefficiency, believed to be separately distributed as a truncation at zero of the the $N\ (\mu_{i,t}, \sigma_u^2)$ distribution, with a mean stated as:

$$\mu_{i,t} = z_{i,t}\delta \tag{5}$$

The observable variable $z_{i,t}$ impacts banks' efficiency ratings at time t, whereas δ is an estimated parameter vector of $p \times 1$. The error term total variance $(\varepsilon_{i,t})$ is $\sigma^2 = \sigma_v^2\sigma_u^2$, with the random component contributing $\sigma_v^2 = \sigma^2/(1 + \lambda^2)$ and the inefficiency component contributing $\sigma_u^2 = \sigma^2\lambda^2/(1 + \lambda^2)$, where $\lambda = \sigma_u/\sigma_v$ reflects the relative contribution of u and v to $\varepsilon_{i,t}$ (Goddard et al., 2013, p. 359).

The one-step maximum likelihood technique estimates cost frontier parameters. Both the cost frontier and inefficiency specification parameters will be assessed for significance using the Likelihood Ratio (LR) test:

$$LR = -2[L(H_0) - L(H_1)] \tag{6}$$

Where stochastic frontier model log-likelihood values are $L(H_0)$ and $L(H_1)$ (Kumbhakar et al., 2015: 113). The regression error estimates efficiency. In estimating, $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u^2/\sigma^2$ are used to repair the terms. The parameter, γ, should be between 0 and 1. Close to 0, inefficiency is low. $CEit = 1/exp\ (u_{it})$ from the projected frontier calculates the cost efficiency value for every bank at time t. The metric ranges from 1 to 0. Efficiency is higher in banks with scores around 1. The summary statistics of the variables are presented in Table 1.

Table 1. The Variable's Summary Statistics

	Mean	Std. Deviation	Min.	Max.
Total Assets	72360.47	93613.85	949	392077

Table 1 (Continued). The Variable's Summary Statistics

	Mean	Std. Deviation	Min.	Max.
Outputs				
GL	46804.68	60086.04	201	262930
OBSI	29943.16	38053.73	139	223751
OEA	16307.66	23119.57	155	84508
Inputs				
TIE	2779.18	3519.81	23	14234
Labour	752.9	858.48	22	4047
OOE	1106.67	1776	20	12203
Inputs Prices				
P-Labour	0.013523	0.00423	0.006207	0.032653
P-Fund	0.071431	0.02569	0.009676	0.220678
P-Capital	0.019139	0.01058	0.002013	0.065536
Total Cost	4638.75	5808.14	72.47	28563.54

3.2.2. Variable Definition of Cost Frontier Estimate Function

To apply the SFA approach for conventional and participation banks concurrently, pick consistent input and output variables for assessing efficiency. Shariah laws may influence production since Shariah-based banking operates differently from traditional banking. The banning of interest-bearing instruments may limit the deployment of some banking technologies by reducing potential banking outputs compared to traditional banks. Controlling participation bank-specific parameters that affect the projected frontier and potential production is essential for gauging efficiency. Participation bank managers are compelled by Shariah restrictions, yet SFA allows them to measure efficiency to a reasonable frontier by considering operational differences between conventional and participation banks (Abdul-Majid et al., 2010, p. 36).

Intermediation and production techniques are prominent SFA input-output selection approaches. Benston's (1965, p. 323) production approach views banks as deposit loan service providers, utilising capital and manpower as inputs and accounts as output. The number of each kind of account is a good output specification. The main drawback of this strategy is that such precise information is not publicly accessible. The alternative intermediation concept, developed by Sealey and Lindley (1977, p. 1256), accepts banks as intermediaries between investors and savers. This method concludes that deposits, capital, and labour generate securities and loans.

This study uses the intermediation strategy to pick variables since it is more popular in bank studies and more compatible with participation banking's equitable participation concept. Under the intermediation technique, the parametric frontier method translog function supports many inputs and outputs. Thus, the analysis chooses three inputs and three

outputs: gross loans (GL), which include net loans and advances to customers (mainly commercial, consumer, industrial, and other loans) and loan loss reserves; and off-balance sheet items (OBSI), which include guarantees, acceptances, documentary credits, committed credit facilities, managed securitised assets, other exposure to securitisations, and total interest expense (TIE), wages, and other operational expenditures include other securities and bank inputs.

The input prices are (1) labour (P-Labour), personnel expenses divided by number of employees, (2) fund (P-Fund), interest expenses divided by total deposits, (3) physical capital (P-Capital), and other operating expenses divided by total assets. All variables are reported in millions of Turkish Liras (TL) and adjusted in real terms using the yearly GDP deflator and 2011 prices to exclude inflation.

The SFA in this research includes macroeconomic factors and cross bank observation to capture the influence of domestic macro variables on Turkish banking efficiency. Analysing these variables $\mu_{i,t}$ has the following form:

$$\mu_{i,t} = \delta_0 + \delta_1 GDPGR + \delta_2 INTR + \delta_3 INF + \delta_4 Islamic \quad (7)$$

Where δ_0 is constant, $GDPGR$ measures GDP growth, $INTR$ measures real interest rate, INF measures Turkish economy inflation, and participation is a dummy variable for bank category certainty. D = 0 for normal banks, 1 for participation banks. To evaluate bank efficiency using exogenous variables, STATA Version 15.0 was utilised to create maximum likelihood estimates and indicated cost efficiency.

4. Experimental Results

This section compares the cost efficiency of the 27 participants and traditional banks using the Battese and Coelli (1995, p. 329) inefficiency specification and a stochastic translog cost frontier model with panel data. The parameters of maximum likelihood estimates measured cost efficiency of both bank kinds in Türkiye from 2011 to 2016. The cost frontier estimation findings are based on the one-step technique and the estimate of λ, which is the ratio of the standard deviation owing to inefficiency and random noise. Note that the parameter is considerably different from 0. Table 2 shows the likelihood-ratio (LR) test's major emphasis for model selection.

Table 2. Analysis Result of The Likelihood

Null hypothesis	Likelihood Ratio (LR) Test	Decision
Test: No presence of the one-sided error term, σ_u^2.	10.19*	Reject Null

** Kodde and Palm (1986) describe the essential value at 10% significance level. 9.998 is the test essential number.*

4.1. Cost-Efficiency Outcomes

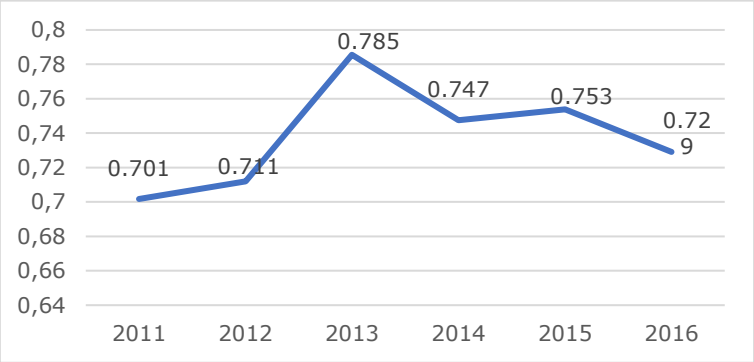
According to estimations, the Turkish banking industry had an average cost efficiency of 0.74 over the analysed period. Turkish banks averaged 74% cost efficiency throughout the research. A typical bank in this sample utilises 74% of its resources effectively or wastes 26% compared to a best-practice bank. This study's Turkish banking cost efficiency analysis yielded worse results than earlier research. Işık and Hasan (2002, p. 265) reported an average cost

efficiency of 0.90 for Turkish banks, whereas Yılmaz and Güneş (2015, p. 386) reported a mean of 0.82.

Adverse developments, such as increased funding costs due to strong competition between banks to collect insufficient deposits, a short-term concentration of bank deposits in the banking business at the examined period, and the incorporation of a variety of macroeconomic variables in the model, likely affected efficiency results.

Figure 1 illustrates the average bank efficiency across the study period. The study shows that average bank efficiency varies. Despite improving between 2011 and 2013, banks' average cost efficiency declined to a value similar to the beginning point after six years. Its efficiency peaked at 0.79 in 2013.

Figure 1. The Annual Average Efficacy of The Banking Sector



The slope of the line shows Turkish banks' dubious efficiency. The rising efficiency level indicates that conventional bank managers can pick inputs at the correct price and use them efficiently. Bank management mismanaged inputs throughout the downturn. The 2011–2013 rise in Turkish bank cost efficiency was largely due to better financing circumstances and a higher lending volume, which increased interest revenue. Clearly, lower financing costs and higher lending, mostly for property purchases, benefited Turkish banks. Net consumer loans grew 35.7% in 2013, the highest pace in the study. Reduced staff and operational costs also improved Turkish banking efficiency in 2013.

After 2013, the banking system's financing costs rate increased from 4.22% to 4.78% between 2013 and 2016. Rising finance costs raise loan rates. Thus, bank profitability suffers. As banks have a significant percentage of foreign resources and limited equity, rising borrowing rates reduce efficiency. Additionally, consumer deposits and asset growth fall substantially. Therefore, banks struggled to deliver affordable and trustworthy financing to their companies. This reduced their revenue and efficiency.

However, inflation and interest rate are crucial in cost efficiency equations at 10%, according to empirical data. Figure 2 shows that interest, inflation, and efficiency are inversely related. Thus, the study supports the idea that high inflation and interest rates go down bank operations. This is because rising inflation causes major banking issues. Banks' supposedly increasing earnings under inflation are declining in actual terms while their resources shrink. Inflation raises banks' resource and operational expenses, which narrows loan interest rates, particularly for low-risk loans. Increased problem loans in the Turkish banking system with

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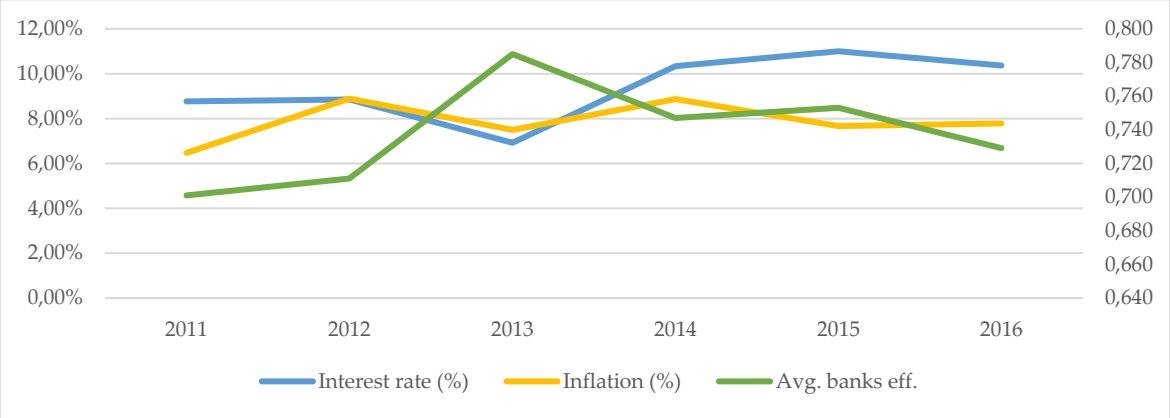
JOURNAL OF SOCIETY, ECONOMICS AND MANAGEMENT
Cilt Volume 5 Sayı Issue 1 Ay Month Şubat February Yıl Years 2024

high inflation are another key issue. For instance, higher interest rates reduce bank receivables recovery. Uncollected receivables on the spot diminish bank resource mobility and raise financing costs.

Figure 2. The Relation Between Efficiency, Inflation and Interest Rate



In addition to macro and bank-specific variable changes, Basel III's stricter capital regulations may decrease bank efficiency. Considering the 2013 rise in minimum capital ratios and capital buffer requirements, Basel III high capital regulations led to high lending rates and slower credit growth in the banking industry. Due to cost constraints from the law, banks eliminated branches, reducing lending performance and credit usage. Thus, these new regulatory criteria may have contributed to this period's cost efficiency decline.

4.2. Participation Versus Conventional Bank Efficiency

Figure 3 shows conventional and participation bank cost efficiency by year from 2011 to 2016. With the exception of 2011 and 2012, conventional banks had greater average cost efficiency outcomes than participation banks. Thus, the data show that conventional banking is more efficient than participation banking. This supports past DEA and SFA investigations (Abdul Majid et al., 2010, p. 33; Ahmad and Rahim Abdul Rahman, 2012, p. 254; Beck et al., 2013, p. 441; Hassan 2006, p. 62; Johnes et al., 2014, p. 99; Saaid et al. 2003, p. 134 and Zuhroh et al., 2015, p. 1128).

Figure 3. Comparison Between Participation and Conventional Banks' Cost Efficiency

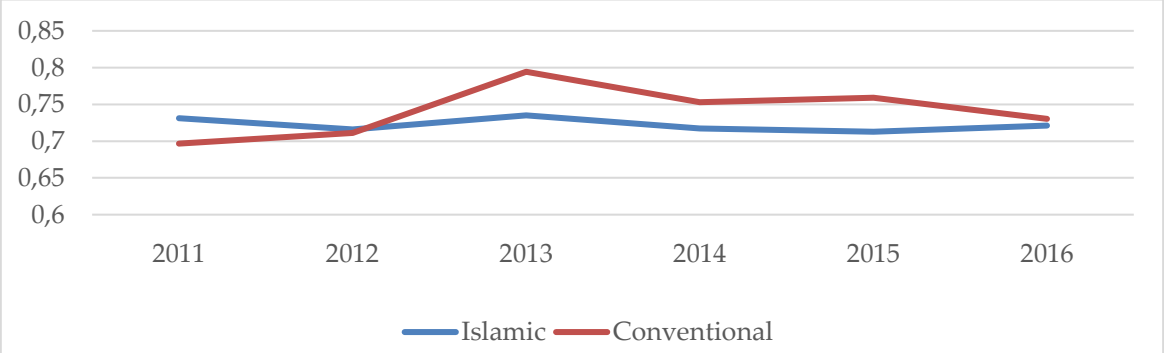


Figure 3 shows that participation banks were more efficient than conventional banks at the start of the trial, despite cost savings. Analysis shows participation banks' cost efficiency declined from 0.731 to 0.716 between 2011 and 2012. It was constant at 0.722 from 2012 to 2016.

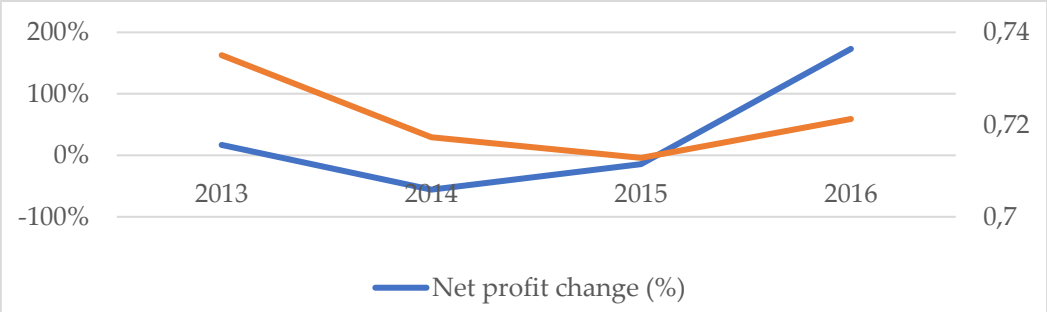
The 2014 cost efficiency of 0.71 was lower than in past years. However, the inter-temporal comparison of the scores in figure 3 reveals that traditional banks' average cost efficiency varies from 0.70 (in 2011) to 0.80 (in 2013), while the average cost efficiency is 0.74. Thus, cost efficiency increased by 10% throughout the six-year period. However, traditional banks' cost efficiency did not increase continuously between 2011 and 2013. The cost effectiveness of conventional banking declined to participation banking after the study period.

Johnes et al. (2014, p. 104) say participation banking is less efficient than traditional banking, as is expected. Participation banks use unique equity (profit-loss sharing) or service contracts (mark-up pricing, leasing agreements). Many customer-specific factors, including repayments, maturity, and collaterals, are included in these contracts. The bank must analyse stock-type contract profitability and feasibility as a financier. Based on type and project size, this is costly and time-consuming. The Shariah board of a participation bank must also approve its financial products. Every participation bond issuance (Sukuk) and most equity-based contracts need Shariah board approval, except for fee-based contracts, which are becoming increasingly standardised. Participation banks have higher administrative expenses than normal banks, which reduces their efficiency.

Participation banks have lesser inefficiency than normal banks since they lack economies of scale owing to their smaller size. Participation banks' asset size climbed from 2.44% to 5.6%, however their proportion in the banking system remains modest compared to traditional banking. Participation banks account for 4.6% of deposits, a key banking system input. Participation banks finance 5.2% of SME loans, or 13%. Despite conventional banking's large branch network, participation banks have 8.8% of the banking sector's branch network (BAT, 2016, p. 23). Based on this research, participation banking may be less efficient in servicing a limited region than traditional banking.

Figure 4 shows a parallel performance between profitability and efficiency in the participation banking system from 2013, despite previous studies not confirming a significant relationship (Hassan, 2006, p. 64; Işık and Hassan, 2002, p. 271; Kosmidou, 2008, p. 153). The participation banking system was particularly hit by macroeconomic prudential requirements after 2013, which reduce banking sector profitability. Thus, participation bank earnings fell 55.8% and 14.4% in 2014 and 2015, respectively. However, the high profitability rate in 2016 improved participation bank efficiency and average cost efficiency.

Figure 4. Relation Between Participation Banks' Efficiency and Profit



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Cilt 5 Volume Sayı 1 Issue Ay Şubat Month Yıl 2024 Years

4.3. Bank Individual Efficiency Scores

Table 3 demonstrates the results of the cost-effectiveness of participation and conventional banks by dividing them into groups.

Table 3. Average Cost Efficiency in Years for Conventional and Participation Banks

Bank Type	2011	2012	2013	2014	2015	2016
Participation	0.731	0.716	0.735	0.717	0.713	0.721
Conventional	0.696	0.711	0.794	0.753	0.759	0.730

ING Bank, which topped the rankings for much of the analysed time, is a cost-efficient bank. With 17% retail banking deposit growth, ING Bank outperformed the industry average of 14%. ING Bank's net profit was TL 571 million and sales rose 24.3%. Shareholder equity rose 12% and expenses/income declined to 53.6%, improving cost efficiency. Total lending increased 6% and deposit volume 7% for ING Bank. Turkland Bank, the least efficient bank, had its total assets drop 1%. A 9% drop in aggregate deposits deteriorate the bank's operations, lowering the net credit portfolio by 8%. The bank's main inputs, net interest and net commission income, have fallen 4% and 7%, respectively. These unfavourable outcomes have decreased Turkland Bank efficiency. Banks' ranking for cost efficiency is displayed in Table 4.

Table 4. Cost Efficiency Rankings for Banks

Bank Name	Bank Type	2011	2012	2013	2014	2015	2016	Overall
Akbank	Conventional	**7**	**6**	**2**	**3**	**7**	**14**	**3**
Albaraka Türk	Participation	**21**	**17**	**24**	**22**	**23**	**18**	**25**
Alternatifbank	Conventional	**16**	**22**	**6**	**5**	**6**	**23**	**12**
Anadolubank	Conventional	**2**	**2**	**17**	**16**	**18**	**21**	**11**
Arap Turkish Bank	Conventional	**12**	**20**	**11**	**7**	**25**	**1**	**6**
Burgan Bank	Conventional	**27**	**25**	**4**	**8**	**8**	**15**	**20**
Citibank	Conventional	**24**	**27**	**7**	**6**	**17**	**24**	**23**
Denizbank	Conventional	**8**	**12**	**21**	**21**	**12**	**11**	**16**
Deutsche Bank	Conventional	**26**	**3**	**1**	**26**	**2**	**9**	**2**
Fiba Bank	Conventional	**5**	**1**	**16**	**15**	**20**	**25**	**15**
Finansbank	Conventional	**20**	**4**	**9**	**9**	**13**	**10**	**8**
Garanti Bank	Conventional	**11**	**15**	**8**	**10**	**5**	**7**	**5**
Halk Bank	Conventional	**18**	**23**	**18**	**19**	**19**	**19**	**22**
HSBC Bank	Conventional	**23**	**24**	**5**	**2**	**9**	**5**	**9**
ICBC Türkiye Bank	Conventional	**19**	**19**	**20**	**4**	**1**	**6**	**4**
ING Bank	Conventional	**1**	**5**	**3**	**1**	**3**	**2**	**1**
İşbank	Conventional	**14**	**11**	**25**	**17**	**21**	**8**	**18**
Kuveyt Türk	Participation	**3**	**10**	**26**	**27**	**24**	**20**	**21**
Şekerbank	Conventional	**17**	**14**	**19**	**13**	**11**	**13**	**17**

Table 4 (Continued). Cost Efficiency Rankings for Banks

Bank Name	Bank Type	2011	2012	2013	2014	2015	2016	Overall
TEB	Conventional	**9**	**21**	**27**	**24**	**22**	**22**	**24**
Turkish Bank	Conventional	**22**	**7**	**23**	**14**	**4**	**3**	**13**
Turkland Bank	Conventional	**15**	**16**	**12**	**25**	**26**	**26**	**27**
Türkiye Finans	Participation	**6**	**9**	**13**	**11**	**11**	**4**	**7**
Vakıfbank	Conventional	**4**	**13**	**15**	**18**	**16**	**7**	**14**
Yapı Kredi	Conventional	**10**	**8**	**10**	**12**	**14**	**16**	**10**
Ziraat Bank	Conventional	**25**	**26**	**14**	**20**	**15**	**12**	**26**

Türkiye Finans is the most efficient participation bank. Türkiye Finans has 31% of participation bank utilised funds and 1.5% of the banking industry. Profit increased 13% and equity capital 9% over the study period. The most crucial fact is that although profit share spending climbed by 25%, other non-profit share revenue increased by 185%. Thus, it was named 'top participation Bank of Türkiye' for the third time in 2016 by the participation financial news magazine's top bank poll. Albaraka Türk was the least efficient participation bank at this time. Net non-performing loans rising from 0.2% to 1% was a major factor for the bank's poor efficiency. The average return on assets dropped, while the number of additional branches and employees increased expenditures.

Finally, the four major banks excluding Ziraat Bank had cost efficiency ratings between 0.72 and 0.78. All banks seeking profitability and efficiency faced cost administration challenges throughout the analysed period.

CONCLUSION

This article analyses the efficiency of participation and conventional banks in Türkiye based on bank performance mechanisms. The empirical investigation used panel data from 23 commercial banks and four participation institutions. From 2011 to 2016, the research lasted six years. One-step input oriented SFA was used to estimate each bank's efficiency utilising three intermediation method inputs and outputs. The one-step approach controls country- and firm-specific factors and Shariah-compliant banking directly in the estimated frontier by using technology and output differences caused by the two banking systems' operating characteristics.

The Turkish banking industry had an average cost efficiency of 0.74 throughout the research. However, the research yielded lower results than earlier literature (Işık and Hasan, 2002, p. 269; Yılmaz and Güneş, 2015, p. 389) on Turkish banking cost effectiveness. This is likely due to adverse developments like an increased funding cost, strong competition between banks to collect insufficient deposits, a short-term concentration of bank deposits in the banking business in Türkiye, and the incorporation of macroeconomic variables in the model that affect efficiency results.

Bank financing costs were high over the analysed period, raising lending rates. As banks use a lot of foreign resources and have minimal equity, higher borrowing rates damage

their efficiency. In addition, empirical evidence shows that inflation and interest rates affect cost efficiency calculations. The findings show that interest and inflation rates inversely affect average efficiency. The study suggests that severe inflationary pressures and high interest rates deteriorate bank operations. With its high capital criteria, Basel III is likely to directly impact the cost efficiency of the Turkish banking industry, even though the regulatory approach is not included in this analysis. High capital rules of Basel III led to high loan rates and slower credit growth in the banking sector, while cost constraints from the law caused banks to shut branches, reducing lending performance and credit utilisation throughout the study.

Except for 2011 and 2012, conventional banks had a greater average cost efficiency than participation banks. In this study, in contrast to the results of Yılmaz and Günes (2015, p. 388) and Batır et al. (2017, p. 93) studies, I find that conventional banks are more efficient than participation banks, similar to the studies of Johnes et al. (2009, p. 8) and Srairi (2009, p. 19). This might be due to numerous things. First, participation banking in Türkiye acquired acceptability in the previous decade due to government goals and public sensibilities. Second, participation banks lack economies of scale and are not yet equipped to compete with traditional banks owing to their lower asset sizes. Thus, despite its rising popularity, participation banking remains a minor part of the financial industry due to its low market penetration and severe rivalry with traditional banks. Türkiye's conventional financial system is deeper than its participation financial system, and participation banks in the Turkish Banking System have less resources when deposit size and other indicators are examined. Participation banks struggle to offer affordable and trustworthy funding for their enterprises, which lowers their revenue and efficiency. Finally, participation banks' tailored contracts cost more to administer. Thus, the financial statistics of this research show that participation banks are less efficient than regular banks.

Turkish interest in participation banking has grown since its founding. Participation banking needs government encouragement to flourish, particularly because it generates idle cash for the economy. Participation banking needs various policy changes to compete with mainstream banking. For instance, participation banks could diversify their product offering and grow their market share by attracting new participants. Establishing a general advisory board for participation banks and standardising their advisory boards helps them make rapid, trustworthy choices. The new legal and regulatory framework that considers participation banks' particular structures may reduce their vulnerabilities, increase their endurance, and assist them manage liquidity, operational, and other risks. Thus, a broader participation financial sector might allow participation banks to compete with regular banks.

To conclude, Turkish banks have lower cost efficiency ratings than earlier research, and participation banks are marginally less efficient than regular banks. Inflation and interest rates decrease bank efficiency for the research period. This empirical research may be expanded by examining efficiency scores over a longer time to understand the big picture. Inputs and outputs might also provide diverse insights. A non-parametric technique like DEA might be used to estimate the cost efficiency of both bank types and compare the findings of the DEA and SFA approaches. Finally, future studies on participation and conventional bank efficiency in other countries, particularly rising markets like Türkiye, would be fascinating to compare.

Statement of Research and Publication Ethics

I declare that I have obtained the data and analyzes I have presented in this study, the information and documents I have acquired within the framework of ethical rules and rules in accordance with the academy. All the information, documents and results I have obtained are ethical.

I declare that I have cited all the works that I have benefited from in my work by making appropriate citations, that I have not made any difference in the data I have used, and that my work is relevant in terms of originality. I declare that I accept all kinds of loss of rights that will occur against me when the opposite situation arises.

Authors' Contribution Rates

This work has been prepared by only one author.

Statement of Interest

There was no situation to experience a conflict of interest in the preparation of this research.

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