THE EFFECTS OF TRANSITION TO MODERN BANKING AND 2008 GLOBAL FINANCIAL CRISIS ON THE EFFICIENCY OF THE TURKISH BANKING SECTOR

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Approval of the Graduate School of Social Sciences

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ABSTRACT

THE EFFECTS OF TRANSITION TO MODERN BANKING
AND
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This thesis measures the effects of transformation of Turkish banks from a "traditional" one to a "modern" one over the period 2002-2009 and 2008 global financial crisis on efficiency of Turkish banks. Malmquist Total Factor Productivity Index is constructed using data envelopment analysis to measure the efficiency change in Turkish banking sector. The paper also analyzes the sensitivity of efficiency measures to different descriptions of inputs and outputs by employing two different approaches to describe the inputs and outputs of a bank. The major difference between the approaches is the use of deposits and non-deposit funds as input or output. Both confirm that the efficiency of the Turkish banking sector had increased over the period under examination and 2008 global financial crisis had adversely affected the efficiency of Turkish banks. The results show that the banks which had advanced in transformation to modern banking before 2001 financial crisis had experienced higher than the average increments in efficiency in the post-2001 financial crisis period.

Keywords: Efficiency, Modern Banking, Malmquist, DEA.

ÖZ

MODERN BANKACILIĞA GEÇİŞ
VE
2008 KÜRESEL FİNANSAL KRİZİN
TÜRK BANKACILIK SEKTÖRÜNÜN VERİMLİLİĞİ ÜZERİNDEKİ ETKİLERİ

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Bu çalışma, Türk bankalarının 2002-2009 döneminde geleneksel bankacılıktan modern bankacılığa geçişinin ve 2008 küresel finansal krizinin Türk bankacılık sektörünün verimliliği üzerindeki etkilerini ölçmektedir. Türk Bankacılık sektörünün verimliliğindeki değişimi ölçmek için veri zarflama analizi kullanılarak Malmquist Toplam Faktör Verimlilik Endeksi oluşturulmuştur. Çalışma aynı zamanda girdi ve çıktıları iki farklı yaklaşımla tanımlayarak verimlilik ölçümünün girdi ve çıktı tanımlarındaki değişime hassasiyetini ölçmektedir. Yaklaşımlar arasındaki temel fark mevduat ve mevduat dışı fonların girdi veya çıktı olarak kullanılmasıdır. Her iki yaklaşım da Türk bankacılık sektörünün verimliliğinin 2002-2009 döneminde arttığını ve 2008 küresel finansal krizinin Türk bankacılık sektörünün verimliliğini olumsuz etkilediğini teyit etmektedir. Sonuçlar, 2001 finansal krizi öncesinde modern bankacılığa geçiş sürecinde ileri seviyelere gelmiş olan bankaların, 2001 finansal krizi sonrasındaki dönemde ortalamanın üzerinde verimlilik artışı sağladıklarını göstermektedir.

Anahtar Kelimeler: Verimlilik, Modern Bankacılık, Malmquist, VZA.

To My Parents and Brother

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CHAPTER 1. INTRODUCTION

The Turkish banking sector is one of the few to survive the 2008 global financial crisis without acquiring any financial backing from the government or requiring additional capital injection by its shareholders. Turkish banking authorities declared that the reasons behind this success are;

- strict banking regulations put into force and measures taken after the 2001 banking crisis in Turkey and
- Turkish banks' balance sheets being devoid from toxic derivative products in contrast with the banks' balance sheets in industrialized countries.

However, besides these rightful reasons, the transition of the Turkish banking system from a "traditional" to a "modern" one over the 1995-2010 period has also been helpful. The transformation of the system increased efficiency of banks, which helped boost banks' assets and profit margins leading to fast growth of equity capital. More efficient working of the banking sector hence helped to maintain the necessary capital adequacy ratios to overcome the 2008 global financial crisis.

Before the year 2001, the Turkish Banking system was indeed undeveloped in terms of equity capital, asset size, diversity of products, education level of employees, organizational structure, data mining capabilities and technological infrastructure compared to its counterparts in industrialized countries. The Turkish banking system experienced a severe banking crisis in 2001 which led to bankruptcies and confiscation of several banks by the government and the sector experienced severe cut backs in employment. However, from 2002 onwards, assets, loans and profits

have increased with unprecedented growth rates. Total assets of the Turkish banking sector grew from 130 billion USD in year 2002 to 530 billion USD in year 2009. Over the same time period, total equity capital grew from 16 billion USD to 71 billion USD; the share of loans in total assets from 26.5% to 47.7%; the return on equity capital from 9.2% to 18.3% and the return on paid capital grew from 19.6% to 48.9%.

The development in the banking sector however, is not limited to these growth rates. Although, the Turkish financial system has grown with a rocket pace after year 2002, it could only restore its pre-crisis-era employment levels in year 2009. While total employment level of the Turkish banking system was 170,401 in year 2000, it reached 172,402 in year 2009.

These figures show us that the efficiency of the banking system had increased after the 2001 crisis but decreased during 2008 global financial crisis. Number of employees, total assets, loans, equity capital, per employee levels of assets, loans and equity capital of the Turkish banking sector are depicted in the appendix A.

Turkish banks had embarked on several projects after 2001 crisis to increase their efficiency. These projects are the major steps of transforming into a modern bank. However, four banks which had started this phase earlier than others and much advanced in modernization process before 2001 financial crisis; Garanti Bank, Akbank, Yapı Kredi Bank and Finansbank (Öngör; 2010, Erel; 2005, Maro; 2005, Sabancı; 2005). All four banks had started to centralize banking operations in operation centers and invest in advanced information technologies before 2001 financial crisis, leaving more time and room for sales activities in branches.

The transformation of a bank from a “traditional” one to a “modern” one means acquiring and employing;

- more efficient organizational structure,
- measurable and effectively manageable database systems,
- effective data mining capabilities,
- highly educated labor,
- effective control of income and expense components,
- decreased operating expenses via centralization of operations,
- better out-of-branch banking capabilities,
- effective and fast sales and processing of loans

Turkey was affected adversely by the 2008 global financial crisis and there is yet no study to analyze the effect of the 2008 global financial crisis on the efficiency of Turkish banking sector.

The aim of this thesis is three fold;

- put forward the effects of transformation of banks from a “traditional” one to a “modern” one on efficiency,
- measure the change in efficiency of Turkish banking sector between over the period 2002-2009 and the effects of 2008 global financial crisis on efficiency of Turkish banks,
- measure the sensitivity of efficiency measures to different descriptions of inputs and outputs by employing two different approaches.

There are two main approaches to obtain an efficiency index for the banking sector, namely “the intermediation approach” and “the production approach”. Both

mentioned approaches and various mixes of them were employed in numerous studies to obtain efficiency index. Both the generally accepted "intermediation approach" and a mix of "intermediation" and "production" approaches will be employed in this paper to obtain efficiency index. More specifically, DEA type Malmquist Total Factor Productivity Index is constructed to measure changes in the efficiency of eight biggest (in terms of assets) Turkish banks over the 2002-2009 period. The technical efficiency change, technological change, pure technical efficiency change and scale efficiency components of Malmquist approach are reported.

The data is obtained from the Banks Association of Turkey. Our sample includes the largest 8 banks out of 45 as of end 2009, which account for 82% of total assets, 77% of total loans, 87% of total deposits, 72% of total equity share capital of the Turkish banking sector. The remaining 37 banks were considered too small to affect efficiency of the banking sector. Number of employees, number of branches, net tangible assets and expenses are employed as inputs, while loans and receivables, other earning assets, off-balance-sheet items and income are employed as outputs. Deposits and non-deposit funds are treated as input in intermediation approach and as output in the mixed approach.

The thesis is organized as follows; Chapter 2 gives an overview of the Turkish banking system, Chapter 3 explains what is expected to change with the transformation of banks from a "traditional" one to a "modern" one, Chapter 4 explains the methodology used and presents a literature survey, Chapter 5 includes a description of data and empirical results, and Chapter 6 concludes the thesis.

CHAPTER 2. OVERVIEW OF THE TURKISH BANKING SECTOR

This chapter gives a summary of the development of the Turkish banking sector since 1997. Turkish economy experienced a severe banking crisis in 2001. This led to the restructuring of the banking system and the adoption of a series of legal precautionary measures. Soundly regulated and structurally strong Turkish banking system had not been affected severely during the 2008 world financial crisis. Summary of the developments in the banking sector over this time period is given in this chapter in three parts:

- 1997-2001 period: an overview of the Turkish economy and 2001 banking crisis,
- 2002-2007 period: a summary of the legal and structural measures taken to prevent a similar banking crisis,
- 2008-2009 period: an analysis of the effects of 2008 world financial crisis on Turkish banking system.

2.1. 1997-2001 Period: An Overview of the Turkish Economy and the 2001 Banking Crisis

2.1.1. Basic Economic Indicators

Turkey has been aiming to enter the EU since 1963 (Ankara EU Association Agreement). To attain this target Turkey has to conform to the Maastricht Criteria, two of which are;

- budget deficit has to be below 3% of GDP,

- public debt has to be below 60% of GDP.

However, as seen in Table 1, the budget deficit had been increasing since 1997. In 2000, Turkey started a new economic program with IMF support. The program contained predetermined levels of foreign exchange rate for one and a half years which would then lead to a floating exchange rate regime.

As it can be seen in Table 1, budget deficit had increased from 7.8 percent of GDP in 1997 to 17.7 percent in 2001. Although, the fiscal indicators had improved with the employment of the IMF program in 2000, budget deficit increased again in 2001 with the breakdown of fiscal and monetary policy. The fiscal discipline could not be maintained, public sector borrowing requirement (PSBR) and public debt increased along with the consolidated budget deficit, except for 2000. The increase in PSBR caused real interest rates to increase due to increasing doubts over possible failure of debt service of Turkish Treasury. This in turn caused a vicious circle: high PSBR led to high real interest rates (due to increased risk premium) and high real interest rates increased interest payments and accordingly PSBR. All these unfavorable conditions increased the fluctuation of GDP growth rates (Table 1). High real interest rates and PSBR and unfavorable economic conditions caused a crowding-out effect (Müslümov, Hasanov, Özyıldırım; 2003), contributing to the volatility of GDP growth rates.

Table 1: Basic Fiscal Policy Indicators in Turkey Between 1997-2001

Source: Özatay, (2009), Finansal Krizler ve Türkiye, Doğan Kitap

Share of GDP (in %)	**1997**	**1998**	**1999**	**2000**	**2001**
Public Sector Borrowing Requirement	7.8	9.6	15.8	12.6	15.7
Duty Loss of State Banks	5.3	7.7	13.4	12.1	0
Consolidated Budget Deficit	7.8	7.3	11.7	10.3	17.7
Consolidated Budget-Interest Payments	7.9	11.8	13.9	16.4	22.7
Public Debt	42.0	41.4	52.6	54.4	104.3
Average Treasury Interest Rate (%)	124.5	115.5	105.6	36.2	99.6
Year-end Consumer Inflation (%)	99.1	69.7	68.8	39.0	68.5
GDP Growth Rate (%)	7.5	3.1	-4.7	7.4	-7.5

Hence, basic economic indicators given above reveal the fact that the fiscal policy between 1997-2000 resulted in;

- Higher budget deficits and PSBR,
- Higher public debt,
- Crowding out effect and
- Increased volatility in GDP growth rates.

2.1.2 The Banking System

By the end of 1997, there were 72 banks in Turkish banking system with total assets of 95 billion USD and 154,864 employees (Banks Association of Turkey, 2010 b). The number of commercial banks was 59 with total assets of 90 billion USD, total

loans of 40 billion USD, total deposits of 61 billion USD and 149,618 employees. 95% of the banking system was controlled by commercial banks. The largest 5 banks consisted of 2 state banks (Ziraat Bank and Halkbank) and 3 private banks (Is Bank, Yapı Kredi Bank and Garanti Bank). The concentration in the banking system was pretty high, where the largest 5 banks controlled 46% of total assets, the largest 10 banks controlled 70%. Moreover, 48% of the total profit was generated by the largest 5 banks and 81% by the largest 10 banks. Only 5 state banks were employing 46% of total employees while controlling 37% of total assets. 37 private banks, on the other hand, were employing 42% of employers while controlling 60% of total assets. This could be seen as an indicator of labor inefficiency in state banks. 17 foreign banks, however were almost inexistent, controlling only 3% of total assets and total equity capital (Table 2).

Table 2: Control Share of Commercial Banks in 1997

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

		Total Share (%)					
	No. of Banks	**Assets**	**Loans**	**Deposits**	**Equity Capital**	**Profit**	**Employees**
State Banks	5	37	37	40	30	9	46
Private Banks	37	60	61	58	67	85	53
Foreign Banks	17	3	2	2	3	6	1
The Largest Five Banks*	5	46	50	47	47	48	52
The Largest Ten banks*	10	70	74	72	72	81	75

Note: *In terms of assets

Increasing interest rates due to high PSBR and fixed exchange regime created profit opportunities through carry trade and funding the government. However, there were two main problems with the banking sector in Turkey between 1997 and 2001;

1. ratio of FX obligations to FX receivables was very high,
2. there was serious maturity mismatch between payables and receivables on banks' balance sheets.

Banks were funding the Turkish Treasury with overnight REPO's. The profits were high and so were the risks. There was a serious maturity mismatch; if the prices of treasury bills would go down immediately, it would increase the interest rates making it very expensive to use overnight REPO's as a source of funding Turkish Treasury (Özatay; 2009). Currency crisis would aggravate the situation since the FX receivables/FX obligations ratio in the banking sector was falling (Table 3).

Table 3: Turkish Banking Sector Indicators Between 1997-2001

Source: Özatay, F., Finansal Krizler ve Türkiye, Doğan Kitap, 2009

(Percentage)	**1997**	**1998**	**1999**	**2000**	**2001/9**
NPL/Loans	2.4	7.2	10.7	11.6	18.6
FX Receivables/FX Obligations	89.6	84.9	79.4	75.9	81.0
FX Obligations-FX Receivables (billion USD)					
on Balance Sheet	5.0	8.4	13.2	17.4	12.4
off Balance Sheet	1.9	2.9	2.9	5.5	0.7
Receivables/Obligations (with maturity equal to or less than three months)	45.8	45.7	46.3	39.9	43.9

Table 3: Turkish Banking Sector Indicators Between 1997-2001

Source: Özatay, F., Finansal Krizler ve Türkiye, Doğan Kitap, 2009

(Percentage)	**1997**	**1998**	**1999**	**2000**	**2001/9**
Deposits with maturity less than 6 months/ Total Deposits	24.7	22.9	28.2	15.1	11.6

Private banks were financing long term interest earning assets with very short term funds at REPO market. Structure of deposits was also risky. Interest earning assets were mostly TL, while share of FX deposits to TL deposits was over 200% in private banks between 1997 and 2000 (Table 4).

Table 4: Structural Characteristics of Turkish Banks (1997-2000)

Source: Özatay, F., Finansal Krizler ve Türkiye, Doğan Kitap, 2009

Ratio		**1997**	**1998**	**1999**	**2000**
Loan/Domestic Government Bonds (DGB)	Private	114	119	83	131
	State	86	88	66	59
REPO/TL Deposit	Private	123	83	107	53
	State	22	19	14	27
FX Deposit/TL Deposit	Private	212	202	275	209
	State	46	36	26	29
Share of FX Loans	Private	14	14	16	20
	State	3	3	2	3
Ratio of Equity Capital	Private	9	10	11	12
	State	5	4	4	3
Share of Duty Loss	State	27	28	32	31

State banks, on the other hand, were establishing loans to agricultural sector and small and medium sized enterprises with interest rates much lower than market rates.

This was a government policy. The loss was booked as "Receivables from Government Due to Duty Losses" on balance sheets. Then the overdue part of such receivables would be booked as "duty loss" on state banks' income statements. Size of duty losses were over 50% of their total assets (Uçarkaya; 2006). Those subsidies could be carried out of government budget through state banks' duty losses. Those losses lowered the equity capital of state banks. The ratio of "non performing loans (NPL) to total loans" of the banking sector increased from 2.4% in 1997 to 11.6% in 2000. Control of 7 private banks was given to Savings Deposit Insurance Fund (SDIF) in December 1999 and October 2000. It was then understood that non-performing loans on the balance sheets of those banks were much higher than thought, actually mentioned banks were all bankrupt (Özatay; 2009).

State banks and private banks with major maturity mismatch problems were having serious liquidity problems. There was an FX rush; both domestic and foreign residents preferred to convert TL to USD. Increased fragility in the banking system eliminated the effectiveness of the monetary policy and liquidity management conducted by Central Bank of Republic of Turkey (Serdengeçti; 2002).

A political crisis in on 19th of February 2001 triggered a new financial crisis causing overnight interest rates to increase to 4,019% on February 21. State banks were not able to fulfill their obligations in money and REPO markets. Securities and domestic money market and payment systems ceased to function (Turkish Government; 2009). The peg could not be defeated any longer. By February 23, floating exchange rate system was employed instead of the fixed exchange rate regime to stop the decrease in FX reserves of CBRT.

The excess risks taken by some private banks and disguised bankruptcies all revealed the fact that banking supervision in Turkey was insufficient and inefficient. Private

banks were sources of funds to government while state banks were used as fund sources for out of budget-government spending. The crowding out effect caused by high PSBR, were tightening funds to real sector in need of liquidity. This in turn was causing volatility in growth rate of GDP. Also government spending policies using state banks were sweeping off the equity share of state banks, which were controlling 37% of total assets and 40% of total deposits in 2007.

The problems mentioned above were mainly due to dangerous populist government spending, ineffective banking supervision system and incapacitated risk management in small and medium sized Turkish banks.

Financial crisis of 90's and the devastating results weakened the major function of the banking system: to support real sector. The share of loans in total assets fell from 47% in 1990 to 33% in 2000, the loan/deposit ratio on the other hand fell from 84% in 1990 to 51% in 2000 (Turkish Government; 2009).

By the end of 2002, there were only 54 banks in the system with total assets of 130 billion USD (BAT; 2010 b). Control of 20 banks, with 33,405 employees and assets totaling to 15% of the total assets of the banking system was given to SDIF. Full SDIF guarantee for saving deposits was annulled in 2004. Total loss emanated from those 20 banks was 23,2 billion USD. The structural problems were a real threat to an efficient financial system and had to be solved within a new legal framework, specifying new rules for banking and supervision. The next section gives an overview of measures to solve the structural problems of Turkish banking system.

2.2. 2002-2007 period: Legal and Structural Measures

The 2001 financial crisis showed that budget deficit and populist government spending was harmful to both banking sector and real sector. Structurally weakened state banks that were controlling 40% of deposits was a threat to banking sector. High interest rates due to high PSBR was causing a crowding out effect disabling private investment. The crisis showed that banking supervision was very poor. State banks and some of the small and medium sized private banks turned out to be structurally weak. The 2001 financial crisis triggered a liquidity crisis. Money markets seized functioning during crisis and trust in banking system was very low in the post-crisis era. State banks needed to be restructured, bankrupt banks needed to be liquidated by SDIF and supervision of the banking system needed to be strengthened.

2.2.1. Short Term Measures

A new program was employed in May 2001 to restructure the banking system in Turkey. The elements of restructuring of the Turkish banking system is depicted in the working paper (Turkish Government; 2009) written by a work group formed by the members of Banking Regulation and Supervision Agency, Saving Deposit Insurance Fund, Undersecretariat of Treasury, Central Bank of Republic of Turkey. The aim of the program was to;

- restructure state banks,
- liquidate of the banks under control of SDIF,
- rehabilitate private banking system,
- strengthen the banking supervision and audit,
- increase efficiency of the banking system

Banking regulation and supervision had been conducted by various government agencies (Undersecretariat of Treasury, Central Bank of Republic of Turkey, Prime Ministry, Ministry of Finance, Capital Markets Board of Turkey, Turkish Court of Accounts) until November 2000. By the enactment of Banking Law No. 4389 in June 1999, the regulation and the supervision was handed to a single authority, namely the "Banking Regulation and Supervision Agency (BRSA)". BRSA started to operate in November 2000.

The analysis of bankruptcies during crisis revealed the fact that;

- Infirmity in issuing of banking licenses,
- Low barriers to entry to the banking sector,
- Hardship of annulment of banking licenses

were major sources of corruption in banking system (Turkish Government; 2009). CBRT and Undersecretariat of Treasury ensured liquidity of the banking system through declared o/n interest rates in REPO market and coordinated FX sales and "Duty Losses" of state banks are paid to fulfill their liquidity needs. Turkish Treasury exchanged short-term TL treasury bills with long-term, USD-index-linked TL treasury bills to mitigate the currency mismatch of the banking system (Serdengeçti; 2002).

2.2.2. Restructuring of the Banking System

The restructuring of the banking system can be classified under five main titles. These are mainly the restructuring of the state banks, resolution of the banks under

control of SDIF, restructuring of private banks, enhancement of supervision and audit of banking system and new legal arrangements, resolution of non-performing loans (Turkish Government; 2009). Each element of restructuring program is explained below.

The following measures are taken during the restructuring of state banks (Turkish Government; 2009, Uçarkaya; 2006);

- the duty losses carried by state banks (almost 17 billion USD by the end of 2001) were paid back to state banks by treasury bills and the legal arrangements for duty losses were annulled,
- about 3,5 billion USD of capital injection (mostly as securities) were made,
- state banks were given "corporation" status subject to corporate and banking laws,
- technological, organizational infrastructure and risk management systems were updated,
- 27% of the existing employees were given the option of early retirement by 30.09.2003,
- 32.5% of the branches have been shut down and 50% of the employee were transferred to other public corporations.

Control of 20 banks, with 33,405 employees and assets totaling to 15% of the total assets of the banking system was given to SDIF. Full SDIF guarantee for saving deposits was annulled in 2004. Total loss emanated from those 20 banks was 23.2 billion USD. Total collection from the controlling shareholders had been 18.7 billion USD by 31.12.2009 (SDIF, 2010).

Shareholders of private banks provided 2.7 billion USD capital injection between 2001-2003. Legal arrangements were made to prevent concentration of loans in terms of company groups and sectors. Accounting system had been adjusted according to international standards (Turkish Government; 2009).

High level of non-performing loans was resolved by a platform of banks with support of new legal arrangements (The Istanbul Approach in 2002 and Anatolian Approach in 2007) and asset management companies.

Other legal arrangements can be itemized as follows (Turkish Government; 2009);

- CBRT was prohibited from establishing loans to treasury (November 2001),
- administrative autonomy of CBRT was secured,
- capacity of BRSA has been increased to take on audit of financial holdings, financial leasing companies and other finance companies along with banks,
- banks are started to be rated and monitored according to CAMELS criteria (capital adequacy, asset quality, management, earnings, liquidity, sensitivity to market risk),
- technology and information systems of banks started to be audited on regular basis,
- banks are warned not to use risky derivative products except for the purpose of hedging,
- "Target ratio" application has been put into practice in November 2006. Minimum level of required capital adequacy ratio for banks (CAR) has been set to 12% (8% of minimum ratio+4% of contingency interval) and banks are forbidden to open new branches unless they provide necessary ratio,
- banks are advised to ask permission from BRSA in order to distribute dividends, if they could not provide necessary CAR,

- a “coordination committee” has been established to increase level of coordination between regulatory, supervising and implementing institutions,
- general impairment charges for loans were increased (banks have to book provision expenses for a certain share of the loans they establish).

After the employment of above mentioned restructuring programs and legal measures, CAR of the banking system increased from 9.3% in 2000 to 18% in 2008 and 19.47% as of May 2010.

2.3. 2008-2009 period: Effects of 2008 World Financial Crisis on Turkish Banking Sector

The post-crisis era was a success story: GDP increased from 229 billion USD in 2002 to 742 billon USD in 2008, when annual inflation decreased from 50% to 8%. The unemployment rate on the other hand, increased from 10.3% to 14%. Basic macroeconomic variables are given in Table 5 below.

Table 5: Macroeconomic Variables of Turkish Economy

Source: Banks in Turkey 2009, Banks Association of Turkey, 2010, http://www.tbb.org.tr/Dosyalar_eng/Yayinlar/Dokumanlar/2Bankalarimiz2009ING.pdf

Country Statistics	**2002**	**2008**	**2009**
GDP (billion USD)	229	742	618
GDP Growth Rate (%)	6.2	0.7	-4.7
GDP Per Capita (USD)	3,296	10,436	8,590
Inflation Rate (CPI) (%)	50	8	6
Unemployment (%)	10.3	14	13.5

Table 5: Macroeconomic Variables of Turkish Economy

Source: Banks in Turkey 2009, Banks Association of Turkey, 2010, http://www.tbb.org.tr/Dosyalar_eng/Yayinlar/Dokumanlar/2Bankalarimiz2009ING.pdf

Country Statistics	**2002**	**2008**	**2009**
Interest Rates (%) (overnight)	-	16	7

2.3.1 Economic Impact of the 2008 Financial Crisis and the Banking Sector

On the contrary to 2001 financial crisis, the 2008 global financial crisis was not a local financial crisis. This time foreign banks were a threat to the financial stability, rather than the Turkish banks. However, the 2008 global financial crisis affected the Turkish economy negatively. Major negative effects of the crisis in Turkey were decrease in consumer demand, inflation, capital inflows and increase in unemployment, budget deficit and public debt stock.

The major response administrative was to assure that no liquidity problems would be experienced in the banking system and keep the local demand vivid during the crisis. Hence the major policy response of CBRT and Turkish government was to decrease interest rates and increase flexibility of legal liquidity requirements while decreasing tax rates on some consumer goods in order to prevent a sharp drop in consumer demand. Consumer loans had been stagnant in terms of TL between October 2008-April 2009, however it was never lower than the level of August-2007 even in USD terms. Consumer loans continued to expand after February 2009.

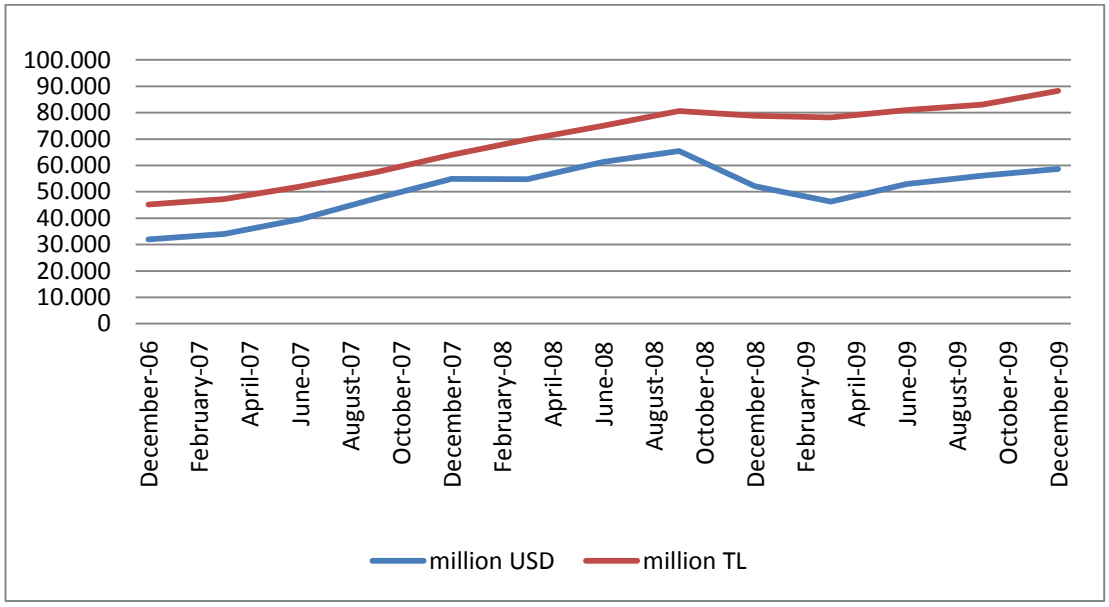

Figure 1: Consumer Loans in Turkey (2006/12-2009/12)

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

All these measures could not stop the decrease in demand for corporate loans, since no firm was willing to embark on new long-term investment projects. But the investments in energy sector continued to grow since Turkish government has declared its strategic support for such investments.

The decrease in interest rates and increasing consumer loans led to a very important result: increase in profits and assets of the banks. Deposits were increasing and banks increased their security portfolios (Turkish treasury bonds/bills) to compensate for the diminishing stagnant level of loans on the asset side of their balance sheets. Falling CBRT overnight borrowing interest rate led to a decrease in interest rates on time deposits, increase in interest margins (deposit-loan margin) and increase in security prices (treasury bills/bonds).

The results above boosted bank profits. The margins, however, started to shrink in 2010, putting more pressure on commission income. Commission gains were considered irrelevant in inflationary times when interest margins were much wider.

2.3.2. The Structure of Turkish Banking Sector in the Post 2008 Financial Crisis Era

The policy response of government and CBRT helped banks to successfully overcome the adverse affects of 2008 global financial crisis on real and financial sector. Altough there has been an increase in non-performning loans, credit and market risks were successfully managed by Turkish banks. Hence, contrary to the rest of the world, the Turkish banking sector increased its profits and assets during the financial crisis and continued its growth since 2002. The increase in total assets, loans, deposits and equity capital can be seen in Table 6 below.

Table 6: Key Data of Turkish Banking System

Source: Banks in Turkey 2009, Banks Association of Turkey, 2010, http://www.tbb.org.tr/Dosyalar_eng/Yayinlar/Dokumanlar/2Bankalarimiz2009ING.pdf

Turkish Banking System* (million USD)	**2002**	**2008**	**2009**
Assets	130,116	466,753	546,587
Loans (excl. NPL)	31,786	242,611	253,984
Non-Performing Loans (NPL)	1,861	8,739	13,608
Deposits	86,809	299,622	344,799
Profit	1,442	8,447	12,665
Equity Capital	15,723	54,682	62,571

* Excludes 4 participation banks.

Although assets and equity shares had increased, the number of private banks fell from 20 in 2002 to 11 in 2009, while number of foreign banks increased from 15 to 17. The number of branches also increased by 50%. While total number of banks in the system fell from 54 in 45, the number of branches increased from 6,106 to 9,027. Turkish Banks' CEOs, declared their plans to;

- increase the number of branches in Turkey and
- open new branches and representative offices in Russia, former Soviet Union countries, the Balkan states, Middle Eastern countries and Egypt

to become "regional financial power". Furthermore, Turkish State Planning Organization declared a strategy document and action plan to make Istanbul an international finance center (Turkish Official Journal, 2009). The vision of the plan is to make Istanbul a global financial center by implementing legal and financial incentives and simpler financial laws.

Table 7: Number of Banks and Branches in Turkey

Source: Banks in Turkey 2009, Banks Association of Turkey, 2010, http://www.tbb.org.tr/Dosyalar_eng/Yayinlar/Dokumanlar/2Bankalarimiz2009ING.pdf

Turkish Banking System*	**2002**		**2008**		**2009**	
	No of banks	No of branches	No of banks	No of branches	No of banks	No of branches
All Banks	54	6,106	45	8,790	45	9,027
Commercial Banks	40	6,087	32	8,741	32	8,991
- *State Owned Banks*	*3*	*2,019*	*3*	*2,416*	*3*	*2,530*

Table 7: Number of Banks and Branches in Turkey

Source: Banks in Turkey 2009, Banks Association of Turkey, 2010, http://www.tbb.org.tr/Dosyalar_eng/Yayinlar/Dokumanlar/2Bankalarimiz2009ING.pdf

Turkish Banking System*	**2002**		**2008**		**2009**	
- *Overtaken by the Fund***	*2*	*203*	*1*	*1*	*1*	*1*
- *Private Banks*	*20*	*3,659*	*11*	*4,290*	*11*	*4,390*
- *Foreign Banks*	*15*	*206*	*17*	*2,034*	*17*	*2,062*
Development and Investment Banks	14	19	13	49	13	44

Notes: * Excludes 4 participation banks (*katilim bankasi*). **Savings Deposit Insurance Fund (SDIF)

Although assets and profits had continuously increased since 2002, the pre-crisis level employment could only be restored in 2009. The most significant increase in employment was due to increasing activities of foreign banks. Foreign banks declared their confidence in the Turkish Banking system by acquisitions and investments to increase branch network. The employment by foreign banks increased from 5,416 in 2002 to 39,676 in 2009. The distribution of employment can be seen in Table 8 below.

Table 8: Number of Employees in the banking system

Source: Banks in Turkey 2009, Banks Association of Turkey, 2010, http://www.tbb.org.tr/Dosyalar_eng/Yayinlar/Dokumanlar/2Bankalarimiz2009ING.pdf

Turkish Banking Sector*	**2002**	**2008**	**2009**
Number of Employees	123,271	171,598	172,402

Table 8: Number of Employees in the banking system

Source: Banks in Turkey 2009, Banks Association of Turkey, 2010, http://www.tbb.org.tr/Dosyalar_eng/Yayinlar/Dokumanlar/2Bankalarimiz2009ING.pdf

Turkish Banking Sector*	**2002**	**2008**	**2009**
Commercial Banks	118,329	166,325	167,063
- *State Owned Banks*	*40,159*	*43,333*	*44,856*
- *Overtaken by the Fund*	*5,886*	*267*	*261*
- *Private Banks*	*66,869*	*82,158*	*82,270*
- *Foreign Banks*	*5,416*	*40,567*	*39,676*
Investment Banks	4,942	5,273	5,339

Note: * Excludes 4 participation banks.

Although the Turkish banking system has come a long way in terms of asset quality, accumulation of capital and technological infrastructure, it is still far below the EU levels in terms of asset size. Asset quality refers to the possibility of impairment of assets. As the quality of assets increase, the possibility of impairment decreases. Ratio of non-performing loans to total loans is the most important indicator of asset quality. Asset per employee in EU is 84,711 Euro while it is only 5,453 Euro in Turkey as of 31.12.2008 (Table 9). Moreover, ratio of total assets to GDP, population to number of employees/branches/banks is still much lower in Turkey than the EU average, as it is seen in Table 9 below.

Table 9: Comparison of EU and Turkish Banking System at end 2008

Source: Banks in Turkey 2009, Banks Association of Turkey, 2010, http://www.tbb.org.tr/Dosyalar_eng/Yayinlar/Dokumanlar/2Bankalarimiz2009ING.pdf

	EU 27	**Turkey**
Asset Size per Employee (Euro)	84,711	5,453
Total Assets / GDP (%)	337	77
Population / Num. of Employee	149	389
Population / Number of Branches	2,092	7,640
Population / Number of Banks	58,550	1,459,531

Another striking change is the increase in the willingness of state and foreign banks to take on the credit risks of Turkish companies. While the share of private banks in the loan market decreased from 65% in 2002 to 52% in 2009; the share of state banks increased from 20% to 27% and the share of foreign banks increased from 4% to 17%. This may be due to increased risk management capabilities of state banks and confidence of foreign banks in the Turkish economy and domestic producers. The market share of banks according to ownership structure is given in Table 10 below.

Table 10: Market Share of the Banks According to Ownership Structure

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

Type of Banking and Ownership Structure	**Total Assets (%)**			**Total Deposits (%)**			**Total Loans (%)**		
	2002	**2008**	**2009**	**2002**	**2008**	**2009**	**2002**	**2008**	**2009**
Commercial Banks	96	97	97	100	100	100	89	96	96
- *State Banks*	*36*	*29*	*31*	*39*	*36*	*37*	*20*	*24*	*27*
- *Fund*	*	*	*	*	*	*	*	*	*
- *Private*	*56*	*52*	*52*	*58*	*51*	*50*	*65*	*54*	*52*

Table 10: Market Share of the Banks According to Ownership Structure

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

Type of Banking and Ownership Structure	**Total Assets (%)**			**Total Deposits (%)**			**Total Loans (%)**		
	2002	**2008**	**2009**	**2002**	**2008**	**2009**	**2002**	**2008**	**2009**
Banks									
- *Foreign Banks*	*3*	*15*	*13*	*2*	*13*	*13*	*4*	*18*	*17*
Development and Investment Banks	4	3	3	-	-	-	11	4	4

Note: * Less than 1%.

As the number of banks decreased from 54 in 2002 to 45 in 2009, the concentration in the banking system had increased. Assets of the first five banks (in terms of asset size) constitute 63% of total assets. Similarly sum of the deposits of the first 10 banks (in terms of asset size) constitutes 91% of total deposits (by 31.12.2008). The concentration ratios can be seen in Table 11 below. By the end of 2009, there were only 7 banks with asset size over 40 billion USD and four banks with asset size between 10-20 billion USD.

Table 11: Asset Concentration in the Turkish Banking System (%)

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

	2002	**2008**	**2009**
First 5 Banks*			
- Total Assets	58	62	63
- Total Deposits	61	65	66
- Total Loans	55	58	55

Table 11: Asset Concentration in the Turkish Banking System (%)

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

	2002	**2008**	**2009**
First 10 Banks*			
- Total Assets	81	86	87
- Total Deposits	86	90	91
- Total Loans	74	84	85

Notes: * in terms of total assets

A recent research conducted by Morgan Stanley Research Company (Alphawise Survey-2009) pointed out that; degree of multi-banking is very high, meaning that most of the customers use different banks for their daily banking transactions. The research reveals that there is little differentiation among banking product other than pricing and existing brand recognition is important for market penetration. It has been found that consumers place great value on branch and ATM infrastructure.

Lower interest rates and prolonged terms to maturity enabled consumers to use bigger amounts of loans while still paying lower installments. The change in the composition of the loans during 2008 financial crisis shows that consumer loans are as important as corporate loans as a driver of asset growth. The share of consumer loans (excluding credit cards) in total loans increased from 5% in 2002 to 23% in 2009, while the share of corporate loans decreased from 86% to 67%. The share of credit cards remained stable at 9%.

Table 12: Composition of the Loans in Turkish Banking System (million TL)

Source: Banks in Turkey 2009, Banks Association of Turkey, 2010, http://www.tbb.org.tr/Dosyalar_eng/Yayinlar/Dokumanlar/2Bankalarimiz2009ING.pdf

million USD		**% Change**	**% Share**		
	2009	**(2009/2008)**	**2002**	**2008**	**2009**
Corporate Loans*	177.165	9	86	69	67
Consumer Loans*	86.970	7	14	31	33
- **Credit Card**	24.980	1	9	9	9
- **Consumer Loans**	61.990	10	5	22	23
- Housing	29.812	14	1	10	11
- Vehicle	2.938	-24	1	2	1
- Other	29.241	10	3	10	11
Total*	**264.135**	**8**	**100**	**100**	**100**

Note: *Includes participation banks.

Although the Turkish banking sector continued to grow during the 2008 financial crisis, the asset quality did not remain the same. The share of non-performing loans (NPL) increased from 3.6% in 2008 to 5.4% in 2009. This deterioration in loan quality can, however, be considered negligible compared to 19% in 2002. Another important variable is the amount of special provisions granted for non-performing loans. Turkish banks booked provision expenses for 81.4% of the non performing loans on the average in 2008 and 84.5% in 2009 (impairment charge for expected loss emanating from overdue receivables). Hence, the profits of 2008 and 2009 are almost free of the burden of the non-performing loans. Average impairment charge for non-performing loans is higher in bigger banks. Akbank and Is Bank book provision expenses for all of their non-performing loan receivables. (A loan has to be classified as non-performing, if repayment is overdue for more than 90 days. However, a bank can classify an established loan as “non-performing” if the loan is

expected to be non-collectible in the future even if the default period is less than 90 days. Banks has to book provision expenses for a minimum amount of the non-performing loan as specified in the banking law.) It is interesting to note that, Turkish banks book higher provisions than foreign ones. This reveals that Turkish banks prefer a "safer and more reliable" growth path than their foreign counterparts.

Table 13: Non-Performing Loans (NPL) and Special Provisions (SP) Percentage

Source: Banks in Turkey 2009, Banks Association of Turkey, 2010, http://www.tbb.org.tr/Dosyalar_eng/Yayinlar/Dokumanlar/2Bankalarimiz2009ING.pdf

	NPL/Total Loans (%)			SP/NPL (%)	
	2002	**2008**	**2009**	**2008**	**2009**
Commercial Banks	20	3,7	5,6	81,2	84,6
- **State Banks**	24	3,8	4,5	87,5	86,7
- **Private Banks**	9	3,5	5,4	80,3	88,2
- **Foreign Banks**	5	4,1	7,8	75,5	75,3
Development and Investment Banks	3	1,4	2,0	91,7	75,1
Total	**19**	**3,6**	**5,4**	**81,4**	**84,5**

It is also interesting to note that return on asset and equity as of end 2009 is higher in state banks than in private and foreign banks. Furthermore, private banks are more profitable than foreign banks in Turkey. This may be the due to the fact that branch network and primary relations are still important in the Turkish banking system despite the financial sophistication of customers (Morgan Stanley-Alphawise Survey

2009). The ROA (return on assets) and ROE (return on equity) rates can be seen in table 14 below.

Table 14: ROA and ROE Rates in Turkish Banking System as of 31.12.2009

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

	ROA (%)	**ROE (%)**
Commercial Banks	2,4	19,7
- **State Banks**	2,6	27,2
- **Private Banks**	2,4	18,5
- **Foreign Banks**	1,9	13,1
Development and Investment Banks	3,7	7,8
Total	**2,4**	**18,3**

CHAPTER 3. TRANSITION FROM TRADITIONAL TO MODERN BANKING IN TURKEY: WHAT IS EXPECTED TO CHANGE?

In this chapter, basic functions of the banking system and inputs/outputs of banks are defined, differences between traditional and modern banks, and effects of the modernization on bank efficiency are discussed.

The Turkish banking system was a traditional one until 2000. Only four banks, namely Garanti, Akbank Yapı Kredi Bank and Finansbank had initiated projects before year 2000 to transform into a modern bank. The basic steps taken by the mentioned banks are mostly centralizing banking operations in separate buildings than bank branches, to let employees working in branchses to focus on sales functions. This step is also a major step to control cost of banking operations. To transform into a modern bank, traditional banks need to employ;

- sophisticated loan processing systems to decrease cost of non-performing loans,
- operation centers to increase pace of and reduce cost of operational services,
- alternative banking services (out-of-branch banking services) such as internet banking to provide cheaper, faster and uninterrupted financial service,
- computer systems with increased data mining and reporting capabilities for faster market penetration and to increase profit per customer,
- highly educated labor to use sophisticated reports and computer systems,
- better performance evaluation systems for more efficient use of labor.

Below, we scrutinize each of those transformation processes. By year 2001, Akbank, Garanti Bank, Yapı Kredi Bank and Finansbank had already advanced in their transformation into modern banking while other banks had advanced their

transformation only after the 2001 financial crisis. Modern banks are expected to work more efficiently than traditional banks. Yapı Kredi Bank, on the other hand, merged with Kocbank in 2006. The process of merger and acquisition may have adversely affected the efficiency of Yapı Kredi Bank. Hence, we expect Akbank, Garanti Bank, Yapı Kredi Bank and Finansbank to achieve higher efficiency scores in the time period from 2003 to 2009. Also, since modern banks are equipped with better risk management systems, we expect modern banks to be less adversely affected from the 2008 global crisis.

3.1. Basic Functions of Banking System

Properly functioning banking system is vital for economic growth. Banking system provides;

- safe storage for money and other valuables,
- an international payment system,
- mediation between economic units with excess funds and in need of funds,
- loan processing system to make sure that funds are used for productive and feasible projects,
- monetary guarantee arrangements for trading parties by establishing letter of guarantee,
- financial counseling services,
- necessary mechanism for monetary policy to work,
- auditable payment systems making it possible to track illegal monetary transactions,
- a database of global monetary activity,
- internet banking to increase pace and reduce cost of financial services

Each one of those functions needs sophisticated technological infrastructure and highly educated employees. The 2001 Turkish banking and 2008 global financial crises prove that as vital an efficiently working banking system is for an economy, as destructive it may be, if left unsupervised.

3.2. How Do Banks Work?

The most basic functions of banking system are to buy and sell money. They buy (borrow) funds from depositors with excess funds and sell (lend) it to people and companies in need of funds. Banks need to make sure that loans they establish will be paid back. For this reason, banks need to assess the credibility of the borrowers. The process of assessing the credibility of borrowers is called "loan processing". Efficiently working loan processing system is vital for a bank, since banks need to pay back to lenders or depositors. Loan processing systems make sure that;

- individual borrowers have enough credibility and
- commercial loans are used for feasible projects.

Efficiently working loan processing systems in the banking sector positively affect GDP growth since the funds are directed to feasible projects. As a result, production increases along with the increase in velocity of money. Hence, one of the most important efficiently working part of modern banking should be loan processing systems.

Banks generate income mainly by providing;

- safe storage for money and other valuables,
- an international payment system,

- mediation between economic units with excess funds and in need of funds.

Banks pay interest for deposits and earn interest from loans established. The difference between the interest rates on deposit and loan is called “net interest margin”. Banks also charge fees for;

- for each deposit account for operating expenses,
- electronic fund transfer and check payments,
- issuing letter of credit,
- for loan processing services such as analyzing credibility of borrowers and estimating value of collaterals.

Banks also sell and buy money and securities on international money market. They earn interest income for money sold and pay interest for money bought. They also earn interest from interest paying assets such as treasury bills and make capital gains/losses due to changing prices of securities.

A bank basically needs capital, employees and branches (branch buildings and ATM’s) to operate. The target of a bank is to collect deposits and establish loans in order to earn fee and net interest income.

3.3. Loan Processing Systems

Modern banks are equipped with sophisticated loans processing system. Modern loan processing systems provide;

- possibility of credit default of prospective borrowers when financial data of customers are input to computer system,
- continuous assessment of credibility of borrowers,
- early warning system when credibility of a commercial borrower deteriorates,
- online credit history and financials of borrowers.

A modern loan processing system helps banks better manage the credit risk. This in turn lowers ratio of non-performing loans (NPL). Hence we expect modern banks to have lower NPL ratio and higher efficiency scores.

3.4. Faster and Low Cost Financial Services

Banks have two main types of income, interest income and non-interest income. Similarly they have two main types of expenditures, interest expenditures and non-interest expenditures. One of the main non-interest expenditures is personnel expenditures. While, the interest rate elasticity of demand for loans is expected to be high, customers not only base their decisions on interest rates but also on the quality of banking services. Bank customers expect faster financial services and one-to-one customer relation.

While banking operations are handled in bank branches in traditional banking, they are handled in operations centers in modern banks. Operation centers make use of increased level of specialization and mass production. Today all modern banks handle documentation at operation centers while leaving more room for one-to-one customer relation in bank branches. Central processing of banking operation increases pace of services while decreasing costs. Hence, one of the most important aspects of modern banking is use of increased level of specialization by employment of operation centers.

To sell more products, banks need to analyze the needs of their customers, so they can sell the most suitable product/service to their customers at the most profitable price/fee. One of the most important strategies in marketing to increase sales income is segmentation. Segmentation enables companies to charge different prices to customers with different income levels and demand elasticity. In order to segment its customers, banks need to have enough information about customers. Banks hold important amount of customer data. However, while acquiring data from customers need very little effort, analyzing data with the aim to reveal customer needs requires sophisticated data mining abilities. Internet banking, on the other hand, enables banks to decrease their operational costs, since it is self-service banking. Internet banking enables customers to do banking transactions without need to go to bank branches. Also, customers are offered higher interest rates for deposits and lower fees if they carry out their transactions using internet banking. Similarly as the online workflow of banking services increases, the use of paper decreases.

While operation centers decrease cost and increase pace of rendering financial services, increased data-mining capabilities increase income per customer. Hence, we expect modern banks to have higher "non-interest income/non-interest expense" ratio along with higher efficiency scores. Hence technological advancement increases total factor productivity since it enables banks to render more of financial services with less number of employees, branches and stationery goods.

3.5. Capacity of Market Penetration

One of the main differences between traditional and modern banking is the data-mining capabilities. While traditional banks would keep data only for identity verification and accounting purposes, modern banks keep data to analyze;

- needs of customers,
- cost of each product and service rendered,
- income earned from each customer at each product level.

This enables modern banks to;

- better manage their sources,
- increase service and product quality,
- identify needs of customer faster and
- maximize profits per customer.

Banks manage their customer relations at two different levels: segment level and customer level. Segment level refers to marketing and sales strategies based on common characteristics of customers such as wealth or income level. Customer level relation refers to one-to-one customer relation management.

There are two main determinants of customer segments, namely “type” and “asset size or income level” of consumer. Type of customer refers to whether customers are merchants or not. A customer is named “commercial customer” if he/she is either a merchant, a company or an institution; otherwise named “individual customers”. Once a customer is classified as either “individual” or “commercial”, then they are segmented according to asset size they keep at bank or annual income level.

Sophisticated data infrastructure used by modern banks, let them measure profit at customer and product level. This means, banks know how much they earn from each customer, furthermore, they can identify the level of profit from every product the

costumer uses. Traditional banks on the other hand did not know profit per customer. Traditional banks could not measure;

- cost of resources used per type of banking activity,
- amount of banking activity rendered per customer,
- income earned per customer and
- profit per customer.

Better risk management systems, faster and cheaper financial service capabilities and increased market penetration capabilities allow modern banks to operate with higher "profit/equity share" ratio. Hence, we expect modern banks to operate with higher "profit/equity share ratio" along with higher efficiency scores.

3.6. Sound and Stable Macroeconomic Environment

An increase in public sector borrowing requirement causes real interest rates to increase due to increasing doubts over possible failure of debt service of Turkish Treasury. High PSBR causes a crowding-out effect. Sound and stable macroeconomic environment, on the other hand, increases confidence in Turkish economy, causing risk premium affiliated with Turkish economy to decrease. As inflation and risk premium decreases, so do the real interest rates. Lower real interest rates;

- decrease cost of investment,
- increase investment spending and demand for loans,
- decrease cost of deposit and non-deposit funds.

We expect banks to operate more efficiently as real interest rates and PSBR decreases. Banks, on the other hand, are expected to act more cautious in terms of risk taking during times of financial crisis. They may prefer to stay away from some profitable but risky business to take more liquid positions on balance sheets. Output levels of loans are expected to decrease at those times, decreasing or limiting growth of net interest income. Hence, we expect efficiency of banks to be adversely affected during times of financial crisis.

3.7. Education Level of Labor

Sophisticated technological infrastructure and data architecture is the main difference between traditional and modern banking. Sound technological infrastructure lets banks to measure their costs and incomes in a more precise and detailed manner. Banks can better manage their risks, when they can measure their risks more accurately. Also, better data mining capabilities let banks to increase their market penetration ratios. While the sophisticated banking computer systems analyze data, properly use of reports produced by the sophisticated computer systems is dependent on the education level of employees. Modern banking systems need highly educated labor for effective use of reports that reveal operational risks and customer needs. Hence, one of the aspects of modern banking systems are employment of highly educated employees. It is very interesting to note that the ratio of university graduates employed in banking sector increased from 56% in 2002 to 76% in 2009. Banks also invest more in education of employees in the transformation. In-company-educations not only include technical educations such as using computer but also cultural components such as customer relations, social activities and time management. We expect the increase in the number of highly educated labor to increase the efficiency of banks.

Hence, modern banks are supplied with;

- more sophisticated loan processing systems enabling faster loan processing and facilitating decision making process,
- modern banks are supplied with operation centers, enabling faster processing of banking transactions at lower costs,
- modern banks are supplied with better data-base and data-mining capabilities enabling customer segmentation and identification of customer needs,
- modern banks are supplied with higher educated employee capable of understanding sophisticated data reports produced for sales and marketing functions.

3.8. Better Performance Evaluation to Increase Labor Productivity

While salary in traditional banks is same for every personnel at the same rank, the wages in modern banks are a function of performance evaluation. In modern banks, every personnel is given targets to attain in a given time period. Basically, there are two kind of targets;

- new product sales and
- average level of deposits and loans.

Traditionally, banks are described as intermediaries between lenders and borrowers. From this point of view, deposits are considered as input while loans as output. However, banks also make profits from other financial services. Hence, not only loans should be viewed as output but also deposits should be treated as outputs.

Banks are composed of physical capital, branches and labor. Labor is supplied with enough monetary sources to attain targeted loan and deposit levels. As a corollary, targets namely loans, deposits and other sales of banking products should be treated as output along with interest and non-interest income when measuring efficiency of banks. However, sales volume of banking products is not revealed by banks. As it will be explained in chapter 4, we will use both intermediation approach which treats "deposits and non-deposit funds" as inputs and a mixed approach which treats "deposits and non-deposit funds" as outputs while measuring efficiency of banks.

3.9. Level of Capital Adequacy Ratio and Free Capital

New supervisory and legal structure in Turkish banking sector forces banks to attain a minimum level of capital adequacy ratio (CAR) where CAR is simply defined as ratio of banks capital to its risks and formulated as follows:

CAR = Capital / (Credit Risk+Market Risk+Operational Risk)

While high rates of CAR mean that bank is operating safely in terms of risk management, it does not ensure high efficiency. We may expect banks to work less efficiently, to avoid taking some market risks in order to ensure a higher level of CAR to increase confidence of supervisory authority, actors of financial markets and customers in the bank. A modern bank on the other hand is expected to better manage its credit and operational risk than a traditional bank, automatically increasing CAR. Hence, we are not sure of the effect of CAR on efficiency levels.

Free capital is equal to the difference between total equity share and tangible fixed assets. Higher levels of free capital means banks can hold more levels of liquid and interest earning assets, increasing its income levels. Traditional banks in Turkey,

especially Is Bank and public banks, were holding shares of industrial companies to lead production in certain sectors. However, as transition to modern banking advances, banks are more focused on financial sector. This increases level of free capital. Hence, we expect changes in levels of free capital to explain changes in efficiency rates.

To sum up; we expect Akbank, Garanti Bank, Akbank and Finansbank, the Turkish banks to have advanced in transition to modern banking before year 2002, to be experience higher increase in efficiency. We also expect modern banks to have;

- lower NPL ratios due to better credit risk management systems, hence changes in NPL levels,
- higher "non-interest income/non-interest expense" due to better sales and marketing capabilities, hence changes in "non-interest income/non-interest expense" ratios,
- "profit/equity share ratio" due to better data mining and risk management systems, hence changes in "profit/equity share" ratios,
- higher ratio of university graduates as employees and changes in ratio of university graduates among the employees,
- higher levels of free capital and changes in levels of free capital

to explain some of the change in efficiency scores. We also expect; high PSBR, real interest rate, to affect efficiency of banks adversely. We also expect global financial crisis to affect efficiency adversely, since banks would act more conservative and cautious in terms of risk taking, hence avoiding from some profitable business for more liquid positions on balance sheets. We do not have clear expectations, on the other hand, about the affect of CAR on efficiency scores.

Table 15 provides a summary of the likely effects of the factors discussed above on the change in the efficiency of the banking sector. As the discussion in this section illustrated, the banking sector in the 2002-2009 period have witnessed rather important economic and institutional changes so that the efficiency of the sector is expected to have changed over time. The direction of the change naturally depends on the effect and the magnitude of change in the factors that determine efficiency. Although isolating the effect of these factors on efficiency is beyond the scope of this thesis, Table 15, nevertheless, provides a guide as to the likely impact of these factors and therefore will help interpret the findings in Chapter 5.

Table 15: Factors Effected to Affect Efficiency of Banks (Independent Variables)

Factors	**Variable Representing the Factor**	**Expected to Affect Efficiency**
Better Credit Risk Management	Non-Performing Loans/Total Loans	Positively
Better Sales and Marketing Ability Better Data Mining Capacity	Non-Interest Income/Non Interest Expense	Positively
Better Risk Management Better Data Mining Capacity	Profit/Equity Share	Positively
Level of Education Among Employees	Number of University Graduates/Total Number of Employees	Positively
Level of Free Capital	(Capital-Tangible Fixed Assets/Total Assets)	Positively
PSBR	PSBR/GDRP	Negatively

Table 15: Factors Effected to Affect Efficiency of Banks (Independent Variables)

Factors	Variable Representing the Factor	Expected to Affect Efficiency
Real Interest Rate	Real Interest Rate	Negatively
Capital Adequacy Ratio	Capital/(Market Risk+Credit Risk+Operational Risk)	-
Completion of Transition to Modern Banking	Dummy Variable is defined to Identify Garanti and Akbank as Modern Banks	Positively

CHAPTER 4. METHODOLOGY AND LITERATURE SURVEY ON BANK EFFICIENCY

This chapter discusses the methodology used in efficiency evaluation of banks. The chapter starts with the definition of basic concepts used and proceeds with methods of evaluating the efficiency of banks.

4.1. Methodology

4.1.1. Basic concepts: Input and output

Basic inputs of a bank are employees, net fixed tangible assets, branches and enough money to pay for expenses such as interest expense, non-interest expense, personnel expense and other expenses. One may argue that the most basic input of a bank is capital. We do not take capital itself as an input, however, it should be clear that all the inputs we use are financed with capital. Hence, we are not interested in capital itself but the part of the capital utilized in the period that we measure efficiency.

Basic outputs of a bank are loans, interest earning assets, off-balance sheet items and income such as interest income, non-interest income and other income.

However, it is a controversial issue whether deposits and non-deposit funds are inputs or outputs. As will be discussed below in more detail, deposits can be considered either an input or an output. If we think of banks as companies that intermediate between lenders and borrowers, deposits can be considered as an input, while loans as an output. The income from intermediation is the difference between the amount of interest paid for deposits and interest earned from loans.

Modern banks manage and direct employees in line with risk management policies specified by board of directors. They give targets to employees to reach the desired level of deposits and loans in order to manage risks associated with time and currency mismatch. Hence, we can argue that a bank is working efficiently if employee can reach its target levels of loans and deposits set in line with specified risk management policies. From this point of view, all the variables subject to specified targets given to employee should be treated as outputs.

It should be noted that, banks not only earn interest income, but also non-interest income such as operation fee charged for every single deposit account. Hence, each deposit account is itself a source of income, whether or not all deposit funds are utilized as source of money to sell on market. Furthermore, the level of deposits is a sign of;

- how well the one-to-one customer relations are managed,
- how much confidence customers have in risk management capability of a bank.

Non-deposit funds can be treated as a sign of;

- whether managers of the bank can attain the desired level of asset size set by the board of directors,
- confidence of international financial actors in a bank and
- capability of bank managers to attain such level of confidence of financial markets.

Depending on the approach used to measure efficiency of banks, deposits and non-deposit funds can either be treated as inputs or outputs.

The production function of the banking system is defined by technological infrastructure, organizational structure, risk management and data-mining capabilities. For a true specification of production function we need to know the number of accounts and other banking products such as internet banking etc. Insufficient data makes it difficult to specify the true form of the production function.

The choice of inputs and outputs along with the source and characteristics of data used in this study will be explained in detail in Chapter 5.

4.1.2. Methods of Evaluating the Efficiency of Banks

While the definition of efficiency changes depending on the field of science it is used, the most convenient one is the definition made by Paul Hayne in the Concise Encyclopedia of Economics:

"Efficiency is a relationship between ends and means. When we call a situation inefficient, we are claiming that we could achieve the desired ends with less means, or that the means employed could produce more of the ends desired. "Less" and "more" in this context necessarily refer to less and more value. Thus, economic efficiency is measured not by the relationship between the physical quantities of ends and means, but by the relationship between the value of the ends and the value of the means."(Hayne, 1993)

There are three main methods to evaluate the performance and efficiency of the banking system: ratio analysis, parametric methods and non-parametric methods. Each of those methods has its own advantages and disadvantages (İnan, 2000).

4.1.2.1. Ratio Analysis

Ratio analysis is the most practical and widely utilized method to evaluate the performance of banks. However, this method is not suitable to evaluate efficiency of a multi-input/output production unit. Hence, ratio analysis is not the most proper method to evaluate performance of banks, since a bank has more than one input and output. While the ratio analysis is good for quick capture of changes in efficiency, it can not capture efficiency changes in all variables at once. Hence, it is explanatory but does not provide enough information for strategic management decisions.

4.1.2.2. Parametric Methods (Stochastic Frontier)

In parametric methods, a certain form for the production function has to be assumed, formulating the relationship of the efficient level of outputs to the level of inputs. The three main parametric methods are stochastic frontier approach, distribution free approach and thick frontier approach. Parametric methods are criticized for their use as the method of evaluation for the efficiency of the banking industry for the following two reasons:

- it is not always possible to assume right form for the production function due to insufficient data,
- the parametric methods can only use one dependent variable, while employing several independent variables; which is not in line with the fact that the banking industry has multiple inputs and outputs (İnan, 2000).

4.1.2.3. Non-Parametric Methods (Linear Programming)

When a non-parametric method is employed, no assumptions have to be made about the form of the production function. The frontier, however, can be estimated empirically using the observed inputs and outputs (Yıldırım, 2002). Non-parametric methods use optimization under constraints to measure the distance to the efficient border (linear programming) and allow the use of multiple inputs and outputs with constant or variable returns to scale. The most frequent used non-parametric method is Data Envelopment Analysis (DEA).

Non-parametric methods, compares the decision making units (DMU), banks in our case, which are assumed to be homogeneous. Each decision making unit is compared to the linear combination of the rest of the sample which is found to produce the maximum output(s) possible under constraint set for the input(s).

There are two main approaches to measuring efficiency if a non-parametric method is employed, the "production" and the "intermediation" approaches.

The production approach defines banks as "production units", which uses capital, labor and other equipment to produce deposits and other balance sheet items. The major shortcoming for this approach is the measurement of outputs. In this approach, number of the accounts and operations are usually used for output instead of their monetary value.

The intermediation approach defines banks intermediating between the suppliers and the demanders of funds. Hence, funds supplied by depositors (deposits) are defined as inputs and the funds used by the credit customers (loans) are defined as output. Banks are, by description, aim to make profit from converting deposits into loans.

While production approach employs only the operational expenses as inputs along with capital, labor and equipment, intermediation approach uses the interest expense in addition.

There are quite a number of studies which utilized DEA for measuring efficiency of Turkish banks. Below is a summary of some studies that evaluate the effectiveness of banking system.

Table 16: Studies on Evaluating Effectiveness of Turkish Banking System

	Author	Time Span	Inputs	Outputs	Method	Approach
1	Wheelock and Wilson (1999)	1984-1993	Labor, Physical Capital, Purchased Funds (Saving and Time Deposits and Non-Deposit Funds)	Real Estate Loans, Commercial and Industry Loans, Consumer Loans, Other Loans and Total Demand Deposits	DEA	Intermediation
2	Staub, Souza and Tabak (2009)	2000-2007	Interest Expenses, Operational Expenses, Personnel expenses	Investments, Total Loans and Deposits	DEA	Intermediation
3	Isık and Hassan (2000),	1988-1996	Labor, Capital, Loanable Funds	ST Loans, LT Loans, Risk Adjusted Off Balance Sheet Items, Other Earning	DEA	Intermediation

Table 16: Studies on Evaluating Effectiveness of Turkish Banking System

	Author	Time Span	Inputs	Outputs	Method	Approach
				Assets		
4	Cingi and Tarım (2000)	1989-1996	Total Assets, Total Expenses	Total Profit, Total Loans, Total Deposits and Return on Loans	DEA	Mixed
5	Denizer, Dinc and Tarımcılar (2007)	1970-1994	Physical and Financial Capital Used for Production Function, Operational Expenses Used for Production Function, Interest Expense, Fees Paid (In Production Approach)/ Physical and Financial Capital Used for Intermediation Function, Operational Expenses Used for Intermediation Function, Total Deposits (In Intermediation Approach)	Total Deposits and Non-Interest Income (In Production Approach)/ Total Loans, Banking Income (In Intermediation Approach)	Two Stage-DEA	Intermediation and Production (Each approach is adopted in one step of two-stage DEA)

Table 16: Studies on Evaluating Effectiveness of Turkish Banking System

	Author	Time Span	Inputs	Outputs	Method	Approach
6	Aysan and Ceyhan (2008)	1990-2007	Labor Capital Loanable Funds	ST Loans LT Loans Risk Adjusted-Off B/S Items Other Earning-Assets	DEA	Intermediation
7	Güneş (2009)	2002-2007	Labor Net Fixed Tangible Assets Loanable Funds	Loans Other Earning Assets	DEA	Intermediation

As it can be seen in the table, there is no consensus over the inputs and outputs of a bank. However, using DEA along with the intermediation approach has been the most common method of measuring efficiency of Turkish banks in the last decade.

In this study, we will utilize a non-parametric method, DEA, to construct Malmquist Total Factor Productivity Index. Malmquist index, which will be explained in depth in the following section, shows the changes in productivity from one period to another. We will be constructing two different Malmquist index, using different inputs and outputs. The first index will be constructed using intermediation approach, while the latter will be different from both of the approaches, and we will name it "mixed approach". Mixed approach is different from intermediation approach in that deposits and non-deposit funds are treated as outputs rather than inputs. The reasons for such a treatment were explained earlier in Chapters 3-section 3.9 and 4-section 4.1.

4.1.3. The Malmquist Total Factor Productivity Index

Data Envelopment Analysis (DEA) is widely used to evaluate efficiency of firms. DEA is an extreme point method that compares each producer with the maximum potential output level at a certain time period. The maximum potential output level at a certain time period is the maximum output level which is a linear combination of output levels of the producers other than the producer whose efficiency level is being examined, under the constraint that the same linear combination of inputs of other producers does not exceed the input level used by producer whose efficiency level is being examined.

The maximum potential output, in other words "the frontier" can be formed by linear programming. If the output level of a producer is less than the maximum potential output, then the producer is said to be technically inefficient. In a single-input, single-output model, the frontier would be S^t shown in Figure 2, where for each time period t = 1,...,T, the production technology S^t models the transformation of inputs, $x^t \in R_+^N$, into outputs, $y^t \in R_+^M$ (Färe et al; 1994);

$S^t = \{(x^t, y^t): x^t \text{ can produce } y^t\}$

The efficiency of every single producer can be measured by how much it can produce compared to the maximum potential output. This can be found using distance functions. Distance functions are function representations of multiple-input, multiple-output technology which require data only on input and output quantities (Färe et al; 1994). Following Färe et al. (1994), the output distance function is defined as;

$$D_o^t(x^t, y^t)$$

$$=\inf\{\theta: (x^t,\ y^t/\theta) \in S^t\} = \left(sup\{\theta: \left(x^t, \theta y^t\right) \in S^t\}\right)^{-1}$$

where, the subscript "o" defines that this is an "output" distance function and t stands for the time period. The distance function seeks the reciprocal of the greatest proportional increase in output(s), given input(s), such that output is still feasible (Färe et al; 1994).

The reference technology or the frontier can be constructed as follows, where there are n inputs, m outputs and k producers (banks in our case):

$$S^t = \left\{(x^t, y^t): y_m^t \leq \sum_{k=1}^{K} z^{k,t}, y_m^{k,t}\right\}$$

$$\sum_{k=1}^{K} z^{k,t}, x_n^{k,t} \leq x_n^t$$

$$z^{k,t} \geq 0$$

m=1,…,,M ;
n=1,…..,N;
k=1,…..,K.

The linear programming problem for the distance function $D_o^t(x^t, y^t)$ for each one of the k'=1,….,K firms is solved as follows:

$$\left(D_o^t\left(x^{k't}, y^{k't}\right)\right)^{-1} =$$

$$max\theta^{k'}$$

subject to

$$\theta^{k'} y_m^{k',t} \leq \sum_{k=1}^{K} z^{k,t} y_m^{k,t}$$

$$\sum_{k=1}^{K} z^{k,t} x_n^{k,t} \leq x_n^{k',t}$$

$$z^{k,t} \geq 0$$

m=1, …., M ;

n=1, …., N;

k=1, …, K.

If a single producer is producing at the point (x^t, y^t) at time period t, the maximum potential output is y/θ* where θ* is the reciprocal of the greatest proportional increase in output(s), given input(s);

$$D_o^t(x^t, y^t) = \|y^t\| / \|y^t/\theta^*\| = 0a/0b$$

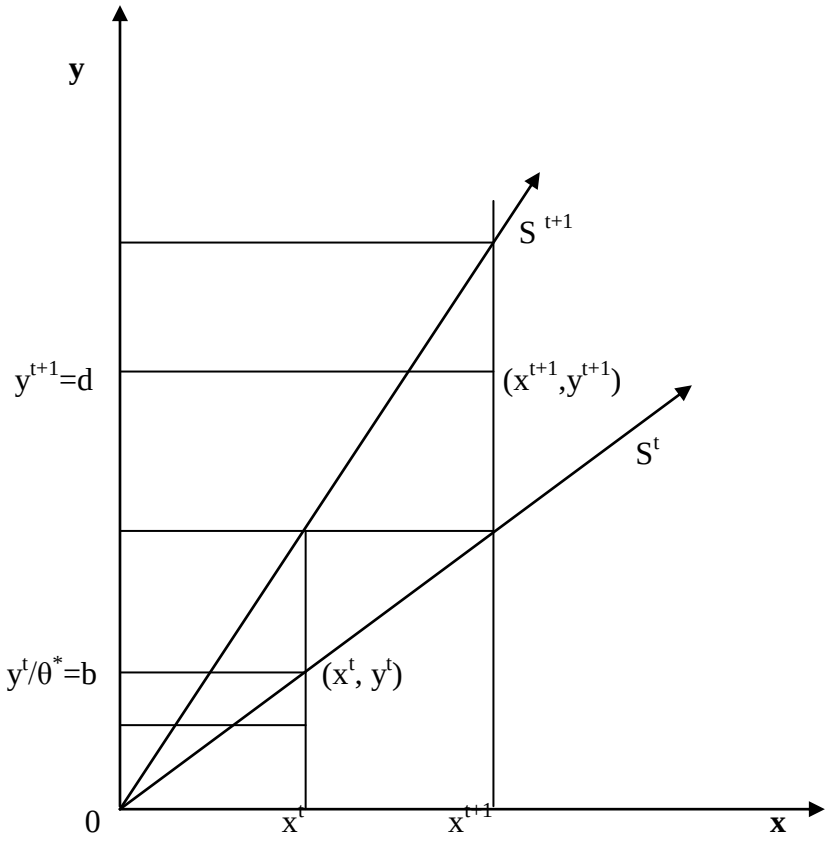

Figure 2: Frontier and the Relative Efficiency

Source: Färe et al. (1994), *Productivity Growth, Technical Progress and Efficiency Change in Industrialized Countries*, The American Economic Review, Vol. 84, No. 1, pp. 70.

$D_o^t(x^t, y^t) = 1$ when production is technically efficient, and $D_o^t(x^t, y^t) \leq 1$ if inefficient. Malmquist index is used for measuring change in productivity from one year to another by constructing quantity indexes as ratios of distance functions calculated for two different time periods, t and t+1. The efficiency of the output based on the technology of the first period is $D_o^t(x^{t+1}, y^{t+1})$ and is computed as follows;

$$\left(\mathrm{D}_{\mathrm{o}}^{\mathrm{t}}\left(\mathrm{x}^{k',\mathrm{t}+1}, \mathrm{y}^{k',\mathrm{t}+1}\right)\right)^{-1} =$$

$$max\theta^{k'}$$

subject to

$$\theta^{k'} y_m^{k',t+1} \leq \sum_{k=1}^{K} z^{k,t} y_m^{k,t}$$

$$\sum_{k=1}^{K} z^{k,t} x_n^{k,t} \leq x_n^{k',t+1}$$

$$z^{k,t} \geq 0$$

In other words, the output of two periods is compared to the maximum potential output of the chosen period. Malmquist index constructed can be based on the technology of first period, S^t as;

$$M_o^t = \frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)}$$

where

$$\mathrm{D}_{\mathrm{o}}^{\mathrm{t}}(\mathrm{x}^{\mathrm{t}+1}, \mathrm{y}^{\mathrm{t}+1})$$

$$=\inf\{\theta: (\mathrm{x}^{\mathrm{t}+1}, \mathrm{y}^{\mathrm{t}+1}/\theta) \in S^t\} = 0d/0e$$

or on S^{t+1} instead of S^t as;

$$M_o^{t+1} = \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^t, y^t)}$$

The calculation of $D_o^{t+1}(x^{t+1}, y^{t+1})$ is the same with $D_o^t(x^t, y^t)$except that we substitute t+1 with t. A better way of defining efficiency change is to incorporate technology of both periods instead of only S^t or S^{t+1}:

$$M_{o(x^{t+1}, y^{t+1}, x^t, y^t)} = \left[\left(\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)}\right)\left(\frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^t, y^t)}\right)\right]^{1/2}$$

which equals to;

$$\frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \times \left[\left(\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})}\right)\left(\frac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)}\right)\right]^{1/2}$$

Efficiency Change (Technical Efficiency Change) | Technical Change (Technological Change)

The first part of the equation is the efficiency change and the part in the brackets is technical change. The efficiency change tells us how much the producer got closer to (or away from) the frontier from one period to another (from t to t+1). It is the change in relative efficiency. The technical change, on the other hand, shows us the shift in technology from one period to another. This is the geometric mean of the change in maximum potential output from t to t+1, measured at two different levels of inputs, x^t and x^{t+1}. It should be noted the "efficiency change" component is also referred to as "technical efficiency change" while technical change component is also referred to as "technological change". Hence;

Total Factor Productivity Change = Efficiency Change * Technical Change

or

= Technical Efficiency Change*Technological Change

From the Figure 2, we can see what Malmquist index equals to:

$$M_{o(x^{t+1}, y^{t+1}, X^t, y^t)} = \left(\frac{0d}{0f}\right)\left(\frac{0b}{0a}\right)\left[\left(\frac{0d/0e}{0d/0f}\right)\left(\frac{0a/0b}{0a/0c}\right)\right]^{1/2}$$

$$= \left(\frac{0d}{0f}\right)\left(\frac{0b}{0a}\right)\left[\left(\frac{0f}{0e}\right)\left(\frac{0c}{0b}\right)\right]^{1/2}$$

The efficiency change component calculated relative to the constant-returns-to-scale technology can be decomposed into a pure-efficiency-change component (calculated relative to the variable returns technologies) and a residual-scale component (Färe et al; 1994). Hence Malmquist index can be formulated as;

Tehnical Efficiency Change = Pure Efficiency Change × Scale Change

and

$$M_{o(x^{t+1}, y^{t+1}, X^t, y^t)} = \text{Pure Efficiency Change} \times \text{Scale Change} \times \text{Technical Change}$$

where efficiency change is calculated under constant returns to scale and pure efficiency is efficiency change calculated under variable returns to scale. If Malmquist TFP or any of its components is;

- greater than 1, there is an increase in efficiency,
- smaller than 1, there is a decrease in efficiency,
- equal to 1, there is no change in efficiency

compared to the previous period. The DEAP software version 2.1 is utilized to solve the models.

4.2. Literature Survey

There are quite a number of studies to measure efficiency of banking sector worldwide. These have a wide range of focus: while some studies focus on cost and allocative efficiency of banks, others aim to find effects of certain bank traits on Malmquist Total Factor Productivity Index and its components. The studies on the Turkish banking sector, on the other hand, mostly focus on the effects of liberalization, ownership type (public, foreign and private) and post-crisis (2001) macroeconomic conditions on efficiency of Turkish banks.

Most of the work on efficiency of efficiency of Turkish banks, however, either focus on a period that is not examined by this study or on a period that is relatively narrow. Some studies, on the other, hand use ratio analysis to conclude on the efficiency level of Turkish banking sector. Bumin (2009) examined the profitability of Turkish banking sector using ratio analysis over the period 2002-2008; the results show that the profitability of the Turkish banking sector increased from 2002 to 2007, while adversely affected by 2008 global financial crisis. Chambers and Çifter (2006) investigate the productivity of Turkish banks according to the effect of scale, using quarterly data from 2001:1 to 2004:3. The study applies DEA while using financial ratios and number of branches and employees as input and output. The results show that change in efficiency mainly emanates from technical efficiency rather than scale efficiency. Atan and Çatalbaş (2005) examined the efficiency of the Turkish banks over the period December, 2002-September 2004 using DEA. The study found that size of the bank and profitability have positive, while capital adequacy ratio and

number of branches have negative effect on bank efficiency and private and foreign banks are more efficient than state banks.

Chen (2001) examines the relation between X-efficiency and bank size, location, specialization and agricultural factors at country level where agricultural factors are regarded as proxy for local economic activity. Study also examines the degree to which commercial bank X-efficiencies are affected through time by monetary policy and macroeconomic factors. The study uses translog flexible function form to measure efficiency and over the period 1988-1997. Agricultural lending is found to be positively correlated to bank efficiency (including non-agricultural banks) and it is not necessary to be large in size to be efficient for the banks with loan specialization. For the effect of monetary policy and macroeconomic factors, the results show that leading business conditions are positively related to bank performance, however, banking sector is not found to be significantly susceptible to a systemic event due to business cycle conditions alone; the entrance of large banks into the local financial market does enhance small bank efficiency simultaneously.

The studies given below examines efficiency of banks using DEA over relatively longer time periods.

Wheelock and Wilson (1999) analyzed the change in efficiency of US banking industry over the time period from 1984 to 1993. The authors estimated Malmquist index using DEA. The study adopts intermediation approach, employing labor (number of full-time equivalent employees), physical capital (book value of premises and fixed assets) and purchased funds (saving and time deposits and non-deposit funds) as input; real estate loans, commercial and industry loans, consumer loans, all other loans and total demand deposits as outputs. The findings indicate large advances over in technology and large increases in average technical inefficiency

over 1984-1993. However, it is found that the advances in technology failed to offset the increases in technical and scale inefficiencies. The authors' conclusion is that much of the inefficiency increase can be attributed to the general failure of banks to adopt technological improvements made by a few banks that advanced the efficient frontier.

Staub, Souza and Tabak (2009) investigate cost, technical and allocative efficiency of Brazilian banks over the period from 2000 to 2007 using DEA with intermediation approach. The study employ interest expenses, operational expenses net of personnel expenses (proxy for capital expenses) and personnel expenses as inputs; investments, total loans and deposits as outputs. The study find that non-performing loans and market share are important indicators of efficiency levels. State-owned banks are found to be more cost-efficient than foreign and private banks.

Wezel (2010) investigates the efficiency of banks in Central American region during 2002-2007. Both data envelopment and stochastic frontier analysis are used to measure efficiency. The study specifies 3 different DEA models, each relating different input and outputs. The sample consists of 86 banks in 6 countries. The study found that foreign banks does not outperform local and regional banks, but globally operating bank are inferior in efficiency over the period under examination.

Isık and Hassan (2000), estimate the efficiency of Turkish banks over 1988-1996 time period. The study found that efficiency of the Turkish banking sector deteriorated over the specified time period and the major source of inefficiency is technical inefficiency rather than allocative inefficiency which is attributed to diseconomies of scale. The sample includes all commercial banks that have operated in Turkey between 1988 and 1996. The study adopts the intermediation approach employing labor (number of employees), capital (book value of premises and fixed

assets), loanable funds (sum of deposit and non-deposit funds) as inputs; short term loans, long term loans, risk adjusted off balance sheet items and other earning assets (loans to special sectors, inter-bank funds sold, investment securities) as outputs.

Cingi and Tarım (2000) constructed DEA Type Malmquist Total Factor Productivity Index to examine the efficiency of 21 Turkish banks from 1989 to 1996. They followed a mixed approach rather than a pure intermediation or production approach. Total assets and total expenses are employed as inputs while total profit, total loans, total deposits, and return on loan as outputs under constant returns to scale assumption. The study shows that private banks are more efficient than state banks over the sample period.

Denizer, Dinc and Tarımcılar (2007), examine the efficiency of Turkish banks during pre-and post-liberalization period. The study used a two stage-input oriented DEA employing both intermediation and production approaches to examine the efficiency of the banking sector from 1970 to 1994. The authors mangled total own resources (physical and financial capital) and total operational expenses (personnel expense, amortization, provision and other expenses) into two parts; resources and expenses used for intermediation function and production function. Each part is used in related stage of DEA. Total own resources of bank for production function, total operational expenses for production function, interest expense and fees paid are employed as inputs; total deposits and non-interest income is employed as outputs in production approach while total own resources of bank for intermediation function, total operational expenses for intermediation function, total deposits are employed as inputs; total loans and banking income (interests, commissions and charges collected for banking) as outputs in intermediation approach. Two major findings of the study are that liberalization programs were followed by decline in efficiency and growing

macroeconomic instability of the Turkish economy and financial sector are major reasons of the decline in efficiency.

Aysan and Ceyhan (2008) analyze the productivity change in the Turkish banking sector between 1990 and 2007. The study constructed DEA Type Malmquist Total Factor Productivity Index over the specified period with a sample of 20 commercial banks. The findings reveal that the Turkish banks experienced a productivity increase when the benchmark years are 1990 and 2001. While the increase in total efficiency was emanated from both efficiency change and technological improvement before 2000; it was solely due to technological improvement after 2001 reflecting the restructuring of the Turkish banking sector. The study shows that state banks, which were the least efficient group before 2001, experienced a sharp increase in efficiency after 2001.

Güneş (2009) analyzes the efficiency of Turkish commercial banks in the period between two financial crisis, from 2002 to 2007 using intermediation approach. The number of banks changed between 33 and 40 over the sample period. The study estimates cost, allocative, technical and pure technical and scale efficiencies using DEA. Güneş, employs labor, capital and loanable funds as inputs and loans and other earning assets as outputs. The efficiency scores show that there is an upward change in efficiency especially after 2004 with the help of financial stability in the sector. The results show that foreign banks are more efficient than domestic banks. Moreover, it is found that ratio of non-performing loans, capital adequacy ratio and ratio of other expenses to total operating income have statistically significant impact on efficiency scores.

CHAPTER 5. DATA AND EMPIRICAL RESULTS

5.1. Data

There were 45 banks and 4 participation banks[1] in Turkey as of end-2009. 32 of those banks were commercial banks while 13 were investment and development banks. The focus of this thesis is measuring efficiency of commercial banks, which account for 97% of the total banking sector in terms of asset size. Moreover, the biggest eight banks in terms of asset size (T.C. Ziraat Bankası A.Ş., T. İş Bankası A.Ş., T. Garanti Bankası A.Ş., Akbank T.A.Ş., T. Vakıflar Bankası T.A.O, Yapı ve Kredi Bankası A.Ş., T. Halk Bankası A.Ş., Finansbank A.Ş.) account for;

- 82% of total assets,
- 77% of total loans,
- 87% of total deposits,
- 72% of total equity share capital

of the Turkish banking sector. We will be working with these eight banks, since the remaining 37 banks only account for 18% of the total assets and not likely to affect total efficiency of the banking system considerably. The data is annual, covering the period 2002-2009 and obtained from the financial statements of banks, published on the internet by the Banks Association of Turkey. The balance sheet and the off-balance sheet items are converted to US dollars by year-end rates since balance-sheets are snapshot views of financial positions at a point in time; while income statement items are converted to US dollars using annual average rates, since items

[1] Participation banks are Albaraka Türk, Bank Asya, Kuveyt Türk and Türkiye Finans.

in the income statement are flow variables. The variables used in the empirical analyses and their sources are listed in the table below:

Table 16: Input and Output Variables and Their Sources

Variable	Balance Sheet/Income Statement Items Included	Input/ Output
Number of Branch	None	Input
Number of Employees	None	Input
Net Tangible Assets (B/S-A)	- Net Tangible Assets	Input
Expense (P/L)	- Interest Expense - Fees and Commissions Paid - Other Operating Expenses (Includes Personnel Expense)	Input
Deposits and Non-Deposit Funds (B/S-L)**	- Deposits - Derivative Financial Liabilities Held For Trading - Funds Borrowed - Money Market Funds - Marketable Securities Issued - Funds - Sundry Creditors - Other Liabilities - Factoring Payables - Lease Payables - Derivative Financial Liabilities for Hedging Purposes	Input or Output*
Loans and Receivables (B/S-A)	- Loans and Receivables	Output

Table 16: Input and Output Variables and Their Sources

Variable	Balance Sheet/Income Statement Items Included	Input/ Output
Other Interest Earning*** Assets (B/S-A)	- Cash and Balances with The Central Bank - Banks - Factoring Receivables - Financial Assets at Fair Value Through Profit and Loss - Lease Receivables - Money Market Placements - Derivative Financial Assets for Hedging Purposes - Financial Assets Available For Sale - Investments Held to Maturity	Output
Off-Balance Sheet Items (O-B/S)	- Off Balance Sheet Contingencies and Commitments	Output
Income (P/L)	- Interest Income - Fees and Commissions Received - Other Operating Income	Output

Notes: *Deposit and Non-Deposit Funds are treated as input in intermediation approach, output in mixed approach.

**B/S-A : Balance sheet items on asset side

B/S-B : Balance sheet items on liabilities side

P/L : Income Statement items

O-B/S : Off balance sheet items

*** : Other earning assets includes "Trading Securities (Net)", "Reserve Deposits", "Miscellaneous Receivables" and "Accrued Interest and Income Receivable" for 2002, 2003, 2004 and 2005. The mentioned account names are

annulled in 2006 and their balances are included in the other accounts given in Table 16.

The minimum, maximum and mean values of the variables for each bank are given in the table below.

Table 17: The Minimum, Maximum and Mean Values of Variables over the Period 2002-2009: Income, Expence, Number of Branch, Number of Labor and Off-Balance Sheet Items

Bank		Income*	Expense*	No of Branch	No of Employees	Off-Balance Sheet Items*
Akbank	Min.	2,613,930	2,003,793	619	9,011	5,101,466
	Max.	9,102,525	6,678,975	878	15,127	35,764,313
	Mean	5,459,027	3,812,409	711	12,033	18,038,289
Finans Bank	Min.	664,335	497,937	126	2,811	2,001,166
	Max.	3,443,248	2,451,360	461	10,107	31,605,402
	Mean	1,899,307	1,263,777	287	6,950	16,377,479
Ziraat	Min.	6,703,469	4,746,503	1,146	20,373	2,827,667
	Max.	11,107,680	8,564,461	1,316	23,330	16,300,686
	Mean	8,299,777	6,177,908	1,212	21,508	7,253,336
Garanti .	Min.	1,865,031	2,089,090	304	7,407	6,411,168
	Max.	8,950,085	7,113,396	788	16,827	45,929,182
	Mean	4,991,388	3,768,492	498	11,851	25,022,011
Halkbank	Min.	3,073,189	2,349,735	527	8,515	841,754
	Max.	5,877,130	4,440,478	707	12,505	15,149,462
	Mean	4,291,002	3,222,031	604	10,839	5,593,593

Table 17: The Minimum, Maximum and Mean Values of Variables over the Period 2002-2009: Income, Expence, Number of Branch, Number of Labor and Off-Balance Sheet Items

Bank		Income*	Expense*	No of Branch	No of Employees	Off-Balance Sheet Items*
	Min.	2,789,257	2,350,869	839	14,873	5,717,563
	Max.	9,716,443	7,663,313	1,093	22,473	46,195,305
Is Bank	Mean	6,023,427	4,493,184	922	18,141	22,134,930
	Min.	1,790,551	1,775,748	296	7,150	2,431,102
	Max.	5,692,736	4,583,269	545	10,153	13,362,638
Vakıfbank	Mean	3,512,126	2,759,060	368	8,169	7,300,755
	Min.	2,202,552	2,411,779	405	10,211	12,367,839
	Max.	6,929,944	5,612,563	861	14,795	48,630,828
YKB	Mean	4,228,507	3,740,607	577	12,323	24,258,439

Note: *In 1,000 USD

Table 18: The Minimum, Maximum and Mean Values of Variables over the Period 2002-2009: Loans and Receivables, Other Earning Assets, Deposit and Non-Deposit Funds and Net Tangible Assets

Bank		Loans and Receivables*	Other Earning Assets*	Deposits and Non-Deposit Funds*	Net Tangible Assets*
Akbank	Min.	3,843,894	10,619,423	12,487,012	288,605
	Max.	31,781,388	35,214,456	53,175,548	600,563
	Mean	17,968,207	20,703,405	33,674,847	479,686
Finans Bank	Min.	1,060,789	1,651,563	2,647,948	65,829
	Max.	12,170,013	7,027,618	15,708,480	248,062

Table 18: The Minimum, Maximum and Mean Values of Variables over the Period 2002-2009: Loans and Receivables, Other Earning Assets, Deposit and Non-Deposit Funds and Net Tangible Assets

Bank		Loans and Receivables*	Other Earning Assets*	Deposits and Non-Deposit Funds*	Net Tangible Assets*
	Mean	6,818,538	3,790,495	9,370,949	161,597
Ziraat	Min.	2,914,592	19,318,044	19,766,557	379,535
	Max.	24,390,361	56,878,350	74,438,878	556,855
	Mean	12,409,956	38,813,067	46,634,726	510,016
Garanti .	Min.	3,462,003	6,758,398	10,684,688	626,598
	Max.	33,029,617	34,905,012	59,692,485	1,048,612
	Mean	18,270,114	16,819,143	32,383,649	818,085
Halkbank	Min.	738,081	9,563,944	9,176,061	249,403
	Max.	21,556,798	17,710,473	35,825,834	756,434
	Mean	9,105,939	14,588,154	21,470,591	500,262
Is Bank	Min.	4,426,211	7,120,734	11,551,417	1,223,181
	Max.	32,101,206	37,591,564	63,714,362	1,650,233
	Mean	18,645,008	23,381,371	39,027,047	1,365,260
Vakıfbank	Min.	2,073,200	4,827,271	7,056,650	568,470
	Max.	22,961,184	18,391,433	37,487,066	831,352
	Mean	12,046,616	11,871,407	21,983,147	700,248
YKB	Min.	4,335,369	4,666,934	9,558,503	721,508
	Max.	25,572,275	15,932,095	35,691,118	1,789,531
	Mean	14,636,187	10,347,986	23,324,894	1,139,526

Note: *In 1,000 USD

5.2. Empirical Results

Two different DEA type Malmquist efficiency indices are constructed; one using intermediation approach and the other mixed approach. The results are given in below.

5.2.1. Empirical Results under Intermediation Approach

Table 19 shows the Malmquist Index summary of annual means under intermediation approach and Table 20 shows the Malmquist Index summary of firm means under intermediation approach. Table 23 in appendix B shows the technical efficiency scores relative to the technology of previous, current and subsequent years for every single year under intermediation approach, in the period under examination; Table 24 in appendix B shows Summary of Malmquist Index under intermediation approach.

The results show that total factor productivity increased in all years between 2002-2009 except for 2008, the year of the global financial crisis. Average increase in total productivity per year is 7.9% and the main source of efficiency increase is technological innovation.

The 2008 global financial crisis seems to cause a decrease in both technical efficiency (efficiency relative to frontier) and technological change (shift in frontier), indicating that riskier banking environment is associated with less efficient managerial decisions and limited banking sales opportunities. The average decrease in total productivity in year 2008 (effect of financial crisis) is 4.3% under intermediation approach. The major source of productivity increase between 2002 and 2009 is technological innovation rather than increase in technical efficiency,

indicating that transformation to modern banking had vastly increased market penetration capabilities of the banking sector.

There is almost no change in pure technical efficiency (efficiency change under variable returns to scale) over the period, while there is slight fluctuation in technical efficiency (efficiency change in constant returns to scale). Akbank, Garanti Bank, Finansbank and Ziraat Bank are found to be working technically efficient throughout the period under examination (technical efficiency relative to technology of time t is 1 for every year for the mentioned banks as seen in Table 23 in appendix B). Is Bank is found to be operating technically inefficient in the years 2002, 2003 and 2008; Vakıfbank in 2002; Halkbank in 2008 and 2009 and Yapı Kredi Bank in 2004 and 2006.

All of the banks, except for Halkbank experienced an increase in total factor productivity between 2002-2009. Efficiency of Halkbank deteriorated by over 5% per year on average in the post financial crisis (2001) period; while efficiency of all other banks increased at least by 4% on average in the same time period under intermediation approach.

Finansbank, Garanti and Akbank, which had advanced in transformation to modern banking before 2001 financial crisis experienced an average increase of 10% per annum on average in efficiency. Yapı Kredi Bank, on the other hand, experienced an average increase of 6.3% per annum.

The state banks Vakıfbank and Ziraat Bank experienced increase in efficiency (average of 12.9% and 4.2% per annum respectively) while the state bank Halkbank experience a decrease in efficiency (average of 5.1% per annum) overall, indicating

that level and direction of change in efficiency increase is vastly related with decisions of bank management rather than the ownership itself.

Table 19: The Malmquist Index Summary of Annual Means Constructed by Intermediation Approach

MALMQUIST INDEX (IA*) SUMMARY OF ANNUAL MEANS**					
Year/Eff.* **	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
2002-2003	0.999	1.067	1.008	0.990	1.066
2003-2004	1.013	1.074	1.000	1.013	1.088
2004-2005	1.001	1.097	1.000	1.001	1.097
2005-2006	0.999	1.095	1.000	0.999	1.094
2006-2007	1.001	1.115	1.000	1.001	1.116
2007-2008	0.997	0.960	1.000	0.997	0.957
2008-2009	1.003	1.143	1.000	1.003	1.146
Mean	**1.002**	**1.077**	**1.001**	**1.001**	**1.079**

Note: *Intermediation approach, **All Malmquist index averages are geometric means, ***EFFCH: Technical Efficiency Change, TECHCH: Technological Change, PECH: Pure Technical Efficiency Change, SECH: Scale Efficiency Change, TFPCH: Total Factor Productivity Change

Table 20: The Malmquist Index Summary of Firm Means Constructed by Intermediation Approach

MALMQUIST INDEX (IA*) SUMMARY OF FIRM MEANS**					
Bank/Eff* **	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
Akbank	1.000	1.128	1.000	1.000	1.128
Finansbank	1.000	1.157	1.000	1.000	1.157
Ziraat	1.000	1.042	1.000	1.000	1.040
Garanti	1.000	1.128	1.000	1.000	1.128
Halkbank	1.000	0.949	1.000	1.000	0.949
Is Bank	1.005	1.049	1.000	1.005	1.054

Table 20: The Malmquist Index Summary of Firm Means Constructed by Intermediation Approach

MALMQUIST INDEX (IA*) SUMMARY OF FIRM MEANS**					
Bank/Eff* **	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
Vakıfbank	1.010	1.118	1.009	1.000	1.129
YKB	1.000	1.063	1.000	1.000	1.063
Mean	**1.002**	**1.077**	**1.001**	**1.001**	**1.079**

Note: *Intermediation approach, **All Malmquist index averages are geometric means, ***EFFCH: Technical Efficiency Change, TECHCH: Technological Change, PECH: Pure Technical Efficiency Change, SECH: Scale Efficiency Change, TFPCH: Total Factor Productivity Change

5.2.2. Empirical Results under Mixed Approach

Table 21 shows the Malmquist Index summary of annual means under mixed approach and Table 22 shows the Malmquist Index summary of firm means under mixed approach. The major findings are as follows: Table 25 in appendix C shows the technical efficiency scores relative to the technology of previous, current and subsequent years for every single year calculated under mixed approach, in the period under examination; Table 26 in appendix C shows Summary of Malmquist Index under mixed approach.

The results show that the magnitude of efficiency change is greater under assumptions of mixed approach (the minimum and maximum values are -8.5% in 2008; 23.1% in 2009) where the total factor productivity increased in all years between 2002-2009 except for 2008, the year of global financial crisis. Average increase in total productivity per year is 11.0% (as opposed to 7.9% under intermediation approach) and the main source of efficiency increase is technological innovation.

The average decrease in total productivity in year 2008 (effect of financial crisis) is 8.5% as opposed to 4.3% found under intermediation approach. On the contrary to intermediation approach, mixed approach indicates that Turkish banking sector experienced increase in both technical and pure technical efficiency during 2008 global crisis (3% and 2.4% respectively under mixed approach, as opposed to -0.03% and 0% found under intermediation approach), when technological efficiency decreased vastly (-11.2% under mixed approach, -4% under intermediation approach). The fall in technological efficiency can be associated with increased credit and market risk during global financial crisis, when investments with lower risk and returns are preferred.

Pure technical efficiency (efficiency change under variable returns to scale) and technical efficiency (efficiency change under constant returns to scale) move in the same direction, indicating that change in scale assumption has insignificant effect under assumptions of mixed approach.

Akbank, Garanti Bank, Finansbank and Ziraat Bank are found to be working technically efficient throughout the period under examination (technical efficiency relative to technology of time t is 1 for every year in for the mentioned banks in as seen in Table 25 in appendix C), where this result is in line with the results found under intermediation approach. Isbank is found to be operating technically inefficient in the years 2002, 2003, 2004 and 2007 (2002, 2003 and 2008 under intermediation approach); Vakıfbank in 2002 (in line with results found under intermediation approach); Halkbank in 2004, 2005, 2006, 2007 and 2008 (in 2008 and 2009 under intermediation approach) and Yapı Kredi Bank in 2004, 2005, 2006, 2007 and 2008 (in 2004 and 2006 under intermediation approach). The number of the years in which Isbank, Halk Bank and Yapı Kredi has been operating technically inefficient is found to be higher under mixed approach compared to intermediation approach (Isbank 3,

Halkbank 2, Yapı Kredi Bank 2 years under intermediation approach and Isbank 4, Halkbank 5, Yapı Kredi Bank 5 years under mixed approach respectively).

All of the banks, except for Halkbank experienced an increase in total factor productivity between 2002 and 2009. Efficiency of Halkbank deteriorated by over 0.1% per year on the average in the post financial crisis (2001) period; while efficiency of all other banks increased at least by 7.7% on average in the same time period. Akbank, Garanti, Yapı Kredi and Finansbank which had advanced in transformation to modern banking before 2001 financial crisis experienced an increase in efficiency over 10% per annum on average (However, Yapı Kredi Bank is found to experience lower than average increase (6.3%) in efficiency per annum under intermediation approach).

The state banks Vakıfbank and Ziraat Bank experienced increase in efficiency (16.5% and 7.7% per annum, on average, respectively) while the state bank Halkbank experienced a decrease in efficiency (-0.001 per annum, on average) indicating that level and direction of change in efficiency is vastly related with decisions of bank management rather than ownership itself.

Table 21: The Malmquist Index Summary of Annual Means Constructed by Mixed Approach

MALMQUIST INDEX (MA*) SUMMARY OF ANNUAL MEANS**					
Year/Eff.* **	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
2002-2003	1.017	1.092	1.018	0.998	1.110
2003-2004	0.966	1.185	0.990	0.976	1.145
2004-2005	1.009	1.127	0.979	1.031	1.138
2005-2006	1.030	1.098	1.032	0.998	1.131
2006-2007	0.976	1.157	0.976	1.001	1.130

Table 21: The Malmquist Index Summary of Annual Means Constructed by Mixed Approach

MALMQUIST INDEX (MA*) SUMMARY OF ANNUAL MEANS**					
Year/Eff.* **	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
2007-2008	1.030	0.888	1.024	1.006	0.915
2008-2009	1.006	1.224	1.001	1.005	1.231
Mean	**1.005**	**1.105**	**1.003**	**1.002**	**1.110**

Note: *Mixed approach, **All Malmquist index averages are geometric means, ***EFFCH: Technical Efficiency Change, TECHCH: Technological Change, PECH: Pure Technical Efficiency Change, SECH: Scale Efficiency Change, TFPCH: Total Factor Productivity Change

Table 22: The Malmquist Index Summary of Firm Means Constructed by Mixed Approach

MALMQUIST INDEX (MA*) SUMMARY OF FIRM MEANS**					
Bank	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
Akbank	1.000	1.145	1.000	1.000	1.145
Finansbank	1.000	1.152	1.000	1.000	1.152
Ziraat	1.000	1.077	1.000	1.000	1.077
Garanti	1.000	1.140	1.000	1.000	1.140
Halkbank	1.000	0.999	1.000	1.000	0.999
Is Bank	1.015	1.079	1.000	1.015	1.095
Vakıfbank	1.022	1.140	1.021	1.001	1.165
YKB	1.000	1.118	1.000	1.000	1.118
Mean	**1.005**	**1.105**	**1.003**	**1.002**	**1.110**

Note: *Mixed approach, **All Malmquist index averages are geometric means, ***EFFCH: Technical Efficiency Change, TECHCH: Technological Change, PECH: Pure Technical Efficiency Change, SECH: Scale Efficiency Change, TFPCH: Total Factor Productivity Change

In summary, regardless of whether we use the intermediation approach or the mixed approach, the results confirm an increase in efficiency scores in the post banking crisis era and decrease in efficiency during the 2008 global financial crisis. Both approaches verify that banks which had advanced in transformation to modern banking before 2001 financial crisis has been operating technically efficient throughout the period under examination and experienced higher average annual increase in efficiency. The findings reveal that the direction and magnitude of change in efficiency is different among state banks, pointing to the fact that each state bank has experienced different levels of technological innovation along with managerial and organizational enhancement.

These results are in line with the findings of Aysan and Ceyhan (2008) and Güneş (2009) in the sense that Turkish banking sector experienced an efficiency gain in the post 2001 crisis period. The major source of increase in efficiency is technological innovation rather than technical efficiency (relative efficiency compared to frontier); which is in line with the findings of Aysan and Ceyhan (2008) stating that the major source of increase in efficiency is both change in technical efficiency and technological innovation before 2001, but only the latter between 2001 and 2007. The only bank to lose efficiency, on the average, over the sample period is a state bank, Halkbank. The same reasoning of Wheelock and Wilson (1999) for the efficiency loss of US banks can be used for Halkbank. In this sense, much of the inefficiency increase of Halkbank can be attributed to the general failure of Halkbank to adopt technological improvements made by other banks that advanced the efficient frontier.

The increase in efficiency of the banking system is not surprising given that Turkish banks have been going through a process of transformation to modern banking after the 2001 financial crisis; investing in advanced technological infrastructure and

education of labor. Throughout the transformation period, Turkish banks started employing;

- sophisticated loan processing systems to decrease cost of non-performing loans,
- operation centers to increase pace of and reduce cost of operational services,
- alternative banking services (out-of-branch banking services) such as internet banking to provide cheaper, faster and uninterrupted financial service,
- computer systems with increased data mining and reporting capabilities for faster market penetration and to increase profit per customer,
- highly educated labor to use sophisticated reports and computer systems,
- better performance evaluation systems for more efficient use of labor.

There are no sales and marketing departments in the organizational structure of traditional banks. Change in managerial and organizational structure is necessary to employ marketing and sales departments in order to make possible the efficient use of reports produced by sophisticated computer systems. Despite the change in managerial structure, the major source of increase in efficiency is expected to emanate from technological innovation. The results confirm the above allegations; the banks that invested in transformation process experienced efficiency gains, However, there have been efficiency loss during global financial crisis, the recovery period has been very short for the Turkish banks. The main reasons of such fast recovery is discussed in section 5.2.4.

5.2.3. Efficiency Change vs. Technological Change

Our findings indicate that the major source of increase in productivity over the sample period is technological innovation rather than efficiency change. With intermediation approach, the average increase in total factor productivity per annum is 7.9%; 7.7% emanating from technological innovation and 0.02% emanating from efficiency change and there is only 0.1% increase in pure efficiency over the sample period. With the mixed approach, on the other hand, the average increase in total factor productivity per annum is 11%; 10.5% emanating from technological innovation and 0.05% emanating from efficiency change and there is only 0.03% increase in pure efficiency over the sample period.

This result is not surprising given the fact that the basics of transformation to modern banking lies in technological advancement. Like all other service sector, market penetration and profit maximization in banking sector is closely related to the ability to discover customer needs in shorter time spans. The backbone of technological sophistication is increasing ability to collect and process customer data. As modern banks discover the needs of customers and demand elasticity of customer segments for loans and financial services, they increase their profit per customers. Another aspect of technological sophistication is the ability to better measure and control operational costs. As the use of internet banking and ATM's increases, the need for employees and branches needed to render financial services decreases; similarly as the online workflow of banking services increases, the use of paper work decreases. Hence technological advancement increases total factor productivity since it enables banks to render more of financial services with less number of employees, branches.

However it is also true that, better utilization of such advanced technologies is dependent of the ability of employees to use those sophisticated computer systems and reports produced by such systems. Hence the increase in education level of the

personnel is also an important factor. Not surprisingly, the ratio of university graduates employed in banking sector increased from 56% in 2002 to 76% in 2009. Bansk not only are hiring higher educated employees, but also invest more on education of their employees. The education of employees during the transformation years not only include technical education, such as using computer systems and reading technical reports, but also cultural components such as customer relations, social activities and time management.

5.2.4. Effect of Global Financial Crisis (2008) and Macroeconomic Variables of Post-Crisis Period (2009)

The effect of the 2008 global financial crisis is negative under both intermediation (-4.3%) and mixed approach (-8.5%), however the magnitude is higher with mixed approach. This result is expected because the outputs of banks in both approaches are correlated with risk. Although there is high return on riskier investments, all banks preferred to stay on the safe side of the market, staying away from risky investments during the financial crisis. Staying away from risky investments means, establishing less amount of loan and forgoing assets with higher returns. Banks started to carry more of treasury bonds, since they bear low risk and improve risk weighted asset portfolio, decreasing banks need for equity to keep higher capital adequacy ratio. The crisis also led banks to save on expense side, to keep profits from falling.

It is interesting to note that all the total factor productivity and all of its components improved in 2009. Macroeconomic variables moved in favor of banks in 2009. First of all, all the deferred demand for consumer loans and risk appetite of banks coincided in year 2009 leading to an increase in consumer loans. More importantly, Central Bank of Turkey decreased interest rates on overnight lending and borrowing during the 2008 financial crisis. This caused interest rates on deposits to fall. Banks,

on the other hand, were much slower and reluctant in decreasing rates on loans. The fast falling interest rates on deposits along with higher interest rates on loans (downward sticky interest rates on loans) enabled banks to operate with higher interest rate margins. Falling interest rates, on the other hand, led prices of securities on the asset side of banks' balance sheets to increase. This, in turn, caused profits and equity of banks to increase. Hence, year 2009 was associated with higher efficiency scores due to;

- relative decrease in expenses,
- increase in amount of loans established,
- increase in interest rate margins,
- increase in the prices of securities.

Nonetheless, features of modern banking, helped Turkish banks to better manage market and credit risks, decrease costs of banking operations and increase sales during and after global financial crisis.

Aysan and Ceyhan (2008) found that the 2001 financial crisis decreased the political pressures on the management of state banks. This, in turn, led to an increment in efficiency of state banks. The results of our study confirm the increase in efficiency in state banks in the post crisis period, except for the Halkbank case. Aysan and Ceyhan, on the other hand, found that 21 out of 34 banks had experienced efficiency growth from 2001 to 2002. The results show that foreign and state banks experienced decrease in total factor productivity; while private banks experienced increase in total factor productivity during the 2001 financial crisis. The decrease in efficiency of foreign banks may be emanating from less efficient positions taken deliberately by foreign banks to stay away from risky banking environment. For example, foreign banks may have refrained from establishing loans during 2001 crisis in order to

ameliorate risk structure of their assets. Private banks on the other hand may have experienced increase in efficiency due to their better risk management and market penetration and cost control capabilities.

5.2.5. Sensitivity of Efficiency Scores to Description of Inputs and Outputs: Intermediation Approach vs. Mixed Approach

We had used both intermediation and mixed approaches to construct DEA type Malmquist Efficiency Index. We employed "deposits and non-deposit funds" as input in intermediation approach and as output in the mixed approach. This change in description of inputs and output increased the magnitude of change in total factor productivity index and its components. The maximum average per annum increase and decrease in TFP is found to be 14.6% and -4.5% in the intermediation approach and 23.1% and -8.5% in the mixed approach.

While annual average pure technical efficiency was observed to be constant, the average technical efficiency was observed to fluctuate with intermediation approach. Both variables, on the other hand, seemed to move in the same direction under mixed approach, indicating that scale assumption did not affect the direction of change (increase or decrease) in relative efficiency (whether the observed production is getting any closer to frontier or not).

Both approaches confirm that;

- global financial crisis had adverse effects on the efficiency of the banking sector,
- Vakıfbank experienced higher increases in average annual efficiency than other state banks,

- Halkbank is the only bank to experience deterioration in average total factor productivity per annum over the sample period,
- private banks that had advanced in transformation to modern banking experienced higher rates of efficiency gain than other private banks.

CHAPTER 6. CONCLUSIONS

Turkish banking sector was immature in terms of technology, asset size and product variability before 2001 financial crisis. While state banks were devoid of advanced risk management and data mining capabilities, they were also badly managed, experiencing decrease in equity share. The restructuring of the Turkish banking sector as a whole could not be achieved before 2001 crisis. The 2001 crisis ended in 22 bankruptcies in the sector.

Post crisis era was a restructuring period of the Turkish banking sector. While few of the private banks had advanced in transformation to modern banking before 2001 financial crises, the rest of the sector embarked on projects to upgrade technological infrastructure and restructure their organizational form in the post-2001-crises period. The transformation of the Turkish banks to modern banks includes decreasing cost of banking transactions through employment of operation centers and out-of-branch capabilities such as internet banking, advanced risk management systems and data mining capabilities, marketing and sales departments and employees with higher level of education.

While the 2008 global financial crisis created a risky business environment for Turkish banks, in 2009 the banking sector made unprecedented levels of profits due to increased demand for consumer loans, higher level of interest rate margins and increasing prices of securities due to falling interest rates. Hence we expect all banks in Turkey to gain efficiency over the sample period 2002-2009, except for the year 2008.

The aim of this thesis has been three fold:

- put forward the effects of transformation of banks from a “traditional” one to a “modern” one on efficiency,
- measure the change in efficiency of Turkish banking sector between over the period 2002-2009 and the effects of 2008 global financial crisis on efficiency of Turkish banks,
- measure the sensitivity of efficiency measures to different descriptions of inputs and outputs by employing two different approaches.

The efficiencies of eight largest (in terms of assets) Turkish banks (Akbank, Garanti, Is Bank, Yapı Kredi Bank, Finansbank, Ziraat Bank, Halkbank and Vakıfbank) are measured from 2002 to 2009, employing both intermediation and the mixed approaches. The banks subject to examination accounts for 82% of total assets of the banking sector. The difference between the intermediation and the mixed approaches is the definition of inputs and outputs. Deposits and non-deposit funds are employed as inputs in intermediation approach and as output in the mixed approach. DEA type Malmquist Total Productivity Index was constructed with each one of the mentioned approaches and the technical efficiency, pure technical efficiency, technological change and scale efficiency components of the index are reported.

Both approaches confirm that the efficiency of Turkish banking sector had ameliorated over the period 2002-2009 except for 2008, the year of global financial crisis; the results are in line with the findings of Aysan and Ceyhan (2008) and Güneş (2009). The magnitude of change in total factor productivity and its components are higher when mixed approach is used. Average increase in total factor productivity per annum is %7.9 when intermediation approach is adopted, %11.0 when mixed approach is adopted.

The major source of increase in efficiency is technological innovation (shift in frontier) rather than change in technical efficiency (change in relative efficiency compared to frontier); which is in line with the findings of Aysan and Ceyhan (2008) stating that the major source of increase in efficiency is both change in technical efficiency and technological innovation before 2001, but only the latter between 2001 and 2007. The fact that efficiency gain has emanated solely from technological progress implies that the investments made to reform technological infrastructure and organizational structure of Turkish banks for the transformation into modern bank purposes had increased the efficiency of banks as expected.

2008 global financial crisis seems to cause a deterioration in total factor productivity (by 4.3% when intermediation approach is adopted; 8.5% when mixed approach is adopted). Both approaches confirm that banks which had advanced in transformation to modern banking before 2001 financial crises experienced higher than average efficiency gains (over 10%) per annum (except for the results found for Yapı Kredi Bank with intermediation approach).

The efficiency change was very different among public banks, Vakıfbank and Ziraat Bank gained efficiency while Halkbank experienced deterioration in efficiency on average. The same reasoning of Wheelock and Wilson (1999) for the efficiency loss of US banks can be used for Halkbank. In this sense, much of the inefficiency increase of Halkbank can be attributed to the general failure of Halkbank to adopt technological improvements made by other banks that advanced the efficient frontier.

The changes in macroeconomic variables in post crisis period were in favor of efficiency. Widening interest rate margins, falling interest rates and increasing prices of securities along with banks operational-cost saving strategies seems to cause total factor productivity and all of its components to increase in 2009 (TFP increased by

14.6% on the average when intermediation approach is adopted and 23.1% on the average when mixed approach is adopted).

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APPENDICES

A. Figures of Total Assets, Loans and Equity Capital of Turkish Banking Sector

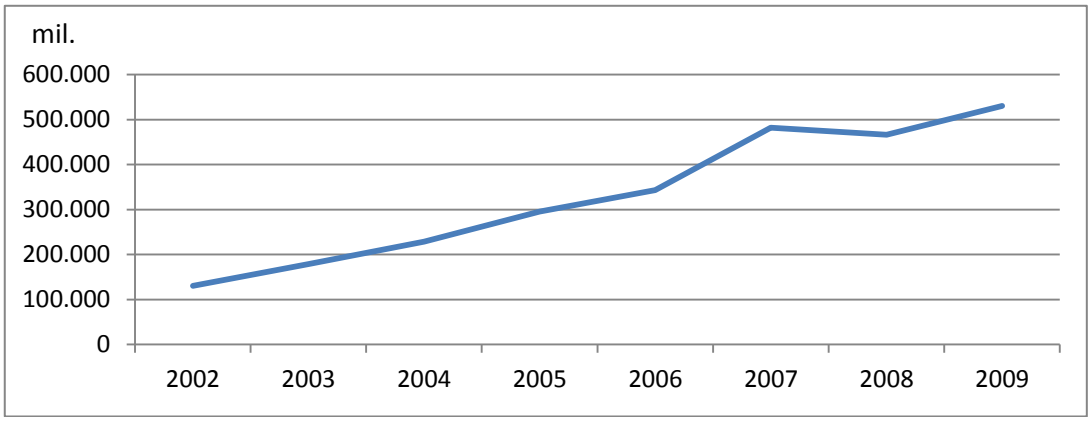

Figure 3: Total Assets of Turkish Banking Sector

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

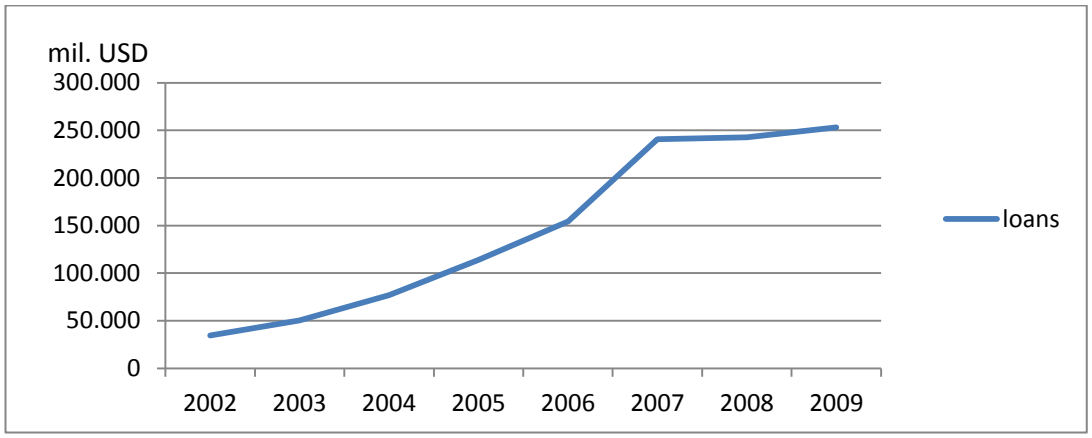

Figure 4: Total Loans of Turkish Banking Sector

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

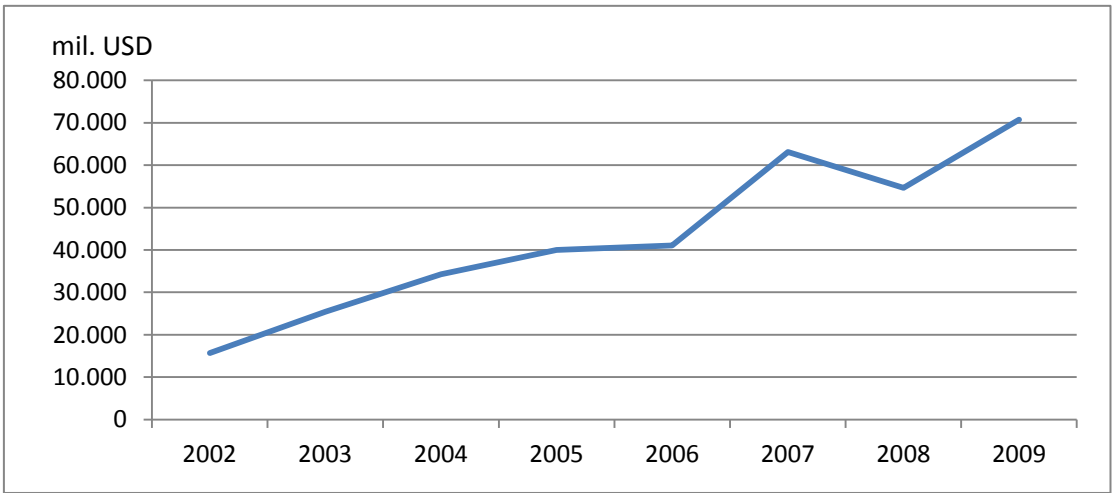

Figure 5: Equity Capital of Turkish Banking Sector

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

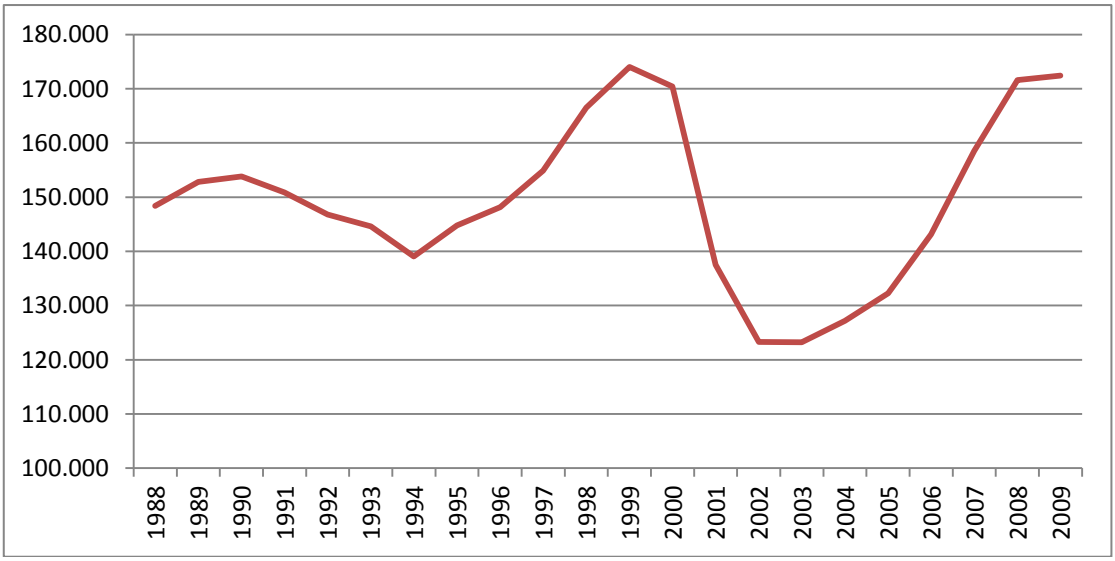

Figure 6: Number of Employees in the Turkish Banking Sector

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

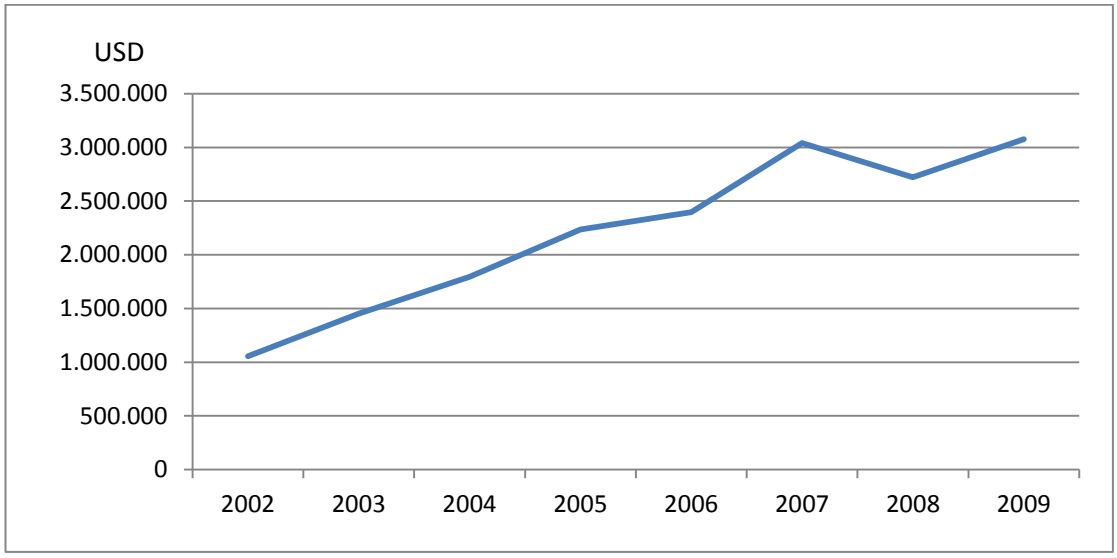

Figure 7: Asset Size per Employee of the Turkish Banking Sector

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

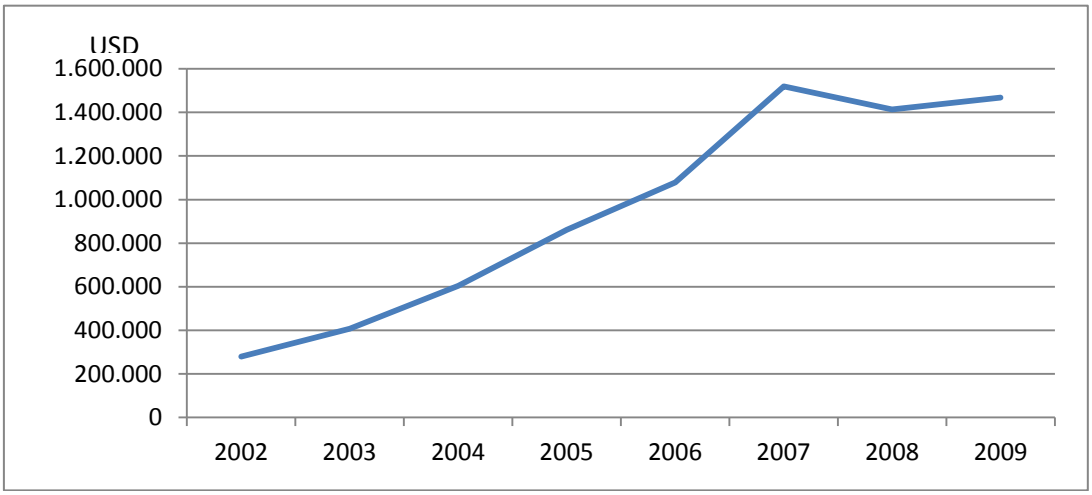

Figure 8: Loans per Employee of Turkish Banking Sector

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

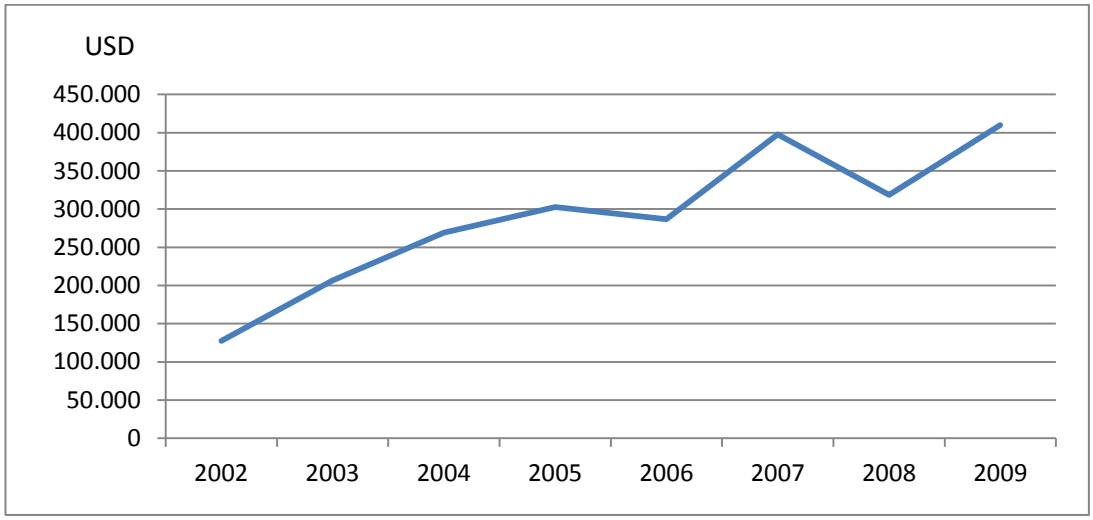

Figure 9: Equity Capital per Employee of the Turkish Banking Sector

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

B. Distance and Malmquist Index Values Found Under the Intermediation Approach

Table 23: The Technical Efficiency Measures (Distance Functions) Calculated Relative to Previous, Current and Subsequent Years Under Intermediation Approach

DISTANCES SUMMARY (IA*)				
Technical Efficiency (TE) Relative to Technology at Year (t-1), t and (t+1) Under CRS Assumption				
Bank/Eff.* **	**TE Relative to Technology of Period (t-1)**	**TE Relative to Technology of Period t**	**TE Relative to Technology of Period (t+1)**	**TE Under VRS Asmpt.**
Year 2002				
Akbank	0.000	1.000	1.030	1.000
Finansbank	0.000	1.000	1.224	1.000
Ziraat	0.000	1.000	1.511	1.000
Garanti	0.000	1.000	1.215	1.000
Halkbank	0.000	1.000	1.720	1.000
Is Bank	0.000	0.969	0.991	1.000
Vakıfbank	0.000	0.935	0.971	0.936
YKB	0.000	1.000	1.411	1.000
Mean**	**0.000**	**0.988**	**1.259**	**0.992**
Year 2003				
Akbank	1.546	1.000	1.124	1.000
Finansbank	1.690	1.000	1.091	1.000
Ziraat	1.438	1.000	1.443	1.000
Garanti	1.647	1.000	1.114	1.000
Halkbank	1.236	1.000	1.689	1.000
Is Bank	1.072	0.897	0.928	1.000
Vakıfbank	1.272	1.000	0.964	1.000
YKB	1.449	1.000	1.253	1.000
Mean	**1.419**	**0.987**	**1.201**	**1.000**
Year 2004				

Table 23: The Technical Efficiency Measures (Distance Functions) Calculated Relative to Previous, Current and Subsequent Years Under Intermediation Approach

DISTANCES SUMMARY (IA*)				
Technical Efficiency (TE) Relative to Technology at Year (t-1), t and (t+1) Under CRS Assumption				
Bank/Eff.* **	**TE Relative to Technology of Period (t-1)**	**TE Relative to Technology of Period t**	**TE Relative to Technology of Period (t+1)**	**TE Under VRS Asmpt.**
Akbank	1.517	1.000	1.124	1.000
Finansbank	1.828	1.000	1.039	1.000
Ziraat	1.383	1.000	1.114	1.000
Garanti	1.479	1.000	1.056	1.000
Halkbank	1.081	1.000	1.084	1.000
Is Bank	1.153	1.000	1.014	1.000
Vakıfbank	1.459	1.000	1.017	1.000
YKB	1.260	0.995	0.957	1.000
Mean	**1.395**	**0.999**	**1.051**	**1.000**
Year 2005				
Akbank	1.645	1.000	1.244	1.000
Finansbank	1.326	1.000	1.030	1.000
Ziraat	1.246	1.000	1.087	1.000
Garanti	1.385	1.000	1.038	1.000
Halkbank	1.002	1.000	1.094	1.000
Is Bank	1.157	1.000	1.213	1.000
Vakıfbank	1.446	1.000	1.236	1.000
YKB	1.026	1.000	0.915	1.000
Mean	**1.279**	**1.000**	**1.107**	**1.000**
Year 2006				
Akbank	1.212	1.000	0.991	1.000
Finansbank	2.475	1.000	1.216	1.000
Ziraat	1.237	1.000	1.054	1.000
Garanti	1.474	1.000	0.942	1.000

Table 23: The Technical Efficiency Measures (Distance Functions) Calculated Relative to Previous, Current and Subsequent Years Under Intermediation Approach

DISTANCES SUMMARY (IA*)				
Technical Efficiency (TE) Relative to Technology at Year (t-1), t and (t+1) Under CRS Assumption				
Bank/Eff.* **	**TE Relative to Technology of Period (t-1)**	**TE Relative to Technology of Period t**	**TE Relative to Technology of Period (t+1)**	**TE Under VRS Asmpt.**
Halkbank	1.091	1.000	1.118	1.000
Is Bank	0.949	1.000	0.962	1.000
Vakıfbank	1.436	1.000	1.028	1.000
YKB	1.123	0.993	0.949	1.000
Mean	**1.375**	**0.999**	**1.033**	**1.000**
Year 2007				
Akbank	1.446	1.000	1.290	1.000
Finansbank	1.289	1.000	1.780	1.000
Ziraat	1.345	1.000	1.284	1.000
Garanti	1.396	1.000	1.361	1.000
Halkbank	1.011	1.000	1.117	1.000
Is Bank	1.280	1.000	1.246	1.000
Vakıfbank	1.398	1.000	1.225	1.000
YKB	1.145	1.000	1.001	1.000
Mean	**1.289**	**1.000**	**1.288**	**1.000**
Year 2008				
Akbank	1.222	1.000	1.326	1.000
Finansbank	1.330	1.000	1.244	1.000
Ziraat	1.231	1.000	1.273	1.000
Garanti	1.135	1.000	1.232	1.000
Halkbank	1.132	0.992	1.221	1.000
Is Bank	1.031	0.985	1.135	1.000
Vakıfbank	1.145	1.000	1.302	1.000
YKB	1.149	1.000	1.222	1.000

Table 23: The Technical Efficiency Measures (Distance Functions) Calculated Relative to Previous, Current and Subsequent Years Under Intermediation Approach

DISTANCES SUMMARY (IA*)				
Technical Efficiency (TE) Relative to Technology at Year (t-1), t and (t+1) Under CRS Assumption				
Bank/Eff.* **	**TE Relative to Technology of Period (t-1)**	**TE Relative to Technology of Period t**	**TE Relative to Technology of Period (t+1)**	**TE Under VRS Asmpt.**
Mean	**1.172**	**0.997**	**1.244**	**1.000**
Year 2009				
Akbank	1.790	1.000	0.000	1.000
Finansbank	1.700	1.000	0.000	1.000
Ziraat	1.593	1.000	0.000	1.000
Garanti	1.606	1.000	0.000	1.000
Halkbank	1.501	0.999	0.000	1.000
Is Bank	1.736	1.000	0.000	1.000
Vakıfbank	1.600	1.000	0.000	1.000
YKB	1.527	1.000	0.000	1.000
Mean	**1.632**	**1.000**	**0.000**	**1.000**

Note: *Intermediation approach, **All means are geometric means

Table 24: Malmquist Index Constructed Under Intermediation Approach

MALMQUIST INDEX SUMMARY (IA*)					
Year/Bank**	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
2002-2003					
Akbank	1.000	1.225	1.000	1.000	1.225
Finansbank	1.000	1.175	1.000	1.000	1.175
Ziraat	1.000	0.975	1.000	1.000	0.975
Garanti	1.000	1.164	1.000	1.000	1.164
Halkbank	1.000	0.848	1.000	1.000	0.848
Is Bank	0.925	1.081	1.000	0.925	1.000
Vakıfbank	1.069	1.107	1.068	1.001	1.184
YKB	1.000	1.013	1.000	1.000	1.013
Mean	**0.999**	**1.067**	**1.008**	**0.990**	**1.066**
2003-2004					
Akbank	1.000	1.162	1.000	1.000	1.162
Finansbank	1.000	1.294	1.000	1.000	1.294
Ziraat	1.000	0.979	1.000	1.000	0.979
Garanti	1.000	1.152	1.000	1.000	1.152
Halkbank	1.000	0.800	1.000	1.000	0.800
Is Bank	1.115	1.055	1.000	1.115	1.177
Vakıfbank	1.000	1.230	1.000	1.000	1.230
YKB	0.995	1.005	1.000	0.995	1.001
Mean	**1.013**	**1.074**	**1.000**	**1.013**	**1.088**
2004-2005					
Akbank	1.000	1.210	1.000	1.000	1.210
Finansbank	1.000	1.130	1.000	1.000	1.130
Ziraat	1.000	1.058	1.000	1.000	1.058
Garanti	1.000	1.145	1.000	1.000	1.145
Halkbank	1.000	0.961	1.000	1.000	0.961
Is Bank	1.000	1.068	1.000	1.000	1.069
Vakıfbank	1.000	1.192	1.000	1.000	1.192
YKB	1.005	1.033	1.000	1.005	1.038
Mean	**1.001**	**1.097**	**1.000**	**1.001**	**1.097**
2005-2006					

Table 24: Malmquist Index Constructed Under Intermediation Approach

MALMQUIST INDEX SUMMARY (IA*)					
Year/Bank**	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
Akbank	1.000	0.987	1.000	1.000	0.9870
Finansbank	1.000	1.550	1.000	1.000	1.550
Ziraat	1.000	1.067	1.000	1.000	1.067
Garanti	1.000	1.192	1.000	1.000	1.192
Halkbank	1.000	0.999	1.000	1.000	0.999
Is Bank	1.000	0.885	1.000	1.000	0.885
Vakıfbank	1.000	1.078	1.000	1.000	1.078
YKB	0.993	1.112	1.000	0.993	1.104
Mean	**0.999**	**1.095**	**1.000**	**0.999**	**1.094**
2006-2007					
Akbank	1.000	1.208	1.000	1.000	1.208
Finansbank	1.000	1.029	1.000	1.000	1.029
Ziraat	1.000	1.130	1.000	1.000	1.130
Garanti	1.000	1.218	1.000	1.000	1.218
Halkbank	1.000	0.951	1.000	1.000	0.951
Is Bank	1.000	1.153	1.000	1.000	1.153
Vakıfbank	1.000	1.166	1.000	1.000	1.166
YKB	1.007	1.095	1.000	1.007	1.103
Mean	**1.001**	**1.115**	**1.000**	**1.001**	**1.116**
2007-2008					
Akbank	1.000	0.973	1.000	1.000	0.973
Finansbank	1.000	0.864	1.000	1.000	0.864
Ziraat	1.000	0.979	1.000	1.000	0.979
Garanti	1.000	0.913	1.000	1.000	0.913
Halkbank	0.992	1.011	1.000	0.992	1.003
Is Bank	0.985	0.917	1.000	0.985	0.903
Vakıfbank	1.000	0.967	1.000	1.000	0.967
YKB	1.000	1.071	1.000	1.000	1.071
Mean	**0.997**	**0.960**	**1.000**	**0.997**	**0.957**
2008-2009					
Akbank	1.000	1.162	1.000	1.000	1.162

Table 24: Malmquist Index Constructed Under Intermediation Approach

MALMQUIST INDEX SUMMARY (IA*)					
Year/Bank**	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
Finansbank	1.000	1.169	1.000	1.000	1.169
Ziraat	1.000	1.119	1.000	1.000	1.119
Garanti	1.000	1.142	1.000	1.000	1.142
Halkbank	1.007	1.105	1.000	1.007	1.113
Is Bank	1.016	1.227	1.000	1.016	1.246
Vakıfbank	1.000	1.108	1.000	1.000	1.108
YKB	1.000	1.118	1.000	1.000	1.118
Mean	**1.003**	**1.143**	**1.000**	**1.003**	**1.146**

Note: *Intermediation approach, **All Malmquist index averages are geometric means, ***EFFCH: Technical Efficiency Change, TECHCH: Technological Change, PECH: Pure Technical Efficiency Change, SECH: Scale Efficiency Change, TFPCH: Total Factor Productivity Change

C. Distance and Malmquist Index Values Found Under the Mixed Approach

Table 25: The Technical Efficiency Measures (Distance Functions) Calculated Relative to Previous, Current and Subsequent Years Under Mixed Approach

DISTANCES SUMMARY (MA*)				
Technical Efficiency (TE) Relative to Technology in Year (t-1), (t) and (t+1) Under CRS Assumption				
Year/Bank**	**TE Relative to Technology of Period (t-1)**	**TE Relative to Technology of Period t**	**TE Relative to Technology of Period (t+1)**	**TE Under VRS Asmpt.**
Year 2002				
Akbank	0.000	1.000	1.030	1.000
Finansbank	0.000	1.000	1.218	1.000
Ziraat	0.000	1.000	1.428	1.000
Garanti	0.000	1.000	1.215	1.000
Halkbank	0.000	1.000	1.466	1.000
Is Bank	0.000	0.899	0.933	1.000
Vakıfbank	0.000	0.858	0.907	0.864
YKB	0.000	1.000	1.225	1.000
Mean	**0.000**	**0.970**	**1.178**	**0.983**
Year 2003				
Akbank	1.546	1.000	1.037	1.000
Finansbank	1.690	1.000	1.091	1.000
Ziraat	1.438	1.000	1.191	1.000
Garanti	1.647	1.000	1.061	1.000
Halkbank	1.236	1.000	1.253	1.000
Is Bank	1.092	0.879	0.695	1.000
Vakıfbank	1.272	1.000	0.776	1.000
YKB	1.449	1.000	1.120	1.000
Mean	**1.421**	**0.985**	**1.028**	**1.000**
Year 2004				
Akbank	1.517	1.000	1.067	1.000

Table 25: The Technical Efficiency Measures (Distance Functions) Calculated Relative to Previous, Current and Subsequent Years Under Mixed Approach

DISTANCES SUMMARY (MA*)				
Technical Efficiency (TE) Relative to Technology in Year (t-1), (t) and (t+1) Under CRS Assumption				
Year/Bank**	**TE Relative to Technology of Period (t-1)**	**TE Relative to Technology of Period t**	**TE Relative to Technology of Period (t+1)**	**TE Under VRS Asmpt.**
Finansbank	1.828	1.000	1.005	1.000
Ziraat	1.413	1.000	1.016	1.000
Garanti	1.479	1.000	1.018	1.000
Halkbank	1.046	0.891	0.892	0.943
Is Bank	1.153	0.881	0.931	0.997
Vakıfbank	1.459	1.000	0.980	1.000
YKB	1.219	0.847	0.837	0.977
Mean	**1.389**	**0.972**	**1.115**	**0.990**
Year 2005				
Akbank	1.645	1.000	1.244	1.000
Finansbank	1.326	1.000	1.026	1.000
Ziraat	1.246	1.000	1.087	1.000
Garanti	1.385	1.000	1.038	1.000
Halkbank	0.883	0.797	0.850	0.849
Is Bank	1.196	1.000	1.219	1.000
Vakıfbank	1.446	1.000	1.236	1.000
YKB	0.962	0.897	0.721	0.913
Mean	**1.261**	**0.962**	**1.053**	**0.970**
Year 2006				
Akbank	1.212	1.000	0.964	1.000
Finansbank	2.475	1.000	1.216	1.000
Ziraat	1.237	1.000	1.028	1.000
Garanti	1.474	1.000	0.921	1.000
Halkbank	0.917	0.970	0.975	1.000
Is Bank	0.930	1.000	0.968	1.000

Table 25: The Technical Efficiency Measures (Distance Functions) Calculated Relative to Previous, Current and Subsequent Years Under Mixed Approach

DISTANCES SUMMARY (MA*)				
Technical Efficiency (TE) Relative to Technology in Year (t-1), (t) and (t+1) Under CRS Assumption				
Year/Bank**	**TE Relative to Technology of Period (t-1)**	**TE Relative to Technology of Period t**	**TE Relative to Technology of Period (t+1)**	**TE Under VRS Asmpt.**
Vakıfbank	1.436	1.000	0.961	1.000
YKB	1.123	0.937	0.818	1.000
Mean	**1.351**	**0.988**	**0.981**	**1.000**
Year 2007				
Akbank	1.446	1.000	1.290	1.000
Finansbank	1.289	1.000	1.780	1.000
Ziraat	1.345	1.000	1.284	1.000
Garanti	1.396	1.000	1.378	1.000
Halkbank	0.982	0.924	1.117	0.984
Is Bank	1.280	0.976	1.251	1.000
Vakıfbank	1.398	1.000	1.227	1.000
YKB	1.144	0.832	0.992	0.834
Mean	**1.285**	**0.966**	**1.290**	**0.977**
Year 2008				
Akbank	1.222	1.000	1.253	1.000
Finansbank	1.029	1.000	1.058	1.000
Ziraat	1.231	1.000	1.177	1.000
Garanti	1.135	1.000	1.173	1.000
Halkbank	0.910	0.970	0.958	1.000
Is Bank	0.867	1.000	0.944	1.000
Vakıfbank	1.030	1.000	1.20	1.000
YKB	0.913	0.982	0.952	0.995
Mean	**1.042**	**0.994**	**1.091**	**0.999**
Year 2009				
Akbank	1.7900	1.0000	0.0000	1.0000

Table 25: The Technical Efficiency Measures (Distance Functions) Calculated Relative to Previous, Current and Subsequent Years Under Mixed Approach

DISTANCES SUMMARY (MA*)				
Technical Efficiency (TE) Relative to Technology in Year (t-1), (t) and (t+1) Under CRS Assumption				
Year/Bank**	**TE Relative to Technology of Period (t-1)**	**TE Relative to Technology of Period t**	**TE Relative to Technology of Period (t+1)**	**TE Under VRS Asmpt.**
Finansbank	1.700	1.000	0.000	1.000
Ziraat	1.593	1.000	0.000	1.000
Garanti	1.606	1.000	0.000	1.000
Halkbank	1.527	1.000	0.000	1.000
Is Bank	1.740	1.000	0.000	1.000
Vakıfbank	1.601	1.000	0.000	1.000
YKB	1.527	1.000	0.000	1.000
Mean	**1.636**	**1.000**	**0.000**	**1.000**

Note: *Mixed approach, **All Malmquist index averages are geometric means

Table 26: Malmquist Index Constructed Under Mixed Approach

MALMQUIST INDEX SUMMARY (MA*)					
Bank/Eff.* **	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
2002-2003					
Akbank	1.000	1.225	1.000	1.000	1.225
Finansbank	1.000	1.178	1.000	1.000	1.178
Ziraat	1.000	1.004	1.000	1.000	1.004
Garanti	1.000	1.164	1.000	1.000	1.164
Halkbank	1.000	0.918	1.000	1.000	0.918
Is Bank	0.979	1.094	1.000	0.979	1.070
Vakıfbank	1.165	1.097	1.158	1.007	1.279
YKB	1.000	1.087	1.000	1.000	1.087
Mean**	**1.017**	**1.092**	**1.018**	**0.998**	**1.110**
2003-2004					
Akbank	1.000	1.209	1.000	1.000	1.209

Table 26: Malmquist Index Constructed Under Mixed Approach

MALMQUIST INDEX SUMMARY (MA*)					
Bank/Eff.* **	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
Finansbank	1.000	1.294	1.000	1.000	1.294
Ziraat	1.000	1.089	1.000	1.000	1.089
Garanti	1.000	1.181	1.000	1.000	1.181
Halkbank	0.891	0.967	0.943	0.945	0.862
Is Bank	1.002	1.286	0.997	1.004	1.288
Vakıfbank	1.000	1.371	1.000	1.000	1.371
YKB	0.847	1.134	0.977	0.866	0.960
Mean	**0.966**	**1.185**	**0.990**	**0.976**	**1.145**
2004-2005					
Akbank	1.000	1.242	1.000	1.000	1.242
Finansbank	1.000	1.149	1.000	1.000	1.149
Ziraat	1.000	1.108	1.000	1.000	1.108
Garanti	1.000	1.166	1.000	1.000	1.166
Halkbank	0.894	1.052	0.900	0.994	0.941
Is Bank	1.135	1.064	1.003	1.132	1.208
Vakıfbank	1.000	1.214	1.000	1.000	1.214
YKB	1.060	1.041	0.935	1.134	1.103
Mean	**1.009**	**1.127**	**0.979**	**1.031**	**1.138**
2005-2006					
Akbank	1.000	0.987	1.000	1.000	0.987
Finansbank	1.000	1.553	1.000	1.000	1.553
Ziraat	1.000	1.067	1.000	1.000	1.067
Garanti	1.000	1.192	1.000	1.000	1.192
Halkbank	1.216	0.942	1.178	1.032	1.145
Is Bank	1.000	0.873	1.000	1.000	0.873
Vakıfbank	1.000	1.078	1.000	1.000	1.078
YKB	1.045	1.221	1.095	0.954	1.276
Mean	**1.030**	**1.098**	**1.032**	**0.998**	**1.131**
2006-2007					
Akbank	1.000	1.225	1.000	1.000	1.225
Finansbank	1.000	1.030	1.000	1.000	1.030

Table 26: Malmquist Index Constructed Under Mixed Approach

MALMQUIST INDEX SUMMARY (MA*)					
Bank/Eff.* **	**EFFCH**	**TECHCH**	**PECH**	**SECH**	**TFPCH**
Ziraat	1.000	1.144	1.000	1.000	1.144
Garanti	1.000	1.231	1.000	1.000	1.231
Halkbank	0.953	1.028	0.984	0.968	0.980
Is Bank	0.976	1.164	1.000	0.976	1.136
Vakıfbank	1.000	1.206	1.000	1.000	1.206
YKB	0.887	1.255	0.834	1.064	1.114
Mean	**0.976**	**1.157**	**0.976**	**1.001**	**1.130**
2007-2008					
Akbank	1.000	0.973	1.000	1.000	0.973
Finansbank	1.000	0.760	1.000	1.000	0.760
Ziraat	1.000	0.979	1.000	1.000	0.979
Garanti	1.000	0.908	1.000	1.000	0.908
Halkbank	1.050	0.881	1.016	1.033	0.925
Is Bank	1.024	0.822	1.000	1.024	0.842
Vakıfbank	1.000	0.917	1.000	1.000	0.917
YKB	1.181	0.883	1.193	0.990	1.043
Mean	**1.030**	**0.888**	**1.024**	**1.006**	**0.915**
2008-2009					
Akbank	1.000	1.195	1.000	1.000	1.195
Finansbank	1.000	1.268	1.000	1.000	1.268
Ziraat	1.000	1.163	1.000	1.000	1.163
Garanti	1.000	1.170	1.000	1.000	1.170
Halkbank	1.031	1.243	1.000	1.031	1.282
Is Bank	1.000	1.358	1.000	1.000	1.358
Vakıfbank	1.000	1.151	1.000	1.000	1.151
YKB	1.018	1.255	1.005	1.013	1.278
Mean	**1.006**	**1.224**	**1.001**	**1.005**	**1.231**

Note: *Mixed approach, **All Malmquist index averages are geometric means, ***EFFCH: Technical Efficiency Change, TECHCH: Technological Change, PECH: Pure Technical Efficiency Change, SECH: Scale Efficiency Change, TFPCH: Total Factor Productivity Change

D. Figures of Input and Output Variables

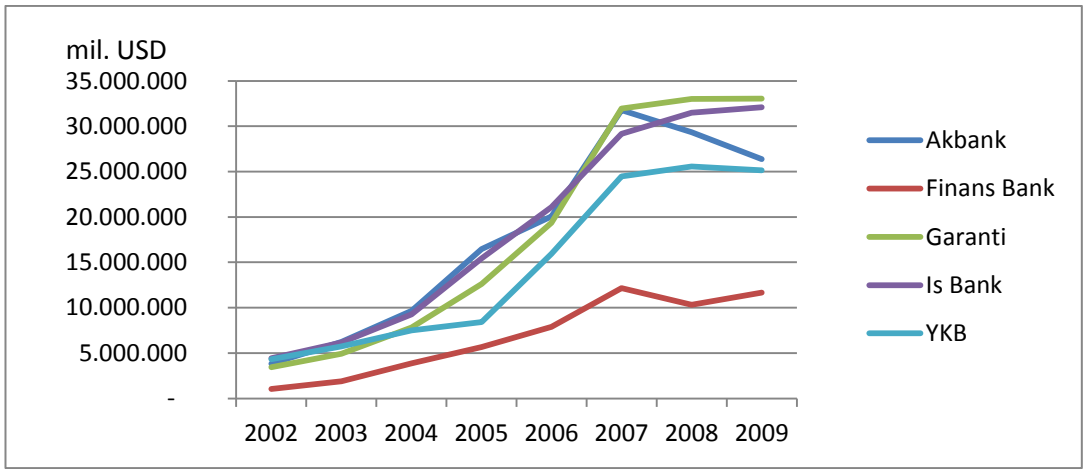

Figure 10: Loans and Receivables of Private Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

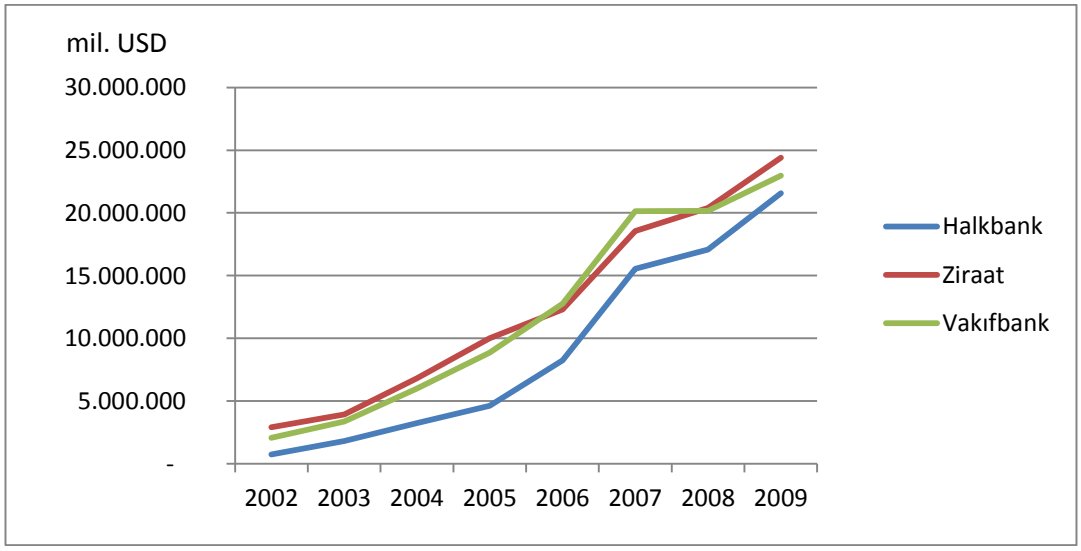

Figure 11: Loans and Receivables of State Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

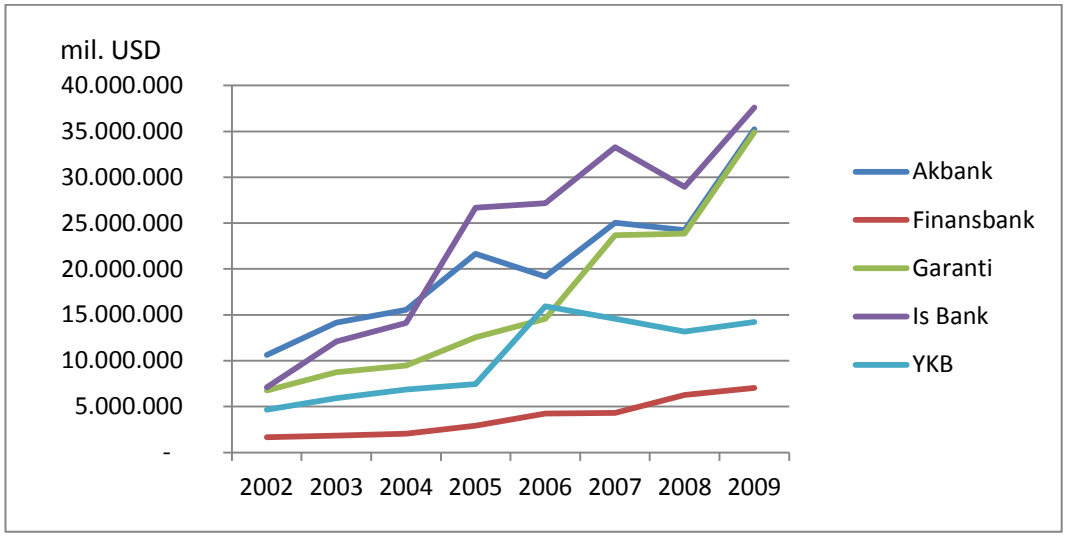

Figure 12: Other Earning Assets of Private Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

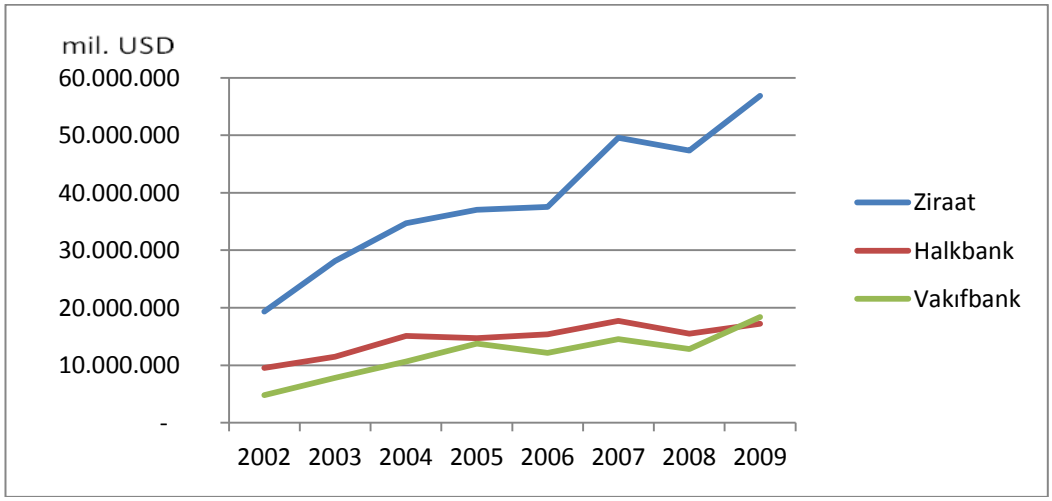

Figure 13: Other Earning Assetsof State Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

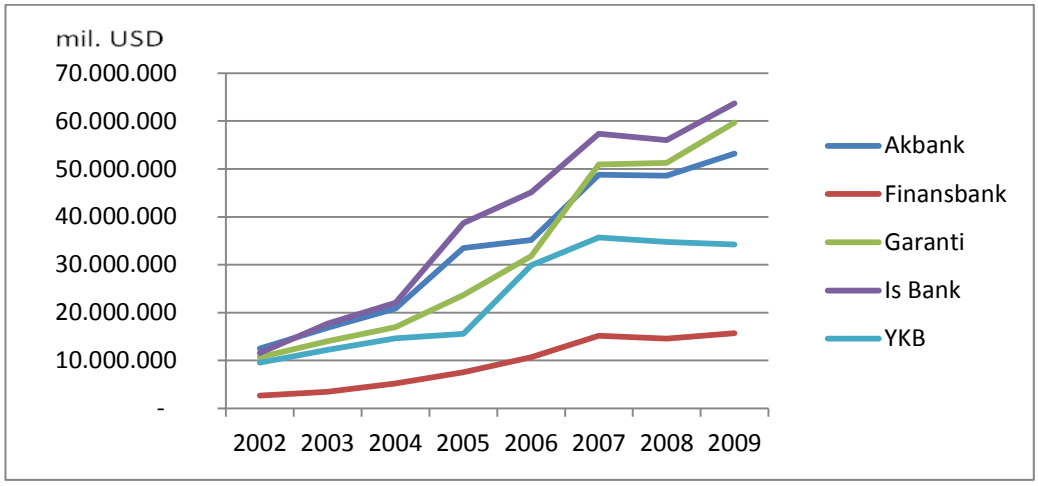

Figure 14: Deposits and Non-Deposit Funds of Private Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

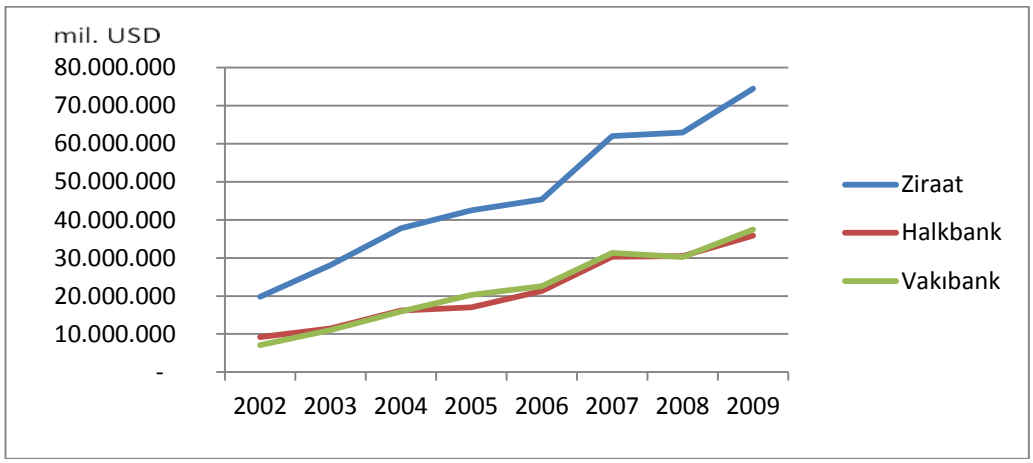

Figure 15: Deposits and Non-Deposit Funds of State Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

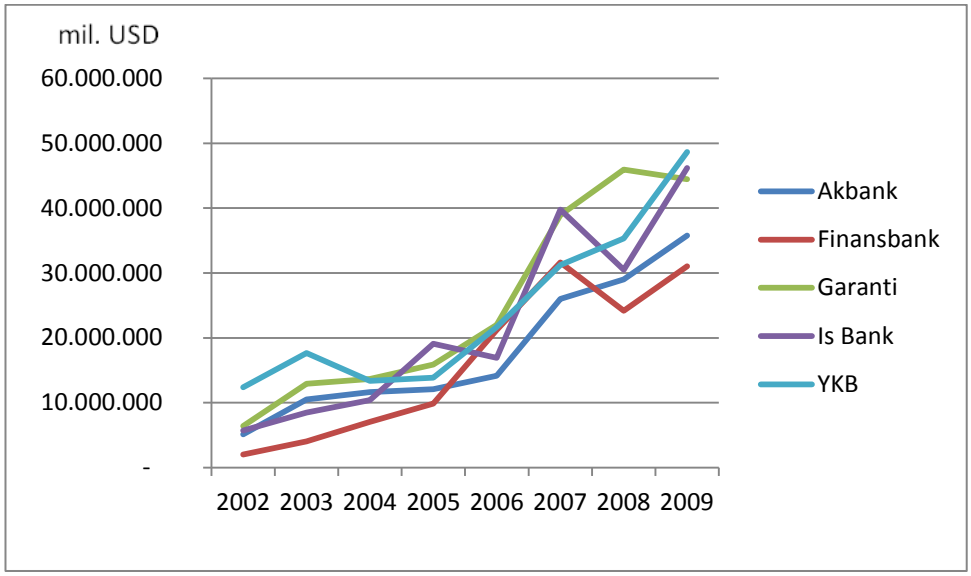

Figure 16: Off-Balance Sheet Items of Private Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

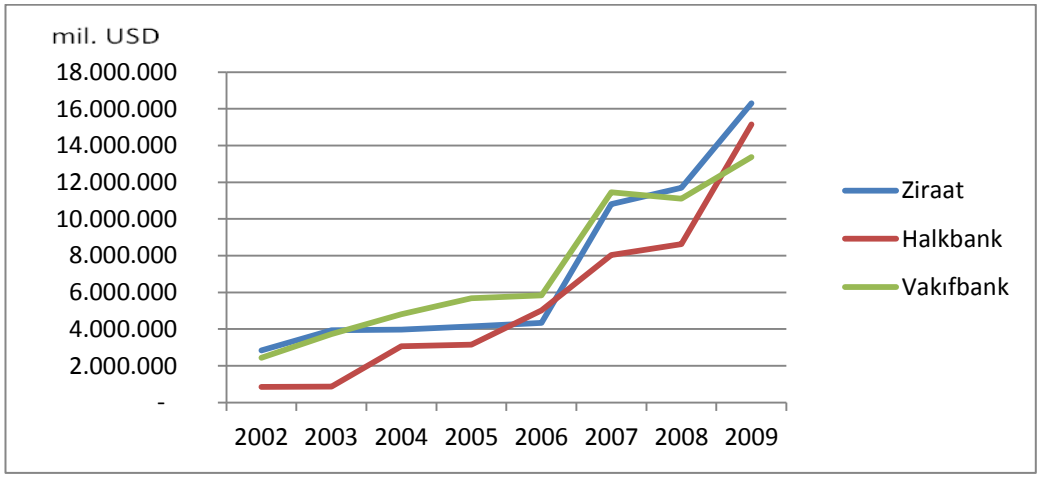

Figure 17: Off-Balance Sheet Items of State Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

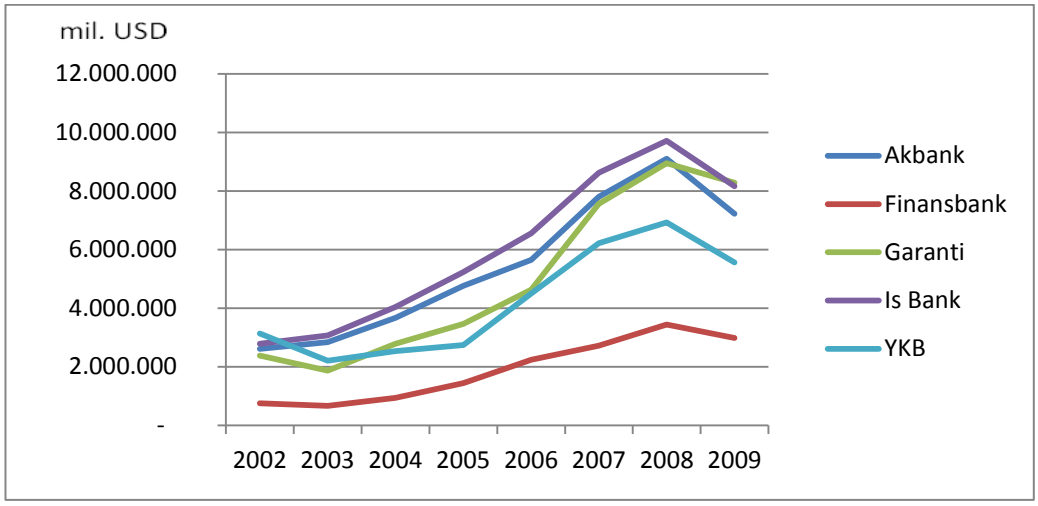

Figure 18: Income of Private Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

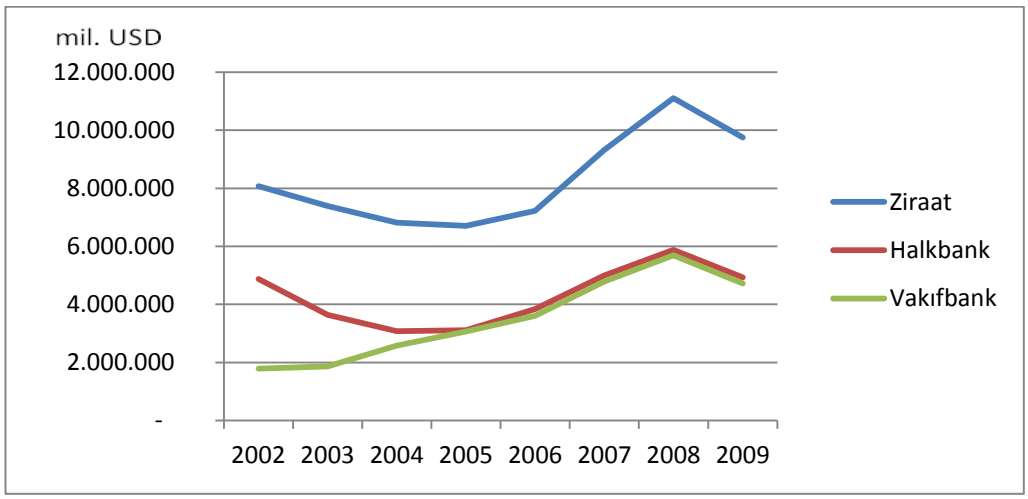

Figure 19: Income of Sate Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

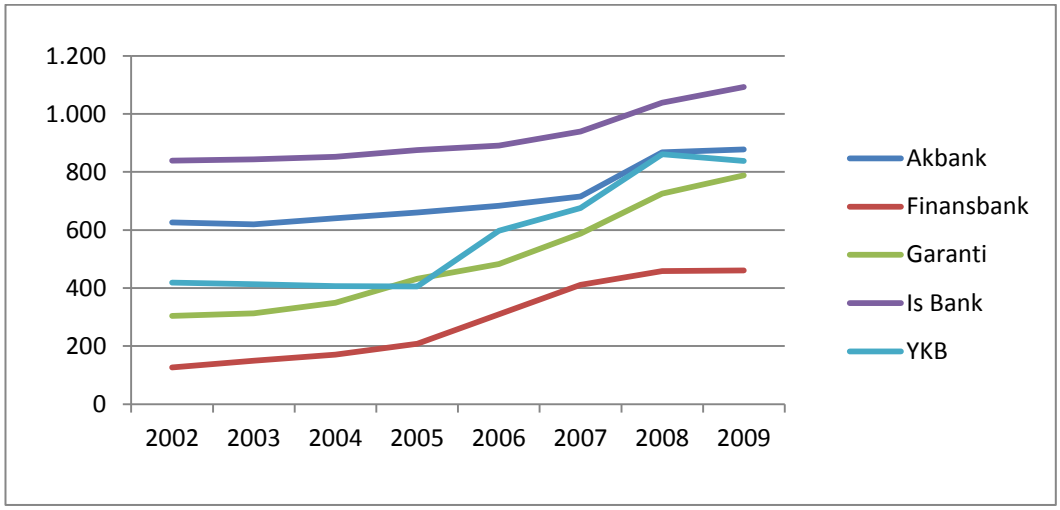

Figure 20: Number of Branches of Private Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

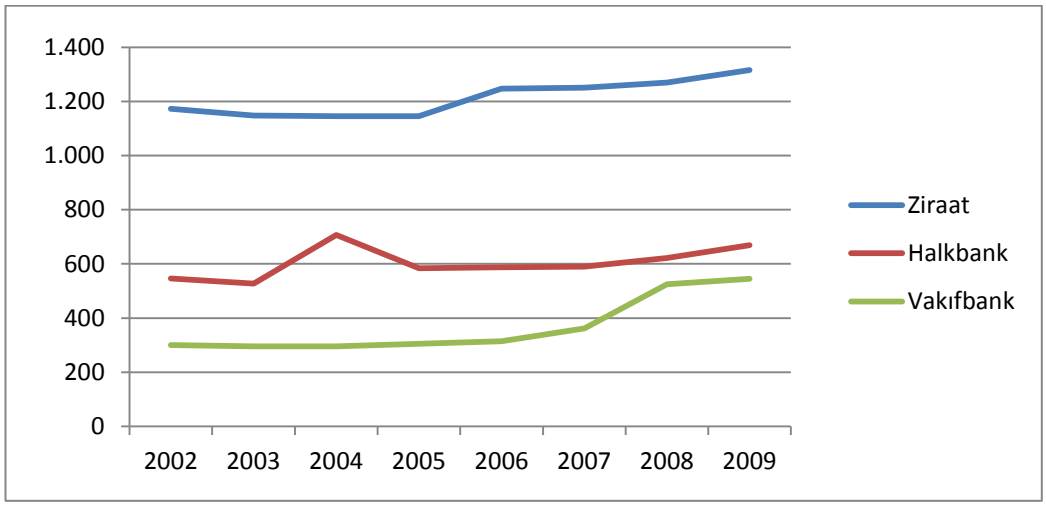

Figure 21: Number of Branches of State Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

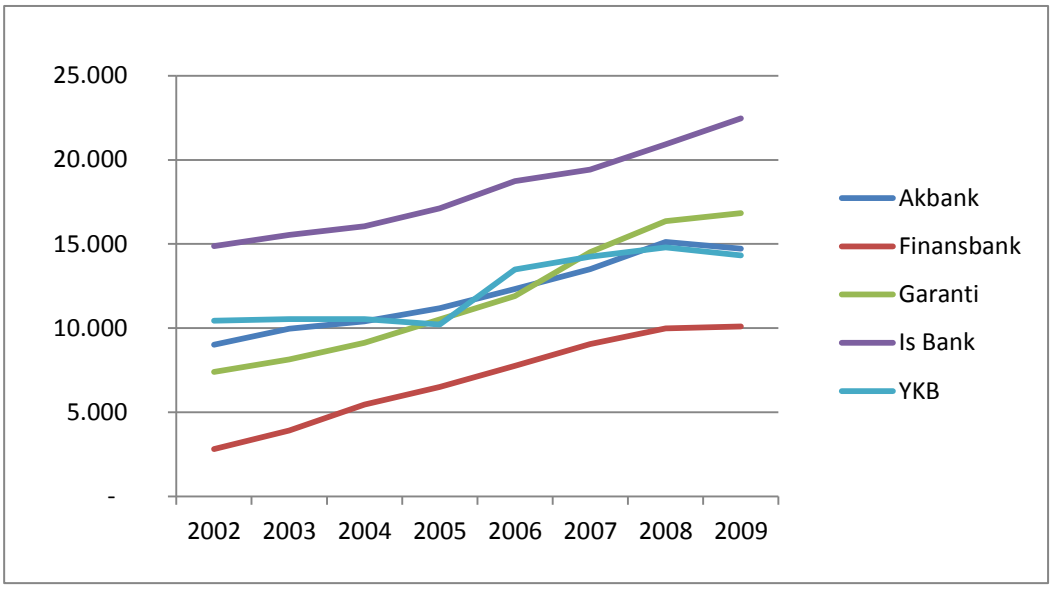

Figure 22: Number of Employees of Private Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

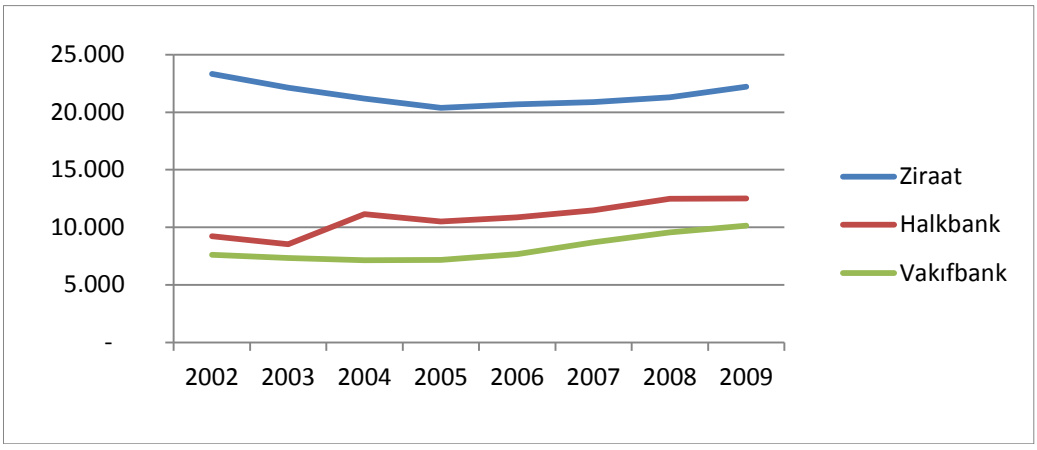

Figure 23: Number of Employees of State Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

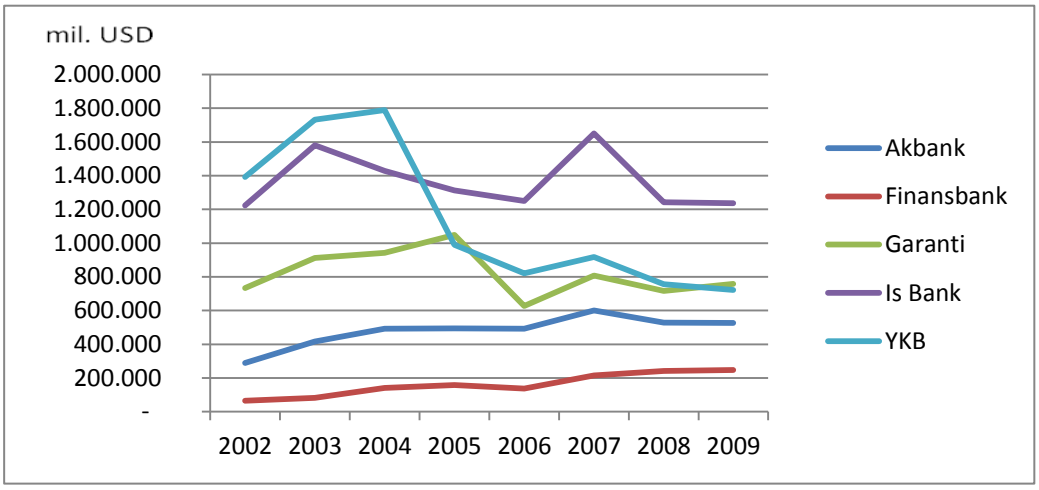

Figure 24: Net Tangible Assets of Private Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

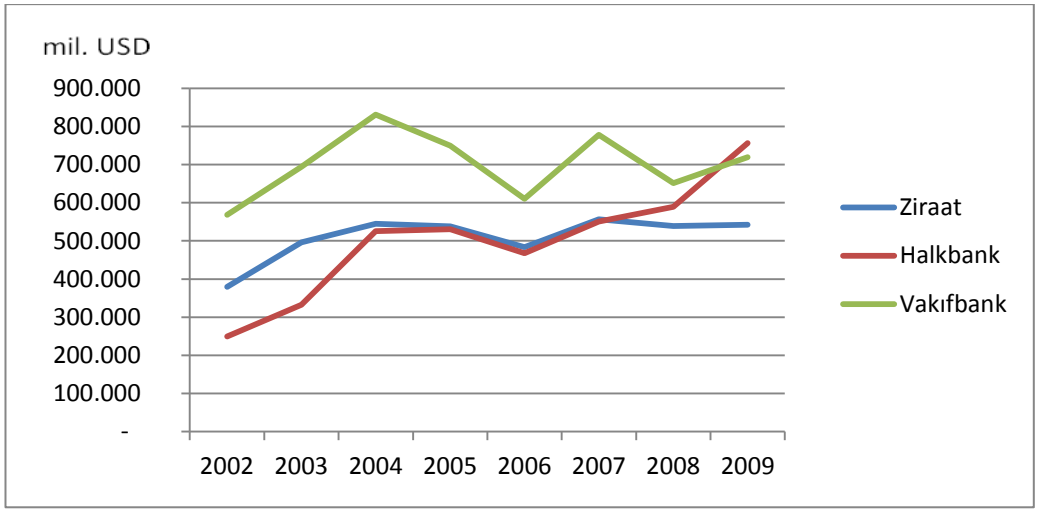

Figure 25: Net Tangible Assets of State Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

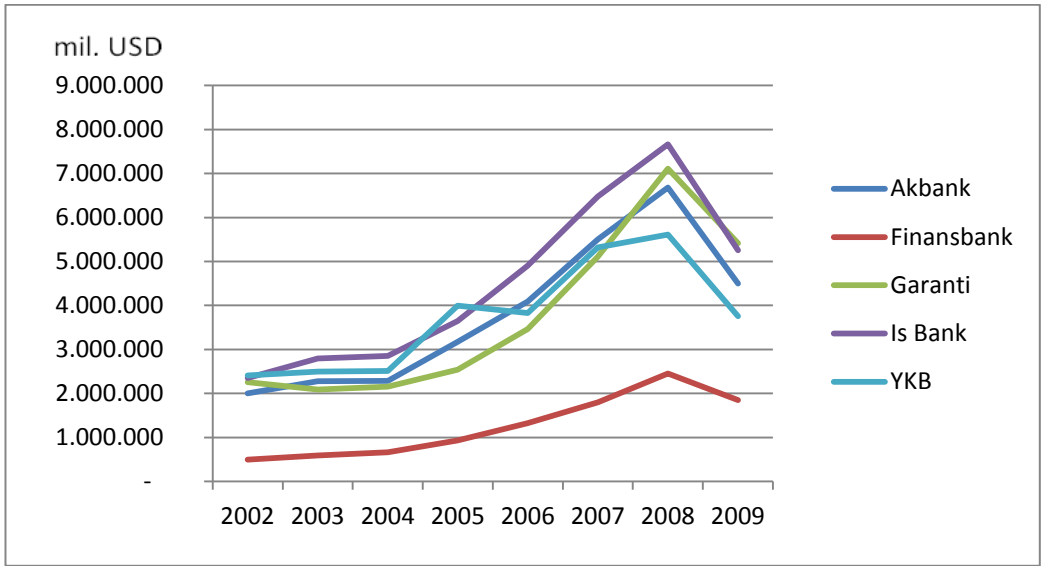

Figure 26: Expense of Private Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx

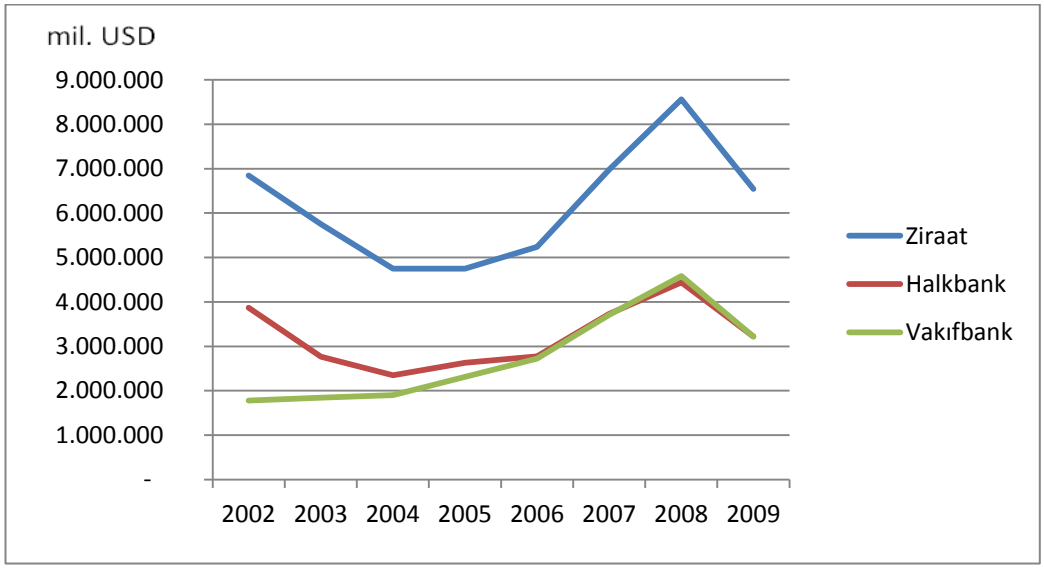

Figure 27: Expense of State Banks

Source: Banks and Banking Sector Information, Banks Association of Turkey, http://www.tbb.org.tr/eng/Banka_ve_Sektor_Bilgileri/Banka_Bilgileri.aspx