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# The effect of scale and mode of ownership on the financial performance of the Turkish banking sector: results of a DEA-based analysis

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## Abstract

Turkey and the International Monetary Fund (IMF) agreed to a stand-by arrangement at the outset of 2000. Consequently, Turkey implemented an exchange-rate based stabilization program to combat its high inflation. However, two financial crises followed: one in November, 2000 and the other in February, 2001. As the result some banks became problematic. This necessitated restructuring of the banking sector to increase its financial efficiency.

This paper presents a financial performance index for commercial banks. The index allows one to observe the effects of scale and of the mode of ownership (public/domestic, private/domestic/foreign) on bank behavior and, therefore, on bank performance in a developing economy. It documents the effects of financial liberalization, cross-country movements, and the impact of financial crises originating in neighboring countries e.g. Russia. The study applies Data Envelopment Analysis (DEA) to selected fundamental financial ratios using 1989–99 data from commercial banks in Turkey. Year-by-year results explain the effects on this sector of major shifts in both national macro-economic policy and various international developments. The banks that were taken over by the regulatory government agency most recently in the analyzed period were observed to perform poorly with respect to their DEA performance index values.

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## 1. Introduction

Financial institutions bridge the needs of lenders (savers) and those of borrowers. They provide the flow of resources from one party to the other. Among financial institutions, commercial banks play the major role. They have the largest share of intermediation and are at the very core of a financial system

The basic function of a bank is to collect deposits from savers and to extend loans to investors (or consumers). Yet, the scope of banking activities differs from country to country. For example, while banking activities are, by law, limited in some countries, a wider scope of operations is allowed in others (as in the universal banking system in Europe). In terms of portfolio diversification, expanding the scope of activities may result in risk reduction. However, trends toward “universal banking” have created new risk sources.

The scope and nature of banking activities have evolved over time. In the late 1960s and early 1970s, volatility in the rapidly developing financial markets, due mainly to fluctuating interest rates, forced banks to take measures against uncertainty. Market volatility increased in the ensuing years, as the result of the economic crises in the 1970s. In this period, the definition of bank liquidity shifted from holding liquid assets toward an ability to raise funds as needed. This coincided with high levels of and fluctuations in interest rates, thus increasing interest rate risk. Combined with longer maturities of loans vis-à-vis sources of funds, the situation led to losses on banks’ income statements. As a countermeasure, banks introduced floating rates on loans. This transferred the interest rate risk to loan customers, and increased the credit risk. At the same time, international banking gained pace. Banks both collected funds from international markets, and invested in foreign markets. This gave rise to the foreign exchange (FX) risk.

Bridging lenders and borrowers puts banks at the very core of any economic activity as well as any policy decision concerning the economy. It is not a coincidence that in many countries structural changes (aimed at enhancing economic growth, increasing efficiency in allocation of resources, and integration with the global economy) resulted from the liberalization of financial markets and, specifically, the liberalization of the banking sector.

The “fragile” nature of banks and the fact that they are popularly perceived to be institutions of “confidence”, threatens not just banking institutions but the entire economy. This is due in part to the strong backward and forward linkages between institutions in this sector and the rest of the economy. Recent experiences in developing countries show how destructive problems in the banking sector can be for the entire economy [1].

Financial markets experienced a “wind of change” in the 1980s. International capital movements shifted from “state-to-state” character to an environment where private capital movements became dominant.

“Until recently capital flows to developing countries were more limited and dominated by public and publicly guaranteed flows. Financial intermediation did not play as important a role. Today, private flows to developing countries are huge and are increasingly channeled by domestic banks throughout the economy. This augments the potential of the financial system, but it also magnifies any inefficiencies or problems.” (Stiglitz [2])

Many developing economies (emerging markets), requiring foreign capital for economic growth, initiated liberalization of their capital accounts. Consequently, cross-nation capital flows

moved more freely. Short-term capital dominated these transactions. This short-term capital was used (directly/indirectly) by emerging countries to finance other needs as well. Governments' capability to thus finance budget deficits led to easing of fiscal policies. Capital inflows to domestic money and securities markets increased drastically. This led to appreciation of domestic currencies, making imports more attractive, while financing these very same imports. Consequently, the budget and/or current account deficits of such countries increased. According to Balkan and Yeldan [3], even though the main motive behind liberalization was to restore growth and stability by raising savings and improving economic efficiency, in fact, financial liberalization increased financial instability. This contributed to a series of financial crises within developing countries. Financial liberalization, by way of reliance on short-term capital inflows, intensified the already existing problems such as budget deficits, monetary instability and market distortions. The very nature of these inflows created instabilities in exchange rates, interest rates and in prices of financial assets.

As economic fundamentals deteriorated in these developing economies (implied by the rise in the budget and/or current account deficits), foreign investors' risk perceptions increased. This resulted in huge outflows of foreign capital. The rush to foreign currency (sometimes called "currency attack") in several cases led to a sudden and sharp depreciation of local currencies [4].

Eichengreen [5] argues that banks enjoying government guarantees and seeking to lever up their bets can do so more readily when the capital account is open. If they borrow in foreign currency, they strip the authorities of their ability to act as lenders of last resort: A central bank cannot print foreign currency, and its capacity to provide commercial banks the foreign exchange they need to make good on foreign obligations is limited by its stock of international reserves. Even if the liabilities of the banks are denominated in domestic currency, a central bank trying to peg the exchange rate will find itself in a very difficult situation. It will have to choose between draining liquidity from the markets to defend the exchange rate, or injecting liquidity to defend the banks.

If the central bank opts to raise interest rates to protect the currency or devalue the domestic currency to protect its reserves – both moves known to affect the banking sector due to banks carrying short FX positions and/or having a maturity mismatch between assets and liabilities (against the assets) – domestic and foreign currency liquidity crises are typical results. Moreover, banking sectors in emerging countries are caught by such crises while in a relatively undercapitalized position. With rising interest rates and devaluation of domestic currency, both leading to losses, undercapitalization turned banking operations into negative net worth territory. This makes radical banking sector restructuring a necessity. Many Latin American and East Asian countries had to face this necessity in recent decades. Eichengreen and Rose [6] reviewed the budgetary costs of resolving financial crises and recapitalizing banking systems. Accordingly, budgetary costs reached 10% of GDP in Malaysia (1985–88), 15% of GDP in Mexico (1994–97), 20% of GDP in Venezuela (1994–97), 30% of GDP in Chile (1981–86), and 50% of GDP in Kuwait (1990–91). Moreover, the authors claimed that the significance of the macroeconomic costs contributed to the fact that most of the banking crises were accompanied by major recessions [6].

Vulnerability to crises in the banking sector appears to be associated with the following factors [7]:

1. A weak macroeconomic environment characterized by slow GDP growth and high inflation,

2. Vulnerability to sudden capital outflows,
3. Low liquidity in the banking sector,
4. High share of credit to the private sector,
5. Past credit growth,
6. Existence of explicit deposit insurance,
7. Weak institutions.

Crises in Argentina, Venezuela and Paraguay, led Garcia-Herrero [8] to conclude that a well-funded deposit insurance scheme and a flexible lender-of-last-resort facility help reduce negative macroeconomic impacts of banking crises. Conversely, a poorly regulated offshore banking system and substantial off-balance-sheet operations in the domestic banking system increase the impact of crises. On the other hand, countries with rapid, consistent and comprehensive policy responses reduced their macroeconomic consequences of crises. Thus the financial well-being of banks is especially crucial under such circumstances. It is for this reason that risk management, and specifically asset-liability management, in recent years, have gained utmost importance.

Consequently, this paper presents a financial performance index for commercial banks. The index allows one to observe the effects of scale and of the mode of ownership (public/domestic, private/domestic/foreign) on bank behavior and, therefore, on bank performance. Specifically it examines the actual performance of banks in the Turkish banking sector during the 1989–99 period, and tries to shed light on issues concerned with increasing such performance. The following sections discuss: recent macroeconomic and banking sector developments in Turkey, the relevant efficiency and performance literature, the research methodology and the data used in this study. Finally, the findings are discussed and the paper is concluded.

## **2. Recent developments in the Turkish economy and its banking sector**

Turkey, a developing country, experienced a period of financial liberalization including capital account liberalization and structural change, interrupted frequently, especially in the last decade, by financial crises.

Before 1980 the Turkish financial system was characterized by having a negative real interest rate, lack of capital markets, restrictions on FX operations and centrally established deposit and loan rates. In 1980 a structural adjustment program was launched to turn the economy from an inward to an outward orientation and to establish free market principles. Measures to deepen the financial markets and increase efficiency and competition went hand in hand with this program of structural adjustments.

Major steps taken in the structural reforms included: liberalization of deposit and of loan rates; establishment of government securities (1985) and interbank markets (1986); introduction of open market operations with government securities (1987); re-opening of the Istanbul Stock Exchange (1985) and its becoming operational (1986); and the liberalization of the foreign exchange regime. Finally the liberalization of capital movements and acceptance of the convertibility of the Turkish Lira in 1989 and 1990, to a large extent, integrated Turkey into the global financial system. As a result of these steps, the Turkish financial sector grew rapidly. Competition, service quality, technology, investment in human capital, as well as the importance given to asset-liability

management increased. However, risks increased as well. Not only domestic, but also global risks appeared on the agenda of Turkey's banks. In consequence, Turkey experienced several crises. In 1991 the crisis following the emergence of the Gulf war; in 1994 the chain of events leading to devaluation; in 1997 the Far East crisis; in 1998 the Russian crisis and its strong contagion effect; in 1999 the earthquakes of August and November; and in 2000 and 2001 liquidity crises exploding in the midst of restructuring and disinflation programs, resulting in devaluation during 2001. These crises greatly impacted the banking sector which in turn magnified the adverse impact on the economy.

Table 1 shows that the mode of bank ownership changed drastically during the 1990s. State banks declined in sector share compared to private and foreign banks.<sup>1</sup> The size of the banking sector (assets/GDP) increased rapidly especially after 1995. Despite some fluctuations, a high asset share concentration (largest 10 banks) remained. Significantly, the structure of the balance sheet changed. The share of loans in total assets declined, while the share of securities (mainly government debt instruments) rapidly increased particularly between 1997 and 1999. The level of repo (repurchase agreement) transactions in the off-balance sheet items increased during this period as well. These may be considered an indicator of the “crowding out” effect. Borrowing requirements rose sharply during this period.

The FX levels on balance sheets increased. FX liabilities (mainly funds borrowed abroad) rose more rapidly than FX assets. This created a significant short FX position in the banking sector, making banks vulnerable to the FX risk.<sup>2</sup> Yet, despite the rise of FX on the balance sheets between 1989 and 1994, the share of FX in assets and liabilities remained relatively stable even after 1994. This was so even after experiencing the pain of an open position in the FX crisis. On the other hand, the maturity horizons shortened in the sector as a result of the instability. These crises eroded the capital base of the banking sector enhancing the need for its restructuring.

In consequence of the IMF stand-by arrangement, Turkey implemented an exchange rate based stabilization program in 2000 so as to combat its high inflation (the average CPI inflation for the second half of 1990s approximated 80%). A devaluation rate compatible with the targeted inflation was set. Interest rates started to fall and positive developments on the fiscal side took place. However, the rapidly growing domestic demand and the real appreciation of the TL, soon led to an explosion in current account deficits. Combined with the declining pace of structural reforms, problems began. Firstly, in November 2000, a squeeze on the market, fueled by the liquidity requirement of a medium sized bank created turmoil. This resulted in interest rates jumping and in assignment of the above bank to the SDIF. The crawling peg regime however was sustained thanks to a supplementary allocation from the IMF, amounting to USD 7.5 billion. Nevertheless, this initiated a “confidence crisis” in the market creating the potential of yet a bigger crisis exploding. In February 2001, a political dispute was perceived as the triggering factor and a deep crisis indeed did start. Turkey abandoned the crawling peg regime and shifted to a floating exchange rate. In the meantime interest rates skyrocketed followed by rapidly rising exchange rates. This resulted in huge losses for banks.

<sup>1</sup> However the picture changed in the 1997–2001 period. Eighteen private banks (as of September 2001) were taken over by the Saving Deposits Insurance Fund (SDIF).

<sup>2</sup> This short FX position led to serious losses during the 1994 and 2001 crises.

Table 1

Developments in the consolidated balance sheet of the Turkish Banking System: 1989–1999

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Number of banks	51	55	59	66	67	67	68	69	72	75	81
Asset share of the state commercial banks	0.43	0.43	0.4	0.42	0.39	0.4	0.38	0.38	0.35	0.35	0.35
Asset share of the private commercial banks <sup>a</sup>	0.45	0.46	0.48	0.48	0.51	0.5	0.52	0.53	0.55	0.56	0.49
Asset share of the foreign commercial banks	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.05	0.04	0.05
Asset share of the largest 5 banks	0.54	0.53	0.5	0.49	0.48	0.5	0.48	0.46	0.44	0.44	0.46
Asset share of the largest 10 banks	0.75	0.74	0.72	0.71	0.69	0.73	0.71	0.69	0.67	0.68	0.68
Asset size (billion USD)	47	58	58	65	73	53	67	83	95	118	134
Assets/GDP	0.46	0.42	0.46	0.5	0.52	0.52	0.53	0.61	0.67	0.71	0.93
Loans/assets	0.42	0.47	0.44	0.42	0.42	0.39	0.43	0.43	0.45	0.38	0.30
Securities/assets	0.12	0.1	0.12	0.11	0.11	0.11	0.11	0.15	0.13	0.14	0.17
Deposits/assets	0.58	0.56	0.56	0.55	0.51	0.63	0.65	0.69	0.65	0.66	0.67
Deposits in foreign currency/assets	0.15	0.15	0.19	0.22	0.25	0.34	0.36	0.35	0.34	0.33	0.33
Borrowed funds from abroad/assets	0.04	0.06	0.07	0.09	0.12	0.05	0.05	0.06	0.08	0.07	0.09
(Deposits + non-depository funds)/shareholders' equity	10.2	9.72	10.5	12.8	11.5	13	13	13.7	12.6	14.1	30.8
Shareholders' equity/assets	0.07	0.08	0.07	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.03
Net profit/assets	0.02	0.03	0.03	0.03	0.04	0.02	0.03	0.04	0.03	0.03	–0.00
Short foreign currency position (assets in foreign currency–liabilities in foreign currency)/assets	0.01	–0	–0.03	–0.05	–0.06	–0.01	–0.04	–0.03	–0.05	–0.07	–0.10

<sup>a</sup> The confiscated banks are not included.

It is widely understood that an emerging market country aiming to decrease inflation and setting its economy on a stable growth path must typically restructure its banking sector. The first restructuring process step usually involves disposition of problematic banks to its SDIF equivalent in order to prevent a banking “confidence crisis”. However, a comprehensive process also involves increasing the sector’s efficiency, increasing competition therein, decreasing concentration, decreasing the share of public banks through privatization (if not possible, through closure), limiting connected lending, opening the sector to foreign capital, strengthening the capital base, increasing the quality of assets (especially loans) and introducing well-designed and comprehensive risk management procedures. High on the agenda are bank mergers.

In addition to the original stand-by loan and supplementary reserve facility granted by the IMF, Turkey also received funds for this purpose from the World Bank. One of the major

problems in Turkish banking sector was diagnosed to be a huge duty loss stock<sup>3</sup> of the state banks which lead to excessive borrowing almost overnight, and hence, exposing these banks to interest rate and liquidity shocks. This was combined with poor management, negative net worths in the state and the SDIF controlled banks, distortionary effect on competition of a blanket deposit guarantee, systemic deterioration in asset quality as well as undercapitalization in the private banks.

Many steps were (and are being) taken to rehabilitate and restructure the Turkish banking sector. First, the duty losses of state banks were paid back by the Treasury via the Government Debt Instruments (GDIs) and the Central Bank helped liquidate these securities. The short-term (overnight) borrowing requirement problem of these banks was thus solved. Second, state and SDIF banks were recapitalized. Third, professional administrators were appointed in the state banks to restructure and prepare them for privatization. Additionally, banks under the SDIF umbrella were either to be privatized or closed if no customer was found. Finally, specific measures have been taken in order to promote the soundness of private banks.

### 3. Literature survey

A great deal of research measuring the performance or the efficiency of financial institutions was recently recorded. However, significant differences exist in modeling approaches and in findings. These differences result from the lack of a globally accepted methodology for measuring bank performance. This in turn is due to the fact that banks perform multi-input/multi-output production processes. Most important, however, are the differences in defining efficiency. Berger and Mester [9] examine three distinct economic efficiency concepts: Cost efficiency measures the proximity of a bank's cost to that of a best-practice bank's cost for producing the same output bundle under the same conditions. Standard profit efficiency measures how close a bank is to producing the maximum profit possible given particular levels of input and output prices. The last definition represents the alternative profit efficiency concept. This may be of help when the assumptions underlying cost and standard profit efficiency are not fully met. For example, an alternative efficiency may measure how close a bank comes to earning maximum profits given its output levels rather than its output prices. They conclude by suggesting that all three concepts be used to assure robustness of the conclusions.

Clearly using different measurement methods can yield different conclusions. Failure to account for the equity position of a bank seems to yield a strong scale bias, making large banks appear to be more efficient than small banks by virtue of the equity mix built up over time. However choices involving the measurement technique, functional form, and most other variables usually make very little difference in terms of either the average industry efficiency or the rankings of individual firms within a given observation set [9].

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<sup>3</sup> Large stock of state banks' losses—a consequence of government-mandated subsidized lending. These loans were predominantly to the agricultural sector and to small and to medium enterprises (SMEs). The losses were kept as "assets" on state banks' balance sheets until redeemed in 2001 by government bonds. In 2001, legislation was enacted to prevent future state bank financial position distortions. Accordingly, banks can no longer be compelled to run duty losses unless funding was a-priori allocated for the purpose.



Two mainstream approaches to selection of bank performance or bank efficiency criteria dominate the literature. These are the production approach and the intermediation approach [10] and [11]. The former relies on physical magnitudes reflecting the operational efficiency (number of branches, personnel, accounts, transactions, etc.). The latter examines monetary magnitudes reflecting the financial intermediation function of banks (deposits, loans, securities portfolio, interest income and expenses, etc.). In line with the second approach, the financial performance of banks is generally measured by the internationally accepted ratio-based CAMEL approach. The ratios related to Capital adequacy, Asset quality, Management, Earnings, and Liquidity as obtained from banks' financial statements are considered to measure performance. For every financial dimension, numerous financial ratios can be derived. Dimensions such as the composition of off-balance sheet items, the types of risks taken, the growth of the balance sheet and the intermediation function can also be examined. Moreover, both the technical and the scale efficiencies can be analyzed using parametric and non-parametric measurement methods. A comparison of the Non-parametric Data Envelopment Analysis (DEA), the Parametric Stochastic Frontier Approach (SFA), Thick Frontier Approach (TFA), and Distribution Free Approach (DFA) [12], resulted in a set of desired consistency conditions for the frontier efficiency approaches. The efficiency estimates should be consistent in their efficiency levels, rankings, and identification of best and worst firms. They should be consistent over time and with competitive conditions in the market. Lastly, they should be consistent with standard non-frontier measures of performance.

Moreover, a survey outlining the results of 130 efficiency studies of financial institutions applying five different frontier approaches, and covering 21 countries [10] finds efficiency estimates from non-parametric studies (i.e. DEA) to be similar to those from parametric frontier models. However, the non-parametric methods generally yield slightly lower mean efficiency estimates and seem to have greater dispersion than do results from parametric models.

As indicated, the global literature recorded much work devoted to analyzing banking sector efficiency in many countries. These address a variety of aspects. Among these are liberalization, foreign bank entry, financial sector consolidation, banking sector restructuring, etc., using both parametric and non-parametric methodologies [13–25]. There are also a number of financial performance studies utilizing parametric approaches to address Turkish banking [26–33]. The Turkish banking sector was also studied using non-parametric approaches including DEA [34–36].

Among the non-parametric methods, DEA is used most widely. It was developed to assess the relative efficiencies of decision-making units which are similar in terms of goods and services produced [37]. This method uniquely allows evaluation of organizations, using multiple inputs to produce multiple outputs, without a priori assuming the existence of some formal analytic function. DEA yields a single dimensionless performance index (efficiency score). Thus far only a handful of studies have compared bank financial ratio findings with DEA scores. Yeh [11] offered one of the earliest such comparisons. Based on DEA bank performance evaluation, she demonstrated that in conjunction with financial ratio analysis, DEA can effectively aggregate a large number of ratios into meaningful financial dimensions. This, according to Yeh, gives analysts useful insight into financial operating strategies employed by banks.



#### **4. Application of non-parametric approaches to the financial performance measurement of the Turkish banking sector**

This study used financial ratios as both inputs and outputs in DEA to assess the 1989–99 relative financial performance of Turkish banks. The ratio of weighted outputs to weighted inputs constitutes the DEA performance index. This definition of performance transforms the multidimensional nature of both the inputs and the outputs into a single scalar ratio of a single virtual output to a single virtual input. The term “relative” is rather important. The best performing decision-making units (DMU) (identified by the DEA) in its set may not be the best performer when similarly evaluated in other sets of units/organizations. DEA compares organizations’ observed outputs and inputs, identifies the relatively “best practice” units to define the “efficient frontier” and then measures the degree of inefficiency of the other units relative to the efficient frontier thus defined. The literature offers different mathematical forms for the DEA model. The formulations used in this study are based on the form suggested in [37] and shown in Appendix A. Steps in the application of the method and results obtained are presented below.

##### *4.1. The method*

Financial ratios as used for performance analyses worldwide, show only one dimension related to the operational success of a firm. However, the most criticized aspect of uni-dimensional ratio analysis is that some ratios may indicate a successful firm performance whereas others may show the opposite. Therefore, and especially in multi-input/multi-output firms, derivation of only one performance index giving meaningful weights to various ratios leads to DEA. The relative performance measurement of DEA is a two-staged process:

- (i) Determining the best performing DMU(s) that produce(s) greatest output with the least input. Assigning a DEA performance-index value of unity (1) to such DMU(s) and placing them on the efficient frontier.
- (ii) Determining the DEA performance-index values for all other DMUs in the set. Such values are represented by the distance of the less efficient units from the above defined efficient frontier. The DMUs in this subset use more inputs given an output level or produce less output for a specific level of inputs.

##### *4.2. Selecting the observation set*

Financial data of all commercial banks released by the Banks Association of Turkey between 1989 and 1999 were used in selecting the observation set. This set should be as homogeneous as possible to be meaningful within the DEA relative efficiency measurement characteristic. The DEA scores were calculated from a pool of 11 years’ banking data in order to satisfy that need. This allowed for a meaningful year-by-year comparison of the effect of scale and type of ownership on bank performance. The set consists of 587 observations, each representing the selected variables in a given year.

### 4.3. Selecting the set of variables

Selection of proper variables to define and to measure financial performance is always an extremely important decision. It is especially so in using DEA for such measurements as different outcomes may result from different sets of variables used on the very same set of institutions. For example, on their balance sheets some banks may indicate a high share of loans and deposits or a high share of FX. Others may rely heavily on funds borrowed from abroad or have a relatively high security stock in their total assets vis-à-vis other banks. Therefore, to properly assess the financial performance of institutions comprising so diverse a banking system, it is necessary to avoid institution-specific structural characteristics [34]. Hence, variables chosen for this study represent the dimensions widely used within the CAMEL applications of bank-performance measures.

In this study it was assumed that macroeconomic environment developments during the relatively long (11-year) period considered affected all banks similarly. Financial ratios were used throughout this study inter-alia to minimize any distortions due to inflation. The input set consisted of two main items:

- (i) *Personnel expenses/Earning assets*<sup>4</sup>—this ratio shows the amount that a bank spends on personnel (the most important non-financial bank input item) in order to create a unit of earning asset. It provides general information about management performance within the CAMEL model.
- (ii) *Total expenses/Total income*—indicates the efficiency of a bank in its profit generation process. In the CAMEL methodology, it is used to evaluate management performance.

The output set consisted of three main elements:

- (i) *Earning Assets/Total Assets*—shows the share of income generating assets in the Bank's total assets. This variable evaluates the asset quality and liquidity dimensions within the CAMEL approach.
- (ii) *(Shareholders' equity+Net profit)/Total liabilities*—is used to measure the capital adequacy and profitability within the CAMEL framework. It also indicates the share of internal resources used to generate profit.
- (iii) *Average return on equity (Net profit/Average shareholders' equity)*—helps in evaluating bank profitability. It is representative of the income creation dimension in the CAMEL approach.

The DEA model used assumed constant returns to scale and could not treat negative data. Therefore, in order to obtain reliable results from this DEA model, observations having negative signs had to be excluded from the observation set. This required exclusion of 42 observations with negative ROEs representing the confiscated banks. Hence 545 observations comprised the final data set.

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<sup>4</sup>Earning assets are defined as the sum of liquid assets and loans.

#### 4.4. Main findings

The average (DEA performance) index value of the 545 observations for each year fell between 25% and 45%. This indicates low performance for most banks considered. It is a most surprising finding in light of the fact that the worst performers (negative observations) were excluded. It should be noted that it is possible to increase the level of the average DEA performance index by excluding best practice units from the sample. This was indeed done and the relative standing of performance-index values over the years and among banks did not significantly change—a gratifying finding. Clearly, by constructing a new “efficient” frontier for the further reduced data base, the average performance level did increase.

##### 4.4.1. Remark 1

Simple averages of DEA performance-index values were calculated and their behavior examined over time to study the commercial banking sector’s general performance. These averages indicate major performance dislocations during 1990 and 1994. An increasing trend in performance index started following the liberalization of capital movements in 1989 and continued until 1993. However the 1994 economic crisis reversed that trend. The average performance-index value followed a downward trend between 1994 and 1999, except for an increase in 1999. Table 2, clearly shows the severity of the 1994 crisis effects on the financial performance of the Turkish banking sector.

##### 4.4.2. Remark 2

To evaluate bank performance according to the mode of ownership, banks were classified as state-owned (public), private (domestic) and foreign. Average DEA performance-index values for each group were analyzed over time. These averages indicate state-owned banks to have the lowest performance within the 11-year period except for 1989. Moreover, that sub-sector behaved quite differently from the rest in 1990—the year in which capital movements were liberalized.

Table 2, also shows that the 1994 financial crisis affected Turkish private banks, differently from the others. In that year, both state-owned and foreign banks exhibited their highest performance-index value.

Table 2  
Average DEA index values for bank groups<sup>a</sup>

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Commercial banks	0.28	0.28	0.34	0.37	0.40	0.41	0.33	0.32	0.32	0.28	0.29
Private banks	<b>0.24</b>	<b>0.25</b>	0.34	0.39	0.44	<b>0.39</b>	0.34	0.32	<b>0.29</b>	<b>0.24</b>	<b>0.24</b>
Large scale banks	<b>0.22</b>	<b>0.21</b>	<b>0.21</b>	<b>0.20</b>	<b>0.23</b>	<b>0.25</b>	<b>0.24</b>	<b>0.29</b>	<b>0.32</b>	0.30	0.30
Medium scale banks	<b>0.21</b>	<b>0.22</b>	<b>0.28</b>	<b>0.34</b>	0.47	<b>0.29</b>	0.35	0.33	<b>0.26</b>	<b>0.26</b>	<b>0.26</b>
Small scale banks	<b>0.27</b>	<b>0.27</b>	0.41	0.44	0.47	0.44	0.36	<b>0.31</b>	<b>0.31</b>	<b>0.22</b>	<b>0.21</b>
State-owned banks	0.29	<b>0.23</b>	<b>0.21</b>	<b>0.23</b>	<b>0.27</b>	<b>0.33</b>	<b>0.18</b>	<b>0.21</b>	<b>0.20</b>	<b>0.15</b>	<b>0.13</b>
Foreign banks	0.33	0.35	0.37	0.38	<b>0.37</b>	0.49	0.34	0.35	0.40	0.38	0.41

<sup>a</sup> Bold numbers in the table indicate performance index values of bank groups lower than the average corresponding values of commercial banks.

Table 3

Some 1994–95 ratios of public, private, and foreign banks

	Public banks		Private banks		Foreign Banks	
	1994	1995	1994	1995	1994	1995
Total expense/total income	0.789	0.939	0.632	0.687	0.493	0.632
Av. return on equity (ROE)	0.307	0.256	0.626	0.824	1.950	1.007
Securities/total assets	0.141	0.102	0.130	0.129	0.175	0.127
FX position [(assets in foreign currency–liabilities in foreign currency)/total assets]	0.014	–0.007	–0.055	–0.084	0.013	–0.119
(Interest income + foreign currency gains)/(interest expense + in foreign currency losses)	1.853	1.162	1.302	1.556	2.222	2.053
(Non-interest income–net foreign currency loss)/non-interest expense	0.632	0.630	2.424	1.121	1.702	1.268

Table 3 indicates that the reason behind state and foreign bank successes during the 1994 crisis might be their long FX position and hence, a lower FX risk. Additionally, in that year, their exposure to government debt instruments was quite high as compared to private banks. However following that crisis year, the banks in these two groups chose to open their FX positions and reduce lending to the Turkish Treasury. On the other hand, the private banks' policy was to open their FX positions and to invest in government paper. This policy difference allowed private banks to attain high ROE values and low efficiency ratios compared to 1994. At the same time state-owned and foreign banks' profitability declined considerably. Thus, the performance of these two sub-sectors worsened in 1995 and registered a significant decline compared to Turkish private banks.

It appears that the 1994 Turkish financial crisis and the 1998 “Russian” (worldwide) crisis caused declining trends in Turkish private banks' performance starting around 1994 and continuing till 1999. These trends culminated in the confiscation of five banks by the SDIF at the end of 1999. State-owned banks followed the same trend after 1994 except for some recovery during 1996 and 1997. Foreign banks' performance, on the other hand, started to increase after 1995. Their financial performance increased from 34% in 1995 to 41% in 1999.

#### 4.4.3. Remark 3

A close analysis of the index distribution for private banks (Table 2) reveals that the efficiency index of large-scale banks is quite different from that of the others during the 11-year period. The 1994 financial crisis did not significantly alter the average performance of large-scale banks. This group shows an increasing trend starting after 1992 continuing until 1997 except for a small decline in 1995. On the other hand, medium- and small-scale banks were significantly harmed by the 1994 crisis. Performance levels of both these groups decreased especially so after 1993, dipping below that of large-scale private banks after 1997. The differences in financial performance

Table 4  
Comparative DEA performance-index values of SDIF controlled banks and the average of private banks<sup>a</sup>

	Date of transfer	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Private banks		0.24	0.25	0.34	0.39	0.44	0.39	0.34	0.32	0.29	0.24	0.24
SDIF banks												
First group of banks	Turkbank	Nov 6, 1997	<b>0.18</b>	<b>0.18</b>	<b>0.17</b>	<b>0.17</b>	<b>0.14</b>	<b>0.17</b>	<b>0.25</b>	—	—	—
	Interbank*	Jan 7, 1999	0.26	0.29	0.37	0.41	0.44	<b>0.23</b>	0.32	<b>0.19</b>	—	—
	Bank Ekspres	Dec 12, 1998	—	—	—	<b>0.33</b>	<b>0.65</b>	<b>0.27</b>	<b>0.25</b>	<b>0.21</b>	—	—
Second group of banks	Egebank	Dec 22, 1999	<b>0.16</b>	<b>0.17</b>	<b>0.21</b>	<b>0.24</b>	<b>0.29</b>	<b>0.21</b>	<b>0.25</b>	<b>0.25</b>	<b>0.17</b>	—
	Esbank	Dec 22, 1999	<b>0.24</b>	<b>0.23</b>	<b>0.25</b>	<b>0.28</b>	<b>0.33</b>	<b>0.25</b>	<b>0.24</b>	<b>0.20</b>	<b>0.17</b>	—
	Sumerbank	Dec 22, 1999	0.57	0.41	<b>0.27</b>	0.40	0.77	0.92	<b>0.23</b>	<b>0.22</b>	<b>0.14</b>	—
	Yasarbank	Dec 22, 1999	<b>0.23</b>	<b>0.25</b>	<b>0.25</b>	<b>0.25</b>	<b>0.25</b>	<b>0.20</b>	<b>0.21</b>	<b>0.21</b>	<b>0.22</b>	—
	Yurtbank	Dec 22, 1999	—	—	—	—	1.00	0.49	<b>0.28</b>	<b>0.21</b>	<b>0.12</b>	—
Banks taken over in 2000	Bank Kapital	Oct 27, 2000	—	—	1.00	0.70	<b>0.40</b>	—	0.41	0.24	<b>0.20</b>	<b>0.14</b>
	Etibank	Oct 27, 2000	0.36	—	—	—	<b>0.12</b>	—	<b>0.28</b>	—	<b>0.20</b>	<b>0.17</b>
	Demirbank	Dec 6, 2000	<b>0.24</b>	0.27	<b>0.34</b>	<b>0.44</b>	0.81	0.46	0.42	<b>0.26</b>	<b>0.23</b>	<b>0.24</b>
Banks taken over in 2001	Ulusal Bank	Feb 27, 2001	0.31	0.28	<b>0.27</b>	<b>0.31</b>	<b>0.35</b>	<b>0.33</b>	<b>0.18</b>	0.55	0.66	0.48
	Ikisat Bank	Mar 15, 2001	<b>0.24</b>	0.26	<b>0.33</b>	<b>0.38</b>	0.45	<b>0.33</b>	<b>0.31</b>	<b>0.28</b>	<b>0.21</b>	<b>0.18</b>
	Sitebank	Jul 9, 2001	—	—	0.40	0.47	0.98	1.00	0.54	0.40	<b>0.17</b>	<b>0.17</b>
	Tarisbank	Jul 9, 2001	<b>0.22</b>	<b>0.21</b>	<b>0.19</b>	—	<b>0.18</b>	—	<b>0.22</b>	<b>0.21</b>	—	—
	Bayindirbank	Jul 9, 2001	—	—	0.95	<b>0.28</b>	<b>0.20</b>	<b>0.25</b>	<b>0.18</b>	<b>0.27</b>	<b>0.21</b>	<b>0.20</b>
	Kentbank	Jul 9, 2001	—	—	—	0.50	0.46	<b>0.32</b>	<b>0.24</b>	<b>0.25</b>	<b>0.21</b>	<b>0.21</b>
	EGS Bank	Jul 9, 2001	—	—	—	—	—	—	<b>0.27</b>	<b>0.21</b>	<b>0.18</b>	<b>0.16</b>

<sup>a</sup> Bold numbers in the table indicate performance index values of the Banks Under the Savings Deposits Insurance Fund Administration lower than the average performance index values of private commercial banks.

\*Following the confiscation of five banks at end-1999, SDIF banks emerged as a serious problem to be dealt within the country's banking system. Therefore, Interbank, which was also taken over in 1999, was treated differently and put into the first group.

between sub-groups (by size) of private banks could be attributed to the dissimilarity of their funding decisions especially after 1994.

After the liberalization of capital movements, small- and medium-size banks with fewer branches than large-scale banks, gained access to foreign funds between 1989 and 1994. This development clearly had a positive affect on performance. However, following the 1994 crisis foreign investors showed a reluctance to extend credit to Turkish banks. They were concerned with Turkey's country risk and the movements of households' deposits to large banks perceived to be safer. These were the main reasons for small-scale banks' funding problems which deepened the effect of the crisis on this bank group. Performance deterioration of these banks continued until 1998.

At first, the foreign funding increases in both large- and medium-scale banks after 1995 might seem contradictory to the decline in average performances for this period as observed in Table 2. However, the standard deviation of the DEA performance-index values decreases with asset size. From the spread in their performance values it can be inferred that medium- and small-scale bank groups consist of institutions having performance values at both extremes. This indicates that the success of small and medium scale banks depends on their ability to manage funding problems.

#### 4.4.4. Remark 4

The quality of the variables selected and the DEA performance-index values obtained was tested with findings for the banks taken over by the SDIF<sup>5</sup> following 1994. Three banks (Turkbank, Bank Eksam, and Interbank) taken over in 1999 had negative ROE ratios as a result of extremely deteriorating financial variables. Because of the exclusion of these banks from the observation set as previously indicated, the DEA performance index of Bank Eksam and Interbank for 1998–99 and of Turkbank for 1997–1998–1999 could not be calculated. However, Table 4 clearly shows their financial performance well below that of competitors for the years in which these banks were included and had their DEA index values calculated. This validates the inputs and the model used as well as the results obtained.

Significantly, the DEA performance index results also show that the other five banks taken over by the SDIF at the end of 1999 gave prior signals of deterioration in their financial structure. The DEA scores of these five banks' (Egebank, Esbank, Sumerbank, Yasarbank, and Yurtbank) were less than 25% out of 100%. Moreover except for Yasarbank all these banks appear at the bottom of all DEA scores.

Lastly, the DEA performance index values of banks<sup>6</sup> taken over by the SDIF in 2000 and 2001, despite the fact that their data are not continuous, exhibit a declining trend after 1996.

<sup>5</sup>Three banks (Marmara Bank, TYT Bank, Impex Bank) closed down after the 1994 crisis. They could not be analyzed due to lack of available data.

<sup>6</sup>In Table 4, Ulusalbank's and Demirbank's performance-index values are well above or close to that of commercial banks' averages between 1997 and 1999. Owned by the same shareholder before the takeover, these banks were exposed to a high interest rate risk due to their large government securities portfolio funded by short-term resources. Therefore skyrocketing interest rates in November 2000, which paved the way to erosion of their equity as the result of huge market-to-market losses on their securities portfolio and large funding losses, forced the authorities to takeover these banks.

## 5. Conclusion

The impact of ownership and size differences on behavior and performance of Turkish banks has not received much attention if any. Applications of DEA to the Turkish banking sector are also very limited. The objectives of this paper were to fill the above gaps by examining the financial performance of the Turkish banking sector during 1989–99 taking into consideration modes of ownership and asset size, and to assess the sector's sensitivity to substantial changes in its operating environment. It should be noted that this period included at least two major macroeconomic dislocations.

The results validate intuition. Namely, the 1989 Turkish government's liberalization of capital movements and the 1994 financial crisis greatly influenced the performance of Turkish banks. The average financial performance index for all commercial banks kept increasing until 1993 at which time it started to decrease. Detailed examination shows that foreign and privately owned Turkish commercial banks outperformed their state-owned competitors. The financial structure deterioration of state-owned banks in 1997, 1998 and 1999 was confirmed by the study. Moreover, while the performance of small- and medium-scale banks deteriorated considerably after 1994, the relative performance of large banks was better.

## Appendix A. Data Envelopment Analysis

Data Envelopment Analysis (DEA) is a non-parametric approach for evaluating the relative efficiency of decision-making units (DMUs) using multiple inputs to produce multiple outputs. It was first introduced in the seminal paper by Charnes et al. in 1978 [37], and has created a literature of over 1800 papers published in 490 refereed journals worldwide as of August 2001 [38,39]. The model is

The objective function:

$$(1) S_F = \text{Max} \left( \sum_{r=1}^p u_r Y_{rF} \right) / \left( \sum_{i=1}^m v_i X_{iF} \right) \quad (1)$$

subject to:

$$(2) \left( \sum_{r=1}^p u_r Y_{rj} \right) / \left( \sum_{i=1}^m v_i X_{ij} \right) \leq 1, \quad \text{for } j = 1, \dots, n \quad (2)$$

$$(3) u_r, v_i \geq \varepsilon > 0, \quad \forall r, i, \quad (\varepsilon \text{ is a sufficiently small positive number}) \quad (3)$$

In this model,  $S_F$  is the relative DEA performance index value of DMU  $F$  in the observation set,  $u_r$  the weight of  $r$ th output assigned by DMU  $F$ ,  $v_i$  the weight of input assigned by DMU  $F$ ,  $Y_{rj}$  the  $r$ th output produced by  $j$ th DMU,  $X_{ij}$  the  $i$ th input produced by  $j$ th DMU,  $Y_{rF}$  the  $r$ th output produced by DMU  $F$ ,  $X_{iF}$  the  $i$ th input produced by DMU  $F$ .

The linear fractional programming model above can be transformed into an ordinary linear programming model by letting  $\mu_r = tu_r$  and  $v_i = tv_i$  where  $t^{-1} = \sum v_i X_{iF}$ . Then the equivalent



DEA model can be stated as

$$S_F = \text{Max} \sum_{r=1}^p \mu_r Y_{rF} \quad (4)$$

subject to:

$$\sum_{i=1}^m V_i X_{iF} = 1, \quad (5)$$

$$\sum_{r=1}^p \mu_r Y_{rj} - \sum_{i=1}^m v_i X_{ij} \leq 0, \quad \text{for } j = 1, 2, \dots, n \quad (6)$$

$$\mu_r, v_i \geq \varepsilon > 0 \quad \forall r, i, \quad (\varepsilon \text{ is a sufficiently small positive number}) \quad (7)$$

In this context there are  $N$  banks in the observation set  $\zeta$ , each producing  $r$  different outputs using  $i$  different inputs, and the goal is to determine the relative productivity of bank  $F$ , to be called “Base Bank”  $F \in \zeta$  with respect to all other banks in the set  $\zeta$ . The relative productivity  $S_F$  is a ratio of the weighted outputs of Base Bank  $F$  to its weighted inputs. This definition of relative performance transforms the multidimensional nature of inputs and outputs to a single scalar ratio of a single virtual output to a single virtual input. The objective is to assign the highest possible value to  $S_F$  by comparing the observed outputs and inputs of all banks in the set  $\zeta$  such that none of the banks has a relative performance value greater than unity (1). This means that Base Bank  $F$  is allowed to determine the values of  $\mu_r$ 's and  $v_i$ 's which are most favorable compared to itself. They are most favorable in the sense that  $\mu_r$ 's and  $v_i$ 's are optimally determined from the viewpoint of Base Bank  $F$  and are used to calculate the relative performance of other banks in  $\zeta$ . Of course changing the Base Bank results in a different set of weights and productivity values. Although they are favorable to the bank being evaluated, the model still provides a means of consistently obtaining the values of  $\mu_r$ 's and  $v_i$ 's.

A complete DEA involves the solution of  $N$  programs as formulated in (4)–(7) yielding  $N$  different  $(\mu_r, v_i)$  weight sets. In each program, the constraints are held same while the ratio to be maximized is changed.

A detailed discussion of the method can be found in [37,35].

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