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Full Length Article

Determinants of bank efficiency in Turkey: Participation banks versus conventional banks

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Abstract

This study examines the technical, allocative, and cost efficiency of conventional and participation banks in Turkey with data envelopment analysis (DEA) method. In the wake of finding technical, allocative, and cost efficiency results by DEA intermediation approach, Tobit regression analysis is used to determine the factors influencing the efficiency. The main purpose of this paper is analyzing efficiency of the banking system in Turkey and compare the efficiency of participation banks and conventional banks. The results of DEA indicate that average participation bank efficiency is higher than the average conventional bank efficiency each year. Regarding Tobit regression analysis, while expenses and loan quality have a significantly negative relationship with efficiency of conventional banks, they have a significantly positive relationship with the efficiency of participation banks. While the total loans have a significantly positive relationship, external variables have a significantly negative relationship with efficiency of both types of the banks.

JEL classification: G20; G21; C29

Keywords: Conventional bank; Participation bank; Efficiency; DEA; Tobit; Turkey

1. Introduction

In the early 1980s, the financial sector in Turkey was deregulated with the neo-liberalization process.[1] These regulations enhanced the efficiency of the Turkish banking system (Zaim, 1995, p. 78). By these reforms, Islamic finance emerged, named as a Special Finance House (SFH) in Turkey. Soon after, Al Baraka Turk was established as the first SFH in 1985 and Kuveyt Turk followed it, in 1989 (Aysan, Dolgun, & Turhan, 2013, p. 99). Currently there are 5 active participation banks in Turkey.

In 2005, SFH's were completely included by the Banking Regulation and Supervision Agency (BRSA), through the 5411 Banking Law. Thus they completely gained the same functions and privileges with the conventional banks and attained more importance and popularity. Based upon the change from 5411 Banking Law, the name "special finance house" was changed to "participation bank" (PB) in 2005 (Aysan et al., 2013, p. 99). While "Islamic banking" is the term commonly used in the world, "participation banking" term is used in Turkey to represent the banks that use Islamic financial instruments. According to Aysan et al. (2013) the reason of using this term is the sublime meaning of Islam, and it should be used carefully in denotation of financial institutions. However, according to Asutay (2013), the reason of using "participation bank" instead of "Islamic bank", is the fragile political culture of Turkey.

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[1] By the neoliberalization process, Turkey took a step to free market economy, and the stress on the financial system is diminished.

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Theoretically Islamic finance is significantly different from conventional finance. There are five main principles that differentiate Islamic finance from conventional finance. These principles are the prohibition on interest, the prohibition on risk and uncertainty (speculation), the prohibition on financing unsuitable and illegal sectors in terms of Shariah, such as alcohol, pork, drugs. Besides there are profit–loss sharing principle and all transactions have to be based on a real economic transaction which includes a tangible asset principle (Beck, Demirguc-Kunt, & Merrouche, 2013, pp. 434–435).

However there are main differences between Islamic finance and conventional finance as stated above, practically, Islamic scholars have developed similar products to those of conventional banking, replacing interest rate payments and discounting with fees and contingent payment structures. It is seen that purposes and functions of Islamic banking resemble to those of conventional banks (Ada & Dalkilic, 2014, p. 11; Beck et al., 2013, pp. 433–434). Furthermore when the financial statements of both banks are checked, it is seen that main items are almost same.

By the end of March 2014, 45 conventional banks were operating in Turkey. Of the 45 conventional banks in the system, 32 were commercial banks, and 13 were investment and development banks. Three of commercial banks were state banks, 11 of them were domestic private, 1 of them was transferred to SDIF, and 17 of them were foreign banks.

According to Blejer (2006), financial efficiency is an important issue since it enhances financial stability. In a rapidly changing globalized financial market, bank managers, regulators, and investors pay attention to transform their expensive inputs into various financial products and services more efficiently (Isik & Hassan, 2002a, p. 720).

This study contributes the literature in two ways. First, this study compares the technical, cost, and allocative efficiency of participation banks and conventional banks (state, domestic, foreign). There has been a considerable amount of research on conventional bank efficiency in Turkey, but research on participation bank efficiency is scarce. Second, to our knowledge, this is the first empirical study that has analyzed the internal (related to bank), and external (macroeconomic and structural) determinants of participation and conventional banks' efficiency in Turkey.

2. Literature review

Berger and Humphrey (1997) reported that most of the studies on bank efficiency (about 95%), focused on developed countries and 70% of them are of the US. Many researchers suggest that more research should be done about comparing and measuring efficiency from different countries to provide global financial stability (Beim & Calomiris, 2001; Berger & Humphrey, 1997; Eichengreen, 2002). Berger and Humphrey (1997) assesses the technical, allocative, and cost efficiency of conventional and participation banks using a country-level database. It contributes to literature by finding explanations of efficiency that may help government policy, identify the economic conditions that create inefficiency, and improve the managerial performance.

In recent decades, there has been an increasing amount of literature on efficiency. A large and growing body of literature has focused on bank efficiency. As Islamic banks are gaining more importance each year, there is a large volume of published studies focusing on the comparison between conventional and Islamic banks such as Beck et al. (2013), Hassan, Mohamad, and Bader (2009), Ismail, Abd Majid, and Rossazana Ab (2013), Abdul Rahman and Rosman (2013).

As well as comparison studies, there are some studies which consist only of Islamic banks or only of conventional banks. Previous studies such as Isik and Hassan (2003), El-Gamal and Inanoglu (2005), Tsionas, Assaf, and Matousek, (2015) and Saha, Ahmad, and Dash (2015), have mostly focused on conventional bank efficiency. Although fewer, some studies focus on the efficiency of Islamic banks such as Kamarudin, Nordin, Muhammad, and Hamid, (2014), Sufian and Noor (2009), Ada and Dalkilic (2014).

Sufian and Noor (2009) analyzed the determinants of Islamic banks' efficiency in Middle East and North Africa (MENA) and Asian countries in the period of 2001–2006. They used DEA, as a first stage of their analysis, and then used Tobit regression analysis as a second stage to determine the drivers of efficiency. They found that while loan, size, capitalization and profitability have significantly positive relationship with efficiency, non performing loans has a negative relationship with efficiency. The aim of the study was filling a demanding gap in the literature by providing the latest empirical evidence on the determinants of the performance of Islamic banks in 16 MENA and Asian countries.

Ismail et al. (2013) and Saha et al. (2015) also employed two stage analysis (DEA and Tobit regression analysis) in their studies. Ismail et al. (2013) studied the efficiency of Islamic and conventional banks in Malaysia over the period of 2006–2009. They found that average efficiency of conventional banks is higher than Islamic banks in Malaysia, and detected that profitability and loan quality have negative relationship with efficiency of both types of banks, equity and size are negatively related with the efficiency of Islamic banks but positively related with the efficiency of conventional banks, and expense has a positive relationship with efficiency of both type of banks. As a result this paper contributed to literature on the efficiency of both Islamic and conventional banks and the effect of banks' specific characteristics on their efficiency.

The most recent study, Saha et al. (2015) studied on the drivers of the technical efficiency in Malaysian banking system between the years 2005–2012 based on conventional banks. They found that while size, capital and profit have signficantly positive relationship with efficiency, expenses and non-performing loans have significantly negative relationship with the efficiency.

Hassan et al. (2009) and Mohamad, Hassan, and Bader (2008) investigated the efficiency of conventional and Islamic banks consisting Organization of Islamic Conference

(OIC) countries. Hassan et al. (2009) used the parametric model Stochastic Frontier Approach (SFA), and Mohamad et al. (2008) used non-parametric method DEA. Both of the studies showed that there was no significant difference between the efficiency of conventional and Islamic banks.

Focusing on the efficiency studies in Turkey, it is seen that most of the studies only consist conventional banks such as Isik and Hassan (2002a,2002b,2003), El-Gamal and Inanoglu (2005), Catalbas and Atan (2005), Abbasoglu, Aysan, and Gunes (2007), Ozkan-Gunay, Gunay, and Gunay, (2013) and Assaf, Matousek, and Tsionas (2013).

Isik and Hassan (2002a) studied the technical, scale and allocative efficiency of Turkish banking which focused only conventional banks for the period of 1988–1996. Employing a non-parametric approach, DEA, and a parametric approach economic frontier analysis (EFA) to measure the efficiency, their results showed that technical inefficiency is bigger than allocative inefficiency in Turkey. They found that foreign banks are more efficient than domestic banks and there is a strongly negative relationship between bank size and efficiency. The study aimed to investigate input and output efficiency in the Turkish banking industry to understand the impact of size, international variables, ownership, control and governance on profit, cost, allocative, technical, pure technical and scale efficiency measures.

Isik and Hassan (2002b) found that private banks are more efficient than state banks. They found foreign banks perform more efficient than domestic banks and there is a strongly negative relation between bank size and efficiency in their (2002a) study. El-Gamal and Inanoglu (2005) detected that state banks are not inefficient overall, they use labor inefficiently and that special financial houses (participation banks) do not cause any harm to financial system and perform efficiently. Catalbas and Atan (2005), Abbasoglu et al. (2007) and Ozkan-Gunay et al. (2013) found a positive relationship between bank size and efficiency. Assaf et al. (2013) detected foreign banks are more efficient than domestic banks.

Some researches focus on the efficiency of Islamic banks and conventional banks in Turkey. Arslan and Ergec (2010) studied the efficiency of 4 participation banks and 26 conventional banks in the period of 2006–2009 by using Data Envelopment Analysis (DEA). As a result they found that participation banks performed better. Er and Uysal (2012), compared the efficiency of participation banks and conventional banks for the period of 2005–2010. By employing DEA they found that participation banks are more efficient than conventional banks in that period.

As it is seen from the studies in Turkey, research on bank efficiency is not sufficient. Especially research comparing participation banks and conventional banks' efficiency is seldom. So, via our study we aimed to contribute the literature, by analyzing and comparing the efficiency of participation and conventional banks in Turkey, and by detecting some bank specific and macroeconomic characteristics that effect bank types' efficiency. So we thought that it could be helpful for policy makers.

This study adopts the two stage methodology, to analyze the efficiency of participation and conventional banks of Turkey.

3. Data and methodology

This study uses banks' balance sheet and income statement data for a sample of Turkish conventional and participation banks between 2005 and 2013. The annual accounting data of the Turkish conventional banks is obtained from Banks Association of Turkey (BAT), while the annual accounting data of the Turkish participation banks is obtained from Participation Banks Association of Turkey (PBAT). Central Bank of the Turkish Republic and Turkish Statistical Institute's websites are used to obtain macroeconomic variables. Recently, financial reports of the banks and economical data have become much more reliable, detailed and easily accessible in Turkey.

The beginning year of the study is selected 2005, since in that year participation banks gained the same functions with conventional banks and they were firstly named as “bank” while they were called “special financial house” before. The ending year is selected as 2013, because deterioration in one of the participation banks in this year, which represents 25% of participation banks, financially may affect the results of participation banks. Therefore, our study is terminated in that year.

Of the 49 banks in the Turkish banking system, 4 were participation banks, 32 were commercial banks and 13 were investment and development banks. In performance analysis, production units should be homogenous and provide similar services and resources. Therefore, since the investment and development banks have a small market share in the sector, and different structure and goal (non-depository), this study excludes the investment and development banks (I Isik & Hassan, 2002a, p. 725). We include only continuously operating commercial banks over the period of 2005–2013. While Adabank and JP Morgan continuously operated over the sample period, they do not have loan data, and therefore are not included in empirical analyze. Thus our sample includes 4 participation banks and 27 conventional banks (3 are state owned, 11 are privately owned and 13 are foreign banks). The banks included in our sample are listed in Table 1:

There are two different frontier analysis methods that is used to measure bank efficiency. These are non-parametric and parametric methods (Berger & Humphrey, 1997, p. 4). The principal parametric method is stochastic frontier approach (SFA), which uses econometric methods; while the principal non-parametric method is Data Envelopment Analysis (DEA), which uses mathematical programming (T. J. Coelli, Rao, O'Donnell, & Battese, 2005, p. 161). Some of the researchers, such as Altunbas, Evans, and Molyneux, (2001), Isik and Hassan (2002b), Mohamad et al. (2008), Srairi (2010), Rozzani and Rahman (2013) used SFA to analyze efficiency; and some of the researchers, such as Isik and Hassan (2002a), Casu and Molyneux (2003), Hassan et al. (2009), Ismail et al. (2013), Ozkan-Gunay et al. (2013) and Kamarudin et al. (2014) employed DEA method.

Table 1
Conventional and Islamic Banks in Turkey continuously active, between the years of 2005–2014.

Conventional banks	
State owned banks	**Foreign banks**
Türkiye Cumhuriyeti Ziraat Bankası A.Ş.*	Alternatif Bank A.Ş.*
Türkiye Halk Bankası A.Ş.*	Arap Türk Bankası A.Ş.*
Türkiye Vakıflar Bankası T.A.O.*	Bank Mellat*
Domestic private banks	Burgan Bank A.Ş.*
Akbank T.A.Ş.*	Citibank A.Ş.*
Anadolubank A.Ş.*	Denizbank A.Ş.*
FibaBank A.Ş.*	Deutsche Bank A.Ş.*
Şekerbank T.A.Ş.*	Finans Bank A.Ş.*
Tekstil Bankası A.Ş.*	Habib Bank Limited*
Turkish Bank A.Ş.*	HSBC Bank A.Ş.*
Türk Ekonomi Bankası A.Ş.*	ING Bank A.Ş.*
Türkiye Garanti Bankası A.Ş.*	Société Générale (SA)*
Türkiye İş Bankası A.Ş.*	The Royal Bank of Scotland N.V.*
Yapı ve Kredi Bankası A.Ş.*	Turkland Bank A.Ş.*
Participation banks	
Albaraka Türk	
Bank Asya[a]	
Kuveyt Türk	
Türkiye Finans Katılım Bankası	

[a] By 22 July 2016, BRSA terminated the activity of Bank Asya. Because of the time period of our analysis it has been used the data of Bank Asya.

Both of parametric and non-parametric methods have some advantages and disadvantages. Parametric approach has the strength of allowing for noise in the measurement of inefficiency but its weakness is to impose a particular functional form being estimated and the distribution of efficiency. Non-parametric approach doesn't require specification of functional form or distributions. However, its weakness is that all deviations from the frontier are attributed to inefficiency with no allowance made for noise in standard models. Both techniques utilize all the information contained in the data (Isik & Hassan, 2003, pp. 1372,1373). Since DEA has the ability of using multiple inputs and outputs, and following the studies employed non-parametric methods; DEA method is preferred in this study. Celik (2012) analyzed the Turkish conventional banks in the period of 2005–2010 using both SFA and DEA methods. She found that both methods showed similar results.

Data envelopment analysis was originally developed by Farrell (1957) and extended by Charnes et al. (1978), by linking the estimation of technical efficiency and production frontiers (Casu & Molyneux, 2003, p. 1866). Sherman and Gold (1985) applied the method to banking sector for the first time. DEA is a performance measurement method focused on identifying the unit efficiency. This method basically allows to focus on cost efficiency (CE) of banks, that can go into more detail by technical (TE) and allocative (AE) efficiency components (I Isik & Hassan, 2002a, p. 723). The relative technical efficiency is calculated as Equation (1) (Charnes, Cooper, Lewin, & Seiford, 1994, p. 6):

$$\text{Efficiency} = \frac{\text{weighted sum of outputs}}{\text{weighted sum of inputs}} \quad (1)$$

While TE measures the proportional reduction in input usage, AE measures the proportional reduction in costs if the right mix of inputs are chosen by banks. In addition, CE is equal to the product of allocative and technical efficiency and can be represented as (Cooper, Seiford, & Tone, 2007, pp. 258–260; Isik & Hassan, 2002a, pp. 723,724):

$$CE = AE*TE \quad (2)$$

The cost efficiency as a measure of proportional reduction in costs that can be acquired if the bank is technically and allocatievely efficient while the allocative efficiency is the measure of proportional reduction in costs when the bank chooses the right mix of inputs and technical efficiency is the measure of proportional reduction in input usage that can be obtained if the bank operates efficiently (Isik & Hassan, 2002a, p. 719).

DEA can be used in two ways as input and output oriented. The input oriented model explores the most appropriate input composition for a certain output that is produced most efficiently, while output oriented model investigates obtaining the most output with a certain input (Catalbas & Atan, 2005, p. 52). For research, we use an input oriented model of DEA to determine efficiency.[2] Charnes, Cooper and Rhodes (1978) proposed this model and assumed constant returns to scale (CRS). Input oriented CRS model was the first model to be widely applied (T. J. Coelli, Rao, et al., 2005, p. 162). In many studies, researchers have tended to select input-oriented. The orientation should be chosen according to which quantities (inputs or outputs) the managers have most control over (T. Coelli, 1996, p. 23). Coelli, Prasada Rao, et al. (2005, p. 161–181) and Coelli, Rao, et al. (2005) summarized this model basically as below:

Presuming that there are N inputs and M outputs for each of K firms, X is the (N × K) input matrix, Y is the (M × K) output matrix. "v" is a N × 1 vector of input weights, and "u" is an M × 1 vector of output weights, the optimal weights are provided by solving the mathematical programming problem:

$$\begin{aligned} &\max_{u,v}(u'y_i/v'x_i), \\ &\text{s.t.} \quad u'y_j/v'x_j \le 1, \quad j = 1,2,\ldots K \\ &\qquad u, v \ge 0 \end{aligned} \quad (3)$$

This involves finding values for u and v, such that the efficiency measure of the i-th decision making unit (DMU) is maximized, subject to the constraint that all efficiency measures must be less or equal to one. To avoid the infinite number of solutions problem, the constraint $\alpha' xi = 1$, can be imposed on the Equation (3):

$$\begin{aligned} &\max_{\mu,\alpha}(\mu' y_i), \\ &\text{st} \quad \alpha' x_i = 1 \\ &\qquad \mu' yj - \alpha' x_j \le 0, j = 1,2,\ldots,K, \\ &\qquad \mu, \alpha \ge 0, \end{aligned} \quad (4)$$

The notation change from u and v to μ and α reflects the transformation. This form is known as the multiplier form of the linear programming problem. Using the duality in linear

[2] DEAP 2.1 computer program is used for analysis.

programming, equivalent envelopment form of this problem is as below:

$$\begin{aligned} &\min_{\theta,\lambda}\theta, \\ &\text{st} \quad -y_i + Y\lambda \geq 0, \\ &\qquad \theta x_i - X\lambda \geq 0, \\ &\qquad \lambda \geq 0 \end{aligned} \tag{5}$$

where θ is a scalar and λ is a $K \times 1$ vector of constants. The value of θ, represents the efficiency of *i*.th DMU. So it should be solved K times, for each DMU. (For more information about DEA methodology it can be seen Cooper et al. (2007), Charnes et al. (1994) and Coelli, Prasada Rao, et al. (2005, p. 161–181) and Coelli, Rao, et al. (2005).

Selecting inputs and outputs is important in the DEA method. While selecting inputs and outputs, Humphrey (1985) made a useful distinction between production approach and intermediation approach for banks. In the production approach, banks produce loans and deposits by using capital, labor and materials. However, in the intermediation method, banks are transformers of funds and deposits to loans and other assets (Assaf et al., 2013, p. 511; Humphrey, 1985). The intermediation approach may be superior for evaluating entire financial institutions, since it includes interest expenses, which usually accounts for more than half of total costs (Berger & Humphrey, 1997, p. 31). In this study, we consider the primary function of banks as intermediation, and, therefore, use the intermediation approach. According to intermediation approach, and following the studies of Isik and Hassan (2002a), Sufian and Noor (2009) and Srairi (2010); inputs and outputs of the study are selected as below (Table 2):

Since the participation banks' number of personnel can not be reached, personnel expenses divided by total asset is used as the price of labor, following Altunbas et al. (2001) and Srairi (2010).

Table 3 shows the mean and standard deviation of inputs and outputs used in DEA. As it is seen in the table while loans, off balance sheet items, labor and funds of conventional banks are two times of participation banks', capital of conventional banks is approximately 5 times of the capital of participation banks. Looking at the input prices it is seen that they are similar for both of the banks. As suggested by the standard deviations, participation banks are relatively quite stable. That may be caused by their standardized rules and limited financial instruments.

Several studies have used a two-stage approach to estimate the determinants of bank efficiency (Casu and Molyneux (2003), Ismail et al. (2013) and Saha et al. (2015)). In the first step, the efficiency scores are estimated by DEA method; in the second step, estimated efficiency scores are used as dependent variable of the regression analysis, to identify the determinants of efficiency.

A Tobit regression model is selected to find the determinants of efficiency. The DEA score changes between the interval 0 and 1, it make the dependent variable a limited dependent variable. A commonly implemented model in previous studies is that the use of the Tobit model can handle the characteristics of the distribution of (in)efficiency measures and thus provide results that can provide important policy guidelines to improve performance. In this direction, DEA efficiency scores obtained in the first stage are used as a dependent variable in the second stage, one side censored Tobit model in order to allow for the restricted [0, 1] range of efficiency values (Sufian & Noor, 2009, p. 124). Dependent and independent variables used in the Tobit model are shown in Table 4:

Table 2
Input and Output variables used in DEA analysis.

	DEA
Input	*Description*
Labor	Personnel expenses
Capital	Fixed assets
Funds	Total deposit
Output	
Total loans	Sum of long term and short term loans
Off-balance sheet items	Sum of guarantees, commitments and financial derivative instruments
Input prices	
Price of Labor	Personnel expenses divided by total assets
Price of physical capital	Personnel and non interest expenses/fixed assets
Price of funds	Total interest expenditure on deposits/total deposits, (total profit share on deposits/total deposits for participation banks)

Table 3
Descriptive statistics for DEA input and output variables.

All years	Participation banks			Conventional banks			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Loans	7406	5122	36	15,730	25,693	261	14,721	24,297	297
OBS items	12,618	13,183	36	29,298	52,942	261	27,276	50,123	297
Labor	159	91	36	327	435	261	307	413	297
Capital	170	127	36	876	1667	261	790	1580	297
Funds	7197	4804	36	18,583	29,686	261	17,203	28,118	297
Labor price	0.02	0.01	36	0.02	0.01	261	0.02	0.01	297
Capital price	2.26	1.02	36	2.47	3.44	261	2.44	3.25	297
Funds price	0.07	0.07	36	0.09	0.35	261	0.08	0.33	297

*All variables are millions Turkish Lira (TL).

According to Table 4, basic regression equation can be stated as Equation (6):

$$\theta_{it} = \beta_0 + \beta_1 \text{Profit} + \beta_2 \text{Capital} + \beta_3 \text{Expense} + \beta_4 \text{Deposit} + \beta_5 \text{Loan} + \beta_6 \text{NPL} + \beta_7 \text{Size} + \beta_8 \text{GDP} + \beta_9 \text{Inflation} + \varepsilon_{it} \quad (6)$$

θ represents the efficiency (TE, CE, AE) as a dependent variable, while β_0 is constant, $\beta_1 - \beta_9$ are coefficients of independent variables, and ε is the disturbance term.

4. Empirical results

Results of DEA and Tobit regression analysis are presented in this section. Table 5 indicates the mean, and standard deviation of technical efficiency (TE), cost efficiency (CE), and allocative efficiency (AE) of each conventional banks, participation banks and all banks for each year over the period of 2005–2013. According to Isik and Hassan (2002a), TE is related to managerial issues, however AE is related to regulatory factors. As it is seen from the Table 5, mean technical efficiency scores, which implies utilizing all factor inputs, are higher than allocative efficiency, which implies choosing the proper input mix given the prices. So it can be said that, the main source of the cost inefficiency is AE.

Comparing the average efficiency result of participation banks and conventional banks, it is clearly seen that the scores of all efficiency types for participation banks are higher than of conventional banks. This result may infer that participation banks utilize their resources more efficiently. However, the standard deviation of efficiency is considerably lower for participation banks. This result is compatible with Arslan and Ergec (2010), and Er and Uysal (2012) who found that participation banks performed better in Turkey. However this result is not supported by some researchers that found conventional banks perform more efficient than Islamic banks, such as Kamarudin et al. (2014), and Ismail et al. (2013). Different country based studies may be the reason of this conflicting results.

Table 4
Dependent and Independent variables used in Tobit regression analysis.

Tobit regression analysis	
Dependent variables	
TE	Technical efficiency results from DEA
CE	Cost efficiency results from DEA
AE	Allocative efficiency results from DEA
Independent variables	
Internal determinants	
Profitability	Return on Assets
Capital Adequacy (equity)	Total equity divided by total assets
Expense	Personnel and non-interest expenses divided by total assets
Deposit	Total deposit divided by total assets
Loan	Total loans divided by total assets
Loan Quality (NPL)	Non-performing loans divided by total loans
Size	Logarithm of total assets
External determinants	
Gdp growth	Yearly growth of Gdp (%)
Inflation	Yearly increase of consumer price index (%)

Figs. 1–3 demonstrate the technical, cost and allocative efficiency of state, foreign, domestic and participation (Islamic) bank types individually.

Figs. 1–3 demonstrate that, the most efficient bank type is participation banks. Within the conventional banks, the most efficient bank type is foreign banks, then, domestic private banks and state banks come respectively. These results are in line with Isik and Hassan (2002a), Catalbas and Atan (2005), and Assaf et al. (2013). Isik and Hassan (2002a) and Assaf et al. (2013) found that foreign banks perform more efficiently than domestic banks. Catalbas and Atan (2005) found that foreign banks are the most efficient banks in conventional banks and private domestic banks and state banks follow it respectively. Especially after 2009, there seems a substantial decrease in the efficiency of all banks. That might be caused by the 2008 global financial crisis. This result supports Ozkan-Gunay et al. (2013) who found that Turkish economy experienced the worst year in 2009, during the global crisis.

If technical efficiency is examined individually, Fig. 1 shows that technical efficiency score of participation banks are not influenced by the global crisis as other banks. However, their cost and allocative efficiency scores drops during that period. In a crisis period, participation banks were good at utilizing all factors of inputs but they were relatively not good at allocating their resources, so they performed bad in allocative and cost efficiency.

Table 6 indicates the determinants of efficiency for conventional and participation banks. Following the DEA efficiency results, Tobit regression analysis is implemented as a second step to reveal how internal (controllable by banks) variables and external (macro economic) variables effect the TE, AE and CE. To indicate the effect of internal variables separately, two regression analysis is executed, one of which has only internal variables as independent variable, while the other consists internal and external variable together as independent variable. TE_N, AE_N, and CE_N show the result of regression which use only internal variables as independent variable. TE_M, AE_M, and CE_M demonstrate the result of the regression which use the both of internal and external variables as independent variable.

According to the results of Table 6, results will be explained in two steps. In the first step, looking at the influence of banks' internal variable, first, it is found that there is no significant relationship between profitability and efficiency. Only for participation banks, it seems cost efficiency of PB is negatively associated with profitability. So, higher profitability of participation banks means less cost efficiency of them. This result is in line with Ismail et al. (2013) and Saha et al. (2015) who found a negative relationship between efficiency and profitability, while it contradicts Sufian and Noor (2009).

Second, for conventional banks, expense has a significantly negative impact on technical and cost efficiency. That means more expense leads to less efficiency in utilizing inputs for a certain output. This result supports the study of Mokhtar, Abdullah, and Alhabshi (2007) who also found a negative

Table 5
Efficiency scores of conventional, participation and all bank types for each year.

2005						
Bank types	Technical efficiency		Cost efficiency		Allocative efficiency	
	Mean	SD	Mean	SD	Mean	SD
Conventional banks	0.680	0.243	0.482	0.281	0.687	0.258
Participation banks	0.989	0.021	0.924	0.0820	0.933	0.066
All banks	0.718	0.249	0.535	0.302	0.717	0.255
2006						
Bank types	Technical efficiency		Cost efficiency		Allocative efficiency	
	Mean	SD	Mean	SD	Mean	SD
Conventional banks	0.768	0.234	0.558	0.273	0.715	0.252
Participation banks	0.933	0.047	0.865	0.071	0.926	0.041
All banks	0.788	0.226	0.595	0.276	0.741	0.246
2007						
Bank types	Technical efficiency		Cost efficiency		Allocative efficiency	
	Mean	SD	Mean	SD	Mean	SD
Conventional banks	0.767	0.285	0.461	0.279	0.559	0.229
Participation banks	0.972	0.035	0.769	0.054	0.791	0.043
All banks	0.792	0.275	0.498	0.281	0.587	0.228
2008						
Bank types	Technical efficiency		Cost efficiency		Allocative efficiency	
	Mean	SD	Mean	SD	Mean	SD
Conventional banks	0.757	0.229	0.581	0.246	0.757	0.220
Participation banks	0.927	0.078	0.862	0.061	0.930	0.023
All banks	0.778	0.222	0.615	0.249	0.778	0.214
2009						
Bank types	Technical efficiency		Cost efficiency		Allocative efficiency	
	Mean	SD	Mean	SD	Mean	SD
Conventional banks	0.768	0.214	0.560	0.253	0.719	0.250
Participation banks	0.877	0.098	0.804	0.140	0.913	0.071
All banks	0.781	0.206	0.589	0.254	0.743	0.243
2010						
Bank types	Technical efficiency		Cost efficiency		Allocative efficiency	
	Mean	SD	Mean	SD	Mean	SD
Conventional banks	0.609	0.270	0.430	0.313	0.647	0.251
Participation banks	0.950	0.068	0.659	0.235	0.689	0.216
All banks	0.650	0.277	0.457	0.311	0.652	0.244
2011						
Bank types	Technical efficiency		Cost efficiency		Allocative efficiency	
	Mean	SD	Mean	SD	Mean	SD
Conventional banks	0.882	0.213	0.553	0.264	0.600	0.239
Participation banks	0.950	0.0630	0.768	0.220	0.801	0.185
All banks	0.890	0.201	0.579	0.266	0.625	0.240
2012						
Bank types	Technical efficiency		Cost efficiency		Allocative efficiency	
	Mean	SD	Mean	SD	Mean	SD
Conventional banks	0.809	0.249	0.536	0.257	0.644	0.223
Participation banks	0.867	0.087	0.687	0.180	0.783	0.134
All banks	0.816	0.235	0.554	0.252	0.661	0.217
2013						
Bank types	Technical efficiency		Cost efficiency		Allocative efficiency	
	Mean	SD	Mean	SD	Mean	SD
Conventional banks	0.828	0.265	0.547	0.287	0.618	0.254
Participation banks	0.905	0.109	0.716	0.237	0.777	0.172
All banks	0.837	0.251	0.568	0.283	0.638	0.249

relationship between the expense and TE, and CE. But for participation banks, a positive association has been found between the expense and AE and CE which means more expense may lead to more allocative and cost efficiency. This result is in line with Ismail et al. (2013) who found a significantly positive relationship between technical, scale, and cost efficiency and expense.

Third, while there is no significant relationship for participation banks, there is a significantly negative relationship between technical efficiency of conventional banks and the ratio of total equity divided by total assets, which means more leverage may lead to more technical efficiency. This result is in line with Catalbas and Atan (2005) and Isik and Hassan (2003) who found a negative relationship with capitalization and CE and AE of conventional banks in Turkey, but contradicts with Sufian and Noor (2009) who found well capitalized banks to be more efficient.

Fourth, there is no significant association between deposit and efficiency for participation banks. However there is a significantly negative association between the technical and cost efficiency of conventional banks and deposit while there is a positive relationship between the allocative efficiency of conventional banks and deposit. This result may mean that the higher ratio of total deposit divided by total asset causes the less technical and cost efficiency and the more efficiency on allocating the inputs.

Fifth, there exists a significantly positive relationship between the loans and efficiency for both conventional and participation banks. This result is in line with Sufian and Noor (2009) and Isik and Hassan (2003) who found significantly positive relationship between the ratio of total loans to total asset and bank efficiency.

Sixth, the "loan quality", calculated by the nonperforming loans divided by total loans has significantly negative association with the efficiency of conventional banks, which means, problem loans decrease the efficiency of conventional banks. This result supports the studies of Isik and Hassan (2003),

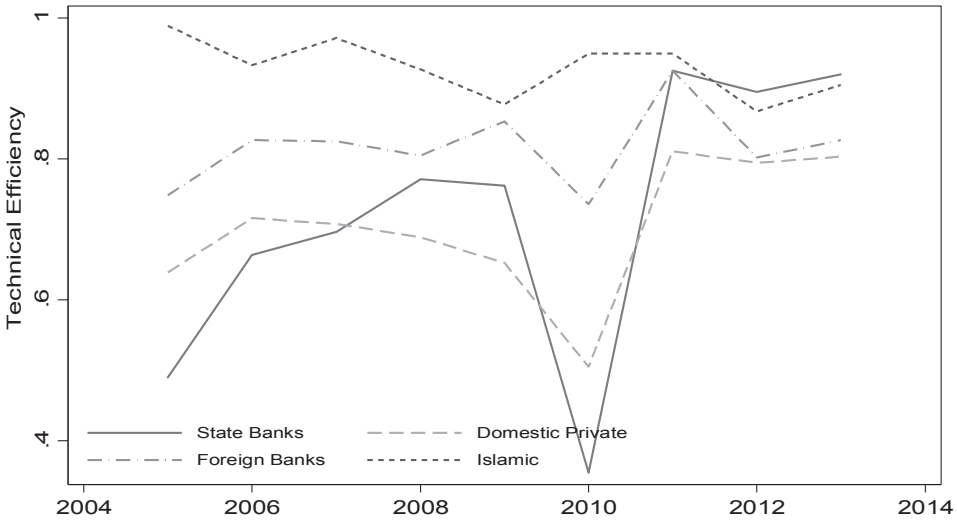

Fig. 1. Technical efficiency for state, private, foreign and Islamic Banks.

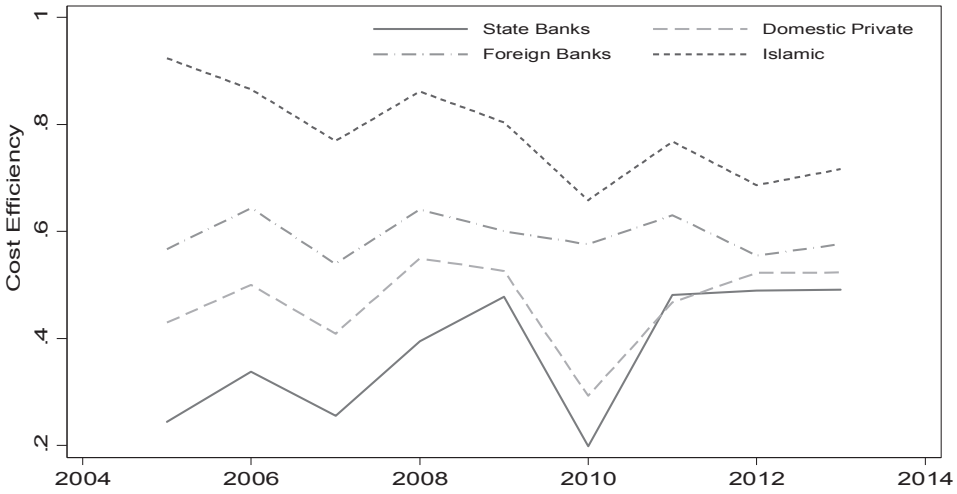

Fig. 2. Cost efficiency for state, private, foreign and Islamic Banks.

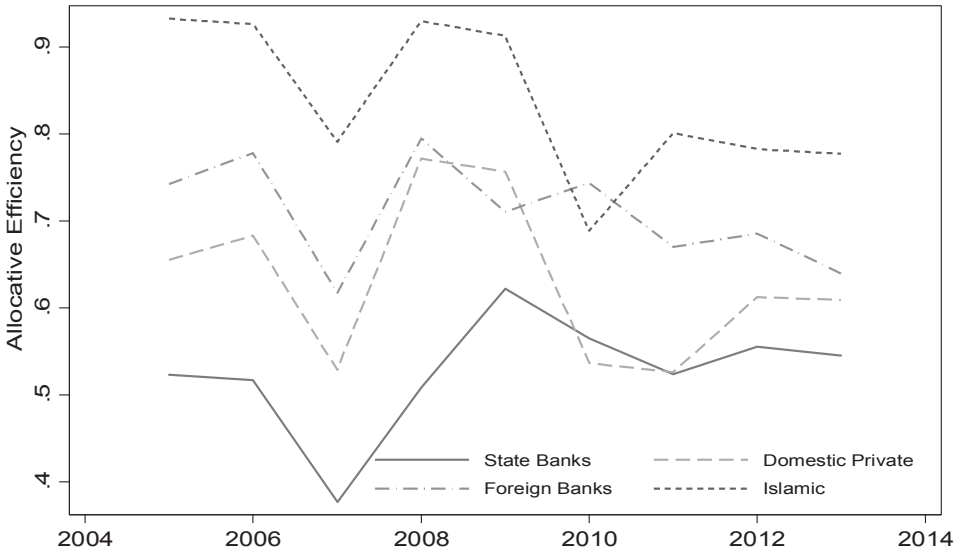

Fig. 3. Allocative efficiency for state, private, foreign and Islamic Banks.

Table 6
Tobit regression estimates for all banks.

Independent variables	Bank type	Dependent variables					
		TE_N	TE_M	AE_N	AE_M	CE_N	CE_M
Profitability	Conventional banks	0.002	−0.001	0.003	−0.001	−0.002	−0.007
		(0.219)	(−0.153)	(0.297)	(−0.103)	(−0.223)	(−0.777)
	Participation banks	−0.016	−0.014	−0.045	−0.056	−0.085	−0.089*
		(−0.672)	(−0.573)	(−0.994)	(−1.415)	(−1.619)	(−1.764)
	All	0.004	0.002	0.003	−0.001	0.001	−0.004
		(0.575)	(0.256)	(0.317)	(−0.158)	(0.086)	(−0.481)
Expense	Conventional banks	−0.013	−0.016*	0.004	−0.001	−0.014	−0.020*
		(−1.404)	(−1.819)	(0.371)	(−0.148)	(−1.307)	(−1.958)
	Participation banks	−0.013	−0.013	0.055**	0.063***	0.042	0.049
		(−0.824)	(−0.830)	(2.101)	(2.621)	(1.362)	(1.622)
	All	−0.013	−0.014*	0.005	0.000	−0.012	−0.017*
		(−1.484)	(−1.745)	(0.545)	(0.007)	(−1.162)	(−1.741)
Equity	Conventional banks	−0.006***	−0.005***	−0.002	−0.001	−0.002	−0.001
		(−2.997)	(−2.714)	(−0.771)	(−0.250)	(−1.049)	(−0.327)
	Participation banks	−0.003	−0.001	0.009	0.006	0.007	0.005
		(−0.433)	(−0.188)	(0.744)	(0.616)	(0.525)	(0.386)
	All	−0.007***	−0.006***	−0.002	−0.001	−0.003	−0.002
		(−3.615)	(−3.364)	(−0.954)	(−0.373)	(−1.587)	(−0.902)
Deposit	Conventional banks	−0.005***	−0.005***	0.003**	0.002**	−0.001	−0.002
		(−4.803)	(−5.019)	(2.398)	(2.342)	(−1.337)	(−1.464)
	Participation banks	−0.003	−0.005	0.000	0.006	−0.002	0.001
		(−1.021)	(−1.621)	(0.064)	(1.108)	(−0.421)	(0.203)
	All	−0.004***	−0.004***	0.003***	0.003***	−0.001	−0.001
		(−4.684)	(−4.868)	(2.878)	(2.820)	(−0.626)	(−0.724)
Loans	Conventional banks	0.006***	0.007***	0.003***	0.003***	0.005***	0.006***
		(6.035)	(6.935)	(2.898)	(3.179)	(5.013)	(5.685)
	Participation banks	0.005*	0.005*	0.007	0.005	0.007	0.007
		(1.722)	(1.886)	(1.120)	(1.076)	(1.080)	(1.107)
	All	0.006***	0.007***	0.003***	0.004***	0.006***	0.007***
		(7.203)	(7.921)	(3.709)	(3.962)	(6.247)	(6.846)
Loan quality	Conventional banks	−0.002	−0.002	−0.007**	−0.007*	−0.008**	−0.007**
		(−0.679)	(−0.613)	(−2.079)	(−1.922)	(−2.182)	(−2.038)
	Participation banks	0.004	0.005	0.057**	0.050**	0.062**	0.053*
		(0.285)	(0.386)	(2.038)	(2.119)	(2.034)	(1.796)
	All	−0.002	−0.002	−0.007*	−0.006*	−0.006*	−0.006*
		(−0.507)	(−0.540)	(−1.900)	(−1.808)	(−1.800)	(−1.746)
Size	Conventional banks	−0.001	0.003	−0.048***	−0.043***	−0.034**	−0.026
		(−0.049)	(0.212)	(−3.572)	(−3.133)	(−2.043)	(−1.576)
	Participation banks	−0.070**	−0.093***	−0.025	0.026	−0.094	−0.061
		(−2.340)	(−2.811)	(−0.467)	(0.463)	(−1.408)	(−0.867)
	All	−0.012	−0.008	−0.049***	−0.044***	−0.047***	−0.039***
		(−0.963)	(−0.650)	(−4.202)	(−3.649)	(−3.202)	(−2.665)
Gdp growth	Conventional banks		−0.022***		−0.010**		−0.020***
			(−5.599)		(−2.102)		(−4.504)
	Participation banks		0.007		−0.021***		−0.016
			(1.292)		(−2.684)		(−1.583)
	All		−0.019***		−0.011***		−0.020***
			(−5.304)		(−2.707)		(−4.803)
Inflation	Conventional banks		−0.038***		0.002		−0.018*
			(−4.322)		(0.151)		(−1.811)
	Participation banks		−0.000		−0.029**		−0.026
			(−0.044)		(−2.027)		(−1.473)
	All		−0.033***		−0.002		−0.019**
			(−4.163)		(−0.271)		(−2.084)

t statistics in parentheses.
***, **, *, Statistical significance at one, five and ten percent, respectively.

Sufian and Noor (2009), and Ismail et al. (2013) who found that loan loss provision and non-performing loans enhance the inefficiency of banks. However, a significantly positive relationship has been found between the nonperforming loans and efficiency for participation banks, which means problem loans may increase the efficiency of participation banks. This result may mean that conventional banks are not as good at solving the problem loans issue.

Seventh, the last internal variable, bank size has a significantly negative relationship with the allocative and cost efficiency of conventional banks and technical efficiency of participation banks. That means size has negative effect on the efficiency of banks. This result is in line with Isik and Hassan (2002a) and Catalbas and Atan (2005) who found a negative relationship between bank size and efficiency in Turkish banking system.

Finally, looking at the influence of banks' external (macroeconomic) variables as a second step, it's seen that both of the variables; GDP growth, and inflation have negative association with the efficiency of both types of banks which means high GDP growth and high inflation causes low efficiency.

5. Conclusion

Our purpose in this paper has been to compare efficiency amongst a sample of participation banks and conventional banks, located in Turkey over the period 2005–2013. The efficiency estimates for each bank are calculated using input oriented, non-parametric DEA method, via DEAP 2.1 programme. After evaluating efficiency of banks, how some selected bank specific and macroeconomic variables effect the technical, allocative and cost efficiency of participation banks and conventional banks has been found. To find these determinants Tobit regression analysis has been employed.

This study has showed that technical efficiency is bigger than allocative efficiency for both types of banks in Turkey. This may mean that the main contributor to cost efficiency is technical efficiency rather than allocative efficiency and increasing the efficiency on allocating and utilizing the resources may increase the cost efficiency in Turkish banking system. According to the mean efficiency of bank types, average TE, AE and CE of participation banks are substantially bigger than of conventional banks. Thus, it may be said that participation banks seem to function more efficiently than conventional banks. This result is compatible with Arslan and Ergec (2010), and Er and Uysal (2012) who found participation banks more efficient in Turkey. As well, the figures which indicate participation banks, state banks, foreign banks, and domestic private banks separately, clearly show that average technical, allocative and cost efficiency is bigger for participation banks. Then, foreign banks, domestic private banks and state banks follow it respectively. This result supports Catalbas and Atan (2005) who found the most efficient banks are foreign banks, domestic private banks and state banks respectively within Turkish conventional banks.

Finally, exploring the determinants of efficiency for participation banks and conventional banks, it has been found that there is a significant positive relationship between efficiency and the loans, while there is a significant negative association between efficiency and expense, capital, deposit, non-performing loans, bank size, GDP growth and inflation for conventional banks. That means the loans contribute to efficiency positively, but selected external variables such as, bank size, GDP growth and inflation, and selected internal variables such as expense, capital, total deposit and non-performing loans negatively affects the efficiency of conventional banks. Looking at the participation banks, while expense, loans and non-performing loans influence the efficiency positively; profit, bank size, GDP growth and inflation operates negatively. As it is seen from the results, same variables may affect the efficiency of conventional banks and participation banks in a different way.

This research will serve as a base for future studies and indicates the determinants of efficiency for both conventional and participation banks in Turkey. Further research would be done to investigate the profit and revenue efficiency of participation and conventional banks. Also a further study could assess the efficiency with parametric methods like SFA and could include other country datas.

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