Essays on Bank Networks and the Turkish Banking Crisis

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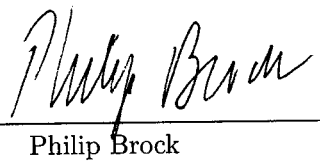

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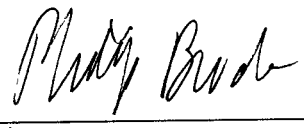

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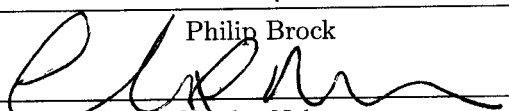

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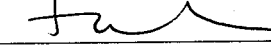

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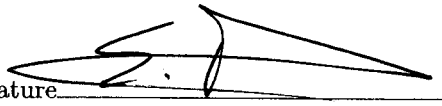
Signature 

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Abstract

Essays on Bank Networks and the Turkish Banking Crisis

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This series of essays examines the role of bank networks before, during and after the Turkish Banking Crisis of 1999-2001. The analysis focuses on different aspects of bank interaction, such as payment and settlement systems, mergers and acquisitions and technology sharing. After a short introduction of the roots and causes of the crisis, the first essay investigates whether banks have been able to realize cost savings during and after the crisis through sharing their ATM networks with each other. The second essay suggests that network effects arising from the high level of interaction between banks may have played an important role in allowing unsound banking practices to flourish before the crisis. Finally, the third essay looks at the consolidation wave that has followed the crisis and argues that mergers and acquisitions have allowed banks to increase their competitiveness while reducing their excess capacity. Overall, these results provide insights into the complicated interactions between banks and dynamics of distress in the banking sector. Some of the insights gained through these essays are crucial in understanding micro-foundations of banking crises and effectiveness of policy responses.

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I wish to express my most sincere appreciation to my friends and family for their endless encouragement and support. None of this work would have been possible without the advice and endless patience of my colleagues and instructors at the Department of Economics.

DEDICATION

To my parents.

Chapter 1

THE TURKISH BANKING SECTOR IN THE 1980S, 1990S AND BEYOND

1.1 Introduction

For the Turkish banking sector, mid-1999 to late-2001 was a confusing period, with intermittent bank failures and a major currency crisis taking place while a significant restructuring program was being implemented. Although Turkey had experienced three previous crises during the 1980s and 1990s, the experience of 1999-2001 was unique, as banking sector distress was spread out over an uncharacteristically long period.[1]

Due to the long period of distress, some studies (such as Soral, İşcan and Hebb, 2003) have argued that Turkey has had two separate banking crises during this period, one in December 1999 and one in July 2001. However, an analysis of the timing of bank nationalizations during this period and the measures taken at each step suggest that the banking sector has experienced a single crisis between December 1999 and July 2001. As seen in Table 1.1 this period has been marked by a string of bank failures, which seem to connect the two big waves of nationalizations that took place in December 1999 and July 2001.

The goal of this study is to present a compact but complete analysis of Turkish banking crisis of 1999-2001. Such an overview is essential in understanding the issues examined in the following three essays, which are focused on how the bank networks could have contributed to the crisis (Chapter 3) and how the interactions between banks seem to be eliminating some inefficiencies in the banking sector (Chapter 4), while potentially causing

[1] A "banking crisis" is defined as an episode in which significant segments of the banking sector become insolvent, illiquid and large-scale nationalizations take place. This definition is based on Beck, Demirgüç-Kunt and Levine (2003), who have a somewhat larger set of events that constitute a banking crisis. Based on their definition, Beck *et al.* determine that Turkey has experienced banking crises in 1982, 1991, 1994.

Table 1.1: Bank failures (and nationalizations) between December 1999 and July 2001. The figures refer to deposit collecting institutions only.

Date	# of bank failures
Dec. 1999	6
Oct. 2000	2
Dec. 2000	1
Feb. 2001	1
Mar. 2001	1
Jul. 2001	5

new problems to emerge through an increase in unproductive, excess capacity (Chapter 2).

The rest of the chapter is structured as follows. Section 1.2 analyzes the roots of the crisis that lie in the financial liberalization of the 1980s and presents an overview of the profitability and the operational structure of the banking sector in the 1990s. Section 1.3 describes the crisis and its aftermath. Section 1.4 concludes.

1.2 The 1980s and the 1990s: Roots of the Crisis

1.2.1 Liberalization and the Banks' Initial Response: 1980-1993

Prior to 1980, the Turkish banking sector was highly repressed and tightly regulated. There were ceilings on deposit and lending rates, restricted entry and high reserve requirements (Akyüz, 1990). Out of the 40 deposit collecting institutions, 12 were state owned and 4 were foreign banks. According to Atiyas (1990), the system was highly concentrated, with the largest four banks holding 58% of total assets and 56% of total deposits. The restrictions on deposit rates have resulted in banks competing for deposits by establishing large branch networks, which had resulted in excessive numbers of branches and personnel (Zaim, 1995).

The goals of the financial liberalization program in Turkey, which was launched in July 1980, were to create a market-based system and to increase efficiency in the banking sector. This program eliminated interest rate controls, permitted new entry and allowed banks to

issue certificates of deposits (CDs). This initial wave of liberalization was followed by the establishment of an interbank money market and the re-establishment of the İstanbul Stock Exchange (İSE) in 1986.

The banks' behavior during the initial phases of the liberalization (1980-1993) can be summarized as a cautious shift towards increased competition in interest rates and away from competition in branches. The initial announcement of the liberalization program was followed by a period of intense competition in interest rates, where banks used brokerage houses to market CDs to the public at high interest rates. Atiyas (1990) argues that the driving force behind the increased rates were smaller banks, who were resisting attempts by the big banks to form a cartel and set interest rates at low levels. In mid-1982, the pressure from the big banks and the government forced the small banks to stop the flow of CDs and the system collapsed. Five banks, along with many brokerage houses were liquidated.

It appears that the crisis of 1982 made the major banks in Turkey cautious about competing in interest rates. In the high inflationary environment of the 1980s, the Central Bank of the Republic of Turkey (CBRT) had to intervene and increase deposit rates three times. This was done in order to push real interest rates to positive levels and prevent larger banks unduly keeping interest rates low (Denizer, Gültekin and Gültekin, 2000). As there was limited competition in interest rates, the banks either maintained or expanded their branch networks and employees in an effort to stay competitive. It wasn't until the late 1980s when banks started cutting costs by eliminating excess branches and personnel. This pattern of downsizing between 1985 and 1993 can be seen in Table 1.2.

There were many different reasons for the reduction in excess capacity between 1985-1993. Undoubtedly, the most important cause was the change in the business strategy of banks and a move away from traditional banking activities. In an environment of high inflation and growing budget deficits, the Turkish government was increasingly forced to rely on issuing government securities at high interest rates. As the capital account was liberalized in the mid-1980s, Turkish banks found it increasingly profitable to borrow foreign currency denominated funds from abroad and lend them to the Turkish government at high rates. The resulting high net interest margins (also known as NIMs) made traditional banking activities such as loans to the real sector appear less profitable. Furthermore, as access to

Table 1.2: Number of banks, branches and employees in the Turkish banking sector, along with average number of branches and employees for select years between 1980 and 2003. All figures refer to deposit collecting institutions only.

		Total Number		Average per bank	
Year	# of Banks	Branches	Employees	Branches	Employees
1980	40	5,948	124,918	149	3,123
1982	45	6,347	130,966	141	2,900
1985	47	6,292	137,752	133	2,930
1988	52	6,516	149,264	128	2,870
1991	55	6,460	150,780	117	2,741
1993	58	6,208	142,449	109	2,456
1994	55	6,085	136,879	111	2,489
1996	56	6,419	142,046	115	2,537
1998	57	7,002	154,630	123	2,713
1999	54	6,946	152,578	129	2,826
2000	50	6,734	144,950	135	2,899
2001	40	6,481	125,883	162	3,147
2002	38	5,884	112,443	155	2,959
2003	34	5,774	114,089	170	3,356

Source: Banks Association of Turkey (BAT).

foreign borrowing increased, banks found it unnecessary to maintain large and costly branch networks to collect deposits (Isik and Hassan, 2003).

Another reason for the reduction in excess capacity was the uncharacteristically efficient management of the state banks between 1983-1993. Isik and Hassan (2002) argue that the executives brought in by the government during this period have managed the state banks like private banks and have increased their efficiency through downsizing. This was a likely contributor to the elimination of excess capacity between 1985-1993. Finally, the end of CBRT interventions in the deposit rates during the late 1980s made interest rate competition more feasible, decreasing the need for maintaining large branch networks in order to attract more deposits. It appears that by 1993 Turkish banks had adapted to the new environment created both by financial liberalization and high inflation.

Another impact of the liberalization program during the 1980s was increased entry. Between 1980-1993, the number of foreign banks in Turkey increased from 4 to 20. Similarly, the number of private banks went up from 24 to 32. However, some of these new banks were to fare quite badly during the crises of 1994 and 1999-2001.

1.2.2 The Crisis of 1994 and Its Aftermath: 1994-1999

By all accounts, the crisis of 1994 was the result of serious policy mistakes by the Turkish authorities. According to Isik and Hassan (2003), the budget deficit and internal debt stock had become uncontrollable by the end of 1993. At this point, the Turkish government decided to monetize the debt, cut interest rates on government securities and therefore reduce the cost of the internal debt stock. The Treasury, eager to decrease the interest rates as quickly as possible, cancelled a series of auctions. This action in turn triggered a speculative attack on the currency, as agents realized the strategy of the Treasury and demand for foreign currency denominated assets went up. As a result, the credit rating of Turkey was reduced in early 1994. A massive devaluation of the Turkish Lira (TL) and significant increases in interest rates soon followed.

As mentioned above, by this time most Turkish banks were heavily engaged in borrowing from abroad and investing in TL denominated government securities. The devaluation of the

currency left banks with large open positions, as their TL denominated assets were worth much less than their foreign currency denominated liabilities. Many banks tried to cover this shortfall by borrowing from abroad. However, the downgrading of the Turkish credit rating and general unease about the economic situation prevented banks from acquiring such funds. By the summer of 1994, three banks were liquidated and the rest of the banks were forced to reevaluate their portfolios.

The impact of the 1994 crisis (which was the most severe crisis of the country's 71 year history) was significant and as it caused banks to change their business strategies. It is clear that Turkish banks (both foreign and domestic) have stopped eliminating their branches and employees after the crisis. Isik and Hassan (2003) argue that the end of the downsizing in the sector was directly tied to the reduced access to foreign borrowing. As the crisis resulted in a lower Turkish credit rating and a general pessimism about the economy, many small banks found it difficult to raise funds abroad. As a result, they were forced to increase their branch networks in order to collect more deposits. Table 1.3 shows the increased importance of deposits for Turkish banks after the crisis. Although the availability of purchased funds seem to have increased after 1997, collection of deposits remained as an important aspect of private banks' activities.

The trend towards branch network expansion can be seen in Table 1.4. Between 1994 and 1999, branch networks of smaller private banks (less than 100 branches in 1994) more than doubled, whereas larger banks opened new branches at a much slower pace. This build-up of additional capacity would prove to be instrumental in the crisis of 1999-2001.

The other major impact of the crisis was the introduction of full deposit insurance by the government during 1994. Limited deposit insurance had first been implemented in 1983, but faced with the flight of capital during the crisis, complete insurance of savings accounts (both foreign currency and TL) was introduced in 1994. Although the premiums of banks were also increased at this time, many studies have argued that the presence of full deposit insurance has resulted in moral hazard problems in the sector.

Along with full deposit insurance, the government's unwillingness to allow exit from the sector also caused moral hazard problems. As Soral *et al.* (2003) point out, between 1985 and 1999, 15 banks were placed on the Treasury's surveillance list for poor financial status.

Table 1.3: Liability composition of Turkish banks as a percentage of all liabilities, for the period 1993-1999. All figures refer to deposit collecting institutions only.[a]

	State Banks		Private Banks		Foreign Banks	
Year	Deposits	Purchased Funds	Deposits	Purchased Funds	Deposits	Purchased Funds
1993	61.4%	18.6%	54.6%	25.0%	21.9%	40.0%
1994	69.9%	14.1%	69.6%	9.5%	40.0%	22.4%
1995	74.6%	10.5%	67.4%	9.3%	61.0%	9.3%
1996	79.0%	8.1%	69.5%	12.2%	58.5%	13.3%
1997	74.7%	8.4%	66.3%	15.8%	47.0%	30.4%
1998	76.4%	8.9%	66.5%	14.2%	40.2%	33.1%
1999	76.3%	9.0%	69.8%	15.9%	34.8%	42.7%

[a] "Deposits" refer to all TL and foreign currency denominated demand and time deposits. Purchased funds refer to funds borrowed from the interbank market, the Central Bank, domestic and foreign banks, and funds raised issuing securities.

Source: Banks Association of Turkey (BAT).

Table 1.4: Developments in the branch networks of Turkish banks between 1994 and 1999. All figures refer to deposit collecting institutions only.

	# of banks	Change in branches	Growth Rate
State Banks[b]	4	129	4.71%
Large Private Banks[a,b]	9	304	10.99%
Small Private Banks[b]	27	1500	223.39%
Foreign Banks	14	116	31.40%

[a] Private banks that had more than 100 branches at 1994.

[b] In 1994, there were 6 state banks but 2 were privatized between 1994 and 1999. One of these banks has been counted in the Large Private Banks category and the other has been included in the Small Private Banks category.

Source: Banks Association of Turkey (BAT).

The average period of a bank being on this list was nine years, as the government was worried about consequences of closing these banks. As a matter of fact, none of these banks were liquidated until late 1999. As banks became aware of the government's unwillingness to close weak banks, sound banking practices were increasingly abandoned and many banks' conditions started to deteriorate around 1997.

The increased weakness in the banking sector was due to the flawed business strategies followed by many of the (mostly smaller) banks. Even after the crisis of 1994, these banks continued to abandon traditional banking activities in favor of using their funds to purchase government securities. Although the government had announced an IMF backed stabilization plan after the crisis, this plan was quickly abandoned, and Turkey entered into what has sometimes been called a period of "stop-go stabilization policies." Although the fiscal situation improved between 1994-1999, the lack of a credible program increased the perception of risk. In order to increase exports, the CBRT pursued a policy of stabilizing the real exchange rate. Combined with the budget deficit, this policy resulted in high inflation and high interest rates (Akyüz and Boratav, 2003). Therefore, the banks were once again tempted to collect domestic deposits, borrow from abroad and use these funds to purchase Treasury securities. As Denizer *et al.* (2000) wrote: "By the end of the 1990s, the sole function of the financial system in Turkey was nearly reduced to transferring funds from the domestic and international markets to the Treasury."

The problems of the banking sector did not stop with the reliance on government securities. The loan portfolios of banks also deteriorated during this period. During the 1990s, most of the new domestic entry into the banking sector was from large industrial conglomerates founding their own banks. There is evidence suggesting that some of these industrial groups were granted banking licenses due to their political connections.[2] Founding their own banks were attractive to these conglomerates, as the poor regulatory structure allowed for large amounts of lending to in-group companies. Although most of these companies were well-established enough to have access to equity markets, connected lending from an

[2]One of the banks that failed in the December 1999 was owned by the nephew of Süleyman Demirel, who was the president of Turkey between 1993 and 2000. The owner of another conglomerate, whose bank failed in late 1999 was a minister in the early 1990s.

Table 1.5: Role of securities and non-performing loans in the portfolio composition of Turkish Banks 1995-1999. All figures refer to deposit collecting institutions only.

	State Banks		Private Banks		Foreign Banks	
Year	Sec/Assets[a]	NPL/Loans[a]	Sec/Assets	NPL/Loans	Sec/Assets	NPL/Loans
1995	10.3%	3.0%	11.6%	1.8%	12.8%	3.1%
1996	16.7%	2.8%	14.9%	1.6%	23.8%	2.5%
1997	11.0%	2.8%	15.2%	2.0%	16.6%	1.3%
1998	10.7%	5.6%	16.5%	9.0%	23.2%	1.3%
1999	10.7%	10.0%	21.0%	13.0%	31.4%	2.7%

[a] "Sec/Assets" refer the ratio of all treasury bills, government and other securities to total assets. "NPL/Loans" refer to the ratio of non-performing loans to total loans.
Source: Banks Association of Turkey (BAT).

in-group bank provided cheaper and easier access to credit (Denizer, *et al.*, 2000).

The banking sector was also plagued by an increasing level of illegal activity during this period. These activities included, among many others, funds transferred to bank owners/executives though fictional loans or shell companies and falsifying equity capital. In an interesting study of the books belonging to a bank that failed in 1999, Soral *et al.* (2003) find evidence of what has been referred to as "looting."[3] The extent of illegal activity also appears to be large. In the bank studied by Soral *et al.*, illegally made loans accounted for about 32% of all loans. As a result of such activities, the weight of non-performing loans on banks' portfolios significantly increased during the late 1990s.

Table 1.5 below provide evidence in support of both increased weight placed on the purchase of securities by banks and the proliferation of non-performing loans due to moral hazard problems and illegal activities. The ratio of securities to total assets has risen steadily between the 1995 and the beginning of the 1999-2001 crisis. Similarly, there has been a marked increase in non-performing loans of domestic banks, especially after 1997.

[3] The term has its origins in Akerlof and Romer (1993), who define looting as a situation where the owners of a firm can extract personal gains from going bankrupt at the society's expense.

1.2.3 Summary

During the 1980s and 1990s, the Turkish banking sector went through a drastic change. In certain aspects, such as increased competition in the sector, the liberalization program was a success. The number of state banks declined from 12 in 1980 to 4 in 1999. Similarly, the share of the largest 4 banks in total assets of the banking sector fell from 58% to 44%. The total number of depository institutions increased from 40 to 54 and there was significant foreign entry into the sector (15 net entries). Therefore, it could be argued that the liberalization program achieved its goals of creating a competitive sector, compatible with international markets.

On the other hand, a closer inspection reveals that the Turkish banking sector also developed significant weaknesses during this period. As far as the capacity (number of branches and employees) of banks is concerned, the sector came full circle between 1980 and 1999. The words "overbranched" and "overstaffed" were used to describe the banking sector both in the late 1970s and late 1990s.[4] The increase in the average branch network size of banks were also documented in Table 1.2.

Perhaps the most damaging development of the 1990s was the abandonment of traditional banking activities, such as making loans to the real sector, in favor of investing in government securities. Banks became increasing reliant on collecting foreign currency denominated domestic deposits and lending these funds to the government at TL denominated debt. This strategy resulted in banks becoming increasingly dependent on interest rates remaining high and the TL not getting devalued. In a sense, the banks became dependent on the continuation of the high inflation, high budget deficit situation in Turkey. As seen below, the implementation of disinflation program in 1999 was to cause great distress for banks.

Similar to their securities portfolio, the loan quality of banks also suffered during the mid- to late-1990s. The widespread increase in excessive risk taking, connected lending and illegal activities were discussed above. Furthermore, performance of state banks deteriorated

[4]Zaim (1995) has argued that there was excessive branches and personnel before the liberalization. Similarly, Akçay (2001) makes the observation that by 1999, the Turkish banking sector was "overbanked, overbranched and hence overstaffed."

after the 1994 crisis as well. The professional and competent managers brought in during the 1980s were forced out and the state banks started to incur significant losses associated with subsidized lending. These so-called "duty losses" seriously undermined the quality of the state bank loan portfolios (Isik and Hassan, 2002).

The overall performance and profitability of the banking sector in the 1990s has been an issue of debate in the literature. Based on the high net interest margins (NIM) of Turkish banks during the 1990s, the IMF cited Turkey as having the most profitable banking sector in the OECD.[5] Denizer *et al.* (2000) also argue that based on bank profit measures such as return on assets (ROA) and return on equity (ROE), Turkish banks were very profitable throughout the 1980s and the 1990s. However, they do acknowledge that the lax accounting regulations in Turkey that were in place during this period could have resulted in unrealistically high ROA and ROE figures.

On the other side of the argument, a number of studies have found that bank performance steadily decreased during the 1990s. Akçay (2001) argues that the limited entry of foreign banks during the 1995-1999 period (a net entry of one) suggests that the sector was not as profitable as previously thought. Using input-output efficiency measurement techniques, Zaim (1995) argues that efficiency of Turkish banks went up during the 1980s. However, it appears that most of these gains in efficiency and profitability were reversed during the 1990s. Yildirim (2002) finds no efficiency gains between 1988-1999 and argues that the sector suffered from excess branches and personnel. These findings are echoed by Isik and Hassan (2002), who find that bank efficiency declined during 1988-1996.

Based on these observations, it can be argued that the banking sector was very fragile in early-1999. Banks were too dependent on their government securities portfolios for profits and their over-extended branch networks for the foreign currency deposits being lent to the government. In that sense, the sector had come back to where it was in 1979: over-branched, overly dependent on deposits and without a diversified, market driven portfolio. Although some aspects of the liberalization of the 1980s was a success, the program had failed in its main goal of developing a market driven, cost efficient and competitive banking sector. The

[5]NIM represents net interest income scaled by total assets. The IMF's assessment of Turkish banks' profitability can be found in the IMF Staff Country Report (2000).

consequences of this failure were to be seen during the crisis.

1.3 Crisis and Restructuring: 1999-2001

1.3.1 The Initial Stages: January 1999-February 2001

Although many studies have determined December 1999 as the start of the Turkish banking crisis, the first signs of distress in the sector came between January 1998 and January 1999. During this period, the State Deposit Insurance Fund (SDIF) took over two insolvent banks, using the authority given to it in 1994 when full deposit insurance was introduced. The bigger of these two, Interbank, was found to have made a significant amount of its loans to affiliated companies. The other bank (Bank Ekspres) experienced a run on its deposits and found itself incapable of raising funds to meet its obligations.[6] The impact of these events were fairly limited and the take over of these banks did not trigger any new policies towards the regulation of the banking sector.

By December 1999, the Turkish government had decided to embark on an IMF supported disinflation program and took action on five insolvent banks. Denizer *et al.* (2000) report that the government overcame its unwillingness to intervene in these banks only after significant IMF pressure. Although the takeovers were greeted with some reaction, their full effect was not felt until the fall of 2000.

The main feature of the disinflation program was a crawling peg, where the TL was pegged to a basket consisting of the dollar and the euro. The inflation goals were tied to the preannounced value of the basket, which was to gradually increase until mid-2001. At this point, the peg was to be abandoned in favor of a gradually widening exchange rate band, completing the transition to a float. As discussed by Akyüz and Boratav (2003), the program was very successful during its initial stages. There was considerable improvement in the fiscal situation and interest rates fell at a rate much faster than anticipated. However, inflation did not fall as quickly, which reduced confidence in the program. With lower confidence in the economy and falling interest rates, banks found it harder to borrow funds from abroad.

[6]The details of the Bank Ekspres takeover has been provided in Banking Regulation and Supervision Agency (BRSA) press release, June 2003. Available at www.bddk.org.tr.

This problem was compounded in October, when it became public that some of the banks that were nationalized in the past two years were being criminally investigated. During late October two more banks were taken over by the SDIF, causing more speculation on the health of the banking sector. Finally, problems with the privatization of key industries caused the IMF to postpone a scheduled transfer of funds. All these factors caused an outflow of capital which resulted in a sharp increase in the overnight interest rates.

The result of this series of events was the collapse of Demirbank, which had invested heavily in government securities with the expectation that interest rates were going to continue their descent. As the interest rates shot up, the value of Demirbank's securities portfolio fell and the bank found it impossible to raise funds in the interbank market. With foreign investors staying away, the bank collapsed, forcing the SDIF to take it over. At the time of its takeover, Demirbank was the ninth largest bank in Turkey and its insolvency had a significantly negative effect on the foreign investors' confidence in the Turkish economy and the disinflation program. However, it should also be noted that unlike most of the other banks that failed during the crisis, the extent of excessively risky or illegal activity seems to be very limited in Demirbank. Its failure seems to be almost completely a result of the capital flight and the lack of liquidity in the markets.

The government's response to the events of November-December 2000 was the initiation of a comprehensive "Banking Sector Restructuring and Rehabilitation Program." The main features of this program were recapitalization of weak banks, elimination of open foreign exchange positions, mergers and acquisitions between banks and operational restructuring of state banks.[7] However, as Akyüz and Boratav (2003) point out, these goals were difficult to achieve because the restructuring of banks was taking place in the middle of a crisis.

By the middle of December 2000, the announcement of a new financial package from the IMF had stopped the flight of capital and a resemblance of stability had returned. However, there was no more confidence left in the disinflation program and uncertainty about the economy continued. Finally, an argument between the President and the Prime Minister on February 19 caused a massive outflow of funds, causing another liquidity crunch.

[7]The details of the program can be found in "Towards a Sound Banking Sector." Available at www.bddk.org.tr.

By late February, overnight interest rates have reached 5,000% and the CBRT had no choice but to abandon the peg. The currency lost a third of its value within a day.

The resulting financial turmoil resulted in the failure of two more banks, one in late February and on in early March. Both banks had large foreign currency denominated debt and TL denominated assets. With the devaluation of the currency, their situation became untenable and a takeover became inevitable. Furthermore, one of these banks was determined to have transferred funds in excess of legal limits to its shareholders.

1.3.2 The Clean-Up: March - December 2001

The effects of the February crisis was felt until May 2001, when a new agreement was reached with the IMF. The transfer of new IMF credits stabilized the economy and inflation targets were revised upward. According to Akyüz and Boratav (2003), the economy started to grow during the summer and the fiscal situation improved. This allowed the government to recapitalize the state banks and stem their large losses.

On the other hand, the newly reconstituted Banking Regulatory and Supervisory Agency (BRSA) continued on with the restructuring of private and nationalized banks. The first step of the program was taken immediately before the February crisis, when five such banks were merged into one and put on sale. This was followed by the merger of another three failed banks in June. This newly merged bank and Demirbank (which had failed in December 2000) were also put on sale. Finally, one of the banks that had failed in 1999 was sold to an investment bank. Also, two of the smaller banks that belonged to the same group decided to merge, fulfilling another goal of the program.

Problems in the banking sector also continued during this period. The final stage of the crisis took place on July 10, when the SDIF took over five private depository institutions and the BRSA liquidated two investment banks. These banks had failed in closing their open positions and reducing their exposure to exchange rate risk. It appears that the government was worried about these banks eroding confidence in the new IMF agreement. Furthermore, three of these banks could not be saved because their "resources have been directly or indirectly used in favor of partners that controlled the management and supervision of the

bank, thus endangering the safety of the operations carried out by the bank."[8]

Although there were few more bank failures after July 2001, this point can be considered the end of the Turkish Banking Crisis. During the rest of the year, some of the banks under SDIF supervision were sold and others were put into a liquidation process. Two state banks were also merged with each other, in an attempt to get rid of some of the excess branches and employees. Finally, the BRSA started to arrange an asset sale to eliminate some of the non-performing loans under its supervision.

Overall, the cost of the crisis was high. A total of 20 banks were closed, either through liquidations or mergers. Almost 36,000 bank employees were laid off (out of 174,000) and the initial losses of the failed banks were estimated at $6.2 billion. Between December 1999 and April 2003, the SDIF spent another $21.4 billion in an attempt to recapitalize these banks and make them attractive acquisition targets. Despite these efforts not all of these banks were sold and had to be liquidated. The Turkish Treasury spent $6.8 billion in eliminating short-term foreign currency positions of banks and another $2.4 billion were spent on recapitalizing private banks through voluntary debt swaps. The strain placed on the Turkish economy was significant and there has been great public pressure on the government to avoid a repeat, especially the widespread illegal activities.[9] This pressure was a possible contributor to the design and efficient implementation of the restructuring program, including charges being brought against many bank owners and managers.

1.4 Conclusion

The state of the Turkish economy after the February 2001 currency crisis has sometimes been referred to as "standing still and moving forward" (Akyüz and Boratav, 2003). This term is used within the context of some problems being fixed, whereas others not receiving the attention they deserve. The post-crisis situation of the banking sector also fits this characterization, in the sense that certain weaknesses seem to remain despite the restructuring

[8]BRSA Press Release, July 10, 2001. Available at www.bddk.org.tr.

[9]There have been many books and countless press articles written on the "looting" of banks during the late 1990s. This public outrage was compounded by the fact that most of the owners of looted banks were prominent political figures.

program. As shown in Chapter 2, the efficiency of smaller banks remain low and they seem to suffer from excess capacity. The continued investment in Automated Teller Machines (ATMs) has contributed to this new phase in the build up of excess capacity. Furthermore, bank failures related to illegal activities have continued, albeit at a lower rate, as evidenced by the failure of two banks in the summer of 2003.

However, there have also been encouraging signs coming from the banking sector. As discussed in Chapter 4, the consolidation wave following the crisis has allowed the banking sector to move into new, under-banked markets and hence allocate its resources more efficiently. Similarly, there have been signs of banks finally moving away from the their business strategy of relying heavily on buying government securities and earning high net interest margins. With the fall in inflation and improved fiscal situation, borrowing from abroad and lending to the government has become less profitable, forcing banks to return to more traditional activities.

In conclusion, although stability seems have returned since the crisis of December 1999-July 2001, the history of the Turkish banking sector sounds a note of caution. Since the liberalization of 1980, the sector has been incapable of resisting the temptation of earning their profits through lending to the government. Similarly, despite going through cycles of growth and downsizing, Turkish banks have also been susceptible to creating excess capacity in an attempt to collect more deposits. Whether this current spell of stability is transitory or permanent remains to be seen.

Chapter 2

THE EFFECTS OF SHARED ATM NETWORKS ON THE EFFICIENCY OF TURKISH BANKS

2.1 Introduction

Since their introduction in 1969, the use of Automated Teller Machines (ATMs) has increased drastically, first in developed countries in the 1970s and 1980s, and followed by developing economies in the 1990s. ATMs were first seen as a way of replacing branches and tellers with a cheaper alternative and making banking services more attractive to customers by offering 24 hour access to their accounts. Therefore, the first ATM networks were proprietary networks of single banks, accessible only by a single bank's customers.

However, starting in the mid-1970s, U.S. banks realized that the services offered by their ATMs could be made cheaper and more attractive to depositors if they shared their ATM networks with each other (McAndrews, 1991). Due to the relatively large geographic area of the U.S., the shared ATM networks of U.S. banks started as regional networks which became national networks only in the 1980s. A similar pattern of ATM sharing took place in European countries such as Germany.

The literature on ATM sharing and bank competition has shown that there are two opposing effects associated with shared ATM networks. The positive effects associated with shared ATM networks have been discussed at length by Prager (1999), who argues that there are two factors that motivate the sharing of ATM networks between banks: network effects and economies of scale.[1] Network effects suggest that the value customers attach to ATM services offered by a bank goes up as the size of the ATM network increases. In other words, the addition of a new bank or a new ATM to the network increases the attractiveness

[1] Prager also looks at links between ATM sharing and increased market power, but as the market structure of Turkey is significantly different than the U.S., this link will not be examined in this study.

of all banks within the network to their customers.

Economies of scale implies that the cost per transaction at an ATM inversely related to the number of transactions. Each ATM has a variable cost and a fixed cost associated with it. The variable costs are incurred mostly by supplies (film, paper, etc.) and they are directly proportional to the number of transactions conducted at the particular ATM. The fixed costs include the cost of information systems, the cost of purchasing or leasing the ATMs, along with service and marketing costs (Saloner and Shepard, 1995). The average fixed cost declines as the number of transactions at the ATM location increases. Therefore, it is possible that an ATM that is too costly to operate under a proprietary network can be profitable under a shared network if ATM sharing increases the number of transactions by a sufficient amount.

On the other hand, the presence of shared-ATM networks can also have a negative impact on participating banks. This effect arises because ATM sharing reduces the level of product differentiation between banks and allows depositors to switch banks without incurring high costs. For example, an ATM sharing arrangement between a very small bank and a very large bank can result in the large bank not being able to differentiate itself as the bank with better access, because the consumers of the small bank can now also use the ATMs of the large bank. As the amount of differentiation between banks decrease, the depositors of the big bank can switch to the small bank in order to enjoy higher rates and still be able to access their accounts at various locations. In their study of compatibility of ATM networks, Matutes and Padilla (1994) refer to this as the "substitution effect" and show that its presence can be an impediment to achieving full ATM compatibility within the banking sector.

In simple terms, whether a bank can benefit from a shared-ATM network will depend on which one of the effects described above dominates. If the network and economies of scale effects dominate, then the bank will be able to offer a more convenient product, collect more deposits and potentially increase profits. On the other hand, if the substitution effect dominates, then making an ATM sharing arrangement will result in a loss of depositors and profits.

This problem can easily be framed within the concept of "productive efficiency" of banks.

The productive efficiency of a firm is defined as the ratio of its outputs to its inputs. If it is assumed that the bank is a productive unit that uses inputs such as ATMs, branches, deposit rates etc., in the "production" of deposits, then sharing ATMs can influence the input-output levels and change the bank's productive efficiency.

For example, if the network and scale effects dominate the substitution effect, this would suggest that sharing its ATMs will enable the bank to offer a more attractive product to its depositors. Therefore, the depositors would be willing to accept a lower interest rate because of the higher utility they derive from having increased access to their accounts.[2] In this case, the bank will be able to collect more deposits (i.e. produce more "output") without changing its inputs. This would increase the productive efficiency of the bank.

On the other hand, if the substitution effect dominates, then the bank could be losing some of its ability to differentiate itself, resulting in a loss of depositors. In this case, the bank would have to make its product more attractive by increasing one or more of its inputs, in an effort to win back some of its depositors. As a result the bank may end up collecting less deposits, while using more inputs and its productive efficiency may decrease.

The main goal of this essay is to define an input-output structure for Turkish banks in a way that would account for the effects of shared ATM networks and subsequently to compute their productive efficiencies. If certain patterns can be found between the productive efficiencies of banks and the characteristics of shared ATM network structures, then it would be possible to draw conclusions on what kind of banks benefit from sharing their ATMs and which banks suffer from imperfect ATM sharing decisions.

In analyzing the ex-post effects of shared network formation in terms of productive efficiency, this study deviates significantly from the existing literature that concentrates on the presence of network externalities in the *adoption* of new technology by banks.[3] The

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[2]The substitutability of interest rates on deposit accounts for extended branch or ATM networks is well documented in the literature. See Neuberger and Zimmerman (1990) for an example.

[3]There are many studies that have looked at the presence of network externalities in the adoption of financial technology. Saloner and Shepard (1995) and Kaufman, McAndrews and Wang (2000) find significant network externalities in ATM networks. Gowrisankaran and Stavins (2002) find moderately large network externalities in the adoption of the Automated Clearinghouse (ACH) electronic payment systems, whereas Stavins (2003) fails to find any network externalities in the adoption of electronic check payment services.

purpose of this study is not to investigate whether there are network externalities that result in the under or over usage of ATM technology among Turkish banks. Rather, the goal is to see whether the banks have been able to realize the network and scale effects that may have prompted them to adopt ATM technology and then link their ATMs with other banks in the first place. As seen below, the findings of this study have implications concerning how ATM sharing can result overcapacity in the banking sector and how shared network structures can be changed in order to eliminate this overcapacity.

The rest of this chapter is structured as follows: Section 2.2 describes the Turkish Banking Sector and the evolution of shared ATM networks in Turkey. Section 2.3 introduces the Data Envelopment Analysis (DEA) method that was used in calculating the efficiencies of the banks in the sample, followed by a survey of studies on the efficiency of Turkish Banks. Section 2.4 describes the method, the data and the results. Section 2.5 discusses an alternative specification of the model and possible extensions. Section 2.6 concludes.

2.2 Evolution of Shared ATM Networks in Turkey

ATM technology was introduced in Turkey in 1988, starting with one bank and followed by a rapid adoption of ATMs after 1990. Due to increased competition between banks for deposits, there was a widespread increase in the deployment of ATMs, with nearly 5,000 ATM locations by the end of 1995 and passing 10,000 by the end of 1999 (Isik and Hassan, 2002). By this date 27 out of 62 deposit collecting institutions had adopted ATM technology and another 7 had issued ATM cards to be used in other banks' ATMs, although these banks themselves did not own or operate their own ATMs.

The first shared ATM network in Turkey was formed in 1993 between Yapi Kredi Bank (YKB) and Pamukbank. These two banks were closely related to each other through cross share holdings, so the reasons for the formation of this shared network may not have been the same as the early shared networks in the U.S. The formation of the Pamukbank-YKB network was soon followed by a shared ATM arrangement between four banks, named "Golden Points."

Unlike the U.S. Banking Sector, the shared ATM networks in Turkey did not go through

the "regional network" stage, because Turkey is significantly smaller and most big banks operate in all of the major cities and most rural provinces. Therefore, the development of shared ATM networks in Turkey have started from the "national network" stage. Despite Golden Points being formed early on, ATM sharing became a widespread phenomenon only after 1998. During this period three more banks joined the Golden Points and 16 small and medium sized banks formed another shared ATM network in 1998, named "Common Points." Although there were some banks leaving or switching networks after 1998, these three networks remain as the only national shared ATM networks in Turkey, with a number of banks operating proprietary networks.[4]

As discussed in Chapter 1, starting with crisis of 1999-2001, there was a wave of nationalization of banks and the consolidation of the sector as a whole. In total, 18 deposit collecting banks were taken over by the State Deposit Insurance Fund (SDIF) between December 1998 and November 2001. Some of these banks were merged with each other and sold to private banks, some were sold without being merged and others were liquidated. A few foreign banks were also liquidated without being transferred to the SDIF. Furthermore, there was a merger of 3 commercial banks and 2 state banks were merged by the government. The number of deposit collecting commercial banks decreased from 62 in December 1998 to 40 in December 2002. However, the crisis did not have a significant effect on the growth of ATMs as the new owners continued to operate the existing networks of the banks they have acquired. Table 2.1 below gives some statistics on the banking sector and the ATM networks of Turkish banks before, during and after the crisis.

As seen in Table 2.1, the rate of attrition among banks has been very high, with the number of deposit-collecting banks decreasing by one-third between 1999 and 2002. There has also been a drop in the number of bank branches, but the number of ATMs has risen, although at a slower pace compared to the pre-crisis period. The number of debit cards has also continued to rise, at about the same rate of growth before, during and after the crisis.

The developments in the market share of shared ATM networks versus the proprietary networks for 2000-2003 (2nd quarter) are given in Table 2.2. Panel A shows the market share

[4]There also was a short lived ATM sharing agreement between two state-owned banks between 1999-2000, but no data or information exists about this sharing agreement in the literature or the popular press.

Table 2.1: Developments in the Turkish Banking Sector 1998-2003.

	1998	1999	2000	2001	2002	2003 (Q2)
ATM Terminals	8363	9939	11991	12127	12069	12530
Debit Cards (millions)	19.35	24.10	29.56	31.65	35.05	37.50
Bank Branches	7002	6946	6734	6481	5884	5774
Depository Banks	60	62	61	49	40	37
Non-Depository Banks	15	19	18	15	14	14

in the number of ATM terminals and the market share in the volume of ATM transactions (millions USD) is displayed in Panel B.[5] Table 2.2 suggests that, although the market share of shared ATM networks is greater than the proprietary networks, the single-bank networks still retain a big portion of market share. Furthermore, it is clear that Golden Points dominates the other networks both in the number of ATMs and transaction volume.

The current state of ATM networks in Turkey can be summarized as follows: About 65% of the ATMs belong to a shared network, with one particular network dominating the others. The remaining 35% belong to proprietary networks, where the bank card of the customer works only in the ATMs of his/her own bank. Such a structure makes the Turkish banking sector an interesting case for analyzing the presence (or absence) of benefits associated with ATM sharing.

2.3 Measurement of Efficiency in Banking

2.3.1 Different Approaches

Two different approaches can be used in the measurement of productive efficiency: parametric and non-parametric. The parametric approach involves specifying a production function for the producing unit. Then, using econometric techniques, deviations from the maximum feasible output are determined and these deviations are separated into random noise and

[5] "ATM transactions" includes bank card transactions, but not credit card transactions.

Table 2.2: Market Share of Different ATM Network Structures.

	2000	2001	2002	2003 (Q2)
Panel A: # of ATMs				
Golden Points	31.22%	31.12%	33.88%	34.26%
Common Points	9.04%	11.14%	13.53%	14.55%
Pamukbank-YKB	18.91%	17.84%	17.32%	16.38%
Proprietary NWs	40.27%	39.90%	35.27%	34.81%
Panel B: ATM Transactions				
Golden Points	34.95%	38.71%	42.06%	42.99%
Common Points	1.64%	2.40%	3.57%	5.33%
Pamukbank-YKB	26.03%	23.61%	20.53%	17.52%
Proprietary NWs	37.37%	35.28%	33.84%	34.17%

inefficiency components.[6] In contrast, non-parametric methods use linear programming to construct an efficient frontier from the observed input-output combinations of firms. Inefficiency is then measured as the distance between the firm's observed input-output combination and the efficient frontier. Non-parametric approaches make no assumptions about the functional form of the production function and construct the frontier based solely on observed data (Lovell, 1993).

Each approach has one significant advantage and one significant disadvantage compared to the other. Parametric approaches try to distinguish between noise and inefficiency, whereas non-parametric methods make no such attempt and lump both together as inefficiency. In this sense, their results can be biased due to the presence of noise. However, non-parametric approaches do not require any assumptions about the production function and they are less prone to biases that arise from specification errors. Efficiency measures obtained by a parametric method can be vulnerable to errors associated with assumptions about the functional form of the production technology and the random error terms.[7]

[6]The parametric method can also be applied by specifying a cost or profit function and then determining deviations from either minimum feasible cost, or maximum potential profit.

[7]For a more detailed comparison of the two approaches, see Lovell (1993).

There are a few other practical advantages of non-parametric methods. For example, non-parametric methods are preferable for studies with small sample sizes. Because parametric methods are based on econometric techniques, employing such methods on a small sample may not correctly separate random noise from inefficiency. Another reason to employ non-parametric methods has been presented by Ataullah, Cockerill and Le (2004), who argue that market imperfections in developing countries can result in distorted input/output prices, making it harder to measure cost or profit functions using parametric techniques.

Another advantage of the non-parametric approach is that it can allow for zero output values, which parametric methods can not deal with (Grabowski, Rangan and Rezvanian, 1994). Furthermore, despite being extremely sensitive to outliers, non-parametric methods can, in principle, handle zero input values as well. However, if such observations are included in the sample, it becomes necessary to employ alternate specifications of the model and compare the efficiency scores to check for the accuracy of the results (Resti, 1997 and Favero and Papi, 1995).[8]

2.3.2 Overview of the DEA Method

This section will present a brief introduction to the DEA model used in deriving the results explained in Section 2.4.[9]

Consider I producers producing m number of outputs given by the vector y_j, $j = 1, ..., m$, using n number of inputs given by the vector x_j, $j = 1, ..., n$. The purpose of the DEA model is to convert this multiple input, multiple output setup into a setup where each producer produces one "virtual output" using a single "virtual input." The levels of virtual input and virtual output are determined by applying a set of input and output weights on the actual levels of inputs and outputs. Productive efficiency is then defined as the level of virtual output produced divided by the level of virtual input used. The efficiency of

[8]Some studies, such as Yildirim (2002) and Ataullah *et. al* (2004), opt to drop observations with zero input/output values from their sample. However, as the main goal of this study is the compare the efficiency of banks with shared ATM networks, banks with proprietary networks and banks without ATM technology, this approach is not feasible. Instead, efficiency scores from alternate specifications will be presented and compared below.

[9]This presentation in this section draws from the input-oriented model given in Yildirim (2002), complimented by the output-oriented model described in Lovell (1993).

producer 0 is given by:

$$e_0 = \frac{u^T y_0}{v^T x_0}$$

where u is a vector of output weights and v is a vector of input weights. y_0 is the vector of the amounts of each output produced and x_0 is the vector of the amounts of each input used by producer 0. This efficiency measure is maximized according to the following problem:

$$\max_{u,v} \frac{u^T y_0}{v^T x_0} \tag{2.1}$$

subject to:

$$\frac{u^T y_i}{v^T x_i} \leq 1 \qquad i = 1, ..., I \tag{2.2}$$

$$u, v \geq 0 \tag{2.3}$$

Equations (2.1), (2.2) and (2.3) imply that a set of nonnegative input and output weights are desired such that the efficiency measure of producer 0 is maximized, subject to the constraint that no other producer in the sample (producers 1 through I) has an efficiency measure greater than unity (suggesting that no producer is more than 100% efficient given the weights that maximize producer 0's efficiency).

However, this problem has an infinite number of solutions for the input and output weights (v and u respectively). On the other hand, if the virtual input of the unit is normalized to one, it is possible to get a unique solution for u and v. The normalization in applied in the following linear programming model:

$$\max_{u,v} u^T y_0$$

subject to

$$v^T x_0 = 1$$

$$v^T x_i - u^T y_i \geq 0 \qquad i = 1, ..., I$$

$$u, v \geq 0$$

The dual formulation to this linear problem is given by the following "envelopment" problem, which yields the same result:

$$\min_{\theta,\lambda} \theta \tag{2.4}$$

subject to:

$$\lambda X \leq \theta x_0 \tag{2.5}$$

$$\lambda Y \geq y_0 \tag{2.6}$$

$$\lambda \geq 0 \tag{2.7}$$

Where X is an n by I input matrix with columns x_i, Y is an m by I output matrix with columns y_i and λ is an I by 1 weight vector (also referred to as the "intensity vector"). These values have to be such that, for each input, the weighted combination of input does not exceed the proportion θ of that input used by producer 0 (i.e. the weights calculated do not violate the minimized proportion of the input, given by Equation (2.5)) and for each output, the weighted combination of output is at least as great as the observed output of producer 0 (i.e. the calculated weights do not yield a level of output that is consistently higher than the measured levels of output, given by Equation (2.6)).[10] These constraints are necessary in order to ensure that at least some of the firms are found to be efficient. This problem is then solved I times to generate I optimal values of (θ, λ).

This DEA problem is "input-oriented", since it minimizes the amount of input for given levels of output. This is a more appropriate specification for the banking sector, as it is easier for banks to adjust their inputs (number of branches or interest rate on deposits), compared to outputs (deposits collected or loans given out).

Another feature of the model above is that it assumes constant returns to scale (CRS) technology. Under this assumption, the efficiency measure θ gives the "overall technical efficiency", where the value θ is between zero and one. A value of one implies long-run optimal scale of operations and a value close to zero implies almost complete inefficiency.

[10]Intuitively, these constraints can be interpreted as the following: the firm can be said to be inefficient, if a linear combination of the inputs used by other producers that is less than or equal to the input used by the firm can yield at least the same level of output that the firm produces.

It is possible and quite common to relax the CRS assumption. If the following constraint is added to the problem defined by equations (2.4)-(2.7), then the problem will model a variable returns to scale (VRS) technology:

$$e^T\lambda = 1 \tag{2.8}$$

Where e^T is an I by 1 vector of ones. Then, the DEA problem becomes:

$$\min_{\phi,\lambda} \phi$$

subject to:

$$\lambda X \leq \phi x_0$$

$$\lambda Y \geq y_0$$

$$\lambda \geq 0$$

$$e^T\lambda = 1$$

The measure of efficiency of this problem, ϕ ranges from zero to one and it is a measure of "pure technical efficiency." Pure technical efficiency is input based and measures whether the firm is using too much input to produce a given level of output. Therefore, it is also sometimes referred to as "managerial efficiency." On the other hand, "scale efficiency" (given by ψ) is found by dividing the overall technical efficiency score by the pure technical efficiency score. This output based measure captures whether the firm is operating on the right scale or not.

$$\psi = \frac{\theta}{\phi} \tag{2.9}$$

The value of ψ goes from zero to one. If $\psi \neq 1$, then scale inefficiency exists and the source of this inefficiency can be either increasing returns to scale or decreasing returns to scale. In order to determine the source of any scale inefficiency, it is necessary to solve the problem with the following restriction instead of (2.8):

$$e^T\lambda \leq 1 \tag{2.10}$$

This restriction allows for non-increasing returns to scale (NIRS) technology. Defining the efficiency measure for NIRS technology to be ν, then it can be said that increasing returns to scale (IRS) exists if $\phi \neq \nu$. $\theta \neq \phi$ implies decreasing returns to scale (DRS) and if $\theta = \phi = \nu = 1$, then there is no scale inefficiency. Based on the source of scale efficiency, conclusions can be made about the production levels of the firm. If a firm is found to be scale inefficient and operating under DRS, then it can be said that the firm is too big (and the opposite is true if the firm is operating under IRS).

2.3.3 Previous Applications of Efficiency Measurement on Turkish Banks

Application of non-parametric methods in studies of bank efficiency is not a new phenomenon. In their survey of 116 efficiency studies for banking, Berger and Humphrey (2000) find that non-parametric approaches tend to be a bit more preferred to parametric techniques (55% of the studies in their survey used non-parametric methods). They also conclude that a majority of banking efficiency studies concentrate on the U.S., with 66 out of 116 single country studies focusing on the U.S. financial institutions.

A closer look on Berger and Humphrey's survey also suggests that developing countries have not received much attention in this literature. Out of the 50 "non-U.S." studies, there are only 7 studies focusing on what could be called "developing countries."[11] And as far as the methodology of the non-U.S. studies are concerned, the overwhelming majority (74% of 50 studies) employ the non-parametric method. This can be explained by the lack of large data sets for such countries, which was an issue in this study as well.

Although a number of studies on the efficiency of the Turkish Banking Sector exist in the literature, none of these have looked at the impact of shared ATM networks or the efficiency performance of banks after 1999. Considering that 2000-2001 was an important

[11]These countries are: Cyprus (one study), India (one study), Saudi Arabia (one study), Tunisia (two studies) and Turkey (two studies).

period for the sector, it is possible that the efficiency scores of banks have changed after 1999.

Looking at the earliest post-liberalization period, Isik and Hassan (2003a) employ a DEA-type Malmquist Total Factor Productivity index approach and show that the Turkish banks have recorded significant efficiency increases between 1980 and 1990. They conclude that the main source of inefficiency in the sector was low technical efficiency. Similarly, using a DEA approach, Zaim (1995) compares the efficiency of banks in 1981 and 1990. His results seem to agree with Isik and Hassan, suggesting that there were significant efficiency gains during this period.

On the other hand, using a variety of parametric and non-parametric approaches, Isik and Hassan (2002) conclude that the efficiency of Turkish banks have declined during the 1988-1996 period. Furthermore, their results suggest that in contrast to the 1980s, the main source of inefficiency is scale and not technical inefficiency. They conclude that small Turkish banks tend to suffer from scale inefficiencies related to Increasing Returns to Scale (IRS). In this sense, the small banks would like to grow to reach the right scale but either output conditions or competition would not allow them to do so. On the other hand, big banks experience Decreasing Returns to Scale (DRS), because at some point they have grown past the right scale in order to meet demand for their services.

These findings seem to be confirmed by Yildirim (2002), who uses a DEA approach to look at the evolution of efficiency in the banking sector between 1988 and 1999. She concludes that the sector did not achieve consistent efficiency gains over this period and the banks suffered mainly from scale inefficiencies. Combining the results of these studies suggest that there were rapid and significant efficiency gains immediately after financial liberalization, followed by scale efficiency losses due to banks overextending themselves.

However, a question about the scale efficiency of Turkish banks during the 1990s has been raised by Isik and Hassan (2003b). Looking at a period that spans the financial crisis in 1994, they find that the main source of the efficiency losses by Turkish banks between 1992 and 1996 was technical. This increase in scale efficiency during a crisis may be explained by a reduction in the outstanding loans of banks. If banks reduce loans (an output) due to increased risk aversion during a crisis, then banks operating under DRS may come back

to the efficient scale, as they produce less. However, this argument can not explain the resurgence of scale inefficiency after 1996, as observed by Yildirim (2002). Looking at the possible economies of scale effects due to shared ATM networks can shed some light on the presence and evolution of scale (in)efficiencies in the Turkish Banking sector.

2.4 The Model and Data

2.4.1 Application of DEA and the Data

The literature on the measurement of efficiency in the banking sector identifies two different approaches to specifying the inputs and outputs. A detailed explanation of these two distinct approaches was first offered by Humphrey (1985), but one of the most comprehensive surveys on these techniques and their applications is provided in Colwell and Davis (1992).

The first approach is called the "production approach" and it assumes that banks are engaged in the production of deposit and loan accounts (outputs) using labor and capital (inputs). Due to this specification of the production process, only the operating expenses of banks are considered in the analysis, without including interest expense on deposits. Furthermore outputs are measured by the number of deposit accounts and loans, as opposed to the monetary value of these variables. By not taking interest expense and the monetary value of deposits or loans into account, the production approach only looks at the cost efficiency of banks (i.e. whether the bank is minimizing operating costs for the number of deposit and loan accounts being created and serviced).

On the other hand, the "intermediation approach" treats banks as intermediaries of financial services, rather than firms which use capital and labor to produce deposit and loan accounts. In this sense, this approach is more concerned with the economic viability of the banks. If the intermediation approach is used, interest expense is usually included as a part of the bank's costs along with operating expenses. Capital and labor are also commonly used as inputs. Although virtually all studies using the intermediation approach use the monetary value of loans as an output, there is disagreement in the literature on whether deposits of a bank is considered an input or an output.

Colwell and Davis (1992) provide a detailed discussion of the different schools of thought

on how to classify deposits if the intermediation approach is used. They show that earliest studies have tended to classify all liabilities, including deposits, as inputs and all assets as outputs. In this sense, deposits are simply an input in the production of loans. However, considering the fact that the creation of deposits may have substantial value added, some have argued that deposits should be treated as an output and not an input. The approach that treats deposits as an output is called the "value added" approach.

The general argument of the value added approach is that some categories of produced deposits, such as savings, time, and demand deposits are important outputs, as they account for a significant portion of value added. For example, Berger and Humphrey (1992) find that savings, time, and demand deposits have accounted for 48% of all U.S. bank value added in 1988. Purchased funds such as interbank loans purchased, foreign deposits or large CDs do not require a significant amount of labor and capital and their value added requirements are very low. As a result, all purchased funds are treated as as outputs.[12] Although there seems to be no consensus in the literature on how to classify deposits, it is clear that this classification depends on the goals of the study and how the characteristics of the banking sector are specified.

There is also some controversy in the literature on whether interest expense should be included as an input if deposits are specified as outputs. For example, Berg *et al.* (1993) have argued that interest expense can be excluded from being an input depending on the conditions of the banking sector in the country of interest. Some studies in the literature seem to have agreed with this argument and have excluded interest expense from their inputs. However, most of these studies concentrate on countries with low interest rates or with "collusive" banking sectors where banks do not have to intensely compete with each other for deposits. As discussed below, the Turkish banking sector does not exhibit the characteristics that are suitable for excluding interest expense as an input.

This study uses the value added approach which treats deposits as an output. As discussed in the previous sections, the goal of this study is to see whether the creation of shared ATM networks have resulted in net positive network and scale effects for banks by allowing

[12]See Colwell and Davis for specific examples from the literature. Aly, *et al* (1990) and Berger, Hanweck and Humphrey (1986) also provide some discussion on the role of deposits.

them to collect more deposits given their input levels. The definition of the network effects as changes in the banks' ability to collect deposits in a competitive environment suggests that time and demand deposits should be used as outputs and not inputs. Furthermore, the high level of competition for deposits between banks in Turkey, at least within urban areas, has been well-documented in the existing literature. Therefore, the monetary value deposits is considered as an output along with the monetary value of loans. Zaim (1995) also uses a very similar approach with time and demand deposits specified as outputs, but the other studies of bank efficiency in Turkey have chosen to use a more traditional intermediation approach where deposits are considered as inputs.[13]

Interest expense on deposits has been included among the inputs due to the relatively high interest rates in Turkey. These high rates, combined with the relatively immature stock or bond markets makes even demand deposits an important financial instrument for households. In this sense, the interest offered by a bank is likely to have a large impact on the amount of deposits collected, which may not be the case in the developed countries where interest rates on deposit accounts are much lower. On the other hand, one could also argue that the inclusion of interest on deposits as an input can bias the results, as interest expense can dominate many of the other inputs that a bank can use to "produce" deposits. Therefore, the results from a specification that does not use interest expense on deposits as an output will be presented in Section 2.5.

It should also be mentioned here that using the production approach can be somewhat attractive for the purposes of this study. As ATMs are important in servicing the deposit accounts of customers and attracting new accounts, it would make sense to have an alternate specification, where ATMs is a part of capital used in deposit collection and the number of deposit accounts serviced would be one of the outputs. Comparing the results of the production approach with the results of the value added approach may prove to be interesting. Unfortunately, *number* of deposit accounts data is only available for the years 2001 and 2002 and no data exists on the *number* of loans, making such a comparison difficult.

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[13]Zaim's method is not unique among the studies of bank efficiency outside the U.S. Berg *et al.* (1993) uses a similar approach for Nordic countries and Resti (1997) treats deposits as an output in a study of bank efficiency in Italy.

However, an alternative specification of the model, where the limited data on the *number* of deposit accounts is used as an output, is discussed in Section 2.5.

The analysis includes a total of six inputs and four outputs. The inputs are the number of ATMs owned and operated by the banks, the number of additional ATMs that the bank's customers can use through a shared ATM network[14], the number of branches, the number of employees, total operating costs and total interest expense on deposits.

The use of the number of employees and branches as proxies for labor and capital is common in the literature. Due to this study's interest in the effects of shared ATM networks, the number of ATMs of the bank and the number of shared ATMs available to the bank are also included as inputs. As discussed above, interest paid on deposits is included in the inputs as the value added approach is being used. The final input is the total operating costs. This variable includes salary paid to employees, spending on capital such as rental expenses, depreciation and taxes.

The outputs are defined as: total deposits (both time and demand), total performing loans, value of all ATM transactions and commissions and fees received from services. The reasons for treating total deposits as an output have been discussed above. Total loans have been included as an output in an effort to capture possible effects of ATM sharing on consumer loans. It is possible that consumers seeking consumer loans will be attracted to a bank that offers easy access; however, accounting standards in Turkey make it impossible to distinguish consumer loans from other loans. As a result, total loans have been included among the outputs, with the knowledge that large portions of a bank's loan portfolio are likely to be invariant to ATM technology and ATM sharing.

The volume of all ATM transactions is used as an output, in order to make sure that the effects of ATM technology are being completely captured. For example, it could be the case that a bank has a large ATM network, but it is not used frequently by its customers. In this sense, the bank's efficiency measurement could have an upward bias if none of the outputs directly reflect ATM usage (this is especially true for banks that operate proprietary

[14]The number of ATMs owned and operated by the banks takes the value of zero if the bank does not employ ATM technology. Similarly, if the bank operates a proprietary network, then the number of ATMs within a shared network is zero.

networks). It should be kept in mind that the volume of ATM transactions is a direct product of ATMs: if the bank doesn't employ ATM technology, then there will be no ATM transactions. Since banks that don't have ATM technology are also included in the sample, having the volume of transactions as an output can be useful in determining whether the bank can increase efficiency by giving up one input (ATMs) and one output (transactions).

The final output is the commissions and fees received from services, which include switch and usage fees collected by a bank from banks whose customers use that bank's ATMs. This output is also included in order to capture the efficiency of the ATM networks in question.[15]

Although non-interest income can also be thought of as another output, there is a potential problem associated with using this variable. Foreign exchange transactions dominate the non-interest incomes of Turkish Banks and income from FX transactions is not necessarily a direct output of the production process envisioned in the specification of the model. However, the changes in accounting regulations for banks in 2001 have resulted in multiple sub-items of non-interest income to be merged into one entry, which makes separating the "non-FX transactions income" components impossible for the years after 2001. As a result, non-interest income has not been added to the outputs of the model.

As mentioned above, the observations for the inputs and outputs span the period 2000 - June 2003. The rather small number of observations is due to the fact that the data on the number of ATMs operated by each bank has only been collected since 2000. There is data on the aggregate number of ATMs and transaction volume for 1998-1999, but it has not been broken down to the individual bank level. The observations for 2000-2002 are annual observations, whereas the data for 2003 goes through the end of the second quarter. Although this could be a problem in a setting where the interaction of the variables across time is a factor, it is not so for DEA analysis. As explained above, DEA estimates an efficient frontier for a given time period and the movement of the frontier or changes in the input-output combinations of the productive units across time do not factor in the analysis.

[15]Private discussions with Turkish bankers seem to indicate that the switch and usage fees in shared ATM networks are fairly significant. It should also be noted here that some networks do not pass these costs onto their customers (i.e. the "foreign ATM fees" that are very common in the U.S. do not exist for two of the three shared ATM networks). Of course, there are other non-ATM related commissions and fees banks collect from services, therefore the "fees and commissions received" entry for banks without ATM technology or with proprietary ATM networks are not zero.

The data has been collected from two sources. The data on the number of ATMs per year and the volume of ATM transactions has been supplied by a major bank in Turkey, although the data itself has been collected by the Interbank Card Center (ICC). The remaining data has been gathered from the annual publication of the Bankers Association of Turkey's (BAT) "Banks in Turkey", which includes balance sheet and income statements of all banks. All of the BAT data is reported in U.S. Dollars and the ICC's ATM transaction data was converted to U.S. Dollars by using the exchange rate on December 31 of each year (for June 2003, the exchange rate on June 30, 2003 was used). The use of the exchange rate at the end of the year is due to the fact that Turkish Banks close their books on the last day of the year and the conversion is done with that day's exchange rate.[16]

Although an attempt was made to include all depository institutions, some banks had to be eliminated from the sample. Two banks were left out of the 2000 sample because they bought nationalized banks from the State Deposit Insurance Fund (SDIF) in 2000. However ICC reported the post-merger ATM data for these banks in 2000, whereas the balance sheets supplied by the BAT have the pre-merger numbers. Due to this discrepancy both banks were dropped from the sample for 2000.

There were 5 banks that were not included in the sample. Three of these banks were already under SDIF control when the sample period began and they were subsequently liquidated either in late 2000 or early 2001. The remaining two banks were nationalized in mid-2001 and they are still operated by the SDIF. These two banks had ATM technology, but their ATM systems were abandoned after nationalization. Although balance sheet data exists for these banks, there is no ICC data reported for the pre-nationalization period. As including these banks as if they didn't have ATM technology could bias the results, they were also excluded from the sample.

For the years 2001 and 2002, there were some changes and omissions from the data set as well. One bank was nationalized in 1999 and was operated by the SDIF in 2000. In 2001, it was sold to a foreign bank and went through restructuring in 2001 and 2002. Therefore, although ICC data on ATMs exist for this bank, the data reported by the BAT has entries

[16]The data for 2003 (Q2) comes from the quarterly balance sheets that the banks have started issuing after the beginning of 2003. No such quarterly data exists for the years prior to 2002.

Table 2.3: Summary Statistics of the Data. Total number of observations: 148.

Outputs	Mean	Standard Deviation
ATM Transactions (mil. USD)	475.75	1176.32
Total Deposits	2401.47	4070.70
Total Loans	822.267	1328.12
Fees and Commissions	36.28	63.72
Inputs		
# of ATMs	316.62	564.38
# of Shared NW ATMs	899.05	1084.34
# of Branches	166.30	278.49
# of Employees	3320.72	5813.79
Interest on Deposit	464.22	1144.74
Operating Expenses	151.24	238.61
Size of banks		
Total Assets (mil. USD)	3272.03	5486.27

that are very close to zero for all items of the balance sheet. Finally, a member of the Common Points network was taken over by the SDIF in 2001 and almost immediately sold to another Common Points member. Therefore, the bank did not exist in 2002 and was left out of the sample from 2002 on.

The summary statistics of the data set are presented in Table 2.3. The most striking observation of the summary statistics is the diversity of the banks that are included in the sample. All of the variables have very large standard deviations, suggesting that both very big and relatively small banks operate ATMs and participate in shared networks. The implications of such diversity on bank efficiency is discussed in the next section.

2.4.2 Analysis and Results

Common vs. Separate Frontiers for the Sample

The first step in the analysis concerns the issue of whether a estimating a common efficient frontier for all banks is feasible. As seen in the sample statistics above, there exists great variation between banks in Turkey and it is possible that certain subgroups of banks use different production technologies. If this is the case, then there would be separate efficient frontiers for these subgroups.

The main issue here is the size of Turkish banks. From the sample statistics above, it is clear that both very large and very small banks operate in Turkey. In the middle are banks that are neither too big or too small (hence called medium banks). Looking at the asset size of banks in the sample, it was determined that using cutoff points of $ 1 billion and $ 5 billion are reasonable for distinguishing between big, medium and small banks in Turkey. Any bank that has total assets greater than $5 billion is categorized as a "'big bank" and any bank with assets less than $1 billion is called a "small bank." The banks that have assets between $1 billion and $5 billion are the "medium banks." The categorization of banks according to size for the sample is given below.

Table 2.4: Number of banks according to their size categorization.

	2000	2001	2002	2003 (Q2)
Big	8	7	7	7
Medium	7	10	9	9
Small	23	21	21	19
Total	38	38	37	35

Looking at the different size categories of banks, it would be possible to imagine that small and medium size banks face a different production frontier compared to big, more established banks. Most of the big banks in Turkey are well established banks with long histories and reputations to be somewhat "safe." Three of these big banks are state banks

and they have the advantage of collecting the direct deposits of public sector employees who choose to receive their salaries directly in their accounts. The private big banks are among the most established, with the backing of big holding companies. In all, it is possible that big banks can collect deposits more easily due to their established reputation, compared to small and medium banks, of whom a majority are relatively young, being founded after the liberalization of 1980. As a result, one could hypothesize that the nature of the banking business is different for these three categories of banks and a separate frontier would be more suitable for each.

The presence of a common frontier for all Turkish banks can be tested using the following procedure[17]: first separate frontiers are estimated by employing DEA on subsets of the data categorized by size. Then, hypothesis tests are performed in order to see whether these separately estimated efficiency measures are drawn from the same distribution or not. The null hypothesis is that the three categories of banks in Turkey have identical production technologies and therefore using a common frontier for all banks is appropriate.

Two different hypothesis tests were performed in the data. The first is an ANOVA test, which tests whether the means of the separately estimated efficiency measures are equal. If the subgroups have the same means, then the variability between subgroups should be same as the variability within each subgroup. The second is a van der Waarden test, which tests whether the medians of the separately estimated efficiency measures are equal to each other. The basic idea of this test is similar to the ANOVA test. Therefore, the null hypothesis in each test is that using a common frontier for all subcategories is appropriate. The results of these tests are presented in Table 2.5, along with the p-values of each test statistic.

The results suggest that with the exception of overall efficiency (with a CRS technology assumption) for 2000, the null hypotheses for both tests can not be rejected simultaneously at a 5% level. There are a few other van der Waarden p-values that are at or below 5%, but no test result rejects the null hypothesis at a 1% level and therefore it appears that it is feasible to use a common frontier for all different size banks.[18]

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[17]This procedure was outlined in Elyasani and Mehdian (1990) and used by Isik and Hassan (2002).

[18]Although the results have not been shown here, hypothesis tests performed according to a simpler categorization of "small banks" versus "non-small banks" and "big banks" versus "non-big banks" also

Table 2.5: Results of ANOVA and van den Waarden tests

		ANOVA		van der	
Year	Measure	F-stat	p-value	Waerden value	p-value
2000	Overall	3.348	0.046	6.013	0.049
	Pure Tech.	0.429	0.654	1.729	0.421
	Scale	2.794	0.075	6.521	0.038
2001	Overall	2.101	0.137	5.120	0.077
	Pure Tech.	1.158	0.325	5.476	0.064
	Scale	1.433	0.252	2.512	0.284
2002	Overall	2.132	0.134	6.016	0.049
	Pure Tech.	0.423	0.658	2.256	0.323
	Scale	1.661	0.204	6.032	0.049
2003(Q2)	Overall	1.059	0.358	5.704	0.057
	Pure Tech.	0.487	0.618	2.051	0.358
	Scale	0.697	0.505	5.956	0.050

Common Frontier DEA Results

The results of the DEA analysis for each year is presented in Table 2.6. The measures given in the table are average efficiency estimates for the entire sample, along with the mean efficiency figures for different categories of banks according to their shared ATM network participation. Three estimates of efficiency are reported: the overall technical efficiency (calculated under the CRS assumption), pure technical efficiency (calculated under the VRS assumption) and the scale efficiency (calculated by dividing the CRS efficiency measure by the VRS efficiency measure).

In trying to determine whether sharing ATMs have resulted in net positive benefits for banks, the pure technical and scale efficiency measures will be interpreted according to the network and scale effects associated with ATM sharing. As described above, the main idea behind the network effect is that a shared-ATM network allows the bank to collect more

fail to reject the null hypothesis of the means and the medians being equal.

Table 2.6: Mean efficiency scores of banks, categorized according to shared network affiliation.

	2000		2001		2002		2003(Q2)	
	#	Overall	#	Overall	#	Overall	#	Overall
Common Points	12	0.646	13	0.851	12	0.839	12	0.855
Golden Points	5	0.874	5	0.917	5	0.917	5	0.93
Pamukbank-YKB	2	1.00	2	1.00	2	0.878	2	1.00
Proprietary NWs	3	1.00	3	0.953	3	1.00	3	1.00
Banks w/o ATMs	16	0.80	15	0.899	15	0.756	13	0.891
All Banks	38	0.787	38	0.899	37	0.831	35	0.90
	Pure Tech.	Scale	Pure Tech.	Scale	Pure Tech.	Scale	Pure Tech.	Scale
Common Points	0.817	0.806	0.864	0.983	0.861	0.976	0.917	0.932
Golden Points	0.964	0.90	0.918	0.998	0.936	0.972	0.971	0.952
Pamukbank-YKB	1.00	1.00	1.00	1.00	0.918	0.952	1.00	1.00
Proprietary NWs	1.00	1.00	1.00	0.953	1.00	1.00	1.00	1.00
Banks w/o ATMs	0.925	0.848	0.929	0.948	0.953	0.795	1.00	0.891
All Banks	0.91	0.862	0.918	0.97	0.923	0.90	0.967	0.929

deposits (an increase in output) without increasing its inputs. Therefore, the pure technical efficiency measure will be interpreted as capturing the presence (or absence) of network effects. On the other hand, as the scale effects are directly related to whether a bank can deploy more ATMs and reach the efficient scale, the scale efficiency results of a bank will be capturing whether a bank realized positive scale effects or not. Finally, the overall efficiency results can be interpreted as capturing the presence (or absence) of both effects.

The results in Table 2.6 do not reveal a common pattern about any potential efficiency gains from having a shared-ATM network. The banks that participate in shared ATM networks seem to be relatively less efficient compared to banks with proprietary networks for any of the periods except 2001. This is not a very surprising result, as it is possible that the network and scale effects dominate the substitution effect for some banks that participate in shared ATM networks, but not for others.

Further complicating the results, some of the banks with shared ATM networks are less technically efficient compared to banks that do not employ ATM technology. This finding is exactly opposite to the idea of positive network effects associated with shared ATM networks, which are supposed to increase the technical efficiency of banks by increasing their attractiveness to depositors. On the other hand, banks with shared ATM networks are more scale efficient compared to banks without ATM technology for all four years.

Looking at the shared ATM networks individually, it is clear that the two networks with fewer banks and more ATMs (Pamukbank-YKB and Golden Points) are more efficient compared to the network with more banks but fewer ATMs (Common Points). This observation is true for every year except 2002, where the Common Points network is more scale efficient compared to the other two networks. Therefore, the main conclusion that can be drawn from Table 2.6 is that network and scale effects do not uniformly result in net efficiency increases and a closer inspection based on a different categorization may be more intuitive.

To this end, the banks were categorized according to their size and their participation in a shared ATM network (or whether they have ATM technology or not). The results are presented below.

Categorizing the banks by size yields a clearer picture of the possible effects of shared ATM networks on the efficiency of Turkish Banks. It is immediately clear that the big banks

Table 2.7: Mean efficiency scores of banks, categorized according to size.

	2000		2001		2002		2003(Q2)	
	#	Overall	#	Overall	#	Overall	#	Overall
Big Banks w/ NW	5	1.00	4	1.00	4	1.00	4	1.00
Big Banks w/o NW	3	1.00	3	0.953	3	1.00	3	1.00
Medium Banks w/ NW	6	0.649	9	0.904	9	0.82	9	0.87
Medium Banks w/o ATMs	1	1.00	1	1.00	0	-	0	-
Small Banks w/ NW	8	0.654	7	0.809	6	0.838	6	0.846
Small Banks w/o ATMs	15	0.786	14	0.892	15	0.756	13	0.891
	Pure Tech.	Scale	Pure Tech.	Scale	Pure Tech.	Scale	Pure Tech.	Scale
Big Banks w/ NW	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Big Banks w/o NW	1.00	1.00	1.00	0.953	1.00	1.00	1.00	1.00
Medium Banks w/ NWs	0.91	0.718	0.915	0.989	0.862	0.95	0.946	0.917
Medium Banks w/o NW	1.00	1.00	1.00	1.00	-	-	-	-
Small Banks w/ NW	0.77	0.859	0.818	0.985	0.848	0.986	0.892	0.949
Small Banks w/o ATMs	0.931	0.838	0.924	0.945	0.953	0.795	1.00	0.891

that participate in shared ATM networks are relatively as efficient as the big banks with proprietary ATM networks. On the other hand, medium and small size banks are much less efficient relative to the big banks.[19] However, it appears that small banks that participate in shared ATM networks may have realized some positive scale effects, as they are more scale efficient compared to both medium banks with shared networks (with the exception of 2001) and small banks without ATM technology. These observations suggest that the size of the bank is an important determinant of whether the positive network and scale effects dominate the negative substitution effect or not.

Based on the results, it can be concluded that the presence of a shared ATM network has allowed big banks to be relatively as efficient as the big banks with proprietary networks. There is evidence that this efficiency has come at the expense of medium and small banks, as these banks are significantly less efficient relative to the big banks with shared networks. On the other hand, there is also some evidence that small banks are more capable of realizing positive scale effects from a shared network, as they are more scale efficient compared to both medium banks and small banks without ATM technology.

Medium banks, however, seem to fail in realizing both network effects and scale effects through forming shared networks. Not only that they fail to be relatively as efficient as big banks with or without shared networks, they also tend to be more scale inefficient compared to small banks. This is a surprising result, because the literature on bank efficiency repeatedly concludes that big banks tend to be more prone to being scale inefficient due to DRS (i.e. they are too big) and small banks tend operate at IRS (i.e. they are too small). In this analysis, however, the DEA analysis suggests that the big banks are experiencing constant returns to scale (CRS), whereas a majority of medium size banks and a significant majority of small banks are experiencing decreasing returns to scale (DRS).

The technical and scale efficiency figures in Table 2.8 seem to indicate that the substitution effects related to ATM sharing are fairly small for big banks but significant for medium and small banks. This could be due to the nature of the banking competition in Turkey.

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[19]The category "Medium Banks w/o ATMs" is somewhat deceptive, as it only includes one bank. This bank went through a decline in its total assets and fell under the "small bank" category in 2002, subsequently being nationalized and liquidated in the Summer of 2003.

Table 2.8: Developments in Returns to Scale.

	2000		2001		2002		2003 Q2	
	#	%	#	%	#	%	#	%
All Banks								
With CRS	20	52.63%	23	60.53%	20	52.63%	20	57.14%
With DRS	12	31.58%	6	15.79%	7	18.42%	14	40.00%
With IRS	6	15.79%	9	23.68%	10	26.32%	1	2.86%
Big Banks[a]								
With CRS	8	100.00%	6	85.71%	7	100.00%	7	100.00%
With DRS	0	0.00%	1	14.29%	0	0.00%	0	0.00%
With IRS	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Medium Banks[b]								
With CRS	1	14.29%	5	50.00%	4	44.44%	2	22.22%
With DRS	6	85.71%	3	30.00%	4	44.44%	7	77.78%
With IRS	0	0.00%	2	20.00%	1	11.11%	0	0.00%
Small Banks w/ NW								
With CRS	2	25.00%	3	42.86%	1	16.67%	1	16.67%
With DRS	5	62.50%	1	14.29%	3	50.00%	5	83.33%
With IRS	1	12.50%	3	42.86%	2	33.33%	0	0.00%
Small Banks w/o ATMs								
With CRS	9	60.00%	9	64.29%	8	53.33%	10	76.92%
With DRS	1	6.67%	1	7.14%	0	0.00%	2	15.38%
With IRS	5	33.33%	4	28.57%	7	46.67%	1	7.69%

[a,b]The category "big banks" includes 3 banks with proprietary networks for every year. The category "medium banks" includes one bank that did not employ ATM technology for the years 2000 and 2001. These categories were not divided into sub-categories to save space.

Although there are no branching restrictions or deposit rate ceilings in Turkey, most of the small and medium size banks have been concentrated in major urban areas (defined by İstanbul, Ankara and the western seaport of İzmir) and to some extent in the coastal areas where tourism is important. On the other hand, the big banks tend to have more extensive branch and ATM networks, which extend to the non-urban areas, which include the industrial areas of northwestern and western Turkey along with the agricultural regions and ports of southern Turkey. Therefore, the competition for deposits in urban areas are very intense, with small, medium and big banks all competing for deposits, whereas in non-urban areas, big banks only compete against each other and have easier access to deposits.[20]

The reasons behind the discrepancy between the average efficiency measures of different shared ATM networks are reflected in their membership structure. As of June 2003, the Golden Points network had 5 members, 3 of which were big banks and 2 were medium banks. The Pamukbank-YKB network had two members, 1 was a big bank and the other was a medium bank. In contrast, out of the 12 members of the Common Points network 6 were medium and 6 were small banks. The fact that the average efficiency of Common Points is well below the other two networks can be due to this membership structure.

The main idea behind network benefits being generated from a shared-ATM network is that that the network increases access locations for customers, increasing the attractiveness of the bank. However, if the ATMs of the shared network are all concentrated one area, then the additional convenience of the network is relatively small. If the depositors are unlikely to get higher utility from the sharing arrangements, then the presumed positive network effects would be very small. Furthermore, the additional cost of linking ATM networks and upkeep of the machines would be likely to offset any small but positive network effects realized by the bank.

On the other hand, the substitution effect is likely to be large and negative for small and medium banks, who mostly belong to the same network. While cooperating within this shared ATM network, these banks are also competing with each other for deposits in the urban areas. However, as discussed above, sharing ATMs with competitors is likely to

[20]It also should be mentioned here that banks set uniform deposit rates in Turkey which apply to all regions. Therefore, depositors in urban areas receive the same rate as the depositors in the rural regions.

decrease the amount of differentiation between the products offered by these banks, making them better substitutes for each other in the eyes of the depositors. If the depositors start considering these banks as closer substitutes, then the banks may have to respond by increasing the number of their branches or offering higher rates in an effort to prevent their depositors from switching, decreasing their efficiency.

The relatively higher efficiency scores of shared ATM networks that include big banks seem to support this conclusion. Unlike the small and medium banks, the degree of differentiation between the products offered by big banks are fairly large, as big banks have extended branch networks and higher reputation among the public.[21] As a result, the costs associated with a depositor switching from a big bank to another are likely to be higher, making the substitution effect less significant for big banks. Unlike medium and small banks that share their ATMs with each other, medium and small banks that participate in a sharing arrangement with big banks can truly increase their level of product differentiation, by allowing their depositors to utilize the large ATM networks of big banks.

As the main findings of the analysis seem to be based on the location and density of the ATMs within different networks, a comparison of the concentration of different networks' ATMs can prove useful. However, information about the location of ATMs could only be found for June 2003, whereas information about the location of bank branches is only available through December 2002. Combining the available information makes it possible to examine the concentration of different networks in urban areas.

Table 2.9 shows that the banks of the Common Points network (which are all medium and small size banks) are heavily concentrated in the major urban areas, whereas the banks of the Golden Points network and the banks with proprietary networks are also active in non-urban areas. Finally, although the branches of the Pamukbank-YKB network are heavily concentrated in the urban areas, the percentage of ATMs within urban areas is much smaller, suggesting that this network operates many off-site ATMs that are not attached to a branch in non-urban areas. These findings seem to confirm that banks that are heavily

[21] For example, the fact that most big banks are "too-big-to-fail" makes them attractive for depositors. Therefore, in theory it is difficult for a depositor to easily switch from a bank that is too big to fail to a small bank that could fail in the future. This significantly increases the depositors' switching costs.

Table 2.9: Concentration of branches and ATMs in urban areas.

	2000		2001		2002		2003 Q2	
	#[a]	%	#	%	#	%	#	%
Golden Points	1557	51.3%	1453	53.5%	1511	54.7%	2760	29.3%
Common Points	680	59.2%	923	60.1%	1111	57.8%	1258	43.3%
Pamukbank-YKB	622	60.9%	615	60.9%	613	60.8%	1512	31.7%
Proprietary NWs	2961	27.9%	3244	29.3%	3558	32.4%	3695	14.7%

[a]# refers to the total number of branches within the urban areas, defined as Istanbul, Ankara and Izmir. For the year 2003 (Q2), the number of ATMs within these cities was used.

concentrated in urban areas have lower efficiency scores, due to the intense competition in these areas for deposits.

In order to complement this finding, correlation tests were performed for the efficiency scores of banks with ATM technology and various measures of size and urban concentration. For these tests, the variables of interest were the number of branches the bank has in urban areas ("urban") and the ratio of the bank's urban branches to total number of branches ("urban-to-total"). The market presence of a bank was measured by the percentage of all bank branches in urban areas belonging to that bank ("urban-power"). The concentration of ATMs belonging to a shared network was measured by the number of shared ATMs that a bank's customers can access in urban markets ("urban-network"). Finally, three size dummies were included to see the correlation between the size and the efficiency of a bank ("small", "medium" and "big").[22]

The correlation tests that were performed are: Pearson correlation test and Spearman rank correlation test. Pearson correlation test calculates the correlation between two variables, whereas the Spearman rank correlation test calculates the correlation between the ranking of two variables. The Spearman rank test was included in the analysis, as it is

[22]Unfortunately, data on ATM locations is only available for June 2003, but branch location data is available for 2000-2002. A combination of this limited location information was used in correlation tests. Using branch location data is less than ideal, but as almost all bank branches in have on-site ATMs, it is a reasonable estimate of how many ATMs can be accessed through a shared network in urban areas.

less sensitive to extreme values compared to the Pearson test. Both tests have the null hypothesis that the efficiency measures and the urban concentration and size measures are independent. The test results for efficiency measures of banks with ATM technology is given in Table 2.10 below.

From the results, it is immediately clear that being a big bank is positively correlated and being a small or medium bank is negatively correlated with bank efficiency. For the big and small size dummies, this relationship is statistically significant, whereas for the medium size dummy, the statistical significance is weaker.

The correlation tests also reveal that concentrating heavily on urban areas increases efficiency only if the bank has captured a significant share of the market for deposits in these areas. The number of branches in urban areas and the market share in urban areas (for which "urban-power" is a proxy) are positively correlated with efficiency measures, but the ratio of urban area branches to total number of branches is negatively correlated with overall and scale efficiency. This finding seems to confirm that the heavy presence of small and medium banks in urban areas have resulted in these banks competing with each other for deposits and this intense competition has prevented the banks from realizing gains from forming shared ATM networks. It also should be noted here that the extent of the shared networks within urban areas (proxied by "urban-network") is not significantly correlated with efficiency, suggesting that the increase in access locations within urban areas do not create significant network benefits and increases in efficiency.

Interpretation of the Results

Based on the branch and ATM concentration data and the results of the correlation tests, it can be argued that the participation in shared ATM networks has not generated significant positive network benefits for medium size banks, all the while increasing their costs due to relatively high costs of deploying and maintaining ATMs. Small banks have also failed to realize significant network benefits, although they seem to be more efficient compared to medium banks. This discrepancy between the average efficiency scores of medium and small banks can be explained by the presence of many small banks that do not employ ATM

Table 2.10: The results of correlation tests.[a]

		Overall	Pure Tech.	Scale
Overall	s	1.000		
	p	1.000		
Pure Tech.	s	0.8535***	1.000	
	p	0.8801***	1.000	
Scale	s	0.8699***	0.5731***	1.000
	p	0.5546***	0.0955***	1.000
urban	s	0.5407***	0.4582***	0.4617***
	p	0.4071***	0.3357***	0.2577**
urban-to-total	s	-0.2191**	-0.1262	-0.3131***
	p	-0.0773	-0.0432	-0.0891
urban-power	s	0.5170***	0.4281***	0.4617***
	p	0.4125***	0.3487***	0.2469**
urban-network	s	-0.0667	-0.0388	-0.0664
	p	0.0625	-0.0376	0.2028*
big	s	0.5980***	0.4786***	0.5654***
	p	0.4822***	0.3712***	0.3523***
medium	s	-0.2685**	-0.1504	-0.3311***
	p	-0.1965*	-0.0436	-0.3234***
small	s	-0.3449***	-0.3412***	-0.2474**
	p	-0.2985***	-0.3395***	-0.0350

[a] s denotes the test statistic for the Spearman rank correlation test, whereas p denotes the test statistic for the Pearson correlation test. $***$ suggests significance at 1% level, $**$ is significance at 5% level and $*$ implies significance at 10% level.

technology. Like the small banks without ATMs, some of the small banks participating in shared networks provide specialized banking services to small groups of select clients and firms. Having ATM technology can allow these banks to differentiate themselves in this "sub-market" of competition which offers customized banking services to a "sub-group" of depositors. Therefore, it could be the case that the small banks participating in shared networks are more efficient than medium size banks not because sharing ATMs have allowed them to better compete with big banks, but rather because they can better compete with other small banks without ATMs.

It appears that another problem of the medium banks is that they are "too small" to compete with big banks and they are "too big" to compete with the small banks for select clients. In other words, the medium banks in Turkey may be heavily involved in retail banking but their branch/ATM networks are not developed enough to compete with the big banks. Some of these medium size banks have joined shared networks with big banks and have managed to differentiate themselves from medium and small banks who participate in the same shared ATM network, while competing with each other for deposits in urban areas. For their part, big banks that have shared ATM networks seem to have done so in order to combine forces and compete with the three big banks that operate extensive proprietary ATM networks across Turkey.

The lack of significant network and scale effects for many medium and small banks fits the conclusions reached by Matutes and Padilla (1994). The results of this study supports their conclusion that ATM compatibility is easier and more effective if shared-ATM networks are formed by banks that are limited to different locations because of regulatory reasons or due to geographical factors. For example, according to Matutes and Padilla, the first shared-ATM networks in Spain were formed by savings banks that had their market areas restricted by law. The recent linking of shared ATM networks between Bahrain, Kuwait, Qatar and Saudi Arabia is an example of how banks that are restricted by international borders can be more likely to share their networks.[23] On the other hand if banks competing for deposits within the same locations decide to share their ATMs, this may decrease the

[23] "Bahrain links ATM network with Saudi", Bahrain Tribune, February 13, 2002.

level of product differentiation between these banks, causing the sharing arrangement to become costly and ineffective, as reflected by their low efficiency scores.

The findings of this study also seem to support Carbo, Gardener and Williams (2003), who find that technological progress and technology sharing arrangements have disproportionally benefited large European savings banks while failing to reduce the costs of small and medium ones. Similarly, Vesala (2000) argues that in the early stages of ATM sharing, with multiple networks competing with each other, it is possible that banks will "oversupply" ATM machines, creating expensive idle capacity. The findings presented above makes it possible to argue that the efficiency of these banks is precisely lower due to this idea of idle capacity being created and the subsequent increase in network upkeep costs.

There is ample evidence of the idle capacity that has been created by banks who both increase the number of their ATMs in urban areas and link these to a network through sharing arrangements. This study provides some empirical evidence, as shown above in Table 2.8 that a majority of medium size banks and some small banks operate under DRS. It is likely that some of the idle capacity of these banks is caused by ATMs that are deployed in urban areas, but infrequently used. Other evidence has been put forward by the Banks Association of Turkey, which has concluded that "some ATMs operated by banks are located too close to each other and this is a waste of resources." It has suggested that banks should try "to increase the sharing of existing ATMs before deploying new ones."[24]

One possible solution to this problem of idle capacity and low efficiency among small and medium banks would be for these banks to form more partnerships with big banks. This would allow them to truly expand the services they offer to their customers and to gain an advantage over their competitors. Some banks have made strides towards achieving this goal, with one small and one medium bank from the Common Points network signing an ATM sharing agreement with the Pamukbank-YKB network in early 2003.[25] This arrangement may increase the accessibility of these banks in non-urban areas and make

[24]Banks Association of Turkey: ATM Systems Working Group Meeting Notes (October 2002). Available at www.tbb.org.tr.

[25]This sharing agreement was not included in the empirical analysis, as it didn't go into effect until the very end of the sample. However, DEA calculations (not shown) has shown that including these banks in both networks does not result in a significant change in the mean efficiency scores.

them more attractive compared to their competitors, some of which are also members of the Common Points network. It is possible that the nature of ATM sharing arrangements in Turkey will move in this direction, with banks switching networks, forming new networks or participating in multiple networks at the same time. The formation of a single, national network, however, seems unlikely based on the nature of the competition for deposits in urban areas and the findings of Matutes and Padilla (1994).

On the other hand, there exists some precedent that could suggest that big banks' willingness to share their ATMs with small banks may not be as high as the recent developments in Turkey suggest. In the previous five years, there have been instances in both the U.S. and Germany where big banks have decided to either prevent or limit the access of small banks' customers to their ATMs. In the U.S., some big banks have stopped accepting ATM deposits of other banks' customers, which limits the access of small banks' customers to their accounts. In Germany, big banks have resorted to having prohibitively high ATM usage fees for customers of small banks, while forming alliances with each other in order to get rid of foreign ATM fees for their customers. The small banks have tried to retaliate by blocking the customers of big banks from using their ATMs. Finally, the development of shared ATM networks in Canada took place significantly later than the U.S., as most of the major banks operated nationwide proprietary networks and resisted the idea of sharing their terminals with smaller rivals. This sentiment of big banks can be attributed to the fact that small banks "piggyback" on big banks' ATMs in prime locations and potentially prevent them from being able to exploit their large ATM networks.[26]

Similar worries have been echoed by the big banks in Turkey, who have stated that "the possible effects of increased sharing on the banks with extensive branch and ATM networks is an important issue."[27] Therefore, it is unlikely that big banks that enjoy relatively higher efficiency levels would be willing to increase their rivals' access to the rural markets by

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[26]For the U.S., see "ATM Deposits: Why some no longer share?" (American Banker, July 2003), for Canada, see "Canadian banks in ATM sharing project" (Financial Times, November 1984) and for Germany see "Sparkasse blocks use of ATMs for Bank 24 customers" (Frankfurter Allgemeine Zeitung, March 27, 1998) and "Competition Agency deals with ATMs" (Frankfurter Allgemeine Zeitung, February 10, 1998).

[27]Banks Association of Turkey: ATM Systems Working Group Meeting Notes (October 2002).

entering into extensive sharing arrangements with more small and medium size banks.

Another possibility has been put forward by Carbo, Gardener and Williams (2003), who argue that the lack of uniform benefits from technology sharing arrangements should promote consolidation in the banking sector. In the context of the Turkish banking sector, the consolidation argument would suggest that the large number of small and medium banks that offer similar products can be consolidated into a few big banks that would be able to offer differentiated products and be able to compete with other banks. One of the consequences of the 1999-2001 banking crisis in Turkey has been a wave of consolidation, encouraged by the government. Whether these mergers and acquisitions will increase the efficiency of the banking sector remains to be seen.

2.5 Alternate Specifications and Extensions

2.5.1 Alternate Specifications of the Model

As discussed in Section 2.4, the addition of interest expense on deposits as an input in the DEA model may be an issue of contention. It was also mentioned above that the results of the model using the production approach can also be of some interest. As a result, two additional input-output specifications were analyzed. First the analysis of the previous section was repeated without the inclusion of interest expense as an input. With the exclusion of interest expenses, there are five inputs (number of ATMs, number of additional shared ATMs, number of branches, employees and total operating expenses) and four outputs (volume of ATM transactions, total deposits, total loans and fees and commissions received from services). The results of the analysis are presented below in Table 2.11.

Although the mean efficiency scores are mostly smaller with this setup, there was not a significant change in the general results. On the contrary, for the years 2000 and 2001, the big banks with shared ATM networks are shown to be relatively more scale efficient compared to the big banks with proprietary networks, suggesting that big banks with shared networks did realize positive scale effects for these two years. The conclusion about the small banks being relatively less inefficient compared to the medium banks is robust, although the efficiency scores are somewhat different for 2003.

Table 2.11: Mean efficiency scores of banks without including interest expense as an input.

	2000		2001		2002		2003(Q2)	
	#	Overall	#	Overall	#	Overall	#	Overall
Big Banks w/ NW	5	0.989	4	1.00	4	1.00	4	1.00
Big Banks w/o NW	3	0.951	3	0.953	3	1.00	3	1.00
Medium Banks w/ NW	6	0.531	9	0.891	9	0.792	9	0.764
Medium Banks w/o NW	1	1.00	1	1.00	0	-	0	-
Small Banks w/ NW	8	0.523	7	0.718	6	0.80	6	0.799
Small Banks w/o ATMs	15	0.613	14	0.775	15	0.69	13	0.718
	Pure Tech.	Scale	Pure Tech.	Scale	Pure Tech.	Scale	Pure Tech.	Scale
Big Banks w/ NW	1.00	0.989	1.00	0.953	1.00	1.00	1.00	1.00
Big Banks w/o NW	1.00	0.951	1.00	0.953	1.00	1.00	1.00	1.00
Medium Banks w/ NWs	0.706	0.793	0.901	0.989	0.832	0.953	0.771	0.989
Medium Banks w/o NW	1.00	1.00	1.00	1.00	-	-	-	-
Small Banks w/ NW	0.644	0.852	0.757	0.941	0.829	0.957	0.817	0.972
Small Banks w/o ATMs	0.893	0.695	0.897	0.847	0.929	0.694	0.931	0.781

The new result of big banks with shared networks being relatively more efficient in 2000 can be due to the fact that two of the three big banks with proprietary networks are state banks. State banks have the advantage of being the only banks that the state pensioners and public sector employees can use for direct deposit from the government. Combined with the general belief that these banks are too-big-to-fail, they can offer lower interest rates than the private banks and still be able to collect and retain deposits. However, as interest expense has been taken out of this model, it appears that private banks can turn out to be more efficient than state banks if the advantage of low interest rates offered by state banks are taken out of the picture.

The second input-output specification made use of the limited data available on the number of deposit accounts for all banks in Turkey for the years 2001 and 2002. As described in the previous section, a "production approach" would use the number of deposit accounts and number of loans as outputs instead of the total amount of deposits and loans. In order to make sure that the inclusion of the number of deposit accounts would not significantly affect the results, an input-output specification consistent with the production approach and the available data was analyzed for the years 2001 and 2002. In this analysis, the outputs are defined as the number of Turkish Lira savings accounts and the number of foreign exchange accounts, whereas the inputs are the number of ATMs, the number of shared network ATMs, the number of branches and the number of employees. The efficiency estimates of the banks categorized according to size and network affiliation is given in Table 2.12.

Although the mean efficiency scores of medium and small banks are significantly lower under this setup, the general results are robust to using the number of deposit accounts as outputs. For both 2000 and 2001, big banks that participate in shared ATM networks are found to be more scale efficient than big banks with proprietary networks. Furthermore, in 2001, big banks with shared ATM networks are also more efficient overall compared to the banks with proprietary networks.

The only main difference between the results of the previous section and this analysis is that the medium banks are significantly more efficient compared to the small banks with shared networks. However, it should be kept in mind that the number of loans of a bank is not included among the outputs (due to the lack of data availability) and this is likely

Table 2.12: Mean efficiency scores of banks with the *number* of deposit accounts as an output.

	2001			2002		
	Overall	Pure Tech.	Scale	Overall	Pure Tech.	Scale
Big w/ NW	0.856	0.856	0.999	0.864	0.864	0.999
Big w/o NW	0.911	1.00	0.911	0.859	0.904	0.938
Medium w/ NW	0.515	0.519	0.989	0.481	0.486	0.986
Small w/ NW	0.33	0.346	0.884	0.337	0.343	0.979
Small w/o ATMs	0.259	0.797	0.344	0.353	0.89	0.412

to negatively effect the efficiency scores of small banks. As discussed above, many small banks in Turkey deal with a limited number of select clients for collecting deposits and use these funds for a variety of loans including consumer loans. Therefore the number of deposit accounts they have is likely to be small, with the number of loans exceeding the number of deposits. So, if the number of loans given out by the bank could also be included in this analysis, then it is likely that the efficiency scores would be higher. Despite this possible bias in the efficiency scores, these two alternate specifications discussed in this section are useful in ensuring that the results of the previous section are robust to the different definitions of input and outputs.

2.5.2 Specification Without Outliers

As discussed above, the main drawback of DEA is its inability to deal with outliers. Therefore, based on the suggestions from existing studies, efficiency scores from two alternate specifications were compared with the results presented above. The goal of this exercise was to make sure that the inclusion of outliers has not influenced the main findings.

The alternate specifications address issues related to entering zeros for the "number of ATMs" input and "ATM transaction volume" output for banks without ATM technology and the "number of shared ATMs" input being zero for banks without ATM technology and banks with proprietary networks. The first specification follows Resti (1997) and Favelo and

Papi's (1995) suggestion by excluding the number of ATMs and number of shared ATMs from the inputs and not using the volume of ATM transactions as an output. The results of this specification suggest that efficiency scores do not drastically change once these three variables are omitted. Correlation tests performed on the efficiency scores from the original model and this alternate specification are also reassuring. The correlation coefficients are for 70.6% overall efficiency (significant at 1%), 74.1% for pure technical efficiency (significant at 1%) and 71.5% for scale efficiency (significant at 1%).

The second specification follows the more cautious method of dropping all the banks that have a zero output or input value from the sample. Although the results appear to be robust, the findings are not quite as strong. The correlation coefficients are 36.4% for overall efficiency (significant at 1%) and 29.56% (significant at 5%). The correlation coefficient is negative and insignificant for scale efficiency scores, suggesting that there could be some issues related to outliers in the sample. However, the overall results of the alternate specifications do not appear to directly contradict the main findings.[28]

2.5.3 Possible Extensions

One of the main shortcomings of this study is the possible biases in the efficiency measures calculated through the DEA procedure. DEA measures efficiency by estimating the true frontier, which is not observed, and then measuring the distance of the firms' input-output combinations to the frontier. However, as the estimate of the true frontier is obtained from a finite sample, it is possible that the efficiency measures will have a bias.

Several studies has suggested that a bootstrap procedure can be used to construct confidence intervals for the efficiency scores and also to calculate the bias in the DEA procedure. Different methods of applying a bootstrap procedure has been discussed by Ferrier and Hirschberg (1997), Lothgren and Tambour (1999) and Simar and Wilson (1998). Applying a bootstrap to this study can prove to be useful, especially considering that the difference

[28]Rank correlation tests were also performed for both specifications. For the first specification, the rank correlation coefficients are 62.9% for overall efficiency, 68.4% for pure technical efficiency and 71.5% for scale efficiency (all significant at 1%). For the second model, the coefficients are 45.25% and 31.94% for overall and pure technical efficiency, respectively (both significant at 1%). Although not statistically significant, the rank correlation coefficient is positive for scale efficiency, which is encouraging.

between the efficiency scores of different categories of banks are sometimes only a few percentage points and any upward or downward bias in some of the efficiency scores can result in a misinterpretation of the results.[29]

2.6 Conclusion

This chapter has looked at the evolution of shared ATM networks in Turkey and has attempted to see whether banks have been able to realize net positive network and scale effects through ATM sharing. Using a non-parametric DEA method to calculate the productive efficiency of Turkish banks, it was shown that although evidence of network and scale benefits exist, the effects are not uniform across all banks.

The results indicate that big banks in Turkey have been the main beneficiary of both ATM technology and shared ATM networks, whereas the medium banks and small banks have failed to capture significant benefits associated with ATM sharing. Data on the location of bank branches and ATMs suggest that medium and small banks try to compete against each other in urban areas, while sharing their ATM networks. This dual competition and cooperation setup negates most of the positive effects, as an expansion of the shared network within urban areas fail to make banks more attractive to consumers in a market that is already over-saturated with ATMs. Furthermore, ATM sharing tends to decrease the level of differentiation between the different products offered by these banks, intensifying the level of competition for deposits. On the other hand, medium banks that have linked their ATM networks with big banks have recorded relatively high efficiency scores, suggesting that their arrangements have given them access to the rural markets where competition for deposits is not as intense. Sharing ATMs with big banks have also allowed these medium banks to differentiate themselves from the rest and capture more deposits in urban areas.

The period covered in the study is also significant, as it corresponds to a severe banking crisis and the best planned and executed rehabilitation program of the banking sector. The main characteristic of the rehabilitation program has been consolidation of banks, with

[29]However, it should be added here that studies on bootstrap procedures in a DEA setting has found the biases to be mostly less than a single percentage point. Therefore, it is unlikely that the main findings of the study will be reversed after the application of a bootstrap.

the number of branches and depository institutions decreasing significantly between 2000 and 2003. On the other hand, the growth rate of ATMs has remained high and positive, suggesting that bankers and the regulatory authorities do not consider the build-up of ATMs as a serious overcapacity issue. This study, however, makes point of caution that more ATM sharing does not automatically mean efficiency gains for banks. On the contrary, an increase in ATM sharing solely within the urban markets will be likely to increase the costs of banks without generating any benefits for the banks or their customers. Although ATMs are still significantly cheaper than branches, operating and sharing unproductive ATMs can possibly contribute to another build-up of overcapacity. The only two options for preventing this potential problem are either further consolidation of the banking sector or a carefully planned restructuring of the sharing arrangements.

Chapter 3

DO BANKING NETWORKS TOLERATE BAD BANKING PRACTICES?

3.1 Introduction

The last three decades of the twentieth century have witnessed a dramatic increase in the occurrence and severity of banking sector problems in the world. These episodes have not been confined to developing countries, as a number of industrial nations have also experienced significant banking sector problems. The typical symptom of a banking crisis is the presence of bank insolvencies. As banks play a key role in the economy by intermediation, credit allocation and maintaining financial discipline, the presence of bank insolvencies can have important implications for the economy as a whole. The U.S. Savings and Loan Crisis of the 1980s, the Nordic Banking Crisis of the early 1990s, the East Asian Crisis in 1997, the Turkish Banking Crisis of 1999-2001 and the current banking sector related problems in Argentina are good examples of the adverse effects of an unsound banking system.

Although the macroeconomic causes of banking crises have attracted significant interest in the literature, the microeconomic factors behind bank insolvencies remain somewhat unexplored. In their study, Caprio and Klingebiel (1996) find that microeconomic factors play a more important role in bank insolvencies than previously believed. These microeconomic factors, however, are too complicated to be investigated as a whole. Therefore, this study will attempt to explain the reasons behind the presence of one important microeconomic factor: the presence of "bad banking practices."

In broad terms, bad banking practices can be seen as a spectrum of unsound banking activities, ranging from deficient bank management to connected lending and outright fraud. The presence of "bad banks" is a common theme across almost all banking crisis episodes of the twentieth century. Caprio and Klingebiel find that 69% of the bank insolvencies in

their data set were caused by "deficient management." Furthermore, 30% of these "deficient management" cases could be classified as outright fraud. This view seems to be verified by White (1991) in his study of the Savings and Loan Crisis. Although White finds that the bulk of S&L's problems were not caused by outright fraud, he describes the causes as "an amalgam of deliberate risk-taking, carelessness, poor management, excessive optimism, bad luck, and fraud and criminal activity, compounded by the decline in the price of oil in the mid-1980s and by changes in the tax laws."[1] Similarly, in an analysis of bank failures during the Turkish Crisis of 1999-2001, Soral, İşcan and Hebb (2003) find evidence of illegal activities and excessive risk taking through connected lending and falsified equity capital.

However, it must be kept in mind that the accumulation of losses associated with bad banking practices does not occur overnight; it is an ongoing process. Therefore, it can be concluded that bad banks manage to "hide" within a banking sector without being detected and punished, at least for a certain amount of time. This is a potentially dangerous situation for the banking sector as a whole, since unexpected macroeconomic shocks can tip the balance for these "hidden bad banks" by forcing them into insolvency. For example, White (1991) notes that although the bulk of the S&L losses occurred between 1983-1985, the wave of failures did not start until 1986. Similarly, during the Turkish Banking Crisis, most of the losses were accumulated during 1998 and 1999 even though the first wave of nationalizations of the banks by the State Deposit Insurance Fund did not occur until December 1999. The available data for the Turkish crisis suggests that most of the banks in question (17 in all) were still collecting funds both from depositors and the interbank market during this time period.[2] This continuing support from the interbank market is a puzzling phenomenon. As interbank loans are generally not covered by deposit insurance (see Demirgüç-Kunt and Kane, 2001), banks should have an incentive not to make loans to suspected bad banks, as these interbank loans are unlikely to be paid back in case of insolvency or failure.

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[1] White, "The S&L Debacle", page 6.

[2] An illustrative example is the case of three of the five Turkish banks that failed in December 1999. Between January 1999 and December 1999 the "Loans due to the interbank market" to "Total liabilities" ratio for these banks increased from 1.42%, 2.48% and 3.57% to 4.47%, 4.49% and 14.46% respectively. One of the two remaining banks experienced a decline in this ratio and the other experienced a marginal increase.

The ability of bad banks to collect funds from the interbank market can also decrease the effectiveness of depositor monitoring of bad banks. There is growing evidence in the literature that uninsured depositors and even sometimes insured depositors monitor and discipline banks that are engaged in excessive risk taking or other types of bad behavior.[3] However, if bad banks have the ability to raise funds from other banks to satisfy the demand for withdrawals of depositors, the level of depositor monitoring can decline, relieving disciplinary pressure on the bank. This can be compared to a Ponzi scheme, in the sense that if enough depositors get their deposits back from a bank, the other depositors may be inclined to think that the bank is actually sound and not demand to withdraw their funds.

Therefore, the toleration of bad banking practices by other banks not only increases the level of losses associated with bad banks, but it can also interfere with depositor monitoring and make it ineffective. Providing a potential explanation to this puzzling toleration of bad banks is the main motivation of this essay.

The main idea behind the analysis presented below is that some services provided by banks are network goods: an additional user of the good increases the benefit of this good for all users. The presence of these network benefits may be one of the reasons behind why bad banks can participate in the interbank market and go unpunished by other banks (called "good banks" from this point on). Even though the interbank market support given to these bad banks can result in losses for the good banks in the sector, the alternative will cause a loss in network benefits (as denying support and letting the bad bank go into bankruptcy causes a decrease in the network benefits of all users). Therefore, if the potential loss of network benefits exceeds the potential loss from interbank support, then bad banks will be "tolerated" by the interbank market.

The chapter is organized as follows: Section 3.2 discusses the nature of banking networks and the history of such networks in the U.S. Section 3.3 builds up the main motivation behind this study. Section 3.4 develops a model of interaction between a bank that could be

[3]Calomiris and Wilson (1998) find that depositors punished risky banks by withdrawing their funds in the 1930s. Similarly, Goldberg and Hudgins (2002) find that uninsured depositors were actively monitoring S&Ls in the 1980s and 1990s by withdrawing their funds. Finally, Martinez Peria and Schmukler (2001) have argued that insured and uninsured depositors have punished bad banks in Latin America during 1980s and 1990s.

tempted to engage in bad banking and its depositors. Section 3.5 investigates the conditions under which an interbank network will tolerate the presence of a bad bank and the impact of the network's interference on the level of depositor monitoring. Section 3.6 concludes.

3.2 Functions of Banking Networks from a Historical Perspective

Although there is no established theory of banking networks, three characteristics of banking have been identified to have network good properties. These are payment and settlement, liquidity and credit.[4] This study is primarily interested in the network good properties of payment and settlement systems. Historically, these systems have been formed due to three reasons: economizing on transaction and information costs, providing liquidity support during bank runs and enhancing the attractiveness of the banks to their depositors by offering services that are compatible with other banks. All of these exhibit network good properties. For example, being involved in a check-clearing network can reduce transaction costs and also make the bank more attractive to its customers by allowing for speedy clearing of checks. Each additional bank within the network increases this network benefit.

One particular type of payment and settlement network that has attracted the most attention in the literature is a clearinghouse arrangement. Clearinghouses were an important feature in the U.S. during the National Banking Era of the nineteenth century and similar arrangements are a part of the modern financial markets around the world. The clearinghouses of the late nineteenth century served the purpose of clearing checks and bank notes. Without a clearinghouse system, a bank that wished to clear a check or redeem a note had to physically ship the check/bank note to the paying bank and wait for the arrival of currency (which resulted in significant transactions costs). Under these circumstances, it was common for financial instruments to be cleared at a sub-par rate.[5] A clearinghouse arrangement enabled banks to clear bank notes and checks at par, to reduce transaction costs and also sped up the process of clearing financial instruments.

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[4]See Honohan and Vittas (1996) for a detailed discussion of all three examples.

[5]Calomiris and Kahn (1996) present an extensive discussion of the Suffolk Bank System, which was a large bank note clearing system in New England. For a discussion of the late 19^{th} century check clearinghouses, see Gorton (1985).

The clearinghouse arrangements of today are not much different. Interbank networks such as Automated Clearinghouse Electronic Payment Systems (ACH) and The Clearing House Inter-Bank Payments System (CHIPS) provide banks with settlement of day-to-day transactions with member banks, without incurring large transaction costs.[6] As of 1990, 20% of all U.S. financial institutions were still members of private check clearinghouses, despite the fact that the Federal Reserve Banks offer check clearing services, often at rates cheaper than of clearinghouses. (Clair, Kolson and Robinson, 1995)

In addition to reducing transaction costs, clearinghouses serve another important purpose, which is to provide liquidity during times of distress. Although this function has become less prevalent during the twentieth century, acting as the "lender-of-last-resort" was an important feature of nineteenth century clearinghouses. During banking panics or depositor runs on individual banks, clearinghouses would issue emergency loans to their distressed members if they were deemed to be only temporarily insolvent. The main idea was to assure the public that the bank in question was structurally sound by displaying a show of confidence in the bank via the loans that were issued. In their study of the 1932 Chicago Banking Panic, Calomiris and Mason (1997) find that "interbank support" from other banks were instrumental in stopping the runs on certain banks. Similarly, during the 1837 Banking Panic, New England banks fared better because of the loans they secured from Suffolk Bank, the operator of their clearinghouse (Rolnick, Smith and Weber, 2000).

These lender-of-last-resort (and sometimes deposit insurance) functions that the clearinghouse displayed during times of financial instability are a curious phenomenon. Gorton (1985) states that "during banking panics, the clearinghouse united banks into an organization resembling a single firm which produced deposit insurance." However, this does not imply that all member banks were included in the united organization. The issuance of emergency loan certificates was contingent on whether the clearinghouse members were deemed to be structurally sound or not. If assistance was refused, this would serve as a signal to the public to run on this bank and drive it out of business. Dowd (1994) has argued that during banking panics, the clearinghouse would "circle the wagons" with the

[6]CHIPS is owned and operated by the New York Clearing House Association, which started out as a check clearinghouse in the mid-19th century.

banks that were deemed to be sound and throw the unsound banks "to the wolves" by refusing them assistance. In their model of a banking sector with a number of independent and small banks, Gorton and Huang (2002b) find that a bank coalition can be welfare improving during a banking panic.

The above mentioned "dual-functions" make a clearinghouse arrangement an interesting network setup. During non-panic times, the clearinghouse serves the purpose of reducing transaction costs, whereas during panic times it takes on some of the functions of a central authority (if there is no central bank). Although the existing literature treats these two functions as complements to each other, none of the studies take into consideration the effects of admitting or expelling banks from a network good perspective. Although there is something to be gained from refusing assistance to a bank that is deemed "bad", any expulsion from the network will also reduce network benefits for all remaining network members. Therefore, it is conceivable that there can be cases where tolerating (and assisting) a bad bank is more beneficial to the network than expelling the bank. Investigating the conditions under which this scenario occurs is the main thesis of this study. This thesis is presented in the following section along with some theoretical and empirical support from the existing literature.

3.3 Basic Theory

As described above, a decision to expel a "bad bank" from a network by refusing assistance during a bank run or a liquidity shortage comes with a benefit. This benefit can be generalized as a "prevention of contagion." Contagion can be summarized as one bank's liquidity problems propagating throughout the banking sector via contractual or informational links. Contagion has two different definitions that are used in the literature. The first definition is usually called "informational contagion" and it can be summarized as bad news about one bank causing bank runs on other banks. According to this definition, uninformed or unsophisticated depositors can run on sound banks just because there was a run on another bank. The presence of this type of contagion is well documented in the literature, although the magnitude of these contagion-induced runs are more suspect. Calomiris and Mason

(1997) find marginal contagion effects in the 1932 Chicago Banking Panic. In a subsequent study Calomiris and Mason (2000) look at various bank failures throughout the U.S. during the Great Depression and conclude that informational contagion was not a factor in much of the bank failures. On the other hand, Ó Gráda and White (2002) find strong evidence of contagion during the 1857 Banking Panic in New York and Carlson (2002) concludes that some bank failures during the 1893 Banking Panic were caused by informational contagion. Regardless, this type of contagion is not of interest for the analysis in this essay.

The other type of contagion is a liquidity-based effect and is usually called "financial contagion." This is the type of contagion that is of interest to this study. In this setup, liquidity problems of a bank propagate throughout the system because a bank with liquidity problems can not make payments promised to other banks. So these banks, who may have been counting on payments from the troubled bank, may not be able to meet their promised payments either. This chain effect can result in a disruption of the allocation of liquidity in the interbank market and result in more banks having problems.[7] Freixas and Parigi (1998) find that net settlement systems are more prone to financial contagion compared to gross settlement systems, despite the fact that a net settlement setup can be more beneficial than gross settlement by reducing the need to keep non-interest bearing reserves. Allen and Gale (2000) and Freixas, Parigi and Rochet (2000) show that market failure due to contagion can also occur in simpler interbank markets, where only lending and borrowing occur.[8]

There is historical evidence in the literature on the presence and severity of financial contagion. Calomiris and Schweikart (1991) argue that the Banking Panic of 1857 spread from New York to other states because banks in these states were unable to redeem their funds kept in NY banks and therefore were not able to satisfy the withdrawal demands of their customers. This observation, combined with the theoretical evidence mentioned above, suggests that banks have an incentive to monitor each other in an interbank setting

[7] An alternative cause of financial contagion has recently been presented by Diamond and Rajan (2002), who argue that bank failures lead to a contraction in the common pool of liquidity. This contraction can be shown to lead to further bank insolvencies.

[8] Among these three studies, only Freixas and Parigi explicitly discuss potential solutions to contagion. They stress that "interbank suspension of convertibility" (i.e. not honoring payments due to troubled banks) can prevent contagion. This idea is similar to a refusal to grant emergency loans to a bad bank by a clearinghouse.

and punish bad banks by not giving them the support they need to survive bank runs.

On the other hand, some (or all) members of an interbank network may also have an incentive not to expel a bad bank and give it assistance, despite the threat of contagion. This incentive is related to the potential loss of network benefits associated with disconnecting a user of the network good. There is evidence in the literature that such network benefits can be quite large. In their studies of the ACH system, Gowrisankaran and Stavins (2002) and Ackerberg and Gowrisankaran (2002) find moderately large network benefits associated with the adoption of ACH technology. In their examination of the adoption of automated teller machines (ATMs), Saloner and Shepard (1995) also find evidence of large network benefits associated with ATM networks.

However, these network benefits create positive network externalities that can result in the under-utilization of the network good, unless the externality is internalized. One way of internalizing the externality is to pay a subsidy to network users, who may not be receiving large benefits from participating in the network. These subsidies can increase the usage of the good to the optimal level. The idea of banks subsidizing each other in order to internalize network externalities is a common theme in the literature. Ackerberg and Gowrisankaran (2002) suggest that moderate subsidies between banks are welfare improving in the ACH system. In his study of the Suffolk system, Bodenhorn (2002) argues that the lack of subsidies (in the form of membership-fee discounts) to country banks that benefited much less from the network compared to city banks, was the main cause of defections from the system and its eventual collapse in 1860. Weinberg (1997) also argues that payment networks need to price their membership in a way that would allow certain users to recognize some of the external benefits of their participation in the network (i.e. a subsidy).

Another view on banks within a network assisting each other in times of distress has been presented by Leitner (2003). This study assumes that the payoffs of all banks within a network decrease if one of the banks go bankrupt. Under this setup banks would be willing to bail each other out in order to increase their payoffs. Although Leitner describes such a bailout as an attempt to prevent contagion, the general setup resembles positive benefits associated with keeping network members.

Combining these elements creates a more complicated picture of interbank market dis-

cipline than the literature recognizes. Depending on the benefits that a bad bank generates for other network members, an interbank network may choose to support a bad bank by granting it support. This support can also be viewed as a subsidy for this bad bank, which may not be realizing significant benefits from being in the network. Under this setup, the potential loss associated with the loans being made and the threat of financial contagion can be outweighed by the network benefits that will be realized by the members in the future. In a sense, this lax monitoring (and the support) is the subsidy given to the bad bank, in order to convince the bank to join the network and internalize the externality. If such an equilibrium exists, it would go against the conventional view described in the previous section, about the selectivity of networks (especially clearinghouses) during times of financial stress. The model presented below examines the conditions under which such an equilibrium may be achieved.

3.4 The Model With No Network Formation Opportunity

3.4.1 Overview and Setup

This section will specify the conditions under which a bank may be tempted to engage in bad banking practices and how interactions with its depositors can prevent the bank from doing so when there are no network formation opportunities. As explained below, the particular bad banking practice modelled in this study is excessive risk taking.

It should be noted here that this model is not meant to be a general model of interaction between banks and their depositors. Rather, the goal is to show, in the simplest way possible, how the depositors can prevent the bank from being tempted to engage in bad banking practices. The results of this model will serve as a benchmark in analyzing the effects of an interbank network on depositor monitoring. In order to achieve the goal of simplicity, the model assumes complete information, where the depositors know all of the information concerning the bank.

The presence of depositor monitoring is modelled around the ability of depositors to withdraw a certain portion of their funds early enough, so that a bank will not be able to invest all of its deposits in risky (or bad) assets. This phenomenon has been discussed

in the literature on depositor monitoring, where depositing funds in demand deposits, as opposed to time deposits is considered as "punishment" for banks, as an increase in demand deposits and a decrease in time deposits restricts the bank's opportunities for using funds in long-term projects (Martinez Peria and Schmukler, 2001).[9]

The model has three periods and the setup is similar to the model of Diamond-Dybvig (1983). At the initial period ($t = 0$) the bank collects \$1 in deposits from a group of depositors. The number of depositors is normalized to 1. The bank has to allocate its deposits between three available assets. The first asset is a storage technology (i.e. reserves) that yields \$1 at $t+1$ for each \$1 invested at t. As seen below, the only reason that the bank would invest in the storage technology is to have sufficient funds at date $t = 1$ to satisfy any demand for withdrawals. The other two assets are long-term assets, they must be bought at $t = 0$ and they yield returns at $t = 2$. Investing in one of these assets will represent a bad banking practice and the other will be considered a sound banking practice. The details of these assets are discussed below.

The demand for withdrawals at $t = 1$ comes from a portion of depositors who choose to withdraw their funds. The portion of deposits withdrawn at $t = 1$ is given by z. It will be shown in the analysis of the model that the amount of funds withdrawn early will be an important determinant of bank behavior. The depositors who withdraw their funds at $t = 1$ do not get an interest payment on their deposits, whereas the depositors who withdraw their funds at $t = 2$ are promised an interest payment of $(1 + i)$.[10]

The timing of the model is formalized as follows:

- At $t = 0$, depositors deposit \$ 1 in the bank and set the amount of deposits to be withdrawn at $t = 1$ (given by z)

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[9]This type of action may not correspond to "monitoring" in the typical sense, where monitoring may include an audit, punishment, renegotiation, information gathering or similar behavior. Restricting the bank's options by depositing funds in a short-term account can be considered as "setting the scale" of the bank, as less funds are not available for long-term investment. However, this study follows the existing literature and calls such actions "monitoring" and "punishment" instead of attempting to create a new definition.

[10]Withdrawals at $t = 1$ with no interest payment vs. withdrawals at $t = 2$ with interest payment can be thought of as checking or savings accounts vs. money market accounts (which have a higher interest rate attached to them).

- The bank sets reserves and allocates the non-reserve funds in the assets available.
- At $t = 1$ depositors withdraw z from the bank. If the bank can't pay its depositors, it goes bankrupt.
- At $t = 2$ nature chooses the state of the world. Returns on the long-term assets are realized.
- Remaining depositors (given by $1 - z$) withdraw their funds. If the bank can't pay its depositors, it goes bankrupt.

In addition to reserves, the bank can invest its funds in two different long-term assets. The first is a "safe asset" that returns $R_1(x)$ with certainty at $t = 2$ for each $\$x$ invested at $t = 0$, where $0 \leq x \leq 1$. $R_1(x)$ is assumed to be positive for all values of x and to be a concave, well-behaved function with decreasing returns to scale.[11] It is also assumed that the bank will be able to pay its depositors in full if it chooses to invest all of its funds in the safe asset: $(1 + i) < R_1(1)$.

The other long-term asset is a "risky asset" that can be thought of as a project. With probability γ (where $0 < \gamma < 1$), the project is a success and it yields a public and verifiable return of R_2 at $t = 2$ for each \$1 invested at $t = 0$. This public return is assumed to be large enough to pay the interest payment promised to the depositors ($R_2 > (1 + i)$). With probability $1 - \gamma$, the project is a failure and yields a public return of 0. The risky asset also yields a private, unverifiable return of P for the banker if the project succeeds. The implications of this private benefit will be further discussed below.

Finally, it is assumed that:

$$\gamma(R_2 + P) > R_1'(1)$$

This assumption states that the marginal benefit from investing all of the deposits in the safe asset (given by $R_1'(1)$) is less than the marginal benefit from investing in the risky

[11] Specifically, these assumptions are $R_1(x) > 0, R_1(0) = 0, R_1'(x) > 0, R_1''(x) < 0$ and $R_1'(0) = \infty$.

asset (given by $\gamma(R_2 + P)$). This ensures that the bank will want to invest some portion of its deposits in the risky asset.

Investment in the risky asset is considered a bad banking practice for two reasons. First, the risky asset is not desirable to the depositors because if it fails the bank will go bankrupt and the depositors will not get their deposits back. On the other hand, the safe asset guarantees them to get their funds back at $t = 2$. Therefore, the risk-neutral depositors would like the bank to invest all of its funds in the safe asset, which yields them a return of $(1 + i)$ with certainty, whereas the risky asset yields an expected return of $\gamma(1 + i)$ only.

The second reason why investment in the risky asset is considered a bad banking practice lies with the private benefit. The private benefit can be thought of and modelled as a bribe or some other form of monetary gain that solely benefits the banker and not the whole society. Benefits bank owners receive from "looting" their banks is a good example. Both in the S&L crisis in the U.S. and the banking crises in developing countries, it has been observed that private benefits derived from bad banking practices has been turned into funds in off-shore accounts or private perks for bank owners, which are unlikely to benefit the society as a whole. As a result, investing in an asset that generates a private benefit for the banker is considered a bad banking practice.[12]

The last variable of interest is the personal bankruptcy cost of the banker. If at any time the bank is unable to satisfy the depositors' demand for withdrawals, it will go bankrupt. In case of bankruptcy, the banker will face a personal bankruptcy cost. This cost is assumed to be a "loss of reputation" and it is given by B. The intuition is that if a bank invests heavily in the risky asset and the project is a failure, then the bank will go bankrupt. Under limited liability, it is unlikely that there will be a transfer of funds from the banker to the depositors in case of bankruptcy. However, if a banker causes his/her bank to go bankrupt

[12]For example, during the S&L Crisis there were some banks which have engaged in "lavish spending on new corporate headquarters, executive salaries, client entertaining and company parties." However, the studies on the S&L Crisis tend to diminish the importance of such behavior, as it can not account for a majority of bank failures during that period (White, 1991). On the other hand, similar activities were featured prominently during the Turkish Banking Crisis (Soral, *et al.*, 2003). Another example of a private benefit that does not increase social welfare has been observed in Chile, where business groups used loans from affiliated banks to increase their market power and political clout during the 1970s and 1980s (de la Cuadra and Valdez, 1992). Finally, there were multiple bank owners and managers who were convicted for transferring bank funds into offshore accounts during the recent banking crisis in Turkey.

due to excessive risk taking, then the banker will face a substantial loss of reputation and it will be harder for him/her to re-enter the banking business, either as a manager or as the owner of a new bank.

The analysis below will first examine the bank's problem to determine the conditions under which the bank will avoid taking excessive risk (this will be interpreted as "good behavior"). As the monitoring decision of the depositors will prove to be an important determinant of the bank's behavior, the depositors' problem will also be examined in detail.

3.4.2 The Bank's Problem

The main goal of this section is to show the conditions under which the bank will be "good" and avoid bankruptcy at time $t = 2$. First, the banker's objective function will be specified and discussed. Then, it will be shown that the private benefit associated with the risky asset (P) is an important determinant of bank behavior. The main finding is that if P is sufficiently low, then the bank will be good regardless of the values of z and B.

The remaining parts of the analysis will show that even if P is not low, the bank can still be induced to be good through and interaction of depositor monitoring (z) and the banker's accumulated reputation (B).[13] The banker's problem is followed by an analysis of the objective function of the depositors.

The Banker's Objective Function

The banker can allocate its deposits in reserves, the safe asset or the risky asset. As discussed above, the bank needs to set reserves equal to z in order to satisfy the depositors' demand for withdrawals. The non-reserve funds (given by $1-z$) are allocated between the long-term assets. The amount of non-reserve funds allocated in the safe asset is denoted by q. The amount of funds allocated in the risky asset is therefore given by $1 - z - q$.

Investment in the risky asset does not automatically suggest that the bank will go bankrupt. If the risky asset is a failure (with probability $1 - \gamma$), the bank can still be solvent if the return on the safe asset is sufficient to pay the depositors. In other words, as

[13] A relatively uninteresting case of a bank avoiding excessive risk taking solely due a very high level of reputation (B) will also be briefly discussed.

long as the weight of the risky asset in the bank's portfolio is small, then the bank can still pay its depositors even if the risky asset fails. This implies a cutoff value for q (denoted q^c) such that if $q > q^c$, the bank will avoid bankruptcy in the bad state. This cutoff value q^c is defined by the following condition:

$$R_1(q^c(z)) = (1-z)(1+i) \tag{3.1}$$

Note that the cutoff value is written as $q^c(z)$ and is decreasing in z.

However, if it turns out that $q^c(z) > 1-z$ and the risky asset fails, then the bank will not be able to stay solvent, as the amount that needs to be invested in the safe asset exceeds the amount of available non-reserve funds. The digression below rules out this case, by showing that $q^c(z) \leq 1-z$ for all values of q and z.

$q^c(z) \leq 1-z$ can also be written as:

$$R_1(q^c(z)) \leq R_1(1-z)$$

Substituting (3.1) into this expression yields:

$$(1-z)(1+i) \leq R_1(1-z) \tag{3.2}$$

The lowest value that z can take is 0. Substituting $z = 0$ into (3.2) yields $(1+i) \leq R_1(1)$, which is true by assumption. The highest value z can take is 1. Substituting $z = 1$ into (3.2) yields $0 \leq 0$, which is always true. Therefore, for the range $0 \leq z \leq 1$, $q^c(z) \leq 1-z$ always holds implying that the banker will always have enough funds available to invest in the safe asset and avoid bankruptcy if he/she chooses to do so.

The definition of the cutoff value $q^c(z)$ makes it possible to distinguish between "good" and "bad" behavior by the banker. Throughout the rest of the analysis, setting $q < q^c(z)$ (and hence taking on excessive risk) will be called bad behavior and setting $q \geq q^c(z)$ will be referred to as good behavior.

Based on the relationship between q and $q^c(z)$, the expected payoff function of the banker for given values of z and B is:

$$\Pi = \begin{cases} \gamma\Big[R_1(q) + (1-z-q)(R_2+P) - (1-z)(1+i)\Big] & \\ \qquad -(1-\gamma)B & \forall q < q^c(z) \\ \gamma\Big[R_1(q) + (1-z-q)(R_2+P) - (1-z)(1+i)\Big] & \\ \qquad +(1-\gamma)[R_1(q) - (1-z)(1+i)] & \forall q \geq q^c(z) \end{cases}$$

This expression can be simplified to:

$$\Pi = \begin{cases} \gamma\Big[R_1(q) + (1-z-q)(R_2+P) - (1-z)(1+i)\Big] & \\ \qquad -(1-\gamma)B & \forall q < q^c(z) \\ \Big[R_1(q) - (1-z)(1+i)\Big] + \gamma(1-z-q)(R_2+P) & \forall q \geq q^c(z) \end{cases} \tag{3.3}$$

Based on this expected payoff function, the bank chooses the optimal value of q that maximizes (3.3). If the q that maximizes (3.3) falls within the range $q < q^c(z)$, the banker will be bad and if the optimal q falls within $q \geq q^c(z)$, the banker will be good.

For simplicity, the expected payoff from setting $q < q^c(z)$ will referred to as $A(q)$ and the expected payoff from setting $q \geq q^c(z)$ will be referred to as $C(q)$ throughout the analysis presented below.

As seen in (3.3), B only appears in $A(q)$ as losing accumulated reputation is only an issue for the banker if $q < q^c(z)$ and the risky asset is a failure. Therefore, it can be shown that the expected payoff function has a positive discrete jump at $q = q^c(z)$. Consider $A(q)$ and $C(q)$ at the point $q = q^c(z)$:

$$A(q^c(z)) = \gamma\Big[R_1(q^c(z)) + (1-z-q^c(z))(R_2+P) - (1-z)(1+i)\Big] \\ -(1-\gamma)B$$

$$C(q^c(z)) = \Big[R_1(q^c(z)) - (1-z)(1+i)\Big] + \gamma(1-z-q^c(z))(R_2+P)$$

Substituting (3.1) into these expressions for $R_1(q^c(z))$ and simplification yields:

$$A(q^c(z)) = \gamma(1-z-q^c(z))(R_2+P) - (1-\gamma)B \tag{3.4}$$

$$C(q^c(z)) = \gamma(1 - z - q^c(z))(R_2 + P) \tag{3.5}$$

From (3.4) and (3.5), it is clear that as long as $B > 0$, $C(q^c(z)) > A(q^c(z))$ and the jump of the expected payoff function at $q = q^c(z)$ is positive.

If the optimal value of q that maximizes (3.3), given by q_1^*, is greater than $q^c(z)$, then the first order condition is:

$$R_1'(q_1^*) = \gamma(R_2 + P) \tag{3.6}$$

If the optimal q, given by q_2^*, is smaller than $q^c(z)$, then the FOC is:

$$R_1'(q_2^*) = (R_2 + P) \tag{3.7}$$

The assumptions about the shape of the function $R_1(q)$ discussed above ensure that this problem has an interior solution. From (3.6), (3.7) and the assumption that $R_1'(0) = \infty$, it is clear that $0 < q_2^* < q_1^*$, and the optimal value of q can not be 0. Furthermore, as it was assumed that $R_1'(1) < \gamma(R_2 + P)$, it is clear the optimal value of q can not be equal to 1. Therefore, both corner solutions can be ruled out.

Of course, if $z > 0$, then the "corner" is $1 - z$ and not 1. However, this possibility can be ruled out intuitively though the behavior of the depositors. It should be kept in mind that z is set by the depositors and as shown in the depositors' problem below, they would like to set the smallest z possible. Now consider a situation where the depositors have set a z such that $1 - z < q_1^*$. In this case, it is clear that the expected payoff of the banker from setting $q > q^c(z)$ has a positive slope at $q = 1 - z$. As z goes down, the expected payoff for the range $q > q^c(z)$ increases until $q_1^* = 1 - z$ is reached. Therefore, by actually *reducing* the level of monitoring, the depositors increase the likelihood of good behavior by the banker. As the depositors benefit from inducing good behavior by setting the smallest z possible, they will never set a z such that $1 - z < q_1^*$. This observation effectively rules out $1 - z$ from being a local maximum for the range $q > q^c(z)$.[14]

[14]Although not shown, this can also be mathematically proven by differentiating $A(q_2^*)$ and $C(1 - z)$ with respect to z. This differentiation shows that as long as $1 - z < q_1^*$, $\partial C(1 - z)/\partial z > \partial A(q_2^*)/\partial z$, suggesting that a decrease in z increases the payoff from being good at a faster rate compared to the payoff from being bad. Therefore, a decrease in z would make the bank more likely to be good. Knowing this, the depositors would never set $1 - z < q_1^*$.

Given these specifications, the bank's problem can be summarized as follows: As seen in (3.3), the expected payoff function has two distinct parts, $A(q)$ for $0 < q < q^c(z)$ and $C(q)$ for $q^c(z) \leq q < 1 - z$. For each part there is a local maximum, which yields the highest payoff associated with being bad and being good. These payoffs are given by $\max_q A(q)$ and $\max_q C(q)$ respectively. The bank will be good and set a q within the range $q^c(z) \leq q < 1-z$, as long as:

$$\max_q C(q) \geq \max_q A(q)$$

The goal of the analysis below is to find the conditions under which the bank will display this behavior. However, before that analysis can be performed, an investigation into the location of the local maxima for both $0 < q < q^c(z)$ and $q^c(z) \leq q < 1 - z$ is necessary.

Given the expected payoff function specified in (3.3), it is possible to determine the shape of the objective function and the location of the local maxima by using the slopes of $A(q)$ and $C(q)$ at the point $q = q^c(z)$. Once the local maxima are known, then the maximum expected payoffs from being good ($\max_q C(q)$) and being bad ($\max_q A(q)$) can be compared. This comparison makes it possible to determine the conditions under which the bank will choose to be good and set a q that falls within the $q^c(z) \leq q < 1 - z$.

The slopes of $A(q)$ and $C(q)$ at the point $q = q^c(z)$ are given by:

$$A'(q^c(z)) = \gamma\Big[R_1'(q^c(z)) - (R_2 + P)\Big]$$
$$C'(q^c(z)) = R_1'(q^c(z)) - \gamma(R_2 + P)$$

The sign of $A'(q^c(z))$ is used in determining the local maximum for the range $0 < q < q^c(z)$. If $A'(q^c(z)) > 0$, then q_2^* can not be a local maximum. It should be kept in mind that q_2^* is derived from the first order condition (3.7), which states $R_1'(q_2^*) = (R_2 + P)$. However, if the slope of $A(q)$ is positive at $q = q^c(z)$, then it is clear that q_2^* lies within $q > q^c(z)$. Therefore, q_2^* can not be a local maximum for the range $0 < q < q^c(z)$ and the local maximum given by $q = q^c(z)$.

On the other hand, if $A'(q^c(z)) \leq 0$, then $q = q_2^*$ is the local maximum for the range $0 < q < q^c(z)$. In order to account for the role of $A'(q^c(z))$ in determining the local maximum, the local maximum for the range $0 < q < q^c(z)$ will be denoted as $\hat{q}_2(z)$, where

$$\hat{q}_2(z) = \begin{cases} q_2^* & \text{if } A'(q^c(z)) \leq 0 \\ q^c(z) & \text{if } A'(q^c(z)) > 0 \end{cases}$$

Similarly, the sign of $C'(q^c(z))$ determines the local maximum for $q^c(z) \leq q \leq 1 - z$. If $C'(q^c(z)) \geq 0$, then $q = q_1^*$ is the local maximum, as $R_1'(q_1^*) = \gamma(R_2 + P)$ is achieved at a $q_1^* \geq q^c(z)$. However, if $C'(q^c(z)) < 0$, then q_1^* can not be the local maximum, as $q_1^* < q^c(z)$. In this case, the local maximum will be $q = q^c(z)$. Denoting the local maximum for $q^c(z) \leq q \leq 1 - z$ as $\hat{q}_1(z)$:

$$\hat{q}_1(z) = \begin{cases} q_1^* & \text{if } C'(q^c(z)) \geq 0 \\ q^c(z) & \text{if } C'(q^c(z)) < 0 \end{cases}$$

As both $A'(q^c(z))$ and $C'(q^c(z))$ are functions of P, the location of the local maxima for the two ranges of the objective function will also be determined by the value of P. The following analysis will show that there are two ranges of values that P can take. These ranges will be called: "low" and "high", with the conditions under which the bank will be good depending on the range P falls in. The precise definitions of these ranges and their implications on the bank's behavior are discussed below.

Low P

This section will show that even when there is no depositor monitoring ($z = 0$), it is possible for the bank to be good and set $q \geq q^c(0)$, as long as P is sufficiently small. This condition will allow for the derivation of the "low" range of values for P.

Consider a general case where $A'(q^c(z))$ is strictly positive and there is no depositor monitoring ($z = 0$). $A'(q^c(0)) > 0$ implies:

$$\gamma[R_1'(q^c(0)) - (R_2 + P)] > 0$$

As $R_1'(q^c(0)) > (R_2 + P)$, then it must be true that $C'(q^c(0)) > 0$. Therefore, for this case, the local maxima of the objective function are given by $\hat{q}_2 = q^c(0)$ and $\hat{q}_1 = q_1^*$. In this setting, the maximum expected payoffs associated with being bad and being good are given by:

$$\max_q A(q) = A(q^c(0))$$
$$\max_q C(q) = C(q_1^*)$$

It was shown above that the expected payoff function given in (3.3) has a positive jump at $q^c(z)$ for all values of z, which implies $C(q^c(0)) > A(q^c(0))$. As $q_1^* > q^c(0)$, it is clear that $C(q_1^*) > A(q^c(0))$ and the optimal value of q that maximizes (3.3) is q_1^*. As setting a q such that $q > q^c(z)$ is considered "good behavior" by the bank, $A'(q^c(0)) > 0$ is a sufficient condition to induce the bank to be good.

As $A'(q^c(0))$ is a function of P, a condition on the values that P can take can be derived from $A'(q^c(0)) > 0$:

$$A'(q^c(0)) = \gamma\Big[R_1'(q^c(0)) - (R_2 + P)\Big] > 0$$

which implies:

$$P < R_1'(q^c(0)) - R_2 \tag{3.8}$$

From (3.8) a special cutoff value for P can be defined, such that as long as P is below this cutoff value $A'(q^c(0))$ will be negative and the bank will be good and set $q > q^c(z)$ even if $z = 0$. So, if the depositors observe that the private benefit of the banker is below $P^c(0)$, then they will set $z = 0$, as monitoring is not necessary. The range of values $P < P^c(0)$ will be referred to as "low" values of P. Intuitively, this condition suggests that if the private benefit associated with the risky asset is sufficiently low, the banker will choose to be good and invest a large portion of its funds in the safe asset, even if there is no depositor monitoring. This case is illustrated in Figure 3.1.

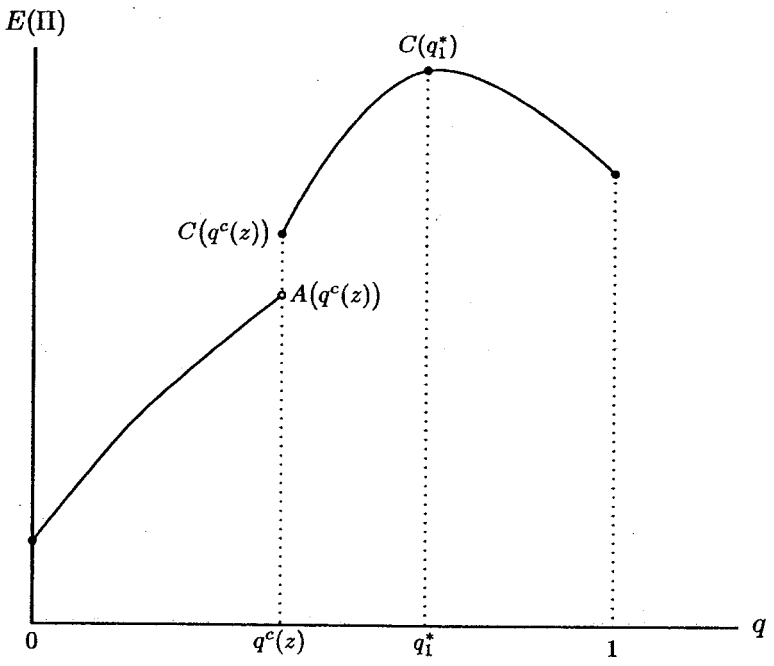

Figure 3.1: The expected payoff function for the bank when P is "low." Note that for this case, $A'(q^c(0))$ and $C'(q^c(0))$ are both positive.

High P

As discussed above, the bank being good in the absence of depositor monitoring is conditional on whether $P < P^c(0)$ (which implies $A'(q^c(0)) > 0$) or not. This section will show that even if P is not low, the bank can be induced to be good through an interaction of z (depositor monitoring) and B (banker's accumulated reputation) or solely through B.

As $A'(q^c(z)) \leq 0$, the local maximum for the range $0 < q < q^c(z)$ is now given by $\hat{q}_2(z) = q_2^*$. On the other hand, the sign of $C'(q^c(z))$ is indeterminate and there are two possible local maxima for the range $q^c(z) \leq q < 1$, given by:

$$\hat{q}_1(z) = \begin{cases} q_1^* & \text{if } C'(q^c(z)) \geq 0 \\ q^c(z) & \text{if } C'(q^c(z)) < 0 \end{cases}$$

Based on these local maxima, the expected payoff from being bad ($\max_q A(q)$) is given by $A(q_2^*)$. The expected payoff from being good ($\max_q C(q)$) is $C(\hat{q}_1)$. These expressions are reproduced below for convenience.

$$A(q_2^*) = \gamma\Big[R_1(q_2^*) + (1 - z - q_2^*)(R_2 + P) - (1 - z)(1 + i)\Big] - (1 - \gamma)B$$

$$C(\hat{q}_1) = \Big[R_1(\hat{q}_1) - (1 - z)(1 + i)\Big] + \gamma(1 - z - \hat{q}_1)(R_2 + P)$$

Consider a case where for a given z, P and B, the expected payoff from being good ($C(\hat{q}_1)$) is equal to the expected payoff from being bad ($A(q_2^*)$). This case is illustrated in Figure 3.2, where the solid line represents the case where $\hat{q}_1 = q_1^*$ and the dashed line represents the case where $\hat{q}_1 = q^c(z)$. In both cases, the banker is indifferent between being good and being bad, and it is assumed that he/she will choose to be good.

This can also be written as:

$$A(q_2^*) = C(\hat{q}_1) \tag{3.9}$$

Now, assume that B falls. If it can be shown that good behavior of the bank can be restored with an increase in z, it will be clear that an interaction of reputation (B) and

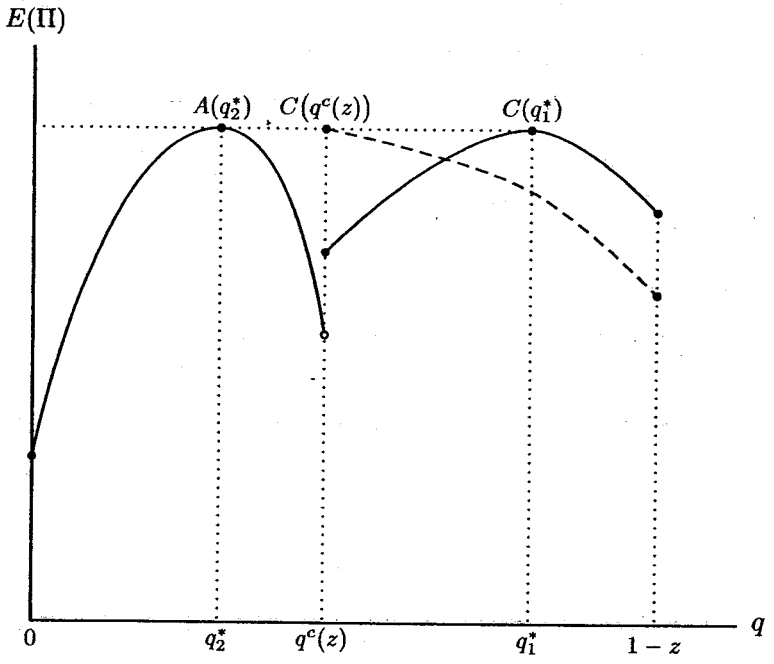

Figure 3.2: The shape of the expected payoff function of the bank when P is high but the presence of z forces the bank to be good.

depositor monitoring (z) can induce the bank to be good. Therefore, it must be shown that $\frac{dz}{dB} < 0$ for both $\hat{q}_1 = q_1^*$ and $\hat{q}_1 = q^c(z)$.

Totally differentiating (3.9) yields:

$$\begin{aligned} &\frac{\partial A(q_2^*)}{\partial B}dB + \frac{\partial A(q_2^*)}{\partial z}dz + A'(q_2^*)\frac{\partial q_2^*}{\partial z}dz \\ &= \frac{\partial C(\hat{q}_1)}{\partial B}dB + \frac{\partial C(\hat{q}_1)}{\partial z}dz + C'(\hat{q}_1)\frac{\partial \hat{q}_1}{\partial z}dz \end{aligned} \tag{3.10}$$

There are two important points to be noted in (3.10). First, as q_2^* is solely determined by the first order condition (3.7), it is not a function of z and therefore $\partial q_2^*/\partial z = 0$. Second, as B does not appear in $C(q)$, $\partial C(\hat{q}_1)/\partial B = 0$. Making these substitutions, (3.10) becomes:

$$\frac{\partial A(q_2^*)}{\partial B}dB + \frac{\partial A(q_2^*)}{\partial z}dz = \frac{\partial C(\hat{q}_1)}{\partial z}dz + C'(\hat{q}_1)\frac{\partial \hat{q}_1}{\partial z}dz$$

Manipulation yields:

$$\frac{\partial A(q_2^*)}{\partial B}dB = \left[\left(\frac{\partial C(\hat{q}_1)}{\partial z} - \frac{\partial A(q_2^*)}{\partial z}\right) + C'(\hat{q}_1)\frac{\partial \hat{q}_1}{\partial z}\right]dz \tag{3.11}$$

Although these derivatives can be calculated separately and substituted into (3.11), some of their signs are obvious without explicit calculations. $\partial A(q_2^*)/\partial B$ has a negative sign. $C'(\hat{q}_1)$ equals 0 if $q = q_2^*$ and it is negative if $q^c(z)$. $\partial \hat{q}_1/\partial z$ is zero if $q = q_1^*$ and it is negative if $q = q^c(z)$.

The only two derivatives that need to be calculated are $\partial A(q_2^*)/\partial z$ and $\partial C(\hat{q}_1)/\partial z$, which are given by:

$$\frac{\partial A(q_2^*)}{\partial z} = \gamma[(1+i) - (R_2 + P)] \tag{3.12}$$

$$\frac{\partial C(\hat{q}_1)}{\partial z} = (1+i) - \gamma(R_2 + P) \tag{3.13}$$

Therefore, $\partial C(\hat{q}_1)/\partial z - \partial A(q_2^*)/\partial z = (1-\gamma)(1+i) > 0$. Re-examining (3.11):

$$\frac{dz}{dB} = \frac{\left[\overbrace{\left(\frac{\partial C(\hat{q}_1)}{\partial z} - \frac{\partial A(q_2^*)}{\partial z}\right)}^{(+)} + \overbrace{C'(\hat{q}_1)\frac{\partial \hat{q}_1}{\partial z}}^{(\geq 0)}\right]}{\underbrace{\frac{\partial A(q_2^*)}{\partial B}}_{(-)}} < 0 \tag{3.14}$$

The only exception to this analysis is when the accumulated reputation of the banker B is so large, that the bank will be good even if there is no depositor monitoring. This would be the case if $C(\hat{q}_1) \geq A(q_2^*)$ when $z = 0$. This corresponds to a case where the banker's accumulated reputation is so high that the private benefit generated by the risky asset is not tempting enough for the banker to risk his/her reputation. Finding the value of B that forces the bank to be good in the absence of depositor monitoring is trivial and it can be found by substituting $z = 0$ into (3.3) and setting $C(\hat{q}_1) = A(q_2^*)$.

The main results of the analysis performed in this section is summarized below.

Proposition 1 *The behavior of the bank is dependent on the values of P, B and z. If P is sufficiently low, then the bank will be good for all values of z and B, making both depositor monitoring and accumulated reputation irrelevant. If P is high, then the bank can be induced to be good via an interaction of z and B (where $\partial z/\partial B < 0$) or solely though B (if B is high enough to induce $C(\hat{q}_1) \geq A(q_2^*)$ when $z = 0$).*

3.4.3 The Depositors' Problem

This section will specify an expected payoff function for the depositors and show that the depositors will choose the smallest z possible.

The model is specified such that the depositors always have an outside opportunity of not depositing their funds in the bank and keeping them "under the mattress." If so, the depositors will earn \$1 at $t + 1$ for each \$1 kept under the mattress at t.

Depositing funds in the bank, but then withdrawing them at $t = 1$ (i.e. monitoring the bank) is costly for the depositors. Funds withdrawn at $t = 1$ get no interest payment, whereas at $t = 2$ depositors can get $(1 + i)$. As a result, the depositors would like to withdraw as much as possible at $t = 2$, which implies that the depositors will choose the smallest z possible.

The analysis above has shown that the bank will be good in the absence of depositor monitoring, if either P is low, or B is sufficiently large to force the bank to be good when P is high. Therefore, for both of these cases, there is no need for depositor monitoring and the depositors will choose to set $z = 0$ and avoid unnecessary monitoring costs.

In order to determine depositor behavior for the remaining case (when P is high and B is not sufficiently high to induce good behavior by itself), the following expected payoff function has been specified:

$$E(\Pi_D) = \max_z \quad D_1 + D_2 - 1 \tag{3.15}$$

s.t

$$D_1 = \quad z \tag{3.16}$$

$$D_2 = \begin{cases} \gamma(1-z)(1+i) & \forall z < \overline{z}(P,B) \\ (1-z)(1+i) & \forall z \geq \overline{z}(P,B) \end{cases} \tag{3.17}$$

where $\overline{z}(P,B)$ represents the value of z that would make the bank indifferent between being good or being bad for given values of B and P. For notational simplicity the arguments (P,B) will be suppressed and $\overline{z}(P,B)$ will be referred to as $\overline{z}$ throughout the rest of the analysis.

According to this expected payoff function, the depositors maximize the sum of withdrawals from the bank at $t = 1$ (denoted D_1) and $t = 2$ (denoted D_2). As the amount withdrawn at $t = 1$ is defined as z, it is clear that $D_1 = z$.

Equation (3.17) specifies the payoff of the depositors for different values of z. If the depositors set $z < \overline{z}$, then the level of monitoring will be insufficient to force the bank to be good. In this case, the depositors will only get $(1-z)(1+i)$ in the good state of the world (with probability γ). If the depositors set a $z \geq \overline{z}$ then they will receive $(1-z)(1+i)$ with certainty.

From the specification of the problem, it is clear that the expected payoff function is downward sloping for $z \geq \overline{z}$. If $z \geq \overline{z}$, substituting (3.16) and (3.17) into (3.15) yields:

$$\max_z z + (1-z)(1+i) - 1$$

where the slope is $1 - (1+i) < 0$, implying that the depositors can increase their expected payoff by increasing z. Therefore, the highest expected payoff from setting $z > \overline{z}$ is achieved at $z = \overline{z}$ and it is given by:

$$E(\Pi_D|z=\overline{z}) = \overline{z} + (1-\overline{z})(1+i) - 1 \tag{3.18}$$

In (3.18), $E(\Pi_D|z=\overline{z})$ was used to denote expected payoff when $z=\overline{z}$. As the depositors can set different levels of z, this notation is useful in distinguishing between expected payoffs associated with different values of z.

On the other hand, the slope of the expected payoff function for $z<\overline{z}$ is not immediately obvious. For this range, the expected payoff function becomes:

$$E(\Pi_D|z<\overline{z}) = \max_z z + \gamma(1-z)(1+i) - 1$$

where the slope is $1-\gamma(1+i)$ and it is positive if:

$$\gamma < \frac{1}{1+i} \tag{3.19}$$

The inequality in (3.19) implies a link between the probability of the risky asset succeeding and the monitoring behavior of the depositors. If the risky asset is unlikely to succeed (if γ is low), then the depositors can increase their expected payoff by increasing z. In this case, they would like to set the highest z possible, which $z=\overline{z}$. The expected payoff from doing so is given by:

$$E(\Pi_D|z=\overline{z}) = \overline{z} + \gamma(1-\overline{z})(1+i) - 1 \tag{3.20}$$

A comparison of (3.18) and (3.20) immediately reveals that (3.18)>(3.20) and the depositors will always choose to monitor by setting a z such that $z>\overline{z}$.

On the other hand, if the risky asset is likely to succeed (i.e. γ is high and (3.19) does not hold), then the depositors can increasing their payoff by decreasing z. As a result the depositors will set $z=0$ and their expected payoff will be:

$$E(\Pi_D|z=0) = \gamma(1+i) - 1 \tag{3.21}$$

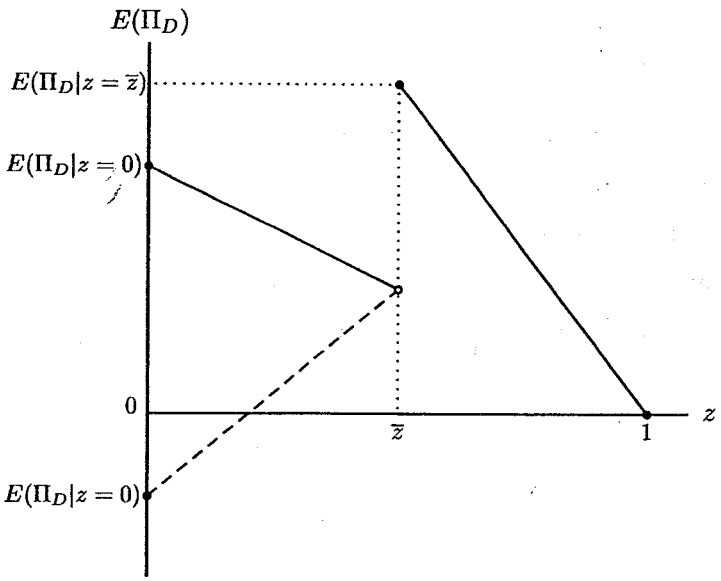

Figure 3.3: Expected payoff function of the depositors.

In this case, it is not immediately obvious whether $E(\Pi_D|z=\overline{z}) > E(\Pi_D|z=0)$ or not. If it is, then the depositors will choose to monitor at $z=\overline{z}$, if not, then the depositors will choose to deposit their funds in the bank but not monitor the bank at all (set $z=0$). If depositors set $z=0$, then it could be argued that monitoring is too costly for the depositors.

In comparing $E(\Pi_D|z=\overline{z})$ and $E(\Pi_D|z=0)$, the role of the banker's accumulated reputation (B) becomes important. As shown in the analysis of the bank's problem, $\overline{z}$ and B are inversely related. Therefore, there exists a level of B, such that if B is high enough, then $z=\overline{z}$ becomes sufficiently low to satisfy $E(\Pi_D|z=\overline{z}) > E(\Pi_D|z=0)$. It is assumed here that B is high enough to ensure that $E(\Pi_D|z=\overline{z}) > E(\Pi_D|z=0)$, which makes monitoring "affordable" for depositors.

The two possible shapes of the expected payoff function are plotted in Figure 3.3, where the dashed line represents the case where (3.19) holds and the slope of the depositors' expected payoff function is positive. The solid line represents the case where (3.19) does

not hold, but monitoring is still affordable for the depositors. Under this specification the global maximum of the expected payoff function is given by $z = \overline{z}$.

The findings of the analysis of depositor behavior is summarized below.

Proposition 2 *If the risky asset is unlikely to succeed (i.e. (3.19) holds), then the depositors will choose to monitor the bank at a level just enough to induce good behavior. On the other hand, if the risky asset is likely to succeed (i.e. (3.19) doesn't hold), then depositor behavior is determined by the value of B. If B is sufficiently high, then monitoring becomes "affordable." Otherwise, monitoring is too costly and the depositors will choose not to monitor.*

Now that the interaction between the bank and the depositors has been examined, the next section will investigate how the presence of an interbank network and positive network benefits can interfere with the depositor monitoring of a bank that could be tempted to be bad.

3.5 The Model with Network Formation Opportunity

3.5.1 Overview and Setup

The banking sector consists of a network of banks and a bank that has just entered the banking sector (from here on referred to as "the bank.").

The network is assumed to have a very high level of reputation, as it has been interacting with the depositors for a long time. Due to its high reputation, the network will be "good" even in the absence of depositor monitoring.

On the other hand, the new bank is relatively unknown to the depositors and has a low level of reputation. The reputation of the bank is given by B.

The private benefit of the banker from the risky asset (P) is chosen by nature after the bank and the network decide on whether the bank will join the network or not (the process of the bank joining the network is described below). With probability α, the bank gets a "high" private benefit from the risky asset (given by P_h) and with probability $1 - \alpha$, the bank gets a "low" private benefit from the risky asset (given by P_l). Once nature chooses

P, this is revealed both to the bank and to the network, but not to the depositors. It should be noted here that unlike the benchmark model in the previous section, this model does not assume complete information. The network observes all variables, whereas the depositors only observe B and they don't observe P or the network benefit generated by the bank joining the network (this will be described in full detail below).

The behavior of the bank depends on the interaction between the reputation of the bank and the private benefit from the risky asset, in a manner similar to the no-network case. In the previous section it was shown that if the accumulated reputation of the banker is sufficiently large, the bank will be good even if there is no depositor monitoring. Therefore, it is assumed that if $P = P_l$, then B will be sufficient to make the bank be good even if $z = 0$. On the other hand, if $P = P_h$, then B is not large enough to make the bank be good by itself and a level of depositor monitoring given by $z = \overline{z}(P_h, B)$ (denoted $\overline{z}_h$) will be necessary.

3.5.2 Network Membership and Network Benefits

At $t = 0$, the bank has an opportunity to become a member of the network. If the bank joins the network, this *could* create a network benefit of N for the network and 0 for the bank at $t = 2$.[15]

The value of N is chosen by nature after the bank responds to the membership offer (along with the bank's private benefit P). With probability ρ, N is high (given by N_h) or with probability $1 - \rho$, it is low (given by N_l). This variation in N can come from an exogenous shock either to the economy or to the behavior of the banks' customers. For example, an exogenous reduction in the usage of checks by the public would result in a decrease in the benefits generated by a clearing and settlement network.

The value of N is revealed both to the bank and the network after it has been chosen by nature. The observation of N by the network and the bank can be thought of as an analysis of potential cost savings generated by the presence of the bank within the network. Within the context of the nineteenth century clearinghouses discussed above, the observation of N

[15]The analysis would be similar if bank got a positive network benefit which was smaller than network's benefit of N.

after the bank becoming a member can represent the close analysis of the members' books by the network (Gorton and Huang, 2002b).

The value of the benefit received by the network at $t = 2$ is also influenced by the behavior of the depositors at $t = 1$. It is assumed that if the depositors monitor the bank at $t = 1$, then the network receives no benefit at $t = 2$. In other words, a wave of withdrawals from the bank at $t = 1$ eliminates all network benefits.[16] Although this assumption may seem extreme, an elimination or reduction of network benefits due to a bank run is not uncommon in the banking sector. If the network benefits are assumed to come from clearing and settlement between banks, then it is clear that the network benefits will be higher if the bank is investing most of its funds in long-term assets. If there is depositor monitoring, however, the bank has to keep some of its funds as reserves and it is unlikely that funds kept as reserves will generate network benefits through clearing and settlement. If the degree of depositor monitoring (given by z) is severe enough, then the network benefits will completely disappear. The assumption that the network benefits disappear (as opposed to being reduced) allows for simplicity in the analysis presented below.

Similarly, it is assumed that if the bank fails to pay its depositors and goes bankrupt in either $t = 1$ or $t = 2$, all network benefits are eliminated. This is also commonly observed in the banking sector, as when a bank goes bankrupt, it becomes difficult for other banks to claim settlement balances held by or fees that are due from the bankrupt bank. Therefore, in this setup, the network can only realize the network benefits associated with the bank if the bank does not get monitored by the depositors and it manages to stay solvent through $t = 2$.

It should be reiterated here that the membership of the bank creates direct benefits for the network but not the bank. So, it is possible that the network will have to offer an incentive to the bank in order to induce its participation. As the network is reaping all the benefits of the bank's participation in the network, some of these benefits may have to be transferred to the bank in order to prevent it from refusing to join. This transfer

[16]It would be possible to specify the model such that depositor monitoring reduces but not completely eliminates the network benefit. Although this would make the analysis a little more complicated, the main findings would not be different.

represents the subsidization of network users who do not receive large direct benefits from participation in the network, as discussed in Section 3.3.

In the setup of the model, the subsidy (incentive) takes the form of a specific liquidity transfer that can be used to pay the depositors at $t = 1$ or $t = 2$. This liquidity transfer is denoted L and the value of L is determined at $t = 0$, before nature chooses the values of P and N (the idea behind this timing is discussed below). The size (and transfer) of L is observed by the depositors as well. The fact that the depositors observe L is based on the fact that the declaration of liquidity assistance by the network serves as a signal to the depositors and allows them to update their information. This is an important feature of interbank networks that was discussed in detail in Sections 3.2 and 3.3. Before the mechanics of the determination of the size of L and the actual transfer of the funds can be discussed any further, a more precise definition of L may be necessary to highlight its role in the model.

L can simply be thought of as a transfer from the network to a member if it is having difficulty meeting the withdrawal demands of depositors at $t = 1$ or $t = 2$. The presence of L allows the bank to reduce the amount reserves needed to pay the depositors at $t = 1$, as it now has access to L along with its reserves. Similarly, L can be used at $t = 2$ to partially compensate the depositors if the bank fails to have sufficient funds to pay the depositors and goes bankrupt.

The best example of this arrangement comes from the bank networks in the U.S. during the nineteenth century. In this period, clearinghouses would issue "loan certificates" to qualified members in times of bank runs. These loan certificates were fully convertible at all other clearinghouse members and banks could satisfy the withdrawal demands of their customers with these certificates, as opposed to giving out currency. The presence of the loan certificates enabled the banks to free up their funds and invest them in assets, as opposed to keeping them as reserves. Therefore, although the certificates could not be used by the banks to purchase assets, they still prevented the banks from prematurely liquidating their portfolios in order to satisfy withdrawals. Even if some of the banks ended up going bankrupt, the presence of the loan certificates allowed the depositors to get some of their funds back from other banks. Some studies in the literature have argued that these loan

certificates represented *de facto* deposit insurance, provided by clearinghouses (Gorton and Mullineaux, 1987), whereas others have considered them to be closer to discount window loans (Gorton and Huang, 2000a).

Based on this example of loan certificates, the role of L can be thought of as follows. In case of depositor monitoring at $t = 1$, the bank can ask for and receive L from the network in order to pay its depositors. If there is no depositor monitoring at $t = 1$, then there is no transfer of L from the network to the bank, as there is no need for liquidity assistance. Similarly, if the bank fails to pay its depositors at $t = 2$ and goes bankrupt, some of the depositors can receive L from the network as partial compensation (this can also be thought of as partial deposit insurance). The determination of the size of L and any actual transfer of these funds are discussed below.

At the initial date $t = 0$, the network offers L to the bank and this action constitutes an offer of membership. In this stage, the offer guarantees the size of a potential transfer (given by L), but not the actual transfer of the funds. If the bank accepts the size of L, then it becomes a member of the network. If the offer is rejected, then the bank will not join the network and the analysis of the bank's problem will be identical to the no network case discussed in the previous section.

If the bank accepts the membership offer, the bank and the network jointly observe the values of P and N. In a sense, the network has to offer L and induce the bank's participation in order to be able to observe the values of P and N. It is reasonable to assume that the network will only have access to their members' books and records, so in order to find out about the private benefit of the bank and the potential network benefits associated with the bank's membership, it has to first induce the bank to join the network.

At this stage, based on the state of the world, the network decides whether to honor the guarantee or not. If the network decides not to honor the guarantee, the there will be no transfer at $t = 1$ or $t = 2$ and the bank's membership in the network is terminated. A refusal to honor the transfer guarantee is tantamount to termination of membership, because it is assumed that all members of the network are entitled to liquidity assistance in times of need. Exclusion from this liquidity protection means that the bank no longer enjoys membership privileges and is effectively kicked out of the network. If the network

decides to honor the guarantee, it credibly commits to transferring L to the bank in $t = 1$ or $t = 2$, if the bank is having difficulty paying its depositors. As discussed below, the ability to terminate the bank's membership is the primary monitoring tool of the network, in the sense that the network's decision will have informational value for the depositors. As a result, the monitoring decision of the depositors will be influenced by this action.[17]

The setup of the model can be summed up in the following timeline:

- At $t = 0$, the network makes membership offer (size of L) to the bank.
- The bank accepts or rejects the membership offer. Both the size of L and the bank's response are observed by the depositors.
- Nature chooses the value of the network benefit N and the private benefit P of the bank. This is observed by the bank and the network.
- Based on the state, the network can choose whether to withdraw the liquidity transfer guarantee or not. If the guarantee is withdrawn, the bank's membership is terminated.
- Depositors observe the network's decision, deposit \$1 in the bank and decide to monitor or not (set z).
- The bank sets reserves and allocates the non-reserve funds in the assets available.
- At $t = 1$ depositors withdraw z from the bank.
- If the depositors can not be repaid, the bank goes bankrupt.

[17]This is similar, but not exactly identical to how clearinghouses operated in the nineteenth century. Every bank that became a member of a network would be guaranteed to get loan certificates in the case of a bank run. However, the actual issuing of the certificates was contingent on the asset quality of the bank, determined by the network via an examination of the bank's books (Gorton and Mullineaux, 1987). It was also possible for the clearinghouse to refuse liquidity assistance to a weak member. The refusal of assistance distanced the bank from the network and served as a signal to the depositors to run on the bank (Dowd, 1994). The main difference between the clearinghouse example and this setup is that as long as the member remained as a member, the clearinghouse could choose to give the bank a higher or lower amount of loan certificates depending on the state of the bank's asset quality. In this setup, however, the transfer can take the values L or zero only. A comparison of this setup to the modern banking would be a loan guarantee conditional on further examination of the bank's assets, collateral etc.

- At $t = 2$ asset returns are and N are realized.

- The depositors who did not withdraw their funds at $t = 1$ demand their funds (given by $(1 - z)(1 + i)$).

- If the depositors can not be fully repaid, the bank goes bankrupt.

Both the size of L and the network's ability to terminate the bank's membership after the state is revealed are crucial features of the model. These two features combined give the network the ability to prevent depositor monitoring, which in turn allows the network to receive network benefits if the bank is solvent at $t = 2$. The size of L is important because the possibility of partial repayment in case of bankruptcy at $t = 2$ reduces the depositors' incentives to engage in monitoring. This is a desirable outcome for the network as depositor monitoring at $t = 1$ eliminates all potential network benefits.

The network's ability to withdraw the guarantee also influences depositor behavior, as this action has informational value for the depositors. As shown in the network's problem below, based on the state of the world and the size of L, the network may choose to terminate the bank's membership. It should be kept in mind that if the depositors do not monitor the bank but the bank goes bankrupt at $t = 2$, the network will suffer a net loss. In case of bankruptcy, the network would have to transfer L to the bank, but it will not receive any network benefit. Therefore, the network's decision to honor or withdraw the guarantee will depend on both P and N. Observing this decision, the depositors will then be able to update their beliefs about the state of the world.

Based on this setup, it is clear that the network has significant advantages over the depositors. Not only that the network has an informational advantage (it observes the state whereas the depositors do not), but it also has the ability to deter depositor monitoring by setting a large L and in fact insuring a certain portion of deposits. Therefore, the network could choose to use these advantages in order to prevent the monitoring of a bad bank and to collect any network benefits that may occur at $t = 2$. If such an outcome can be found for this model, it would imply that interbank networks could tolerate bad banking practices,

motivating the phenomena discussed in Sections 3.2 and 3.3. This possibility is investigated in the analysis of the model below.

3.5.3 Outline of the Problem

This section will specify how one set of parameter values can result in an equilibrium that motivates the phenomena discussed in Sections 3.1, 3.2 and 3.3. The goal is to find a set of parameter values such that the incentives of the network and the depositors diverge, with the network tolerating the presence of a bad bank in a certain state of the world. If this set of parameter values can be found and shown to be feasible (i.e. they do not constitute an empty set), then it can be argued that it is possible for interbank networks to tolerate bad banking practices in equilibrium.

As discussed above, based on the values of P and N that the nature can choose from, there are four states of the world.

- (P_l, N_h) with probability $(1-\alpha)\rho$
- (P_l, N_l) with probability $(1-\alpha)(1-\rho)$
- (P_h, N_h) with probability $\alpha\rho$
- (P_h, N_l) with probability $\alpha(1-\rho)$

Out of these four states, it is clear that the incentives of the depositors and the network are aligned in (P_l, N_h) and (P_l, N_l). In both cases, the bank will be good even if there is no depositor monitoring (as $P = P_l$), therefore the depositors would not want to monitor the bank if they could know with certainty that one of these two states of the world has occurred.

Similarly, the network would like to prevent the depositors from monitoring the bank in these states, because even in the absence of depositor monitoring, the bank will stay solvent and the network will collect the network benefit. Although the network benefit is low for the state (P_l, N_l), knowing that the bank will not go bankrupt and the network benefit will be realized aligns the incentives of the network with the depositors.

On the other hand, it is likely that both the network and the depositors would like to monitor the bank in the state (P_h, N_l). The depositors would like to monitor the bank because as $P = P_h$, the bank will be bad and potentially go bankrupt in the absence of depositor monitoring.

The network also may be unlikely to continue the bank's membership, because even if there is no depositor monitoring, the bank is likely to go bankrupt at $t = 2$. If the bank does go bankrupt, the network will have to transfer L and still lose the network benefit, resulting in a negative payoff. On the other hand, if the bank does not go bankrupt the network will not have to transfer L and it will receive the low network benefit N_l. The network's decision to terminate the bank's membership will depend on whether the expected payoff from honoring the guarantee is negative or not. This will be discussed in detail below.

The state of the world where the incentives of the network and the depositors are most likely to diverge is (P_h, N_h). If the depositors could observe that this state has realized they would choose to monitor the bank. On the other hand, the network want to prevent depositor monitoring because of the high value of the network benefit that is realized if the bank is solvent at $t = 2$. Even after adjusting for the possibility that the bank may go bankrupt and the network may not be able to collect the benefit, the *expected* network benefit can still be high enough for the network to prevent the depositors monitoring the bank.

Based on these incentives and the informational advantage of the network, there are different possible outcomes of the model. One possibility is that the network's incentives will be such that it would prefer the bank not to be monitored in either (P_h, N_h) or (P_h, N_l). Combined with the fact that there is no need for depositor monitoring in states (P_l, N_h) and (P_l, N_l), this would imply that the bank will never get monitored. On the other hand, it is also possible that in equilibrium the network would like the bank to be monitored in state (P_h, N_l), but not in any of the three remaining states. Both of these outcomes can be used to motivate the phenomenon discussed above in the sense that the network prevents the monitoring of a bad bank. However, in order to keep the analysis simple, only one of these outcomes will be investigated.

The analysis presented below examines the possibility of the equilibrium in which the

network uses its informational advantage to facilitate depositor monitoring in (P_h, N_l) but not in (P_h, N_h). Based on the dynamics between the actions of the network and the presence of depositor monitoring, the analysis will concentrate on finding the set of parameter values that results in the following equilibrium:

The network will offer (and the bank will accept) a value of L such that if the network observes the state (P_h, N_l), it will terminate the bank's membership. This will allow the depositors to know the state with certainty and they will monitor the bank. If any of the other three states of the world is observed, the network will honor the guarantee and transfer L if the bank is incapable of paying the depositors. The depositors will not monitor the bank as it is impossible for them to know the state with certainty. As a result, in the state (P_h, N_h), the actions of the network prevent the depositors from monitoring a bad bank.

In order to find the conditions under which this equilibrium exists, the model will be solved by backward induction. The depositors' monitoring decision will be examined first, followed by an analysis showing that the bank will always accept the network membership offer. Finally, the conditions under which the network will make the membership offer described above will be analyzed. Using the findings of this three stage analysis, the set of parameter values that ensure the existence of this equilibrium can then be examined and discussed.

3.5.4 The Depositors' Problem

As described above, the depositors' monitoring decision is based on two factors. First, depositors observe whether the bank accepts the membership offer or not. If the bank refuses the membership offer, then the model reverts back to the no-network case. On the other hand, if the bank accepts the membership offer, then the depositors' action depends on the size of L and whether the network honors the guarantee for transferring L after learning the state. The analysis below examines both possibilities, starting with the case where the bank refuses the membership offer.

Depositor Behavior if the Bank Rejects the Membership Offer

If the bank does not join the network, then the depositors will base their monitoring decision on the comparison between the expected payoffs from monitoring versus not monitoring. The value of z that they need to choose in order to monitor the bank is dependent on the value of P.

In the absence of network membership, the depositors do not know the state, but they know that P is either equal to P_l or P_h. For $P = P_l$, there is no need for monitoring, but if $P = P_h$, the depositors would like to monitor the bank. If the depositors decide to monitor, they have set a z such that $z = \overline{z}_h$. In this case $\overline{z}_h$ represents the level of z for which the bank will be indifferent between being good and being bad for $P = P_h$. This level of z is derived from Equation (9) in Section 3.4.

The depositors will never set $z = \overline{z}(P_l, B)$ (denoted $\overline{z}_l$), because $\overline{z}_l$ is not sufficient to make the bank be good if $P = P_h$ and there is no need for a positive z if the depositors believe that $P = P_l$. Therefore, the depositors will have to set $z = \overline{z}_h$, knowing that they will be unnecessarily "over-monitoring" the bank if the true (but unobserved) value of P is P_l.

If the depositors choose to set $z = \overline{z}_h$, their expected payoff will be:

$$E(\Pi_D | z = \overline{z}_h) = \overline{z}_h + (1 - \overline{z}_h)(1 + i) \tag{3.22}$$

If the depositors choose not to monitor the bank, their expected payoff is:

$$E(\Pi_D | z = 0) = (1 - \alpha)(1 + i) + \alpha\gamma(1 + i) \tag{3.23}$$

In the absence of network membership, the depositors will monitor the bank only if $E(\Pi_D | z = \overline{z}_h) \geq E(\Pi_D | z = 0)$. Whether this is true or not will depend on the cost of monitoring ($\overline{z}_h$), which in turn depends on B. It was shown in the no-network case that $\overline{z}_h$ decreases as B increases. Therefore, it is assumed that B is high enough to ensure $E(\Pi_D | z = \overline{z}_h) \geq E(\Pi_D | z = 0)$ and the depositors monitor the bank if there is no network. As shown below, the fact that the depositors choose to monitor the bank if it refuses to join

the network will be a determining factor in the bank's decision on accepting or rejecting a membership offer.

Depositor Behavior if the Bank Accepts the Membership Offer

If the bank accepts the membership offer, the bank and the network observe the state of the world and the network decides whether to terminate the bank's membership or not. After observing this, the depositors will be able to update their beliefs about the state of the world and make their monitoring decision accordingly.

For instance, the equilibrium described above states that the network will terminate the bank's membership only in (P_h, N_l). In this case, observing a termination of membership will allow the depositors to know the state with certainty. As the depositors learn that $P = P_h$, they will set $z = \overline{z}_h$, inducing the bank to be good.[18]

On the other hand, if the depositors observe that the bank continues its membership, then they will only know that (P_l, N_h), (P_l, N_l) or (P_h, N_h) has occurred. Only in (P_h, N_h) can the depositors increase their expected payoff by monitoring the bank, as for the first two states the bank will be good absent depositor monitoring. Therefore, if the depositors observe that the network is willing allow the bank to continue its membership and transfer L to the bank if necessary, they can choose not to monitor. Their expected payoff is given by:

$$E(\Pi_D|z=0) = \frac{[(1-\alpha)\rho]}{[(1-\alpha)+\alpha\rho]}(1+i) + \frac{((1-\alpha)(1-\rho))}{[(1-\alpha)+\alpha\rho]}(1+i) + \frac{\alpha\rho}{[(1-\alpha)+\alpha\rho]}[\gamma(1+i)+(1-\gamma)L]$$

which can be simplified to:

$$E(\Pi_D|z=0) = \frac{(1-\alpha)+\alpha\rho\gamma}{[(1-\alpha)+\alpha\rho]}(1+i) + \frac{\alpha\rho(1-\gamma)}{[(1-\alpha)+\alpha\rho]}L \tag{3.24}$$

In Equation (3.24), the first term reflects the payoff to the depositors if the bank is solvent at $t = 2$. With probability $(1-\alpha)/[(1-\alpha)+\alpha\rho]$, the state is either (P_l, N_l) or

[18]The decision for the depositors to monitor the bank if $P = P_h$ follows directly from the analysis of the no-network case in Section 3.4. Since P_h is high enough to make the bank be bad if $z = 0$, the depositors will be better off by setting $z = \overline{z}_h$ and monitoring the bank.

(P_l, N_h) and the bank will be good in the absence of depositor monitoring. On the other hand, with probability $\alpha\rho/[(1-\alpha)+\alpha\rho]$, the state is (P_h, N_h) and the bank will be bad if $z = 0$. In this case, with probability γ the risky asset will be a success and the bank will be solvent, paying the depositors $(1+i)$ at $t = 2$.

The second term represents the payoff to the depositors if the state is (P_h, N_h) and the risky asset fails. In this case (with probability $\alpha\rho(1-\gamma)/[(1-\alpha)+\alpha\rho]$), the bank is bankrupt at $t = 2$. However, the depositors still receive a payment from the bank, because the bank has L available to pay the depositors. As $z = 0$, there were no transfers from the network to the bank at $t = 1$, but at $t = 2$ the bank can still receives L if the risky asset fails. Unlike the case where the bank does not participate in a network, the depositors now can at least be partially repaid if the bank goes bankrupt.[19]

The presence of L further discourages depositor monitoring by increasing the level of z required to force the bank to be good. As discussed in the analysis of the no-network case, depositor monitoring induces the bank to be good by increasing the amount of reserves that the bank has to hold in order to satisfy withdrawals at $t = 1$. The presence of reserves decreases the amount of funds available to be invested in the risky asset, preventing the bank from risking bankruptcy by investing heavily in the risky asset.

However, after accepting the membership offer, the bank can receive a transfer of L from the network if the depositors choose to monitor the bank at $t = 1$. Therefore, a level of z that would have forced good behavior in the no-network case may not be sufficient to induce good behavior in a bank that belongs to the network and receives L. For a given level of z, the bank only has to keep $z - L$ as reserves, which leaves a relatively large portion $(1 - z + L)$ of the funds to be invested in the risky asset. Therefore, if the depositors decide to monitor the bank when the network is willing to transfer L, they would have to adjust the level of z in order to accommodate for these additional funds at the bank's disposal. If it is the case that $P = P_h$, then setting $z = \overline{z}_h$ will not deter the bank from being bad and

[19]These expected payoffs are specified such that the depositors behave and get paid collectively and not as individuals. It is assumed that in case of bankruptcy, L is divided evenly among all depositors, as opposed to a "first-come-first-serve" model of bank runs where the depositors line up and the ones in the front of the line get paid in full until the funds run out. In this setup, the depositors at the end of the line do not receive any funds (Calomiris and Kahn, 1996).

the depositors have to set $z > \overline{z}_h$, which implies a higher cost of monitoring.

As the level of z that would induce the bank to be good is increasing in L, it is possible that for a certain value of L, depositor monitoring becomes infeasible. By setting an L above this value, the network can effectively prevent depositors from engaging in monitoring. This value of L can be calculated using the expected payoffs of the depositors associated with monitoring the bank vs. setting $z = 0$.

The degree of monitoring that the depositors can engage in is constrained by the upper bound $z = 1$. Therefore, there exists a level of L such that if the depositors would like to monitor despite the network guaranteeing to transfer L to the bank, they would have to set $z = 1$ and withdraw all funds at $t = 1$. If it can be shown that this value of L exists and the network is willing to offer this amount, then it can be argued that the network can successfully deter depositor monitoring in states (P_l, N_l), (P_l, N_h) and (P_h, N_h).

If the depositors choose to monitor the bank at this level of L by setting $z = 1$, then they will be withdrawing all of their funds at $t = 1$ and none at $t = 2$, which implies that their expected payoff will be:

$$E(\Pi_D|z=1) = \frac{[(1-\alpha)\rho]}{[(1-\alpha)+\alpha\rho]}1 + \frac{((1-\alpha)(1-\rho))}{[(1-\alpha)+\alpha\rho]}1 + \frac{\alpha\rho}{[(1-\alpha)+\alpha\rho]}1 = 1$$

Faced with this expected payoff, the depositors will choose not to monitor the bank if $E(\Pi_D|z=0) \geq E(\Pi_D|z=1)$. This condition can be written as the following inequality.

$$\frac{(1-\alpha)+\alpha\rho\gamma}{[(1-\alpha)+\alpha\rho]}(1+i) + \frac{\alpha\rho(1-\gamma)}{[(1-\alpha)+\alpha\rho]}L \geq 1$$

From here, a condition on L can be derived using algebraic manipulation.

$$L \geq 1 - \frac{[(1-\alpha)+\alpha\rho\gamma]}{[\alpha\rho(1-\gamma)]}i \tag{3.25}$$

If the actual liquidity transfer from the network to the bank falls within the range given in (3.25), then the depositors will not monitor the bank if they observe that the network is honoring the guarantee for transferring L to the bank. It should be noted here that L

falling within the range in (3.25) is a sufficient condition to prevent depositor monitoring.[20]

The condition given in (3.25) comes solely from the depositors' problem and it describes the values of L for which the depositors can be deterred from monitoring the bank if the network does transfer L. However, the question remains as to whether the network would be willing to offer and transfer a value of L that falls within this range for the three states of the world that were described above. This will be determined by the analysis of the network's problem.

3.5.5 The Bank's Problem

This section will show that the bank will accept any amount of L, as long as membership in the network prevents depositor monitoring in at least one state of the world. This finding is solely based on the analysis of the bank's behavior in the no-network case.

As described above, membership in the network affects the bank through the presence of L. As discussed in the depositors' problem above, there is a level of L such that if the bank accepts the membership offer and receives this amount, the depositors do not monitor the bank in states (P_l, N_h), (P_l, N_l) and (P_h, N_h). On the other hand, if this level of L is offered, but the bank rejects the offer, the depositors will monitor the bank by setting $z > 0$. Even without examining the bank's expected payoff function analytically, it is clear that the bank will choose to accept the membership offer and avoid being monitored in three out of four states of the world.

It was shown in the analysis of the no-network case above that depositor monitoring works through increasing the amount of reserves that the bank has to hold. An increase in reserves suggests that the bank has less funds available to invest in the long-term assets, which decreases the expected payoff of the banker. As the banker's expected payoff is decreasing in z, then the bank will be better off if $z = 0$. As membership in the network implies $z = 0$ for three states of the world, it is clear that the bank will always choose to

[20]It is possible that the network can prevent depositor monitoring by setting L less than the cutoff value given in (3.25). In this case, the depositors' behavior will determined by the interaction of $\overline{z}_h$ and L. For a given $\overline{z}_h$, there is a level of L such that $E(\Pi_D|z = 0) \geq E(\Pi_D|z = \overline{z}_h)$ and the depositors will choose not to monitor. However, as it is not possible to calculate $\overline{z}_h$ analytically, the rest of the analysis will concentrate on the sufficient condition given in (3.25).

accept the membership offer and increase its expected payoff.[21]

3.5.6 The Network's Problem

The analysis above has shown that there exists a range of values of L that the network can offer, such that the bank will always choose to join the network. Observing the bank's decision to join the network, the depositors will refrain from monitoring the bank as long as the network does not terminate the bank's membership upon learning the state. However, the conditions under which the network would be willing to offer an L within this range of values and allow the bank to remain in the network for states (P_l, N_h), (P_l, N_l) and (P_h, N_h) are yet to be established. This section will establish these conditions by examining the network's problem.

The network is primarily interested in maximizing the benefits associated with having the bank within the network. As discussed above, the realization of this payoff by the network depends on three factors: the state of the world, depositor monitoring and whether the bank stays solvent until $t = 2$.

If the network chooses not to terminate the bank's membership, its expected payoff (denoted $E(\Pi_n)$) will be as follows.

State	$E(\Pi_n)$ if $z = 0$	$E(\Pi_n)$ if $z > 0$
(P_l, N_l)	N_l	$-L$
(P_l, N_h)	N_h	$-L$
(P_h, N_l)	$\gamma N_l - (1-\gamma)L$	$-L$
(P_h, N_h)	$\gamma N_h - (1-\gamma)L$	$-L$

As seen above, if $z > 0$, then the expected payoff of the network is always negative. This is due to the fact that the network benefit is assumed to disappear completely if the

[21] It is possible and relatively straightforward to prove this analytically using concepts from the previous section. For the purposes of this section, however, this intuitive approach should be sufficient to show that the bank will always accept a membership offer (in the form of a value of L), for which the depositors will only monitor the bank if (P_h, N_l) realizes.

depositors engage in monitoring. In this case, the network realizes no network benefit and also loses L, as it would have to transfer these funds to the bank to be used in paying the depositors.

If the depositors choose not to monitor the bank ($z = 0$), then the network's expected payoff is conditional on the state of the world and the solvency of the bank at $t = 2$. If the state is (P_l, N_l) or (P_l, N_h), $E(\Pi_n)$ will always be positive. As $P = P_l$, the bank will always choose to be good and it will be solvent at $t = 2$. The network will be able to get the network benefit and will not have to transfer L, as the bank would not need liquidity assistance in paying its depositors.

For the other two states of the world, the sign of $E(\Pi_n)$ is determined by the size of L. If $P = P_h$ and $z = 0$, the bank will be bad and risk being insolvent at $t = 2$. With probability $(1 - \gamma)$, the risky asset will fail and the bank will go bankrupt, making the network benefit disappear. In this case, the network gets no network benefit and loses L, as it will have to transfer L to the bank at $t = 2$. With probability γ the risky asset will succeed and the network will realize the network benefit without transferring L to the bank. Depending on the value of L the expected payoff of the network in these two states can be positive or negative when $z = 0$.

As the value of L is determined before the network and the bank observe the state, the network may choose to terminate the bank and withdraw the transfer guarantee for L once the state is revealed. This would occur when the "pre-determined" value of L large enough to make the expected payoff of the network negative. For example, consider a case where the value of L is such that:

$$\gamma N_l - (1 - \gamma)L < 0 < \gamma N_h - (1 - \gamma)L \tag{3.26}$$

In this case, the expected payoff of the network is negative for the state (P_h, N_l) and positive for the remaining three states. If the network observes that the state of the world is (P_h, N_l), then the network would be better off by refusing to honor to guarantee. This refusal is equivalent to the bank's membership in the network being terminated. Observing the bank being thrown out of the network allows the depositors to know with certainty that

the state is (P_h, N_l) and monitor the bank.

On the other hand, $E(\Pi_n)$ is positive for the other three states of the world and the network will honor the transfer guarantee. However, the depositors will not be able to know with certainty which one of these three states have realized. As shown in the depositors' problem above, if L is sufficiently large (given by (3.25)), the depositors will choose not to monitor the bank. If the true state of the world is (P_h, N_h), then in equilibrium the network's actions will prevent the depositors from monitoring a bad bank.

The range of values for L derived from (3.26) is:

$$\frac{\gamma}{1-\gamma} N_l \leq L \leq \frac{\gamma}{1-\gamma} N_h \tag{3.27}$$

Setting a value of L that falls within this range gives an incentive to the network not to honor the transfer guarantee if the state (P_h, N_l) realizes. This strategy of the network is compatible with the equilibrium being examined. A value of L that satisfies (3.27) only ensures that the network transfers L for states (P_l, N_l), (P_l, N_h), (P_h, N_h). However, for the depositors not to monitor the bank, L also has to be large enough to discourage monitoring. The condition for the depositors' monitoring behavior is given by (3.25). Therefore, the feasibility of this equilibrium depends on whether there exists an L that satisfies both (3.25) and (3.27).

3.5.7 Equilibrium

The analysis of the network's and the depositors' problem have yielded two conditions on L. If these two conditions are compatible with each other, then in equilibrium, the network will have an incentive not to honor the transfer guarantee only if (P_h, N_l) realizes. Seeing this action, the depositors will know with certainty what the state is and they will monitor the bank. For the other three states of the world, the network will transfer L to the bank and the depositors, unable to determine the state, will not engage in monitoring.

The two conditions on L are reproduced below for convenience:

$$L \geq 1 - \frac{[(1-\alpha) + \alpha\rho\gamma]}{[\alpha\rho(1-\gamma)]} i$$

$$\frac{\gamma}{1-\gamma}N_l \leq L \leq \frac{\gamma}{1-\gamma}N_h$$

The values of L implied by these two conditions will not constitute an empty set if:

$$\frac{\gamma}{1-\gamma}N_h \geq 1 - \frac{[(1-\alpha)+\alpha\rho\gamma]}{[\alpha\rho(1-\gamma)]}$$

which can be simplified to:

$$N_h \geq \frac{(1-\gamma)}{\gamma}\left[1 - \frac{[(1-\alpha)+\alpha\rho\gamma]}{[\alpha\rho(1-\gamma)]}\right] \tag{3.28}$$

If N_h is high enough to satisfy the condition (3.28), then the following will occur in equilibrium:

Proposition 3 *If N_h is high enough to satisfy (3.28) then in equilibrium the network would offer a value of L such that the bank will join the network. After the state of the world is realized by the network and the bank, the network will withdraw the transfer guarantee for L only if the state is (P_h, N_l). In this case, the depositors will know the state of the world with certainty and monitor the bank. For the other three states of the world, the network will honor the guarantee and the depositors will choose not to monitor the bank after observing that the the network has guaranteed to transfer L if necessary. Therefore, in state (P_h, N_h) the network prevent depositors from monitoring a bad bank.*

This equilibrium illustrates the initial motivation of this study to the extent that it is possible for a network to tolerate a bad bank. The network can pledge to assist a bad bank, because the network benefit generated by having this bank within the network at $t = 2$ is high. The depositors will not be able to monitor the bank efficiently, as the liquidity support given to the bank makes monitoring prohibitively costly. This is similar to the intuitive example given in Sections 3.2 and 3.3 of how the declaration of support for a bank serves as a strong signal to the depositors about the quality of the bank and the network's desire to prevent the bank from being run on.

The condition placed on the size of L by (3.25) is also intuitive, as any liquidity support from other banks has to be sizable enough to make an impact. For example, Gorton and

Mullineaux (1987) state that for the single firm-type organizational structure of the clearinghouse to be successful "the amount of currency released from use in the clearing process through use of loan certificates had to be large enough to signal to depositors that the one-to-one deposit exchange rate was, in fact, correct." Although the specification of this model has some differences from the clearinghouse setup, the conclusions are quite similar.

However, it should also be noted here that the "under-monitoring" of the bank by the depositors and the network is welfare reducing in only one state. If $P = P_l$, the bank isn't monitored and this makes everyone better off. In this sense, this equilibrium can be welfare improving for the depositors, because in the absence of a network, they always monitor the bank despite knowing that with probability $(1 - \alpha)$, the bank will have a low private benefit. Also, in equilibrium, the bank gets monitored if it has a high private benefit *and* a low network benefit. For these three states of the world, the monitoring incentives of the depositors and the network are aligned. The fact that the bank is being under-monitored reduces the depositors' welfare only in (P_h, N_h).

It is important to note here that the equilibrium described above seems to sum up both the advantages and the disadvantages of interbank monitoring though networks. The presence of a network increases the depositors' expected payoff by allowing the depositors to monitor the bank when (P_h, N_l) and preventing them from over-monitoring the bank if (P_l, N_l) and (P_l, N_l). However, network monitoring fails when (P_h, N_h), as the bad bank is tolerated by the network and this toleration interferes with depositor monitoring. When the incentives of the network and the depositors diverge, it is the depositors who lose because the network uses its informational advantage and prevents the depositors from monitoring the bank and eliminating the network benefit it gets from having the bank as a member.

3.6 Conclusion

The network good-like properties of interbank arrangements have not received much attention in the literature. However, this study attempts to demonstrate that interbank networks and the network benefits associated with them can be an important issue related to the efficiency (or inefficiency) of interbank market discipline. The results presented above imply

that the presence of certain network benefits can give incentives for otherwise "good banks" to interact with "bad banks."

This interaction also has negative effects on depositor monitoring of banks. As banks always have more information about each other compared to depositors, it is true that some interbank monitoring is better than no interbank monitoring. As shown above, the presence of a network that can gather information about the bank and signal the depositors when to monitor can be welfare improving for the depositors, who may over-monitor banks that do not have to be monitored. However, when the monitoring incentives of the interbank networks and depositors diverge, it is likely that the bank will not be monitored, because the presence of network support to the bad bank makes it too costly for depositors to monitor. This is potentially an important finding concerning the incentives of two different monitors of banks, with implications concerning information sharing between banks, banking networks and depositors. In the model presented above, if the depositors learn the value of the network benefit along with the bank and the network, they would be able to determine the private benefit of the bank with certainty and they may monitor the bank even if the network is not.

The limitations of this study, however, should also be kept in mind. The foremost limitation of this study is that there is no central authority in this model, which can be seen as somewhat unrealistic. However, it is important to examine a *laissez-faire* banking system for two reasons. First, this simple model can be thought of as a springboard to a deeper model with a central bank and other possible enrichments. Second, the findings discussed above contribute to the literature on the origins of central banking and whether a central bank is necessary to regulate the banking sector. Some scholars, after a thorough study of the nineteenth century free banking systems, have concluded that banking networks such as clearinghouses can evolve into entities that can efficiently serve the functions of a central bank. According to this view, private networks are capable of efficiently distributing liquidity and also enforcing optimal bank closure policies by recognizing bad banks and forcing them into insolvency. The proponents of this view argue that a central bank is unnecessary on the basis that its functions can be replicated efficiently by private networks. This study can be thought of as making a counterpoint. The fact that private banking

arrangements can fail in their interbank monitoring due to network externalities can be seen as a pro-central bank argument. Of course, it should be kept in mind that studies have also found that central bank policies, such as too-big-to-fail (TBTF), also can result in inefficient monitoring.[22]

In conclusion, this study shows that it is possible for private banking arrangements fail due to network-good issues related to some of the services they perform. This is not a brand new theme in the literature, however it is a theme that has not received the attention it has deserved. It should be stressed that this study does not attempt to imply that all aspects of banking networks should be regulated in order to prevent such market failures. As shown in Section 3.5, monitoring performed by private banking arrangements fail only under certain circumstances. However, considering that the economic and social losses associated with banking crises have been very significant during the twentieth century, understanding the circumstances under which bad banks get tolerated by the banking sector is a useful start in understanding what leads to banking crises and what can be done to prevent them.

[22]See Tirole (1994) and Rochet and Tirole (1996) form conditions under which a TBTF policy is not justified. Also, Boot and Thakor (1993) discuss the socially suboptimal regulation implemented by a self-interested bank regulator. For a more detailed survey of this literature, see Gorton and Winston (2002).

Chapter 4

DOES POST-CRISIS RESTRUCTURING DECREASE THE AVAILABILITY OF BANKING SERVICES? THE CASE OF TURKEY

4.1 Introduction

The last twenty years have seen a drastic increase in both the frequency and severity of banking crises across the world. In the aftermath of these crises, both developed and developing countries have had to work on the formulation and implementation of strategies to strengthen their banking sectors and fend off future crises. One of the most common tools of a post-crisis operational restructuring has been encouraging "consolidation" in the banking sector, which refers not only to mergers and acquisitions (M&As) but also the liquidation and closure of the worst banks in the sector.

It appears that regulatory agencies around the world favor post-crisis M&As in the banking sector for two reasons. The first motivation for increased merger activity in the banking sector stems from the belief that merging two weak institutions (or one weak and one healthy institution) creates a much healthier bank by achieving asset diversification and strengthening the financial position of the combined banks. This motivation appears to have been dominant in the clean-up after the Asian financial crisis, with a significant number of bank mergers in almost every East Asian country. In his study of bank mergers after the Asian crisis, Shih (2003) quotes the governor of the central bank of the Philippines: "The central bank favors mergers as a way to keep the number of bank failures to a minimum... We would like to encourage mergers among our banks even before problems arise, to the extent that these will result in stronger banking institutions."[1]

The other use of M&As after banking crises is related to the reduction in what is some-

[1]The quote has originally appeared in "Philippines to attempt to spur bank mergers." *The Asian Wall Street Journal*, July 29, 1998.

times called "excess capacity" that is accumulated before a crisis. There seems to be almost universal agreement in the literature that certain conditions, such as financial liberalization or temporary increases in profitability, can lead to rapid and usually unsustainable rates of growth in the banking sector.[2] After a crisis, one problem facing the central regulatory authority is excessive branches and personnel, which are remnants of pre-crisis growth. As discussed in Section 4.2, consolidation is widely seen as a way of eliminating this, since the acquirer of a weak institution would have an incentive to close unprofitable branches.

An examination of banking crises of the past two decades reveals that using M&As as a way of eliminating excess capacity is common practice. In describing the plan to deal with insolvent Savings and Loans (S&Ls) in the U.S., White (1991) notes that "acquirers would be expected to acquire groups of adjacent or complementary insolvent thrifts, thereby allowing the acquirer to close overlapping branches and consolidate operations."[3] Similarly, one of the first steps taken by the central authority in Turkey after the banking crisis was to ask solvent banks to come up with letters of commitment outlining an implementation plan for combining, among other measures, "mergers and acquisitions, rationalization of branches and personnel, and cost reduction."[4] Besides using their considerable persuasive power, regulators have also used incentives (such as tax breaks) to encourage such M&As.

Despite the common policy tool of encouraging bank mergers after a banking crisis in

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[2]The most common cause for a rapid growth in the banking sector is a high inflationary environment in which banks tend to collect as many deposits as they can and lend it to the government at high rates. A consequence of this strategy is a proliferation of bank branches, as banks engage in intense competition to collect deposits from the public. The cases of Turkey in 1999-2001, Brazil during 1995-1997 (Baer and Nazmi, 2000) and Argentina in the 1980s (Catao, 1998) provide excellent examples of this situation. Deregulation can also cause rapid and unsustainable growth in the banking sector even in a low and stable inflationary environment, simply by increasing competition between banks. It is possible that at a time of increased competition, banks would be willing to expand rapidly and take losses, because they believe that market share gained in this initial stage will bring large profits in the future. In their study of the Mexican banking sector, Gruben and McComb (2003) refer to this behavior as "supercompetition" and argue that the deregulation of 1991-1992 has contributed to a buildup of excess capacity through a sudden increase in the level of competition. Another example is the rapid growth in the U.S. Savings and Loans (S&L) sector between 1983-1985, which was a period of high profitability due to deregulation. In all five cases the rapid growth was followed by a crisis.

[3]White, "The S&L Debacle" page 153.

[4]Banking Regulation and Supervision Agency, "Towards a Sound Turkish Banking Sector" (May 2001). Available from www.bddk.gov.tr. The other measures specified mostly involve financial restructuring, such as capital injections, credit restructuring, subsidiaries and partnerships.

order to eliminate excess branches, the economic impact of such branch closures is an issue of debate in the literature. The existing evidence on bank mergers in the U.S. suggest that changes in the competitive environment of markets due to post-merger branch closures can lead to negative outcomes. Garmaise and Moskowitz (2003) find that areas that experience a great number of mergers tend to also see reduced access to loans and increased crime rates. Similarly, Scott and Dunkelberg (2003) argue that an increase in bank concentration following mergers tends to increase "non-price" loan terms (such as fees), which could be interpreted as reduced access to loans. Prager and Hannan (1998) find that mergers lead to lower deposit rates and interpret this finding as evidence of increased market power. Overall, there seems to be enough evidence in the literature that a bank merger wave can have a negative impact on the consumers by leading to an increase in concentration; however, there is no unanimous agreement on whether these are short term or long term effects.[5]

Finally, looking at the issue of post-crisis bank consolidation from the point of view of a developing country, Baer and Nazmi (2000) note that widespread closure of private bank branches in the peripheral areas of Brazil has left the state banks as the sole providers of banking services. This could make privatization of these banks more difficult as the closure of inefficient rural branches will leave vast areas without any bank presence, which would be detrimental to the local economy. It is possible that such concerns apply to other developing countries covering large, underdeveloped areas, similar to Brazil.

This chapter tries to shed light on some of these issues by investigating the relationship between post-crisis bank consolidation and bank branch closures in Turkey.[6] Although certain notions seem to exist concerning the usefulness of bank mergers after a crisis, an important question remains unanswered: Do post-crisis bank mergers really cause a reduction in bank branches? By answering this question, this study attempts to measure the effectiveness of using consolidation as a tool for eliminating post-crisis excess capacity in the

[5]For example, Rosen (2003) argues that mergers that do not lead to increased concentration in urban markets increase deposit rates, benefiting consumers in the long-run. Park and Pennacchi (2004) find that bank consolidation harms depositors by decreasing deposit rates but benefits borrowers by increasing competition in the loan market. Finally, Focarelli and Panetta (2003) find that long-term efficiency gains associated with bank mergers in Italy tend to dominate the short-term adverse impact on consumers.

[6]The use of mergers as a method for improving the financial situation of banks is not an issue of interest in this study. For the financial implications of bank mergers in Turkey, see Zenginobuz and Mumcu (2003).

banking sector. This issue deserves attention due to the relatively high costs associated with encouraging and supervising a consolidation wave following a crisis. In all of the cases mentioned above, governments and/or central regulatory authorities have invested significant resources into providing incentives for banks to consolidate. These incentives can include (among others), tax breaks for merging institutions, capital injections or an assumption of liabilities by the central authority, in order to make some banks more desirable acquisition targets.[7]

As described in Section 4.2, the case of Turkey has not been different, with the central authority spending considerable resources in order to encourage banks to consolidate after the crisis. One of the goals in spending these funds was to reduce excess capacity in the banking sector by decreasing the number of banks in the sector and by eliminating excess branches and employees. If the mergers and acquisitions that took place did not achieve the goal of reducing excess capacity in the banking sector, this could signal that the policy was ineffective. The policy implications derived from the effectiveness of post-crisis bank consolidation is the most important aspect of this essay.

Furthermore, different types of bank consolidation can take place following a crisis. For example, it is commonly observed that banks that fail during a crisis are nationalized and subsequently sold by the central authority. On the other hand, it is also possible for healthy banks to merge in order to take advantage of incentives being provided by the central authority. As the implementation of these two types of M&As can differ, it is important to distinguish between privately arranged mergers and sales of failed institutions in analyzing the impact of consolidation on bank branching patterns. This differentiation allows the analysis below to examine whether one type of bank consolidation has a different impact on branch closures than the other. If so, this would call into question the usefulness of encouraging both types of consolidation in order to reduce excess capacity.

A secondary goal of the analysis is to determine whether certain markets are more affected by post-crisis bank consolidation that others. Such links between market characteristics and branching patterns can be helpful in determining whether post-crisis consolidation

[7]For an example, see White (1991), who discusses the incentives provided during the S&L crisis in detail.

is more effective in some markets compared to others. For example, if it is the case that consolidation leads to branch closures only in over-banked markets, then it could be argued that the policy has been effective in eliminating excess capacity. On the other hand, if most branch closures take place in highly concentrated markets with few banks, this would suggest that the policy may not have eliminated excess capacity and there could be other factors in play.[8] This question of what type of markets are most affected by bank mergers is well motivated by the findings in the theoretical literature that are reviewed below.

The empirical analysis presented below relies on a specially constructed data set that combines branch level address data with "district level" socioeconomic data.[9] The construction of this data set enables this study to analyze bank behavior in Turkey in detail and draw conclusions not present in previous studies of the Turkish banking sector. However before the data set and the results of the empirical analysis is presented, Section 4.2 reviews the existing literature on bank competition and bank mergers in order to build the relevant theoretical framework. This overview is followed by a brief description of the Turkish banking crisis of 1999-2001 and the subsequent consolidation in the industry. Section 4.3 describes the data and results of the empirical analysis. The sensitivity of the results are investigated in Section 4.4. Finally, Section 4.5 concludes.

4.2 Theoretical Framework

4.2.1 Overview of Relevant Theories

Although a complete theoretical model of branching patterns after bank M&As does not yet exist in the literature, some studies of bank competition provide useful insights into changes in the branch networks of newly-merged banks. As the impact of M&As on branching pat-

[8]Such a finding could suggest that some of the issues raised by, among others, Garmaise and Moskowitz (2003) could apply to Turkey as well as the U.S. In fact, an increase in bank concentration could have an even greater negative effect in Turkey, as Beck, Demirgüç-Kunt and Maksimovic (2003) argue that higher levels of bank concentration are more likely to reduce access to credit in developing countries. However, since a complete consumer welfare analysis is outside the scope of this study, such findings can only be used to draw very general conclusions on consumer welfare. As a result, the consumer welfare aspect of this study remains relatively less important and will not be discussed at great length.

[9]As explained in Section 4.3 below, the concept of a district is roughly comparable to a county in the U.S.

terms depends on many factors, arguments based on the findings of the existing studies will be highlighted categorically. The findings of the empirical analysis will then be interpreted according to the validity of each argument in the case of the Turkish banking sector.

Elimination of "excess capacity"

There is agreement in the literature that an expanded branch network can allow a bank to increase its market share by offering a more convenient product to its customers. As depositors tend to travel between locations, a branch network has the advantage of offering increased access to customers and allow the bank to charge a higher price for its product. For example, Neuberger and Zimmerman (1990) find that banks with more branches offer lower deposit rates to their customers, because in addition to interest received on deposits, the customers derive additional utility from having greater access to their accounts.[10] Using this concept, there have been attempts at modelling bank competition from an industrial organization point of view, where banks compete not only in deposit rates (prices) but also in the number and location of their branches.

In one such study, Cerasi (1996) finds that branching patterns depend on both the size of the market and the degree of collusion between the banks. If the market is small, then in equilibrium both banks will operate only one branch. On the other hand, if the market is sufficiently large, then the banks will engage in what is sometimes called "rivalrous strategic branching", which will increase the number of branches in the market. In this sense, competition in branches can lead to "overbranching" in which banks use additional branches to steal customers from their competitors. Kim and Vale (2001) also find that banks can increase their market share through expanded branch networks, but in their model branching has no significant effect on the overall size of the market. In this sense, the increased market share comes directly from stealing customers from another bank.

In Cerasi (1996), collusion between banks causes a decrease in the total number of branches. This is due to the fact that in competition, an increase in the number of a bank's branches reduces the profits of its competitors by stealing their customers. If banks choose

[10]This finding is confirmed by Hannan and Prager (2004), who argue that banks that are competing in multiple markets offer lower deposit rates compared to single market banks.

to collude, then they will internalize this effect and reduce the size of their branch networks. This finding has direct implications concerning M&As in the banking sector, as it suggests that after a merger involving two competitors, the newly merged bank will have an incentive to reduce the size of its branch network. In a sense, a merger between two competitors can reduce the number of bank branches in a market as the newly merged institution eliminates the "excess capacity" represented by branches that were a result of overbranching.

Efficiency

Another argument for a reduction in the number of branches after M&As has been put forth by Berger, Leusner and Mingo (1997) using an empirical analysis of bank branch efficiency in the U.S. They argue that M&As can result in increases in branch efficiency if a bank decides to close one or more branches and transfer the deposits to a branch in the same geographical area.[11] Combined with the theoretical evidence discussed above, their argument strengthens the expectation that mergers between banks that are competitors in the same geographical location will result in branch closures.

Market Power

If a merger between two banks is the result of a quest for market power, it can lead to a reduction in bank branches as the newly merged institution uses its new market power to eliminate competitors. This reduction in branches is a different phenomenon than those addressed in the two arguments presented above. In the first two cases, the newly merged banks close branches in order to increase efficiency or to eliminate excess capacity, whereas in the case of market power, it is the competitors of the newly merged institutions that are being forced to close their branches.

The main idea behind the market power argument has been presented by Calem and Nakamura (1998), who argue that a bank can capture market power by establishing branches in areas where its competitors do not have a presence. In their model, the depositors travel

[11] Berger *et al.* (1997) argue that such branch closures may not apply to the U.S., where interstate M&As dominate and the branch networks of merging banks do not overlap. As discussed below, the nature of the banking sector and the bank M&As are quite different in Turkey, making such branch consolidations likely.

between the central city (competitive market) and outlying locations (noncompetitive market). A bank that has branches in both areas can capture market power in the competitive market by being able to differentiate itself via its branch network. In doing so, the bank can use its market power to eliminate small, localized banks and this leads to a reduction in the number of bank branches.[12]

Effects of concentration

As most of the studies mentioned above use models of monopolistic competition between a limited number of market participants, the effects of bank M&As on branching patterns in a market with a large number of competitors remains largely undiscussed.[13] In fact, it could be the case that consolidation in an unconcentrated market leads to an increase in bank branches through increased competition. For example, banks in unconcentrated U.S. markets like New York City and Chicago have responded to recent mergers between their competitors by increasing their own branch networks.[14] Such a response could be interpreted as increased competition in branches, as described in Cerasi's (1996) model. As a result, it is possible for the impact of post-crisis consolidation to vary with the level of concentration of different markets and this possibility needs to be addressed in the analysis.

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[12]The theory behind this argument assumes that there are no regulatory procedures in place to prevent a decline in competition. Pilloff (2002) argues that mergers in the U.S. have not resulted in increased market power, because regulators have forced banks to divest (sell off) branches in areas where there is substantial overlap between merging institutions. If such divestitures are taking place, the effects of the merger on branching patterns may be ambiguous.

[13]The elimination of excess capacity argument is based on a setup such that the level of competition in the market decreases after a merger. However, this argument may not apply to markets, where two banks with small market shares decide to merge. In that case, it is not a given that the level of competition (and hence the number of branches) will decrease after the merger. Similarly, Avery, Bostic, Calem and Canner (1999) argue that market power effects can be more substantial in concentrated markets compared to markets that are unconcentrated. This is due to the fact that a merger would have a much larger impact on the competitive environment of a concentrated market.

[14]At least one New York bank executive sees mergers between his competitors as an opportunity to capture more market share, stating that acquisition "is a good way to lose customers. It dilutes your model, dilutes your culture, distracts your firm and dilutes your brand." ("McBank's", *The Economist*, April 17, 2004)

Branch network overlap

Another problem associated with the studies above is the assumption of collusion/merger between banks that have branches in the same area. On the other hand, if the branch networks of merging banks do not overlap, the effects of a merger are ambiguous. In Calem and Nakamura's (1998) study, a bank captures market power by establishing branches in outlying areas where its competitors do not have a presence. Therefore, if a bank establishes this presence by merging with another bank that has branches in these "new markets", then it will have an incentive to keep these "outlying" branches. In this case, a merger between two banks that do not have overlapping branch networks will not result in a decrease in the number of branches. Furthermore, Avery, *et al.* (1999) argue that the entry of an outsider can create incentives for the incumbents to increase their branch network.

On the other hand, it is possible that the acquirer may choose to close newly acquired branches if they are not sufficiently profitable or the regions in which they are located do not complement the existing branch network. For example, if the depositors do not travel frequently between two locations, then the positive effects of having branches in both locations described by Calem and Nakamura (1998) may not apply, making the branch in the "new market" unnecessary. In this sense, the efficiency argument of Berger, *et al.* (1997) applies to all types of bank mergers, regardless of branch network overlap.

Liquidation

Finally, it should be noted that, it is also possible that a bank can fail and subsequently be liquidated. In the case of liquidation, it is reasonable to expect that the number of bank branches in markets where the bank is liquidated will initially decrease. In the long-run, however, competitors may increase the number of their branches to capture the customers that used to be served by the liquidated bank.

Summary and Goals of the Analysis

In the only comprehensive empirical study of the effects of banking sector consolidation on branching patterns, Avery, *et al.* (1999) find that mergers and acquisitions in the U.S.

have only caused a decrease in the number of bank branches in markets where there was significant overlap between the branch networks of merging institutions. However, the differences between the structure of the banking sector in Turkey and the U.S., along with the relatively large number of bank failures that have preceded the current merger wave, suggest that a more detailed analysis should be performed to uncover the effects of banking sector consolidation on the availability of banking services in Turkey.

As discussed in the previous section, one of the main goals of the central authority in encouraging bank consolidation was to reduce the presence of bankrupt and financially weak banks. As most of these banks were characterized by over-extended and inefficient branch networks, the elimination of this excess capacity through branch closures was an important aspect of the restructuring program implemented after the crisis.[15] Therefore, the goal of this study is to investigate whether consolidation activity in the Turkish banking sector has affected bank branching patterns in a way that has facilitated the elimination of excess capacity. Achieving this goal requires finding out which arguments presented above apply to the Turkish case. This will make it possible to examine the validity of consolidation as a post-crisis clean-up tool and to draw policy implications regarding bank mergers.

4.2.2 Crisis and Consolidation in the Turkish Banking Sector: 2000-2003

Although a variety of micro- and macroeconomic factors contributed to the 2000-2001 banking crisis in Turkey, the proliferation of weak banks and an overextension of the branch networks has been identified as the main structural weakness of the sector prior to 2000. As a result, one of the priorities of the regulatory authorities following the crisis was to address the problem of "low profitability performance stemming from small-scaled and fragmented banking structure that lacks efficiency." The assessment of the Banking Regulation and Supervision Agency (BRSA) was that both state and private banks needed "rationalization

[15]The reports issued by the central regulatory authority in Turkey regularly refer to losses in failed banks due to high operational costs and the need to eliminate branches and employees in the banks that were nationalized after the crisis. For an example, see "Banking Sector Restructuring Program Progress Report - (VI)" (April 2003). Available from www.bddk.org.tr.

of branches and personnel" in order to increase their profitability and efficiency.[16]

The roots of the overexpansion of the branch networks lie in the high inflation era of the 1990s, when banks found it profitable to collect deposits from the public and lend them to the government at high rates. The expanding budget deficits and the high real interest rates made investing in government securities profitable and banks expanded their branch networks rapidly in order to tap into more niches in the market and increase their deposit base.[17] Although an IMF report in 2000 cited Turkey as having the most profitable banking sector in the OECD, Akçay (2001) points to the limited entry of foreign banks during the 1990s as a sign of actual bank profits being much lower.

Although foreign entry into the sector was limited, the number of private domestic banks increased rapidly during the late 1990s. As existing banks increased their deposit base and used these funds to purchase more government securities, there was severe crowding out of the private sector.[18] This, and the lucrative government securities market, caused large private sector firms to enter the banking sector, which further increased the number of banks and bank branches. As Akçay (2001) observed, by 1999, the sector was "overbanked, overbranched and hence overstaffed." IMF also reached the same conclusion, reporting that "Turkey has remained 'over branched' throughout the period under consideration. Some consolidation in the sector is thus to be expected as inflation declines."[19] Table 4.1 below shows the rapid growth, and the subsequent reduction, in both the number of deposit collecting institutions and bank branches between 1995 and 2003.

The response of the BRSA to the onset of the crisis in late 1999 was to initiate an operational restructuring plan for the banking sector. The restructuring program took

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[16] "Banking Sector Restructuring Program Progress Report - (VI)" (April 2003) and "Towards a Sound Turkish Banking Sector" (May 2001).

[17] Measuring bank profitability solely by looking at net interest margins (more commonly known as NIM, which represents net income scaled by total assets) is not a desirable method, as NIM excludes non-interest income and expenses. However, both the IMF Staff Country Report (2000) and Akçay, Erzan and Yolalan (2001) agree that high NIM is a good measure of bank profitability in Turkey, because a large portion of Turkish banks' incomes comes from interest and not from fees and commissions.

[18] In support of this argument, Akçay *et al.* (2001) note that between 1990 and 1999, the ratio of loans to assets in the Turkish banking sector decreased from 0.42 to 0.30.

[19] IMF Staff Country Report (2000).

Table 4.1: Developments in the Turkish Banking Sector 1995-2003. All numbers refer to deposit collecting institutions only.

	Banks	Branches	Employees
Dec. 31 1995	55	6223	139,038
Dec. 31 1996	56	6424	142,280
Dec. 31 1997	59	6800	149,842
Dec. 31 1998	60	7348	161,438
Dec. 31 1999	62	7666	168,821
Dec. 31 2000	61	7812	132,384
Dec. 31 2001	46	6890	132,329
Dec. 31 2002	40	6087	118,329
Dec. 31 2003	37	5946	118,606

four different approaches which were very similar to the restructuring programs initiated in other developing countries during banking crises.[20] Brief discussions of these approaches are presented below.

Recapitalization: Although different recapitalization schemes were made available to both state and private banks, the main beneficiaries of such funds were state banks. As of mid-2003, state banks have received significant capital injections from the Turkish Treasury and their short-term liabilities to private banks and non-bank firms worth $6.8 billion were eliminated. Private banks have also received capital increases worth $2.4 billion through voluntary debt swaps conducted by the Treasury. Some private banks also chose to be a part of the "Bank Capital Strengthening Program" where their capital needs were determined by the BRSA and additional capital was raised either through loans from the Treasury or from the shareholders of banks, negotiated by the BRSA.

Sales of banks by the State Deposit Insurance Fund (SDIF): It should be noted here that the stated goal of the BRSA with respect to the sale of SDIF banks was to minimize

[20]For example, it can be argued that the restructuring program implemented in Turkey was very similar to Brazil's plan which was implemented during 1995-1997. For details of the Brazilian experience see Baer and Nazmi (2000).

the cost to the economy and not the continuity of financial services offered through these banks to the public. The "Banking Sector Restructuring Program Progress Report - (VI)" reports that

> For the resolution of insolvent banks, three main alternatives existed; direct liquidation by repayment of all liabilities, liquidation by repayment of liabilities subject to deposit insurance system, and finally, sale after a financial and/or operational restructuring process.
>
> Although direct liquidation of the SDIF banks through repayment of all their liabilities is accepted to be a rapid method, applicability of this alternative was very low under the conditions of the time. Indeed, if this resolution method were to be chosen, substantial amounts of cash funds would have to raised through extensive borrowing through the markets which would distort budgetary balances and increase interest rates further by exerting an additional pressure on already shallow financial markets.

To this end, all SDIF banks were offered for sale after a financial and operational restructuring process. The financial restructuring phase included transfers of certain liabilities to other banks, reductions in the foreign exchange positions and decreases in the deposit rates of these banks. The goals of the financial restructuring were to increase the attractiveness of the failed banks to prospective buyers and to contribute to the overall stability of the financial sector. In making these banks attractive acquisition targets, SDIF incurred significant costs. As of April 2003, SDIF had used $21.4 billion for the restructuring of the failed institutions. Other incentives were also provided for potential buyers, such as the bank being sold without its problem loans or some liabilities.[21]

The banks that were transferred to the SDIF also went through some operational restructuring. However, the degree to which the banks were restructured has varied greatly

[21]The most common example of this strategy concerns large time-deposits and corporate loans. In most SDIF sales, time-deposits and potentially troubled large corporate loans were not transferred to the buyer but taken over by state banks. For these assets, SDIF has implemented a banking asset sale similar to the ones observed in the U.S. and South Korea in the 1990s.

between the different banks; some banks have gone through almost no operational restructuring (little or no branches closed or employees laid off), whereas some banks were merged with others and offered for sale as one bank. This initial operational restructuring period makes the mergers involving these failed banks much different than the privately-arranged mergers of healthy institutions described below.

Mergers: During the restructuring process, the BRSA and the government made a serious effort to encourage bank mergers by providing tax incentives for banks involved in consolidation activity. Also, capital assistance was made available only to small banks that had increased market share through mergers and acquisitions, providing an incentive for small banks to merge either with each other or with larger banks. These incentives resulted in a number of mergers between 2001 and 2004. Four of these mergers have included commercial banks, one merger was between two investment banks and one merger involved a non-bank consumer credit institution and a commercial bank. As discussed above, the main mergers of interest are the ones involving commercial banks, so the latter two mergers will not be considered in the analysis presented below.

Another important development in the banking sector during this period was the merger of two state banks, which was initiated by the government and the BRSA. Although the credit related functions of state banks in Turkey are much different compared to the private commercial banks, it appears that both efficiency and elimination of excess capacity arguments apply to both this merger and mergers between private banks. In fact, BRSA has argued that within the framework of the merger, these two state banks "were ensured to follow the principles of efficiency and productivity and number of their branches and personnel has been reduced to rational levels" (Banking Sector Restructuring Program Progress Report - VI, April 2003). As this framework is similar to the implementation of private bank mergers, the merger of the state Housing Bank (Emlak Bankasi) and Agriculture Bank (Ziraat Bankasi) was included in the analysis.[22]

Liquidation: A number of banks that were taken over by the SDIF were liquidated during the restructuring process of 2001-2003. Some of these banks were liquidated after

[22]Although not shown, the replication of the analysis without this merger suggest that the most of the results remain unchanged. This validates the inclusion of the state bank merger in the data set.

attempts to sell them were unsuccessful, and some were liquidated without being restructured or offered for sale. In all 11 banks were liquidated during this period and one bank was turned into a "transition bank" whose purpose is to assist the SDIF in its restructuring operations, such as deposit insurance payments etc. As this transition bank currently operates two branches and does not provide any financial services to the public, the restructuring of this bank is considered as a liquidation for the purposes of this study. Overall, the liquidation process has resulted in the closure of 843 branches along with 265 branches that were sold to existing private commercial banks. Most of these branches were sold along with their employees and deposit accounts, however in most cases large deposit accounts and loans were not included in the sale.

Summary: Based on these developments in the banking sector, this chapter looks at the effects of bank mergers, sales of banks by the SDIF and liquidation of failed institutions, on the number of bank branches in Turkey.[23] The mergers involving sales of failed banks by the SDIF are considered to be different than mergers between healthy institutions due to the involvement of the central authority in the process. The failed institutions involved in SDIF organized sales have gone through two stages of operational restructuring. These banks were first restructured by the SDIF, in order to make them attractive to the prospective buyers, followed by a restructuring by the purchasing bank after the sale has been completed.[24] As the branching patterns of these banks are likely to be different than the branching patterns of two (or more) healthy banks merging voluntarily, differentiating between these two types of mergers becomes important. It is reasonable to assume that efficiency concerns are more important in sales of failed institutions, as it is highly unlikely that all of the managerial inefficiencies contributing to the failure of the bank would have been eliminated by the SDIF prior to the sale. This differentiation will allow the results of the empirical analysis to be

[23]Although the recapitalization scheme implemented by the BRSA could also have had an effect on the branching patterns of banks, this will not be considered because data on recapitalization is not available.

[24]An illustrative example of this two stage restructuring process is the case of Demirbank, which was bought by HSBC in 2001. During the 12 month period when Demirbank was under the control of SDIF, 10 of its 198 branches were closed. According to the data available from the Banks Association of Turkey (BAT), HSBC has closed 37 branches after the acquisition, while opening only 2 new branches. An example of the opposite case is Sitebank, which was nationalized in 2001 and sold to the Portuguese-Greek Nova Bank in 2002. Between 2001-2002, SDIF closed 8 branches (out of 13), but after the acquisition Nova Bank has increased the number of branches to 12.

interpreted according to the arguments specified in the preceding section.

4.3 Data and Empirical Approach

Prior to the description of the data set, an introduction to the administrative divisions may be necessary for readers not familiar with the characteristics of Turkey. Turkey is divided into 7 geographical regions and 81 provinces (called "il" in Turkish). All provinces consist of multiple districts (called "ilçe"), which are basically equivalent to counties. A significant number of the provinces have a "central district", which is basically the capital of the province. However, several big cities (such as İstanbul) do not have a central district and their "provincial capitals" consist of two or more districts. With a few minor exceptions, the central district is the most urbanized and highly populated part of the province. The remaining districts are usually centered around a town and it is common for the districts to be subdivided into townships and villages. The data has been collected at the district level for all 923 districts, although recent administrative redistributions in Turkey have resulted in some of the individual districts being dropped (this is explained in more detail below).

The idea of a district constituting a market by itself is well supported by the findings of previous studies. Recent studies of the banking sector in the U.S. have concluded that depositors obtain banking services at local banks.[25] Therefore, in analyzing the effects of consolidation in the banking sector, obtaining and analyzing data at a local level is important. For example, Avery *et al.* (1999) treat each zip-code as a separate, local market. On the other hand, Garmaise and Moskowitz (2003) define local banks as banks located within 24 km (15 miles) of a consumer.[26] For the purposes of this study, neither of the above approaches was feasible due to constraints on the availability of detailed geographical data. Therefore, a banking market was defined as an individual district, which is smaller than a province or a region, hence more compatible with the goals of the analysis.

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[25]For examples of this literature, see Amel and Starr-McCluer (2001) and Amel and Hannan (1999).

[26]Amel and Starr-McCluer use a similar geographical definition but use 48 km (30 miles) as the maximum distance between consumer and their local banks.

4.3.1 Data

The data has been collected from multiple sources for the years 2000 and 2003. The data on the location of bank branches and branch openings and closures at the district level were derived from a database of bank branches supplied by the Banks Association of Turkey (BAT). Although the number of bank branches at the provincial level is available from a variety of sources, the unique aspect of the BAT database is the presence of opening date, closure date (if applicable) and location of a bank branch at the district level. However, a certain amount of effort was required to clean the data for the purposes of this study. The most common issue with the branch data was the fact that a merger between two banks is shown in the database as the closure of all branches of the merging institutions and the reopening of all branches under the newly merged entity. As these entries do not constitute real branch openings and closures (as the branch continues its operations during the merger), they had to be eliminated.

Another issue was changes in locations of banks within the same district. If the location change did not interrupt the branch's operations (such as an extended closure) then these entries were eliminated. In determining whether a branch had moved, the reported closure date for the old location was matched with the reported opening date for the new location. If the closure date of one branch was the same as the opening date of another branch of the same bank, then it was assumed that the branch had moved to a new location. Finally, there were a few cases of "branch consolidation", where a bank had closed two branches and opened a new, possibly larger, branch at a different location. These entries were treated as a single branch closure. As the focus of the analysis is on deposit collecting institutions, non-depository banks were left out.

Almost all of the economic and demographic data has been collected from the State Institute of Statistics (SIS) of Turkey. The data sources within the SIS include the 1990 Census, 1997 Population Count, 2000 Census and annual GDP calculations. As there was not a census at 2003, the population estimates at the district level for this year were based on the census data for 1990 and 2000. However, for districts that were constituted after 2000, there was no data available and these were eliminated from the data set. Finally, the

distance between a district and the central district of its province was calculated using a distance calculator provided by the Turkish General Directorate of Highways.[27]

4.3.2 Empirical Approach

Based on the stated goals of this study, the baseline analysis concentrates on the effects of banking sector consolidation (mergers and bank liquidations) on the number of bank branches, while controlling for market characteristics, such as the size, level of competition and the demand for banking services in a market. The equation for the baseline regression is given as:

$$\text{CHANGE}^{00}_{i,03} = \alpha + \beta_1 \text{CONSOLIDATION}^{00}_{i,03} + \beta_2 \text{MARKET}^{00}_{i} + \beta_3 \text{DEMAND}^{00}_{i} + \epsilon^{00}_{i,03} \quad (4.1)$$

In Equation (4.2), $\text{CHANGE}^{00}_{i,03}$ is the change in the number of bank branches per 10,000 people in district i between time 2000 and 2003. Following the arguments presented by Avery *et al.* (1999), the change in the number of branches per 10,000 people was used as the dependent variable instead of the change in the number of branches. A per capita measure is better than a level measure, because it captures the effects of branch closures on the availability of financial services for the public more accurately. However, as there is no population data available for 2003, $\text{CHANGE}^{00}_{i,03}$ was constructed using population estimates based on the 1990 and 2000 population data. [28]

As described above, merger activity was divided into two categories: mergers involving the sale of failed institutions by the SDIF and privately arranged mergers between two healthy institutions. Furthermore, merger activity was divided into subcategories according to the overlap in the branch networks of merging institutions. According to these categorizations, the variable "MergerIn" refers to the percentage of bank branches in a district

[27] The calculator is available at www.kgm.gov.tr.

[28] Although potential problems associated with using an estimate for population are obvious, a replication of the analysis with using the level change in bank branches (not shown) has found that the results remain virtually the same. As a result, $\text{CHANGE}^{00}_{i,03}$ was kept as the dependent variable, which would allow the results to be compared and contrasted with the findings of Avery *et al.* (1999).

that were acquired by a bank that also had at least one branch in the same district. On the other hand, "MergerOut" refers to the percentage of bank branches in a district that were acquired by a bank that did not have a branch in that district prior to the merger.

Sales of failed banks were also separated into two variables according to the degree of branch network overlap between the acquiring institution and the institution being sold by the SDIF. "SDIFIn" represents the percentage of bank branches in a district that were sold by the SDIF to a bank that also had one or more branches in that district. "SDIFOut" captures the number of bank branches in a district sold by the SDIF to a bank that had no prior presence in that market.[29]

This definition of network overlap is based on the branches of the bank being acquired, rather a measure of overlap between both institutions. The assumption behind this definition is that the acquired institution will be more likely to have its branches closed, rather than the purchasing bank closing its own branches and keeping the branches of the acquired bank. As bank mergers in Turkey have so far involved weaker institutions being purchased by stronger banks, this assumption seems reasonable.

The other two variables within the consolidation category account for bank failures and liquidations that took place during the period 2000-2003. "Fail" is the percentage of bank branches in a district in 2000, which belonged to institutions that failed between 2000 and 2003, whereas "Liquidate" refers to the percentage of bank branches that belonged to institutions that were liquidated during this period. It should be noted here that the liquidation of a bank may not directly apply to all of its branches, as some branches of the banks being liquidated were sold by the SDIF to healthy banks.

The variable MARKET_i^{00} captures the level of concentration and competition in market (district) i in 2000, which could have influenced bank branching decisions between 2000 and

[29]There is a possible complication concerning the definitions of SDIFIn and SDIFOut as the measure of bank branch network overlap between the failed bank and its acquirer. As described above, some branches of the failed banks were closed by the SDIF prior to the sale, presumably as a part of the negotiations with the acquirer. Therefore it may appear that using the total number of branches at 2000 for these institutions is misleading since the acquirer never took control of the branches that were closed by SDIF. However, a close inspection of the actual branch closure dates reveals that a vast majority were closed immediately before the sale. As a result, it is reasonable to assume that these branches were closed according to the concerns of the buyer and this alleviates the concern that the incentives of SDIF and the buyer were not aligned.

2003. The level of concentration is measured by two indices that are similar to Herfindahl indices regularly used in the literature. In existing studies, a Herfindahl index is calculated using the market share of a firm; however, this method was not applicable in this study due to lack of data. Not only that there is no data available on the deposits (or loans) of particular bank branches at the district level, there is also no such data available at the provincial level. As a result, two "quasi-Herfindahl" (called "HHI" from here on) indices were calculated using the percentage of a bank's branches.[30] The use of the number of branches instead of market share is less than ideal, as deposits (and market share) can and do vary between bank branches. However, as the level of concentration in the market is identified in the literature as an important determinant of branching patterns, having an imperfect measure of market concentration is preferable to excluding this variable altogether.

Although the relevant banking market for the analysis has been determined to be a district, another possibility was also considered in the calculation of the Herfindahl indices. The first HHI was calculated at the district level, and the second was calculated at the provincial level. The provincial level index was thought to be relevant due to the issue of how banks and bankers define a market. As there usually are strong commercial ties between the districts of a province and the central district, it is possible that banks consider multiple districts as a single market. If banks do not consider different districts of a province to be separate markets, then their branching decision could be made at the province and not district level.[31] The inclusion of the provincial level HHI can account for these branching decisions made at the province level.

Of course, whether a particular district can be served by bank branches in the central district depends on the distance between these locations, as well as the frequency with which residents of a district travel to the central district. Unfortunately such travel data do not seem to exist, though the the distance between a district and the central district of that province has been included in order to capture the effects of the central district bank

[30] A Herfindahl index is the sum of squared market shares of all firms in a market. It takes a value between 0 and 1, with 0 representing a perfectly competitive market and 1 suggesting a monopoly.

[31] For example, a bank may choose to close a branch in a district not because it has too many branches in that district but because it has too many branches in the province that the district is a part of.

branches also serving customers in nearby districts.[32]

A final indicator of the level of competition in a given market can be the presence of state-owned banks in that district. Especially in rural areas, state banks can capture market share rather easily, due to their government-mandated lending relationships with the agricultural industry and governmental organizations.[33] Therefore, the variable "State" has been included in MARKET_i^{00}, capturing the percentage of state owned bank branches in district i at 2000.

DEMAND_i^{00} variables consist of the GDP per capita in each district[34], log of population and the percentage of population living in urban areas during the year 2000. Furthermore, the estimated percentage change in population between 2000 and 2003 was used to capture the effects of population on change on the number of bank branches per 10,000 residents. The population density of each district, measured by the number of people per square kilometer, is also included in the analysis. Population density can be a factor in determining demand, because a branch in a district with low population density may not have as many customers as a branch in a densely populated district. Therefore, branches in low population density areas may be less efficient, simply because they can not serve as many customers as the ones in high density (mostly urban) districts.

The number of bank branches per 10,000 people in 2000 was also included in DEMAND_i^{00}, which is an indicator of whether there was a substantial bank presence in a given district or not. This is an important variable, as it captures whether banks tend to leave areas with a large number of bank branches in order to exit highly competitive markets with excess capacity. The final two variables in this category are a dummy that indicates whether or not the district is a central district and another dummy indicating whether or not the district

[32]It is also possible that the residents of a district find it more convenient to travel to the central district of a neighboring province. However, as the only method available to measure travel distances between districts in Turkey is the relatively cumbersome method of entering each pair of locations into an internet based mapping service, this possibility was ignored in the analysis.

[33]For example, almost all public servants in Turkey receive their pension direct-deposits in state banks. In rural areas where public servants can constitute a significant portion of the bank customers, this creates a significant advantage over private banks.

[34]For unknown reasons, the SIS has collected district level GDP data only for the period 1994-1996. From this data, the share of each district's GDP in the GDP of its province for 1996 was calculated. This ratio was then multiplied by the province level GDP for 2000 to estimate GDP per capita for each district.

is part of İstanbul province.

An examination of the sample characteristics reveals starkly different patterns in districts depending on the level of bank presence. Table 4.2 shows that there are 501 districts (out of 853) that had 3 or less bank branches in 2000. These districts are almost completely dominated by state banks and the developments in the banking sector between 2000 and 2003 do not seem to have any impact on these districts, as the percentage of branches in these areas that were involved in a merger or liquidation is extremely small. As a result, the sample was split into two and Equation (1) was separately estimated for each sub-sample. However, due to the almost negligible impact of mergers and acquisitions on the districts that have less than 3 branches, significantly more attention was paid to the sub-sample of districts that had more than 3 branches in 2000. Although this sub-sample corresponds to only 42% of all districts, it includes 89% of all bank branches (6832 out of 7666).[35]

A point that should be made here concerns the values of certain variables shown in Table 4.2. Compared to the studies of bank branching patterns in the U.S. and Europe, an average change of 0.25 branches per 10,000 people may appear upon first glance to be insignificant. However, in an economy where the average number of bank branches per 10,000 residents was 0.977 in January 2000, a decrease of 0.25 within 3 years can constitute a significant change in the availability of financial services in Turkey.[36] A comparison between the U.S. data and the data used in this study can illustrate this point. In their study of bank branching patterns in the U.S. between 1985 and 1995, Avery *et al.* (1999) note that in 1985 there were approximately 4 branches per 10,000 residents in urban areas and this number decreased by 19% over the course of 10 years. On the other hand, the number of bank branches per 10,000 people decreased by more than 25% over three years in Turkey. In that sense, the change in the availability of bank branches in Turkey is comparable to the experience of the U.S.

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[35]The results of robustness checks using regressions on the entire sample will be presented in Section 4.4.

[36]A comparison with other developing countries reveals that Turkey does not have an uncharacteristically low or high number of bank branches per 10,000 residents. There exist countries that have much lower averages, such as India with 0.625 (2002) and Russia with 0.268 (1999). On the other hand, there are also developing countries with somewhat higher averages: Czech Republic with 1.76 (2000) and Argentina with 1.175 (2003)

Table 4.2: Sample characteristics.

	Whole Sample	Branches > 3	Branches ≤ 3
# of Districts	853	352	501
Change	-0.2561	-0.3536	-0.1876
$CONSOLIDATION^{00}_{i,03}$			
MergerIn	0.0337	0.0798	0.0013
MergerOut	0.0001	0.0003	0
SDIFIn	0.0011	0.0027	0
SDIFOut	0.0147	0.0347	0.0006
Fail	0.0675	0.1603	0.0023
Liquidate	0.0363	0.091	0.0006
$MARKET^{00}_{i,03}$			
HHI District	0.4906	0.1678	0.7173
HHI Province	0.1443	0.1179	0.1628
State	0.7202	0.4173	0.9331
Distance	56.50	43.42	65.68
$DEMAND^{00}_{i,03}$			
GDP per Capita	2259.3	2958.06	1768.36
Log(population)	10.621	11.5	10.003
Population change	0.011	0.0382	-0.0081
Population density	489.65	1110.57	53.392
Urban	0.4865	0.596	0.4091
Branch per 10,000	0.977	1.281	0.8568

Table 4.2 also reveals that the degree of branch network overlap in mergers involving sales of failed institutions by the SDIF is very low. This is consistent with the fact that most of the buyers in these sales were small banks looking for a bigger share of the Turkish market. On the other hand, privately arranged mergers seem to have taken place between institutions that operate in the same markets, as evidenced by the fact that MergerOut is very close to zero, but MergerIn is relatively high. This difference in the nature of these mergers can signal the different impacts they have on branching patterns in Turkey.

The initial stage of the analysis is the estimation of Equation (1) using ordinary least squares (OLS). The results of this baseline regression are presented in Table 4.3. The results seem to confirm the arguments in favor of splitting the sample, as the impact of consolidation activity on the dependent variable varies greatly between the two sub-samples.

For the sub-sample of districts with more than 3 branches in 2000, the only statistically significant M&A variable is SDIFIn. Therefore, it can be argued that an SDIF sale will result in a decline in the number of bank branches in a district, when both the buyer and the failed institution being acquired have branches in that district. On the other hand, there is no evidence that an SDIF sale will result in a branch closures in the districts where the acquirer has no market presence but the failed bank does. Although the cause of the relationship can not be determined with certainty from the regression analysis, it is still possible to draw some conclusions about this negative relationship between SDIFIn and the change in bank branches per capita.

As discussed above, a negative relationship between merger activity and the change in bank branches could be due to a reduction in the branches of the newly merged institution (elimination of excess capacity and efficiency arguments) or a reduction in the branch network of the competitors (market power argument). However, the fact that the variable SDIFIn deals with sales of failed institutions, it seems improbable that the decline in bank branches is solely a result of market power being exercised by the newly-merged institutions. Although issues of economies of scale and scope are likely to apply in the long-run for these acquisitions, it is highly unlikely that the all of the inefficiencies that have resulted in the failure of these banks would have been eliminated in a short period of time (two or three years), leaving the newly merged institution in a position to obtain and exercise market

power.[37] As a result, it is likely that eliminating excess capacity and increasing efficiency were the main incentives behind the branching strategies of both the SDIF (first stage of the reorganization) and the management of the newly merged institution (second stage).[38]

The remaining three M&A variables do not seem to have a statistically significant relationship with the change in the number of bank branches per 10,000 residents. For the cases where the merging institutions do not have overlapping branch networks (variables MergerOut and SDIFOut) this is not a surprising result, since the general consensus in the literature is that such mergers have ambiguous effects on the number of bank branches. On the other hand, the the lack of any statistically significant relationship between private mergers with branch network overlap (MergerIn) and the dependent variable is somewhat surprising and it warrants further analysis.

For the sub-sample with less than three branches, the results suggest that private mergers (represented by MergerIn) increase the number of bank branches per capita. On the other hand sales of failed institutions (SDIFOut) result in a decrease in bank branches. Although this can be explained by an elimination of inefficient rural branches, the positive relationship between MergerIn and the change in bank branches is surprising and its implications will be explained within a larger context below.

Bank failures and liquidations have a negative and statistically significant relationship with the the dependent variable, although the significance is weaker for the sub-sample of districts with more than 3 branches in 2000. This could reflect the rather large number of branches that were sold by the SDIF and possibly imply that competitors have established new branches in areas where some branches were closed due to liquidation.

Several market characteristics (variables within $\text{MARKET}^{00}_{i,03}$) are also found to be important in determining the patterns in bank branching. The coefficienct of the district-

[37]The studies of bank mergers in the U.S. seem to indicate that it takes two to four years for a newly merged bank to fully restructure itself. For example, Calomiris and Karceski (2000) argue that it takes three years for the merger to be fully implemented, and the realization of cost savings takes "several years."

[38]It also should be kept in mind that the acquirers of failed banks were also given substantial financial assistance by the BRSA during this period. It is possible that some acquisitions were motivated by the availability of these funds. However, this possibility does not rule out the conclusion that the newly merged institutions would have too many inefficiencies preventing it from exercising market power.

Table 4.3: Baseline regression results (robust standard errors). Dependent variable: change in the number of bank branches per 10,000 residents.[a]

	Branches > 3		Branches ≤ 3	
	Coefficient	Std. Error	Coefficient	Std. Error
$CONSOLIDATION^{00}_{i,03}$				
MergerIn	0.3780	0.2352	0.5613***	0.134
MergerOut	0.3472	0.382	-	-
SDIFIn	-3.5474***	1.2582	-	-
SDIFOut	-0.1785	0.3787	-1.0052***	0.1671
Fail	-0.4851**	0.2347	-0.9838***	0.209
Liquidate	-0.4763*	0.2878	-0.7342***	0.1589
$MARKET^{00}_{i,03}$				
HHI District	1.1980***	0.388	0.5448***	0.1089
HHI Province	0.7924***	0.2289	0.1382	0.1479
State	-1.2427***	0.207	-0.9635***	0.0967
Distance	-0.0002	0.0003	0.005***	0.001
$DEMAND^{00}_{i,03}$				
GDP per Capita	0.00001***	0.000007	-0.000002	0.000004
Log(population)	0.0358	0.0258	-0.1537**	0.0636
Population change	-0.4159	0.2744	-1.069***	0.3709
Population density	-0.0000007	0.000002	-0.000006	0.0001
Urban	0.0314	0.0702	0.2482***	0.0609
Branch per 10,000	-0.1892***	0.0238	-0.4861***	0.0963
Center	-0.0290	0.0376	-0.0358	0.0359
İstanbul	-0.0287	0.0451	-	-
Intercept	-0.2301	0.3357	2.1138***	0.8035
Adjusted-R^2	0.7223		0.6368	
# of observations	352		501	

[a] *** suggests significance at 1% level, ** is significance at 5% and * implies significance at 10%.

level Herfindahl index is positive and significant for both sub-samples. The province-level Herfindahl also displays a positive relationship with the dependent variable, although this is significant only for the sample of districts with more than 3 branches. These findings suggest that banks tend to be attracted to highly concentrated markets, which has an ambiguous impact on the level of competition. If the increase in the number of branches is due to entry of new banks, this can increase the level of competition. However, it is also possible that the new branches belong to incumbents who are trying to deter entry and establish market power. This would reduce the level of competition in these markets. Although it is difficult to reach a firm conclusion, additional evidence presented below suggests that the positive relationship between the district-level HHI and the change in bank branches per capita is due to both newly merged institutions and their competitors entering new markets.

Finally, it also appears that banks take into consideration the amount of competition at the province level (through the province-level HHI), which reflects an effort to capture market share in the surrounding districts. This could especially be true in small provinces, where customers can easily travel between district in order to obtain banking services.

The percentage of state bank branches has a highly significant and negative relationship with the dependent variable for both sub-samples. This is a reflection of the fact that the Turkish government has been engaged in a serious reorganization of the state banks. As the main goal of this reorganization scheme is to prepare the state banks for eventual privatization, a number of state bank branches have been closed and the findings seem to confirm the effects of these branch closures. The distance between the district and the provincial capital has a positive impact only on the sub-sample of districts with few bank branches. This could reflect the fact that banks tend to open branches in peripheral areas where customers are unwilling or unable to use branches located in other districts.

As far as the demand for banking services ($DEMAND^{00}_{i,03}$) is concerned, there are some differences between the two samples. For the sub-sample with a large number of branches (more than 3), a higher GDP per capita results in an increase in the number of bank branches per capita. This evidence is somewhat consistent with the idea that the size of the market is an important determinant of branching patterns, although the lack of a statistically significant relationship between population and the change in bank branches is

somewhat surprising. The number of branches per 10,000 residents in 2000 has a negative relationship with the change in the number of bank branches, suggesting that banks have realized the over-saturation of some areas and have eliminated branches in such markets.

For the sub-sample with few bank branches (less than 3), both the log of the population in 2000 and the change in population between 2000 and 2003 have an inverse relationship with the dependent variable in the sub-sample of districts with few bank branches. The latter relationship could be reflecting fact that in a time of limited branch openings, an increase in population would result in a decrease in bank branches per capita. Only the percentage of the population living in urban areas within the district has a positive and significant impact on the change in the number of branches per 10,000 residents.

Overall, the relationship between $\text{DEMAND}_{i,03}^{00}$ variables and the change in bank branches is somewhat ambiguous, as it appears that in the districts within this sample, Turkish banks have increased the number of branches in highly urbanized areas and under-banked districts. This could be due to the fact that the major urban areas in Turkey have been over-saturated with bank branches in the 1990s and banks have decided to expand into areas that do not have a large number of branches. Although additional evidence in support of this argument will be provided below, a complete interpretation of these results may require further analysis including estimation of the demand for banking services in under-banked markets, which is beyond the aim and scope of this study.

4.3.3 Interactions

As discussed in the previous section, there is evidence in the literature suggesting that the level of concentration and the size of a market can affect the relationship between M&A variables and the change in the number of bank branches. Some of the models predict that in markets with high levels of concentration a merger between competitors cause a decrease in the number of branches, whereas in markets with low levels of concentration the effects of a merger could be ambiguous.

There is less agreement on whether the relationship between M&A activity and branching patterns depend on the size of the market or not. However, it can be argued that banks

will be more inclined to operate expanded branch networks in large markets, implying that a merger between competitors may not cause a decline in the number of branches. On the other hand, in small markets where banks are inclined to operate a single branch, a merger between competitors can result in the newly merged entity closing some branches and continuing to operate a single branch.[39]

In order to investigate these possible interactions, the sub-sample of districts with more than 3 branches in 2000 was further divided according to the level of concentration and market size. In separating the sub-sample according to concentration, districts with a district level HHI less than 0.18 were considered to be low concentration markets. This separation is defined as such by the Turkish Competition Authority (TCA), which treats markets with HHI greater than 0.18 as highly concentrated markets.[40]

The size division was made according to the aggregate level of GDP of the district (not per capita GDP as used in the previous analysis). The districts with an aggregate level of GDP greater than $250 million were considered to be large markets and the remaining districts were categorized as small markets.[41]

The interaction analysis concentrates on the four merger and acquisition variables. The average values of these variables based on the two different categorizations of the sub-sample are provided in Table 4.4. As the branch network overlap between institutions involved in an SDIF merger is only present in big and not concentrated markets, no interaction dummy will be used for SDIFIn in the analysis presented below. Also, there will be no dummy to account for the interaction between MergerOut and size and concentration, since there does not seem to be a case of a merger involving banks without overlapping branch networks in small and concentrated markets. The analysis below investigates the presence of relationships between the remaining two M&A variables, market concentration and size

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[39]This argument is based on the theoretical findings of Cerasi (1996), who finds that in small markets unit banking can be an equilibrium. If so, a merger between two unit banks may result in the newly merged institution closing one branch and reverting back to a unit banking setting.

[40]See the TCA Board Decision on the case of "Anadolu Efes Brewery Co. and Miller Brewing Company" (2002). Available from the TCA website, www.rekabet.gov.tr (in Turkish).

[41]A more desirable measure of market size would be total bank deposits in a given district, unfortunately this data is not available at the district level.

Table 4.4: Characteristics of the "more than 3 branches in 2000" sub-sample categorized according to market concentration and market size.

	District HHI $\leq$ 0.18	District HHI > 0.18
# of districts	210	142
MergerIn	0.0898	0.0649
MergerOut	0.0006	0
SDIFIn	0.0045	0
SDIFOut	0.0488	0.0138
	Size $\geq$ \$250 mil.	Size < \$250 mil.
# of districts	161	191
MergerIn	0.0768	0.0823
MergerOut	0.0008	0
SDIFIn	0.0058	0
SDIFOut	0.0581	0.0149

by adding interaction dummies to the baseline regression.

Concentration Interactions

The results of the regressions that include interaction dummy variables are given in Table 4.5 below. The left hand side column labelled "HHI District" represents the regression that includes a dummy variable for districts that have a district level HHI less than 0.18. In order to conserve space, only the coefficients of interactions between the concentration dummy variables and the $\text{CONSOLIDATION}^{00}_{i,03}$ variables are presented in the table.

The results of the regression reveal that there is an interaction between private mergers with branch network overlap and the level of concentration in the market. The coefficient of MergerIn without the interaction is positive and significant, whereas the coefficient for the interaction of MergerIn and districts with low concentration (HHI < 0.18 dummy * MergerIn) is negative and significant. A test with the null hypothesis of both coefficients

being jointly equal to zero fails to reject the null hypothesis at 10% level. Therefore, it can be concluded that MergerIn has no statistically significant effect on the sub-sample of districts with HHI less than 0.18.

The main conclusion of the regression with the interaction dummy is that a private merger of banks with overlapping branch networks has a positive and significant relationship with the change in bank branches per capita in concentrated markets (HHI $\geq$ 0.18). In unconcentrated markets, however, private mergers with branch network overlap have no effect on bank branching patterns. The interaction between the level of concentration and SDIFOut is also very weak, so the effects of SDIF sales without any branch network overlap remain ambiguous, regardless of the level of concentration in the market.

The ambiguous relationship between MergerIn and the change in the number of branches in low concentration markets is not a very surprising result. As discussed in Section 4.2, in a highly competitive market the elimination of excess capacity may not be the main determinant of branching patterns after a merger and the empirical findings seem to confirm this argument. This finding has direct implications concerning the role of mergers and acquisitions in the elimination of excess capacity in the banking sector.

On the other hand, the positive relationship between the change in branches in concentrated markets and the percentage of bank branches involved in a merger with overlapping branch networks is very surprising. It was expected that a merger between two competitors in a highly concentrated market would cause a decrease in the number of branches, because of the elimination of excess capacity, increasing efficiency and market power arguments. Elimination of excess capacity and efficiency arguments state that such a merger would result in a decrease in the number of branches of the newly merged institution, as the excessive and inefficient branches are closed after the merger. The market power argument predicts a decline in the number of branches belonging to the competitors, as the newly merged institution can push competitors out of the market by exercising its market power.

This positive relationship observed between MergerIn and change in bank branches per capita in highly concentrated markets and for the sub-sample with less than three branches in 2000 could reflect the changing nature of the conduct of Turkish banks after the crisis. The general sentiment formed among bankers after the crisis was that Turkish banks have

Table 4.5: Results of regressions that include district level HHI and size interaction dummies (robust standard errors). Dependent variable: change in the number of bank branches per 10,000 residents.[a]

	HHI District		Size	
	Coefficient	Std. Error	Coefficient	Std. Error
INTERACTIONS				
dummy * MergerIn	-0.3776**	0.1926	-0.1048	0.2252
dummy * SDIFOut	-0.3233	0.5801	-0.8723*	0.4805
$CONSOLIDATION^{00}_{i,03}$				
MergerIn	0.4870**	0.2501	0.3911	0.2379
MergerOut	0.3646	0.4005	0.4955	0.4209
SDIFIn	-3.7399***	1.2689	-3.9813***	1.2347
SDIFOut	-0.0045	0.5475	0.1870	0.4977
Fail	-0.5025**	0.2364	-0.3867*	0.2205
Liquidate	-0.4294	0.2967	-0.5638**	0.2789
Intercept	-0.2458	0.3387	-0.3546	0.3296
Adjusted-R^2	0.7235		0.7262	
# of observations	352		352	

[a] $***$ suggests significance at 1% level, $**$ is significance at 5% level and $*$ implies significance at 10% level.

drifted far away from traditional banking activities by concentrating on collecting deposits and lending them to the government, as opposed to making loans to the real sector. With the fall in inflation and interest rates after the crisis, there was pressure on banks to reach out to the real sector by making loans. An important aspect of this "new era" is increased presence of banks in rural markets.

It appears that around 2002, the banking sector has reached the conclusion that capacity in the sector was too concentrated in major urban centers, whereas there was room to grow in rural, under-banked provinces. One of the figures most consistently quoted by bankers in the popular press is that as of June 2003, there was one bank branch per 2,200 people in Germany, whereas this number stood at 11,800 in Turkey. Based on figures such as these, the CEO of one major bank has stated that "although we complain that there is a bank branch at every corner", the scope of the banking sector is too narrow for Turkey. [42] Although such a comparison with a developed economy like Germany may not be appropriate, this statement clearly indicates that Turkish banks still see growth potential, mostly in rural areas. A variety of financial services sector participants have also indicated plans for expanding areas outside the major urban centers.[43]

This new strategy of Turkish banks imply that in highly concentrated rural districts, merging institutions would be unlikely to close overlapping branches, in order to gain more market share. In a sense, the newly merged institution could have a "first-mover advantage" by already having a well-established presence in the market and not closing branches can allow it to compete with new entrants more effectively. This incentive for the newly merged banks not to close overlapping branches, combined with entry into these markets can explain the positive relationship between MergerIn and change in bank branches per capita in highly concentrated markets.[44]

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[42] "This type of banking is too narrow for us", *Sabah*, June 6, 2003 (in Turkish).

[43] The popular press in Turkey commonly refers to this as an "expansion into Anatolia." The term "Anatolia" usually refers to central and eastern provinces of Turkey, which are more rural and less densely populated compared to the Western provinces. Referring to the push into rural provinces, the chairman of the BRSA has been quoted in the press as saying: "banks have recently started moving towards the real sector and knocking on the doors of firms located in Anatolia, otherwise it is difficult for them to survive" ("The real banking era starts now", *Yeni Şafak*, March 15, 2004, in Turkish).

[44] An important factor to note here is that some of the branches affected by mergers in highly concentrated

Overall, the inclusion of concentration interactions suggests that private mergers between banks with overlapping branch networks have contributed to increased competition in previously concentrated and under-banked markets. Although the ability of newly merged institutions to use their already established branches in these areas to deter entry is a concern, there is no evidence of banks being unable to enter these markets. This is a welcome development for the local economies of these markets, as increased competition in highly concentrated markets can lead to an increase in service quality and a decrease in non-price loan terms (Scott and Dunkelberg, 2003).

Size Interactions

The results presented in the right hand side panel of Table 4.5 reveal that there is a strong interaction between the size of the market and sales of failed banks by the SDIF (SDIFOut). The coefficient of the interaction between SDIFOut and districts with large market size (size > $250 mil. dummy * SDIFOut) is negative and significant, whereas the coefficient of SDIFOut without the interaction is positive and insignificant. This result suggests that purchases of failed institutions by "outsiders" (i.e. banks that did not have branches in a market prior to the acquisition) causes branch closures only in large markets.

Although this finding is puzzling upon first glance, it can be explained by the pre-crisis behavior of Turkish banks. As the pre-crisis period was characterized by rapid expansion of banks' branch networks, it is possible that most banks opened multiple branches in big markets in order to capture market share. Therefore, the negative relationship between SDIFOut and change in bank branches could be reflecting the acquirers' decision to close some of the branches opened by the failed institutions before the crisis. In other words, rather than suggesting a complete withdrawal of the newly merged institution from some markets, this finding suggests closures of some of the excessive, inefficient branches. This relationship is likely to be absent in smaller markets, which were not as attractive during

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markets belong to the two state banks that merged in 2001. There have been instances of private bank executives expressing concern about state banks, led by the newly merged Agriculture Bank, trying to expand in rural areas. Such statements could be seen as evidence for a newly merged institution not willing to close branches in areas that are becoming more competitive. See, "Ziraat (Agriculture) and Halk (People's) Banks Bother Us", *Sabah*, April 2, 2004 (in Turkish).

the pre-crisis period. As a result, it is likely that the acquirers took over control of fewer branches and without excess branches to close, SDIFOut had no effect on branching patterns in small markets.

A cursory analysis of branch closures in the ten big districts (size > \$250 mil.) with the highest values for the variable SDIFOut seems to confirm these conclusions. In these ten districts, 24% of the branches that were closed between 2000-2003 belonged to banks sold by the SDIF to an outside bank.[45] Furthermore, all of the newly merged institutions still had a market presence in all 10 markets at the end of 2003. These findings confirm that buyers of failed institutions have eliminated excess branches but have not exited these markets all together. Therefore it can be concluded that sales of failed institutions by the SDIF has achieved its goal of eliminating excess capacity in big markets even if there was no branch network overlap between the failed institutions and their acquirers.

4.4 Robustness Tests

This section presents a few additional tests that were performed to assess the robustness of the findings presented and discussed above. After replicating the analysis of the preceding section using the whole sample, the interaction between some additional market characteristics and the effects of mergers and acquisitions is investigated. These interactions are not based on the findings in literature, however, they do present some additional insights into the nature of the banking sector in Turkey. Most of the findings appear to be robust across these different specifications.

4.4.1 Whole Sample Regression

The results of the baseline regression using the entire sample is presented in Table 4.6 below. The findings of the whole sample regression are very similar to the regression using the sample of districts with more than 3 bank branches in 2000. Within the $\text{CONSOLIDATION}^{00}_{i,03}$

[45] Liquidation of failed banks accounted for another 44% of all branch closures. So, a significant majority of branch closures in these markets were due to elimination of inefficient branches through liquidations and SDIF sales, as opposed to newly merged institutions exercising market power and pushing competitors out of the market.

category, the coefficient of SDIFIn is negative and statistically significant, whereas the relationship between the remaining three M&A variables and the change in bank branches per capita are statistically insignificant. The percentage of bank branches in 2000 that belong to an institution that failed between 2000 and 2003 has a negative and statistically significant relationship with the change in bank branches per capita. The sign and significance of the variables within $\text{MARKET}^{00}_{i,03}$ and $\text{DEMAND}^{00}_{i,03}$ categories also remain mostly unchanged.

4.4.2 "Big City" Interactions

Although the variations in post-merger branching behavior based on market size and concentration were examined above, it is also possible that bank behavior can differ according to a more *ad hoc* specification of markets, namely the three major cities in Turkey. These cities, İstanbul, İzmir and Ankara, account for about a quarter of the population and a large portion of economic activity in Turkey. Based on these characteristics, it is possible that the branching patterns of banks can be different in these three cities. For example, it could be the case that the primary motivation of a merger is to penetrate these three markets and if so the acquirer would be unlikely to close branches in these areas.

In order to test for this possibility, the interactions of three M&A variables with a dummy variable indicating whether a district belongs to one of these three provinces were included in the analysis.[46] The results of regressions including these interactions are presented in Table 4.7 in the column labelled "Big City." In this table, only the coefficients of the $\text{CONSOLIDATION}^{00}_{i,03}$ variables are reported in an effort to conserve space.

The results reveal that neither private mergers nor SDIF sales have a different effect in districts that are located within a big city. Similar to the baseline regression presented above, SDIFIn is negative and significant, although the level of significance is somewhat lower in Table 4.7. Neither of the remaining $\text{CONSOLIDATION}^{00}_{i,03}$ variables have a consistently significant relationship with the change in bank branches per 10,000 residents, similar to the findings of the baseline regression.

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[46] As seen below the three variables included in the interaction analysis are MergerIn, SDIFIn and SDIFOut. There was no interaction analysis for MergerOut, as the values of MergerOut for the districts within these three big cities are always equal to zero.

Table 4.6: Baseline regression results using the whole sample (robust standard errors). Dependent variable: change in the number of bank branches per 10,000 residents.[a]

	Coefficient	Std. Error
$CONSOLIDATION^{00}_{i,03}$		
MergerIn	0.0933	0.1205
MergerOut	-0.2707	0.3946
SDIFIn	-2.8947*	1.7358
SDIFOut	-0.0971	0.4231
Fail	-0.6842***	0.263
Liquidate	-0.2329	0.3204
$MARKET^{00}_{i,03}$		
HHI District	0.8780***	0.0533
HHI Province	0.3381***	0.1282
State	-0.9348***	0.0688
Distance	0.0003*	0.0003
$DEMAND^{00}_{i,03}$		
GDP per Capita	0.00001**	0.000005
Log(population)	0.0567**	0.0269
Population change	-0.8652***	0.2466
Population density	-0.000003*	0.000002
Urban	0.1300***	0.0494
Branch per 10,000	-0.2007***	0.0332
Center	-0.0065	0.053
İstanbul	0.0379	0.049
Intercept	-0.5045	0.3475
Adjusted-R^2	0.6513	
# of observations	853	

[a] *** suggests significance at 1% level, ** is significance at 5% and * implies significance at 10%.

4.4.3 Distance Interactions

Another issue related to the analysis above is the question of what constitutes a market. Although each district is a separate administrative unit by itself, it is possible that multiple neighboring districts can be considered as a single market. This is especially likely for districts located around the central district of the province. Therefore, it is possible the distance of a district to the central province can have an effect on the relationship between M&A activity and the change in bank branches. In defining the distance to central district dummy, districts that were less than 40 kilometers to the central district were considered to be close enough to the central district to potentially be the part of the same market.

The results of the analysis using the interactions of the distance dummy with the three M&A variables are given in the column labelled "Distance" in Table 4.7.[47] The inclusion of distance interactions reveal that private mergers increase the number of bank branches per capita in markets that are far away from the central district, regardless of branch network overlap. This finding is consistent with the positive relationship between MergerIn and bank branching patterns in concentrated markets, discussed in the previous section. The increase in bank branches per capita in distant markets could be another indication of Turkish banks trying to expand into new markets according to their new business strategy.

4.5 Conclusion

This chapter has investigated the relationship between post-crisis bank mergers and acquisitions and the change in bank branches per capita in Turkey. Using theoretical relationships developed in the literature and the features of post crisis banking sector restructuring in Turkey, impact of different types of consolidation (SDIF sales vs. privately arranged mergers) were also analyzed. In doing so, this study has expanded the work of Avery *et al.* (1999), who study the impact of bank consolidation on branching patterns in the U.S., without accounting for different types of M&A activity.

After controlling for market conditions using economic and demographic variables, it

[47]The interaction between SDIFIn and the distance dummy was omitted, as the values of SDIFIn for districts further than 40 km to the central district were zero.

Table 4.7: Results of regressions that include Big City and distance from central province interaction dummies (robust standard errors). Dependent variable: change in the number of bank branches per 10,000 residents.[a]

	"Big City"		Distance	
	Coefficient	Std. Error	Coefficient	Std. Error
INTERACTIONS				
dummy * MergerIn	0.4428	0.3018	-0.2103	0.2274
dummy * MergerOut	-	-	-0.9474	0.6769
dummy * SDIFIn	-0.7073	1.7398	-	-
dummy * SDIFOut	-0.1920	0.4707	0.7298	0.448
$CONSOLIDATION^{00}_{i,03}$				
MergerIn	0.3138	0.227	0.4252*	0.2597
MergerOut	0.3641	0.3961	0.8493*	0.4999
SDIFIn	-3.2381***	1.1314	-3.4843***	1.254
SDIFOut	-0.1731	0.4012	-0.6668	0.4952
Fail	-0.4706**	0.2366	-0.4815**	0.2344
Liquidate	-0.4898*	0.2856	-0.4687	0.2877
Intercept	-0.2786	0.3495	-0.2137	0.3406
Adjusted-R^2	0.7213		0.7241	
# of observations	352		352	

[a] $***$ suggests significance at 1% level, $**$ is significance at 5% level and $*$ implies significance at 10% level.

was shown that sales of failed institutions by the central authority (SDIF sales) have caused a decline in bank branches per capita in markets where the acquirer already had a market presence. This finding echoes Avery *et al.* (1999), who argue that mergers between banks with overlapping branch networks lead to a reduction in bank branches per capita.

In trying to understand the underlying cause of this finding, two possibilities were investigated: either the newly merged institutions have eliminated excess branches (a decline in the branches of the merged banks) or they have exercised market power and eliminated competitors. However, the possibility of market power being exercised was ruled out due to the post-crisis developments in the banking sector. From the evidence presented above, it is clear that the next stage of competition in the banking sector is taking place outside the major urban areas of Turkey. As the activities of banks return to the more traditional method of collecting deposits and making loans to the real sector, expansion into the rural areas has become an important priority. On the other hand, the banks that have failed and sold by the SDIF are concentrated in urban areas that are saturated with bank branches. In this era of banks trying to differentiate themselves with well established branch networks outside the major urban areas, it is highly unlikely that sales of failed banks by the SDIF will lead to an institution being able to obtain and exercise market power.[48]

Looking at the effects of privately arranged mergers, it was found that the effects of such mergers depend on the level of competition in the market (represented by districts). In relatively concentrated markets, a merger between competitors causes an increase in bank branches per capita, but this effect is absent in competitive (unconcentrated) districts. This is a surprising result, given that previous studies do not find a relationship between concentration and branching patterns. However, when examined using the post-crisis changes in the strategies of banks in Turkey, this causes behind this finding becomes much clearer. Combined with the elimination of excess capacity after SDIF sales, this finding suggests that banks in Turkey have been shifting their attention into markets that were previously highly

[48]The data on branch closures seem to confirm this. In the 10 districts with the highest percentage of branches sold by the SDIF to a local competitor (variable SDIFIn), 18% of all branches that were closed between 2000-2003 belonged to banks involved in an SDIF sale. The branch closures of banks involved in a private merger account for 20% and liquidations account for 47%. The remaining 15% belong to banks that were not involved in any type of consolidation activity. The even distribution of non-liquidation branch closures suggest that there was not substantial market power being exercised in these markets.

concentrated and under-banked.[49] In a sense, as SDIF sales are reducing excess capacity in big markets, private mergers are spurring competition in concentrated markets.

Another finding of the analysis was that having overlapping branch networks between merging institutions is not always necessary to ensure the elimination of excess branches. It was demonstrated that SDIF sales result in branch closures in big markets even if the buyer does not have a prior presence in those markets. This is an important finding, as it further supports the conclusion that selling failed institutions can result in the elimination of excess capacity. The division of merger activity in Turkey into SDIF sales and privately arranged mergers was instrumental in this study's ability to reach these conclusions.

Based on these findings, it can be argued that consolidation activity has contributed to Turkish banks allocating their capacity more effectively. While banks closed branches in over-banked urban areas, they opened new ones in markets with, according to one bank executive, "millions of people who have not tried out banking services."[50]

In considering the policy of encouraging consolidation as a "post-crisis clean-up tool" by the central regulatory authority, it can be argued that the different approaches to consolidation (sales of failed banks vs. encouraging voluntary mergers) lead to different outcomes regarding capacity in the banking sector. The nationalization and sale of previously insolvent banks are shown to cause elimination of excess capacity, whereas private mergers, do not display this characteristic. On the contrary, voluntary mergers between healthy institutions have been shown to lead to an increase in bank branches in highly concentrated markets. As voluntary mergers can end up creating and not eliminating capacity, the motivation of the central authority in encouraging them becomes important.

If the goal of the central authority is simply to eliminate excess capacity (as opposed to strengthening the financial position of banks and spurring competition in concentrated mar-

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[49] An examination of the data reveals that highly concentrated markets tend to be significantly under-banked. For the sub-sample of districts with more than 3 branches in 2000, the average branch per 10,000 people is 1.05 in concentrated markets (district level HHI > 0.18) and 1.43 in unconcentrated markets.

[50] "Şekerbank turns its attention to Anatolia", *Sabah*, April 3, 2004 (in Turkish). In light of this conclusion, it can generally be argued that the impact of consolidation on consumers has not been negative. As branching patterns have been motivated by efficiency concerns and an expansion of banks into under-banked areas, it is unlikely that consumer welfare has been negatively affected by the post-crisis restructuring.

kets), the usefulness of encouraging bank mergers could be open to question. Of course, the goals of the BRSA in the Turkish restructuring program were many-fold and the voluntary mergers that took place between 2000-2003 were mainly regarded as positive developments in the banking sector. This study simply points out that although these mergers may have increased the financial position of the banks involved (such as diversifying their asset portfolios) and created increased competition in some markets, they were not instrumental in the elimination of excess branches in the banking sector.

The overall conclusion of this chapter is that, bank mergers do not cause an "across-the-board" decrease in bank branches. In that sense, the answer to the question asked in the title of this study ("Does post-crisis restructuring decrease the availability of banking services?") is a "yes under certain conditions." Any negative relationship between merger activity and changes in bank branches seems to stem from efficiency issues in newly merged banks that include previously failed institutions. Furthermore, there is evidence that bank consolidation can actually increase the availability of financial services in some markets.

In summary, this study has extended a framework generally used for the U.S. banking sector into analyzing the use of mergers and acquisitions as a post-crisis restructuring policy tool in a developing country setting. Due to this different framework and the division of M&A activity into different categories, the results have been significantly different compared to earlier studies of the U.S. banking sector. These differences should be treated as an encouraging sign, suggesting that bank mergers can serve different purposes in different countries. In the U.S., M&A activity during the 1990s has been motivated by economies of scale and scope, whereas such activity seem to have allowed the Turkish banking sector to re-allocate its resources more efficiently and put a crisis behind it. Although further work on the pricing and availability of banking services following a merger wave may be necessary, the study can be seen as a first step in gaining a better understanding of a phenomenon that is commonly observed but rarely investigated.

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