



## EFFICIENCY ASSESSMENT OF THE TURKISH BANKING SECTOR IN THE PRE- AND DURING COVID-19 PANDEMIC PERIODS

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Ibrahim Yagli

Nevsehir Hacı Bektas Veli University, Department of Accounting and Finance, Nevsehir, Turkiye.

[ibrahimyagli@nevsehir.edu.tr](mailto:ibrahimyagli@nevsehir.edu.tr), ORCID: 0000-0001-8985-0172

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### ABSTRACT

**Purpose** - As in most emerging economies, banks are the backbone of the Turkish financial system. The banking sector has also undergone many changes such as the liberalization process in the 1980s, and the inclusion of participation banks<sup>a</sup> in 2005, which have caused increased competition in the sector. Therefore, the performance of the Turkish banking sector is always under the scrutiny of regulators and bank managers as well as investors. Considering the devastating impact of the Covid-19 pandemic on the banking sector, the study aims to evaluate the efficiency of deposit and participation banks in the pre- and during pandemic periods.

**Methodology** - Data envelopment analysis is applied to evaluate the relative efficiency of Turkish banks from 2019 through 2021. Adopting the intermediation approach, deposits and labor are employed as inputs while loans and net interest income are used as outputs.

**Findings** - The empirical findings show that the average technical efficiency of the Turkish banks is around 85% in the covering periods. Breaking technical-efficiency into pure technical efficiency and scale-efficiency reveals that most of the inefficiency is due to poor management practices rather than diseconomies of scale. When we turn our attention to bank groups, the mean technical efficiency of participation banks is lower than those of deposit banks.

**Conclusion** - Overall, the efficiency of participation banks is lagged behind the those of deposit banks in Turkey. In addition, Covid-19 does not outstanding effect on the overall efficiency of the Turkish banking sector.

**Keywords:** Efficiency, Islamic banking, conventional banking, Data Envelopment Analysis (DEA)

**JEL Codes:** C61, C67, G21

## 1. INTRODUCTION

Efficiency is broadly defined as achieving goals by using resources with little or no waste. The efficiency of banks is more important than the other business units due to their economic relationships with others. To put it differently, any problem in the banking sector can spread out the national or even the global economy. The various banking crisis including the Asian crisis in 1997, the Russian financial crisis in 1998, the Turkish banking crisis in 2001, the Argentine crisis in 2001, and recently the 2008 global financial crisis corroborate the contagion of banking problems throughout the overall economy. In the same manner, efficiency of the banking sector, whose main role is allocating financial resources across different sectors, can also affect the efficiency of other sectors. Therefore, the efficiency of the banking sector has always been at the forefront issue for regulatory authorities. Besides, banks have the biggest share in most of the financial systems, which also makes it essential closely follow up on their efficiency. Last but not least, the banking sector has become more competitive with the integration of information technology in the financial products and services provided by banks. Blockchain technology also threatens the banking sector, pushing banks to operate more efficiently.

The aforementioned issues have made it important to evaluate the efficiency of banks in a timely manner. In addition, Covid-19 pandemic had a devastating impact on the banking sector with lower profitability and higher credit risk concerns (ECB, 2020). However, the profitability of the Turkish banking sector remained silent during the pandemic period. Furthermore, the profitability of Turkish banks over assets was 2,5% in June 2022, almost double compared to the level in 2019 (TBB, 2022).

Given the importance of efficiency analysis of the banking sector and fluctuations during the pandemic period, the study has two aims: (1) to analyze how the efficiency of the Turkish banking sector is evolved in the pre- and during pandemic periods, and (2) to discover whether the efficiency of deposit banks differ from the those of participation banks.

<sup>a</sup>Interest-free banking is called as "participation banking" in Turkey, whereas it refers to "Islamic banking" worldwide. The main reason behind this denomination is due to the laicist political culture in Turkey (Asutay, 2013).

Efficiency assessment of the Turkish banking sector is important for two reasons. First, the banking sector has the biggest share in the Turkish financial system, and therefore the performance of the sector can directly affect the overall stability of the Turkish economy. Besides, the impact of the pandemic on the Turkish banking sector remained limited compared to their peers in developed economies, and surprisingly the profitability of the sector doubled in the first half of 2022. Therefore, assessing bank efficiency amid the pandemic will reveal how the Covid-19 pandemic has affected bank efficiency in Turkey and whether the higher profitability in 2022 is a result of high efficiency in the previous years.

Even though numerous studies have addressed the efficiency of Turkish banks during periods of instability, a few papers address the efficiency of Turkish banking sector in the pre- and during pandemic periods. For instance, Zaim (1995) evaluated the efficiency of the Turkish banking sector following financial liberalization and found that the liberalization in the 1980s had a favorable impact on the bank efficiency. However, Yildirim (2002), Denizer et al. (2007), Ozkan-Gunay and Tektas (2006) showed that the Turkish banking industry did not experience long-term efficiency benefits following financial liberalization. Fukuyama and Matousek (2011) also investigated the efficiency of Turkish banks before and after the 1994 and 2001 crises and ascertained that even though the restructuring process have positive effects on efficiency, bank efficiency deteriorates in the following period. The impact of the 2008 global financial crisis on the efficiency of Turkish banks has also been analyzed. Ersoy (2009), for instance, analyzed the impact of the financial crisis of 2008-2009 on the technical efficiency of Turkish banks and provided evidence that the ranking of commercial banks slightly changed in the crisis period. Yilmaz (2013) also examined the efficiency of the Turkish banking sector for the period of 2007-2010. The results revealed that even though the efficiency of Turkish banks diminished in 2008 and 2009, it recovered in 2010. However, the Covid-19 pandemic differs from the previous crises both in nature and its effects, therefore analyzing the bank efficiency amid the pandemic provides important insights for both regulatory authorities and bank managers. Even though several studies are conducted to ascertain the effect of Covid-19 on the Turkish banking sector, these studies focused on bank performance using financial ratios rather than efficiency (Gungen, 2020; Tavsanlı and Hamlacı, 2021; Delice and Karadas, 2022). Only recently, Unlu et al. (2022) evaluate the efficiency of Turkish deposit banks by applying multi-criteria decision-making methods, suggesting that the literature needs to be enlarged by further research to figure out how was the efficiency of the Turkish banking sector during turbulent times.

Second, the Turkish banking sector comprises different types of banks. For instance, state-owned and privately-owned deposit banks operate together in the Turkish banking sector. Furthermore, participation banks (formerly known as special finance houses) have equal status with deposit banks. However, participation banks operate based on Islamic finance which differs from conventional banking on several points. The main difference between the two banking groups is the prohibition on interest. Conventional banking allows charging interest whereas participation banking is strictly against it. Alternatively, participation banks operate on a profit-loss sharing basis in which all economic transactions have to be asset-based (Beck et al., 2013). In addition, speculation and providing finance to immoral industries according to the Shariah law (such as alcohol, pork, and drugs) are also forbidden in participation banking. Nevertheless, the goals and functions of participation banking are largely similar to those of deposit banks (Ada and Dalkılıç, 2014). Besides, the literature indicates that the efficiency of banks differs based on the ownership structure, and crises have a divergent impact on the efficiency of different banks (El-Gamal and Inanoglu, 2005; Partovi and Matousek, 2019). However, the previous studies mostly compare state-owned, privately-owned, and foreign deposit banks. The present study, on the other hand, investigates whether the pandemic has a divergent impact on the efficiency of deposit and participation banks considering that those banks operate under different principles. By comparing bank efficiency in the pre- and during pandemic periods, the study ascertains whether the impact of the pandemic differs among deposit and participation banks.

Overall, even though the efficiency of the Turkish banking sector and the efficiency comparison of different bank types are well-addressed, the banking sector efficiency in the Covid-19 turmoil has not been adequately analyzed (Unlu et al., 2022). Therefore, the study aims to analyze the relative efficiency of deposit and participation banks in the pre- and during pandemic periods. In accordance with the aim, the remainder of the study is organized as follows. Section 2 reviews the related studies. Section 3 explains the data set and methodology, Section 4 presents the efficiency evaluation of deposit and participation banks, and Section 5 concludes the study.

## 2. LITERATURE REVIEW

Analyzing the efficiency of banks has become one of the important issues in the finance literature. However, evaluating the efficiency of banks is a complicated process for several reasons (Kinsalla, 1980). First, banks provide a wide range of products and most of them are interdependent. Second, several financial services provided by banks are not directly priced. Third, government regulation has a direct impact on the services provided by banks and their prices. Nevertheless, several approaches have been generated to evaluate bank efficiency including ratio analysis, frontier efficiency approaches, and multi-criteria decision-making methods.

Data envelopment analysis (DEA) is one of the nonparametric frontier efficiency estimators used to evaluate the relative efficiency of homogenous decision-making units (DMUs). The DEA is often applied by regulators and scholars to assess the efficiency of financial institutions since it does not require the existence of a predetermined production function as in the parametric approaches (see Berger and Humphrey, 1997; Fethi and Pasiouras, 2010). The first study evaluating the efficiency of financial institutions was conducted by Sherman and Gold (1985). Following this study, the bulk of studies addressing the efficiency of banks has been realized. Earlier studies have focused on developed economies such as Canada, Denmark, Finland, Italy, Norway, the UK, and the USA (Drake and Howcroft, 1994; Resti, 1997; Schaffnit et al., 1997; Casu and Molyneux, 2003; among others) while the latter studies analyze the bank efficiency in developing economies, including Brazil, China, Czech Republic, India, and Turkey (Oral and Yolalan, 1990; Isik and Hassan, 2002; Sathye, 2003; Denizer et al., 2007; Staub et al., 2010; Ozkan-Gunay et al., 2013; Řepková, 2014; Henriques et al., 2018; Partovi and Matousek, 2019; among others).

The recent tendency is to analyze and compare the efficiency of conventional and Islamic banks since they have similar objectives but adopt different attitudes towards charging interest. Sufian and Noor (2009), for instance, evaluated the activity of Islamic banks operating in 16 MENA and Asian countries and found that Islamic banks in MENA countries outperform their Asian peers in terms of technical efficiency. Ismail et al. (2013) addressed the cost efficiencies of Islamic and commercial banks operating in Malaysia and revealed that technical efficiency is the major factor in the cost efficiency of conventional-banks whereas allocative efficiency is the primary factor for Islamic banks. Majeed and Zanib (2016) also showed that conventional banks in Pakistan outperform their Islamic peers in terms of technical and pure technical efficiencies while Islamic branches of conventional banks are far more scale-efficient compared to their counterparts. Kamarudin et al. (2017) also evaluate the efficiency of domestic and foreign Islamic banks in Malaysia, Indonesia, and Brunei. Their results indicated that domestic Islamic banks have demonstrated superior levels of efficiency compared to their foreign counterparts. More recently, Octrina and Mariam (2021) assessed the efficiency of Islamic banks in Indonesia and showed that Islamic banks, in general, operate inefficiently.

Several studies also compared the efficiency of deposit and participation banks in Turkey. Arslan and Ergec (2010), for instance, assessed the efficiency of deposit and participation banks in 2006 and 2009. The DEA results of 2006 indicated that the efficiency of deposit banks is higher than those of participation banks. However, the results of 2009 showed that participation banks perform better relative to deposit banks. Yilmaz and Gunes (2015) also provided evidence that the average efficiency scores of Turkish participation banks have higher than their conventional counterparts. More recently, Batir et al. (2017) showed that participation banks run more efficiently relative to their conventional counterparts.

To sum up, the efficiency of the banking sector and the comparison of the efficiency of various banking groups based on ownership structure are well-addressed in the finance literature. Nevertheless, only a few studies analyze the efficiency of the Turkish banking sector amid the pandemic. To fill this gap, the study investigates the efficiency of deposit and participation banks in the pre- and during pandemic periods by adopting the DEA approach.

### 3. DATA AND METHODOLOGY

The purpose of the study is twofold: (1) to measure the efficiency of the Turkish banking sector amid the Covid-19 pandemic, and (2) to compare the relative efficiency of deposit and participation banks to discover whether the pandemic has a divergent impact on these banks. Accordingly, DEA is applied to assess the efficiency of the Turkish banking sector from 2019 to 2021. As of June 2022, there are 57 banks operating in the Turkish banking sector; 35 of which are deposit-banks, 16 are development and investment-banks, and 6 are participation-banks. The study focuses on deposit and participation banking since investment banks provide other services such as underwriting, mergers and acquisitions rather than providing loans. However, 3 of the deposit banks are seized by the Savings Deposit Insurance Fund of Turkey. Therefore, these three banks are omitted from the sample. In addition, several banks have a few branches (most of them have only one branch). Therefore, banks with less than 10 branches are excluded to form a more homogenous sample. Our final sample comprises 26 banks; 20 of which are deposit banks and 6 are participation banks. Table 1 shows the banks covered in the study.

**Table 1: Deposit and Participation Banks covered in the study**

<u>State-owned deposit banks</u>	<u>Domestic deposit banks</u>
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.	Akbank T.A.Ş.
Türkiye Halk Bankası A.Ş.	Anadolubank A.Ş.
Türkiye Vakıflar Bankası T.A.O.	FibaBank A.Ş.
	Şekerbank T.A.Ş.
Foreign deposit banks	Türk Ekonomi Bankası A.Ş.
Alternatifbank A.Ş.	Türkiye İş Bankası A.Ş.
Burgan Bank A.Ş.	Yapı ve Kredi Bankası A.Ş.
Denizbank A.Ş.	
HSBC Bank A.Ş.	<u>Participation banks</u>
ICBC Turkey Bank A.Ş.	Albaraka Türk Katılım Bankası A.Ş.
ING Bank A.Ş.	Türkiye Emlak Katılım Bankası A.Ş.
Odea Bank A.Ş.	Kuveyt Türk Katılım Bankası A.Ş.
QNB Finansbank A.Ş.	Türkiye Finans Katılım Bankası A.Ş.
Turkland Bank A.Ş.	Vakıf Katılım Bankası A.Ş.
Türkiye Garanti Bankası A.Ş.	Ziraat Katılım Bankası A.Ş.

DEA is derived by Charnes, Cooper, and Rhodes (1978) based on the efficiency measure of Farrell (1957). In the DEA methodology, the efficiency frontier is constructed based on the best practices of DMUs using the empirical data, and then the efficiency of each DMU is assessed according to the efficiency frontier. Therefore, DEA is an approach that assesses the relative efficiency of DMUs. In the DEA methodology, the aim is to compare each DMU with the most efficient DMUs, rather than the average efficiency of DMUs. In this regard, DEA indicates the most efficient DMUs as well as the inefficient units. DEA also signalizes best practices and guides inefficient DMUs to be efficient.

Even though there are several DEA approaches, CCR (Charnes, Cooper, and Rhodes, 1978) and BCC (Banker, Charnes, and Cooper, 1984) are the two most commonly used DEA approaches. The main difference between the two approaches is the assumption toward a return of scale. The first approach postulates that there is no strong link between the size of the operation and efficiency, suggesting DMUs operate with constant return-to-scale. On the other hand, the latter approach postulates that DMUs have increasing or decreasing return-to-scale. Therefore, the CCR approach assesses the technical efficiency (TE) of DMUs while the BCC approach measures pure technical efficiency (PTE). Then, scale efficiency (SE) is calculated by the ratio of TE to PTE (Henriques et al., 2018). Therefore, any difference between the TE and PTE scores suggests scale inefficiency (Sufian, 2007).

Another important issue related to the DEA is the selection of variables. In this regard, the approach how to deal with operations of the DMUs becomes important. For assessing bank efficiency, two main approaches have been suggested, the production approach (Benston, 1965) and the intermediation approach (Sealey and Lindley, 1977), respectively. Under the production approach, banks are identified as financial service providers and consequently, physical assets (such as labor and capital) are used as inputs while the number and type of financial services are considered as outputs. Alternatively, the intermediation-approach concentrates on the intermediary role of banks and categorizes banks as business units intermediating funds from savers to investors. Accordingly, deposits, the main fund source of banks, are often employed as input while loans are used as output. Both approaches have limitations because neither fully captures intermediary and service provider role of banks (Berger and Humphrey, 1997). However, the approach chosen can directly affect the selection of variables, and therefore the efficiency of banks. For instance, a bank that has more deposits and less loans might be categorized as DMU with low efficiency according to the intermediation approach. On the other hand, the same bank can be regarded as efficient under the production approach since this approach considers deposits as one of the services provided by banks whereas the former approach considers deposits as inputs.

DEA methodology is applied either input-oriented or output-oriented. The first model attempts to minimize inputs to produce a certain output while the latter model aims to maximize outputs with given inputs (Cooper et al., 2000). The study utilizes the input-oriented model because bank managers have more ability to control inputs rather than the quantity of services mostly determined by demand (Schaffnitt et al., 1997). In the study, the intermediation approach is adopted since interest income has the biggest share of the total income for Turkish banks. Accordingly,

deposits and labor are used as inputs while loans and net interest income are determined as outputs. Since the participation banks operate on interest-free basis; deposits, loans, and interest income are substituted by the following variables; funds collected, funds allocated, and net profit share income, respectively. The data have been collected from the official websites of the Bank Association of Turkey, and Participation Banks Association of Turkey as well as banks' financial reports.

Accordingly, a measure of input-oriented TE for  $DMO_o$  is described below:

$$\theta_o^{input} = \text{Minimum possible input}_o / \text{Actual input}_o$$

In the study, both CCR and BCC models are utilized to understand the determinants of overall efficiency. In this regard, CCR and BCC models based on input-oriented approach are formulated as follows (Kumar and Gulati, 2008):

$$\min_{\theta_o, \lambda_1, \lambda_2, \dots, \lambda_n, s_i^-, s_r^+} TE_o = \theta_o - \varepsilon (\sum_{i=1}^m s_i^- - \sum_{r=1}^s s_r^+) \quad (1)$$

Subject to

$$\sum_{j=1}^n \lambda_j x_{ij} + s_i^- = \theta_o X_{io} \quad (2)$$

$$\sum_{j=1}^n \lambda_j y_{rj} - s_r^+ = y_{ro} \quad (3)$$

$$s_i^-, s_r^+ \geq 0 \quad (i = 1, \dots, m; r = 1, \dots, s) \quad (4)$$

$$\lambda_j \geq 0, \text{ if constant returns to scale} \quad (5)$$

$$\sum_{j=1}^n \lambda_j = 1, \text{ if variable to scale} \quad (6)$$

where  $x_{io}$  of input  $i$  used,  $y_{ro}$  quantity of output  $r$  produced,  $m$  the number of outputs,  $s$  the number of inputs,  $n$  the number of DMUs, and  $\varepsilon$  a small positive number.

#### 4. EMPIRICAL FINDINGS

The empirical evidence related to the efficiency of deposit and participation banks is presented in this section. Constructing an efficiency frontier each year is more suitable than one single multiyear efficiency frontier since it allows all estimated coefficients to change over time as technology changes (Deyoung and Hasan, 1998). Furthermore, the study aims to ascertain the impact of the Covid-19 pandemic on the Turkish banking sector. Therefore, an annual efficiency frontier is constructed for each year from 2019 to 2021. Both CCR and BCC models are used in the study to comprehend the factors that affect overall technical efficiency. Concordantly, DEA is applied to the Turkish banking sector from 2019 to 2021 and the three efficiency scores (technical efficiency, pure technical efficiency, and scale efficiency) are obtained for deposit and participation banks.

In the DEA methodology, the efficiency frontier is constructed based on empirical data, therefore efficiency frontier is not a default case, it is an actual observation, suggesting that there is no random error in the efficiency frontier. According to the methodology, DMUs located on the efficiency frontier take the value of 1, whereas inefficient DMUs get a value of less than 1. Table 2 presents efficient DMUs as well as inefficient DMUs in the period of 2019-2021.

In table 2, the efficiency scores of state-owned deposit banks (SB), privately-owned domestic deposit banks (DB), foreign deposit banks (FB), and participation banks<sup>b</sup> (PB) are separately reported. According to the table, the overall technical efficiency score of Turkish banks is around 85%, suggesting that banks, on average, should reduce inputs by 15% to be efficient. Regarding the effect of the pandemic on bank efficiency, the findings reveal that the Turkish banking sector has been marginally affected by Covid-19. Nevertheless, few banks have been inversely affected by the pandemic. For instance, the efficiency of DB2 was 83% in 2019, however, it decreased to 67% in 2021. Similarly, the efficiency score of DB5 is so close to the efficiency frontier (98%) in 2019, but the efficiency dropped to 75% in 2021. On the other hand, several banks have increased their efficiency during the pandemic period. The efficiency of FB9 was %62 in 2019, but it increased to 80% in 2020. PB3 also increased its efficiency to 93% in 2020 from 82% in 2019.

When we turn our attention to the efficiency scores of sub-groups, it can be seen that the average technical efficiency score of SBs is higher than those of DBs and PBs. Furthermore, the efficiency of SBs increased from 2019 to 2021 because only SB1 was efficient in 2019 while SB1 and SB3 became efficient in 2020 and 2021. Regarding domestic deposit banks, only one bank (DB1) is efficient out of seven banks. In addition, the efficiency scores of DB2 and DB5 have gradually decreased from 2019 to 2021. On the other hand, the number of FBs efficient is more than the number of DBs. More specifically, FB2 and FB4 were efficient 2019, FB1 and FB2 in 2020, and FB2, FB5, and FB10 in 2021. Lastly, the overall technical efficiency of participation banks is lower than those of deposit banks. Nevertheless, PB6, one of the state-owned participation banks, was efficient during the whole period.

When technical efficiency is broken into pure technical efficiency and scale efficiency, it is clear that scale efficiency surpasses pure technical efficiency, suggesting that the main reason behind the input waste is due to poor management practices since almost 11% of the 15% of technical inefficiency is caused by pure technical inefficiency. For sub-groups, the scale efficiency scores of the two banking groups are close to each other. However, the pure technical efficiency score of participation banks is lower than those of deposit banks, suggesting that the main reason participation banks was lagging behind the deposit banks is largely due to poor management practices of participation banks.

<sup>b</sup> Note also that PB5 and PB6 are state-owned.

Table 2: DEA Results of the Turkish Banking Sector from 2019 to 2021

DMUs	2019			2020			2021		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
SB1	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
SB2	0,894	0,936	0,956	0,940	0,943	0,997	0,921	0,923	0,998
SB3	0,936	0,976	0,959	1,000	1,000	1,000	1,000	1,000	1,000
DB1	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
DB2	0,834	0,933	0,894	0,722	0,734	0,984	0,667	0,719	0,928
DB3	0,922	0,968	0,952	0,924	0,935	0,988	0,708	0,743	0,953
DB4	0,757	0,760	0,996	0,728	0,738	0,986	0,847	0,873	0,971
DB5	0,982	0,984	0,998	0,868	0,872	0,996	0,747	0,766	0,975
DB6	0,877	0,880	0,997	0,861	0,867	0,994	0,852	0,858	0,993
DB7	0,892	0,893	1,000	0,907	0,912	0,994	0,956	0,959	0,997
FB1	0,960	1,000	0,960	1,000	1,000	1,000	0,939	0,989	0,950
FB2	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
FB3	0,828	0,829	0,998	0,921	0,934	0,986	0,966	0,978	0,988
FB4	0,681	0,735	0,926	0,708	0,711	0,996	0,506	0,553	0,913
FB5	0,717	0,768	0,934	0,684	0,711	0,961	1,000	1,000	1,000
FB6	1,000	1,000	1,000	0,923	0,939	0,983	0,870	0,877	0,992
FB7	0,774	0,795	0,973	0,735	0,800	0,919	0,708	0,793	0,893
FB8	0,910	0,912	0,998	0,957	0,970	0,988	0,949	0,962	0,987
FB9	0,625	1,000	0,625	0,798	1,000	0,798	0,725	1,000	0,725
FB10	0,993	1,000	0,993	0,982	1,000	0,982	1,000	1,000	1,000
PB1	0,650	0,661	0,984	0,671	0,683	0,983	0,629	0,633	0,992
PB2	0,618	0,618	1,000	0,726	0,748	0,969	0,679	0,702	0,967
PB3	0,824	1,000	0,824	0,935	1,000	0,935	0,765	0,777	0,984
PB4	0,745	0,754	0,988	0,740	0,760	0,973	0,704	0,730	0,965
PB5	0,717	0,751	0,955	0,723	0,784	0,922	0,798	0,867	0,921
PB6	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
All banks	0,851	0,890	0,958	0,864	0,886	0,974	0,844	0,873	0,965
Deposit banks	0,879	0,918	0,958	0,883	0,903	0,978	0,868	0,900	0,963
Participation banks	0,759	0,797	0,959	0,799	0,829	0,964	0,762	0,785	0,971

In concluding, the empirical findings seem to suggest that the technical efficiency of Turkish banks has remained relatively constant in the covering periods, indicating the limited impact of the Covid-19 pandemic on the efficiency of Turkish banks. The technical efficiency of deposit banks is higher than those of participation banks. Regarding pure technical efficiency and scale efficiency, deposit and participation banks have similar pure technical efficiency scores whereas scale efficiency scores of participation banks fall behind those of deposit banks.

## 5. CONCLUSION

The efficiency of the banking sector has always been at the forefront issue for regulatory authorities since its efficiency can directly affect other sectors due to banks' economic relationships with others. Bank efficiency is also important for bank managers and investors because their earnings are largely affected by the efficiency of banks. Therefore, the efficiency of banks is one of the well-addressed issues in the finance literature. However, only a few studies addressed the efficiency of the Turkish banking sector in the pandemic period.

The study evaluates the efficiency of the Turkish banking sector in the period of 2019-2021 to understand how the Covid-19 pandemic affects the efficiency of the Turkish banking sector. Adopting an input-oriented approach, two DEA models, CCR and BCC are utilized to assess the efficiency of participation and deposit banks. Under the intermediation approach, deposits/funds collected and labor are employed as inputs while loans/funds allocated and interest income/net profit share income are used.

The results show that the average technical efficiency score of the Turkish banking sector is 85%, suggesting that input waste in the sector is around 15%. The decomposition of the overall-efficiency into the pure-technical- efficiency and scale-efficiency reveals that the technical-inefficiency in the sector is due to pure technical inefficiency. For sub-groups, the technical efficiency of deposit banks surpasses those of participation banks. Regarding pure technical efficiency and scale efficiency scores, participation banks fall behind deposit banks in terms of pure technical efficiency whereas both banks have similar scale efficiency scores. Lastly, the impact of Covid-19 on the efficiency of the Turkish banking sector remains limited.

Overall, the present research evaluates the technical efficiency of deposit and participation banks in Turkey amid the pandemic by applying the DEA methodology. Further research can address the profit and revenue efficiency of these banks. In addition, parametric efficiency estimators can be employed in future studies.

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