Evaluating the Technical Efficiency of Turkish Deposit Banks: An Application of DEA and Panel Data Regression

by

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ABSTRACT

This study aims to understand the impact of major macroeconomic and regulatory changes on technical efficiency measures of deposits banks operating in Turkey. In the first stage of the study, the technical efficiency scores are estimated by using Data Envelopment Analysis (DEA) over the period of 1990-2011. In the second stage, a fixed effect panel data model is conducted in order to investigate determinants of the technical efficiency measures. Empirical findings suggest that, the technical efficiency scores of Turkish deposits banks were improved significantly during the period under study. While the technical efficiency scores fluctuate substantially (in yearly basis) until 2001, they later become smoother, indicating a more stable phase of economic/financial environment. According to panel data regression results, the changes in the technical efficiency scores are not significantly explained by economic crises even if they play a premonitory role for the crises. Restructuring program introduced in 2001, on the other hand, has a significant, positive effect on the technical efficiency scores. Publicly traded banks outperform their non-publicly traded peers and being publicly traded has positive effect on the technical efficiency scores whereas capital adequacy ratio and number of branches have negative effects on the technical efficiency scores. Lastly, there is no robust relationship between the technical efficiency scores and non-performing loans (NPL), liquidity or profitability ratio.

Key words: Efficiency, Data Envelopment Analysis, Turkish banking sector, Panel data analysis

ÖZET

Bu çalışma, temel makroekonomik değişikliklerin ve yapısal düzenlemelerin Türkiye'de faaliyet gösteren mevduat bankalarının verimliliği üzerine etkilerini incelemeyi amaçlamaktadır. Çalışmanın ilk kısmında 1990-2011 yılları arasında Türk bankacılık sektöründe faaliyet gösteren bankaların verimliliği veri zarflama analizi (VZA) tekniği kullanılarak hesaplanmıştır. Çalışmanın ikinci kısmında, verimlilik skorlarını belirleyici değişkenleri analiz etmek amacı ile sabit etki panel veri tekniği kullanılmıştır. Araştırma sonucunda, 1990-2011 döneminde Türk mevduat bankalarının verimliliğinin arttığı gözlenmektedir. 2001 yılına kadar dalgalı seyir izleyen verimlilik skorları, 2001 yılı sonrasında yaşanan makroekonomik gelişmelere paralel istikrarlı bir seyir kazanmıştır. Sabit etki panel veri analizi bulgularına göre, ekonomik krizler bankaların verimlilik değerlerindeki farklılıkları açıklama konusunda istatistiksel olarak anlamlı bir etkiye sahip değildir. Ancak krizlerden önce azalan verimlilik değerleri, verimlilik skorlarının ekonomik krizlerin habercisi konumunda olduğunu göstermektedir. 2001 yılında uygulamaya konulan Bankacılık Sektörü Yeniden Yapılandırma Programı istatiksel olarak anlamlı olup, bankaların verimlilik değerlerine olumlu yönde katkı sağlamıştır. Araştırmada halka açık bankaların verimlilik skorlarının diğer bankalara oranla daha yüksek olduğu ve halka açıklığın verimlilik üzerinde istatistiksel olarak olumlu bir etkiye sahip olduğu görülmektedir. Diğer yandan, istatiksel olarak anlamlı sermaye yeterlilik oranının ve şube sayılarının bankaların verimliliği üzerinde negatif bir etkiye sahip olduğu, sorunlu kredi oranının (NPL), karlılık oranının ve likitide oranının ise istatistiksel olarak verimlilik skorları üzerinde anlamlı bir etkiye sahip olmadıkları görülmektedir.

Anahtar Kelimeler: Veri zarflama analizi, Sabit etki panel veri analizi, verimlilik, Türk Bankacılık sektörü

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ABBREVIATIONS

BAT: Bank Association of Turkey

BCC: Banker, Charnes, and Cooper

BRSA: Banking Regulation and Supervision Agency

CAGR: Compound Annual Growth Rate

CCR: Charnes, Cooper, and Rhodes

CPI: Consumer Price Index

CRS: Constant Returns to Scale

DEA: Data Envelopment Analysis

DFA: Distribution Free Approach

DMU: Decision-Making Units

FDH: Free Disposal Hull

FDI: Foreign Direct Investment

FGLS: Feasible Generalized Least Squares

FX: Foreign Exchange

GDP: Gross Domestic Product

GLS: Generalized Least Squares

GMM: Generalized Method of Moments

GNP: Gross National Product

IMF: International Monetary Fund

ISE: Istanbul Stock Exchange

LSDV: The Least Squares Dummy Variable Model

NPL: Non-Performing Loan

OLS: Ordinary Least Squares

ROE: Return on Equity

SDIF: Saving Deposit Insurance Fund

SFA: Stochastic Frontier Approach

TFA: Thick Frontier Approach

TFP: Total Factor Productivity

VRS: Variable Returns to Scale

1. INTRODUCTION

The Turkish economy has experienced substantial changes in the last three decades, starting with the implementation of liberalization policies on January 24th, 1980. Although positive measures were taken in the first years of the liberalization program, after 1987 the distortions in the Turkish economy started to emerge. Public sector borrowing requirements started to increase and the budget deficit was financed by using either Central Bank resources or domestic borrowing. The main role of the banks was the funding of the state through government debt instruments. Large current account deficit and fiscal deficit (twin deficits), foreign capital-dependent growth and a lax banking regulatory regime resulted in the currency crisis of 1994. As a result of this crisis, inflation reached 125.5% on average, the Turkish lira (TL) depreciated against the dollar by 165% on average, the interest rates of government securities rose to 190%, and the Turkish economy shrank by over 6%. The crisis also affected the banking sector in that total assets, shareholders' equity, and deposit items in banks' balance sheets decreased. The number of branches and the number of employees working in the banking sector also decreased. The stabilization program was conducted with the help of the IMF. Full state guarantees on all deposits were introduced in order to restore confidence.

The easy and politically-connected entry of banks, duty losses, open positions, low capital structure, maturity mismatches, high taxation, connected lending problems, and risky balance sheets were the main characteristics of the 1990s banking environment in Turkey. In addition to structural problems in the banking sector itself, the existence of macroeconomic instability, high volatility in growth, and real interest rates, chronic inflation, fiscal imbalances, and balance-of-payments problems also affected the banking sector.

In order to eliminate imbalances in the economy, the Turkish government launched a three-year disinflation program supported by the IMF. The program aimed to improve growth, decrease inflation, and reduce the interest rate by focusing on areas of fiscal, monetary and exchange rate policies, agricultural policies, the tax policy, transparency, the pension system, the privatization of state economic enterprises, as well as the banking system and regulation. However, stabilization attempts were not able to create the expected recovery and high interest rates along with foreign exchange (FX) market distortions, budget deficits, large capital inflows or outflows, and current account deficits led to the financial crisis of 2000.

The 2000 and 2001 crises had devastating effects on the Turkish economy and banking system. In 2001, the GDP fell by 5.7% in real terms, inflation increased to 54.9%, the Turkish lira lost 51% of its value, and the unemployment rate rise to 10%. Before the crisis, banks enjoyed high amounts of arbitrage income by borrowing from abroad and supplying money to the public sector. Government securities were an important part of banks' balance sheets. However, during the crisis, the situation reversed and the value of banks' portfolios decreased. Banks started to experience difficulties finding funds from abroad and tried to fund themselves by selling government securities in their portfolios. The asset size of the banking sector decreased by 27%, loans decreased by 48%, and deposits decreased by 21%. 20 banks were taken over by the Saving Deposit Insurance Fund (SDIF) during the period of 1999-2001.

Following the crisis, the Banking Sector Restructuring Program was launched. Restructuring state banks, resolution of banks under the SDIF, strengthening of private banks' capital structure, and strengthening the regulatory framework were the main pillars of the banking sector program. In line with the program, public banks' duty losses were liquidated, short-term liabilities were reduced, the capital structure was strengthened, and the number of branches and employees decreased. The capital structure of banks taken over by SDIF was strengthened by an injection of government bonds. Also, the number of branches and employees was reduced in order to achieve reductions in daily operational costs in fund banks. Private banks' FX and interest rate risks were reduced, and NPLs of the banking sector were resolved by restructuring credit debts. During this period, mergers and acquisitions were supported by granting some tax incentives. In addition to restructuring the state banks, resolution of banks under the SDIF, and strengthening the private banks' capital structure, necessary legislation and arrangements have been adopted in order to strengthen the regulatory and supervisory structure. Regulations on capital, risk management, lending, accounting standards, and independent audits along with regulations on mergers and acquisitions were the main pillars of the program.

During the period of 2002-2007, stable and high-rate economic growth was achieved, inflation dropped, public sector debt was decreased, financial discipline was ensured, and the resilience of the Turkish banking sector to external shocks was increased. Total assets, credits, deposits, capital, and profitability of banks all increased during this period. Another important aspect of this period is the acquisition activities performed by foreign banks. Foreign banks' share increased from 7.3% in 2001 to 22% in 2007.

Finally, the effects of the global financial crisis have been seen on the Turkish economy. The banking sector also was affected from these adverse developments in the country. However, the effects of the global financial crises were rather limited compared to other countries and other crises experienced before due to the restructuring process started in 2001.

It is reasonable to assume that all changes posed great challenges to Turkish banks as the environment in which they operated changed rapidly, which consequently affected them. These developments and their wide-ranging effects on the efficiency of banks are the driving force for this study. The main purpose of this study is to evaluate the efficiency of commercial banks and investigate the determinants of efficiency in Turkey during the period of 1990–2011. This study consists of two main stages.

In the first stage, we estimate the technical efficiency scores of Turkish deposit banks over the period of 1990-2011 by using Data Envelopment Analysis (DEA). The first research question addressed in this section is whether the overall efficiency score of the Turkish banking sector has increased over time. The long data set allows us to analyze the long-term trend of efficiency scores of Turkish deposit banks during a 21-year period. Our study focuses on the effects of specific cases such as the 1994 crisis, the twin crises of 2000 and 2001, the restructuring program, and the global financial crisis as well as a 21-year evaluation. Therefore, the second research question addressed is how the 1994 currency crisis, the 2000 and 2001 twin crises, and the global financial crises affected the efficiency of the Turkish banking sector. The study also addresses the question of how efficiency scores were affected as a result of the implementation of the restructuring program after 2001.

In the second stage, we investigate determinants of bank efficiency by conducting two-way fixed effect panel data regression. The research question addressed in this stage is the factors that explain efficiency differences across banks. Efficiency scores estimated in the first step were regressed on banks' specific variables such as capital adequacy ratio, NPL ratio, liquidity, profitability, income-cost ratio, asset shares, and the number of branches. The capital adequacy ratio is used as a proxy to capital risk, the NPL ratio is used as a proxy to management quality of credit risk, the liquidity ratio is used to as proxy to measure the performance of banks and the number of branches is used as a proxy to branch network and service quality across banks. Dummy variables were included for banks whose shares were publicly traded in the Istanbul Stock Exchange (ISE) in order to question whether there exists

any relationship between being publicly traded and efficiency. Also, crises dummies and the reform dummy are included in the model.

Our study differs from the other studies in three main respects. First, the study covers a long time period which includes three domestic crises originating in Turkey as well as one global crisis. Studies in Turkish literature mainly focus on a certain period of time rather than long time periods, such as the 10-year period following the liberalization polices, the periods before and after the crisis, or the period after 2002. To the best of our knowledge, there is a limited number of studies[1] that cover the entire period after the 1990s. Second, there is gap in the Turkish literature on efficiency studies examining the effects of global financial crises on Turkish banking efficiency scores. Finally, our study differs from other studies in terms of the second step econometric model. We used a fixed effect panel data model to investigate sources of inefficiency as opposed to other studies that focus mainly on Tobit regressions and Ordinary Least Squares (OLS).

The rest of paper is structured as follows: Section 2 reviews economic developments and their effects on the Turkish banking sector. Section 3 provides a brief review of DEA studies in both Turkish and international literature. Section 4 describes the data and methodology used in this study. Section 5 presents empirical results and Section 6 concludes the thesis.

2. ECONOMIC DEVELOPMENTS AND THEIR EFFECTS ON THE BANKING SECTOR

In this section we review the critical events and their effects on the banking sector from 1990 to 2011 under seven subsections.

2.1 *The Financial Liberalization Program and Economic Developments in the 1980s*

Until 1980, Turkey had applied a planned economy based on import substitution policies. The financial sector was widely under the control and influence of the government during the planned economy period. The main function of banks was defined as financing the investments which were planned in the development strategies. In accordance with import substitution policies, interest rates, exchange rates, bank commission rates, and credit limits applied to deposits and loans were regulated by the government. In the period between 1960

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[1] Fukuyama and Matousek (2011) and Aysan and Ceyhan (2008)

and 1980, an industrialization policy was pursued. Budget transfers, government borrowing, and resources from private savings and Central Bank loans were used in order to meet the financing needs of investments. Central bank loans generally were created by using an emission mechanism, which caused high inflation. Furthermore, domestic consumption in a high-inflationist environment without consideration to exports led to a significant FX shortage in the 1970s.

In 1980, an industrialization strategy based on import substitution was abandoned and financial reforms were launched. The program initiated in 1980 was devoted to both short-term stabilization and long-term structural adjustment. The main points of the reforms denoted the decrease of the state's role in the economy, abolishing subsidies in most sectors, import liberalization, contracting domestic demand and, accordingly, generous export subsidies, foreign capital investment support, as well as implementing a flexible exchange rate regime with a focus on devaluation. In terms of the financial sector, the program aimed to develop a competitive and efficient financial system that would support a more liberal economy. Therefore, restrictions on deposit and loan interest rates were eliminated and entry conditions eased in the market.

At first, the program provided strong macroeconomic adjustments; for instance, the current account deficit dropped from 5% to 2.5% of GDP and public sector borrowing requirements fell from 10% to 4% of GNP between the years of 1981 and 1982[2]. Moreover, inflation was reduced from its then- current three digit levels to a level of 30% in the first two years of the program. Despite these positive measures, the interest rate competition between small banks and bankers resulted in the Bankers' Crisis of 1982, which then led to the bankruptcy of all the bankers and some of the small banks. As a result, the Central Bank began to reregulate interest rates on deposits. This crisis also demonstrated the necessity for a new regulatory framework in Turkey. A new banking law (Banks Act No. 3182) was enacted. In accordance with Banks Act No. 3182, international supervision and international banking standards were introduced into the banking system; uniform accounting principles were put into practice; banks started to be subjected to external audit, the deposit insurance fund was founded, and a more realistic practice was accepted regarding provisions to be applied to nonperforming loans.[3]

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[2] Akyüz and Boratav (2003)
[3] BAT, (2009). 50th Anniversary of the Banks Association of Turkey and Banking System "1958-2007".

Following the new regulatory framework, the reform process gradually continued. In 1986, the interbank money market started its operations. Moreover, in 1987, the Central Bank launched open market operations. In 1988, the Foreign Exchange and Banknotes Market was established. In 1989, with new legislation in place providing the transition to fully liberalized capital accounts and full convertibility of the Turkish lira, the developments resulted in the removal of restrictions on financial transactions made both by residents and non-residents. In 1990, the Central Bank presented its monetary program and started the implementation of this program in 1990 in order to increase predictability and reduce uncertainties in financial markets. Electronic fund transfers became functional in 1992.

Reforms applied in this period had crucial effects on the banking system. Interest rate reforms and easing entry conditions increased competition in the banking sector. As a result of easing entry restrictions, the number of banks increased from 43 to 66 between 1980 and 1990. In particular, the number of privately owned banks and foreign banks increased in considerable amounts following the liberalization program.[4] In order to survive in such a competitive environment, banks gave up the traditional deposit bank system and started to serve new products and services such as consumer loans, credit cards, FX deposit accounts, leasing, factoring, forfeiting, swaps, forwards, futures, options, automatic teller machines, and point-of-sale terminals. As a result, productivity in the industry rose due to the use of computer systems and other technological novelties as well as the significance placed on staff training. Most banks also began turning their attention to capital market operations, the purchase of government debt securities and Treasury bonds, and FX transactions.

2.2 *The 1994 Currency Crisis and Economic Developments in 1990s*

After 1987, distortions in the Turkish economy started to emerge. Public sector borrowing requirements started to increase and the budget deficit was financed by using either Central Bank resources or domestic borrowing. In 1994, the currency crisis erupted unexpectedly, which proved to be very costly for Turkey. Alper and Öniş (2003) state that the 1994 crisis resulted from a combination of structural weaknesses and economic mismanagement. Large current account deficit and fiscal deficit (twin deficits), foreign capital-dependent growth, and a lax banking regulatory system were the structural weaknesses that the Turkish economy faced. Large current account deficit and fiscal deficit were being financed by foreign capital

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[4] BAT, (2011). 54th Anniversary of the Banks Association of Turkey and Banking System Statistics.

inflow channeled through domestic banks. Although there were increases in the number of banks, regulation was not sufficient. Banks increased their profitability by financing fiscal debt via government securities. The commercial banks' main role was the funding of the state by holding large amounts of government securities in their asset portfolios rather than following their financial intermediation role. Alper and Öniş (2003) state that in this way, the Treasury and the domestic banking system had grown mutually dependent in a symbiotic relationship. The other triggering factor of the crises was economic mismanagement. The state tried to finance public debt by using low interest rate cash advances through the Central Bank. Therefore, announced Treasury auctions were cancelled. In the first quarter of 1994, excess liquidity in the system, lowered international credit ratings, and an accelerated foreign currency demand led to a severe crisis in the financial sector. As a result, capital outflows were observed, the Turkish lira depreciated, average inflation jumped, interest rates soared and domestic demand contracted. Following the crisis, inflation reached 125.5% percent on average, the lira depreciated against the dollar by 165% on average, interest rates of government securities rose to 190%, and the Turkish economy shrank by over 6%.[5]

The banking system was also affected by the 1994 crisis due to a shortage of foreign currency and portfolios mainly composed of government securities. Total assets of the banking system fell to 52.6 billion dollars from 72.4 billion, and its shareholders' equity fell to 3.3 billion dollars from 4.8 billion in 1994. During the crisis, there was a substantial withdrawal of deposits from banks due to the panic created by a sharp depreciation of the lira and a spike in interest rates. Total deposits fell by 12%. The development of assets, loans, and deposits during the crisis can be seen in Figure 2.3. Banks were taken over by the SDIF and the number of banks fell from 70 to 67. The number of branches and employees working in the banking sector also decreased. Detailed numbers can be seen in Table 8: Number of Banks, Branches and Employees From 1990 to 2011 (see Appendix). The program was conducted with the help of the IMF. Full state guarantees on all deposits were introduced in order to restore confidence. According to Alper and Öniş (2003), this improvement would create a major moral hazard problem for the rest of decade.

Following the crisis of 1994, the economy experienced a period of recovery between the years of 1995 and 1997 and capital inflows accelerated. In addition to this, the economy enjoyed growth in excess of 7%. However, the presence of a large budget deficit, a steady increase in

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[5] BAT, (2011). 54th Anniversary of The Banks Association of Turkey and Banking System Statistics

domestic debt, and an increase short term domestic borrowing requirements continued in the post-1994 period. Öniş and Alper (2004) summarize key characteristics of the Turkish banking sector after 1994.

The first problem affecting the Turkish banking sector is the dominance of public banks in the sector and duty loss practices conducted by state-owned banks. Öniş and Alper (2004) argue that public banks have emerged as major instruments of rent distribution in the political process. Therefore, their borrowing and lending operations generally reflect political decisions. The government employed public banks to extend subsidized credits. Ziraat Bank helped to channel funds towards agricultural producers, whereas Halk Bank targeted small and medium-sized businesses, both on a heavily-subsidized basis. Covering duty loss sums financed by state-owned banks was the responsibility of the Treasury Undersecretariat. However, the Treasury could not support these duty losses and the delays by the Treasury in meeting these obligations resulted in heavy and costly borrowing on the part of the public banks. State-owned banks collected deposits and also borrowed from the interbank market with high interest rates. If we analyze the balance sheet of state-owned banks, we observe that the amount of other assets items in which duty losses were written in total assets shows a dramatic increase in the 1990s.While the amount of other earning assets was 14% in 1990, this number reached 48% in 2000. Figure 1 shows the evaluation of the other assets balance sheet items for state-owned banks during the period of 1990 and 2011.

Figure 1: Amount of Other Assets in Total Assets
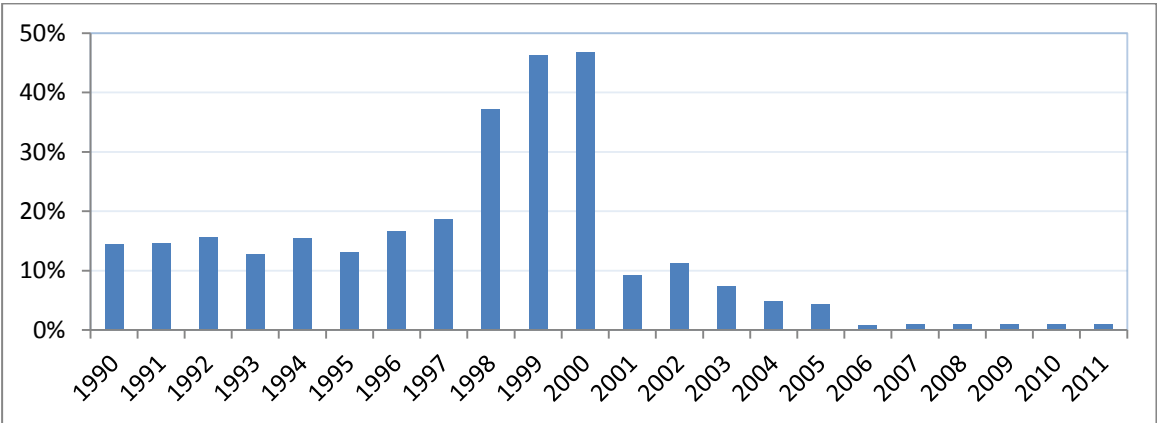
Source: BAT

Öniş and Alper (2004) state that the term "open positions" became as fashionable as the term "duty losses" during 1990s. Privately-owned banks make most of their profit by lending to the government. In order to supply resources to the government, they borrowed from abroad at a very high interest rate. Especially after 1997, a considerable increase in the open position of banks was observed. The open position of the banking system was recorded at 13.2 billion dollars at the end of 1999, which indicates the importance of the arbitrage income in the Turkish banking system.

Another characteristic of the 1990s banking sector is the entry of politically-linked banks into the sector. Governments gave away a lot of licenses to politically linked groups in order to lower borrowing costs. Granting banking licenses with political considerations generated perverse outcomes not only n the banking sector but also on the economy. The last point that needs attention in the 1990s is the entry of foreign banks. Normally, it is expected that the entry of foreign banks improves the quality and availability of financial services in the domestic market and increases the efficiency and productivity of markets.[6] However, in the absence of supervision and regulation, foreign banks, who were only interested in capitalizing on profits originating from market imperfections, entered the market[7]. Therefore, the presence of foreign banks did not create the expected improvements.

In summary, the easy and politically-connected entry of banks, duty losses, open positions, low capital structure, maturity mismatches, high taxation, connected lending problems, and risky balance sheets were the main characteristics of the 1990s banking environment in Turkey. In addition to structural problems in the banking sector itself, the existence of macroeconomic instability, characterized by high volatility in growth and real interest rates, chronic inflation, persistent fiscal imbalances and balance-of-payments problems also affected the banking sector.

2.3 *Turkey Letter of Intent, December 9th, 1999*

In order to eliminate imbalances in the economy, the Turkish government started disinflation attempts in early 1998. The IMF Staff Monitored Program was implemented and some improvements concerning the inflation rate and fiscal imbalances were observed. However, the Russian crisis in August 1998, the general elections in April 1999, and earthquakes in

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[6] Levine (1996), Levine and Min (1998), Berger (2007)
[7] Ersel (2000)

August and October 1999 led to a deteriorating fiscal balance of the public sector[8]. In 1999, fiscal debt and interest rates increased and the economy shrunk by 6%.

As a result of these negative measures, the government launched another three-year disinflation program supported by the IMF. In fact, before the announcement of the program, some regulatory improvements took place. In June 1999, a new banking law (Banking Law 4389) was enacted. The new law aimed to strengthen the banking sector and improve regulation. Following the new banking law, an independent Banking Regulation and Supervision Agency (BRSA) was established. Before the establishment of the BRSA, the Treasury was responsible for the regulation and supervision of banks.

With the new banking law, the minimum amount of capital was defined. All banks had to arrange their capital status according to a capital adequacy ratio. Credit classification and provisioning, indirect lending, and measures on open positions of banks were regulated. Finally, five privately owned banks (Egebank, Esbank, Sumerbank, Yasarbank, and Yurtbank) were taken under the control of the SDIF.

After these measures were taken, The Letter of Intent was rendered on December 9, 1999 and the stabilization program was launched. The program aimed to use exchange rate as a nominal anchor and implement a semicurrency board regime by restricting monetary expansion. In order to reduce the interest rate, a policy of no sterilization was adopted[9]. Fiscal adjustments, stabilization, privatization, reforms regarding the fiscal sector, agricultural policies, tax policy, administration and a pension scheme were on the program's agenda. The structural reforms also included strengthening the banking system and banking regulation. The main points of reforms regarding banking sector are listed below:

- The BRSA will start its operations. Although BRSA was founded in 1999, it did not become operational right away.
- Lending limits to owners and to single or connected parties will be reduced.
- In order to be in line with international standards, some requirements will be put in accounting standards implemented by banks for accurate reporting and financial transparency, a capital adequacy ratio which includes market risks, and internal risk management procedures.

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[8] Kibritçioğlu et al. (2002)

[9] Under the policy of no sterilization, the Central Bank does not conduct contractionary open market operations in order to sterilize the inflow of foreign capital. Thus, the rate of growth of the domestic money supply was determined by foreign capital inflows (Yeldan, 2006).

- Actions will be taken to begin the commercialization of Ziraat Bank, Halk Bank and Emlak Bank and privatization of these banks will be in agenda.

2.4 *The Crises of November 2000 and February 2001*

After deteriorations created by the 2000 and 2001 crises, a lot of studies were conducted to examine causes and consequences of crises. In fact, lots of emerging markets are faced with financial crises in the era of financial globalization. The Asian crisis of 1997 and the Russian crisis of 1998 serve as evidence of the crises in emerging markets. According to Öniş (2003), the problems faced by Turkey were not unique. Many emerging markets faced the same problems and experienced crises. Argentina is the most typical example. At this point, the IMF's liberalization policies were criticized due to these crises. The IMF targeted growth and stability in emerging markets by using financial deregulation, privatizations, a flexible exchange rate regime, a flexible labor market etc. However, high interest rates and FX market distortions in developing markets lead to budget deficits, large capital inflows or outflows, current account deficits, and finally, crisis (Yeldan, 2006).

In fact, the Turkish crisis has common features with the other crises in emerging markets. Yeldan (2006) states that although the cause of crises was touted as the failure of the Turkish bureaucracy to implement the necessary structural adjustment reforms in the global arena on time, the main causes of the crisis stem from problems regarding integration with the global environment. In fact, the Turkish government succeeded in reaching the fiscal targets that were announced in program. Akyüz and Boratav (2003) point out that there were serious shortcomings in the stabilization program launched with IMF support and they claim the methods of the stabilization program were partly responsible for the subsequent crisis. First of all, there was a mix of conditions and incentives. Although the program's agenda included a lot of reforms, financial assistance from the IMF was at a limited level. The IMF failed to provide adequate assistance. In addition, IMF borrowings were not allowed for financing Treasury needs. The other flaw of the program was that the priorities of the program were distorted. Fiscal policy adjustment was emphasized and restructuring of the banking system could not receive immediate attention. Akyüz and Boratav's (2003) final criticism is that the IMF tried to apply a standard model rather than one specific to a developing country. Öniş (2003) stresses the importance of domestic factors that trigger financial collapse in addition to IMF policies. After the first six months, the government's determination to implement

reforms decreased. During that period, a coalition government was in power and ideological distances between parties lead to problems associated with implementation of the program. The government's decreased commitment, along with delays in privatizations and banking regulations made it impossible to generate enough credibility with market participants. Rumors about amount of budget deficit, conflicts regarding budgetary deficit between political parties, and the collapse of Demirbank were the triggers of the crisis.

The paragraph below summarizes the developments of the crisis between 1999 and 2001.

Positive expectations regarding the IMF stabilization program and improvements regarding the relationship between Turkey and the European Union (Helsinki Summit) caused a feeling of optimism in terms of the Turkish economy and the financial system in international markets. Following this initial optimism, capital inflows started to increase. Capital inflows increased liquidity in the system. Normally, under a flexible interest regime the Central Bank would be able to decrease the liquidity of the system. However, under a stabilization program, the Central Bank works as a quasi-currency board and can not intervene in the system. Owing to the no-sterilization rule, market liquidity increased and interest rates decreased. Some banks purchased excessive amounts of government securities and caused the interest rate to go down even further. These banks financed themselves by using repo and interbank loans and used their resources either to purchase government securities or gave excessive amounts of consumer loan. As a result, interest rates were undershot and they decreased much more than expected. The reduction in interest rates increased consumption and investment. However, due to dependence on imports, an increase in consumption and investment led to a current account deficit. The current account deficit, which was 1.3 billion dollars in 1999, reached 9.8 billion dollars in 2000. As a result, Turkey started to experience capital outflows. The balance between the interest rate and capital inflows had broken in the last quarter of 2000. In November, a 5.3 billion dollar capital outflow was observed.

In addition, the banking sector did not adopt itself to the disinflation program. In 1999, the open position of banks was 13.2 billion dollars and it reached 22 billion dollars in 2000. Banks experienced difficulties in an environment that was surrounded by low inflation and a low interest rate because for the first time banks had to make traditional operations in order to gain profit (Alper, 2001). Since the banking sector was already suffering due to a maturity mismatch risk and the duty losses of the state banks along its path to the liquidity crisis, the two factors became instrumental: fleeing capital and bankruptcy rumors of aggressively

positioning banks. Due to the no sterilization rule of the stabilization program, capital outflow could not be sterilized with expansionary open market operations. This accordingly induced a rise in interest rates and reduced the value of government securities as well as causing an increase in Turkey's market risk. Also, Turkish banks started to experience problems regarding finding resources from abroad. Indeed, the Demirbank case is one of the most significant issues from the starting point of the crisis and it also illustrates very well the importance of well-functioning banks. Demirbank was unable to borrow on the overnight market on October 20th. Due to the criterion that prohibited exceeding the ceiling value on net domestic assets, the Central Bank did not lend to Demirbank. Thus, Demirbank was forced to sell some of its government securities, which resulted in an increase of the secondary market interest rates. In fact, this event proved to be the trigger for the initial phase of the crisis. After that, the direction in which the mechanism applied in the first months of 2000 was reversed. Banks started to sell government securities in order to finance themselves and interest rates started to increase. Finally, the Central Bank abandoned its exchange rate anchor and started to purchase government securities in order to help banks that needed funding. The total amount of the liquidity injection from November 17th – November 30th was approximately 4.3 billion dollars. As a result, the provision of the additional domestic credit helped to preclude interest rates accelerating at an increased level; however, in the meantime it contributed to the depletion of international reserves. Due to the fact that the amount of the drain in official reserves exceeded the amount of the increase in domestic credit creation, base money decreased resulting in an even further increase in interest rates. The ratio of current account deficit to reserves rose from 10% to 50%.[10] On November 30th, the Central Bank of Turkey announced that commercial banks would no longer be financed through the interbank market. As result of the announcement, overnight interest rates reached 1,700 levels. On December 4th, the Central Bank lent to Demirbank to prevent its default in spite of the prior announcement of refusing to do so. On December 6th, Demirbank was taken over. Additionally, the IMF announced that it would support the program by opening a new credit line; it introduced a Supplementary Reserve Facility (SRF) and supplied funds totaling 7.5 billion dollars for the duration of three years.

However, the intervention of the IMF was too late. The use of IMF funds was only made possible after a speculative attack on the currency had occurred without any success in solving the illiquidity problem. Additionally, the reduction of interest rates caused a melting

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[10] Akyüz and Boratav (2003)

of commercial banks' equity. On December 18th, the new Letter of Intent was released. On December 20th, the Central Bank of Turkey declared its new monetary program and official reserves increased from 18.3 billion dollars to 28.2 billion dollars with the IMF's support.

After the liquidity crisis in November, rising public debt, high inflation, and the continued currency appreciation increased concerns and the feeling of uncertainty. The conflict between the Prime Minister and the President in a National Security Council meeting on February 19th 2001 was the final trigger for collapse. After the conflict, the interest rate jumped overnight to 2,058% on February 20th and to 4,019% on February 21st and liquidity dried up. The banking sector's demand for foreign currency reached enormous levels. Loss of control over the monetary policy, a rapid drain on international reserves, and a high interest rate level forced the government to abandon its exchange rate regime. After the announcement of free floating the exchange rate, the dollar exchange rate soared from 685,000 to 958,000 liras. As a result, reserves fell dramatically due to a speedy release of capital of around 6 billion dollars from the date of the float until the end of September 2001. From the time of the eruption of the November crisis, a 17 billion dollar net capital outflow was seen during the crisis[11].

2.5 *The Banking Sector Restructuring Program, May 2001*

After all the problems regarding the Turkish economic and financial system, the need for an extensive restructuring problem in the banking sector was clear. Within this framework, a new IMF-supported stabilization program was announced in May 2001 in order to overcome these problems. Restructuring the state banks, resolution of banks under the SDIF, strengthening the private banks' capital structure, and strengthening the regulatory framework were the main pillars of program.

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[11] Özatay and Sak (2003) present a detailed table regarding the important measures of 11/2000-02/2001 crisis.

Details of the cost of the restructuring process are shown in Table 1, below.

Table 1: Total Cost of Re-Structuring in Banking Sector

	USD Billion	Ratio to GDP (%)
Operational Loss of Public Banks	19	12,8
Capital Support Made to Public Banks	2,9	2
Settlement Cost of SDIF Banks	22,5	15,2
Resources Provided by the Public Sector	17,3	11,7
Resources Provided by the Private Sector	5,2	3,5
1st SUBTOTAL	44,4	30
Public Capital Support Provided as Quasi-Capital Loan	0,1	0,1
Cost Faced Within the Aim of Strengthening the Dissolved Capital Base of Private Banks	2,7	1,8
2nd SUBTOTAL	47,2	31,9
Public Financing	39,3	26,6
Private Sector	7,9	5,3
İmar Bankası	6,4	2,3
TOTAL COST	**53,6**	**34,2**

Source: BRSA, Structural Developments in Banking, 2006.

2.5.1 Restructuring of the State Banks

Restructuring state banks was an important element of BSRS because state banks exposed a heavy burden on the banking sector in the form of duty losses, mismanagement of resources, and the state's involvement in management. Under the program, financial and operational restructuring of state banks were achieved.

First of all, duty losses of state banks that reached 17.5 billion dollars at the end of 2001 were liquidated. The Treasury issued special government bonds in the amount of 23 billion TL in order to securitize state banks' receivables from the government. Legislation abolishing regulations causing duty losses was put into force. In order to strengthen the capital structure of state banks, securities and cash were injected. The total paid up capital reached 3.4 billion TL in 2003. In total 28.7 billion TL was transferred to state banks to settle duty losses and strengthen the capital structure.

Within the scope of operational restructuring, Emlak Bankası A.Ş. transferred to and merged with T.C. Ziraat Bankası A.Ş. The number of branches and personnel were decreased. The achievements of operational restructuring culminated in reforming the banking system with regard to organization, human resources, technology, financial control, risk management,

planning, and service quality by making them capable of functioning according to international standards.

2.5.2 *Resolution of Saving Deposit Insurance Fund Banks*

A total 25 banks were taken over between the periods of 1994-2003.[12] According to the Progress Report of the BRSA, the total liabilities of SDIF banks amounted to 32 billion dollars in 2003 and 81% of it ($26 billion) was in deposit accounts. During the resolution processes, share sales, sales of insured deposit and loans (asset and liability transfer), and merger or transfer of other banks were the resolution instruments of SDIF[13]. Fund banks mainly experienced liquidity and capital inadequacy problems as well as majority shareholder exploitation. First of all, management and supervision boards were changed. The broken capital structure of fund banks was strengthened by an injection of government bonds. Within this framework, a 28.3 billion dollar fund was transferred to fund banks. The number of branches and employees was reduced in order to achieve reductions in daily operational costs. Receivables under follow-up, real estate, and subsidiaries-- in other words, the bad assets of fund banks-- were assigned to the Collection Department of the SDIF. Among the 25 banks that were transferred to SDIF, five banks merged with Sümerbank, two banks merged with Etibank, five banks merged with Bayıdırbank, one bank transferred to the public bank, five banks were sold, two banks were under a liquidation process, and five banks' operating permission was revoked. Detailed information regarding SDIF banks is presented in Table 9 in the Appendix.

2.5.3 *Building a Sound Private Banking System*

In addition to inherent structural problems, the effects of crisis deteriorated private banks deeply. In order to construct a healthy banking sector, some private banks were also included in the restructuring program.

First of all, programmed letters of commitment were taken from bank owners and shareholders in order to strengthen the capital structure of private banks. As a result, the total capital increase of banks amounted to 3,289 billion TL at the end of 2002. With the help of the Treasury's voluntary debt swap in June 2001, the FX open positions of private banks were

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[12] BRSA (2006). Structural Developments in Banking
[13] BRSA (2002). From Crisis to Financial Stability, Turkey Experience.

reduced significantly. Private banks' on-balance sheet FX open positions was reduced from 8.4 billion dollars at the end of 2000 to 1.5 billion dollars at the end of 2001.

Within the scope of the program, banks went through the triple audit process and cash capital, loan loss provisions, market risk changes, and securities' valuation were assessed. As a result Vakifbank, Pamukbank and Sekerbank were found to suffer lack of capital.

The private sector's debts to the financial sector were restructured. Debt owners signed letter of commitment. The number of firms included in this program was 318 and it resulted in the restructuring of 5,960 million dollars of credit. Also, asset management companies were established in order to support the resolution of problematic loans.

Finally, tax incentives and some legal incentives were introduced in order to support merger and acquisitions in the banking sector. As a result of these incentives, lots of mergers and acquisitions were observed during 2001 and 2003. Table 11 in the Appendix provides detailed information regarding merger activities in Turkey during 2001 and 2011.

2.5.4 *Strengthening of the Regulatory and Supervisory Structure*

In addition to the resolution of banks under the SDIF, restructuring the state banks, and strengthening the private banks' capital structure, necessary legislations and arrangements were adopted in order to strengthen the regulatory and supervisory structure. The Banking Sector Restructuring Program and Progress Report conducted by the BRSA summarizes regulations under five main headlines: regulations on capital, regulations on risk management, regulations on lending, regulations on accounting standards, independent audit, and regulations on merger and acquisitions.

Within this capital regulation framework, the concept of "consolidated own funds" was initiated. According to this concept, the calculation of standard ratios and lending limits on a consolidated basis was guaranteed. New calculation processes, including exchange rate, interest rate, and equity risks for capital adequacy ratio were set and minimum the capital adequacy ratio for each bank and bank group was determined.

Regarding risk management regulations, the "Regulation on Establishment and Operations of Banks" was implemented on June 27th 2001. Principles of an effective internal audit system

and risk management system were set by this regulation. According to the regulation, as of July 2001 banks stated their activities and organizational arrangements on a quarterly basis, which was evaluated regularly.

Risk group definitions and computation of credit limits for one group were established, taking into account both direct and connected lending. Regulation on Loan Loss Provisioning was enacted in order to clarify the classification of loans and other receivables, as well as principles of collateral and provisioning.

On June 21st, 2002, the "Regulation on Accounting Practices" was published in order to reach transparency and uniformity in bank's account and records. In January 2001, the Regulation on Internal Audit and Risk Management Systems was published. Within this supervision framework, external and internal audit requirements that had to be in line with internationally accepted accounting principles were placed on the banks.

2.6 *Period of Recovery and Growth*

During 2002 and 2007, stable and high rate economic growth was achieved, inflation dropped, public sector debt was decreased, financial discipline ensued and the resilience of the Turkish banking sector to external shocks was increased. During this period, the annual average growth rate of real GDP was 6.8%. Inflation reached single digit figures, down from 68.8% in 1999. Public debt decreased during this period, public debt to the GDP ratio decreased from 61% in 2002 to 30% in 2008. There is also a substantial increase in FDI. FDI increased from 1 billion dollars in 2002 to 22 billion dollars in 2007.

In terms of the banking sector, total assets of the banking sector rose from 130 billion dollars in 2002 to 465 billion dollars in 2007. The ratio of assets to GDP increased from 57% to 77%. Aysan et al. (2011) divide the 2002-2007 period into two sub-periods. According to them, the period between 2002 and 2005 may be referred to as a recovery and stabilization period and the period of 2005 to 2007 can be called a growth period. During 2002 and 2005, the total assets of the banking sector increased by 24% and total loans increased by 45% annually on average. Lots of merger activities were observed and the number of branches decreased from 54 in 2002 to 48 in 2004. In the growth period, acquisition activities performed by foreign banks were observed. Macroeconomic and political stability, EU negotiations and reforms conducted so far increased foreign attention to Turkish banking sector. BNP Paribas acquired a 42.1% share of TEB in 2004, Fortis Bank NV-SA acquired

89.3% of Dışbank's shares in 2005, 57.4% of Yapı ve Kredi Bankası A.Ş. shares were transferred to Koç-Unicredito in 2005, General Electric bought 25.5% of Garanti Bank's shares in 2005, 46% of Finans Bank A.Ş. shares were transferred to National in 2006, 75% of Denizbank's shares were acquired by Dexia Participation Belgique S.A. in 2006, and 20% of Akbank T.A.Ş. was acquired by Citibank Overseas Investment Corporation in 2006. Table 10 and Table 11 in the Appendix show details of merger and acquisitions. Foreign attention continued until 2007 when the global financial crises emerged. Foreign banks' share increased from 7.3% in 2001 to 22% in 2007. The effects of increasing foreign bank shares will be discussed in the later parts of the study.

2.7 *Global Financial Crises*

The global financial crisis that caused a decline in world output by 1.95% affected the Turkish economy as well. Turkey experienced a 14% decline in GDP in the first quarter of 2009, and a 4.7% decline in GDP in 2009. The unemployment rate reached 14% in 2009.

The banking sector was also affected by these adverse developments in the country. However, the effects of the global financial crises were rather limited compared to other countries and other crises experienced before, thanks to the restructuring process started in 2001. Following the global financial crises, liquidity conditions in global markets emerged and Turkish banks' difficulties in terms of borrowing abroad were increased. The cost of external borrowing also increased. Demand for banking services and products decreased. The asset size of the banking sector in 2008 contracted by 4.18% compared to 2007. Deposits decreased by 3.23% and total loans of the sector remained constant. The ratio NPL ratio of the sector increased from 3.6% in 2008 to 5.4% in 2009 and the capital adequacy ratio reached 18.1% in 2008 by decreasing one point compared to 2007.

As of 2011, there are 48 banks operating in Turkey. Four of them are participation banks, thirteen are development and investment banks, and 31 are deposit banks. The number of deposit banks decreased by 1 compared to 2010 due to the merger of Fortis Bank and TEB. One bank is under the SDIF. The total number of branches and employees has continued to increase and reached 9,834 and 181,418, respectively. The Turkish banking sector asset size reached 615 million dollars by decreasing 2% compared to the previous year and the ratio of assets to total GDP was 94%. The total was realized at 315 million dollars by decreasing 7%

and total loans realized 351 million by increasing 6% compared to the previous year. As of 2011, the capital adequacy ratio of the sector was 16.7%, the NPL ratio is 2.7% and return on equity (ROE) is 13.8%. Developments of important balance sheet items are presented in Figure 2.

Figure 2: Development of Selected Banking Sector Indicators from 1990-2001

Figure 2.1: Asset Size and Ratio of Assets to GDP
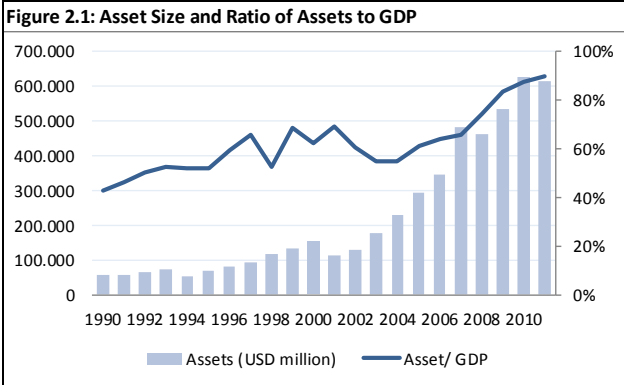
Substantial expansion observed in asset size of banking sector during 1990-2011 periods. Asset size shrank in 2002-2003 due banks closed, transferred to SDIF. After 2003 outcomes of restructuring program started to seen and asset size and ratio of asset to GDP started to increase. As of 2011, ratio of asset to GDP is %89,6.

Figure 2.2: Number of Branches and Employees
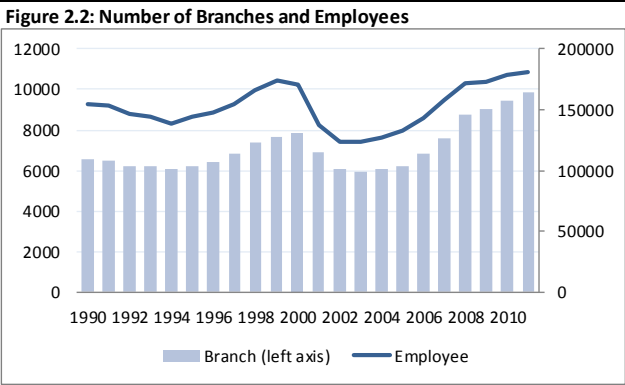
Number of banks, branches and employees increased rapidly between 1990-1999 and reached highest level in 1999. There were 81 banks, 7.691 branches and 173.988 employees in banking sector in 1999. These measures decreased sharply following crisis and continue to decrease until 2003 due to mergers. Although number of banks stays constant numbers, number of branches and number of employees increases after 2004.

Figure 2.3: Loans and Share of Loans in Total Assets
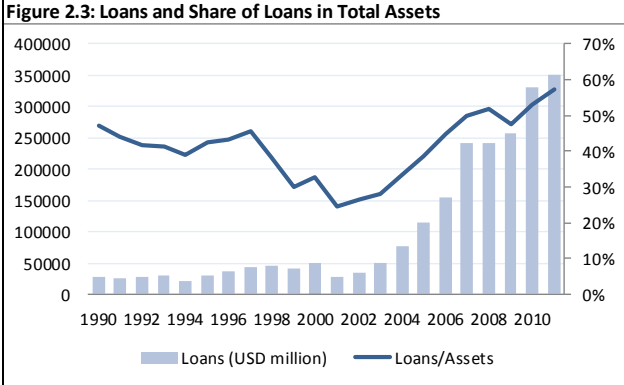
During 1990s increase in loans remained limited due to share of government debt securities.During twin crises %44 decrase observed in loans.After 2002, volume of loans started to increase.Share of loans in total assets decreased especially in late 1990s due to increase in goverment securities in balance sheets of banks. The highest loan to asset ratio of 1990s was %47. Share of loans within total assets started to rise after 2002 thanks to re-establishment of economic stability. As of 2011 share of loans within assets is %57.

Figure 2.4: Deposits and Share of Loans in Total Liabilities
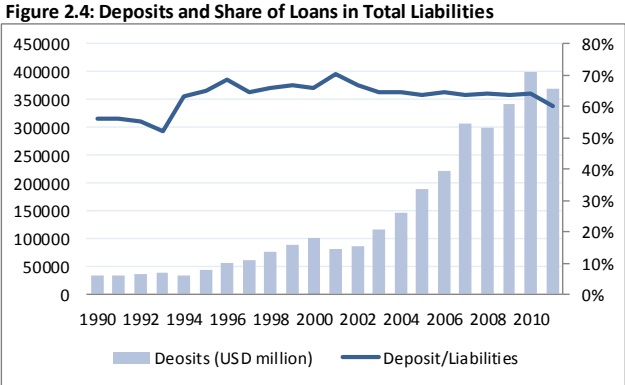
Deposits are most important source in Turkish banking sector. However, due to decline in interest years in last few years, share of deposits within total liablities follows a declining trend. As of 2011, share of deposits within total liabilities is %60. %66 of total deposits is TL deposits and %34 of foreign exchange deposits.

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3. LITERATURE REVIEW

In this section, we reviewed empirical applications of DEA efficiency measurements in the banking sector. In recent years, a growing body of literature has analyzed the efficiency of banks and financial institutions, mostly focused around costs and technical efficiency. The studies differ from each other in terms of the methodologies, assumptions of the estimated models, and the selection of inputs and outputs. There is a vast amount of literature on bank efficiency discussing different aspects of study, such as the role of ownership, bank size and differences in the regulatory framework, stock returns, mergers and acquisitions, and deregulation as well as their impacts on banking efficiency. While some studies focus mainly on one specific country, some prefer to conduct cross-country studies in order to analyze the effects of country-specific environmental variables on efficiency. Cross-country studies' geographical coverage is mainly based on specific groups such as Eurozone countries, Nordic countries, and Middle Eastern North African countries.

Berger and Humphrey (1997) present a comprehensive review of 130 studies which employ frontier efficiency analysis on financial institutions in 21 countries. Their sample comprises 69 studies which employ non-parametric techniques and 60 studies which employ parametric approaches. Of the 69 non-parametric applications, 62 were DEA (Data Envelopment Analyzes), five were FDH (Free Disposal Hull), and two used other approaches. Of the 60 parametric applications 24 were SFA (Stochastic Frontier Approach), twenty were DFA (Distribution-Free Approach) and sixteen were TFA (Thick Frontier Approach). Many of the studies in this review show that the banking sector suffers from a large amount of inefficiency problems. However, Berger and Humphrey (1997) claim that different methods used to calculate efficiency do not give consistent findings to conclude results in a consistent, accurate, and useful way.

A similar review study was conducted by Fethi and Pasiouras (2010). They review studies that examine bank performance by using operational research (OR) and artificial intelligence (AI) techniques over the period of 1998–2009. They find that DEA is by far the most commonly-used OR/AI technique in assessing bank performance. 151 studies out of 196 use DEA techniques to estimate various measures of bank efficiency and productivity growth.

Their result shows that most DEA studies examine banks from the large EU banking sectors.[14]

Miller and Noulas (1996) performed DEA to calculate technical efficiency of 201 large US banks from 1984 to 1990. They also investigated the effects of profitability, size, market power, and location on bank efficiency. Employing four inputs (total transactions deposits, total non-transactions deposits, total interest expense, and total non-interest expense) and six outputs (commercial and industrial loans, consumer loans, real estate loans, investments, total interest income, and total non-interest income), they find an average inefficiency decrease of 5% after the deregulation of the early 1980s. They also find that while size and profitability affects efficiency negatively, market power does not have a significant effect on efficiency. Berger and Mester (1997) analyzed US banks' efficiency scores for the period between 1990 and 1995 and they tried to explain the reason of efficiency differences in financial institutions. Barr et al. (2002) calculated efficiency scores of US commercial banks from 1984 to 1998 by using input-oriented DEA. He finds a strong and consistent correlation between efficiency and independent measures of performance.

Lazono-Vivas et al. (2002) used DEA to compare efficiency measures across 10 European countries and the results show that basic average efficiency scores of the banks of each European country are unusually low. Lazono-Vivas et al. (2002) also applied a complete DEA model to see the effect of environmental variables on efficiency. Complete DEA results show that including environmental variables changes efficiency levels in considerable amounts.

Another study regarding European bank efficiency was performed by Casu and Molyneux (2003). Casu and Molyneux (2003) measured efficiency levels of France, Germany, Italy, Spain and the United Kingdom during 1993 and 1994 by using DEA. The main motivation behind this was to investigate the effects of creation of the Single Internal Market on European bank efficiency. They find that there is a slight improvement in the average efficiency scores over the period of analysis for almost all banking systems in the sample (except Italy) following creation of the Single Internal Market on European banks. They also used the Tobit regression model approach to investigate the determinants of efficiency

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[14] Casu and Molyneux (2003) and Beccalli et al. (2006). Lozano-Vivas et al. (2002) examine 10 EU countries, Bergendahl (1998) focuses on Nordic countries, while Pasiouras (2008) and Tanna (2009) examine international datasets.

differences among countries. They concluded that country-specific aspects of banking technology such as the legal environment, information technology, financial innovation and competition could be the source of efficiency differences between countries.

Pasiouras (2008) estimates the efficiency of the Greek commercial banking industry over the period of 2000 to 2004 using DEA. He estimates five models to examine the effects of loan loss provisions and off-balance sheet items on efficiency scores. His results suggest that off-balance sheet items in outputs do not have an impact on efficiency scores, while the inclusion of loan loss provisions in the inputs contributes to higher efficiency scores. He also use Tobit analysis in the second part of study and finds that higher capitalization, loan activity, market power, and the number of branches positively related with efficiency .

In the Turkish literature, research on efficiency has increased especially after the 1980s. Most studies on the efficiency of Turkish banks focus on the effect of liberalization policies that were applied after 1980[15]. Studies on the efficiency of Turkish banks also investigated the effects of ownership status, size, crises, foreign bank entry and macroeconomic instability on the efficiency scores of banks. Turkish studies mainly focus on a certain period of time rather than long time periods; the ten-year period following liberalization polices, periods before and after a crisis, or the period after 2002 are the most preferred time periods to conduct studies about. To our knowledge, there are two recent studies that cover the period of 1990 to 2007, conducted by Fukuyama and Matousek (2011) and Aysan and Ceyhan (2007). Also, there is gap in the Turkish literature regarding efficiency studies which examine the effects of the global financial crises on Turkish banking efficiency scores.

Zaim (1995) calculated the efficiency score of 1981 and 1990 as representative years for the pre- and post- liberalization eras by using non-parametric frontier methodology. He employs four inputs, namely, the total number of employees, total interest expenditures, depreciation expenditures, and expenditures on materials as well as four outputs, namely, total balance of demand deposits, total balance of time deposits, total balance of short-term loans, and total balance of long-term loans. The main aim of that study is to investigate the effects of post-1980 liberalization policies on the efficiency of the Turkish banking sector. Zaim (1995) concludes that liberalization polices stimulated an efficiency increase in the Turkish banking system.

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[15] Ozkan and Gunay (1997), Yıldırım (2002), Mercan and Yolalan (2003), Kasman (2002), Zaim (1995) and Denizer (2007) examined the effects of liberalization policies in their studies.

Jackson and Fethi (2000) evaluated efficiency scores for 1998 by using DEA and then investigated the determinants of efficiency in the Turkish commercial banks by using the Tobit regression analysis. They found bank size and bank profitability affects efficiency positively and capital adequacy variable affects efficiency negatively. They could not justify any relation between ownership, the number of branches and efficiency.

Yıldırım (2002) analyzed both pure technical and scale efficiency scores of Turkish banks between the periods of 1988 and 1999 by using DEA. She used deposits and expenses as input and loans and incomes as output. The results of the study show that macroeconomic stability and efficiency are positively related with each other and macroeconomic instability in Turkey have a considerable effect on unstained efficiency scores over the period. The author claims that the Turkish banking sector suffers from scale inefficiency rather than pure technical inefficiency and sources of scale inefficiency is diseconomies of scale. She also found a positive relationship between efficiency and size and profitability in her study.

In the most comprehensive study of its kind, Işık and Hassan (2002) employ parametric and non-parametric approaches and estimate five different measures of non-stochastic efficiency scores such as allocative efficiency, technical efficiency, pure technical efficiency, scale efficiency, and overall cost efficiency for the period of 1988 and 1996. Isık and Hassan (2003) also investigated the impact of size, international presence, control and governance, and holding affiliation as well as ownership variables on the Turkish bank efficiency scores by using GLS and Tobit regression analyses. They find that the Turkish banking sector suffers from inefficiency problems and the main source of inefficiency in Turkish banking was due to technical inefficiency rather than allocative inefficiency caused by diseconomies of scale. Their correlation of efficiency analysis suggests that there exists a negative relationship between size and efficiency. They also concluded that foreign banks operating in Turkey are significantly more efficient than their domestic peers and publicly traded banks are significantly more efficient than non-traded banks.

Kasman (2002) examined cost efficiency, scale economies, and technological progress in the Turkish banking system between 1988 and 1998 by using three input–three output Fourier-flexible cost function specification. He excluded state-owned banks from his data set. As other studies analyzing the same period, he finds that although the efficiency of banks operating in the sector increased during the sample period, Turkish banks had a serious efficiency problem. In his study he finds that Turkish banks experience economies of scale

problems rather than diseconomies of scale problems, contrary to Işık and Hassan's (2002) study, which analyzed the same period.

Özkan-Günay and Tektaş (2006) measured efficiency of non-public commercial banks by utilizing DEA method. The main motivation of he was to investigate the relationship between efficiency and bank failures. They constructed two models to show how efficiency scores are sensitive to input and output variable selection. Their study reports that the number of efficient banks and the mean efficiency of banks declined between 1990 and 2001. Thus, they concluded that the crises in 1994 and the late 1990s had a negative impact of bank efficiency.

Denizer et al. (2007) examined the effects of liberalization programs on efficiency by conducting DEA model. Their sample covers pre- and post-liberalization periods, 1970 to 1994. Their study suggests that liberalization did not provide the anticipated efficiency gains and a decline in bank efficiency scores was observed. They found out that the Turkish banking system mainly suffered from a scale problem and they claim that if the Turkish banking system had operated at the optimum scale, the liberalization program would have had more successful results on efficiency.

Aysan and Ceyhan (2007) calculated efficiency and productivity measures of the Turkish banking sector by evaluating the Malmquist TFP Change Index using DEA. Their study points out that technological improvements rather than efficiency increase is the main driving force behind productivity growth in the Turkish banking sector. According to their study, foreign banks were the most efficient bank groups until 2001, after which state banks captured first place. Moreover, they found that in terms of bank size, medium scale banks, which were mainly purchased by foreign banks, are the most efficient bank group. Following this study Aysan and Ceyhan published another study in 2008. Aysan and Ceyhan (2008) tried to explain determinants of efficiency by using panel data fixed effects regression analysis between 1990 and 2006. Their results show that the number of branches correlated negatively with efficiency, while loan ratio and bank capitalization correlated positively. They could not find an explanatory relationship between efficiency and return on equity. Moreover, contrary to expectations, any explanatory relationship could not be found between foreign ownership and efficiency. In the end, the authors remarked that restructuring attempts in a post-crisis era robustly account for the improvement in efficiency scores in recent years.

Aysan et al. (2011) measured cost and profit efficiencies of Turkish banks between 2002 and 2007 by using the panel SFA. Their results show that the efficiency levels of Turkish banks

improve over the period under study. Foreign banks are found to be less efficient and state owned banks found to be more efficient in Aysan's study.

Most recently, Fukuyama and Matousek (2011) measured technical and allocative efficiency levels of Turkish banks over the 1991-2007 periods by using the two-stage network model introduced by Fukuyama and Weber (2010). Fukuyama and Matousek (2011) also calculated the efficiency score by using DEA so that they could compare results obtained from a two-stage network system with the traditional DEA approach. Their long dataset enables us to look at a detailed overview of changes in the Turkish banking sector and to analyze the effects of banking crises. They found that Turkish banks' efficiency was directly affected by changes in the Turkish economy. One year before the 1994 and 2001 crises, Turkish banks' efficiency levels dropped to low levels and after the consolidation and restructuring processes, Turkish banks' efficiency reacted positively and efficiency has gradually improved. The authors also claim that deterioration of efficiency levels from 2004 to 2007 could be explained by strict regulatory rules imposed by the BRSA. In the second part of their study, they investigate the determinants of bank efficiency by applying the bootstrap model. They found out that the NIM (Net Interest Margin) has statistically negatively significant variables, while the market share on loan market is positive, and branch number is negative.

In order to analyze the effect of global financial crises on efficiency scores of Turkish banks, Özkan-Günay (2012) calculated the efficiency scores of Turkish banks from 2002 to 2009. Efficiency scores were calculated by using a new DEA approach. The author incorporates NPLs into the model as an undesirable product. The findings of the author show that the number of efficient banks and overall efficiency follows an increasing trend in the post-crisis period, even in the global financial crisis. This increasing trend is explained by the success of the Banking Sector Restructuring Process and the existence of the BRSA.

4. METHODOLOGY and DATA

1.1 Measurement of Efficiency: *Data Envelopment Analysis*

In recent years, literature on the performance of financial institutions has increasingly focused on frontier efficiency, which measures how close financial institutions are to a best-practice frontier. In other words, the frontier efficiency of an institution measures how well it performs relative to the predicted performance of the best firms in the industry if these best firms were facing the same market conditions. Parametric and non-parametric frontier methods were commonly used to measure frontier efficiency. These approaches differ in the assumptions they make regarding the shape of the efficient frontier, the existence of random error, and if random error is allowed, the distributional assumptions imposed on the inefficiencies and random error in order to disentangle one from the other[16].

The SFA, DFA, and TFA are the main parametric frontier approaches that are used to calculate the efficiency scores of financial institutions. Parametric methods impose more structure on the shape of the frontier by specifying a functional form for the cost, profit, or production relationship among inputs, outputs, and environmental factors, and allows for random error [17]. Parametric approaches also require specific assumptions about the distribution of the error terms.

Nonparametric approaches put relatively little structure on the specification of the best-practice frontier and assume that there is no random error. DEA and FDH are non-parametric approaches are used in the literature. DEA in particular is widely used for measuring the efficiency scores of financial institutions in literature.

By following many studies in the literature, we employed DEA in our study. DEA is a mathematical programming approach to calculate relative efficiency measures of the decision making units (DMU) included in the sample, with multiple numbers of input and output.

Farrell (1957) developed a single input/output technical efficiency measure with the idea of linking the estimation of technical efficiency and production frontiers. Charnes, Cooper, and Rhodes (1978) extended Farrell's (1957) idea and proposed a multiple output/input technical efficiency measure under the assumption of constant returns to scale (CRS). This input-

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[16] Bauer et al. (1998)
[17] Berger and Humhfrey (1997)

oriented efficiency measure technique was named the CCR model, after the authors. After the foundation of the CCR model, studies continued in order to deal with the restrictions of the model. Banker, Charnes and Cooper (1984) came up with the eponymous BCC model that could work under variable returns to scale assumptions.

An algebraic model for the CCR ratio form may be defined as follows:

Assume that n numbers of DMU are using r number of inputs denoted by x_i, $i = 1,\ldots,r$ in order to produce s number of outputs denoted by y_j, $j=1,\ldots,s$. In this case efficiency of DMU_0 could be defined as follows:

$$e_0 = \frac{\sum_{j=1}^{s} w_j\, y_{j0}}{\sum_{i=1}^{r} v_i\, x_{i0}}$$

where y_{j0} is the amount of output jth output produced by DMU_0, x_{i0} is the amount of ith output used by DMU_0, w_j weight chosen for output j and v_i weight chosen for input i. To select optimal weights, mathematical programming problem conducted as follow:

$$\max\ e_0 = \frac{\sum_{j=1}^{s} w_j\, y_{j0}}{\sum_{i=1}^{r} v_i\, x_{i0}}$$

Subject to:

$$\frac{\sum_{j=1}^{s} w_j\, y_{jm}}{\sum_{i=1}^{r} v_i\, x_{im}} \leq 1 \quad m = 1,\ldots,n \tag{1}$$

$$w_j \leq 1 \quad j = 1,\ldots,s \tag{2}$$

$$v_i \leq 1 \quad i = 1,\ldots,r \tag{3}$$

Here, the objective function tries to maximize the ratio of weighted outputs to weighted inputs for DMU_0 under the constraint of all efficiency measures, which must be less than or equal to one and weights are positive. This optimization is performed separately for each DMU in order to calculate weights for each input and output and efficiency measure maximized for each DMU.

The linear programming formulation of the optimization problem could be written by imposing the constraint $\sum_{i=1}^{r} v_i x_{i0} = 1$, which provides[18]:

$$\max \sum_{j=1}^{s} w_j y_{j0}$$

Subject to:

$$\sum_{i=1}^{r} v_i x_{im} - \sum_{j=1}^{s} w_j y_{jm} \geq 0 \quad m=1,\ldots,n$$

$$\sum_{i=1}^{r} v_i x_{i0} = 1$$

$$w_j \leq 1 \quad j=1,\ldots,s$$

$$v_i \leq 1 \quad i=1,\ldots,r$$

This optimization works under a CRS assumption and it is an input-based efficiency measurement. An input-based efficiency measure tries to solve the problem of how much input quantities can be reduced without changing the output quantities produced[19].

A dual form of the model can be written by denoting the input weights of DMU_0 by f_0 and input and output weights of other banks in sample by L_{0m}.

$$\min f_0$$

Subject to:

$$\sum_{m=1}^{n} L_{0m} x_{im} \leq f_0 x_{i0} \quad i=1,\ldots,r \qquad (4)$$

$$\sum_{m=1}^{n} L_{0m} y_{im} \geq y_{j0} \quad j=1,\ldots,s \qquad (5)$$

$$L_{0m} \geq 0 \qquad (6)$$

The value of f_0 obtained will be efficiency score of DMU_0 and must lie between values 0 and 1. According to the definition of Farrell (1957), DMU with a value of 1 indicates a point on the frontier and hence, is technically efficient. If f_0 is lower than 1, a proportional reduction of inputs is needed in order to reach efficient frontier.

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[18] Developed by Charnes et al. (1978)
[19] Coelli (1996)

So far, CRS in production technology are assumed. However, assumption of CRS in production technology is only applicable if all DMUs are operating at an optimal scale. Therefore, Banker, Charnes, and Cooper's (1984) new model (BBC) accounts for variable returns to scale situations.

By imposing restriction of $\sum_{m=1}^{n} L_{0m} = 1$ to the existing CCR model, the CRS assumption could be relaxed to the variable returns to scale assumption. The foundation of the model is as follows:

$$\min f_0$$

Subject to:

$$\sum_{m=1}^{n} L_{0m} x_{im} \leq f_0 x_{i0} \qquad i=1,\dots,r \qquad\qquad (7)$$

$$\sum_{m=1}^{n} L_{0m} y_{im} \geq y_{j0} \qquad j=1,\dots,s \qquad\qquad (8)$$

$$L_{0m} \geq 0 \qquad\qquad\qquad\qquad (9)$$

$$\sum_{m=1}^{n} L_{0m} = 1 \qquad\qquad\qquad\qquad (10)$$

The degree of scale efficiency can be found by dividing the overall efficiency score (f_0), which is measured under the CRS assumption by the technical efficiency score (t_0), which is measured under the variable returns to scale assumption.

$$s_0 = \frac{f_0}{t_0} \qquad \text{where } s_0 \text{ is the degree of scale efficiency}$$

If the scale inefficiency exists, it can be either increasing returns to scale or decreasing returns to scale. In order to decide upon the source of scale inefficiency, the problem should be solved by imposing the restriction below:

$$\sum_{m=1}^{n} L_{0m} \leq 1 \qquad\qquad\qquad\qquad (11)$$

Restriction 11 allows for non-increasing returns to scale technology and new efficiency measure (n_0) calculated under this assumption. If efficiency measures calculated under the assumption of VRSC and NIRTS are equal to each other, it means inefficiency caused from decreasing returns to scale. If efficiency measures are not equal to each other, it means inefficiency caused from increasing returns to scale.

1.2 Empirical Model

In the literature, many studies attempt to investigate determinants of bank efficiency by regressing efficiency scores on bank-specific, country-specific, and environmental variables. These studies used Tobit, OLS, GMM, or GLS regression models for estimating determinants of efficiency. Our data structure has a predominant effect on the selection econometric model. We will estimate the efficiency scores of 99 banks for 22 years (from 1990 to 2011). In a 22 year period, Turkey experienced lots of development in its regulatory environment and in the marketplace, which could affect production technologies and the production function of banks. Also, individual effects specific to each banks affected efficiency scores. Therefore, the model should include time effects and individual effects, which lead us to use panel data analysis in our study.

The panel data is composed of observations on the same units in several different time periods (Kennedy, 2008). Baltagi (2008) states, "Panel data give more informative data, more variability, less co-linearity among the variables, more degrees of freedom and more efficiency." Panel data models estimate two effects: individual specific effects or time effects, or both. One-way models consider only one effect, either individual or time. Two-way models consider both effects. In our study, we will be using two-way models because of the following reasons. The individual specific effect is included because banks show significantly different efficiency scores from each other. The time effect should also be included because we see some trends over time in efficiency scores. There are some specific time intervals that cause efficiency scores to deviate from the usual pattern. To capture both bank specific differences and time specific differences, we use two-way models.

On the other hand, panel data models examine fixed or random effect of subjects. The main difference between two models comes from the role of dummy variables. Fixed effect models consider dummies as part of intercepts where dummies are considered as error terms. In Table 2, there is a comparison of fixed effect and random effect models.

Table 2 : Comparison of Fixed Effect and Random Effect Models

	Fixed Effect Model	Random Effect Model
Functional Form	$y_{it} = (\alpha + u_i) + X'_{it}\beta + v_{it}$	$y_{it} = \alpha + X'_{it}\beta + (u_i + v_{it})$
Intercepts	Varying across groups and/or times	Constant
Error Variance	Constant	Varying across groups and/or times
Slopes	Constant	Constant
Estimation	LSDV, within effect method	GLS, FGLS
Hypothesis test	Incremental F test	Breusch- Pagan LM test

Source: Hun Myoung Park (2011) * $v_{it} \sim IID(0, \sigma_v^2)$

The Hausman specification test proposed by Jerry Hausman in 1978 compares fixed effects versus random effects. The test basically puts the null hypothesis that individual specific effects are uncorrelated with the other regressors in the model (Hausman, 1978). If the hypothesis is rejected, that means a random effect model would produce biased estimators. In this case, fixed effect model should be chosen.

First of all we have conducted the F-test in order to decide whether fixed or random effects exist in the data. Our null hypothesis states that all individual specific effects are equal to zero (such as $H_0 = u_1 = u_2 \ldots = u_{n-1} = 0$). An alternative hypothesis states that at least one individual specific effect is equal to zero. As seen Table 3, the null hypothesis is rejected, which means there is a significant fixed effect that should be included in the model. Then we conducted the Hausman test to decide whether the fixed effect model or random effect model will be used. The null hypothesis states that individual effects are uncorrelated with any regressor in the model (Hausman, 1978). In Table 3, results regarding the Hausman test are presented. According to the Hausman test, the null hypothesis that individual specific effects are uncorrelated with the other regressors is rejected. Therefore, the Hausman specification suggests using a fixed effect panel data model. As a result, we have decided to use affixed two way panel data models.

Table 3: Hausman and F Test Results

Hausman Test for Random Effects		F Test for No Fixed Effects			
m Value	Pr > m	Num DF	Den DF	F Value	Pr > F
27,05	0,0026	94	728	5,33	<.0001

As dependent variables, capital adequacy ratio, NPL ratio, liquidity, profitability, income-cost ratio, asset share, number of branches, GDP growth rate, and inflation rate will be used. A dummy variable will be used for banks whose shares are publicly traded in the ISE. We will also include dummy variables in order to investigate the effects of financial crises and the restructuring program.

The model specification is :

$$y_{it} = \beta_0 + X'_{it}\beta_1 + \alpha_i + \varepsilon_{it}$$

where y_{it} is the efficiency measures of a ith bank measured at time t, α_i is a fixed effect specific to the bank, and δ_t is a fixed effect specific to a time period that is not included in regression and X_{it} is the explanatory variables that were discussed above. Fixed effects specific to bank α_i and fixed effect specific to time period δ_t are unobservable and potentially correlated with x_{it}. Errors are independent identically distributed, $\varepsilon_{it} \sim IID(0, \sigma_v^2)$

1.3 Data and Input Output Specification

According to the provisions of Banking Law Nr. 5411, the Turkish banking sector is classified in three groups which are deposit, participation and development, and investment banks. Deposits banks are defined as institutions that operate primarily for the purposes of accepting deposits and granting loans in their own names and for their own accounts. Participation banks are the institutions operating primarily for the purposes of collecting funds through special current accounts and participation accounts, and granting loans pursuant to Law. Development and investment banks are defined as the institutions operating primarily for the purposes of granting loans and/or to fulfill the duties assigned thereto by their special laws, other than accepting deposit or participation fund pursuant to Law. In short, deposit banks in Turkey depository institutions that cannot take part in the leasing and trading of real goods for commercial purposes and participation, development and investment banks do not collect deposits. Instead, investment banks focus on corporate finance, foreign exchange, mergers, and initial public offerings while development banks provide medium-term finance to industry and give government funds to sectors that have priority for the government (Etkin et al, 2000).

The asset share of participation, development, and investment banks is relatively low compared to deposit banks' asset share throughout Turkish banking history. As of December 2011, 92% of the Turkish banking system's asset size is composed of deposit banks, 4.6% of participation banks, and 3.4% of development and investment banks. In this study, the data is taken from Turkish banks' financial statements published by the Bank Association of Turkey (BAT) from 1990 to 2011. The sample includes all banks in Turkey except participation, development, and investment banks due to their relatively small market shares in the banking industry, as well as their different structures and goals defined in the Banking Law. Also, some banks with zero recorded in any year are excluded from the analysis for that year in because of the fact that the DEA is sensitive to outliers. The number of banks included in this study varies from year to year since the period of 1990 to 2000 is one of most volatile periods in the history of Turkish banking. The sample includes 966 annual observations from a 21 year periods.

Efficiency estimates of DEA methodology are very sensitive to selection of input and output variables. There has been an ongoing debate in the literature on the theory of banking regarding the proper definition of inputs and outputs. Berger and Humphrey (1997) present two main approaches, the "production approach" and "intermediation approach" for the selection of inputs and outputs. According to them, production approach banks are financial institutions that produce services for account holders. Banks use only physical inputs such as labor and capital to produce loans and deposit account services. Under the production approach, the number and type of accounts are used to measure output. The intermediation approach defines banks as intermediary institutions that transform funds between savers and investors. Banks use deposits and borrowed funds as inputs to produce loans and other and other assets.

Although there are many other differences in these approaches, the main disagreement comes from the specification of inputs and outputs for banks. Many authors agree that loans and other major assets should count as outputs. However, the most controversial issue regards the role of deposits. Deposits have a dual role. Deposits could be defined as an input because they are collected in return of interest payments and are used to raise funds. On the other hand, deposits could be defined as an output because safekeeping, liquidity, and the payments services provided to depositors.

Berger and Humphrey (1997) clarify that neither of these approaches are flawless and that each have their own disadvantages because neither fully captures the dual roles of banks as providers of transactions/document processing services and as financial intermediaries. However, they state that the production approach could be more useful while calculating banks' branch efficiency and that the intermediation approach could be more suitable while calculating banks' entire efficiency score. Fethi and Pasiouras (2010) find around 95 applications in bank efficiency use deposits as an input variable and twenty applications use deposits as an output variable in his study, which reviews 151 studies that examine bank performance.

If we look at the Turkish literature, Aysan and Ceyhan (2007), Zaim (1995), Işık and Hassan (2002), and Kasman (2002) adopt the intermediation approach. Accordingly, the intermediation approach has been adopted in this study like many other efficiency studies in literature and we estimate a model that has three inputs and three outputs.

Inputs:

1) Total Deposits
2) Total Cost
3) Shareholders' Equity

"Total deposits" includes time deposits, demand deposits, and borrowed funds from Interbank, the Central Bank, and domestic banks, and both foreign and marketable securities issued.

"Total cost" is defined as a sum of interest expenses and non-interest expenses. Interest expenses include interest paid to deposits, interest paid to Interbank Money Market Transactions, interest paid to loans, and other interest expenses. Non-interest expenses include personnel expenses, provision for other expenses, taxes and fees, losses from capital market transactions, fees and commissions paid, depreciation expenses, losses from foreign FX transactions, and other expenses. Some studies use only personnel or total non-interest expenses as an output. However, according to Casu and Molyneux (2003), "the minimization of total cost, not just production cost, is needed to maximize profits." Therefore, total cost is included as an input variable in calculation of efficiency scores.

Shareholders' equity is used because some banks could use financial capital to fund loans as a substitute for deposits or other borrowed funds. Risk-averse banks in particular could finance their loans by using capital rather than deposits. Since financial capital is more expensive than deposits, this risk-averse incentive could create inefficiency (Mester, 1996). In order to control differences in risk perception between different financial institutions, we used financial capital as an input variable as in Mester (1996), Altunbaş et al. (2000), and Kasman and Yıldırım (2006).

Outputs:

1) Loans
2) Other Earning Assets
3) Off-Balance Sheet Items

"Loans" includes both short term loans (loans with less than one year maturity) and long term loans (loans with more than one year maturity). "Other earning assets" is defined as the sum of money market securities, banks and other financial institutions, investment held to maturity, securities available for sale, and securities held for maturity. Off-balance sheet items are mainly composed of guarantees and warranties, commitments, derivative financial and custody, and pledged securities items. Pasiouras (2008) estimates the efficiency of the banks with and without off-balance sheet activities to observe whether it will have an impact on efficiency and finds that off-balance sheet items do not have a significant impact. In the Turkish banking sector, securities portfolios, which are dominated by government bonds and T-bills, play an important role in the balance sheet of banks. Especially in the 1990s, government securities issued for financing public deficit played an important role the balance sheet of banks. Although a decreasing tendency has been observed in recent years, securities portfolios keep their relative importance. Therefore, other earning assets are included as an output variable. Işık and Hassan (2002) also use other earning assets as an output variable by stating that ignoring other security investments will not be uniform across banks due to the existence of some small banks more active in such investments than others.

Off-balance sheet items are also used as an output variable because of an increase in non-traditional banking activities in recent years. Especially after the 2000-2001 twin crises, the profit margin of banks decreased as a result of the decrease in interest rates and the importance of commission and fees-based activities increased. Following Aysan and Ceyhan

(2007), Altunbaş et al. (2000), Işık and Hassan (2002), and Pasiouras (2008), we have included off-balance sheet items in our analysis.

In a country like Turkey where a high-inflationary environment existed for long time, using local currency in DEA could distort efficiency results and could cause difficulties in comparing results. Therefore, in order to avoid the adverse effects of inflation variables denominated in US dollars by following Fukuyama and Matousek (2011), Işık and Hassan (2002), Özkan-Günay and Tektaş (2006), and Jackson and Fethi (2000).Table 4 presents sample statistics.

Table 4: Input and Output Variables (millions of US dollars)

Variables	1990		1995		2000		2005		2010	
Years	Sum	Mean	Sum	Mean	Sum	Mean	Sum	Mean	Sum	Mean
All Banking Sector										
Outputs										
Loans	24.118	431	26.204	485	46.230	758	108.320	3.186	317.882	10.596
Other Earning Assets	10.113	181	16.995	309	39.313	644	104.836	3.083	197.603	6.587
Off-Balance Sheet Items	100.112	1.788	151.361	2.752	152.918	2.507	642.296	18.891	1.907.769	63.592
Inputs										
Deposits	32.564	581	44.719	813	101.884	1.670	188.984	5.558	399.452	13.315
Total Cost	14.602	261	13.459	245	33.152	543	32.143	945	43.896	1.463
Equity	5.071	91	3.973	72	6.790	111	35.387	1.041	74.687	2.490
State Owned Banks										
Outputs										
Loans	12.340	1.542	11.500	2.300	13.727	3.432	23.512	7.837	95.344	31.781
Other Earning Assets	4.875	609	5.760	1.152	5.869	1.467	48.204	16.068	74.567	24.856
Off-Balance Sheet Items	40.360	5.045	39.911	7.982	17.721	4.430	96.605	32.202	562.745	187.582
Inputs										
Deposits	15.797	1.975	19.383	3.877	41.095	10.274	71.264	23.755	148.465	49.488
Total Cost	6.776	847	6.984	1.397	14.020	3.505	10.145	3.382	13.241	4.414
Equity	2.663	333	1.121	224	1.450	362	9.878	3.293	19.161	6.387
Privately Owned Banks										
Outputs										
Loans	10.809	432	14.029	438	31.064	797	77.003	4.278	170.322	15.484
Other Earning Assets	4.913	197	10.291	322	28.491	731	53.494	2.972	105.280	9.571
Off-Balance Sheet Items	56.153	2.246	105.452	3.295	116.957	2.999	491.432	27.302	863.272	78.479
Inputs										
Deposits	15.990	640	24.188	756	57.490	1.474	108.596	6.033	200.329	18.212
Total Cost	7.296	292	6.141	192	17.310	444	19.936	1.108	22.954	2.087
Equity	2.227	89	2.673	84	4.793	123	23.050	1.281	43.248	3.932
Banks Founded in Turkey										
Outputs										
Loans	504	72	347	50	1.010	202	7.597	1.266	51.790	4.708
Other Earning Assets	207	30	561	80	3.146	629	2.328	388	16.756	1.523
Off-Balance Sheet Items	2.452	350	4.340	620	8.542	1.708	49.898	8.316	470.711	42.792
Inputs										
Deposits	527	75	809	116	2.508	502	8.114	1.352	49.918	4.538
Total Cost	268	38	217	31	1.061	212	1.864	311	7.484	680
Equity	104	15	125	18	323	65	2.208	368	11.355	1.032
Banks Having Branch in Turkey										
Outputs										
Loans	465	29	328	33	428	33	208	30	1.166	194
Other Earning Assets	118	7	383	35	1.806	139	811	116	1.222	204
Off-Balance Sheet Items	1.146	72	1.658	151	9.698	746	4.361	623	8.788	1.465
Inputs										
Deposits	250	16	339	31	792	61	1.010	144	1.038	173
Total Cost	262	16	118	11	761	59	198	28	163	27
Equity	77	5	54	5	224	17	252	36	637	106

5. EMPRICAL RESULTS

5.1 Efficiency Scores

An input oriented DEA model under the assumption of variable returns to scale (VRS) is used to obtain empirical results. DEAP Version 2.1 Computer programming is used to calculate efficiency scores.

DEA efficiency scores are estimated for each bank from 1990 to 2011. As it is explained in the data section, banks are divided into four groups according to their ownership. Table 5 shows the average technical efficiency scores of banks groups calculated for 1990 to 2011. The banks with an efficiency score of 1 are regarded as fully efficient banks whereas bank with efficiency scores below 1 are regarded as banks experiencing inefficiency problems.

Although average technical efficiency scores fluctuate over time, in general the average efficiency of Turkish banks follows an increasing trend over time; the average technical efficiency scores increased from 0.817 to 0.927 between 1990 and 2011. The average technical efficiency scores ranged between 0.794 and 0.951. The minimum average technical efficiency score is measured for 1993 and Turkish banks' inefficiency score was calculated at 22% at that time[20]. Average technical efficiency scores climbed to 92% in 2011 and the inefficiency score was calculated at 8% in 2011. To better interpret efficiency and inefficiency scores, the following characterization of efficiency scores can be given. Since the input oriented DEA model used average technical efficiency, results can be interpreted to mean that Turkish banks could have used 81% and 92% of their resources in order to produce same amount of output.

Table 5 presents the summary statistics of efficiency measures in terms of bank groups that we have analyzed for the period of 1990 to 2011.

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[20] Inefficiency score are calculated based on the formula $\frac{(1-E)}{E}$, where E is efficiency score.

Table 5: Summary Statistics of Efficiency Scores

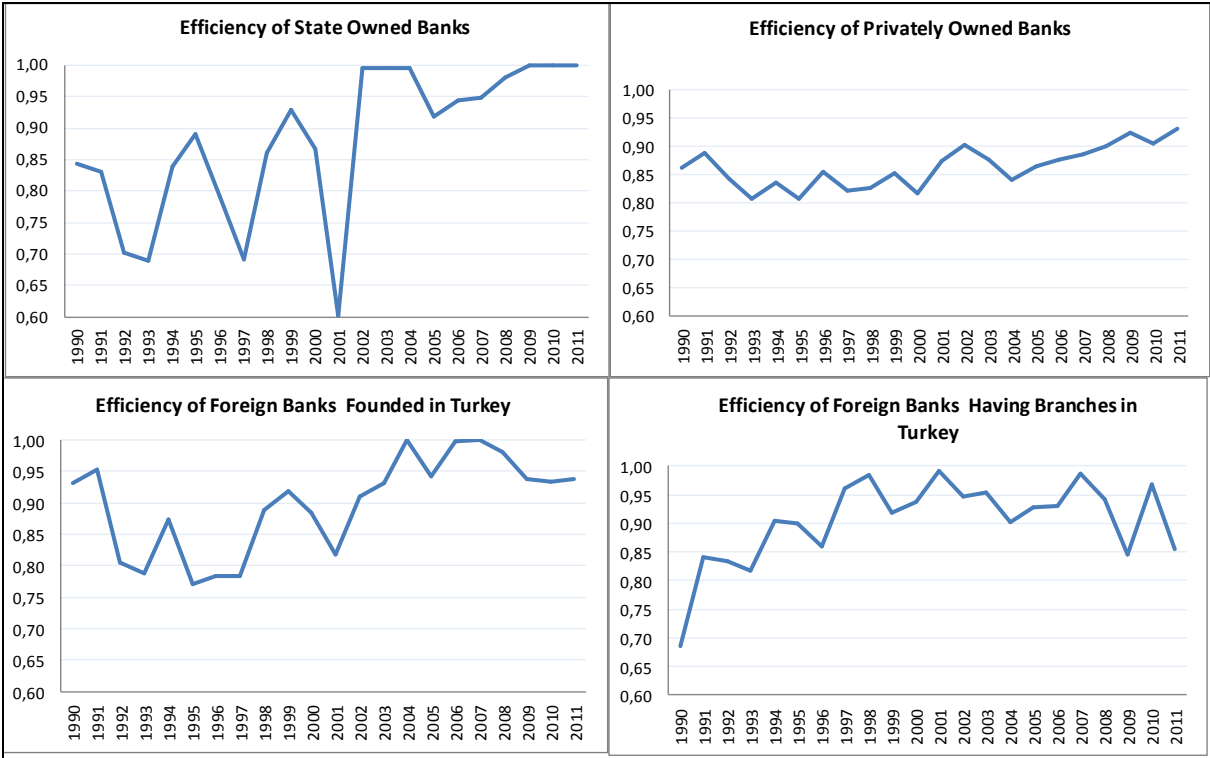| Years	All Banks		State-Owned Banks		Privately-Owned Banks		Foreign Banks Founded in Turkey		Foreign Banks Having Branches in Turkey	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
1990	0.817	0.245	0.844	0.249	0.862	0.193	0.930	0.124	0.685	0.312
1991	0.882	0.207	0.832	0.306	0.890	0.200	0.953	0.069	0.842	0.230
1992	0.821	0.229	0.703	0.418	0.843	0.215	0.805	0.172	0.835	0.184
1993	0.794	0.227	0.689	0.354	0.808	0.214	0.788	0.208	0.817	0.218
1994	0.856	0.176	0.839	0.189	0.836	0.198	0.874	0.147	0.904	0.138
1995	0.828	0.197	0.890	0.153	0.807	0.207	0.772	0.212	0.900	0.171
1996	0.841	0.180	0.793	0.197	0.854	0.171	0.783	0.207	0.859	0.198
1997	0.831	0.192	0.692	0.353	0.821	0.164	0.783	0.243	0.960	0.075
1998	0.866	0.186	0.862	0.277	0.826	0.192	0.888	0.202	0.984	0.041
1999	0.881	0.187	0.929	0.142	0.852	0.205	0.917	0.185	0.917	0.160
2000	0.852	0.213	0.868	0.265	0.817	0.224	0.884	0.202	0.938	0.158
2001	0.881	0.201	0.601	0.362	0.873	0.191	0.818	0.257	0.992	0.028
2002	0.924	0.156	1.000	0.000	0.903	0.154	0.910	0.180	0.946	0.178
2003	0.913	0.191	1.000	0.000	0.876	0.232	0.932	0.137	0.953	0.140
2004	0.888	0.205	0.804	0.393	0.875	0.204	1.000	0.000	0.901	0.135
2005	0.896	0.181	0.918	0.142	0.865	0.207	0.943	0.093	0.927	0.194
2006	0.923	0.139	0.945	0.096	0.878	0.176	0.998	0.006	0.930	0.123
2007	0.951	0.114	0.949	0.088	0.886	0.170	0.999	0.004	0.987	0.027
2008	0.945	0.111	0.979	0.036	0.901	0.155	0.981	0.054	0.943	0.110
2009	0.918	0.149	1.000	0.000	0.925	0.154	0.937	0.118	0.845	0.200
2010	0.938	0.134	1.000	0.000	0.906	0.187	0.934	0.113	0.968	0.084
2011	0.925	0.146	1.000	0.001	0.932	0.159	0.937	0.081	0.854	0.229

Figure 3: Evaluation of Overall Efficiency Scores over Time
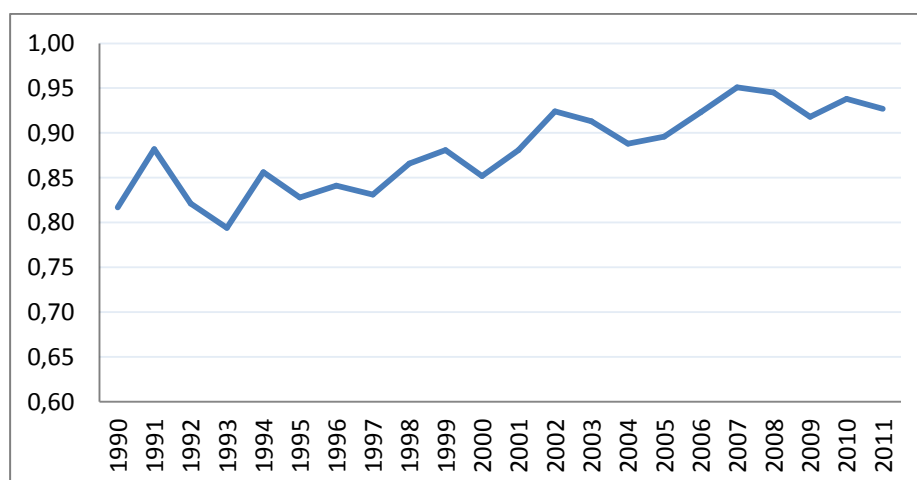
The first observation regarding our results is that the mean technical efficiency scores follow an increasing trend over time. The mean efficiency scores of Turkish banks increase with a CAGR of 0.6%. At first glance, a 0.6% average increase in efficiency scores might seem insignificant; however, over the 20 years, Turkish banks increased their efficiency from 82% to 93%. This means that the Turkish banking system resolved more than half of its inefficiencies that might have stemmed from several sources. Our results regarding the increasing mean technical efficiency over time are consistent with Aysan and Ceyhan's (2007) results. They found that all bank groups have experienced efficiency gains between 1990 and 2006; 52% efficiency in 1990 increased to 98% in 2006. Fukuyama and Matousek (2011) also state that Turkish banking efficiency gradually increased from 1990 to 2004. However, they point out that there is gradual deterioration in efficiency from 2004 to 2007.

Focusing on overall efficiency scores might be misleading because these mean scores are simply average scores of four groups of banks (state-owned, privately-owned, foreign banks founded in Turkey, and foreign banks having branches in Turkey). It is possible to see that there might be an increasing trend in some groups of banks while there may be a decrease in other groups of banks and these might be cancelling each other out, giving misleading results on overall scores. Analyzing each group of banks' mean efficiency scores and comparing relative changes in efficiencies would be beneficial in our study. Figure 4 gives mean efficiency scores of these 4 groups of banks.

**Figure 4: Efficiency Scores According to Bank Groups**

When we look at the CAGR of four groups of banks over 22 years, we see a CAGR of 0.8% in state-owned banks, 0.4% in privately-owned banks, 0.04% in foreign banks founded in Turkey, and 1.1% in foreign banks having branches in Turkey. CAGR directly tells us that overall growth of the Turkish banking system is mainly driven by foreign banks having branches in Turkey. On the contrary, there is almost no contribution given by foreign banks founded in Turkey with a CAGR of 0.04%. While the mean efficiency scores of these banks were 93%, it was still on the level of 93% in 2011. These results actually justify our decision on splitting foreign banks into the two categories: "founded in Turkey" and "having branches in Turkey."

The second observation regarding the efficiency scores of Turkish banks is that changes in the efficiency scores growth rate is decreasing over time. In Figure 5, yearly growth rates of overall efficiency scores over 22 years are presented. Efficiency growth rate follows a fluctuating path by decreasing some periods and increasing others. In fact, boom-bust cycles were observed in efficiency growth rate developments. During a bust phase, the growth of efficiency collapses and this collapse is followed by a rapid increase in a boom phase. We also observe efficiency growth rate fluctuations getting smoother over time. It can be clearly seen that banks were unstable in the years before the 2000s and that instability decreased over

time. This result could be quite intuitive and leading in the sense that this instability before 2000 can be associated with the unstable structure of the Turkish economy in terms of ever-changing inflation, growth rate, and interest rates. Furthermore, the lessons learned from the 2001 crises and the more stable political and economic environment of Turkey can explain why growth of efficiency scores are starting to show a smoother trend after 2001 period.

Figure 5 : Yearly Growth Rates of Overall Efficiency Scores
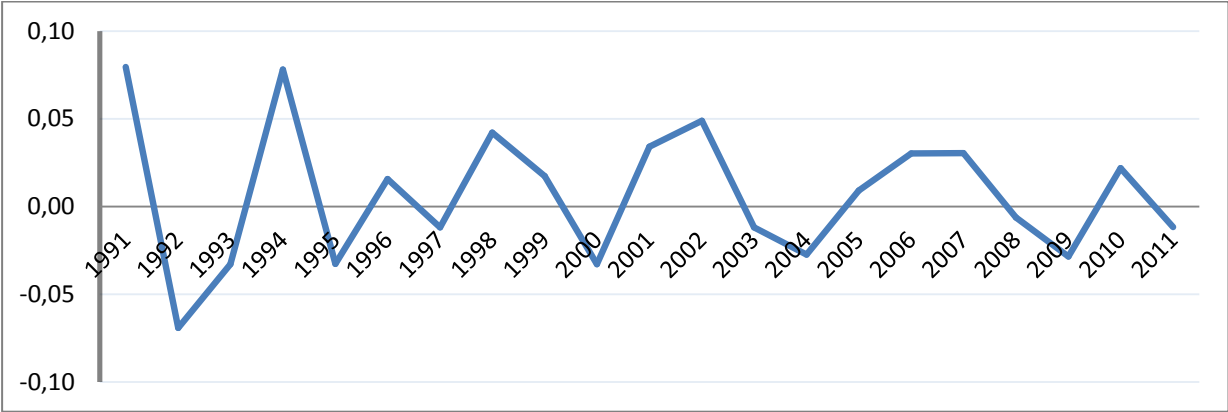
In Figure 6, changes in growth rates are shown for each group of banks. State-owned banks, surprisingly, are the most unstable groups of banks, showing average growth rate changes of 19%. Some growth changes are, for example, that state-owned banks are -15.5% in 1992, 22% in 1994, 25% in 1998, -30% in 2001, and 66% in 2002. However, these unstable behaviors are not seen after 2002. In other words, the unstable structure of the Turkish banking system can be mostly attributed to state-owned banks. Privately-owned banks, on the other hand, are most stable group of banks, with average growth rate changes of 4%.

We observe that privately-owned banks have the lowest change in efficiency growth and that they follow a relatively stable path under the period of study. This low growth rate change could be interpreted that the privately-owned bank group is the bank group least affected by macroeconomic, structural, and political changes. The same point of view leads us to the conclusion that privately-owned groups did not response to the restructuring programs as intended. Yıldırım (2002) also put emphasis on this subject in her study, which covers the period of 1988-1999. She found out that macroeconomic instability was caused by domestic political uncertainties, recession due to being an emerging market, and that inflation has affected the performance levels of banks negatively. According to her study, while privately-owned banks were the most affected bank group from this adverse relationship, foreign banks

were the least affected group. Results of our study may confirm Yıldırım's (2002) findings about the adverse relationship between unstable macroeconomic environment and efficiency. However, our results did not confirm the conclusion that private banks are the most affected group from this adverse relationship. According to our efficiency measures, public banks were the most affected groups between 1990 and 1999.

Figure 6: Efficiency Growth Rates According to Banking Groups
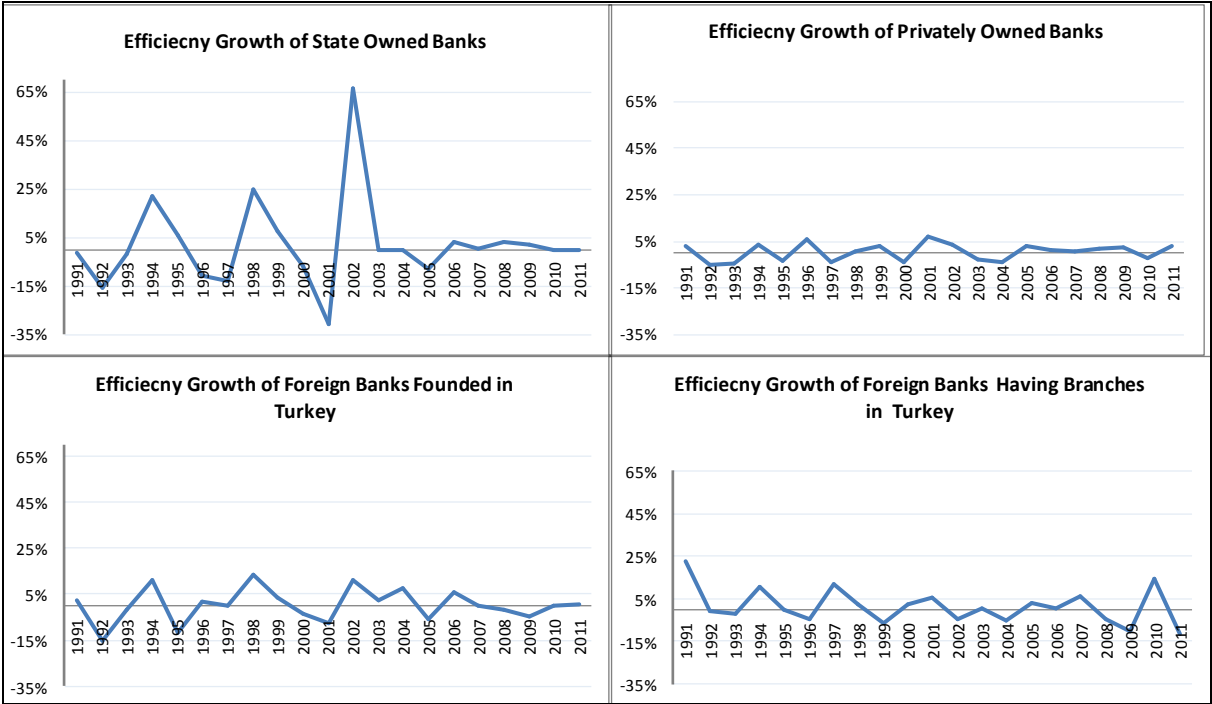
In this study so far, we concentrated on the general trend of efficiency scores of Turkish banks. However, we have to focus on the fluctuations over the periods of 1990 to 2011 instead of focusing on the overall changes in 22 years. As a reminder, efficiency scores are calculated separately for each year and it is the relative efficiency scores of banks. Therefore, from now on, we will be focusing more on the local fluctuations in changes in efficiency scores rather than considering the whole picture.

We observe a sharp decrease in mean efficiency scores from 1991 to 1993. These low efficiency levels for this period were caused by the deterioration of the Turkish economy, including the financial markets. Our results are consistent with the efficiency measures of Fukuyama and Matousek (2011), and Işık and Hassan (2002). Fukuyama and Matousek (2011) measured efficiency by using a two-stage network model and DEA. They found out that the average technical efficiency dropped by 19 percentage points from 1991 to 1993. Işık and Hassan (2002) look in another way and they calculated inefficiency scores by using DEA.

In their view, the inefficiency scores for the commercial banks were 51% in 1991, 34% in 1992, and 49% in 1993. If we analyze this decrease in terms of bank groups, we see all types of bank groups experiencing deterioration in efficiency scores for the period of 1991 to 1993. Public banks and foreign banks founded in Turkey had the lowest efficiency scores among all other bank groups in this period. Public banks and foreign banks founded in Turkey experienced a 17% efficiency decrease from 1991 to 1993. Foreign banks having branches in Turkey experienced low level of loss compared to other group of banks, with a 3% decrease in efficiency scores.

In 1994, Turkey experienced a fundamental economic crisis whose impact was devastating for banks: an approximate 30% shrinkage in banking assets, skyrocketing interest rates (700% at times in the interbank market), and about a 50% devaluation of the Turkish Lira in the first quarter of the year (Celasun, 1998). Although many deteriorations were observed in banks' financial data and the macroeconomic environment and despite the fact that most studies observe efficiency decreases in 1994, according to our results, the mean efficiency levels improved in 1994. Işık and Hassan (2002) claim that the crisis was an exogenous phenomenon whose roots implicitly or explicitly evolved gradually before its inception and whose impacts lasted for awhile after its realization. In our study, mean efficiency levels decreased before the crisis and improved in the peak of the crisis. Fukuyama and Matousek (2011) explain this improvement as a result of the Turkish government injecting capital and bailing out the banking sector, which helped banks alleviate their problems stemming from the crises. To support their idea, we can say that after the injection of capital, the efficiency levels of banks improved, and public banks experienced a 21.8% efficiency increase from 1993 to 1994. We observe a 10% efficiency recovery in foreign banks in both groups. Only 3% improvement has been observed in private banks' efficiency scores, meaning that private banks were less affected by capital injection than other bank groups in terms of efficiency levels. However, we cannot reach such a conclusion yet since we will be looking at the determinant of efficiency scores in the next section.

Between 1994 and 1999, we observe volatile efficiency scores. As seen in Figure 3 and Figure 4, there were sharp increases in efficiency measures. However, these ups and downs are not as deep as the ones in the crisis period. If we analyze this period in terms of bank groups which have the highest and lowest efficiency scores, we observe that foreign banks with branches in Turkey display the highest efficiency scores compared to other bank groups in this period. During this period, there is not a single bank group that has the lowest

efficiency scores; it changes year by year. Foreign banks founded in Turkey had the lowest efficiency scores in 1995 and 1996 and private banks had the lowest efficiency scores in 1998 and 1999. Although public banks experienced the lowest efficiency scores only in one year (1997) public banks' efficiency levels were below the average efficiency level for a large part of that period. Aysan and Ceyhan (2007) found that state banks have the lowest scale efficiency before 2001 and Kasman (2002), Işık and Hassan (2002) and Aysan and Ceyhan (2007) all found that foreign banks were the more efficient bank groups until 2001. Mercan et al. (2003) measure the performance of Turkish banks and find that Turkish private banks' performance follows a declining trend from 1994 to 1999. Finally, five banks were taken over by SDIF. According to the author, the 1994 Turkish financial crisis and the 1998 "Russian" (worldwide) crisis caused this declining trend. On the other hand, Mercan et al. (2003) find that foreign banks' performance started to increase after 1995. Their financial performance increased from 34% in 1995 to 41% in 1999.

After following relatively less volatile fluctuations in the period between 1994 and 1999, bank efficiency levels experienced a sharp decrease in 2000. The decrease in mean efficiency score is 3.3% from 1999 to 2000. In terms of bank groups, we observe that state owned banks showed the highest decrease in efficiency level with 6.6%. State owned banks followed by privately owned banks and foreign banks founded in Turkey with a 4.2% and 3.6% decrease in efficiency. The only bank groups which did not experience any efficiency decrease were foreign banks having branches in Turkey. Interestingly, the banks' efficiency level improved in the peak of the crisis (2001). Fukuyama and Matousek (2011) also observe an increase in mean efficiency in 2001. If we look at the sources of efficiency increase, we observe an increase in mean efficiency scores driven by an increase in efficiency of privately owned banks and foreign banks having branches in Turkey. State owned banks experienced an excessive efficiency decrease from 2000 to 2001. The efficiency loss of state owned banks was 30.7%.

After the crisis, Turkey initiated the Banking Sector Restructuring Program on 15 May, 2001 to recover and create a healthy banking sector. Four of the most important objectives of the Program stand out. The first aim was the financial restructuring and rehabilitation of the state banks and subsequent privatizing stood on the agenda. The second aim of the program was for a resolution of the SDIF banks through sale, merger, liquidation or transfer. The third one looked to the formation of a sound private banking system. The final objective was the

strengthening of the regulatory and supervisory structure as well as an increase in the efficiency of the banking sector.

We can observe the effects of the financial restructuring program in our efficiency results. After 2001, volatile characteristics of efficiency are observed to decrease. Mean efficiency scores increased in 2002. In 2002, state owned banks experience an efficiency gain of 66.3% and then between 2002 and 2004 they display the highest efficiency scores among other groups. In fact, publicly owned banks exhibit their best performance in the period 1990 and 2004. Obviously, liquidation of duty losses which had spiraled to $17.5 billion, payment of government securities before their maturities by the Treasury, as well as operational restructuring with regard to organization, human resources, technology, financial control, risk management, planning, and service quality 2001 had a positive impact on publicly owned banks' efficiency scores. Aysan and Ceyhan (2007) also find that efficiency of state owned banks increased after 2001. According to the authors, decreased political influence on state owned banks coupled with a fall in the number of bank branches, labor, and in operational expenses resulting from the restructuring of state banks and the effects of inflation accounting were the main reference points of authors while explaining the efficiency gain of state owned banks.

If we analyze other bank groups, we observe a relatively low level of efficiency recovery compared to state owned banks in 2002. The efficiency of foreign banks founded in Turkey increased by 3.4%. On the other hand, no recovery was observed in the efficiency scores of any other foreign bank group or foreign banks having branches in Turkey. Although privately owned banks' efficiency scores show little recovery in 2002, privately owned banks have the lowest efficiency scores among other bank groups between 2002 and 2004. While state owned banks experienced the highest efficiency scores, privately owned banks' lowest efficiency leads us to conclude that private banks did not respond to the restructuring program as state owned banks did. One explanation for this low level of efficiency scores is that the financial support to privately owned banks was very low compared to state owned banks. Table 1 gives details of this cost of restructuring. In fact, this was the almost same case as in the 1994 crisis. According to Fukuyama and Matousek's (2011) results, foreign banks were less affected by the consolidation and restructuring process than domestic banks in terms of efficiency levels. These are important results because it has important policy implications. It means that restructuring programs constructed after the crises with the expectation of recovery did not

cover all of the banking sector. Therefore, restructuring programs were not as successful as expected.

Between 2005 and 2007, Turkey and the Turkish banking sector were on a stable path. We observe that the mean efficiency scores of all bank groups and mean efficiency overall in the banking sector increased. In 2007, the mean efficiency of the whole banking sector reached its maximum value for the period under study. Foreign banks founded in Turkey have the highest efficiency scores in the period between 2005 and 2007. On the other hand, as in 2002 to 2004, private banks have the lowest efficiency scores among other groups from 2005 to 2007. Aysan et. al (2011) define the post- 2005 period as a growth period and according to their results, foreign banks were the least efficient bank group and state owned banks were the most efficient bank group in the period between 2005 and 2007. In fact, there were a lot of acquisition activities realized by foreign investors in the period between 2005 and 2007. As a result of these acquisitions, the share of foreign banks increased. At this point, the first question that comes into mind is whether this efficiency increase is related to foreign bank entry or not. Although our results are not in agreement with the results found in the study of Aysan et. al (2011), they are in line with the literature that examines the effect of foreign bank entry on domestic markets in general. There is growing literature on the effect of foreign bank entry on domestic markets since globalization movements in international trade accelerate the globalization of financial services. Levine (1996) claims that foreign banks improve the quality and availability of financial services in the domestic market, stimulate the development of banks' supervisory and legal framework, and enhance a country's access to international capital. Demirgüç, Levine and Min (1998) found that foreign entry – not the share of foreign bank assets -- tends to spur competition and make the banking system more efficient. In fact, increased foreign entry forces domestic banks to eliminate excess overhead and accept lower profits. Berger (2007) reviews and critiques over 100 studies that compare bank efficiencies across nations. According to his results, the efficiency of domestic banks is higher than the efficiency of foreign banks in developed nations while in developing nations this situation is reversed. Denizer (2000) analyzes the effects that foreign bank entry has on domestic banks in Turkey by using the data set from 1980 to 1997. He focused on three performance measures: net interest margin, overhead expenses, and return on assets. His empirical results show that the net interest margin, overhead expenses, and return on assets of domestic banks decrease after foreign bank entry. This indicates that foreign bank entry had a

strong competitive affect in Turkey despite their small share in the market. Following the literature, the efficiency increase from 2005 to 2007 could be explained by foreign bank entry.

In 2008, we observe a 0.6% decrease in the mean efficiency score of Turkish banks. This decrease in 2008 was followed by a 2.9% decrease in the mean efficiency score of Turkish banks in 2009. In terms of bank groups, we observe that both foreign banks founded in Turkey and foreign banks having branches in Turkey experienced an efficiency decrease in 2008. We do not observe any efficiency loss in state owned and privately owned banks' efficiency scores; instead, there is a slight efficiency increase. In 2009, foreign banks with branches in Turkey experience a 10.4% efficiency loss. This is the highest efficiency loss that was experienced by foreign banks with branches in Turkey in the period of the study. Although recovery is observed in the efficiency scores of foreign banks in 2010, in 2011, efficiency loss was again experienced. Efficiency loss in 2011 was 11.8%. During the period of 2009 to 2011, state owned banks had the highest efficiency scores. Privately owned banks scores are lower than state owned banks' scores and higher than foreign banks' score. Efficiency results regarding the period between 2008 and 2011 enable us to conclude that the global financial crises mostly affect foreign bank groups' efficiency scores. As mentioned before, one interesting result from our findings is that average bank efficiency levels decrease one year before the crisis and improve in the peak of the crisis. In the 1994 crisis, we observe an efficiency decrease in 1993 and an efficiency improvement in 1994. In the 2001 crisis, the same pattern continues and the average efficiency level decreases in 2000 and increases in 2001. Fukuyama and Matousek's (2011) study average efficiency results validate our findings. However, in the 2008 global financial crisis, we could not observe the same pattern as in the domestic crises. In the global crisis, the Turkish banking sector response to the crisis was not observed one year before the crisis. Instead, we observe a slight efficiency drop in 2008 and more a significant decrease in 2009 during the peak of the crisis. In fact, the mean efficiency of Turkish banks reached its peak level in 2007 when the global financial crisis started. The 0.6% efficiency decrease is quite low compared to other efficiency decreases experienced in the local financial crisis. The 20-year range of the data set enables us to see the reaction of efficiency scores of Turkish banks during both the local and global financial crises. Looking at our efficiency scores, we conclude that the reaction of Turkish banks to domestic and global financial crises differ from each other. The effect of global financial crises on Turkish banks' efficiency score is very low compared to domestic crises and the source of the decrease in mean efficiency scores in 2009 is a huge decrease in the efficiency

scores of foreign banks. To the best of our knowledge, the only study analyzing the effects of the global financial crises on Turkish banks' efficiency scores was conducted by Özkan-Günay (2012). The author states that although the global financial crises caused deteriorations in the balance sheets of banks, the number of efficient banks and the overall efficiency of banks had an increasing trend from 2002 to 2009, even during the global crisis. According to Günay (2012), the Banking Sector Restructuring Program along with the successful risk diversification and risk management by banks, as well as effective monitoring by the BRSA was successful in improving efficiency and strengthening banks so that banks were more resilient than ever to external shocks.

Finally, we can make a distinction between banks whose shares are publicly traded and the ones that are not and we can examine efficiency differences between listed and non-listed banks. Berger and Humphrey (1997) state that firms owned by stockholders might be expected to face stronger incentives to control costs and enhance profits compared to other firms. Berger and Mester (1997) analyzed US banks' efficiency scores for the period between 1990 and 1995 and they tried to explain the reason of efficiency differences in financial institutions. One of their explanatory variables was the dummy variable which takes a value of one if the financial institution is publicly traded. They claim that according to the market discipline hypothesis, to the extent that the stockholders of the bank can exert discipline over bank management, banks whose shares are publicly traded are expected to be more efficient. They found out that publicly traded banks tend to have higher efficiency results. Casu and Molyneux (2003), in their study which is about efficiency of France, Germany, Italy, Spain, and the United Kingdom banks from 1993 to 1997, used the publicly traded dummy variable as in Berger and Mester (1997). Their results also confirm a positive relationship between efficiency and being publicly traded.

Işık and Hassan (2003) found that Turkish banks whose shares are publicly traded in the stock exchange dominate the banks whose shares are not traded in terms of efficiency.

In Turkey, the number of listed banks is small, though despite the few banks listed, they usually represent a significant share of banking sector assets. There were nine banks publicly traded in the ISE and 29% of the assets of the banking system belonged to publicly traded banks in 1990. The number of publicly traded banks rose to twelve and as of December 2011, 75% of the assets of the banking sector belonged to publicly traded banks. Our efficiency results indicate that the market discipline hypothesis is partly verified, as listed banks present,

on average, a higher level of efficiency than non-listed banks. The difference in efficiency score can be seen in Figure 7 below.

Figure 7: Efficiency Scores of Publicly Traded and Non-Publicly Traded Banks
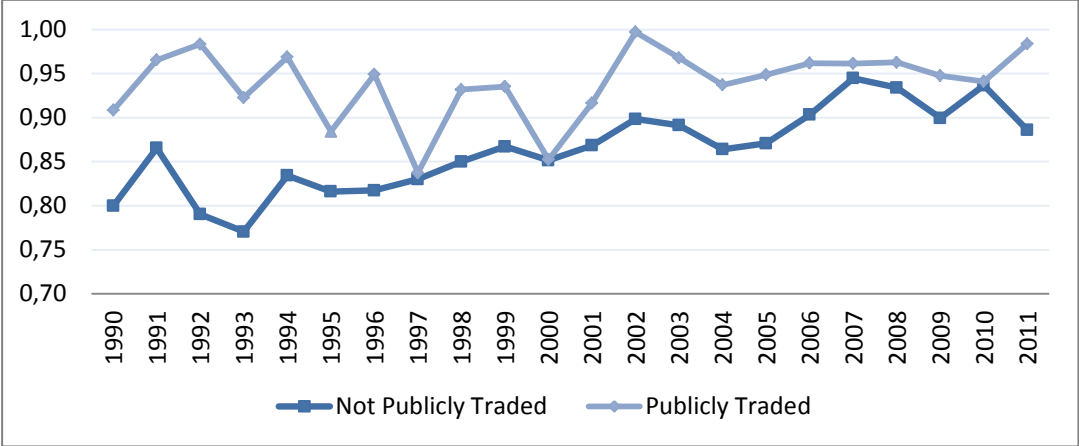
5.2 Regression Model: Determinants of Efficiency

We have analyzed the technical efficiency of Turkish Banks in the previous section. Then, we basically have made some interpretations of the efficiency results by looking the history of Turkish banking and comparing them with the literature. However, we have not yet built a formal model to investigate determinants of efficiency scores of Turkish banks. In this section we will conduct an econometric model in order to investigate determinants of efficiency.

As explained in section 4.1.2, we have decided to use a two-way fixed effect paned data regression model to investigate the determinants of efficiency. As a dependent variable, we use efficiency scores calculated under the variable returns to scale assumption. As potential determinants of Turkish banks' efficiency, we consider seven bank-specific variables, two measures and four dummy variables representing the influence of macroeconomic conditions.

Table 6 presents the definition of independent variables that are used in panel data model.

Table 6: Description of Regression Variables

Variable	Description
Capital Adequacy Ratio	Shareholders' equity to total assets (%)
Asset Quality	Loans under follow-up (gross) to total loans and receivables (%)
Liquidity	Liquid assets to total assets (%)
Profitability	Net profit (losses) to total assets (%)
Income- Expenditure Ratio	Total income to total expense
Asset Share	Assets of specific bank to overall asset of sector
Number of Branches	Number of branches of specific bank
Being Publicly Traded	A dummy, 1 for publicly traded banks and 0 for other banks
	A dummy, 1 for crisis year 1994 and 0 for other years
	A dummy, 1 for crisis year 2000 and 0 for other years
Crises	A dummy, 1 for crisis year 2001 and 0 for other years
	A dummy, 1 for crisis year 2008 and 0 for other years
Restructuring	A dummy, 1 for year 2002 and 0 for other years
	GDP growth rate
Macroeconomic Indicators	Inflation rate

The first group of variables is banks' financial ratios. These key performance indicators are widely used in the banking literature to evaluate banks' performance[21]. We will use capital adequacy ratio, NPL ratio, liquidity, profitability, income-cost ratio, asset share, number of branches and number of employees as balance sheet items. We also used a dummy variable for banks whose shares are publicly traded in the ISE.

The ratio of shareholder' equity to total assets is named as capital adequacy ratio and is included as a proxy for capital risk. Especially after the global financial crises, the riskiness of bank portfolios has become an important subject. Basel committee norms regarding the capital adequacy ratio have gained importance by regulators. In terms of the relationship between efficiency and the capital adequacy ratio, controversial results have been found in literature. One hypothesis is that there exists a positive relationship between the capital adequacy ratio and efficiency because shareholders have their own capital at risk, which brings an increase in monitoring activities and assures that banks operate efficiently by absorbing unexpected operating losses (Eisenbeis et al. 1999). Mester (1996) also states that managers of banks which have a low level of capital have more incentive to take excessive risk and excessive risk-taking activities result in a decrease in efficiency. On the other hand,

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[21] Mester (1996), Işık and Hassan (2003), Casu and Girardone (2004), Fukuyama (2011) , Ariff and Can (2008), Aysan and Ceyhan (2008), Jackson and Fethi (2000), Milller and Noulas (1997), and Fethi and Pasiouras (2010)

the other hypothesis suggests that banks which have a low capital adequacy ratio could undertake risky businesses and increase their efficiency in the short term.

The NPL ratio is used in order to investigate the quality of the management of credit risk across banks. Berger and Deyoung (1997) found the negative relationship between efficiency and NPLs. They found out that the increase in NPLs causes a decrease in efficiency and also a decrease in efficiency, causing an increase in NPLs. In our analysis, we expect to confirm the first statement. NPLs cause an increase in monitoring costs. An increase in NPLs creates incentives to be more diligent in administering the portion of their existing loan portfolio, which needs extra spending.

Liquidity ratio is used to investigate the effect of liquidity risk on efficiency and also could be proxy to measure the performance of banks. Altunbaş et. al (2000) uses the liquidity ratio to control risk since liquid assets represent a cost to bank. Also, seen in Turkish history i.e., the 2000 and 2001 crises, a low level of liquidity increases vulnerability to crises in the banking sector.

The ratio of net profit to total assets is used to measure the profitability of banks. Lazono-Vivas et. al (2002) used the profitability ratio as a proxy variable for competitiveness in the sector. In the literature, Mester (1996), Lazono-Vivas et. al (2002), and Lazono-Vivas et. al (2002) find a positive relation between efficiency and profitability, i.e., the higher the profits, the higher the efficiency.

We also included the ratio of total income to total expenditure as an income cost ratio into our regression analysis. This ratio could be used as a proxy variable of the financial performance of banks because the ratio shows how much income could be generated by banks' total expenditures.

Asset share ratio used as a proxy variable for market power. By looking at asset shares in the sector, it can be concluded that the Turkish banking sector has an oligopolistic market structure. As of 2011, the asset share of the first three banks is 40%, the share of first five banks is 61%, and the share of the first ten banks is 87%. This concentrated market structure makes us curious about the relationship between asset share and efficiency. The quiet life hypothesis states that the market power and efficiency are negatively related because banks in less competitive markets could gain more profit and they do not apply control over costs[22]. On

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[22] Berger and Hannan, 1998

the other hand, the efficient structure hypothesis developed by Demsetz in 1973 states that there exists a positive relationship between efficiency and market power due to the fact that the less competitive environment enables a low cost of production.

Numbers of branches were included since Turkish banks' business operations heavily depend on a branch network. Fukuyama and Matousek (2011) state that the number of branches could be a proxy of performance of branch network and service quality. Also, there is a substantial difference between domestic banks and foreign banks in terms of the number of branches in Turkey. While domestic banks prefer to develop their branch network both in rural and urban areas, foreign banks keep their branch network limited and prefer to expand their branches in urban areas rather than rural areas. Therefore, the branch network's influence on efficiency is a subject of interest.

Berger and Humphrey (1997) state that firms owned by stockholders might be expected to face stronger incentives to control costs and enhance profits compared to other firms. They state that according to the market discipline hypothesis, the extent that the stockholders of the bank can exert discipline over bank management, banks whose shares are publicly traded are expected to be more efficient. Therefore, the publicly traded variable is included in our analysis.

Since our time horizon is 22 years, we believe there might be some economic indicators that would affect banks' efficiency scores. As a reminder from the previous section, the efficiency scores of Turkish banks show an increase over 22 years. There are also specific times (for instance, one year before the economic crises) that efficiency scores substantially fluctuate. These changes might stem from changes in economic environments. Because of those reasons, we added GDP growth rate and inflation rate to the regression. We included dummy variables for each crisis in order to investigate the effects of crises on Turkish banking efficiency. In addition to crisis dummies, we included a reform dummy in order to analyze the effects of the Restructuring Program. These economic indicators do not vary across banks, but instead by years.

After a variable selection, our model specification is:

$$y_{it} = \beta_0 + X'_{it}\beta_1 + \alpha_i + \varepsilon_{it}$$

where y_{it} is the efficiency measure of a ith bank measured at time t, α_i is a fixed effect specific to a bank and δ_t is the fixed effect specific to a time period that is not included in

regression and X_{it} is the explanatory variables that were discussed above. The fixed effect specific to bank α_i and the fixed effect specific to time period δ_t are unobservable and potentially correlated with x_{it}. Errors are independent identically distributed, $\varepsilon_{it} \sim IID(0, \sigma_v^2)$

In Table 7, the parameter estimates of the two way fixed effect panel data regression can be found. In Table 7, fit statistics of the regression are presented. The overall explanatory power of the model (R-Square) is 49%.

When we look at Table 7, we see five out of thirteen variables are significant at a 10% level. Our main contribution in this paper was to look at whether publicly traded banks are more efficient than others. According to the regression, publicly traded banks are significantly more efficient than other banks. In the previous section, we showed that the average efficiency scores of publicly traded banks are higher than non-publicly traded banks. This model confirms that becoming a publicly traded bank has a positive effect on banks performance. The efficient markets hypothesis developed by Fama in 1980 explains two main underlying reasons behind this effect. One is that publicly traded banks are more transparent than others and this transparency can increase banks performance by putting more pressure on bank managers. Second, it is a well-known fact that publicly traded banks are managed by more professional and skilled managers compared to other banks. However, we should admit that this relationship is not explained by a push and pull effect. So we do not imply that if a bank goes to public then its efficiency will increase in the future or that only efficient banks will go public. There is no causality implication in this study. The only interpretation is that publicly traded banks are significantly more efficient than other banks. Our results are consistent with the literature. Berger and Mester (1997) found out that publicly traded banks tend to have higher efficiency results in the US. Casu and Molyneux (2003) examined the efficiency of French, German, Italian, Spanish, and British banks from 1993 to 1997 using the publicly traded dummy variable as in Berger and Mester (1997). Their results also confirm a positive relationship between efficiency and being publicly quoted. In Turkish literature, Işık and Hassan (2003) found out that Turkish banks whose shares are publicly traded in the stock exchange dominate the banks whose shares are not traded in terms of efficiency.

According to our results, the capital adequacy ratio has a statistically significant negative impact on the efficiency of banks. Casu and Girardone (2004), Mester (1996), and Berger and Mester (1997) find a positive relationship between capital adequacy ratio and efficiency, which is in line with moral hazard theory. Işık and Hassan (2003) find that banks with lower

capital are allocatively more efficient and technically less efficient than the banks with higher capital. Our results are consistent with the results of Jackson and Fethi (2001). The negative relationship between the capital adequacy ratio and efficiency could be explained by the fact that banks with a high capital adequacy ratio prefer safer and lower-earning portfolios rather than riskier but higher-earning portfolios. Also, banks can allocate less capital for lending and other profitable activities.

On the other hand, the income-cost ratio has a positive coefficient. Banks that generate more income compared to their costs are more efficient. This is trivial since there are similarities with inputs of efficiency measurement and income-cost structure. So this result is expected and not surprising.

The number of branches is also significant and the sign of coefficient is negative. Our result regarding the number of branches is in line with the results of with Jackson and Fethi (2001), Aysan and Ceyhan (2008), and Fukuyama and Matousek (2011). The negative relationship between the number of branches and efficiency could be explained by the fact that a branch network increases banks' operating cost, and as such, decreases efficiency.

Our statistical findings could not confirm the findings of Isık and Hassan (2003), Berger and Deyoung (1997), or Casu and Girardone (2004), which show a negative relationship between NPLs and efficiency. Also, we could not find any existing relationship between profitability and efficiency. Finally, we could not find any relationship between efficiency and asset size and we were not able to support the quiet life and efficient structure hypothesis.

Table 7: Parameter Estimates of Two Way Fixed Effect Panel Data Regression

Fit Statistics			
SSE	15,3725	DFE	728
MSE	0,0211	Root MSE	0,1453
R-Square	0,4923		

Parameter Estimates				
Variables	Estimate	Standard Error	t Value	Pr > |t|
Intercept	0,7814	0,001	-2,41	0,03
Publicly Traded Flag	**0,0505**	**0,031**	**1,66**	**0,098**
Cap Adequacy	**-0,0013**	**0,001**	**-2,11**	**0,04**
NPL Ratio	0	0	0,82	0,42
Liquidity	-0,0004	0	-0,83	0,41
Profitability	-0,0003	0,001	-0,47	0,64
Income Cost	**0,0004**	**0**	**2,33**	**0,02**
Asset Share	-0,0059	0,007	-0,9	0,37
N of Branches	**-0,0003**	**0**	**-2,1**	**0,04**
Growth Rate	0	very large	.	1
Inflation Rate	-0,2713	very large	.	1
94 Crisis Dummy	0,6532	very large	.	1
2000 Crisis Dummy	0,4561	very large	.	1
2001 Crisis Dummy	0,3986	very large	.	1
2008 Crisis Dummy	0,0054	very large	.	1
Reform Dummy	**0,0505**	**0,026**	**1,86**	**0,06**

Among economic indicators, the reform dummy is positively significant in the regression by supporting the idea that the Restructuring Program has a significant effect on banks' efficiency scores. Our results are consistent with the results of Aysan and Ceyhan (2008). According to our results, the coefficients of all crisis dummies are statistically insignificant. It means that none of crises had an effect on the efficiency scores of banks. In fact, it is an expected result for us. As explained in the previous section, efficiency scores do not decrease in crisis times. We already showed that our efficiency scores respond to crises in the year preceding the crises. So a drop in the efficiency score is not a result of a crisis. On the contrary it is premonitory to an economic crisis. This finding contradicts the results of Yildirim (2002), Mercan and Yolalan (2003), and Işık and Hassan (2002). They reported that the performance of the Turkish banking sector decreased in the 1994 crisis. On the other

hand, Aysan and Ceyhan (2008) find that the efficiency of the Turkish banking sector increased in the 1994 crisis. According to Aysan and Ceyhan (2008), 125 bank branches closed and traditional banking theory, which states that crisis increases the efficiency of sectors by eliminating weak banks was realized.

6. CONCLUSION

This paper aimed to analyze the long term efficiency performance of Turkish commercial banks during the periods of 1990 and 2011. The 3 inputs 3 outputs DEA model was used in order to calculate the efficiency scores of banks. We also were interested in exploring the determinants of efficiency. Therefore, the fixed effect panel data model was conducted and efficiency measures were regressed on banks-specific variables such as capital adequacy ratio, NPL ratio, liquidity, profitability, income-cost ratio, asset share, number of branches, number of employees, a publicly traded dummy, crisis dummies, and a reform dummy.

We found that the overall efficiency of the banking sector and the efficiency scores of all bank groups increased during the period of 1990 and 2011. Also, we observed that fluctuations in efficiency scores started to decrease after 2001. Variance of efficiency growth decreases especially after 2001. This result can be quite intuitive and leading in the sense that this instability before 2000 can be associated with the unstable structure of the Turkish economy in terms of ever-changing inflation, the growth rate, and interest rates. Furthermore, following the lessons learned from the 2001 crisis, attempts to reconstruct the banking sector and a more stable political and economic environment in Turkey explains why efficiency scores have been starting to show a smoother trend after 2001.

In terms of bank groups, our study finds that foreign banks having branches in Turkey were the most efficient bank groups until 2001. The average efficiency of foreign banks with branches in Turkey is 0.886 until 2001. During the period up until 2001, state owned banks performed with the worst average efficiency score (0.795). After 2001, the efficiency performance of state owned banks improved and state owned banks become the most efficient bank group with its 0.979 average efficiency score. On the other hand, privately owned bank groups became the least efficient bank groups with an average 0.891 efficiency score.

Our results show that average bank efficiency levels decreased one year before the 1994 and 2001 crises and improved in the peak of the crises. However, in the 2008 global financial crisis, we could not observe the same pattern as in the domestic crises. We concluded that the reaction of the Turkish banks to domestic and global financial crises differ from each other. The effect of the global financial crisis on Turkish banks' efficiency score is slight compared to domestic crises and the source of the decrease in the mean efficiency scores in 2009 is a huge decrease in the efficiency scores of foreign banks.

The regression results reveal that banks whose shares are traded in the ISE have a higher efficiency score than other banks. This finding is in line with the efficient market hypothesis, with two underlying reasons for this effect: transparency and professional management. Our results show that capital adequacy ratio and bank efficiency are negatively related. Banks holding more capital are less efficient than other banks that hold less capital. The explanation of this inverse relation could be the fact that banks with a high capital adequacy ratio have chosen safer and lower-earning portfolios rather than riskier but higher-earning portfolios and that banks can allocate less capital for lending and other profitable activities. We also find a statistically significant negative relationship between the number of branches and efficiency. An increase in the number of branches causes a decrease in efficiency due to the operational cost of branches. We could not confirm a significant relationship between NPL ratio and profitability ratio, and liquidity ratio and efficiency.

Among the dummy variables, the reforms dummy has a statistically significant positive coefficient. Reforms conducted in line with the Banking Sector Restructuring Program and strict banking sector regulation implemented by BRSA have significant effects on efficiency of banks.

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APPENDIX

Table 8: Number of Banks, Branches and Employees From 1990 to 2011

Years	Number of Banks					Number of Branches	Number of Employees
	State Owned Banks	Privately Owned Banks	Foreign Banks	Banks Under SDIF	Total		
1990	8	25	23		56	6,560	154,089
1991	8	26	21		55	6,477	152,901
1992	6	31	20		57	6,206	146,823
1993	6	32	20		58	6,241	143,983
1994	6	29	20		55	6,104	139,046
1995	5	32	18		55	6,240	144,793
1996	5	33	18		56	6,442	148,153
1997	5	36	18		59	6,819	154,864
1998	4	38	18		60	7,370	166,492
1999	4	31	19	8	62	7,691	173,988
2000	4	28	18	11	61	7,837	170,401
2001	3	22	15	6	46	6,908	137,495
2002	3	20	15	2	40	6,106	123,271
2003	3	18	13	2	36	5,966	123,249
2004	3	18	13	1	35	6,106	127,163
2005	3	17	13	1	34	6,247	132,258
2006	3	14	15	1	33	6,849	143,143
2007	3	11	18	1	33	7,618	158,534
2008	3	11	17	1	32	8,790	171,598
2009	3	11	17	1	32	9,027	172,402
2010	3	11	17	1	32	9,465	178,503
2011	3	11	16	1	31	9,834	181,418

Source: Banking Regulation and Supervision Agency, 54th Year Statistics

Table 9: Banks Transferred to SDIF

Bank	Takeover date	Status
Interbank	Jan 7, 1999	Merged with Etibank on June 15, 2001
Esbank	Dec 21, 1999	Merged with Etibank on June 15, 2001
Egebank	Dec 21, 1999	Merged with Sümerbank on January 26, 2001
Yurtbank	Dec 21, 1999	Merged with Sümerbank on January 26, 2001
Yaşarbank	Dec 21, 1999	Merged with Sümerbank on January 26, 2001
Bank Kapital	Oct 27, 2000	Merged with Sümerbank on January 26, 2001
Ulusalbank	Feb 28, 2001	Merged with Sümerbank on January 26, 2001
İktisat Bankası	Mar 15, 2001	Merged with Bayındırbank on April 5, 2002
Kentbank	Jul 9, 2001	Merged with Bayındırbank on April 5, 2002
Etibank	Oct 27, 2000	Merged with Bayındırbank on April 5, 2002
EGS Bank	Jul 9, 2001	Merged with Bayındırbank on January 18, 2002
Toprakbank	Nov 30, 2001	Merged with Bayındırbank on September 30, 2002
Pamukbank	Jun 19, 2002	Transferred to Türkiye Halk Bankası on November 12, 2004
Bank Ekspres	Dec 12, 1998	Sold to Tekfen Group on June 30, 2001, later merged with Tekfenbank on October 18, 2001
Demirbank	Dec 6, 2000	Sold to HSBC on December 13, 2001
Sümerbank	Dec 21, 1999	Sold to Oyakbank on January 11, 2002
Sitebank	Jul 9, 2001	Sold to Novabank SA on January 25, 2002
Tarisbank	Jul 9, 2001	Sold to Denizbank on December 27,2002
Türk Ticaret Bankası	May 26, 1997	Liquidated on August 9, 2002
Kıbrıs Kredi Bankası	Sep 27, 2000	Operation permission revoked on September 28,2000 and liquidation is going on
Imarbank	Jul 3, 2003	Operation permission revoked on June 08, 2005 and liquidation is going on
Bayindirbank	Jul 9, 2001	Restructured as transition bank
Marmara Bank	April 20,1994	Bankruptcy decision given on June 05,1995
TYT Bank	April 11,1994	Bankruptcy decision given on December 2,1996
Impex Bank	April 23,1994	Bankruptcy decision given on October 22,1996

Source: SDIF, Banking Regulation and Supervision Agency

Table 10: Mergers in the Turkish Banking Sector

Merged Institutions	Title After Merger	Date of Action Completion
Osmanli Bank and Körfezbank	Osmanli Bank	August 31, 2001
Garanti Bank and Osmanli Bank	Garanti Bank	December 14, 2001
HSBC Bank Plc. and Demirbank	HSBC Bank Plc.	December 14, 2001
Tekfen Yatırım and Bank Ekspres	Tekfen Bank A.Ş.	October 26, 2001
Oyak Bank and Sümerbank	Oyak Bank	January 11, 2001
Morgan Guaranty and The Chase Manhattan	JPMorgan Chase & Co	December 14, 2001
Sınai Yatırım Bank and T. Sınai Kalkınma Bank	T. Sınai Kalkınma Bank A.Ş.	March 29, 2002
Milli Aydın Bank (Tarişbank) and Denizbank	Denizbank	December 27, 2002
Finansbank and Fibabank	Finansbank	April 9, 2003
Benkar Tüketici Finansmanı ve Kart Hiz. and HSBC	HSBC	December 25, 2002
Credit Lyonnais SA and Credit Agricole Indosuez T.A.Ş.	Credit Agricole Indosuez T.A.Ş	March 3, 2004
Ak Uluslararası Bankası A.Ş. And Akbank T.A.Ş.	Akbank T.A.Ş.	September 9, 2005
Koçbank A.Ş. ve Yapı And Kredi Bankası A.Ş.	Yapı ve Kredi Bankası A.Ş.	September 28,2006
Türkiye Ekonomi Bankası and Fortis Bank	Türkiye Ekonomi Bankası	February 14, 2011

Source: Banking Regulation and Supervision Agency, Banking Sector Restructuring Program Progress Report (2003) and From Crisis to Financial Stability Turkey Experience 3rd Edition

Table 11: Share Transfer in the Banking Sector

	Transferrer of Equity	Acquirer of Equity	Title after Acquisition	Date	Country of Acquirer Ins.	Explanation
1	Koçbank A.Ş.	Unicredito	Koçbank A.Ş.	08.08.2002	Italy	Banks' indirect share of 49.5% passes to UCI.
2	T. Ekonomi Bankası A.Ş.	BNP Paribas	T. Ekonomi Bankası A.Ş.	28.12.2004	France	BNP Paribas' indirect share at TEB is 42.1%.
3	T. Dış Ticaret Bankası A.Ş.	Fortis Bank NV-SA	Fortis Bank A.Ş.	22.06.2005	Luxembourg-Belgium	89.3% of Dışbank's shares transferred to Fortis Group.
4	Yapı ve Kredi Bankası A.Ş.	Koç-Unicredito	Yapı ve Kredi Bankası A.Ş.	11.08.2005	Turkey-Italy	57.4% of banks shares transferred to Koç-Unicredito.
5	T. Garanti Bankası A.Ş.	General Electric	T. Garanti Bankası A.Ş.	22.12.2005	USA-France	22.5% of banks shares transferred to General Electric Ata ve Müşavirlik Ltd. Şti.
6	Finans Bank A.Ş.	National Bank of Greece SA	Finans Bank A.Ş.	28.07.2006	Greece	46% of Finans Bank A.Ş. Sharres transferred to National Bank of Greece S.A.
7	C Kredi ve Kalk. Bankası A.Ş.	Tarshish Hapoalm Hold.&Inv. Ltd.	Bank Pozitif Kredi ve Kalkınma B. A.Ş.	17.08.2006	Israel	Tarshish Hapoalm Hold. And Invest. Ltd. Company acquired 57.6% of this bank.
8	Arap Türk Bankası A.Ş.	Libyan Foreign Bank	Arap Türk Bankası A.Ş.	22.06.2006	Libya-Kuwait	Libyan Foreign Bank which owns 47.7% of Arap Türk Bankası A.Ş., acquired 10.9% of Tekfen Bank A.Ş.
9	Denizbank A.Ş.	Dexia Participation B. S.A.	Denizbank A.Ş.	28.09.2006	Belgium-France	75% of Denizbank's shares acquired by Dexia Participation Belgique S.A.
10	Tat Yatırım Bankası A.Ş.	Merrill Lynch European A. H. Inc.	Merrill Lynch Yatırım B. A.Ş.	30.11.2006	USA	99.95% of Tat Yatırım Bankası A.Ş. acquired by Merrill Lynch European Asset Holdings Inc.

11	Akbank T. A.Ş	Citibank Overseas I.C.	Akbank T. A.Ş	06.12.2006	USA	20% of Akbank T.A.Ş. acquired by Citibank Overseas Investment Corporation (COIC).
12	Şekerbank T. A.Ş.	Bank Turanalem JSC	Şekerbank T. A.Ş.	21.12.2006	Kazakhistan	33.98% of Bank's shares acquired by Turan Alem Securities JSC, owned by Bank TuranAlem JSC.
13	MNG Bank A.Ş.	Arap Bank BankMed	Türkland Bank A.Ş.	28.12.2006	Jordan-Lebanon	50% of MNG Bank A.Ş. Shares acquired by Arap Bank and 41% by BankMed.
14	Tekfenbank A.Ş.	EFG Eurobank Ergasias S.A.	Tekfenbank A.Ş.	23.02.2007	Greece	70% of Tekfenbank A.Ş. Shares sold to EFG Eurobank Ergasias S.A. (Eurobank)

Source: Banking Regulation and Supervision Agency (2002). From Crisis to Financial Stability, Turkey Experience.