THE DETERMINANTS OF BANK FAILURES IN THE TURKISH BANKING INDUSTRY DURING 1994–2000

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ABSTRACT

THE DETERMINANTS OF BANK FAILURES IN THE TURKISH BANKING INDUSTRY DURING 1994–2000

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Banks are defined as businesses that provide financial services for profit and they play a crucial role in an economy. Determining the reasons behind bank failures has great importance in terms of forming early warning systems. Building a model for early warning is vital and if the early warning models are built effectively and employed in the supervision of banks, the overall bank restructuring costs might be reduced by a significant amount, which has an international average 17,5% of GDP.

The main objective of this study is to examine the determinants of bank failures in the Turkish banking industry, employing a proportional-hazard model developed by Cox (1972) and a logit model for the period 1994–2000. The results of both models suggest that banks with higher capitalization, higher liquidity and wide branch network are less probable to fail. Management quality, asset quality and off-balance sheet activities, however, do not appear to be significant factors in determining bank failure in the Turkish banking industry during the sample period. The results of this study are consistent with the findings of Wheelock and Wilson (2000), Molina (2002), and Logan (2001).

Keywords: Bank Failures, Turkish Banking Industry, Survival Analysis.

ÖZET

TÜRK BANKACILIK SİSTEMİNDE BANKA BAŞARISIZLIKLARININ BELİRLEYENLERİ:1994–2000

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Finans Ekonomisi Yüksek Lisans Programı

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Bankalar borç alma ve verme hizmeti veren kurumlar olarak bir ekonominin işleyişinde en önemli paya sahip kurumlardandır. Bankacılık sektöründe ortaya çıkan bir kriz ise toplumun ekonomiyi derinden etkiler. Carstens vd. (2004) bankacılık krizleri ve yeniden yapılandırmalarının ortalamasının % 17,5'i olduğunu hesaplamıştır (GSYİH'in yüzdesi olarak). Bu nedenle banka başarısızlıklarının sağlıklı erken uyarı sistemleri aracılığı ile önceden tahmin edilerek gerekli önlemlerin alınması hayati önem taşımaktadır. Bu sayede bankacılık krizleri önemli ölçüde engellenecektir.

Bu çalışmanın temel amacı 1994–2000 yılları arasında banka başarısızlıklarının ardındaki nedenleri sağkalım analizi (Hazard model) ve logit modeli ile araştırmaktır. İki modelin de sonuçları sermayesi yüksek, likiditesi fazla ve daha büyük bankaların batma olasılıklarının daha düşük olduğunu ortaya koymaktadır. Bununla beraber, bilânço dışı faaliyetler ile yönetim ve aktif kalitesinin banka başarısızlıklarını etkilemediği görülmüştür. Bu çalışmanın sonuçları bu haliyle Wheelock ve Wilson (2000), Molina (2002) ve Logan (2001) ile tutarlılık göstermektedir.

Anahtar Kelimeler: Banka Başarısızlıkları, Türk Bankacılık Sistemi, Sağkalım Analizi.

dedicated to my matima Elmas Işık...

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LIST OF ABBREVIATIONS

ATM: Automated Teller Machine

BAT: Banks Association of Turkey

BRSA: Banking Regulation and Supervision Agency

CAMEL: Capital Adequacy, Asset Quality, Management, Earnings and Liquidity

DEA: Data Envelopment Analysis

EU: European Union

GDP: Gross Domestic Income

GNP: Gross National Income

IMF: International Monetary Fund

OHR: Overhead Expense Ratio

OLS: Ordinary Least Squares

PCA: Principle Component Analysis

PHM: Proportional Hazards model

PSBR: Public Sector Borrowing Requirement

RINT: Interest Rate Offered By the Bank

ROA: Return on Assets

RSHA: Reciprocal Market Share In the Previous Period

SDIF: Saving Deposit Insurance Fund

USA: United States of America

WPI: Wholesale Prices Index

I. INTRODUCTION

Banks can be defined as businesses that provide financial services for profit. Traditional banking services include collecting deposits, lending money and processing transactions. Banks have been at the heart of the economic activity and play crucial role in a country's economy, one of their most important features is their ability to create money, accomplished through lending and borrowing activities. Thus banks can be said to have a critical role in the overall management of the flow of money and credit in the economy (Roussakis, 1997: 3).

Because total assets of the banking system account for nearly 90 percent of total assets of the financial sector, the banking industry has a distinctive and important place in the Turkish financial system. Although there has been a recent increase in the number and size of non-bank finance institutions, the system is still dominated by the commercial banks (Banks Association of Turkey: 2005)[1].

The banking industry might be considered the most important sector among all sectors in an economy and has a growing importance in macroeconomic stability. A healthy banking system is also an indirect indicator of industrialization and growth. Briefly, a well operating banking system is an indicator of the overall performance of an economy and it is nearly impossible to achieve economic growth and stability with a poorly managed banking industry, which can lead to crises since the failure of a bank may trigger other failures, as a result a possible bank run might lead to a banking and/or financial crisis.

The costs of banking crises are often higher in developing countries than in developed countries. While Demirgüç-Kunt and Kane (2001) state that 93 different

[1] Commercial banks held 96 percent of the total banking system assets in 2006.

countries had banking crises in the last 25 years and Lindgren et al (1996) reports that two-third of the IMF member countries had problems with their banking industry between 1980 and 1996. In addition to these, the international average bank restructuring costs due to banking crises is nearly 17.5% of their GDPs (Carstens, et.al. 2004). Hence, creating an early warning system to predict failures and determine the causes of bank failures is an important step in dealing bank failures and crises.

Turkey witnessed two major banking crises in the last decade in which, many banks failed during the crises period. Studying the determinants of bank failure in the Turkish banking industry would produce some important insight for regulators, researchers and practitioners. The number of commercial banks in Turkey was 66 in 1990 and 81 in 1999. As of end of 2006, there were 46 banks operating in the Turkish banking industry. Of these, 33 were commercial banks and 13 were development and investment banks. Of the commercial banks 13 were privately owned banks, 17 were foreign banks, 3 banks were state owned banks and 1 was in the fund[2]. Of the 13 development and investment banks, 3 were state owned, 6 were privately owned and 4 were foreign development and investment banks. Thus there have been many bank failures especially with the crisis.

In accordance with this importance, the main purpose of this study is to investigate the determinants of bank failures in the Turkish Banking industry, using a proportional-hazard model developed by Cox (1972) and a logit model for the period 1994-2000. To the author's best knowledge, this is the first study that used hazard methodology to explain bank failures in Turkey. Hazard methodology is generally used by biomedical researchers and engineers. In economics it is used in

[2] Birleşik Fon Bank is in the fund and it is the new commercial title of Bayındırbank

the study of new firm survival (Mata & Portugal (1994) and Audretsch & Mahmood (1995)), probability of product exit in marketing (Helsen & Schmittlein, 1993), in labor economics (Kiefer (1988) and Lancaster (1990)) and in many different areas. In this study, this method will be employed for the discontinuance of licenses of Turkish commercial banks.

Although there is no precise definition of failure, the term is generally understood to mean that an institution can no longer operate (Gup, 1998: 27). In this study, the lifetime of a bank is assumed to start at the date of issue of the license and to end when the bank fails to report deposits data, which is followed by withdrawal of its banking license by SDIF (Saving Deposit Insurance Fund). The license duration data can be characterized in terms of the hazard function. In this study hazard methodology is used to explore the indicators considered most important for the survival of banks after the 1994 crisis.

Taking into account this context the rest of the study is composed of three parts: in the first part, the recent Turkish banking industry is outlined historically considering the main characteristics of the period and banking industry. A brief literature review of related empirical studies is given in the second part. The third part is dedicated to the methodologies used in the study and empirical results. Finally a general evaluation of the study and empirical findings is given in conclusion.

II

THE RECENT HISTORY OF THE TURKISH BANKING INDUSTRY

Since the year 1980 is not only a big turning point for the Turkish economy and financial system but also for Turkish Banking industry, this study reviews Turkish banking history from 1980. The Turkish financial system underwent substantial structural and institutional changes in the 1980s due to the financial liberalization programme. Secondly 1994 is considered the second turning point. In this context Turkish banking history is reviewed in three parts in this study as follows: 1980-1994, the 1994 crisis and post 1994 crisis.

2.1. 1980-1994 Period

Boratav (2003) considers the 24th January 1980 decisions as not only a stabilization program but also the starting point of the neo-classical policies concerning with financial liberalization. 24th January Decisions' main objectives were to transform Turkish economy into a free market system, to develop a strong, stable and efficient financial system through fostering competition among banks and also to integrate the national banking system with the international financial and banking system. This involved freeing interest rates and foreign exchange rates, passing the Capital Market Law, establishing the Istanbul Stock Exchange, Foreign Exchange Market and Saving Deposit Insurance Fund (SDIF) and also beginning the Open Market Operations. Banks were given the freedom of determining the loan and deposit interest rate on July 1, 1980. To increase the competition in the system,

most restrictions on market entry were eliminated with the 70th decree law (BAT: 2001).

The fundamental change of the post-1980 period namely transition to positive real rates of interest also known as "July Banking" resulted in increase in interest rates, thus the number of bankers[3] also increased significantly (Yay, 2002: 170). Because banks had to compete with bankers in interest rates, this competitive atmosphere led to an increase in interest rates, as well as technological advance and product diversity. As the interest rates increased, bankers had to offer higher interest rates to repay the deposits with interest. Without any regulation or restriction, bankers were collecting deposits from people in return for interest. In these years for a bank or a banker, the only way to survive was to increase the interest rate. However they reached a point where they were unable to cover their liabilities and this unsustainable situation or so-called ponzi game resulted in one of the most interesting but tragic events in Turkish financial markets, a financial crisis, namely the 1982 *"Bankers Crisis*" (Özçam, 1999: 3).

This crisis revealed the need for a sound, modern legal framework for financial markets. A further result of the bankers crisis, mentioned by Yıldırım (2003) was the loss of confidence in privately owned banks by depositor and they began to put money into state owned banks, the composition of deposit changed considerably after the bankers crisis.

After 1980, uniform chart of accounts was introduced, exchange control regulations were eased and foreign exchange regime was also liberalized. These liberalization measures led to an increase in the foreign exchange transactions of

[3] In this study the term "banker" stands for the people who conducts the business of banking individually.

Turkish banks. With these liberalizations, the percentage of foreign exchange deposit accounts in total deposit increased significantly especially in 1990s. The primary reason behind this increase was the currency substitution due to the high inflation atmosphere.

To have an idea about the effect of these liberalization attempts, the ratio of financial assets to GDP, as a measure of financial depth, increased from 28.3 percent in 1980 to 47.7 percent in 1990 and 85 percent in 2006, whereas the ratio of M2 money supply to GDP hasn't change significantly. [4]

In 1985, the Banking Law No 3182 was introduced. The Interbank money market, under the administration of the Central Bank, was established in 1986 To regulate the liquidity in the banking system. The liberalization process can be said to be completed in 1989 after the enforcement of the decree of the protection of the value of Turkish Currency (Decree No: 32). This Decree has liberalized foreign exchange transactions and capital movements. The convertibility of Turkish Lira was also announced with this decree (Koska: 2005).

After 1985 the government abandoned balanced budget policy and internal debt became an important tool to finance budget deficits. Due to high interest rates offered, domestic government bonds became attractive financial instruments and banks began to prefer these bonds rather than giving loans to private sector (Kepenek, 2000: 244). The private sector was crowded out of the system and banks began to finance government deficits rather than being intermediaries between borrowers and lenders, hence there is no private sector bond trading on financial markets today.

[4] M2/GDP ratio was 21.4 percent in 1980 and around 25 percent in 2006.

With these events after 1980, the banking system has emerged and begun to integrate with the international financial and banking system. With the advent of financial liberalization, foreign banks began to set up offices in Turkey, and the Turkish banking system was exposed to foreign competition, leading the technological infrastructure of the banks to improve using computerized systems (Fethi et al, 2001).

Table 1: Selected Indicators Related to the Progress of the Turkish Banking Industry

	1980	1990	1994	1999	2000	2005	2006
Number of the Banks	43	66	67	81	79	47	46
Number of the agencies	5954	6560	6087	7.691	7837	6247	6849
Number of ATM	..	3209	4023	9939	11991	14000	16511
Number of POS	..	..	16135	188957	299950	913000	1283000
Number of Personnel	125312	154089	139046	173988	170401	132258	143143
Total number of Credit card (Thousand)	..	..	1564	10045	13408	26000	32433

Source: The data for 2000 and before 2000 has been obtained from "Banking Regulation and Supervision Agency" Restructuring program, data for year 2005 is obtained from Ersin Özince (The Banks Association of Turkey's head)'s speech at board meeting Istanbul, May 31, 2005 http://www.tbb.org.tr/turkce/genelkurul48/ersinozince.doc and the data for 2006 is obtained from BAT, Bankalarımız Kitabı 2006.

Introducing ATMs, credit cards, leasing and factoring services to the banking industry led to a competitive atmosphere which also led Turkish banks to be more competitive and also deepened the financial system. Briefly 1980s were the years in which many important reforms that required structural changes began to be implemented.

During 1989-1993 the growth rate was unstable and the inflation was around 60-70 percent. First of all, export led growth policy could not be implemented successfully during this period. The import increased in much faster than export. Following this, the export coverage ratio fell under 50 percent its previous level. Gulf War and the Iraq embargo were the external reasons behind these unfavorable

developments. Another reason was the deficit in the government budget, caused by populist policies which increased wages and agricultural subsidies, resulting in inflation. As a result of these populist policies the PSBR/GNP ratio which was 5.5% in 1989 increased 15.2% in 1993 (Yay, 2002: 172). The third cause was the liberalization of capital movements, short term capital flows led to credit extension which was less than the deposit increase in this period, another reason for high inflation rates.

2.2. 1994 Crisis

With these unfavorable developments explained above, in late 1980s and early 1990s, the government lost control in the financing fiscal deficit and the first financial crisis, which was also an early warning signal for more financial crises in Turkey, occurred in January 1994. As Celasun (1998) and Özatay (1996) point out, the high public sector borrowing requirement was one of the main causes of the 1994 currency crisis in Turkey. In addition to these studies there are many empirical studies that try to explain the reasons behind the 1994 crisis. Üçer et al (1998) using many independent variables in their study, conclude that corrupted macroeconomic indicators led to 1994 crisis. These three empirical studies highlight the importance of budget and current account deficits in the 1994 crisis[5]. Both deficits reached unsustainable levels before the crisis. Therefore, the so-called "twin deficit" phenomenon can be regarded as the main cause of the 1994 crisis. Another empirical study implies that there are three main reasons for 1994 crisis in Turkey. Işık et al (2004), employing factor analysis, found that the currency substitution

[5] Current account deficit was $6.4 billion and foreign trade deficit of $14.2 billion in 1993.

and the open position propensity of banking system are the most important factors that explain the so called 1994 liquidity crisis. Gerni et al (2005) signify the effect of exchange and interest rates on the crisis. They imply that the interest rate-exchange rate nexus in the Turkish economy led to it becoming fragile, triggering the economic crises as well as the increase of risk premium.

There are not only empirical studies on the reasons for the 1994 crisis, but also descriptive studies. According to such descriptive studies (Boratav 1994, Uygur 1994 and Yeldan 1994) the main reason for the 1994 crisis was the unsustainable budget deficits which occurred as a result of insufficient domestic savings. This insufficiency was eliminated by capital movements which were a product of financial liberalization. In this context interest rates rose and exchange rate fell only in the short run. This policy caused a loss in market confidence and triggered 1994 crisis.

As a result of this crisis, GDP fell 6.1 percent, inflation (WPI) reached %149.56, the Central Bank lost half of its reserves ($3 Billion), and in January the value of one U.S. dollar increased from 14000 TL to 42000 TL in three weeks. The average t bill interest rate was 158.2 at the end of 1994 (Koska: 2005).

1994 can also be regarded as another important turning point for the Turkish banking industry. The crisis experienced in 1994 also hit the banks severely and led to capital losses, causing them to contract. Three small banks and four brokerage houses whose loans were mostly denominated in foreign exchange were closed (Soydan, 2002: 13)[6]. The sector recovered from the crisis quickly however, and continued to grow until 1999. One reason for this rapid recovery was the 100%

[6] Impex, TYT and Marmara Bank.

deposit guarantee given by the Government in May 1994. This guarantee has been in force around for over ten years and caused 'moral hazard' on the part of depositors and banks, but at the same time it has helped to prevent 'bank runs'[7]. Although the guarantee was thought as a temporary policy to win depositors' confidence in the financial system, it has since become a permanent application (Steinherr et al, 2004: 14). The moral hazard, a by-product of deposit guarantee, is considered one of the major causes of bank failures.

Müslümov (2002) studied the impact of deposit guarantee on moral hazard and demonstrates empirically that small local banks are more sensitive to deposit guarantee. In the case of guarantee, they lose control of capital adequacy, resulting in an increase in liquidity risk and deterioration in income expenditure balance. Another important finding comes from Demirgüç-Kunt & Detragiache (2000) who also demonstrate that systematic bank crises occur frequently in countries that implement deposit insurance.

In July 2000, as part of the disinflation program, the coalition government started to phase out this guarantee, lowering it to TL100 billion. Due to the December 2000 liquidity crisis, the guarantee was re-introduced six months later and restricted to a ceiling of YTL 50,000. This current ceiling is almost in line with the deposit guarantee in EU countries, whereby the level of deposit protection varies between €20,000 and €60,000. Nevertheless according to Steinherr et al (2004), it is still high for Turkey whose average per capita income is only about one-fifth of that of the EU. The ceiling covers over 90% of the total number of the accounts, but only approximately 60% of the size of accounts.

[7] Gilbert (1988) defines the term bank run as "*a panic environment that depositors suddenly withdraw currency from their accounts because of concern about the safety of their deposits."* Although there have been many bank failures, actually Turkey had no bank run in history.

2.3. Post 1994 Crisis

In 1999, due to the Asian, the Russian Crises and the 17 August earthquake disaster, the Turkish economy shrunk dramatically. Banking industry was also affected negatively by these events. In addition a high public sector borrowing requirement and inflation led to an increase in both nominal and real interest rates, leading to a decrease in credit demand from the private sector. Liquidity structures of the most banks were severely affected, another indicator of financial weakness. The Central Bank of Turkey eased the liquidity requirements of the banks and Türk Ticaret Bank was taken over by the Saving Deposits Insurance Fund in 1997. Bank Express was the second bank that was transferred to Saving Deposit Insurance Fund in 1998. The Government took precautions, then cooperated with the IMF, and unveiled a Stability Program. In order to strengthen the financial structures of the banks, some regulations were brought in, such as establishing Banking Regulation and Supervision Agency (BRSA) in June 1999.

BRSA, an independent authority, responsible for supervision of the banking system in Turkey, started its activities on August 31, 2000. The powers and responsibilities related to the supervision of the banking system, which had previously been divided between the Undersecretaries of Treasury and the Central Bank of the Republic of Turkey have been transferred to the BRSA. The main purposes of the BRSA is to increase the efficiency and the competitiveness of the banking industry, to minimize the losses the sector might create on the economy, to improve the soundness of the sector, and to protect depositors[8]. With these regulations, Turkey also aimed to develop its regulations in line with the EU standards.

[8] Visit www.bddk.og.tr for detailed information.

1999 was a year of problems for Turkish Banking industry. Six banks[9] were taken over by the Saving Deposit Insurance Fund due to the weaknesses in their financial structures. The IMF program, which was agreed the same year, gave its first positive results in the year 2000. The interest rates of Government securities decreased, thus they lost their attractiveness for investors. Banks began to give much more credits to the private sector in comparison to the previous years. As a result, the credit volume of the banking system has increased.

Table 2: Banks Taken Over by the SDIF

Bank	*Date*
Türk Ticaret Bank	November 6, 1997
Bank Ekspress	December 12 , 1998
Interbank	January 7, 1999
Egebank	December 22,1999
Yurtbank	December 22, 1999
Sümerbank	December 22, 1999
Esbank	December 22, 1999
Yaşarbank	December 22, 1999
Etibank	October 27, 2000
Bank Kapital	October 27, 2000
Demirbank	December 6, 2000
Ulusal Bank	February 27 2001
İktisat Bank	March 15 2001
Milli Aydın Bank	July 9, 2001
Kent Bank	July 9, 2001
Sitebank	July 9, 2001
Tariş Bank	July 9, 2001
Bayındır Bank	July 9, 2001
Ege Giyim Sanayicileri Bank	July 9, 2001
Toprakbank	November 30, 2001
Pamukbank	June 18, 2002
İmar Bank	July 3, 2003

Source: Banking Restructuring Program, Esen (2005) and Canbaş et al 2005.

The Restructuring Programs, executed by the IMF, generally have three common goals: firstly to create healthier banks, secondly a more profitable banking system and thirdly to fulfill their intermediation duties between borrowers and

[9] Esbank (7.1.1999) and Sümerbank, Egebank, Yaşar Bank, Esbank, Yurtbank (21.12.1999).

lenders in financial markets. The program was focused on the management problems of the state owned banks, deciding which banks should be transferred to SDIF (Saving Deposit Insurance Fund), strengthening the structure of the private banks and achieving a more effective controlling system (Esen: 2005).

In the year 2000, three banks were taken over by the SDIF[10]. The 100% government guarantee on deposit that was given in 1994 was restricted to a mere YTLs 100,000 on June 1st 2000 and restricted to YTLs 50,000 on January 1st 2001. The required reserve ratio was decreased from 6% to 4% and the solvency ratio from %14 to %12. With these interventions, the cost of deposits decreased. Induced by the November 2000 crisis, foreign currency demand increased dramatically, leading to severe liquidity shortages, and overnight interest rates leapt by an incredible 1,700 percent, and therefore cost of borrowing skyrocketed. When IMF declared that Turkey would be given a $10 billion credit, markets calmed down. With this positive sign, overnight rates fell to just 200 % (Banking Restructuring Program: 2001).

The November 2000 crisis was followed by a new period of difficulty, known as the February 2001 crisis. The government began to implement a floating exchange rate regime on February 22, 2001, which resulted in a 25% devaluation of the TL. As a result banks experienced losses originating in exchange rate risks in 2001. Because the crises caused a recession in the real sector, the balance sheet quality and the capital structure of the banking industry weakened. 2001 was also the start of the Turkish Banking Restructuring Program (May 15, 2001) consisting of 28 pages. To build a stronger banking system after the two severe crises this program was conducted under the control of the IMF.

[10] Bank Kapital and Etibank (27.10.2000), Demirbank (6.12.2000).

Table 3: Highlights in the Turkish Banking Industry

Year	*Event*
1980	Announcement of the economic stabilization and structural adjustment program.
1982	Bankers Crisis
1985	Banking Law no 3182 was introduced.
1985	Government securities began to be auctioned.
1986	Interbank began to operate.
1988	Basel I was introduced.
1989	Enforcement of the decree of protection the value of Turkish Currency.
1994	Depreciation of TL, Crisis hit the banking system.
1994	100% deposit guarantee was given by the government.
1997	Türk Ticaret Bank was the first bank taken by SDIF.
1998	BRSA was established.
1999	Asian crisis and earthquake hit the system.
1999	Parliament approved the new banking law no 4389.
1999	6 banks were taken by SDIF.
2000	November 2000 crisis hit the sector.
2000	BRSA began to operate.
2000	3 banks were taken by SDIF.
2000	100% government guarantee on deposits was restricted to a mere 100000 YTLs
2001	Starting year of the Turkish banking restructuring program (15 May).
2001	Government guarantee on deposits restricted with 50000 YTLs
2004	Basel II accord was signed.
2005	Banking Law no 5411 was introduced.
2007	Basel II began to be implemented.

Source: Banking Restructuring Program (2001) and Banks in Turkey Books (2001-2006)

The first target of the program was to eliminate the problems that state-owned banks caused in financial sector, which in turn led to shrinking of the systems' balance sheets, and so their short-term indebtedness was decreased. State banks are regarded as the main contributors to the crisis (Steinherr et al: 2004). After the 2001 crisis, the state banks (Ziraat, Halk and Emlak) were restructured as part of the banking restructuring programme (e.g., the merger of Emlak with Ziraat and the appointment of a joint management board; the downsizing of branches and employees; and the passing of legislation preventing 'duty losses').

Secondly, solutions were sought for the banks taken over by the SDIF; their personnel and operation expenditures were reduced and a restriction was imposed on their borrowings from short term markets. To build a stronger financial and

operational structure, the efficiency of supervision controls was increased. The assets of the banks were analyzed in detail, non-performing assets were identified, and the necessary provisions were set aside for bad loans. Furthermore shareholders' equity of the banking system has been strengthened and exchange rate risk has been reduced. An improvement has been observed in the rates of return on assets and return on shareholders' equity.

Table 4: Cost of Bank Restructuring (%GDP)

Finland (1991-1993)	11.2	Norway (1988-92)	8
Indonesia (1997)	52.3	Bulgaria (1994-1997)	41.6
Thailand (1997)	34.8	Mexico (1994-1995)	19.3
Chile (1981-1983)	33.5	Japan (1992-98)	8
Turkey (2000)	30.5	USA (1984-1991)	2.1
Korea (1997)	23.1	Poland (1992-1995)	7.4
Czech Republic (1991-1993)	25.4	Venezuela (1994-1995)	12.4
Equator (1998-2001)	21.7	Spain (1977-85)	16.8

Source: Esen (2005)

In short, the aim of these efforts was to create a more efficiently operating banking system. Although the restructuring program has been one of the most costly restructuring programs in the world[11] (Banks in Turkey 2001 Book and BAT 2005 report), the regulations have been brought more in line with the international standards. The program was based on a competitive market system and openness to the world economy and Turkish Banks have begun to operate more profitably since its introduction.

According to BAT reports, Turkish banks were positively affected by the post 2003 economic recovery and the international credit ratings of Turkish banks have risen. Due to the decrease of public sector pressure on financial markets, both

[11] Total cost of restructuring program amounts USD 47.2 billion (BRSA, 2003).

individual and commercial credit demand have increased. Additionally, lending rates fell due to the optimistic expectations and stiff competitive atmosphere.

Regarding the current structure of the system, as of 2007 there are 46 banks operating in the Turkish banking industry[12]. Of these, 33 are commercial banks and 13 are development and investment banks. Of the commercial banks 13 are privately owned, 17 are foreign, 3 banks are state owned and 1 was in the SDIF[13]. Of the 13 development and investment banks, 3 are state owned, 6 are privately owned, and 4 are foreign development and investment banks.

Because there are very few policy constraints for foreign banking activities, many foreign banks operate in the Turkish banking system. Although they still represent only a small market share, they have an important role in the sector due to the new concepts and practices they have introduced. With this enlargement of the financial system funds and loans of the banking industry increased as expected.

As can be seen from the Table 5, the state-owned banks have an important role in the banking system. The three state banks, T.C. Ziraat Bank, T.Halk Bank and T. Emlak Bank hold 30% of total assets, about 37% of total deposits and 22% of total loans of the banking industry in 2006.

Table 5: Sector Shares of Bank Groups (%)

	1980			2002			2006		
	Total Assets	Total Loans	Total Deposits	Total Assets	Total Loans	Total Deposits	Total Assets	Total Loans	Total Deposits
State-Owned Banks	49.3	53.4	34	36	20	39	30	22	37
Private Banks	47.6	44.4	63.7	56	65	58	55	59	53
Foreign Banks	3.8	2.2	2.3	3	4	2	12	15	10

Source: BAT.

[12] The number of banks is taken from BAT on 10.08.2007.
[13] Birleşik Fon Bank is in the fund and it is the new commercial title of Bayındırbank.

After the 2000 and 2001 crises and Basel II, the importance of market discipline in supporting financial stability was understood, and in this context banking supervision gained importance (BAT: 2005). In addition to BRSA supervision, banks are subject to external audits in accordance with internationally accepted principles of accounting. Banks are also examined by their own auditors, who are required to submit quarterly reports to BRSA. The aim of this supervision is to oversee banks and their activities to ensure that they are operated in a safe and responsible manner (Demirgüç-Kunt: 1989).

To conclude this section the importance of the banking industry in the Turkish financial system can be shown by the fact that in 2006 total assets/GDP ratio as a measure of financial depth was 97.6 percent in Turkey and total assets of the banking industry accounted for 86.7 percent of total assets of the institutions in the financial system[14]. Thus banking industry has great importance in the Turkish financial system (BAT: 2006).

[14] This ratio is 250 percent in E.U in 2006.

III

LITERATURE REVIEW

As mentioned in the first part of the study, a healthy banking system is an indicator of a well performing economy and it is nearly impossible to achieve economic growth and stability with a poorly managed banking industry. Following this, if a bank fails, this leads to a loss in the depositors' confidence and triggers other bank failures, and finally causes banking crises. Banking crises are costly to society in two main ways. First, by disrupting credit intermediation they can undermine economic growth. Second banking crises also cause fiscal costs (Esen: 2005). During the past decades many countries have experienced a series of bank failures and the international average bank restructuring costs is nearly 17.5% of their GDPs (Carstens et al: 2004). Bank failure prediction is therefore an important issue for banking system, especially for the regulation and supervision authorities. Thus, building early warning models is vital and if these models are built effectively and employed in the supervision of banks, the overall bank restructuring costs may be reduced by a significant amount in the future.

In accordance with this importance, different econometric and statistical techniques have been employed to model bank failures in the literature. Some descriptive studies have used simple ratios, especially capital ratios, and determined various thresholds for a bank failure (Estrella et al: 2000 and Beaver: 1966). On the other hand, empirical studies have concentrated on building parametric models, namely hazard and probability models to predict and find the determinants of the bank failures. Dabos & Escudero (2004), Gonzalez & Kiefer (2006), Wheelock &

Wilson (1994), Bennett & Loucks (1996), Molina (2002), Wheelock & Wilson (1995), Podpiera & Podpiera (2005), Konstandina (2006), DeYoung (2000), Whalen (1991), Wheelock & Wilson (2000), Carree (2003), Buehler et al (2005) are the examples of studies that employ hazard methodology for bank failures. Thomson (1991), Martin (1977), Pantolone & Plat (1987), Barr et al (1995), Lanine & Vennet (2006), Canbaş et al (2005), Ünsal & Güler (2003) are only eight of many studies that have investigated the determinants of bank failures using discrete choice models.

The probability or discrete choice models consist of logit and probit models, and only determine the variables that affect the failure probability of a bank with a given set of explanatory variables, hazard models on the other hand enable the prediction of the amount of time to failure. Hazard function specification depends on the conditional probabilities, while discrete choice models specification depends on unconditional probabilities (Kiefer, 1988: 649). In discrete choice models, all failed banks are regarded as the same with surviving banks. Thus, for example, a bank that fails on the first day of a two-year interval is regarded as equal to a bank that fails on the last day, and a bank that survives the interval but fails one day after that period ends is treated the same as a bank that survives an additional 10 years. Duration models contain much more information, and thus have more efficient parameter estimates (Wheelock &Wilson, 1994: 64).

The prediction abilities of the two techniques in the second group have been compared by Lee & Urrutia (1996). According to this study, hazard models can find more significant variables than the probability models, and it recommends the two models should be employed together to predict failures. Shumway (2001) is another study that compares discrete choice models and hazard models. He calls discrete

choice as single-period models under static models and summarizes the three main reasons to prefer hazard models for forecasting failures. By ignoring the fact that firms change through time, static models produce biased failure probabilities and inconsistent failure estimates. Therefore, test statistics based on static models tend to give incorrect inferences while hazard models produce more consistent estimates. Thus, hazard models are regarded as more appropriate for predicting failures than the discrete choice models. Here it should be noted that, although there is a huge amount of literature that investigates the determinants of bank failures, there are only relatively few studies that have employed hazard models.

There is also another group of empirical studies that have employed discriminant analysis to predict bank failures (Canbaş et al (2005), Çilli & Temel (1988), Ünsal & Güler (2003). In this section the studies on banks failures in Turkey are first reviewed, secondly the other bank failure studies especially the ones using hazard methodology, are briefly reviewed.

3.1. Empirical Studies on Bank Failures in Turkey

Although there are many studies on US, Russia, and some emerging economies, there are only few studies that analyze bank failures in Turkey. One of the earliest is Çilli & Temel (1988), who tried to create an early warning system using discriminant and factor analysis. One of the important findings of the study is that CAMELS[15] criteria do not represent the specific characteristics of the Turkish commercial banks. It employed 42 different factors, only 14 of which were found to

[15] CAMEL or CAMELS is a rating system that examines the soundness and default risk of banks. This abbreviation stands for Capital adequacy, Asset quality, Management quality, Earnings ability, Liquidity and Sensitivity to the market conditions. This system was implemented in the U.S.A. in 1980s (for detailed information, see Sahajwala and Bergh (2000) and Kaya (2001)).

be significant and concluded that liquidity and working capital are the most important factors that distinguish between the failed and surviving banks.

Ünsal & Güler (2003) also examined bank failures in Turkey. Employing both discriminant analysis and Logistic regression analysis techniques, they investigated which of these gave the best result for the data set of the sector and concluded that logistic regression gives considerably more reliable results than the discriminant analysis.

Canbaş et al (2005) is another example that of a study on bank failures in Turkey. The study aimed to detect the banks that have probability of failure. Because PCA (Principle Component Analysis), probit and logit models were used in the study, and needless to say, it couldn't predict time to failure in this study. The study focused on 40 privately owned Turkish Banks and their financial ratios during 1997-2003. According to the findings, PCA is considered a useful tool for detecting the financial characteristics of the banking system and comparing the banks with respect to these, thus, identifying differences in the financial structures of the banks. Therefore, PCA could be used as an alternative or a supplementary decision support tool to the CAMELS rating system in bank examination process. This study concludes as Çilli & Temel (1988) did, that the CAMELS criteria do not represent the specific characteristics of the Turkish commercial banks. According to Canbaş et al (2005), this could be due to the different applications of Banking Regulation and Supervision Agency (BRSA) in Turkey. Kaya (2001) also states, consistent with the results of these studies using nonparametric statistical test, that CAMEL rating system predicts 60 percent of the bank failures.

A PhD thesis has been written by Suadiye (2006) on the failures of banks traded in Istanbul Stock Exchange Market during 1997-2006. This study considers defaults as bank failures and aimed to find the default risk and the leverage ratios affect on taking risk for Turkish Commercial banks. Black-Scholes (1973) and Merton (1974) Option Pricing Frameworks are employed to estimate asset risks of banks. The findings of the study suggest that volatility of return on bank assets and capital level determine the failure probability of a Turkish bank. As can be seen, none of the previous studies employed hazard methodology to model bank failures in Turkey and to the author's best knowledge; this is the first study using a hazard model to investigate the determinants of bank failures in the Turkish banking industry.

3.2. Other Empirical Studies

Other studies on bank failures are generally concentrated on developed economies. Meyer and Pifer (1970) is the first empirical study on bank failure prediction in US. Using thee OLS (Ordinary Least Squares) technique, they explained bank failures through ten financial ratios.

Whalen (1991) has estimated a PHM (Proportional Hazards model) to obtain the probability that a U.S. bank will survive longer than period ranging from zero to 24 months in the future. He examined the period 1987-1990 and explained the lifespan of U.S. banks with six different factors. Some of the independent variables used in the study are expected to have a positive relation to the probability of survival, like return on assets *ROA*, where overhead expense ratio variable *OHR* is expected to be negatively related to the probability of survival. Using the

independent variables listed in Table 6, the author obtained a useful and effective model that can be used as an early warning tool.

Thomson (1991) estimated a logit model to examine the determinants of the bank failures in the US, using proxies to capture early warning system variables, CAMEL factors, as did many other studies. The explanatory variables of this study are given in Table 6. The results indicate that in a period of up to 30 months before it takes place,, solvency and liquidity are the most important predictors of failure. The positive and significant coefficients on *OVRHDTA* and *INSIDELN* for all sub samples indicate that management risk is positively related to failure.

Wheelock & Wilson (1994) studied the relationship between deposit insurance and likelihood of bank failure empirically. A voluntary deposit insurance system was being implemented in Kansas during 1909-1929, and this study examined the effect of voluntary deposit insurance on bank failure for Kansas in these years. They found that insured banks were less well-capitalized and less liquid than uninsured banks, and capitalization and liquidity were found as important determinants of failure. Deposit insurance encourages banks to rely more heavily on deposits to finance their activities. In the case of deposit insurance banks are said to be willing to accept a lower rate of return on their deposits. Economic theory suggests that banks also tend to choose to hold riskier assets when deposits are insured. This situation is known as "moral hazard" (A similar situation is observed in Turkish banking after 1994. To obtain depositors confidence, 100% deposit guarantee was given by the Government after the crisis.). Wheelock & Wilson (1994) detect significant differences between their capital/assets, deposits/assets and cash reserves/assets between insured and uninsured banks. Using hazard methodology they found that, insured banks are less capitalized and liquid than

others and if capital/assets, reserves/deposits and bond holdings/assets ratios were high, these banks were less likely to fail. This situation also reveals that conservatively managed banks were less likely to fail and, at the same time, banks that have deposit insurance were more risky and, hence, more likely to fail than their uninsured competitors.

Barr et al (1994) built a bank failure prediction model depending on DEA (Data Envelopment Analysis) by focusing the intermediation duty of the banks. Using DEA, management quality scores are employed as a proxy for the 'M' in the CAMEL rating. The results from the study, examining 930 banks confirm the quality of management is vital for a bank's lifespan. DEA scores for surviving institutions are statistically higher than the scores for failed banks. Furthermore, banks that are closer to failure are found to have lower efficiency scores. For failure prediction, the management quality score is combined with variables representing the other four factors in the CAMELS rating, as well as a proxy for local economic conditions.

Wheelock & Wilson (1995) examined the reasons behind bank failures in Kansas during the period 1910-1928 using a proportional hazard rate model. In addition to standard financial ratios calculated technical efficiency scores are employed to explain bank failures during the period. The results of the study indicate that deposit insurance system membership and technical inefficiency increase the probability of failure.

Using probit models, Barr & Siems (1996) developed two different bank-failure prediction models. Both the one-year-ahead and two-year-ahead models use proxy variables for each factor in the CAMEL rating, and a variable to capture local

economic conditions (the last variable in Table 6). Barr & Siems (1996) imply that this was the first bank failure-prediction study that uses DEA efficiency variable as proxy for management quality. The results of the analysis indicate that management efficiency is an important factor in bank failures.

Bennett & Loucks (1996) is another study that uses hazard methodology for bank failures, examining the importance of political influence on the U.S. banks' lifespan during 1986-1990. In this study the term 'political influence' stands for the membership on relevant congressional committees dealing with the banking industry in US: the Senate Committee on Banking, Housing, Urban Affairs and the House Committee on Banking and Finance and Urban Affairs. The paper tests the hypothesis that ceteris paribus regulators allowed undercapitalized banks with representation on these committees to remain open longer than they did undercapitalized banks without such representation. According to the results of the empirical section, the undercapitalized banks with representation on the House banking committee found to survive longer than the other undercapitalized banks. These results suggest that the political influence, which in this study meant membership of relevant house committees, affect the lifespan of banks.

Wheelock & Wilson (2000) have investigated the determinants of the U.S. banks' failures and acquisitions during 1984–1993. Because federal regulators in US evaluate banks on five criteria: capital adequacy, asset quality, management, earnings and liquidity (CAMEL), they have built their model according to these criteria, as well as some other explanatory variables. To evaluate capital adequacy, the *CAPAD* ratio has been chosen and a negative relationship is expected between the variable and failure. Four variables (denoted as A1, A2, A3 and A4 in the Table 6) are employed to characterize asset quality. Because loans are the least liquid and

most risky items of bank assets a positive relationship is expected between these variables and failure. In contrast to other studies, thinking that failing banks are inefficient banks, they have obtained efficiency scores using DEA and use these scores in the M group of variables described in the table. Banks with greater earnings are less likely to fail thus the coefficient of *EARN* is expected to be negative. The log of total assets is used to measure bank size and because smaller banks are more likely to fail, the coefficient of the size variable is also expected to be negative. The *HOLD* variable is used to test whether membership in a multi-bank holding company affects the probability of failure. In addition to these variables, branching dummy variables are used to test whether the opportunity to branch enhanced geographic diversification lessened the chance of failure. If so, the coefficients on *BR1* and *BR2* are expected to be negative. They conclude that highly leveraged banks, banks with low earnings, low liquidity, or risky asset portfolios are the most likely to fail.

Using hazard methodology, De Young (2000) modeled the failure of new banks in US during the period 1980-1985, employing only bank specific variables in this study. The coefficients of *MERGE8098*, *MBHC*, *HHI*, *STATEGROWTH*, *lnASSETS*, *EQASS*, and *ROA* (definitions of abbreviations are given in Table 6.) are expected to be positive and probability of survival is expected to be negatively related to *DELAY*, *LIMITS*, *OCC*, *LOAN*, *NPL*, *BIGDEP*, and *SPEND* variables. The results of the study show that early warning signals may be easier to identify for de novo banks than for older ones. Furthermore the estimated probability of failure is higher for de novo banks than for established banks.

A logit regression methodology was employed by Logan (2001) to determine bank failures in UK. A number of measures of bank weakness — low

loan growth, poor profitability and illiquidity — are all found to be good short-term predictors of failure, as are a high dependence on net interest income and low leverage.

Jagtiani (2002) examined the efficiency of early warning systems (EWSs) with respect to the determinants and identification of capital inadequacy among U.S. commercial banks. Based on samples of banks in the late 1980s and early 1990s, EWS models are empirically tested using logit and trait recognition models, empirical results reveal that banks pending capital deficiency are very different from other banks in terms of their financial health. Also, EWS models were able to detect the early onset of financial distress in commercial banks one year in advance with a reasonable degree of accuracy.

Molina (2002) used the hazard methodology to study banking crises in Venezuela, finding that surviving banks were more profitable and held their assets as government bonds, while the size of the bank was not found to be significant. These factors are considered to be the key points in surviving in a crisis that took down more than half of the Venezuelan banking system.

Carree (2003) has analyzed the disappearance of Russian Banks between the years 1994–1997. Carree (2003) tried to explain bank failures in Russia using four factors. The first is duration and he expected banks that are present in the market for a longer time to have lower hazard than banks that have only recently entered (liability of newness). The second factor is the time period in which the bank is at risk. The default risk of saving banks has increased with the August 1995 interbank crisis. That is, the hazard rate is likely to increase from 1995.III on. The third factor is the market share of the bank. Carree (2003) expected large banks to be less likely

to fail when compared to smaller banks, and this liability of smallness is a common finding in empirical studies. He incorporated the reciprocal market share in the previous period (RSHA), as the covariate measuring the liability of smallness. In his study, rather than total capital and total assets, deposits data has been chosen to measure the size of the bank. The fourth factor is the interest rate offered by the bank. Banks that give higher interest rates are likely to have a low profit margin, since they are likely to have low funding capital. Banks that offer rates much lower than on average do not have risks similar to the high interest rate banks but appear to have little ambition to achieve growing market shares. In order to investigate this possibility in his paper, RINT is incorporate in a quadratic form into the hazard rate equation.

The duration data is characterized in terms of the hazard function in Carree (2003). Employing the special parametric cases of the exponential, Weibull and Gombertz regression models, this research found that market share and duration have negatively affected the hazard rate, while the deposit interest rate has a positive effect. This paper also implies that the lifespan of new and small banks was limited and that banks giving higher interest rates on the saving market were likely to be among the first to exit. Many of the small market participants offered interest rates higher than the larger banks to attract customers, even though it increased the likelihood of their default in addition to their 'standard' liabilities of newness and smallness.

Dabos & Escudero (2004) examined the variables that determine the bank failure in Argentina following the Mexican crisis known as the "tequila effect". They used bank specific variables (CAMEL criterions) to explain bank failures. Categorizing banks as mutual and private national, they found that the survival

function for private national banks is significantly higher than that of mutual banks: at every stage of the crisis, it is more probable to have a mutual bank failure than a private national bank failure. Secondly, the survival function for private national banks decreases slower than that of mutual banks, which shows a strong acceleration approximately 200 days after the Tequila crisis began.

Another study that explains bank failures in a developing country, Brazil, is Sales & Tannuri-Pianto (2005). Using exponential and exponential piecewise-constant hazard functions they not only employed bank-specific factors, but also macroeconomic variables, concluding that foreign banks have distinct empirical survival functions relative to other banks. Macroeconomic conditions was also found to contribute the explanation of bank failures.

Using hazard methodology, Podpiera & Podpiera (2005) found that there is a strong relationship between bank failure and cost inefficiency. To measure this inefficiency they employed Stochastic Frontier Approach. As Wheelock & Wilson (1995) and Wheelock & Wilson (2000) had previously suggested, this study also found a strong relationship between cost efficiency and bank failure therefore it can be said that failing banks tend to be found well behind the efficiency frontier.

Lanine & Vennet (2006) used a logit model and a nonparametric trait recognition approach to predict failures among Russian banks. They found that liquidity plays an important role in bank failure prediction and in addition to this; asset quality and capital adequacy are other important determinants of failure.

Gonzalez & Kiefer (2006) examined the time to bank failure in Colombia during the financial crisis of the late 1990s, demonstrating that among the relevant indicators that explain bank failure, the capitalization ratio appears to be the most

significant one. An increase in this ratio causes a fall in the hazard rate of failure. This ratio shows a non-linear component, implying that the impact of increases in this variable is more important for less capitalized banks. This is consistent with the literature suggesting that banks' capital is vital and implies that managers and supervisors should pay more attention to capital requirements, in order to maintain financial soundness. Other important variables explaining bank failure dynamics are the profitability of assets and the ratio of nonperforming loans to total loans. Leverage appears to affect the hazard rate also, but with lower statistical significance. The estimation procedure assumes the proportional hazards assumption which implies that explanatory variables affect the hazard rate in a proportional way holds.

Gonzalez et al (1997) signified that not only bank-specific factors, but also macroeconomic conditions determine bank failures. Following this criticism, Konstandina (2006) included both micro and macro variables in his study which differed from other studies in the literature. In Table 6 the final six variables refer to macroeconomic variables that affect bank failure. Using logit and hazard models together she found that bank-specific factors play important role in explaining failures and survival times, while macroeconomic variables do not appear important. Using DEA she found also that less efficient banks have higher chances of failure. Higher balances of non-performing loans also bring higher risk of failure, as well as holding of government securities. Liquidity is also another significant factor that influences failure.

Table 6: Empirical Literature of Bank Failures

Author / Methodology	Country and Time Period Studied	Independent Variables
Thomson (1991) / Logit	US 1984-1989	NCAPTA: Book equity capital plus the reserve for loan and lease losses minus the sum of loans 90 days past due but still accruing and nonaccruing loans/total assets. NCLNG: Net charge offs/total loans. LOANHER: Loan portfolio Herfindahl index constructed from the following loan classifications: real estate loans, loans to depository institutions, loans to individuals, commercial and industrial loans, foreign loans, and agricultural loans. LOANTA: Net loans and leases / total assets. LIQ: Nondeposit liabilities / cash and investment securities. OVRHDTA: Overhead / total assets. ROA: Net income after taxes / total assets. INSIDELN: Loans to insiders / total assets. BRANCHU: Dummy variable: equals one if the state is a unit banking state, zero otherwise. DBHC: Dummy variable: equals one if the bank is in a bank holding company, zero otherwise. SIZE: Natural logarithm of total assets. AVGDEP: Natural logarithm of average deposits per banking office. BOUTDVH: Output Herfindahl index constructed using state level gross domestic output by one-digit SIC codes. UMPRTC: Unemployment rate in the county where the bank is headquartered. CPINC: Percent change in state-level personal income. BFAILR: Dun and Bradstreet's state-level small-business failure rate per 10,000 concerns.
Martin (1977) / Logit	US	Net income/ total assets

	1970-1976	Gross charge offs / net operating income
		Commercial and industrial loans / total loans
		Gross capital / Risky assets
Pantolone and Plat (1987) / Logit	1983-1984	Net income / total assets
		Equity capital / total assets
		Total loans / total assets
		Commercial and industrial loans / total loans
		% Change in residential construction
Barr et al (1995) / Probit	US	Equity Capital / Total Loans
		DEA Efficiency Score
		Nonperforming Loans / Total Assets
		Net Income / Total Assets
		Large Deposits / Total Assets
Lanine and Vennet (2006) / Logit and Trait Recognition Model	Russia	ROA: Return on Assets
		LIQ: liquidity risk
		LTA: share of loans to total assets
		BADL: share of overdue loans and overdue promissory notes in total loans
		TBILL: the share of government bonds to total assets
		CAP: the ratio of capital to total assets
		SIZE: log(total assets)
Canbaş et al (2005) / Principal Component Analysis, Discriminant, Logit and Probit	Turkey	Interest Expenses / Average Profitable Assets
	1997-2003	Interest Expenses / Average Non-Profitable Assets
		(Shareholders' Equity +T. Income) / (Dep.+ Non-dep. Funds)
		Interest Income / Interest Expenses
		(Shareholders' Equity +T. Income) / (T.A+Con.and Com.)
		(Shareholders' Equity +T. Income) / Total Assets
		Net Working Capital / Total Assets
		(Salary and Emp'ee Bene.+Res. For Retire.) / No. of

		personel
		Liquid Assets / (Deposits + Non-deposit Funds)
		Interest Expenses / Total Expenses
		Liquid Assets / Total Assets
Ünsal and Güler (2003) / Logit and Discriminant Analysis	Turkey 1997-2003	Standard Capital Ratio Equity / Total Assets (Equity – Fixed Assets) / Total Assets
		Total Loans / Total Assets
		Liquid Assets / Total Assets
		Net Profit (loss) / Total Assets
		Net Profit (loss) / Equity
Barr and Siems (1996) / DEA	U.S. 1986-1989	Non interest incomes / Total Assets Equity Capital / Total Loans Non-performing Loans / Total Assets
		DEA Efficiency Score
		Net Income/Total Assets
		Large Dollar Deposits / Total Assets
Dabos and Escudero (2004) / Hazard Analysis	Argentina 1994-1998	Percentage Change in Residential Construction Equity / Assets Liabilities / Equity
		Immediate liquidity = (Cash + Public Securities) / Deposits
		Structural liquidity = (Equity – Fixed Assets) / Liabilities
		Operating expenses / Liabilities
		Arrears portfolio – Losses provisions / Equity
Gonzalez and Kiefer (2006) / Hazard Analysis	Colombia 1998-2001	Return on equity (ROE) CAP: Capitalization =ratio of equity to assets LEV: Leverage = ratio of total liabilities to equity
		LIQ: Liquidity = ratio of liquid assets net of liquid

		liabilities to deposits EFF: Management efficiency = ratio of operating expenses to total liabilities PROV: Provisions = Provisions over total loans PROF: Profitability of assets = ratio of annualized profits to average annual assets LOAN: Loan participation=total loans over total assets NPL: Non performing loans = nonperforming loans over total loans
Wheelock and Wilson (1994) / Hazard Analysis	Kansas 1909-1929	Insurance dummy Capital / Assets Bonds / Assets Loans / Assets Reserves / Deposits Borrowings / Assets Total Assets
Molina (2002) / Hazard Analysis	Venezuella 1994-1995	Total Capital / Total Assets EFFIC: the indicator for cost management
Wheelock and Wilson (1995) / Hazard Analysis	1910-1928 Kansas Banks	INEFF: inefficiency score ASSETS: Total bank assets CAPRAT: Book value of bank equity / total assets BNDRAT: bond holdings/total assets LOANRT: total loans / total assets CHSDEP: Cash items, currency and coin/ total deposits LIABRT: Borrowed funds and miscellaneous liabilities / total assets
Konstandina (2006) / Logit and Hazard Analysis	Russia 1999–2003	PER4, PER5, PER6, PER7: last four periods CAPT: Equity / Total assets NPLN: Non-performing loans / Total loans GKOT: Government securities / Total assets INBL: Interbank loans / Total assets

		LNRD: Loans to residents / Total assets LNNR: Loans to non-residents / Total assets DEPP: Public deposits / Total assets DEPB: Other banks deposits / Total assets LIQA: Liquid assets / Total assets PROF: Profit margin SIZE: Log (Total assets) EFFD: Efficiency score MOSD: Non-Moscow bank INTR: Real interest rate BGDP: Total banking system loans / GDP NPTL: Non-performing loans / Total loans GDP: GDP CPI: Consumer Price Index EXRT: Exchange rate
DeYoung (2000) / Hazard Analysis	US 1980-1985	YEAR8081 = 1 if bank in the 1980-81 cohort YEAR8283 = 1 if bank in the 1982-83 cohort YEAR8485 = 1 if bank in the 1984-85 cohort DELAY = state prohibition on acquiring de novos, in years STATEGROWTH = annual job growth in state, MERGE8098 = mergers in state / banks in state, 1980-98 URBAN = 1 if in MSA OCC = 1 if national bank MBHC = 1 if affiliate in multi-bank holding company ASSETS (1985, $thousands) HHI = Herfindahl Index in bank's home city or county

		ASSGROW asset growth rate, first observed year LOAN loans / assets NPL nonperforming loans / assets SPEND expenses on salaries, benefits, premises / assets BIGDEP deposits larger than $100,000 / assets EQASS equity / assets ROA net income / assets
Whalen (1991) / Hazard Analysis	US 1985-1990	LAR: Total loans / total assets COMLR: Commercial and industrial loans / total assets CRELR. Commercial real estate loans / total assets CD100R Total domestic time deposits in denominations of $100,000 or more / total assets ROA: Consolidated net income / average total assets OHR: Operating expenses / average total assets PCR: Primary capital / average total assets NPCR: PCR less (total nonperforming loans / average total assets) NCOR: Total net charge offs / average net loans plus leases NPLR: Total nonperforming loans/total loans plus leases PCHPxy: Percent change in state's residential housing permits measured over the 198x to 198y period
Wheelock and Wilson (2000)/ Hazard Analysis	US 1984-1993	CAPAD total equity / total assets. Al = total loans / total assets. A2 = real estate loans / total loans. A3 = other real estate owned / total assets. A4= income earned, but not collected on loans / total assets. A5 = commercial and industrial loans/total loans. Ml = cost inefficiency.

		M2= input distance function measure of technical inefficiency. M3 = 1/output distance function measure of technical inefficiency. EARN = net income after taxes/total assets. LIQ= (federal funds purchased — fed funds sold)/total assets. SIZE = log (total assets). HOLD = 1 if 25% or more of equity is held by a multi-bank holding company;0 otherwise. BR1 = 1 if bank is located in a state allowing limited branching; 0 otherwise. BR2 = 1 if bank is located in a state allowing unlimited branching; 0 otherwise.
Carree (2003) / Hazard Analysis	Russia	RHSA: reciprocal of market share
	1994-1997	RINT: relative interest rate
Podpiera and Podpiera (2005) / Hazard Analysis	Czech Republic	Cost efficiency Bad loans/total assets
	1994-2002.	
Bennett and Loucks (1996) / Hazard Analysis	US	Banks assets
	1986-1990	City population
		Cost to bank insurance fund of bank failure Change in bank assets Senator from bank's home state on the senate banking committee Number of representatives from bank's home state on the House Banking Committee Regulator identity Region of the country
Logan (2001) / Logit	UK	Loan growth in the year to 1991 Q1
	1990-1991	Dependence on net interest income (NII) Liquidity mismatch (STED) Leverage ratio (LEV) Profits / total assets

Jagtiani et al (2002) / Logit and Trait Recognition	US 1988-1990	Net income after taxes/total assets Dummy variable for urban versus rural location Agricultural, Commercial and industrial loan growth rates Consumer loan growth rate lease losses / total assets Other borrowed funds / total assets Net interest income plus non-interest income / Non-interest expenses Number of full-time employees /total assets Non-performing loans past due more than 90 days /total assets Non-performing consumer loans /consumer loans Non-performing real estate loans /real estate loans Other real estate loans /total assets Investment securities /total assets
Sales and Tannuri-Pianto (2005) / Hazard Analysis	Brazil 1994–1998	Ratio of Atypical Assets to Total Assets Operational Margin (Monthly Average in a Semester) Leverage Ratio Ratio of Non-Performing Loans to Total Loan Loan Reserve Coverage Ratio of Other Liabilities to Liabilities Administrative Costs / average assets Return on Assets Non-performing loans/ total loans

IV

EMPIRICAL ANALYSIS

At this part of the study using logit and Cox's proportional hazards analysis, the determinants of bank failures during 1994-2000 are examined empirically. The lifetime of a bank was assumed to start at the date of issue of the license and to end by withdrawal of its banking license by SDIF (Saving Deposit Insurance Fund). Turkish banks' failure is modeled as a function of some banks-specific control variables, including financial ratios and cost inefficiency. Following Wheelock & Wilson (2000), Podpiera & Podpiera (2005) and many other studies, the impact of cost inefficiency on Turkish banks' failure probability is investigated by employing the Stochastic Frontier Approach (SFA). For this reason SFA is introduced first followed by the hazard and logit methodologies. The data description is presented subsequently and application results are discussed finally.

4.1. Efficiency Measurement: Stochastic Frontier Approach

Through estimating efficiency scores the banks that need intervention and corrective measures can be identified only if being inefficient effects bank failures. As previously mentioned, there are two main methods for measuring the efficiency: Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis. DEA is a non-parametric method that depends on linear programming. DEA was firstly introduced by Charnes et al (1978) to measure the technical efficiency level of public schools and compare their relative efficiencies. As Ferrier & Lovell (1990),

Berger (1993) and Wheelock and Wilson (1995) stated that there is no consensus on the appropriate methodology for measuring the efficiency of banks. Both DEA and SFA have several advantages and disadvantages.

In this study Stochastic Frontier Approach is employed to measure cost inefficiency scores of Turkish commercial banks. The term "Cost Efficiency", the most conventional concept of efficiency in bank performance studies, refers to the ability to produce maximum output at minimum cost, given input prices.

The SFA techniques especially have recently gained much greater popularity (Podpiera & Podpiera, 2005: 3). This approach depends on Ordinary Least Squares (OLS) and implies that banks are being ranked according to their relative performance to the bank which engages in the best practice. The best-practice implies the bank that provides financial services at the lowest cost using the most efficient mix of productive inputs. Thus, a cost function can be expressed as equation 1:

$$\ln tc = \ln f(w, y) + \varepsilon \qquad (1)$$

where tc is total cost and w and y represent vectors of input prices and output, respectively. The core of this method is an error term that is assumed to contain two components. The first component of this composite error term is a two-sided error term, which is assumed to be normally distributed and unrelated to inefficiency. The second component represents inefficiency and generally has an asymmetric half-normal distribution. To sum up in note form, in a stochastic frontier error term

$\varepsilon = u + v$, u represents standard statistical noise and v captures efficiency. The efficiency scores take the values between one and zero. The cost efficiency score of the most efficient bank is one where the most inefficient banks' is zero.

Here it should be noted that, the selection of appropriate inputs and outputs for banks is maybe the most important point in efficiency analysis. Nonetheless there is no precise input and output definitions in banking industry. Berger & Humphrey (1997) also signify, that there is no consensus on input and outputs of the banking industry. Nonetheless there are two dominant approaches on this matter: intermediation and production approaches. Production approach evaluates banks as production units that produce services to depositors and borrowers. In this approach production factors, land, labor and capital, are used as inputs to produce services. In this approach, production is measured via number of accounts (Denizer et al: 2000). The Intermediation Approach considers commercial banks as financial intermediaries that collect deposits from depositors and lend to borrowers and assumes that banks collect deposits and other purchased funds with the assistance of labor and physical capital and intermediate these sources of funds into loans (Kasman, 2002: 8).

There are also other approaches such as financial ratios and value added approaches. In value added approach total deposits, total securities, and total loans are considered as outputs. Labor, physical capital, and barrowed funds are used as inputs. Despite not being extensively used in the literature, the value added approach is considered more appropriate for the empirical section of this study since Turkish commercial banks have not fulfilled their intermediation duty during the period being examined, and it is difficult to obtain data on the numberrr of accounts

involved. Table 7 provides detailed information on the approaches and input output measures from previous studies of Turkish banking industry.

Table 7: Input Output Measures From Previous Studies on Turkish Banking Industry

Author	Inputs	Outputs	Approach
Denizer, Dinç and Tarımcılar (2000)	Total own resources of the bank, total personnel expenses and the interest and the fees paid by the bank	Total deposit and income from charges and commissions collected, total loans	PA and IA
Fethi, Jackson and Jones (2001)	Number of employees, sum of non-labor operating expense and direct expenditure on buildings, amortization expenses	Loans, demand deposits, time deposits	IA
Ekren and Emiral (2002)	Deposits +short term debts and total cost	Total loans and other income earning assets	IA
Cingi and Tarim (2000)	Total assets	Income	MA
	Total expenses	Loans	
		Deposits	
		Non-performing	
		Loans/total loans	
Atan and Çatalbaş (2004)	Total assets, total deposits, total equity, paid in capital, number of agencies, number of personnel, off balance sheet liabilities	Total loans	IA
Çukur (2005)	Total deposit, interest payments, non-interest expenses.	Total loans,	IA
		Interest income	
		Non interest income	
Zaim (1995)	Number of employees	Demand deposits	IA
	Interest expenditure	Time deposits	
	Depreciation expenditures	Short-term loans	
	Expenditures on materials	Long-term Loans	
Yolalan (1996)	Non-performing loans/Total assets Non-interest expenses/Total assets	Shareholders'equity + net income)/ total assets Net fees and commissions/ Total assets Liquid assets/Total assets	FR
Jackson et al (1998)	Number of employees Non-labor operating expenses	Loans Demand deposits Time deposits	VA

Table 7 cont'd

Yıldırım (1999)	Demand deposits	Loans	IA
	Time deposits	Interest income	
	Interest expenses	Non-interest income	
Jackson and Fethi (2000)	Number of employees	Loans	VA
	Non-labor operating expenses	Demand deposits	
		Time deposits	
Cingi and Tarim (2000)	Total assets	Loans	MA
	Total expenses	Deposits	
	Income	Non-performing loans/total loans	
Kasman (2002)	borrowed funds, labor, and capital	short-term loans, long-term and specialized loans and securities.	IA
Yayla et al (2005)	Personnel expenses/total assets, other non interest expenses/total assets, number of personnel per agency	Total deposit/ total assets,	PA
		Total loans/ total assets	
	Total deposit/ total assets,nondeposit resources/ total assets, interest expenses/total assets; noninterest expenses/total assets	Total loans/ total assets,	
		İnterest income/total assets	IA
Kaya and Doğan (2005)	Personnel expenses/total assets, other non interest expenses/total assets, number of personnel per agency	Total deposit/ total assets,	PA
		Total credit/ total assets	
	Total deposit/ total assets,nondeposit resources/ total assets, interest expenses/total assets; noninterest expenses/total assets	Total loans/ total assets,	IA
		Interest income/total assets	
Işık and Hassan (2000)	Number of employees, capital (the book value of premises and fixed assets)	Short-term loans, long-term loans, risk-adjusted off-balance sheet items, other earning assets	IA
	Loanable funds (the sum of deposit (demand and time) and non-deposit funds).		

*This table is an extended version of Fethi et al (2001)'s.

SFA requires specification of a cost function involving assumptions about the firms' production technologies, whereas DEA does not. Christensen et al (1973) use a more general and flexible functional form as an extension of the Cobb-Douglas production function, and call this type of cost function transcendental logarithmic (translog) production function. Among parametric models used in the literature, the translog specification has been the most common choice for variable cost functions (Kanishi & Nishiyama, 2002). To model this, the translog functional form is used in this study.

The translog cost function is a useful and advantageous form, since it does not require too many restrictive assumptions about the production technology. The multi-product (three inputs-three outputs) cost function for a given bank *s* at time *t* can be constructed as follows:

$$\ln tc_{st} = \alpha_0 + \sum_{i=1}^{3} \alpha_i \ln y_{ist} + \frac{1}{2}\sum_{i=1}^{3}\sum_{k=1}^{3} \alpha_{ik} \ln y_{ist} \ln y_{kst} + \sum_{j=1}^{3} \beta_j \ln w_{jst} + \frac{1}{2}\sum_{j=1}^{3}\sum_{m=1}^{3} \beta_{jm} \ln w_{jst} \ln w_{mst} + \sum_{i=1}^{3}\sum_{j=1}^{3} \delta_{ij} \ln y_{ist} \ln w_{jst} + v_{st} + u_{st} \quad (2)$$

where *tc* is the total cost, y_i is the *i*th output and w_j is the price of the *j*th input. A well-behaved cost frontier has two standard properties of the cost function, symmetry and linear homogeneity, which are imposed via parameter restrictions. The linear homogeneity conditions are imposed by normalizing total cost (*tc*), the price of labor (w_1), and the price of funds (w_2) by the price of fixed capital (w_3). The symmetry condition requires $\alpha_{ik} = \alpha_{ki} \; \forall \, i, k$ and $\beta_{jm} = \beta_{mj} \; \forall \, j, m$. Finally,

the method of maximum likelihood is used to estimate the unknown parameters of the cost frontier and efficiency levels are estimated using the regression errors.

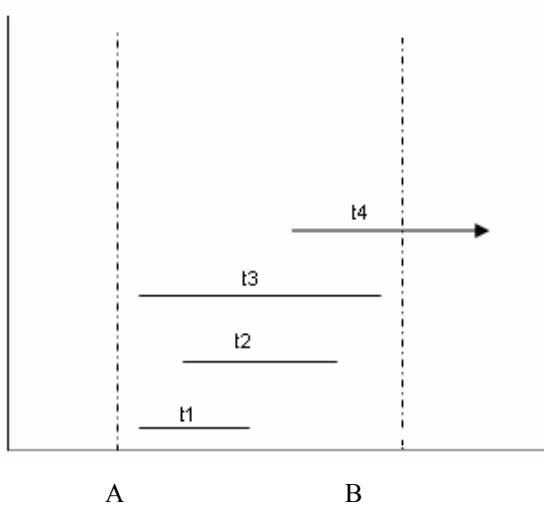
4.2. Cox's Proportional Hazard Methodology

Hazard methodology has been commonly employed by engineers interested in length of time to failure analyses to the durability of electronic and electronic tools. It was used these way decades before economists discovered its value. Biomedical researchers are the other common users of these models, to make estimations related to the length of survival after the onset of a disease or after an operation like heart operation. Other application areas of hazard models include duration of marriages, timing of births (Newman & McCulloch, 1984), unemployment duration (Lancaster 1979; Nickell 1979; Kiefer 1988 and Sider 1985), lifetimes of firms (Santarelli, 1998; Audretsch & Mahmood 1995; Mata & Portugal, 1994), durations of wars and conflicts (Akdede & Oğuş, 2006), the survival of theatre plays (Akdede & Oğuş, 2006), purchase timing decisions especially for durable goods (Jain & Vilcassim, 1991), and length of stay in graduate school (Kiefer, 1988: 648).

Conventional estimation techniques like OLS are not suitable for duration data analysis, main reason being that information with respect to duration may be incomplete, since at the time of the survey there may be some cases that did not fail. These types of observations are called right-censored because it is known that durations may exceed a given threshold, as shown in Figure I (Mata & Portugal, 1994: 230). Dependent variables typically occur as cross sections of durations, t_1, t_2, …t_n in hazard functions. Hazard models are considered as regression-like models in

some sources. The parameter estimates in hazard functions, indicate whether an increase in the value of an independent variable will reduce or extend the expected time until failure.

Figure I: Duration Data



A: Beginning of the observations.
B: End of the observations.
T1, T2, and T3: completed observations.
T4: right censored observation.

Source: Kiefer, 1988.

OLS estimators are biased and inconsistent with such data. Moreover, even where the sample contains completed observations, there are problems using duration data as a dependent variable in a regression, such as how to measure independent variables whose values change during the observation interval. Therefore, even ignoring censoring issue, duration data still have problems (Kiefer, 1988: 647). Hazard models on the other hand take this problem into consideration and these models can be considered as a solution for these types of data (Mata &

Portugal, 1994: 230)[16]. Molina (2001) explains the reason of this remedy as follows:

> *"...the main concern of the hazard models is cross sectional, but it allows the measurement of each cross sectional observation at different times, taking into account the time between measuring the observation and the event of bank failure."*

There are a number of different types of survival models in the literature. Since we use semi-parametric proportional-hazard model (PHM), only this specification is introduced in this study. PHM is firstly proposed by Cox (1972). The dependent variable in PHM is the time until failure, *T*. Survival function is a useful function in duration data analysis and it gives the upper tail area of the distribution which represents the probability of surviving longer than *t* periods, has the following general form (Whalen, 1991: 22):

$$S(t) = \Pr ob(T > t) = 1 - F(t) \tag{3}$$

In equation 3, $F(t) = \Pr(T < t)$ is the distribution function that gives the probability that the random variable T is less than some value t. The density function can be expressed as $f(t) = dF(t)/dt$. Hazard functions can be defined as the ratio of density function $f(t)$ to the survival function $S(t)$ (Kiefer, 1988: 650). However, Whalen (1991) describes hazard function more simply as;

[16] See Halsen and Smittlein (1989) for detailed reasons of choosing of this methodology when studying with duration data.

"*Hazard function is a function that specifies the instantaneous probability of failure given survival up to time t".*

As can be seen, the hazard function, the density function and the survival function are all interrelated. Cox's model, depends on the proportional hazards assumption. Dabos & Escudero (2004) implies that;

"in proportional hazard assumption the effect of explanatory variables on the hazard function is constant over time, that is, a marginal change in any of the explanatory variables induces a vertical shift along time."

According to this definition if being inefficient halves a bank' failure rate at time 0, it also halves the failure rate at time 1, or time 0.5, or time t for any value of t".

$$h(t) = \lim_{\Delta t \to 0} \frac{prob(t \le T \le t + \Delta t / T \ge t)}{\Delta t} = \lim_{\Delta t \to 0} \frac{F(t + \Delta t) - F(t)}{\Delta t S(t)} = \frac{f(t)}{S(t)} \qquad (4)$$

$$h(t) = \frac{-d \ln S(t)}{dt} \qquad (5)$$

Another related function to hazard function, which gives the probability of failure at a given time period conditional on the fact that a bank has survived to time *t,* is the integrated hazard function (Λ) or so-called cumulative hazard function (Lee & Urritia, 1996: 123). The cumulative hazard function is the integral of the hazard function.

$$\Lambda(t) = \int_0^t h(s)ds \tag{6}$$

$$S(t) = e^{-\Lambda(t)} \tag{7}$$

$$\Lambda(t) = -\ln S(t) \tag{8}$$

The integrated hazard function is a basic term in duration analysis. The seventh equation represents the relationship between the survival function and the integrated hazard function. The term "Hazard" means risk and the hazard rate gives the conditional likelihood that the event of interest occurs at duration time t, given that it has not occurred in the duration interval (0,t). Cox (1972) defines the hazard rate equal as equation 9.

$$h(t \mid x) = \lambda(t)\exp(x\ \beta) \tag{9}$$

In this definition x is a vector of explanatory variables and β is the corresponding vector of parameters to be estimated (Carree, 2003: 258). The ninth equation can also be expressed in logarithms as the following form,

$$\ln h(t) = \ln \lambda(t) + x\beta \tag{10}$$

As can easily be seen, the baseline hazard function $\lambda(t)$ equals hazard function for $x = 0$. Thus, the effect of a unit change in an independent variable

causes a constant proportional change in the hazard rate (Mata & Portugal, 1994: 231). The effect of time on hazard rate is represented by the baseline hazard λ(t). It can be seen that the model is semi parametric since $x\beta$ is a parametric form as the baseline hazard doesn't have a specific form and hence nonparametric (Wheelock and Wilson, 1994:71). This is considered as the main advantage of using this approach by Molina (2001) since the researcher does not need to define the baseline hazard, density function, or survivor function.

Parametric types of hazard models require a baseline hazard that has a specific form. Some empirical studies use parametric models for duration. Some commonly used distributions are the exponential, the Weibull and the Gompertz. Although Heckman and Singer (1984) states that a wrong choice of the baseline hazard function can produce unreliable estimates, if properly specified, the parametric representations of the duration distribution produce more efficient estimates (Mata and Portugal: 1994).

To estimate the above model the semi-parametric 'partial likelihood' estimation technique can be used which is proposed by Cox (1972). Finally an important point of hazard methodology should be noted, if the slope of the hazard function is positive the hazard function is said to have positive duration dependence. This implies that the hazard rate increases with time ($dh(t)/dt > 0$). That is, the likelihood of failure at time *t*, conditional upon duration up to time *t*, is increasing in *t*. The opposite case is decreasing hazard or negative duration dependence. The negative duration dependence implies that the hazard rate decreases with time ($dh(t)/dt < 0$) (Mata & Portugal, 1994: 230).

4.3. Logit Regression Methodology

Logit model belongs to the class of limited dependent variable models, (or discrete choice models) and is commonly used in bank failure prediction studies. The aim of building a logit regression is to predict the probability of failure and group membership. The logit model is preferred over the linear probability model because it produces estimates between zero and one. Since logit regression calculates the probability or success over the probability of failure, the results of the analysis are in the form of an odds ratio. The dependent variable in a logit regression model either takes the value 1 with a probability of success θ, or the value 0 with probability of failure 1-θ. Such a variable is called a Bernoulli (or binary) variable. (Konstandina, 2006:12) There is no restriction and assumption on the forms of independent variables in logit model neither do they have to be normally distributed, linearly related or of equal variance within each group (Kolari et al: 2000). A logit regression equation can be expressed as the following form;

$$\theta = \frac{e^{(\alpha+\beta_1 X_1+\beta_2 X_2+.....+\beta_i X_i)}}{1+e^{(\alpha+\beta_1 X_1+\beta_2 X_2+.....+\beta_i X_i)}} \qquad (11)$$

where α = the constant of the equation and, β_i = the coefficients of the independent variables. The above logit regression equation can also be expressed in linear form as the following equation.

$$\log it[\theta(x)] = \log\left[\frac{\theta(x)}{1-\theta(x)}\right] = \alpha + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_i X_i \qquad (12)$$

where θ_i = the probability of bank i's failure, and $\beta = (\beta_1, \beta_2, ..., \beta_n)$ is a vector of regression coefficients for independent variables X_i (i = l, …, n). the above regression can be estimated using Maximum Likelihood (ML) rather than OLS. ML is an iterative estimation technique for equations that are nonlinear in the coefficients. ML calculates coefficient estimates that maximize the likelihood of the sample data set being observed (Stundenmund, 2001: 445). ML and OLS estimates are same where the standard errors are different. ML produces consistent and asymptotically efficient (unbiased and minimum variance for large samples) estimates. Here it should be noted that a logit sample must contain reasonable representation of both alternative choices.

4.4. Construction of Variables

We use bank specific variables to explain the determinants of failures in the Turkish banks after the 1994 crisis. As in previous studies (for example, Wheelock & Wilson (2000), Dabos & Escudero (2004), Barr et al (1994)), the CAMEL criteria are used to explain the reasons behind failure. In addition to capital adequacy, asset quality, management, earnings and liquidity factors, other factors that are thought to be also important included in the model. These variables are defined as follows:

a) EQ: This is the indicator of capital adequacy and defined as total shareholders equity/total assets. The expected sign for this variable is negative.

b) INEFF: This variable measures cost management efficiency and inefficiency scores are derived from Stochastic Cost Frontier model. The expected relationship is positive.

c) LIQUID: The liquidity indicator is defined as (total cash availability in national and foreign currencies)/Total assets. Since a bank with more liquidity can be in a better position to face a deposit run, a negative relationship is expected for this variable.

d) BR: This variable is an indicator of bank size and measured as the number of branches. The expected sign is uncertain.

e) SEC: This variable is defined as Total Security Investments/Total Assets. This is an intermediation indicator and the expected sign for this variable is uncertain[17].

f) NONINT: This variable is defined as Noninterest Income/Total Income. The expected sign is negative.

g) OBS: A window-dressing indicator is defined as (off-balance sheet accounts) /Total Assets. The negative relationship is expected.

h) TL: This variable is defined as Total Loans/Total Assets and an indicator of asset quality. A bank more aggressive in producing loans might decrease quality of loan portfolio and increase default risk. Its expected sign is positive.

[17] Particularly during the sample period, banks operating in the Turkish banking industry have heavily invested in Government bonds and/or Treasury bills. Due to increasing public sector borrowing requirements, Government offered higher interest rates. Since managing security portfolio is less costly than that of loan portfolio, the share of security portfolio in total assets increased to around 25% in 2000.

Since inefficient banks are considered to be more likely to fail, the coefficient of cost inefficiency obtained from the stochastic frontier method is expected to be positive. In this study, cost inefficiency scores are employed as a proxy for the "M" in CAMEL, in other words, the management quality. At this point in the study, it is important to discuss the estimation process of inefficiency scores that are used in the hazard model as an explanatory variable.

As Berger & Humphrey (1997) state, there is no consensus on input and outputs of the banking industry. Nonetheless as previously mentioned, there are two dominant approaches on this matter: Intermediation and Production approaches. Production approach evaluates banks as production units that produce services to depositors and borrowers. In this approach production factors, land, labor and capital, are used as inputs to produce services. In this approach, production is measured via number of accounts (Denizer et al: 2000). The Intermediation approach on the other hand, considers commercial banks as financial intermediaries that collect deposits from depositors and lend to borrowers and assumes that banks collect deposits and other purchased funds with the assistance of labor and physical capital and intermediate these sources of funds into loans (Kasman, 2002: 8). There are also other approaches to consider such as financial ratios and value added approaches.

In this study, we use value added approach to estimate cost inefficiency scores. In this approach, total deposits, total securities, and total loans are considered as outputs, while labor, physical capital, and barrowed funds are used as inputs. The price of labor represents the unit price of labor and is obtained by dividing the expenses for employees by the number of employees. Furthermore, the price of funds represents the unit price of funds and is constructed as the ratio of

interest expenses to borrowed funds and the deposit sum. And finally, the price of physical capital is the ratio of other noninterest expenses (excluding salaries) to fixed assets. Such an approach is called value added approach in the literature (Podpiera & Podpiera, 2005: 9). As previously mentioned even though it isn't extensively used in the literature, since Turkish commercial banks haven't fulfill their intermediation duty during the period and it is difficult to reach number of accounts data, value added approach used as a employed as a more appropriate approach.

4.5. Data Description

The annual data, used in this analysis, cover 54 commercial banks operating in the Turkish banking system during the period 1994-2000. The data is based on balance sheets and income statements of banks that were reported to the Banks Association of Turkey (BAT). 11 banks failed during the sample period[18]. However none of the thirteen foreign banks in the sample failed during the period.

Table 8: Average Values of Bank Specific Financial Variables for the Period 1994-2000

	Y	EQ	LIQUID	INEFF	BR	SEC	OBS	TL
Abn Amro Bank N.V.	7	0,122	0,392	0,215	1,14	0,047	7,448	0,183
Adabank	7	0,174	0,468	0,230	60,26	0,166	0,301	0,165
Akbank	7	0,095	0,212	0,172	527,57	0,209	0,442	0,005
Alternatif Bank	7	0,086	0,128	0,180	16,42	0,295	2,611	0,057
Arap Türk Bank	7	0,068	0,390	0,186	3,71	0,146	0,774	0,109
Bayındırbank (derbank)	7	0,159	0,214	0,199	13	0,133	0,808	0,212
Banca di Roma S.P.A.	7	0,062	0,150	0,121	1,714	0,058	0,254	1,036
Bank Mellat	7	0,066	0,600	0,145	3	0,035	0,102	0,520
Bnp-Ak Dresdner Bank	7	0,092	0,217	0,157	2	0,215	1,371	0,058
The Chase Manhattan	7	0,038	0,538	0,203	1,42	0,147	5,344	0,025
Citibank N.A.	7	0,091	0,377	0,318	6,57	0,086	3,156	0,054
Credit Lyonnais Turkey	7	0,097	0,613	0,136	1,28	0,036	1,451	0,844

[18] 23 banks failed over the period 1994-2006. Of these 12 failed between out of the sample period, 2001-2006.

Table8 cont'd

Türk Dış Ticaret Bank	7	0,081	0,199	0,270	52,71	0,228	2,012	0,031
Türk Ekonomi Bank	7	0,054	0,315	0,267	31,28	0,121	1,589	0,033
Türkiye Emlak Bank	7	0,715	0,038	0,303	402,14	0,101	0,401	0,007
Finans Bank	7	0,078	0,217	0,286	51,42	0,172	2,284	0,020
Türkiye Garanti Bank	7	0,078	0,159	0,240	202	0,167	1,070	0,007
Habib Bank Limited	7	0,413	0,393	0,406	1	0,046	0,101	0,240
Türkiye Halk Bank	7	0,043	0,092	0,152	784,71	0,084	0,184	0,002
HSBC (Midland)	7	0,064	0,299	0,184	1,85	0,303	3,213	0,071
İktisat Bank	7	-0,116	0,096	0,240	36,286	0,213	2,132	0,034
Kentbank	7	0,068	0,144	0,191	50,429	0,198	1,283	0,065
Koçbank	7	0,078	0,168	0,238	55,857	0,206	3,831	0,022
Birleşik Türk Körfez Bank	7	0,068	0,256	0,181	7,571	0,400	1,834	0,012
M.N.G. (Gar.Yat. Tic)Bank	7	0,310	0,306	0,269	9,714	0,182	2,157	0,374
Osmanlı Bank	7	0,083	0,292	0,249	67,571	0,177	1,204	0,020
Oyak Bank	7	0,232	0,202	0,210	7,571	0,097	0,705	0,191
Pamukbank	7	0,089	0,108	0,141	172,857	0,090	0,659	0,013
Şekerbank	7	0,092	0,219	0,283	196,714	0,082	0,863	0,053
Sitebank	7	0,107	0,408	0,232	7,857	0,146	0,948	0,182
Société Générale (SA)	7	0,053	0,416	0,198	1	0,176	2,933	0,111
Milli Aydın bank	7	0,047	0,106	0,197	42,857	0,126	0,518	0,216
Tekstil Bank	7	0,069	0,231	0,230	22,000	0,118	1,927	0,083
Toprakbank	7	0,058	0,234	0,191	120,429	0,133	1,169	0,026
Türk Sakura Bank	7	0,114	0,335	0,160	2	0,218	1,845	0,140
Turkish Bank	7	0,075	0,527	0,158	13,429	0,126	0,635	0,209
Ulusal Bank	7	0,044	0,315	0,290	2,857	0,562	2,271	0,017
Türkiye Vakıflar Bank	7	0,048	0,142	0,163	328,857	0,176	0,573	0,009
Westdeutsche Landesbank	7	0,034	0,306	0,208	2,000	0,244	1,627	0,113
Yapı ve Kredi Bank	7	0,092	0,141	0,162	395,714	0,104	0,946	0,007
Türkiye Ziraat Bank	7	0,040	0,107	0,104	1275,14	0,099	0,322	0,002
Bank Ekspres*	4	-0,230	0,150	0,210	19	0,088	1,387	0,108
Demirbank*	6	0,065	0,171	0,184	83,143	0,259	1,841	0,015
Egebank *	5	-0,220	0,152	0,202	58	0,260	1,024	0,048
Eskişehir Bank*	5	-0,107	0,134	0,186	78,85	0,216	1,140	0,029
Etibank*	6	-0,101	0,159	0,355	138,71	0,135	0,442	0,041
Interbank*	5	-0,090	0,094	0,223	27,857	0,101	0,728	0,020
Bank Kapital Türk *	6	-0,349	0,189	0,207	16,14	0,238	2,658	0,142
Sümerbank*	5	0,007	0,199	0,269	73,14	0,126	1,268	0,030
Türk Ticaret Bank*	3	0,030	0,194	0,203	275,57	0,261	2,689	0,016
Yasar(Tütüncüler)Bank*	5	-0,199	0,113	0,182	78,85	0,193	2,131	0,031
Yurt Ticaret ve Kredi Bank*	5	-0,147	0,082	0,254	18,85	0,177	0,316	0,103

Note: * denotes the failed banks.

Table 8 presents the average values of each bank for the seven years. In this table, Y denotes the number of years until the bank failure, used as dependent variable in the hazard estimation, during 1994-2000. For instance if a bank did not

fail in the period the lifetime related to this bank is seven. If a bank failed in 2000 it is assumed to live six years within the period where a bank failed in 1998 is assumed to live four years within the period. *SEC, LIQUID, TL, EQ* and *OBS* are the ratios of the relevant variables to the total assets where *BR* is in units.

Table 9: Summary Statistics of the Bank Groups by Failed and Nonfailed for 378 obs.

	Failed Banks (11x7)		Nonfailed Banks (43x7)	
	Average	Std. Dev.	Average	Std. Dev.
EQ	-0.112	0.477	0.098	0.189
LIQUID	0.149	0.084	0.260	0.179
INEFF	0.227	0.112	0.215	0.103
BR	81.014	78.599	136.997	261.466
SEC	0.184	0.166	0.157	0.120
NONINT	-0.001	0,998	0.127	1.271
OBS	1.565	1.706	1.433	1.560
TL	0.319	0.156	0.300	0.155
TA	975.826	733.823	1920.417	3493.836

Note: TA indicates total assets and in Millions of US dollars and BR is in units.

Table 9 reports descriptive statistics of the explanatory variables for failed and nonfailed banks during the sample period. The values in the table represent the means and the standard deviations of 77 observations of the variables for failed banks and the means of 301 observations for nonfailed banks.

Table 10: Summary Statistics of the Bank Groups by Failed and Nonfailed for 54 obs.

	Failed Banks (11)		Nonfailed Banks (43)	
	Average	Std. Dev.	Average	Std. Dev.
EQ	-0,122	0,125	0,106	0,126
LIQUID	0,149	0,040	0,270	0,145
INEFF	0,225	0,051	0,211	0,061
BR	78,922	75,155	121,561	249,473
SEC	0,187	0,066	0,163	0,100
OBS	1,420	0,821	1,593	1,464
TL	0,053	0,044	0,136	0,215
TA	976.83	725.96	1933.23	3476.63

Note: TA indicates total assets and in Millions of US dollars and BR is in units.

The values in Table 10 give the averages and the standard deviations of 11 observations of the variables for failed banks and the means of 43 observations for nonfailed banks. The statistics are calculated as averaging the seven year periods of each bank.

As a first approximation describing the main statistical patterns of the variables used in the study is important. To analyze the variables, the sample is divided into two groups: failed and nonfailed banks. The differences in means of the explanatory variables of failed and nonfailed banks are also calculated and the statistical significance of those differences is tested. Through this way we made it possible to determine the explanatory variables before using them together in the empirical models. EQ, LIQUID, BR, and TA are statistically different for both groups. Although the other five explanatory variables haven't significant differences, they are employed as control variables to analyze their effect on bank failures in Turkey.

4.6. Empirical Results

In this study, we use the proportional-hazard model first developed by Cox (1972), to model the Turkish banks failure as a function of a number of banks-specific control variables, including financial ratios and cost inefficiency. The main reason for using this approach is that using time-varying covariates, enables the checking of not only the cross-sectional importance of each financial factor, but also the consideration of the factors' time series effect on each bank failure.

As explained before, the data for each bank are observed in seven years, the last observed year is 2000. The dependent variable in this hazard model is the

number of survival years until the bank failure. For instance if a bank did not fail in the period the lifetime related to this bank is taken as seven. If a bank failed in 2000 it is assumed to live six years within the period where a bank failed in 1998 is assumed to live 4 years within the period. The banks that survived until 2000 without failing are considered to be censored observations in the model. To consider this censoring, a dummy variable d_i is included. The dummy variable is equal to 1 if the bank is failed before the year 2000 and equal to 0 if the bank has not failed 2000, that is, if it is a censored observation. The proportional-hazard estimation results, using the partial likelihood method, are reported in Table 11. As stated before, this estimation is semiparametric since there is no specific distribution of the baseline hazard. The reported coefficients can be interpreted as the covariate effect on the instantaneous probability of a bank failure in this study or generally called hazard rate.

Table 11: Cox Proportional-Hazard Estimation Results

Variables	Coefficients	Standard errors
EQ	-0.696*	0.232
LIQUID	-6.468*	1.234
SEC	-2.371*	1.134
INEFF	0.045	1.221
BR	-0.002*	0.000
OBS	0.043	0.088
NONINT	-0.214	0.176
TL	-1.331	0.971
Number of observations	378	
McFadden Pseudo R-squared	0.06711	
Log likelihood function	-383.488	

Note: * denotes significance level at 5%.

Not surprisingly, the statistically significant coefficient of *EQ* indicates that capitalization plays a crucial role for the banks in Turkey. Obviously, the less equity a bank has the less protection it has against loan losses or other declines in the value

of its assets. This result, agrees with the literature that suggests that banks' capital is vital for bank failures. As Gonzalez and Kiefer (2006) signify that after the Basel accord II, financial institutions and supervisors follow closely the capital ratio requirements in the practical world. They also signify that capitalization is important while determining portfolio decisions, overall financial health, and thus the degree of trouble that they might experience in episodes of financial stress. This result implies that both managers of the banks and supervisors should pay more attention to capital requirements, in order to maintain financial soundness. Negative and significant coefficient of *LIQUID* indicates that higher total cash availability in national and foreign currencies/Total assets reduces the hazard rate that defined as failure in this study.

We also found that *SEC* plays an important role in bank failures in Turkey. This result supports Molina (2001)'s findings. Molina signify that low risk government bonds were the key for a bank not to fail in Venezuelan banking crisis during 1994-1995. These results can be extended to a general case of bank failures under volatile economies such as Turkish economy during 1994-2000. Here it should be noted that during the sample period, banks operating in the Turkish banking industry have heavily invested in Government bonds and/or Treasury bills due to their high interest rates. Since managing security portfolio is less costly than that of loan portfolio, the share of security portfolio in total assets increased to around 25% in 2000.

Following Berger & Humphrey (1992)'s proposition that high cost banks experienced higher rates of failure than more efficient banks, *INEFF* variable that represents management quality is employed and coefficient of *INEFF* here is found positive as expected but insignificant, which means that being inefficient doesn't

matter for bank failures. Implicitly, it shows the management quality doesn't play an important role in bank failures and banks with worse management are not necessarily to fail. This result is contrary to the previous literature that suggests that capitalization is vital. Therefore it can be inferred that efficient and inefficient banks failed with the same probability.

In Turkish banking industry small banks can be considered more likely to fail taking into account the experiences in 1990s and ignoring some experiences in 2000. Additionally Wheelock and Wilson (1995) also signify that casual empiricism suggests that small banks may be more likely to fail. There are two proxies to measure banks' size: number of branches and total assets. Since the number of branches *BR* and total assets *TA* are highly correlated and including both in regression cause multicollinearity problem, thus *TA* is excluded from the analysis. Here it should be noted that Turkish banking system is known to be overbranched compared to the European banks. In this study the *BR* variable is employed to test these claims on bank failure and the coefficient of *BR* was found negative and significant as expected which means that small banks were more likely to fail.

The sign of *OBS* is as expected again but it is statistically insignificant. Thus it can be said that *OBS* doesn't play an important role in bank failures. *NONINT* also has expected sign but it is statistically insignificant. As seen, all of the estimated coefficients exhibit the correct sign although some are statistically insignificant. Another insignificant variable is *TL.* Therefore it can be said that *TL* doesn't have any explanatory power on bank failures in Turkey. This result is also consistent with the earliest empirical finding: Çilli & Temel (1988). Using discriminant analysis, they also suggest that asset quality *TL* doesn't have any explanatory power on bank failures.

As can easily be seen from the Table 11, *EQ, LIQUID, SEC,* and *BR*, are highly significant with the negative signs as expected. Therefore a bank with higher capitalization, higher liquidity level, higher investments in government bonds and higher number of branches was less probable to fail. Inefficiency and off-balance sheet activities have expected signs but are statistically insignificant. Overall, banks with higher proportion of government bonds and cash (higher liquidity), wide branch network, and more importantly higher capitalization are less likely to fail. However these results are consistent with findings of Wheelock & Wilson (2000) and Molina (2002).

In addition to these studies, Kaya (2001) found that CAMEL rating system predicts approximately 60 percent of the bank failures. Moreover Çilli & Temel (1988) and Canbaş et al (2005) have also concluded that the CAMEL criteria only partially represents the specific financial characteristics of the Turkish commercial banks. Although employing different methods, the earliest empirical finding (Çilli & Temel (1988) agree that asset quality (*TL*) has no part in the explanation of bank failure, and focus on liquidity and capitalization as the most important factors. Loans are typically the least liquid and most risky of bank assets. Thus it can be said that the previous findings of the studies on Turkish banks' performances are nearly consistent with the findings of this study.

We also employed a logit model to estimate probability of failure with the same data set. The dependent variable in the logit model takes the value 1 if the bank is failed or the value 0 if the bank is nonfailed. Using Maximum Likelihood (ML) estimation technique the following model is obtained. As explained before ML is an iterative estimation technique for equations that are nonlinear in the coefficients and calculates coefficient estimates that maximize the likelihood of the

sample data set being observed. Here it should be noted that these estimation results are consistent and asymptotically efficient estimates. The results from the logit model are similar to those of the proportional-hazard model. Again, banks with higher capitalization, higher liquidity and wide branch network have a lower failure probability. However these results are consistent with the findings of Logan (2001).

Table 12: Estimation Results from Logit Model

Variables	Coefficients	Standard errors
Constant	1.793	1.068
EQ	-3.389*	0.962
LIQUID	-8.025*	1.695
SEC	-2.871**	1.563
INEFF	-0.066	1.795
BR	-0.003*	0.001
OBS	0.021	0.116
NONINT	-0.384	0.151
TL	-2.332	1.416

Note: * and ** denote significance levels at 10% and 5%, respectively.

As both models indicate, liquidity and capitalization in addition to size are the major contributing factors in bank failures in Turkey during 1994-2000. The coefficients of the bank specific financial explanatory variables in both models have signs and magnitudes similar to the Cox's model. These empirical findings give crucial information for bank's managers, regulators and investors. Bank managers can reallocate bank's assets in the light of these results and therefore can prevent failures.

V. CONCLUSION

The main purpose of this study was to investigate the determinants of bank failures in Turkey, using both a proportional hazard model developed by Cox (1972), and a logit model, after 1994 crisis. Our data consist of a panel of 54 commercial banks operating in the Turkish banking system. Of these 11 banks were failed during the sample period. The data is based on balance sheets and income statements of banks that were reported to the Banks Association of Turkey.

The sample can be considered as an informative sample, since there are enough failures to identify the significant variables that affect failures. The study is composed of three parts: in the first part, the recent Turkish banking sector is presented historically, in the light of the main characteristics of the Turkish economy after 1980 and banking sector. A brief literature review of related empirical studies is given in the second part. The third part is dedicated to the methodologies used in the study and empirical results.

Previous studies on bank failures have used a number of bank-specific control variables that proxy to the CAMEL criteria that have been found significant in bank failure prediction. In this study, to control for managerial quality, we used the Stochastic Frontier Approach to estimate inefficiency scores for failed and nonfailed banks in the sample. Hence, inefficiency scores were used as a proxy for the managerial quality. Equity/Total Asset ratio is employed as a measure of capital adequacy, Total Loans/Total Assets ratio is employed as a proxy for asset quality, and Total Investment Securities/Total Asset is used as a proxy for intermediation and liquidity. The ratio of Liquid assets/ Total Assets is employed as another measure of liquidity. Empirical results from the proportional-hazard and logit

models which gave similar results, suggest that banks with higher liquidity, higher capitalization and a wider branch network are less probable to fail while asset quality and management ability do not appear to be essential.

The results of this study indicate that capitalization plays a crucial role for the banks in Turkey. As Gonzalez and Kiefer (2006) suggested after the Basel Accord II, financial institutions and supervisors now follow closely the capital ratio requirements in the practical world. They also signify that capitalization is an important factor in determining portfolio decisions, overall financial health, and thus the degree of trouble that they might experience in episodes of financial stress.

Here it should be noted that this study used similar methodology and explanatory variables others have done for both developed and developing countries. The results are fairly consistent to those reported by other studies both for other countries. This similarity indicates that Turkish banks' lifespan is affected nearly by the same set of factors as banks in other countries. These results correspond to a certain degree with the previous studies on bank failures in Turkey. For example Canbaş et al (2005) have also signified that the CAMEL criteria only partially represents the specific financial characteristics of the Turkish commercial banks and this may be due to the different applications of bank regulatory and supervisory actions in Turkey.

References

Akdede, H.S. and Oğuş A. 2006. "Duration of Conflicts: Some Empirical Results", *International Jounal of Business, Management and Economics*, 2(7).

Akdede, H.S. and Oğuş A. 2006. "Increasing Returns to Information and the Survival of Turkish Public Theatre Plays", *Applied Economics Letters,* 13.

Atan, M**.** and Çatalbaş K. "Efficiency in Banking and the Effect of Capital Structure on Efficiency in Banks"

URL: http://muratatan.info/academic/article/17.pdf (18.07.2007).

Audretsch, D.B.and Mahmood T. 1995. "New Firm Survival: New Results Using a Hazard Function", *The Review of Economics and Statistics*, 77(1).

Barr, R. et al 1994. "Forecasting Bank Failure: A Non-Parametric Frontier Estimation Approach", *Recherches Economiques de Louvain*, 60(4).

Banks Association of Turkey. 1998. *TBB 40. Yıl Kitabı*, TBB Yayınları,

URL:http://www.tbb.org.tr/turkce/yeni%5F40yil.htm (18.07.2007).

Banks Association of Turkey. 2005. Financial Sector and Banking System in Turkey March 2005 report.

URL:http://www.tbb.org.tr/english/TBBBrosur10032005englishi.pdf (18.07.2007).

Banks Association of Turkey. 2006. Banks in Turkey Book 2006.

Banks Association of Turkey. 2005. Banks in Turkey Book 2005.

Bennett, R. and Loucks, C. 1996. "Politics and Length of Time to Bank Failure: 1986-1990", *Contemporary Economic Policy*, 14.

Beaver, W. 1966. "Financial Ratios as Predictors of Failure", *Journal of Accounting Research*, 4.

Berger, A. N. 1993. "Distribution-free Estimates of Efficiency in the U.S. Banking Industry and Tests of the Standard Distributional Assumptions," *Journal of Productivity Analysis,* 4(2).

Berger, A.N. and Humphrey D. B. 1997. "Efficiency of Financial Institutions: International Survey and Direction for Future Research", *European Journal of Operational Research,* 98.

Boratav, K. 1994. "Ekonomik Özgürlükler, Güven ve Reform Süreci", *İktisat/İşletme ve Finans*, 9.

Boratav, K. 2003. *Türkiye İktisat Tarihi,* İmge Kitabevi Yayinlari**,** Ankara.

Buehler S. et al 2005. "Merge or Fail? The Determinants of Mergers and Bankruptcies in Switzerland, 1995—2000", Working Papers 0506, University of Zurich, Socioeconomic Institute.

BRSA. 2003. "Banking Sector Restructuring Program: Progress Report"

Canbaş, S. et al 2005. "Prediction of Commercial Bank Failure via Multivariate Statistical Analysis of Financial Structures: The Turkish Case", *European Journal of Operational Research,* 166.

Carree, M. A. 2003. "A Hazard Rate Analysis of Russian Commercial Banks in the Period 1994–1997", *Economic Systems* 27.

Cartens, A. et al 2004. "Banking Crises in Latin America and the Political Economy of Financial Sector Policy", IDB-IIC Annual Meetings, Lima, Peru.

Celasun, O. 1998. "The 1994 Currency Crisis in Turkey", Policy Research Working Paper, 1913, April.

Charnes, A. et al 1978. "Measuring Efficiency of Decision Making Units", *European Journal of Operation of Research*, 2(6).

Christensen, L.R. et al. 1973. "Transcendental Logarithmic Production Frontiers", *The Review of Economics and Statistics*, 55(1).

Cingi, S. and Tarim A. 2000. "Türk Banka Sisteminde Performans Ölçümü: DEA Malmquist TFP Endeksi Uygulaması", Türkiye Bankalar Birliği Araştırma Tebliğleri Serisi, Eylül, No. 2000–02.

Cox, D.R. 1972. "Regression Models and Lifetables (With Discussions)", *Journal of the Royal Statistical Society*, Series B 34.

Çukur, S. 2005. "Türk Ticari Bankacılık Sisteminde Etkinlik Analizi", *İktisat İşletme ve Finans Dergisi,* Ağustos 2005 Ek sayı.

Çilli, H. and Temel T. 1988. "Türk Bankacılık Sistemi İçin Bir Erken Uyarı Modeli", Turkish Republic Central Bank, Research, Plan and Education Board Working Paper No: 8804.

Dabos, M. and Escudero W.S. 2004. "Explaining and Predicting Bank Failure Using Duration Models: The Case of Argentina After The Mexican Crisis", *Revista de Analysis Economico*, 19,(1).

Demirgüç-Kunt, A. and Kane E. 2001. "Deposit Insurance Around the Globe: Where does it Work?",

URL:http://www2.bc.edu/~kaneeb/depositInsArndGlobe.PDF (28.5.2006).

Demirgüç-Kunt, A. 1989. "Deposit-Institution Failures: A Review of Empirical Literature", Economic Review, Federal Reserve Bank of Cleveland, issue Q IV.

Demirgüç-Kunt, A. and Detragiache E. 2000. "Does Deposit Insurance Increase Banking System Stability?", IMF Working Paper 00/3.

Denizer, C.A. et.al. 2000. "The impact of financial liberalization on the efficiency of the Turkish Banking System: A Two-Stage DEA Application", The Banks Association of Turkey Working Paper Series, September, No. 2000-02.

DeYoung, R. 2000. "For How Long Are Newly Chartered Banks Financially Fragile?",

URL:http://www.chicagofed.org/publications/workingpapers/papers/wp2000_09.pdf (28.5.2006).

Ekren, N. and Emiral F. 2002. "Türk Bankacılık Sisteminde Etkinlik Analizi (Veri Zarflama Analizi)", *Active Finans*, Mayıs-Haziran Sayısı.

Esen, O. 2005. "Bankacılık Krizleri, Yeniden Yapılandırma Programları ve Türk Bankacılık Sektörü", *Siyasa,* 1(1).

Estrella, A. et al 2000. "Capital Ratios as Predictors of Bank Failure" *Economic Policy Review,* Federal Reserve Bank of New York, issue Jul.

Fethi, M. D. et al 2001. "An Empirical Study of Stochastic DEA and Financial Performance: The Case of the Turkish Commercial Banking Industry", INFORMS International Hawaii Conference, Maui, Hawaii, USA.

Ferrier, G. D. and Lovell C. A. K. 1990. "Measuring Cost Efficiency in Banking: Econometric and Linear Programming Evidence", *Journal of Econometrics,* 46(1).

Gerni, C. et al 2005. "Erken Uyarı Sistemleri Yoluyla Türkiye'deki Ekonomik Krizlerin Analizi", *Ekonometri ve İstatistik*, 2.

Gilbert, R. A. and Wood G. E. 1986. "Coping with Bank Failures: Some Lessons from the United States and the United Kingdom", *Review of Federal Reserve Bank of St. Louis*, 5.

Gilbert, R. A. 1988. "A Re-examination of the History of Bank Failures, Contagion, and Banking Panics", Proceedings of a Conference on Bank Structure and Competition, May 11-13, 1988, Federal Reserve Bank of Chicago.

Gonzalez, J. E. G. and Kiefer N. M. 2006. "Explaining Time To Bank Failure in Colombia During the Financial Crisis of the Late 1990s", URL:http://www.banrep.gov.co/docum/ftp/borra400.pdf (27.06.2007).

Gup, B. E. 1998. *Bank Failures in the Major Trading Countries of the World: Causes and Remedies.* Westport, CT, USA: Greenwood Publishing Group, Incorporated.

Helsen, K. and Schmittlein D.C. 1993. "Analyzing Duration Times in Marketing: Evidence for The Effectiveness of Hazard Rate Models", *Marketing Science,* 12(4).

Heckman, J. and Singer B. 1984. "A method for Minimizing the impact of Distributional Assumptions in Econometric Models for Duration Data", *Econometrica*, 52 (2).

Hutchison, M. and McDill, K. 1999. "Are All Banking Crises Alike? The Japanese Experience in International Comparison", NBER Working Paper, 7253.

Işık, S. et al 2004. "Türkiye Ekonomisinde Finansal Krizler: Bir Faktör Analizi Uygulaması", *D.E.Ü. İ.İ.B.F. Dergisi,* 19(1).

Işık, I. and Hassan K. 2002. "Technical, Scale and Allocative Efficiencies of Turkish Banking Industry", *Journal of Banking and Finance*, 26(4).

Jagtiani, J.A. 2002. **"**The Determinants and Early Detection of Inadequate Capitalization of U.S. Commercial Banks",

URL:http://www.kc.frb.org/Banking/BankingPublications/2002_Kolari_Law_Journal.pdf (27.06.2007).

Jain, D.C. and Vilcassim N.J. 1991. "Investigating Household Purchase Timing Decisions: A Conditional Hazard Function Approach", *Marketing Science,* 10(1).

Kanishi, Y. and Nishiyama K. 2002. "Nonparametrik Test For Translog Specification of Production Function In Japanese Manufacturing Industry", URL:www.iemss.org/iemss2002/proceedings/vol2 html (27.06.2007).

Kasman, A. 2002. "Cost Efficiency, Scale Economies, and Technological Progress in Turkish Banking", *Central Bank Review,* Research and Monetary Policy Department, Central Bank of the Republic of Turkey, 2(1).

Kasman, A. 2005. “Efficiency and Scale Economies in Transition Economies: Evidence from Poland and the Czech Republic”, *Emerging Markets Finance and Trade*, 41(2).

Kaya, Y.T. 2001. “Türk Bankacılık Sektöründe CAMELS Analizi”, Bankacılık Düzenleme ve Denetleme Kurumu MSPD Çalışma Raporları:2001/6.

Kepenek, Y. ve Yentürk Y. 2000. *Türkiye Ekonomisi*. Remzi Kitabevi, İstanbul.

Kiefer, N. M. 1988. “Economic Duration Data and Hazard Functions”, *Journal of Economic Literature*, 26(2).

Konstandina, N. 2006. “Probability of Bank Failure The Russian Case”, Economics Education and Research Consortium Working Paper Series.

Koska, O. 2005. “Financial Liberalization Era in Turkey: Critique on Decree No.32”, Macroeconomics 0506016, EconWPA.

Kolari, J. et al 2000. “Predicting Large U.S. Commercial Bank Failures”, Economic and Policy Analysis Working Paper 2000-1. Office of the Comptroller of the Currency.

Lancaster, T. 1979. "Econometric Methods for the Duration of Unemployment", *Econometrica*, 47(4).

Lane, W.R. et al . 1986. "An Application of the Cox Proportional Hazards Model to the Bank Failure", *Journal and Banking and Finance*, 10(1).

Lanine, G. and Vennet R. V. 2006. "Failure Prediction in the Russian Bank Sector with Logit and Trait Recognition Models", *Expert Systems with Applications* 30(1).

Lee, S. H. and Urrutia J.L. 1996. "Analysis and Prediction of Insolvency in the Property-Liability Insurance Industry: A Comparison of Logit and Hazard Models", *The Journal of Risk and Insurance*, 63(1).

Logan, A. 2001. "The United Kingdom's Small Banks' Crisis of the Early 1990s: What Were the Leading Indicators of Failure?," Bank of England URL:http://www.bankofengland.co.uk/publications/workingpapers/wp139.pdf (27.06.2007).

Mata, J. and Portugal P. 1994. "Life Duration of New Firms", *Journal of Industrial Economics*, 42(3).

Martin, D. 1977. "Early Warning of Bank Failure", *Journal of Banking and Finance,* November 1.

Meyer P.A. and Pifer H.W. 1970. “Prediction of Bank Failures”, *The Journal of Finance*, 25(4).

Molina, C. A. 2002. "Predicting Bank Failures Using a Hazard Model: The Venezuelan Banking Crisis", *Emerging Markets Review,*3(1).

Müslümov, A. 2002. “Mevduat Sigorta Sistemi ve Ahlaki Tehlike: Türk Bankacılık Sektörü Örneği”, *Banka, Mali ve Ekonomik Yorumlar Dergisi,* 39(8).

Newman, J. L. and Mcculloch C. 1984. “A Hazard Rate Approach to the Timing of Births”, *Econometrica,* 52(14).

Nickell, S. J. 1979. “Estimating the Probability of Leaving Unemployment”, *Econometrica,* 47(5).

Özatay, F. 1996. “The Lessons from the 1994 Crisis in Turkey: Public Debt (Mis) Management and Condifence Crisis”, *Yapı Kredi Economic Review*, 7(1).

Özçam, M.1999. "Türk Sermaye Piyasalarının Profili: Kriz Eğilimi Açısından Karşılaştırmalı Bir Değerlendirme", Sermaye Piyasası Kurulu Araştırma Raporu, URL:http://www.spk.gov.tr/yayinlar/ArastirmaRaporlari/1999_MustafaOzcam.pdf (27.06.2007).

Özince, E. 2005. "Türkiye Bankalar Birliği Yönetim Kurulu Başkanı Ersin Özince'nin 48'inci Genel Kurul Toplantısı'nın Açılışında Yaptığı Konuşma", The Banks Association of Turkey's head)'s speech at board meeting Istanbul, May 31, URL: http://www.tbb.org.tr/turkce/genelkurul48/ersinozince.doc (27.06.2007).

Pantolone, C. and Platt M.B. 1987. "Predicting Commercial Bank Failure Since Deregulation", *New England Economic Review,* Federal Reserve Bank of Boston, issue Jul.

Podpiera, A. and Podpiera J. 2005. "Deteriorating Cost Efficiency in Commercial Banks Signals an Increasing Risk of Failure", Working Papers 2005/06, Czech National Bank, Research Department.

URL:http://www.cnb.cz/en/research/research_publications/cnb_wp/download/cnbwp_2005_06.pdf (27.06.2007).

Roussakis, E. N. 1997. *Commercial Banking in an Era of Deregulation,* Westport, CT, USA: Greenwood Publishing Group.

Sahajwala, R. P. and Bergh V.D. 2000. "Supervisory Risk Assessment and Early Warning Systems", BIS Working Papers 4, Bank for International Settlements.

URL: http://www.bis.org/publ/bcbs_wp4.pdf (27.06.2007).

Sales, A.S. and Tannuri-Pianto M.E. 2005. "The Use of Duration Models to Explain Bank Failures in Brazil (1994-1998)",

URL:http://www.econ.fea.usp.br/bacen/2005_2/sales_tannuri_USP.pdf

(27.06.2007).

Santarelli, E. 1997. "Patterns of New Firm Survival and Growth in the Italian Financial Intermediation Industry", Working Papers 278, Dipartimento Scienze Economiche, Università di Bologna.

URL: http://amsacta.cib.unibo.it/archive/00000762/01/278.pdf (27.06.2007).

Shumway, T. 2001. "Forecasting Bankruptcy More Accurately: A Simple Hazard Model", *Journal of Business*, 74(1).

Sider, H. 1985. "Unemployment Duration and Incidence: 1968-82", *American Economic Review,* 75(3).

Soydan, H. 2002. "Bankacılık ve Mali Kurumlar" lecture notes.

Steinherr, A. et al 2004. "The Turkish Banking Sector Challenges and Outlook in Transition to EU Membership", Bruges European Economic Policy Briefings, BEEP briefing no: 9.

Stundenmund, A.H. 2001. *Using Econometrics: A Practical Guide,* Addison Wesley Longman.

Thompson, J.B. 1991. "Predicting Bank Failures in the 1980s", *Federal Reserve Bank of Cleveland Economic Review*, Q1.

Üçer, M. et al 1998. "Leading Indicators of Currency Crises: A Brief Literature Survey and an Application to Turkey", *Yapı Kredi Economic Review*, 9(2).

Ünsal, A. and Güler H. 2005. "Türk Bankacılık Sektörünün Lojistik Regresyon ve Diskriminant Analizi ile İncelenmesi", VII. Ulusal Ekonometri ve İstatistik Sempozyumu Bildirileri Arasında.

URL: http://www.ekonometridernegi.org/bildiriler/o14s2.pdf (27.06.2007).

Uygur, E. 1994. "Türkiye'de Ekonomik Kriz: Oluşumu, Seyri, Geleceği", *İktisat/İşletme ve Finans*, 9.

Whalen, G. 1991. “A Proportional Hazards Model of Bank Failure: An Examination of its Usefulness as an Early Warning Tool”, *Economic Review*, Federal Reserve Bank of Cleveland, 27(1).

Wheelock, D. C. and Wilson P. W. 1994. “Can Deposit Insurance Increase the Risk of Bank Failure? Some Historical Evidence”, Review, Federal Reserve Bank of St. Louis, issue May.

URL:http://research.stlouisfed.org/publications/review/94/05/Deposit_May_Jun1994.pdf (12.05.2007).

Wheelock, D. C. and Wilson P. W. 1995. “Evaluating the Efficiency of Commercial Banks: Does our View of What Banks Do Matter?”, Review, Federal Reserve Bank of St. Louis, issue Jul.

URL:http://research.stlouisfed.org/publications/review/95/07/Evaluating_Jul_Aug1995.pdf (12.05.2007).

Wheelock, D. C. and Wilson P. W. 2000. “Why Do Banks Disappear: The Determinants of U.S. Bank Failures and Acquisitions”, *Review of Economics and Statistics*, 82(1).

Yay, G.G. 2002. "Türkiye ve Meksika'da İstikrar Programlarının Karşılaştırılması:1980–2001", A.A.Dikmen (ed.): Küreselleşme Emek Süreçleri ve Yapısal Uyum (7. Ulusal Sosyal Bilimler Kongresi), Türk Sosyal Bilimler Derneği, Ankara. URL:http://gulsunyay.com/portal/documents/files/meksikatsbd-gyay.pdf (08.07.2007).

Yayla, M. et al.2005. **"**Bankacılık Sektörüne Yabancı Girişi: Küresel Gelişmeler ve Türkiye", Bankacılık Düzenleme ve Denetleme Kurumu ARD Çalışma Raporları No: 2005/6.

Yeldan, E. 1994. "Kamu-Finans Krizinin Ardındaki Etkenlerin Bölüşüm Göstergeleri Açısından İrdelenmesi", *İktisat/İşletme ve Finans*, 9.

Yıldırım, O. 2002. "Türkiye'de Bankacılık Sektörü (Tarihsel Gelişim, Temel Sorunlar, Mali Riskler ve Yeniden Yapılandırma)", URL:http://www.geocities.com/ceteris_tr/o_yildirim.doc (08.07.2007).

Yıldırım, O. 2003. "Türk Bankacılık Sektöründe Yaşanan Finansal Krizler (1980-2002): (Nedenleri, Sonuçları ve Ekonomik Etkileri)", URL:http://paribus.tr.googlepages.com/o_yildirim6.doc (08.07.2007).

Yolalan, R. 1996. "Türk Bankacılık Sektörü için Göreli Mali Performans Ölçümü", *Turkiye Bankalar Birligi Bankacilar Dergisi* 19.

Zaim, O. 1995. “The Effect of Financial Liberalisation on the Efficiency of Turkish Commercial Banks”, *Applied Financial Economics,* 5.

APPENDIX

Table 1: List of Banks

Bank Ekspress (12/12/1998)	Türkiye Garanti Bank
Demirbank (6/12/2000)	Habib Bank Limited
Egebank (22/12/1999)	Türkiye Halk Bank
Eskişehir Bank (22/12/ 1999)	HSBC (Midland)
Etibank (27/10/2000)	İktisat Bank
Interbank (7/6/1999)	Türkiye İmar Bank
Bank Kapital Türk (27/10/2000)	Türkiye İş Bank
Sümerbank (22/11/1999)	Kentbank
Türk Ticaret Bank (6/11/1997)	Koçbank
Yasar(Tütüncüler) Bank (22/11/1999)	Birleşik Türk Körfez
Yurt Ticaret ve Kredi (22/11/1999)	M.N.G. (Garanti Yatırım Tic)Bank
Abn Amro Bank N.V.	Osmanlı Bank
Adabank	Oyak Bank
Akbank	Pamukbank
Alternatif Bank	Şekerbank
Arap Türk Bank	Sitebank
Bayındırbank (derbank)	Société Générale (SA)
Banca di Roma S.P.A.	Milli Aydın Bank
Bank Mellat	Tekstil Bank
Bnp-Ak Dresdner Bank	Toprakbank
The Chase Manhattan	Türk Sakura Bank
Citibank	Turkish Bank
Credit Lyonnais Turkey	Ulusal Bank
Türk Dış Ticaret Bank	Türkiye Vakıflar Bank
Türk Ekonomi Bank	Westdeutsche Landesbank
Türkiye Emlak Bank	Yapı ve Kredi Bank
Finans Bank	Türkiye Ziraat Bank

Notes: The dates in parentheses denote the failure date.