ERF WORKING PAPER SERIES

FINANCIAL DISTRESS AND BANK PERFORMANCE: TURKISH EXPERIENCE

Ihsan Isik, M. Kabir Hassan, & Ebru Meleke-Isik

Working Paper 0217

As of August 1998, financial support towards the ERF Working Papers Series from the Commission of the European Communities (through the FEMISE Program) is gratefully acknowledged. The views expressed in the Working Papers are those of the authors and do not necessarily reflect the views of the European Commission.

ECONOMIC RESEARCH FORUM
منتدى البحوث الاقتصادية
FOR THE ARAB COUNTRIES, IRAN & TURKEY

7 Boulos Hanna St. Dokki, Cairo, Egypt
Tel: (202) 3370810 – (202) 7485553 – (202) 7602882
Fax: (202) 7616042. Email: erf@idsc.net.eg. Website: http://www.erf.org.eg

Abstract

Turkey experienced a severe financial crisis in 1994 that resulted in a record level economic contraction and a large number of failures among industrial and financial firms. Employing a nonparametric approach, we measured the efficiency and productivity of the Turkish banking sector between 1992 and 1996. We also decomposed the productivity growth into its mutually exclusive and exhaustive components (technological change and efficiency change) to understand the impact of the crisis on different aspects of bank productivity. Our results suggest that there was a substantial productivity loss (17%) in 1994, which was mainly attributable to technological regress (10%) rather than efficiency decrease (7%). We also examined the effect of the crisis on different groups of banks operating in Turkey. We found that foreign banks suffered the most from the crisis, followed by private banks. Further, public banks apparently passed through the crisis practically unharmed. Public banks' relative immunity could be explained with their respectively low open positions in foreign exchange in the advent of the crisis and with their relative soundness and safety in the event of the crisis. We also explored the relationship between bank size, productivity and crisis. Our results indicate that even though the crisis affected all sizes of banks dramatically, its adverse impact on small banks was overwhelming. However, measures undertaken by the government and banks' own efforts seem to have helped the financial sector recover and attain its pre-crisis productivity and efficiency levels within the following two years.

1. Introduction

System-wide financial problems make all economic agents concerned as they interrupt the healthy flow of credit to households and firms, limiting both public and private investment and consumption, and thereby causing economic contraction and failure in otherwise sound firms. Such large scale banking problems may even totally endanger the functioning of a payments system. Moreover, asymmetric information problems such as adverse selection and moral hazard may exacerbate financial crises. If confidence in financial institutions is shaken, both domestic and sensitive foreign funds may leave the financial system and the country, increasing the vulnerability of the financial system to subsequent shocks. This process may ultimately lead to severe liquidity problems and force viable banks to shut their doors (Mishkin, 1991; Caprio and Klingebiel, 1996a; Demirguc-Kunt and Detragiache, 1997; Calomiris, 2000).

Turkey experienced a fierce financial crisis in 1994, which is believed to be one of the first rings of the subsequent chain of crises experienced elsewhere in the world such as in Mexico in 1995, in the Far East in 1997, in Russia in 1998, and in Brazil in 1999. This crisis was also an early warning signal for more financial disruptions to come in the country such as the latest November 2000 and February 2001 crises, which necessitated bailouts by the IMF. In the aftermath of the 1994 crisis, the Turkish economy shrunk by 6 percent, a record level of annual output loss in the history of the country; short-term interest rates in the inter-bank market skyrocketed reaching 1,000 percent at times; and the inflation rate hit three digit levels. As a result, the Turkish Lira (TL) was devalued by more than 50 percent against the $US, and half of the Central Bank reserves were eroded in "managing" the crisis. Banking firms were also hit drastically, as evidenced by their 30 percent average total asset loss. The 1994 crisis began primarily in the financial sector and later spread to the real sector. Even though the industrial sector was not as badly injured as the financial sector, its "flu" due to the distress in the banking sector stresses the tight link between the sectors and reminds us of the severity of *systemic risk*-the risk that the problems of a few institutions spread to many other institutions in the system.

Efficiency and productivity indices can be used to assess the impact of major economic events such as financial deregulations (e.g., Humphrey and Pulley, 1997; Leighthner and Lovell, 1998; Isik and Hassan, forthcoming(2), Khumbhakar *et al.*, forthcoming) and financial crises (Fukuyama, 1995) on the performance of banking firms. The record number of bank failures worldwide in recent years has attracted a great deal of attention from researchers, bank managers, regulators and international organizations. As in virtually all-emerging financial markets, banks are the dominant financial institution in Turkey. Thus, their health is very critical to the health of the general economy at large, as demonstrated in recent financial distresses experienced by the country. However, despite its severity and deep influence on both the real and financial sectors, the 1994 crisis of Turkey has not been studied yet in terms of its impact on the productivity, technology and efficiency of the financial industry.

Within the recent economic crises all over the world as well as in Turkey, it is worth examining the 1994 Turkish experience for policy and research reasons. It is believed that the initiation of the 1994 crisis was mainly a product of the policy errors made by the government (Ertugrul and Zaim, 1996; Celasun, 1998; Ersel, 2001; Isik and Hassan, forthcoming1). In this sense, this financial fragility can be seen as a "negative externality" for Turkish banks. Hence, the quantification of the damage in terms of bank efficiency and productivity is in one way the quantification of the cost of this negative externality, that is, a bill of the policy errors. Also, this type of analysis may allow us to assess the successes of the measures undertaken by policy makers in rescuing the financial sector. More importantly, the results may shed some light on the behavior and reaction of banking firms during and after the crisis, which could help policy makers to detect what types of banks (public, private or foreign banks / small or large banks) are more susceptible to shocks. This in turn could induce policy makers to devise preventive strategies about what could be done to strengthen the durability of such banks against future shocks. For the research side, this study will be among the first empirical studies, which link productivity and efficiency of financial institutions with financial disruption. In addition, to prevent possible measurement biases that could distort the qualitative conclusions, this study considers some important non-traditional bank outputs in measuring productivity and efficiency of banks such as risk adjusted off-balance sheet activities, inter-bank loans and security portfolios, which were disregarded in most of the earlier studies.

Employing a nonparametric model, DEA-type Malmquist Total Factor Productivity (TFP) index, we measure the productivity change around the crisis along with its mutually exclusive and exhaustive components (technological change and efficiency change). We *hypothesize* that by limiting the general economic activity and suppressing the production of bank loans and other bank services, a financial disruption can bring about a decline in bank productivity and efficiency. To the extent that the shrinkage in the output side is greater than the shrinkage in the input side for frontier banks, a system-wide financial problem could also result in a temporary contraction of the production frontier (technical regress). Our results suggest that the impact of the 1994 economic crisis on the productivity, technology and efficiency of the Turkish banks was dramatic. On average, Turkish banks faced a 17 percent productivity loss, comprised of a 10 percent technological regress and a 7 percent efficiency decrease in 1994, implying that the major source of productivity decline was a shock to the banking technology rather than an efficiency decrease. More expressively, the occurrence of the crisis was imminent as signaled by deteriorating average efficiency and

productivity scores in the prior years. Our results also indicate that the adverse impact of the crisis on banking firms was persistent, as it has taken the financial system about two years to fully recover and attain its pre-crisis productivity and efficiency levels. Among the different forms of banks operating in the country, public banks were affected the least while foreign banks were affected the most. Furthermore, the results suggest that the effect of the crisis was much sharper for small banks than large banks.

The paper is organized as follows. Following the introduction, section 2 reviews the literature. Section 3 discusses the 1994 crisis. Section 4 introduces the methodology. Section 5 discusses empirical setting. Section 6 analyzes of the impact of the crisis on banking productivity and efficiency. In section 7, we conclude.

2. Banking Crisis Literature

Different economic schools of thought view financial crises from different perspectives. Monetarists (e.g., Friedman and Schwartz, 1963) have linked financial crises with banking panics. This school of thought stresses the importance of banking panics because bank crises are a major source of contractions in the money supply. According to this view, contractions in the money supply in turn may lead to severe contractions in economic activity, as observed both in the United States and abroad. Another group of influential scholars (e.g., Kindleberger, 1978) take a much broader definition of what constitutes a real financial crisis. In their view, financial crises involve one or more of the following elements: sharp decline in asset prices; failure of both large financial and non-financial institutions; deflation or disinflation; and disruption in foreign exchange markets.

Yet some economists present another view on the nature of financial crises. For instance, Mishkin (1991) adopts an asymmetric information framework for understanding the nature of financial crises. In this sense, the asymmetric view of financial crises complements the monetarist view of the importance of bank panics, and explains the transmission mechanism for how a decline in the money supply leads to a decline in economic activity. Mishkin defines a financial crisis as a "disruption to financial markets in which adverse selection and moral hazard problems become much worse, so that financial markets are unable to efficiently channel funds to those who have the most productive investment opportunities." A financial crisis accompanied by a sharp decline in economic output results in the inability of financial markets to function effectively (Isik et al., 2001).

The asymmetric information proposition submits that transactions that take place in financial markets are subject to asymmetric information in which one party knows more than the other party about a transaction to make correct decisions. Asymmetric information creates problems in the financial system in two basic ways: through adverse selection problems (before the transactions are entered into) or moral hazard problems (after the transactions are entered into), which may result in a sharp decline in loan originations and a significant contraction in economic activities. Other economists (e.g., Stiglitz, 1997) also note these two problems are evident in several financial crises. According to Mishkin (1991), there are five factors in the economic environment that can lead to substantial worsening of adverse selection and moral hazard problems: increases in interest rates; stock market declines; increases in uncertainty; bank panics; and unanticipated declines in the price level.

As suggested by the theory, large open positions of banks in foreign exchange can be a source of a systemic banking crisis if the domestic currency unexpectedly and notably depreciates. According to Mishkin (1996), foreign currency debt was one of the reasons for the underlying banking crises in Mexico in 1995, in the Nordic countries in the early 1990s, and in Turkey in 1994. Kaminsky and Reinhart (1996) report that currency crises often precede or accompany banking crises. A sudden flight of foreign capital might also cause a bank sector crisis, as it did in a number of Latin American, Asian, and Eastern European countries in the early 1990s. These so-called "hot money" funds are usually welcomed for an expansion of domestic credit (Khamis, 1996). However, they are typically too sensitive to changes in the economic environment. If domestic interest rates fall, or confidence in the economy is shaken, foreign investors quickly withdraw their funds, which may turn the domestic banking sector illiquid (Calvo et al., 1994). A banking crisis can also arise in countries with a fixed exchange rate because of *currency substitution*, that is, a speculative run to foreign currencies. If economic units sense devaluation soon, they rush to withdraw their bank deposits to convert them into foreign currency deposits abroad making domestic banks illiquid, as occurred in Argentina in 1995.

In their empirical study, Demirguc-Kunt and Detragiache (1997) discuss the causes of banking crises in depth and try to determine the features of the economic environment that prepare the stage for such a system-wide fragility. They estimate the probability of a systemic crisis econometrically, employing a multivariate logit model on data from a large panel of countries, both industrial and developing, for the period 1980-1994. Countries that never experienced banking problems are also included in the panel as controls. The authors find that crises tend to happen in a weak macroeconomic environment characterized by slow GDP growth and high inflation. When these effects are controlled for, neither the rate of currency depreciation nor the fiscal deficit is significant. In addition, vulnerability to sudden capital outflows, low liquidity in the banking sector, a high share of credit to the private sector, and past credit growth are found to be associated with a higher probability of banking crises. Moreover, their results suggest that the presence of explicit deposit insurance is strongly associated with increased vulnerability in the banking sector, implying that moral hazard has a major role in inducing risk-taking behavior leading to the crisis.

Using estimates of the cost of banking crises from Caprio and Klingebiel (1996a), the authors also test whether the set of explanatory variables used in the logit model can also account for the severity of each crisis. They find that most of the same variables that tend to make crises more likely also tend to make them more costly. In a follow-up paper, Demirguc-Kunt and Detragiache (1998) studied the empirical relationship between banking crises and deregulation using a panel of data for 53 countries for 1980-95. They report that banking crises are more likely to happen in liberalized financial systems. However, they also noted that the impact of financial deregulation on banking sector fragility is weaker where the institutional environment is strong, that is, where there is respect for the rule of law, a low level of corruption, and good contract enforcement. Among other things, their study stresses the significance of effective prudential regulation and supervision of the banking system especially in a "lassies faire" environment.

There are a few micro (firm) level studies that investigate the relationship between bank failures and X-efficiency. Some empirical studies found that the management quality score, measured as part of the CAMEL analysis of banks conducted by the regulatory bodies, is positively associated with cost efficiency consistent with expectations (Peristiani, 1996; DeYoung, 1998). Also, it is expressive that DeYoung (1998) found asset quality to be more strongly associated with the management quality score than with any of the other scores. Banks facing financial distress and thus approaching failure have been found to carry a large proportion of non-performing loans (Whalen, 1991 and Barr, Seaford and Siems, 1994). Moreover, the studies on bank and thrift failures showed that there seems to be a positive relationship between operating inefficiency and failure rates (Berger and Humphrey, 1992a; Cebenoyan, Cooperman, and Register, 1993; Hermalin and Wallace, 1994; Wheelock and Wilson, 1995). Barr, Seiford, and Siems (1994) found that this positive relationship between inefficiency and failure is evident a number of years ahead of the eventual failure. It seems that failing banks are characterized with poor management quality, more problem loans, and less cost efficiency. However, some studies have reported that problem loans are negatively related to efficiency even in non-failing banks (Kwan and Eisenbeis, 1994; Resti, 1995).

On the other hand, the authors know of no study in the financial institution literature that links X-efficiency with systemic financial problems except for Fukuyama (1995), who analyzed the performance of Japanese banks between 1989 and 1991 using a non-parametric model. His study period coincides with the bursting (collapse) of the speculative bubble in Japan, even though he made rare references to the crisis. His results imply that Japan's financial shock demonstrated little effect overall on the efficiency of its banks, although the bad loans created during the period, which were expected to be as much as $500 billion by 1990, clearly had a significant adverse effect on the financial conditions of Japanese banks. In this regard, this paper will be among the first empirical studies that attempt to quantify and explain the impacts of a system-wide financial disruption on the productivity, technology and efficiency of financial institutions.

3. A Short Overview of the 1994 Turkish Banking Crisis

Turkey's continuously growing macroeconomic problems, which matured enough to threaten its economic stability in the last months of 1993, turned to a serious economic crisis in 1994. Table 1 portrays the scene by providing the key economic indicators of Turkey around the crisis period, 1992-1996. The cardinal source of the structural problems facing the Turkish economy for the last two decades is the high budget deficits and inefficiently managed state economic enterprises. While the ratio of the public sector deficit to M2 (to GNP) was 26 percent (5 percent) in 1989, it climbed to 90 percent (16 percent) in 1993. High growth policies of recent years, despite the inadequate and scarce domestic resources, caused a record level increase in foreign trade and current account deficits and debt stock. The trade deficit widened considerably reaching $14 billion in 1993 as a reflection of the recent import boom. The Custom Union Treaty, signed with the European Union in 1996, feeds the expectations towards a further increase in the trade and current account deficit, as signaled by a $19 billion trade deficit in 1996. As the capital account balance figures suggest, there was about $4.5 billion net capital flight from the country in 1994 as opposed to $9 billion capital entry in 1993. While the total debt stock (internal + external) was $74 (23+51) billion (49 percent of GNP) in 1991, it climbed to $84 (28+56) billion (53 percent of GNP) in 1992, and then to $100 (33+67) billion (56 percent of GNP) in 1993.

Celasun (1998) presents stylized facts about the 1994 crisis. Like many analysts (Ertugrul and Zaim, 1996; Ersel, 2001), she claims that uncontrollably growing internal debt stock and mistakes made in its financing were the two main underlying reasons preparing the stage for the 1994 crisis. Having firmly decided to reduce the cost of internal debt stock by cutting interest rates on government securities, the state chose to finance its high budget deficit and growth policies through resources advanced from the Central Bank. In turn, the state cancelled several auctions one after another relying on monetization. However, this monetary policy consequently triggered a speculative attack against the foreign currency, as economic agents soon realized the monetization attempt and began to switch their TL-denominated assets to foreign ones in a panicking mood. With its continuously increasing borrowing need as implied by its high PSBRs (public sector borrowing requirements), the state that had been already facing hardship to borrow because long maturities began to fail to raise funds at all in the internal markets. In response, the government turned to international markets to meet its borrowing needs. However, the degradation of the country's credit rating by Moody's and Standard and Poor's in January 1994 restricted the ability of the

state to borrow internationally. As a result of these policy errors, interest rates rose sharply while maturities shortened further. The state that was reluctant to go with market-determined interest rates around 70-80 percent at the end of 1993 had to accept rates around 400 percent in the middle of 1994, which in turn increased the burden of the debt stock further.

Turkish banks, which had been intensively involved in offshore borrowing during the period of 1992-1993, were mainly investing their foreign funds in a TL denominated portfolio of assets, predominantly in government securities. As a result, the share of the foreign exchange liabilities in total liabilities steadily increased reaching almost half of the balance sheet in 1994 (37 percent in 1992, 43 percent in 1993, and 47 percent in 1994). Thus, the banking sector entered 1994 with large open positions and bulky government paper stocks. Threatened by the uncertainty of the economic environment, Turkish banks spent an enormous effort to close their large open positions, which had risen to a level as high as 6 percent of their balance sheets in 1993. Under conditions of easy access to capital markets, this case would not be a problem for the money making banking sector. However, following the downgrading of Turkey's credit rate, banks' access to the international markets was restricted to a great extent. Apart from the high rate of devaluation of the TL and skyrocketing interest rates, Turkish banks had to pay over $7 billion net foreign debts in 1994, which complicated the bank problems further.

Subsequent to the significant contraction of the bank balance sheets in 1994, there has been a substantial change in the portfolio composition of Turkish banks. Table 2 compares the composition of the balance sheet of banking groups between 1991 and 1993 with that between 1994 and 1996. The figures are average fraction of major items in the assets (liquid assets and loans) and liabilities (core deposits and purchased funds). It appears that state and foreign banks increased the fraction of liquid assets and decreased the fraction of loans in their assets. The most striking observation, however, is that all groups increased the proportion of core deposits and decreased the proportion of non-deposit (purchased) funds after the crisis, confirming the reversal of the downsizing trend in commercial banking after 1994.

Foreign banks' initial reaction to the crisis was to reduce their financial investments in the country, as evidenced by the fall of average fraction of loans in their assets from 36 percent to 26 percent, and from the drop of their share in the loan markets. Table 2 indicates that foreign banks swapped riskier commercial and industrial loans with lucrative and less risky government securities, a rational response to the increased risk in the business environment in the 1990s. Consequently, more than half of their assets are liquid assets, which mainly consist of the securities of the Turkish government. This concentration in investment securities coincides with the initial motive of the foreign banks, which entered the market primarily to invest in the papers of the always fund-needy Turkish government. Moreover, after 1994, foreign banks began to use more deposit funds and less purchased funds. As the fraction of their core deposits increased impressively from 26percent to 53 percent, the fraction of their purchased funds fell sharply from 47 percent to 17 percent. The fact that foreign banks more than doubled the portion of core deposits in their liabilities implies that they decided to stay and even pursue growth by penetrating the local deposit markets. As a result, they strengthened their work force (35percent in 1994 and 6percent in 1996) to compete more effectively with domestic banks for scarce transaction deposits. In reaction to the crisis, banks began to issue loans denominated in foreign currency to reduce exposure to foreign exchange risk. However, it should be noted that this policy is not elimination but simply a transfer of foreign exchange risk to borrowers. For example, a state housing bank, namely Emlak Bank, extended a large number of DM-denominated home loans, however most of these loans have failed as a result of the huge depreciation of the Turkish Lira, implying that an increase in problem loans can still hurt bank profitability and safety to a great extent.

Throughout the crisis, the priority was given to the stabilization of the financial markets and prevention of a possible systemic risk, especially after the liquidation of three domestic private banks. In the short-run, to "cool" the system, the Central Bank insured 100 percent of all saving deposits (TL or non-TL) in April 1994. Parallel to this development, the insurance premiums for bank deposits were raised. Also, to boost the demand for the TL, reserve and liquidity requirement rates for banks were revised. Following the stabilization program, the IMF extended a stand-by credit of $742 million with the condition that structural reforms are implemented rapidly to cure the macro-imbalances with deep historic roots. The government soon announced an internationally supported stabilization program, whose main theme was to increase government revenues and decrease government spending to reduce the wide and chronic budget deficit. Apparently, the decisive and determined application of the urgent short-term measures by the state achieved stability in the financial sector. The economy eventually rebounded as evidenced by an impressive 8.1 percent GNP growth in 1995, while inflationary expectations mitigated as signaled by the 80 percent inflation rate, which is still high but much lower as compared to 126 percent inflation rate in 1994. The funds that escaped from the financial system started to return back, reversing the shrinkage in banking business, as implied by the 31 percent growth in total banking assets in 1995 as opposed to about 30 percent contraction in 1994. Similarly, there was an apparent improvement in other economic and financial indicators of the country in 1995 and 1996, as can be verified from Table 1.

The 1980s saw a series of financial reforms, some of which were the deregulation of interest rates and foreign exchange transactions, reducing entry

barriers to the sector, establishment of inter-bank and the stock market, etc., to liberalize the banking business and increase its competitiveness in pursuit of higher productivity and efficiency in provision of financial services. The reforms indeed succeeded to foster efficiency and productivity in banking as evidenced by the immense efforts of banks to downsize their work force and branch offices throughout the 1980s (Zaim 1995; Isik and Hassan, forthcoming2). It is of concern, however, to see what happened to the positive trend in bank performance in the post-liberalization period, especially during the financial chaos of 1994. Our objective in this study is to show the magnitude of the impact of this financial fragility on the productivity of the banks. It is also an empirical issue to study the influence of such a devastating exogenous factor on banking technology, whether there was a shock to the technology, and on banking efficiency, whether the endeavor of banks to catch up with the best-practice banks was interrupted. To the extent that a loss in productivity arose from the policy errors made by the state in 1994, the resulting waste of resources may be viewed as another but influential wake-up call for the policy makers to rigorously implement the medium and long-term goals of the New Economic Policy of 1980 and the Stabilization Program of 1994, which has not been fully achieved yet.

4. Methodology

There exist two basic indexes in the literature, Tornqvist (1936) index and Malmquist (1953) index, to measure total factor productivity change (TFPC) in production units. To investigate the impact of the 1994 crisis on banking productivity, we choose the DEA-type Malmquist TFPC index, which is preferable to the Tornqvist index because it uses exclusively quantity information and thus demands neither problematic price information nor a restrictive behavioral assumption in its calculation. Furthermore, the Malmquist index has an informational advantage as it works well with small samples and allows one to isolate efforts to catch up to the frontier (*efficiency change*) from shifts in the frontier (*technology change)*. Also, the Malmquist index enables one to explore the main sources of efficiency change: either improvements in management practices *(pure technical efficiency change)* or improvements towards optimal size (*scale efficiency change)*.

With a simple case of single-input (**x**) and single-output (**y**), Figure 1 depicts the calculation of technical efficiency and productivity measures. Assuming that all firms are operating at an optimal scale, we get a constant returns to scale frontier (CRS_t: 0GP or CRS_{t+1}: 0ATFR). However, firms in practice might face either economies or diseconomies of scale. Relaxing the CRS assumption and introducing a convexity restriction, Banker, Charnes and Cooper (1984) proposed a variable returns to scale frontier (VRS_t: LKBTES). The VRS_t technology indicates increasing returns to scale (IRS) to the left of point T, decreasing returns to scale (DRS) to the right of T and constant returns to scale (CRS) at point T. As Hunter and Timme (1986) point out, the production frontiers are not static as they may shift upward as a result of major events such as financial liberalization, increased competition and innovation (i.e., technical progress) or may shift downward as a result of severe financial disruptions and shocks (i.e., technical regress).

To understand the above concepts, let us initially assume that the production technology is one of CRS, which has remained unchanged between year t to year t+1 and a bank that was observed at point C in year t, (X_3, Y2) moved to point D in year t+1, (X_3, Y1). Both observations, C and D, represent feasible but technically inefficient production points because both are interior to the CRS_t frontier. Farrell (1957) expressed output-oriented technical inefficiency (TIE_o) measure by the distance CG at time t (DG at time t+1). Thus, the TIE_o at point C is simply the amount by which output could be proportionally increased (from Y_2 to Y_5) without a rise in input (X_3). Alternatively, the distance AC represents input-oriented TIE_i at point C. Efficiency measures are usually expressed in percentage terms. The TIE_i of the firm is AC/Y_2C, reflecting the percentage by which input usage could be reduced (from X_3 to X_1) without reducing the level of output (Y_2). Hence, the technical efficiency (TE) at point C is given by: $TE = 1 - TIE_i = 1 - (AC/Y_2\ C) = Y_2A/Y_2C$. With VRS assumption, we can obtain the 'pure' technical efficiency (PTE) at point C: Y_2B / Y_2C. The firm becomes technically efficient by moving to point B, because given the VRS frontier this is the point where input use is minimized to generate Y_2. Although 'pure' technically efficient, the point B is *not* scale efficient as the firm can still reduce its input use (from X_2 to X_1) if it can attain the CRS. Thus, the firm's scale efficiency (SE) is Y_2A/Y_2B, that is, the firm can produce its current level of output (Y_2) with fewer inputs if it operates at the optimum size. If TE = PTE, then SE=1, because overall technical efficiency, TE = PTE × SE. Efficiency scores take a value between 0 and 1 for the least and most efficient units, respectively.

$$M(t,t+1) = \overbrace{\underbrace{\frac{D_{t+1}^{VRS}(x_{t+1},y_{t+1})}{D_t^{VRS}(x_t,y_t)}}_{PEFCH} \times \underbrace{\left[\frac{D_{t+1}^{CRS}(x_{t+1},y_{t+1})/D_{t+1}^{VRS}(x_{t+1},y_{t+1})}{D_t^{CRS}(x_t,y_t)/D_t^{VRS}(x_t,y_t)}\right]}_{SECH}}^{EFFCH}$$
$$\times \underbrace{\left[\frac{D_t^{CRS}(x_{t+1},y_{t+1})}{D_{t+1}^{CRS}(x_{t+1},y_{t+1})} \times \frac{D_t^{CRS}(x_t,y_t)}{D_{t+1}^{CRS}(x_t,y_t)}\right]^{1/2}}_{TECHCH}$$

We adopt Farrell's (1957) distance functions and Fare et al. (1994) definition of productivity change. The Malmquist index (TFPCH or M**)** is thus defined as the

product of efficiency change (EFFCH), which is how much closer a bank gets to the efficient frontier (catching-up effect or falling behind), and technological change (TECCH), which is how much the benchmark production frontier shifts at each bank's observed input mix (technical progress or regress). Malmquist index (TFPCH or M) can attain a value greater than, equal to, or less than unity depending on whether the bank experiences productivity growth, stagnation or productivity decline, respectively, between periods t and t+1. EFFCH index takes a value greater than 1 for an efficiency increase, 0 for *no* efficiency change, or less than 1 for an efficiency decrease. Likewise, TECCH attains a value greater than 1 for technical progress, 0 for technical stagnation, or less than 1 for technical regress. Adopting variable returns to scale (VRS) assumption, Fare et al. (1994) decomposed the (CRS) technical efficiency change into scale efficiency and pure technical efficiency components (EFFCH = PEFFCH × SCH).[1]

To understand the decomposition, return to the example in Figure 1, in which the firm located at point C moved to point D between year t to year t+1, but the estimated CRS_t and VRS_t frontiers remain unchanged. The above equation suggests that TFPCH = TECCH × EFFCH. Apparently, EFFCH = $(X_3D/X_3G)/(X_3C/X_3G) < 1$ and TECCH = $[((X_3D/X_3G)/(X_3D/X_3G))\times((X_3C/X_3G)/(X_3C/X_3G))]^{1/2} = 1$. Hence, TFPCH < 1, indicating a productivity decline. In moving from point C to point D, not only does the firm become less productive but also less efficient, that is; the firm's output level decreases from Y_2 to Y_1, given the same level of input (X_3), leading to a productivity decline, and the firm's position falls further behind the efficient frontier, leading to an efficiency decrease. In this case, the only reason for the productivity decline is the increased distance of the firm from the efficient frontier (efficiency decrease), as the frontier did not shift.[2] However, in other instances, productivity decline may result from both efficiency decrease and technical regress. For instance, consider once again the bank located at point C. By moving to point D, we saw that the bank became less productive. If we say TFPCH is about 0.85, that is, the firm now produces 15 percent less output with the same level of input (X_3). Also assume that CRS_t frontier shifted inward to CRS_{t+1}; that is, technical regress caused banks to produce 10 percent less output from the same amount of input (X_3). Although both technical regress and efficiency decrease are at work in this case, productivity decline mainly results from technical regress (10 percent) rather than efficiency decrease (5 percent).[3]

5. Empirical Design and Data

For appropriate and fair performance comparisons between different banking groups, the homogeneity of the outputs produced by each group becomes critical. Due to their rather different structure and small share in the system (about 6 percent in 1996), we exclude development and investment banks and instead focus on only commercial banks. We obtained data from the Banks Association of Turkey, which publishes annual financial statements of all banks (foreign or domestic) operating in Turkey. Because the productivity change index requires a bank exist in two consecutive years, our panel data is balanced. Hence, we study the adventure of the same set of banks before and after the crisis, resulting in 54 annual bank observations (more than 95 percent of the banks in each year).[4]

In order to compute efficiency and productivity of banking firms, one first should decide on banking technology. This boils down to understanding the production process in banking: what factors of production (inputs) are employed by banks to produce various financial services and products (outputs)? This study adopts the widely accepted intermediation approach (Sealey and Lindley, 1977) to define the inputs and outputs of banks. Accordingly, all variables except for the input factor labor are measured in millions of U.S. dollars.[5] The ***input vector*** includes (1) labor [LABOR]: the number of full-time employees on the payroll, (2) capital, [CAPITAL]: the book value of premises and fixed assets, and (3) loanable funds [FUNDS], the sum of deposit (demand and time) and non-deposit funds. The ***output vector*** includes (1) short-term loans [ST_LOANS], (2) long-term loans [LT_LOANS]: the loans with less than and more than a year maturity, respectively, (3) risk-adjusted off-balance sheet items [RA_OFF_B/S]: guarantees and warranties (letters of guarantee, bank acceptance, letters of credit, guaranteed pre-financing, endorsements and others), commitments, foreign

[1] For further explanation and calculation of efficiency and *TFPCH* indices using DEA, please see Fare *et al*. (1994) and Wheelock and Wilson (1999).

[2] Obviously, the efficiency decrease (EFFCH<1) is driven by decreases both in pure technical efficiency (PEFCH = $(X_3D/X_3E)/(X_3C/X_3E) < 1$) and scale efficiency (SECH = $((X_3D/X_3G)/(X_3D/X_3E))/((X_3C/X_3G)/(X_3C/X_3E)) < 1$).

[3] Note that efficiency is measured as proximity to the frontier, thus, increase in technical inefficiency is 15 percent relative to the old frontier (CRS_t) and 5percent relative to the new frontier (CRS_{t+1}). 15percent efficiency decrease is partly offset by 10percent downward shift in the frontier, resulting in net 5percent efficiency decrease.

[4] Technologies (frontiers) used by domestic and foreign banks might substantially differ. It might be more appropriate to compare each bank according to the best practice banks in its own specific group, that is, against a separate frontier. Like Aly et al. (1990), using parametric and nonparametric tests, we checked whether the common frontiers or separate frontiers should be used in estimating the efficiency indexes of foreign and national banks. We found that there is no statistically significant difference between common frontier and separate frontier results, suggesting that the data on foreign and domestic banks can be pooled into one sample. Thus, we continue our analysis with the results obtained relative to the common frontier. The results are available upon request from authors.

[5] The denomination of the variables in $U.S. is expected, to an extent, to eliminate the adverse impact of the inflation on the real magnitudes.

exchange and interest rate transactions as well as other off-balance sheet activities, and (4) other earning assets [OTHER_EA]: loans to special sectors, inter-bank funds sold and investment securities (treasury and other securities). Off balance sheet items are risk-adjusted using Basle Accord risk weights to provide conformity with directly issued loans in terms of credit risk. In notional values, the ratio of the off-balance sheet items to the on-balance sheet items for the sector is 1.95, 1.82 and 2.36 for 1988, 1992 and 1996, respectively. Thus, the exclusion of off-balance sheet items might considerably bias the performance measures of the banks that actively engaged in these types of activities (Berger and Mester, 1997; Siems and Clark, 1997; Isik and Hassan, forthcoming1). It is also equally critical to take the securities portfolio into account because Turkish banks have been mowing away from traditional banking business due to increasingly more profitable arbitrage activities, much of which revolve around the management and funding of the large portfolios of government papers. Evidently, the share of loans in total assets of the banking sector declined from 54 percent in 1980 to 47 percent in 1990 and 30 percent in 1999. At the same time, the share of securities portfolio increased from 6 percent in 1980 to 11 percent in 1990 and 17 percent in 1999 (source: BAT). [6]

Table 3 gives the summary statistics of outputs, inputs and size for the industry as well as for the subgroups of banks. To attract attention to the crisis period, the 1994 figures are given in **bold** format. The adverse impact of the crisis on banking is obvious from the sharp drop of both asset and liability items in 1994, indicating a significant shrinkage in banking business during the crisis. The total assets of the banking industry fell from $1,161 million in 1993 to $867 million in 1994, and bounced back to almost its 1993 level in 1995, $1,151 million (Panel c in Table 3). Although all banks felt the shock in one way or another, the most affected banking group was foreign banks as evidenced by about 50 percent erosion in their assets in 1994. It *may* be that foreign banks lost their appetite of doing business in a risky environment and intentionally reduced their business involvement in the country.

Most of the bank loans extended in Turkey concentrate in short term, which is mainly due to the high fluctuations in the general price level in the country. This is actually rational behavior in terms of maturity gap management because a vast majority of the deposits also lie in short term periods (BAT, 1996). Risk adjusted off-balance sheet activities surpass the sum of both short-term and long-term loans in each year, justifying the caution about the bias they could create unless accounted for in the estimation of productivity and efficiency scores. Another important observation is that the standard deviations of all activities are relatively very large, implying perhaps enormous size dispersion within and between banking groups. Yet, it is noteworthy that the dispersion got narrower within each group during the crisis. Uncertainty and instability in the environment seem to have led banks to decrease their activities, which may have resulted in little business transactions by banks and thus less discrepancy between them.

[6] In $ US basis, the real interest rate in the 3-6 month and 6-9 month T-bills and government bonds were 9 percent and 27 percent, 43 percent in 1995 and 9 percent 18 percent and 15 percent in 1996, respectively. As of the end of 1995, 82 percent of the banks' securities portfolio consists of public sector securities such as treasury bills, government bonds and revenue sharing certificates (source: Banks in Turkey 1996).

6. Empirical Results and Analysis

In this section, we analyze performance of Turkish banks before (1992-1993), during (1994) and after the crisis (1995-1996). More plainly, the question is what was the productivity level before the 1994 crisis (e.g., in 1993 with respect to the 'healthy' 1992), during the crisis (e.g., in 1994 with respect to the 'healthy' 1992), and after the crisis (e.g., in 1995-96 with respect to the 'healthy' 1992). As implied, the 1992 year is chosen as the *reference (basis) year,* when calculating the productivity and efficiency change scores. As there is no obvious significant (positive or negative) event in 1992, it could safely serve as a control year. Crisis is a fundamental event, whose sources might have formed in a long time period and whose impacts could persist many years after its occurrence. Thus, we use a long time period (1992-1996) and a fixed reference technology (1992) in our analysis. Since the impact of the crisis might be different across banks, we detail our results by ownership. We try to uncover the relative influence of the crisis on each banking group. We also seek to identify the driving source of the productivity change (THPCH) in each group (*changes in efficiency* [EFFCH] or *shifts in technology* [TECCH]). The impact of scale economies on the efficiency and productivity of banks is also examined.

6.1. Managerial efficiency during the 1994 Turkish banking crisis

Table 4 reports the decomposition of managerial efficiency in Turkish banks calculated relative to the contemporaneous year technology. Panel A gives the results for the industry, whereas Panel B details them according to banking groups. Although the adverse impact of the crisis on managerial efficiency (TE) and its constituents (PTE and SE) is immediately apparent in 1994, its harm is more striking in the following year, 1995 (in Panel A). Moreover, the symptoms of ailment were clear from the deterioration of banking efficiency prior to the crisis: all efficiency measures of banks in 1993 are much lower than those in 1992. Compared to either 1994 or 1995 results, 1996 results demonstrate significant efficiency recovery. These results imply that the devastating impact of the crisis on banking was clear before the crisis and not over just after the crisis, as evidenced by the U-shaped, swinging efficiency measures between 1992 and 1996. Apparently, as it took some time for macroeconomic problems to show their overwhelming effect on bank efficiency, it took some time for the system to recover.

As the results in Panel B demonstrate, the influence of the crisis on efficiency is not uniform across banks. The most effected banking group is foreign banks: foreign subsidiaries' (For_Fou_TR) TE dropped from 81 percent in 1993 to 70 percent in 1994, while foreign branches' (For_Brn_Tr) TE diminished from 70 percent in 1993 to 65 percent in 1994. Whereas, results for domestic banks suggest that their efficiency did not deteriorate as much during the mayhem. On the contrary, the TE of private domestic banks improved in 1994 with respect to that in 1993 by 5 percent. The improvement seems to have been driven mainly by the increase in scale efficiency (by 5 percent) rather than the increase in pure managerial efficiency (by 0.7 percent). Isik and Hassan (forthcoming1) reported that the major source of the cost inefficiency in the Turkish banks is scale inefficiency, which was mainly attributable to diseconomies in scale. The sharp fall in their scale in 1994 might have "naturally" helped the domestic banks, which suffer from excessive production, to move closer to the optimal scale. Stated differently, it seems that the fall in the scale of their production contributed positively since it involved a contraction in the region of decreasing returns to scale (DRS). However, efficiency of domestic banks drops sharply in 1995, the largest fall experienced among the banking groups. This drop mostly results from increased scale inefficiency because while the PTE fell by 5 percent, the SE fell by 12 percent, now implying a wrong movement by private banks, expansion in the region of DRS.

The five-year average TE is 66 percent for domestic state banks, 76 percent for domestic private banks, 77 percent for foreign subsidiaries, and 70 percent for foreign branches, indicating that private banks (domestic or foreign) are more efficient than public banks in transforming bank inputs into financial outputs. It seems that the basic source of inefficiency in public banks is also scale related, perhaps stemming from their giant scales (e.g.; 25 percent of the entire banking assets is owned by a state bank, T.C. Ziraat Bankasi). As the results indicate, foreign banks are relatively immune from scale problems. Although most affected by the crisis and operating in a lesser known market, their overall performance levels up to that of domestic banks in terms of managerial efficiency, maybe owing to their international skills and experiences, state of art technology, more qualified manpower, access to relatively less expensive external funds, and better marketing and operational skills (evidently, until foreign bank entry, domestic banks had no marketing departments).

A direct comparison of efficiency measures across periods may not be an indicator of absolute improvement or deterioration of efficiency, as it would only show changes in relative efficiency vis-à-vis other banks. The frontier could shift from one period to another because of innovation, financial shock or increased competition in the market. Moreover, there could be substantial bank entries and exits over time, resulting in different samples of banks and thus frontiers across periods. For this reason, in a changing environment, the Malmquist TFPC index is commonly used to calculate absolute improvement or deterioration in bank efficiency and productivity (Wheelock and Wilson, 1999).

6.2. Total factor productivity change (TFPCH) during the 1994 Turkish banking crisis

We now turn to an examination of the impact of the crisis on the productivity change and its components. Because the year 1992 is the basis (reference) year, the Malmquist TFPC Index and its components take an initial mean score of 1 for 1992. Thus, any score greater (lower) than 1 in subsequent years indicates an improvement (worsening) in the relevant measure. Average annual values of the indices for the industry and each banking group are provided in Table 5. As Panel A of the table indicates, the deterioration of the banking productivity was imminent prior to the crisis and quite dramatic during the crisis. With respect to 1992, while average productivity of the industry fell by 1.1 percent in 1993, it fell by about 17 percent in 1994. This substantial productivity loss is a result of the combination of a shock to banking technology and a decrease in banking efficiency. However, the regress in technology (10 percent) outweighs the decrease in efficiency (7 percent). Decomposition of the efficiency change into its components suggests that the dominant source of the decrease in bank efficiency in 1994 is managerial-related rather than scale-related, implying perhaps the inexperience of the banks in crisis management. However lower the productivity in 1995 relative to that in 1992 (by 1.4 percent), it improves considerably relative to that in 1994 (15 percent). This is mainly attributable to the rebound (technical progress) in frontier technology in 1995 (39 percent relative to that in 1994 and 29 percent relative to that in 1992). The positive impact of outward shift in frontier is partly offset by the decrease in the efficiency (16 percent relative to that in 1994 and 23 percent relative to that in 1992). Although mainly owing to the expansion in the frontier, the banking system enters 1996 with a recovered productivity both with respect to the reference year, 1992 (5 percent) and previous year, 1995 (6.4 percent). Like the TE index, the productivity change index follows a U-shaped behavior between 1992 and 1996.

Panel B of Table 5 presents the results by ownership. As observed, all forms of banks, except for state banks, experienced significant productivity loss during the crisis. In 1994, the productivity loss is about 7 percent for both private banks (Nat_Privt) and foreign subsidiaries (For_Fou_TR), and about 21 percent for foreign branches (For_Brn_TR). While the productivity loss is mainly driven by a shock to banking technology in private domestic banks (negative 16 percent technical change outweighs positive 10 percent efficiency change), it is predominantly driven by a substantial decrease in efficiency in foreign banks. In contrast, public banks somewhat benefited from the crisis as evidenced by a 13 percent (4 percent) productivity gain with respect to 1993 (1992). Public banks enjoy strong protection and patronage from the state. During a crisis, security of

financial institutions becomes critical, thus the public favors relatively safer state banks, reducing their exposure to crisis. The relatively smaller asset loss of public banks in 1994 provides more evidence in this regard. Most of the productivity gains in state banks throughout the period result mainly from the improvement in scale efficiency, implying that shrinking balance sheets translated itself to the right movement towards the optimal scale in public banks, which were shown by Isik and Hassan (forthcoming1) to suffer from excess level of production.

An analysis based on the *number* of banks is less sensitive to possible outliers. In contrast, an analysis based on productivity *levels* of banks can be biased by a few extreme observations. As a robustness check, Table 6 elaborates the impact of the crisis on the productivity of Turkish banks by summarizing the development in the *number* of banks, which experienced a productivity gain or loss. As the results in Panel A indicate, out of total 54 banks, while 31 had experienced *productivity growth* in 1993, the number of such banks decreased almost by half in 1994 (16 banks). Also, while only 23 banks had faced a *productivity loss* in 1993, the number increased sharply to 38 in 1994. Likewise, while 40 (14) banks had seen progress (regress) in their technology in 1993, the number decreased (increased) notably to 15 (39) in 1994. Also, the number of banks that experienced an efficiency increase (decrease) dropped (rose) from 21 (25) in 1993 to 16 (31) in 1994. After 1994, the number of banks that show productivity growth (loss), technical progress (regress), and efficiency increase (decrease) has grown (lessened) quiet notably. The decomposition of efficiency change (EFFCH) into its components also reveals some interesting facts. Between 1993 and 1994, although the number of banks experiencing a pure efficiency increase (decrease) declined (rose) from 15 (18) to 13 (22), the number of banks experiencing a scale efficiency increase (decrease) rose (fell) substantially from 17 (29) to 23 (22). This result confirms again the right movement (contraction) owing to the "natural disaster" in 1994 in the region of decreasing returns to scale for Turkish banks. As Panel B of Table 6 shows, each banking group demonstrates the typical characteristics of the entire sample discussed above: the productivity growth, technological progress, and efficiency increase are all *disrupted* by the 1994 crisis. For example, while 18 (64 percent) of 28 private domestic banks were experiencing productivity growth in 1993, the number of banks with productivity growth dramatically dropped to 7 (25 percent). Accordingly, as only 6 (21 percent) domestic private banks faced regress in their technology in 1993, the number of such banks skyrocketed in 1994, climbing to 24 (86 percent). The relative immunity of state banks from the crisis is also supported by the results in Table 6.[7]

[7] The drop in the total number of state banks from 6 in 1994 to 5 in 1995 is due to the privatization of one state bank (namely, Sumerbank A.S.) in 1995.

Table 7 is constructed to examine the major sources of the productivity loss and efficiency decrease in Turkish banks during 1994. The results given in this table are simply a decomposition of the previous table, Table 6. For instance, of those 38 banks which experienced productivity loss in 1994 as shown in Panel A of Table 6, the majority, 25, faced the loss mainly due to a shock to their technology (technical regress) as shown in Panel A of Table 7. The rest of the banks, 13, experienced the productivity loss mostly because of a decrease in their efficiency. Of the 31 banks with an efficiency decrease in 1994, 20 experienced the reduction in their efficiency mainly due to a decrease in their pure technical (managerial) efficiency, whereas 11 faced the reduction mostly due to a decrease in their scale efficiency. Subgroup results in Panel B of Table 7 yield similar conclusions. All banks (domestic or foreign) seem to have suffered mostly because of their poor management (pure technical inefficiency) rather than adverse changes in their scale during the crisis.

6.3. Bank size and total factor productivity change during the 1994 Turkish banking crisis

Banks of different sizes might exhibit sharply different operational characteristics. Some differences reflect government regulation; others are associated with variances in the markets served. Small banks in Turkey operate only in three large cities, Istanbul, Ankara, and Izmir, while large banks have an extensive network of branches scattered all across the country including rural areas where the population density is low, and thus, delivery systems are more costly. While this might create a cost disadvantage for large banks, their large scale might enable them to capture economies of scale. For instance, the most efficient computer systems require a high volume of transactions to justify their cost, thus small banks may be too small to process transactions efficiently.

In this section, we divide our sample by size (gross total assets), to explore the relationship between bank size, productivity and crisis. It is of value to know whether the impact of the crisis varies across different sizes of banks. Table 8 exhibits the TFPC and its components according to size. The results suggest that regardless of the size, all banks suffered substantially from the financial disruption in 1994. However, the extent of the harm varies considerably across banks. For example, while the productivity *loss* was 11 percent for small banks, it was 16 percent for medium banks and 8 percent for large banks. It seems that experienced large banks relative to novice small banks managed better the adverse consequences of the crisis. For all size banks, the main reason for the productivity loss in 1994 was the contraction in banking technology (TECCH) rather than an efficiency decrease (EFFCH). It is notable that the productivity pattern according to size reversed completely in 1995: the biggest losers of 1994, small banks, were the biggest winners of 1995, followed by medium banks, the next biggest losers of 1994. On the contrary, large banks, the most formidable group of banks in 1994, could obtain only a slight productivity gain in 1995. It

seems that a sharp fall in the productivity of small and medium banks provided them a large leeway to demonstrate an impressive rebound.

In order to complement our analysis, we tested the strength of the correlation between the bank size and TFPCH and its components. The null hypothesis of the test is that the Spearman rank correlation between the two variables is zero. The results of the test given in Table 9 indicate that the relationship between size and productivity change is positive but strong only in 1996. Generally, the EFFCH index shows a statistically strong upward trend with size. This result, as size increases productivity and efficiency gain increases, is consistent with the results from Norwegian (Berg et al., 1991) and Japanese (Fukuyama, 1995) banking. While PEFFCH also shows a positive trend with size, TECCH demonstrates a negative trend, but those associations are not as statistically strong as the association between size and EFFCH. In Table 10, we trace the sources of the productivity change by size. In 1994, all size banks, whether small, medium or large, experienced productivity loss mostly because of technological regress. Consistent with the results in Table 8, most of the banks whose banking technology regressed are small banks (52 percent), followed by medium banks (32 percent), and then large banks (16 percent). Also, of the banks that experienced efficiency decrease and thus productivity loss, 70 percent were small, while the rest (30 percent) were large.

7. Concluding Remarks

Aside from the descriptive analysis of the 1994 Turkish financial crisis, its impact on the productivity, technology, and efficiency of the Turkish banks has not been studied yet. In this study, utilizing a DEA-type Malmquist Total Factor Productivity Index, we examined the behavior of the productivity change and its components around the crisis (1992-96). Earlier, Zaim (1995) and Isik and Hassan (forthcoming2) demonstrated that the efficiency and productivity of Turkish banks improved significantly as a result of financial liberalization in the 1980s. Our results suggest that the positive trend in bank performance captured in the 1980s has been substantially interrupted in the 1990s. Following the financial disruption in 1994, Turkish banks experienced a 17 percent productivity loss, which was partly due to the inward shift in the frontier (10 percent) and partly due to the decrease in efficiency (7 percent). Apparently, whether on the frontier or inside the frontier, all banks suffered substantially from the crisis. One indication is that financial intermediation diminished considerably during the distress as evidenced by the shrinkage of the banking industry.

Adverse selection and moral hazard problems could explain a large portion of the fall in the stock and flow of the funds in the Turkish banking system during the crisis. In a chaotic environment, it becomes harder for banks to distinguish between lemons (bad credit risks) and non-lemons (good credit risks). The ones who are suffering the most from the crisis and thus riskier are those who would most actively seek out loans and are thus most likely to be selected. The net worth is another type of collateral for banks, which constrains risky behaviors of borrowers. Because equity capital of an average firm erodes notably during crisis, the chance that the borrower might engage in activities that are risky and undesirable from the lender's point of view increases considerably. Both asymmetric problems ultimately lead to less funds intermediated and less services provided, reducing bank outputs. However, bank inputs are relatively less affected during the crisis (see Table 3). Turkish banks cut the work force (variable factor) slightly. The fall in their physical capital (fixed assets) was also minimal. Moreover, the fall in bank deposits, another bank input, was relatively low as the 100 percent insurance scheme launched by the state following the crisis curbed bank runs to a large extent. Thus, the drop in bank outputs was relatively higher than the drop in bank inputs, causing a short-term contraction in frontier and a decline in bank productivity.

Foreign banks suffered the most from the crisis followed by domestic private banks. The substantial decline in the productivity of foreign banks could be attributed to their relatively larger open positions in the advent of the crisis and to the extreme sensitivity of foreign capital to sudden changes in the economic environment. In contrast, state banks were relatively resilient, as they passed through the crisis literally unharmed. Public banks' relative immunity could be explained with their policy to carry low open positions in FX and also with an environment where the most precious asset was security. State banks are relatively safer, making them more attractive for depositors and borrowers in a risky environment. In addition, loan approvals and controls are relatively less stringent in public banks due to social and political goals, thus the production of bank loans and services during crisis is less affected for public banks than private banks. Our results also indicate that all sizes of banks suffered substantially from the financial shock in 1994, however, the impact of the shock on small banks was overwhelming. The too-big-to fail syndrome might have played some role for this outcome. The economic units that are concerned with the survival of small banks might have switched to larger banks, expecting that large banks would not be allowed by the state to fail. The fact that the banks that failed during the 1994 crisis were invariably small size banks somehow validates such behavior and argument.

Additionally, our results suggest that the deterioration of bank efficiency and productivity scores preceded the crisis. One implication is that efficiency and productivity indices could be incorporated into the econometric models along with other factors to predict future systemic disruptions. However, more research and applications from other country experiences are required to warrant this implication. The results also indicate that the devastating impact of the crisis on banking was fully over by 1996. Apparently, regulatory measures along with banks' own efforts have been somewhat successful in stabilizing the system in

the short run. However, repeating economic crises in the country indicate that financial problems in Turkey have deeper roots. Hence, for long term successes, long term remedies are needed such as carrying out unfinished privatization program, tax, and social security reforms; an end to the heavy reliance of the state on banking sector to fund its large budget deficits; adoption of a strict monetary discipline by the state to reduce its monetization of the debt; implementing polices to control inflation and maintain the value of the TL to curb incentives for currency substitution; allowing inefficient and insolvent banks to fail letting their problems spread to otherwise solvent banks (as happened in the savings and loans industry in the U.S.); taking measures to reduce connected lending, which was the main reason behind most banks' failures during the recent crises; encouragement of internal control and risk assessment systems to fortify the risk management skills of banks; enforcing adequate bank capitalization according to international standards; and breaking up the oligopolistic structure of the banking industry where the profit opportunities are abundant, thus cost controls and efficient operations are not essential for survival. In addition, the 100 percent insurance, which came into force in the extraordinary conditions of the 1994 crisis, is still active and should be revised to prevent erosion of market discipline by bank creditors and an increase of moral hazard among bank managers and owners to assume excessive risks, which might breed another banking fragility in the future.

References

Aly, H.Y., Grabowski, R., Pasurka, C., Rangan, N., 1990. "Technical, scale, and allocative efficiencies in U.S. banking: An empirical investigation." *Review of Economics and Statistics* 72, 211-218.

Banker, R.D., Charnes, A. and Cooper, W.W., 1984. "Some models for estimating technical and scale inefficiencies in Data Envelopment Analysis." *Management Science 30,* 1078-1092.

Banks Association of Turkey, *Banks in Turkey 1988-1999*, Banks Association of Turkey, Istanbul, TR.

Barr, R., Seiford, L., Siems, T., 1994. "Forecasting bank failure: A non-parametric approach," *Recherches Economiques de Louvain* 60, 411-29.

Berger A. N., Humphrey, D.B., 1992a. "Measurement and efficiency issues in commercial banking," in Z. Griliches, (ed.), *Measurement Issues in the Service Sectors*, NBER, University of Chicago Press, USA, 245-79.

Berger, A.N. and Mester, L.J., 1997. "Inside the black box: What explains differences in the efficiencies of financial institutions?" *Journal of Banking and Finance* 21, 895-947.

Calomiris, C. W., 2000. *Victorian perspectives on the banking collapses of the 1980s and 1990s*. Manuscript, Columbia University, New York, USA.

Calvo, G. A., Leiderman, L., and Reinhart, C.M., 1994. The capital inflows problem: concepts and issues. *Contemporary Economic Policy*, 12, 54-66.

Caprio, G. and Klingebiel, D., 1996a. "Bank insolvencies: Cross-country experience." World Bank working Paper no. 1620.

Cebenoyan, A.S., Cooperman, E.S., Register, C.A., 1993. "Firm inefficiency and the regulatory closure of S&Ls: An empirical investigation," *Review of Economics and Statistics* 75, 540-45.

Celasun, O., April 1998. "The 1994 currency crisis in Turkey," World Bank working paper no: 1913.

Demirguc-Kunt, A, Detragiache, E., 1997. "The determinants of banking crises: Evidence from developed and developing countries." World Bank Development Research Group, working paper no: 1828.

Demirguc-Kunt, A, Detragiache, E., May 1998. "Financial liberalization and financial fragility." World Bank Development Research Group, working paper no: 1917.

DeYoung, R., 1998. "Management quality and X-efficiency in national banks," *Journal of Financial Services Research* 13, 5-22.

Ersel, H., 2001. "Turkish banking under the Economic Stabilization Program." Paper presented in the *Money in Turkey* session organized by the Middle East Economic Association in the Allied Social Science Association (ASSA) Meeting in January 2001, New Orleans, Louisiana, US.

Ertugrul, A. and Zaim, O., 1996. *Turk bankaciliginda etkinlik: Tarihi gelisim kantitatif analiz*, Bilkent University, Ankara, Turkey.

Fare, R., Grosskopf, S., Norris, M., and Zhang, Z., March 1994. "Productivity growth, technical progress, and efficiency change in industrialized countries." *The American Economic Review,* vol.84, no.1, 66-83.

Friedman, M., and Schwartz, A. J., 1963. *A monetary history of the United States 1867-1960,* Princeton, NJ: Princeton University Press.

Fukuyama, H., 1995. "Measuring efficiency and productivity growth in Japanese banking: A nonparametric approach." *Applied Financial Economics* 5, 95-117.

Farrell, M.J., 1957. "The measurement of production efficiency." *Journal of the Royal Statistical Society* 120, Series A, General, 253-281.

Hermalin, B.E., Wallace, N.E., 1994. "The determinants of efficiency and solvency in savings and loans." *Rand Journal of Economics* 25, 361-381.

Humphrey, D.B. and Pulley, L.B., 1997. "Banks' responses to deregulation: Profits, technology, and efficiency." *Journal of Money, Credit, and Banking* 29, 73-93.

Hunter, W.C. and Timme, S.G., 1986. "Technical change, organizational form and the structure of bank production." *Journal of Money, Credit and Banking* 18, 152-166.

Isik, I., Brogan, J., Ivanova, R., Wadee, S., 2001. "Financial crisis and its impact on financial and industrial firms." Working paper, School of Management, New Jersey Institute of Technology, Newark, New Jersey, U.S.A.

Isik, I. and Hassan, M.K., forthcoming(1). "Technical, scale and allocative efficiencies of Turkish banking industry." *Journal of Banking and Finance*.

Isik, I. and Hassan, M.K., forthcoming(2). "Financial deregulation and total factor productivity change: An empirical study of Turkish commercial banks". *Journal of Banking and Finance.*

Khumbakar, S.C., Lozana-Vivas, A., Lovell, C.A.K. and Hasan, I., forthcoming. "The effects of deregulation on the performance of financial institutions: The case of Spanish savings banks." *Journal of Money, Credit and Banking*.

Kaminsky, G., and Reinhart, C., September 1996. "The twin crises: The causes of banking and balance of payments problems," mimeo.

Khamis, M., 1996. "Credit and exchange rate-based stabilization," IMF working paper no. 51.

Kindelberger, C., 1978. *Manias, panics and crashes.* John Wiley & Sons. Published 1978. Revised 1989. Revised 1996.

Kwan, S. H., Eisenbeis, R., December 1994. "An analysis of inefficiencies in banking: A stochastic cost frontier approach," working paper, Federal Reserve Bank of San Francisco, USA.

Leightner, J.E. and Lovell, C.A.K., 1998. "The impact of financial liberalization on the performance of Thai banks." *Journal of Economics and Business* 50, 115-131.

Malmquist, S., 1953. "Index numbers and indifference surfaces." *Trabajos de Estadistica* 4, 209-42.

Mishkin, F. S., December 1991. "Anatomy of a financial crisis." NBER working paper no. 3934.

Mishkin, F.S., May 1996. "Understanding financial crises: A developing country perspective." NBER working paper no. 5600.

Peristiani, S., 1996. "Evaluating the postmerger X-efficiency and scale efficiency of U.S. banks." Federal Reserve Bank of New York, Working paper.

Resti, A., June 1995. "Linear programming and econometric methods for bank efficiency evaluation: An empirical comparison based on a panel of Italian banks." Working paper, University of Bergamo, Bergamo, Italy.

Sealey, C. and Lindley, J., 1977. "Inputs, outputs, and a theory of production and cost at depository financial institutions," *Journal of Finance* 32, 1251-1266.

Siems, T. F. and Clark, J. A., Dec. 1997. "Rethinking bank efficiency and regulation: How off-balance-sheet activities make a difference." *Financial Industry Studies*, Federal Reserve Bank of Dallas, 1-11.

Stiglitz, J., October 1997. "Building robust financial systems." Keynote lecture at "Private capital inflows: What have we learned?"

Tornqvist, L., 1936. "The bank of Finland's consumption price index." Bank of Finland Monthly Bulletin 10, 1-8.

Whalen, G., 1991. "A proportional hazards model of bank failure: An examination of its usefulness as an early warning tool." Federal Reserve bank of Cleveland, Economic Review, Quarter1.

Wheelock, D.C., Wilson, P.W., 1995. "Explaining bank failures: Deposit insurance, regulation, and efficiency." *Review of Economics and Statistics 77*, 689-700.

Wheelock, D.C. and Wilson, P.W., 1999. "Technical progress, inefficiency, and productivity change in U.S. banking, 1984-1993." *Journal of Money, Credit, and Banking* 31-2, 212-234.

Zaim, O., 1995. "The effect of financial liberalization on the efficiency of Turkish commercial banks." *Applied Financial Economics* 5, 257-64.

Figure 1: The Output distance functions and Malmquist output-orientated productivity index

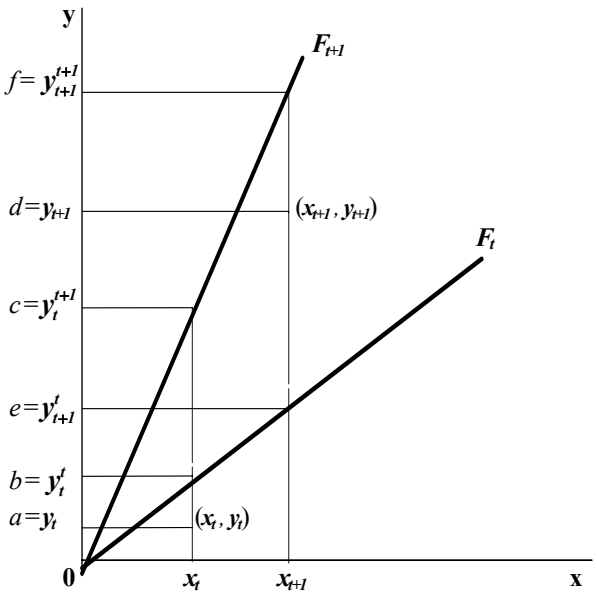

Table 1: Key Economic and Financial Indicators of Turkey: 1992-1996

Indicators	Unit	1992	1993	1994	1995	1996
GNP growth (1990 prices)	%	6.4	7.6	-6.1	8.1	7.5
Income per capita	$US	2,744	3,056	2,161	2,788	2,928
Inflation						
Wholesale (as of Dec.)		61.4	60.3	149.6	65.6	85
Consumer (as of Dec.)		66	71.1	125.5	80	80
PSBR	% of GNP	10.6	12.1	8.1	5.2	9
Domestic debt	$US million	28.31	32.50	26.42	31.13	38.52
External debt	$US million	55.6	67.3	64.4	73.3	79.8
Interest rates (ann. Simple av.)	%					
G-bonds		75.4	85	137	108	124
T-bills		96	86	190	143	158
Av. Maturity of Internal Debt	Years	1	1	0.7	-	-
Exc. Rate (TL/$US)	TL	6,888	10,986	29,670	45,679	83,043
Fixed -capital outlays	% change	1.3	4.9	-15.7	9.6	12.1
Total Consumption	% change	9.5	13.3	-3.1	6.1	7.7
Exports	$ US billion	14.7	15.3	18.1	21.7	23.1
Imports	$ US billion	22.9	29.4	23.3	35.7	42.4
Trade Balance	$ US billion	-8.2	-14.1	-5.2	-14	-19.3
Current Account Balance	$ US billion	-0.9	-6.4	2.6	-2.3	-4.4
Capital Account Balance	$ US billion	2.4	8.7	-4.2	4.7	9.7
Istanbul Stock Exchange Ind.	$US	273	833	413	383	534
Total bank assets[1]	$US million	63,382	71,638	51,630	68,397	83,337
Total bank loans[1]	$US million	26,564	29,146	20,278	29,072	35,906
Total bank deposits[1]	$US million	34,965	35,206	32,665	44,431	57,165
Total bank equity[1]	$US million	3,826	4,675	3,200	4,187	5,028

Notes:[1]The financial sector statistics are total values and not averages, and they belong to all types of banks operating in Turkey (development and investment banks as well as commercial banks). Source: *State Institute of Statistics; State Planning Organization; Banks Association of Turkey (BAT)*

Table 2: Comparison of Asset and Liability Composition of the Turkish Commercial Banks by Group Before and After the 1994 Economic Crisis (% of assets)

Groups →	**State Banks**		**Private Banks**		**Foreign Banks**	
Periods →	**1991-1993**	**1994 -1996**	**1991-1993**	**1994 -1996**	**1991-1993**	**1994 -1996**
Liquid Assets	0.34	0.35	0.43	0.41	0.53	0.59
Loans	0.42	0.40	0.40	0.40	0.36	0.26
Core Deposits	0.62	0.75	0.58	0.69	0.26	0.53
Purchased Funds	0.16	0.11	0.20	0.10	0.47	0.17

Table 3: Sample Statistics of Variables: Outputs, Inputs and Size (million of U.S. dollars)[1]

Banks →	All Banks		National State		National Private		Foreign Banks		Foreign Banks' Branches	
Vars. ↓	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
a.Outputs[2]										
Short-term loans										
1992	279.739	429.384	632.847	563.845	375.880	470.269	57.511	64.397	24.235	28.709
1993	307.875	456.854	516.238	412.045	448.737	538.438	61.011	58.260	24.841	33.734
1994	**207.132**	**348.243**	**438.696**	**431.187**	**289.967**	**394.583**	**27.517**	**46.771**	**9.398**	**9.968**
1995	312.879	512.347	726.947	474.374	407.424	585.831	47.541	81.053	18.476	25.997
1996	399.620	579.651	777.464	582.936	550.939	646.778	62.558	97.519	15.920	18.313
Long-term loans										
1992	27.688	80.372	99.175	89.499	30.881	97.655	3.256	7.098	0.559	0.921
1993	38.128	106.179	87.906	73.902	53.547	137.823	1.351	2.198	0.415	0.846
1994	**31.465**	**89.313**	**75.319**	**55.029**	**43.536**	**116.698**	**2.056**	**2.325**	**0.279**	**0.663**
1995	26.055	62.372	113.638	54.613	26.527	69.178	1.578	1.821	0.451	0.842
1996	43.940	108.539	114.006	97.241	57.615	132.014	1.755	3.239	0.397	0.825
risk-adjusted off-balance sheet items										
1992	389.517	554.049	969.146	637.297	488.838	603.852	111.509	99.635	47.997	65.895
1993	466.122	634.341	853.394	765.135	633.453	703.656	184.557	256.882	44.108	50.773
1994	**351.300**	**508.860**	**743.540**	**601.739**	**460.861**	**571.852**	**112.298**	**143.014**	**44.052**	**53.370**
1995	711.775	886.582	1365.441	834.361	891.853	1002.875	314.855	202.478	143.374	201.401
1996	844.110	1112.286	13338.627	835.076	1119.251	1301.483	316.721	406.090	179.542	245.201
other earning assets										
1992	261.640	849.261	1758.808	2112.524	115.265	156.412	22.286	28.976	13.426	15.976
1993	265.601	977.111	1866.628	2598.014	106.070	124.075	30.064	44.678	5.608	4.659
1994	**187.656**	**668.781**	**1229.705**	**1795.199**	**93.144**	**151.369**	**19.709**	**25.857**	**5.993**	**9.012**
1995	259.233	916.950	1973.279	2650.565	129.306	178.291	24.353	17.964	7.353	9.234
1996	380.295	1252.335	2693.410	3570.886	208.931	271.220	64.567	100.873	12.734	16.503

Table 3: (continued)

	All Banks		National State		National Private		Foreign Banks		Foreign Banks' Branches	
b. Inputs[2]	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Labor										
1992	2661	6338.84	13,037	13,797.945	2231	3843.745	253	415.143	67	34.108
1993	2555	6117.234	12759	13531.530	2122	3566.055	185	211.464	67	38.990
1994	**2489**	**5906.359**	**12410**	**13049.107**	**2040**	**34110.034**	**278**	**461.798**	**69**	**49.422**
1995	2522	5760.688	14540	12772.644	1969	3141.095	308	493.754	75	72.264
1996	2620	5592.297	14057	12261.901	2194	3092.587	319	534.990	85	98.178
Capital										
1992	55.965	171.107	304.057	445.064	41.667	68.585	2.431	1.900	0.839	1.242
1993	61.336	220.810	364.617	614.859	38.342	61.854	6.818	14.319	1.137	1.787
1994	**50.352**	**187.551**	**302.245**	**528.367**	**30.973**	**48.451**	**5.239**	**11.770**	**0.955**	**1.575**
1995	67.631	237.377	457.267	717.776	42.118	64.414	7.843	17.689	2.153	4.614
1996	74.530	260.241	494.593	782.130	46.716	69.953	11.371	25.008	2.166	4.633
Loanable funds										
1992	857.103	1623.541	3701.637	2982.698	797.160	1131.697	119.117	90.455	61.928	75.640
1993	919.426	1683.901	3543.627	3498.828	940.546	1149.453	163.004	116.535	51.255	58.065
1994	**701.108**	**1376.939**	**2881.073**	**2790.809**	**696.811**	**972.009**	**87.256**	**83.458**	**25.605**	**20.110**
1995	921.243	1703.303	4387.788	3418.466	853.223	1089.660	130.931	102.752	46.345	52.141
1996	1207.386	2208.747	5557.033	4910.917	1149.315	1222.003	182.707	232.003	46.003	53.947
c. Assets[2]										
1992	1093.046	2057.063	4627.747	3841.474	1031.521	1442.258	163.406	134.053	82.252	95.489
1993	1161.003	2134.281	4429.614	4447.707	1195.179	1480.326	201.515	159.594	73.057	79.791
1994	**867.110**	**1654.949**	**3430.195**	**3288.997**	**880.735**	**1221.289**	**124.387**	**131.019**	**40.826**	**36.523**
1995	1151.999	2080.104	5159.226	4065.453	1112.066	1474.430	178.937	160.232	65.923	68.972
1996	1444.108	2553.250	6379.214	5470.071	1406.418	1555.662	232.044	296.812	78.408	85.519

[1] Labor: no. of employees on payroll by end of respective year. [2] Panel a, b & c. report sample statistics of outputs, inputs & sizes, respectively, for all banks, & 1.National public banks: owned by Turkish taxpayers & voters; 2.National private banks: more than 50% of shares owned by Turkish residents; 3.Foreign banks founded in Turkey: more than 50% of shares owned by residents of foreign countries; 4.Foreign banks' branches operating in Turkey. Outputs: 1.Short-term loans, & 2.Long-term loans: loans with less than/more than a year maturity, respectively; 3.Risk-adjusted off-balance sheet items, include guarantees & warranties, commitments, foreign exchange & interest rate transactions & other off-balance sheet activities; 4.Other earning assets: consist of loans to special sectors & investment securities. Inputs: 1.Labor: quantity of labor by number of full-time employees on payroll; 2.Capital: book value of premises & fixed assets; 3. Loanable funds: sum of deposit (demand & time) & non-deposit funds as of end of respective year.

Table 4: Decomposition of Managerial Efficiency (TE) in Turkish Commercial Banks During the 1994 Economic Crisis

Indices →	TE		PTE		SE	
Banks ↓	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Panel A.						
All_Bnks						
1992	0.792	0.226	0.891	0.175	0.889	0.159
1993	0.735	0.247	0.848	0.212	0.867	0.166
1994	**0.727**	**0.239**	**0.848**	**0.194**	**0.857**	**0.180**
1995	0.628	0.241	0.809	0.209	0.776	0.215
1996	0.810	0.208	0.905	0.162	0.895	0.153
Panel B.						
1. Nat_State						
1992	0.639	0.191	0.926	0.111	0.690	0.136
1993	0.617	0.303	0.724	0.315	0.852	0.150
1994	**0.550**	**0.209**	**0.815**	**0.276**	**0.675**	**0.128**
1995	0.687	0.175	0.806	0.171	0.852	0.154
1996	0.789	0.215	0.857	0.184	0.921	0.101
2. Nat_Privt						
1992	0.785	0.217	0.903	0.154	0.869	0.167
1993	0.752	0.228	0.895	0.176	0.840	0.170
1994	**0.803**	**0.189**	**0.906**	**0.148**	**0.886**	**0.137**
1995	0.647	0.224	0.846	0.195	0.765	0.184
1996	0.828	0.170	0.922	0.144	0.898	0.122
3. For_Fou_Tr						
1992	0.926	0.119	0.940	0.104	0.985	0.022
1993	0.809	0.197	0.849	0.197	0.953	0.064
1994	**0.695**	**0.213**	**0.792**	**0.231**	**0.878**	**0.121**
1995	0.617	0.232	0.692	0.250	0.891	0.139
1996	0.797	0.242	0.834	0.241	0.956	0.079
4. For_Brn_Tr						
1992	0.813	0.263	0.829	0.261	0.981	0.033
1993	0.695	0.300	0.790	0.239	0.880	0.208
1994	**0.649**	**0.328**	**0.822**	**0.221**	**0.790**	**0.211**
1995	0.551	0.320	0.774	0.234	0.712	0.328
1996	0.775	0.295	0.924	0.152	0.839	0.255

Notes: TE: Technical (managerial) efficiency, PTE: Pure Technical Efficiency, SE: Scale Efficiency, estimated relative to the contemporaneous frontier of each year, for All_Bnks, all banks, and different banking forms in the sample, (1) Nat_State, national public banks that are owned predominantly by the Turkish taxpayers and voters; (2) Nat_Privt, national private banks of which 50 percent of its shares are owned by Turkish residents; (3) For_Fou_Tr, foreign banks founded in Turkey whose more than 50 percent of shares is owned by the residents of foreign countries; (4) For_Brn_Tr, foreign banks' branches operating in Turkey.

Table 5: Decomposition of Total Factor Productivity Change (TFPCH) in Turkish Commercial Banks During the 1994 Economic Crisis (1992 is the basis year)

Indices → Banks ↓	(1) Malmquist index (TFPCH) = (2)*(3)	(2)Technical change (TECHCH) = (1)/(3)	(3)Efficiency Change (EFFCH) = (4)*(5)	(4)Pure efficiency change (PEFFCH) = (3)/(5)	(5) Scale change (SCH) = (3)/(4)
Panel A.					
All_Bnks					
1992	1.000	1.000	1.000	1.000	1.000
1993	0.989	1.061	0.932	0.939	0.993
1994	**0.839**	**0.902**	**0.930**	**0.947**	**0.982**
1995	0.986	1.287	0.766	0.885	0.866
1996	1.050	1.016	1.033	1.025	1.008
Panel B.					
1. Nat_State					
1992	1.000	1.000	1.000	1.000	1.000
1993	0.911	0.842	1.082	0.834	1.298
1994	**1.041**	**1.040**	**1.001**	**0.941**	**1.064**
1995	0.998	0.755	1.321	0.997	1.325
1996	1.297	0.813	1.595	1.084	1.471
2. Nat_Privt					
1992	1.000	1.000	1.000	1.000	1.000
1993	1.107	1.086	1.019	1.041	0.979
1994	**0.933**	**0.844**	**1.106**	**1.036**	**1.068**
1995	1.074	1.294	0.830	0.956	0.868
1996	1.115	1.010	1.104	1.040	1.062
3. For_Fou_Tr					
1992	1.000	1.000	1.000	1.000	1.000
1993	0.967	1.115	0.867	0.898	0.966
1994	**0.933**	**1.184**	**0.788**	**0.849**	**0.928**
1995	1.330	1.876	0.709	0.766	0.925
1996	1.226	1.411	0.896	0.917	0.977
4. For_Brn_Tr					
1992	1.000	1.000	1.000	1.000	1.000
1993	0.995	1.107	0.899	0.934	0.963
1994	**0.792**	**0.906**	**0.874**	**0.946**	**0.924**
1995	1.158	1.534	0.755	0.912	0.828
1996	1.304	1.054	1.237	1.466	0.844

Notes: The table reports the mean scores of the total factor productivity change (TFPCH) index and its components, technical change (TECCH) and efficiency change (EFFCH) that is further decomposed into pure efficiency change (PEFFCH) and scale efficiency change (SCH), for All_Bnks, all banks, and different banking forms in the sample, (1) Nat_State, national public banks that are owned predominantly by the Turkish taxpayers and voters; (2) Nat_Privt, national private banks whose more than 50% of shares is owned by the Turkish residents; (3) For_Fou_Tr, foreign banks founded in Turkey whose more than 50% of shares is owned by the residents of foreign countries; (4) For_Brn_Tr, foreign banks' branches operating in Turkey.

Table 6: Development in the Number of Banks with Productivity Gain or loss / Efficiency Increase or Decrease During the 1994 Economic Crisis[1]

Indices →	# Bnks	Productivity Change (TFPCH)		Technology Change (TECHCH)		Efficiency Change (EFFCH)		
Change → Bank forms ↓		# Growth	# Loss	# Progress	# Regress	# Inc.	# Dec.	# No Δ
Panel A. All_Bnks								
1993	54	31	23	40	14	21	25	8
1994	**54**	**16**	**38**	**15**	**39**	**16**	**31**	**7**
1995	54	27	27	43	11	19	31	4
1996	54	29	25	24	30	24	23	7
Panel B.								
1. Nat_State[2]								
1993	6	3	3	1	5	5	1	0
1994	**6**	**4**	**2**	**4**	**2**	**1**	**5**	**0**
1995	5	3	2	5	0	4	1	0
1996	5	4	1	5	0	4	1	0
2. Nat_Privt[2]								
1993	28	18	10	22	6	12	13	3
1994	**28**	**7**	**21**	**4**	**24**	**11**	**13**	**4**
1995	31	16	15	26	5	10	19	2
1996	31	16	15	14	17	15	13	3
3. For_Fou_Tr[2]								
1993	9	3	6	8	1	2	6	1
1994	**9**	**2**	**7**	**3**	**6**	**2**	**6**	**1**
1995	7	3	4	7	0	2	5	0
1996	7	3	4	3	4	2	4	1
4. For_Brn_Tr								
1993	11	7	4	9	2	2	5	4
1994	**11**	**3**	**8**	**4**	**7**	**2**	**7**	**2**
1995	11	5	6	10	1	3	6	2
1996	11	6	5	7	4	3	5	3

Table 6: cont'd

Indices →	# Bnks	Pure Efficiency Change (PEFFCH)			Scale Efficiency Change (SCH)		
Change → Bank forms ↓		# Inc.	# Dec.	# No Δ	# Inc.	# Dec.	# No Δ
Panel A. All_Bnks							
1993	54	15	18	21	17	29	8
1994	**54**	**13**	**22**	**19**	**23**	**22**	**9**
1995	54	15	23	16	17	33	4
1996	54	19	17	18	26	21	7
Panel B.							
1. Nat_State[2]							
1993	6	1	3	2	6	0	0
1994	**6**	**1**	**2**	**3**	**3**	**3**	**0**
1995	5	2	2	1	4	1	0
1996	5	2	2	1	5	0	0
2. Nat_Privt[2]							
1993	28	11	4	13	9	16	3
1994	**28**	**8**	**9**	**11**	**14**	**8**	**6**
1995	31	7	12	12	10	19	2
1996	31	11	8	12	15	13	3
3. For_Fou_Tr[2]							
1993	9	1	6	2	1	7	1
1994	**9**	**2**	**5**	**2**	**3**	**5**	**1**
1995	7	2	5	0	1	6	0
1996	7	2	4	1	3	3	1
4. For_Brn_Tr							
1993	11	2	6	4	1	6	4
1994	**11**	**2**	**6**	**3**	**3**	**6**	**2**
1995	11	4	4	3	2	7	2
1996	11	4	3	4	3	5	3

Notes: [1]Productivity Growth: Malmquist Index (TFPCH)>1, Productivity Loss: TFPCH<1, Productivity Stagnation: TFPCH=1; Technical Progress: TECCH>1, Technical Regress: TECCH<1, Technical Stagnation: TECCH=1; Efficiency, Pure and Scale Efficiency Increase: EFFCH, PEFFCH, and SCH>1; Efficiency, Pure and Scale Efficiency Increase: EFFCH, PEFFCH, and SCH<1, No Change in Efficiency, Pure and Scale Efficiency: EFFCH, PEFFCH, and SCH=0. [2] In 1995, one of the state banks was privatized, and ownership of two foreign banks founded in Turkey passed to Turkish investors.

Table 7: Dominant Source of Productivity Growth or Loss / Efficiency Increase or Decrease in Turkish Commercial Banking During the 1994 Economic Crisis (1992 is the reference year)

Change → Bank forms ↓	# of Bnks	Productivity Growth because of:		Productivity Loss because of :		Efficiency Increase because of:		Efficiency Decrease because of:		Eff. No Δ
		Tech. Progress	Eff. Incr.	Tech. Regress	Eff. Decr.	PTE Incr.	SE Incr.	PTE Decr.	SE Decr.	
Panel A.										
All_Bnks										
1993	54	21	10	18	5	8	13	13	12	8
1994	**54**	**7**	**9**	**25**	**13**	**9**	**7**	**20**	**11**	**7**
1995	54	19	8	4	23	6	13	14	17	4
1996	54	12	17	8	17	9	15	14	9	7
Panel B.										
1. Nat_State										
1993	6	0	3	2	1	0	5	1	0	0
1994	**6**	**3**	**1**	**0**	**2**	**0**	**1**	**2**	**3**	**0**
1995	5	0	3	2	0	0	4	1	0	0
1996	5	0	4	0	1	0	4	1	0	0
2. Nat_Privt										
1993	28	12	6	2	8	5	7	3	10	3
1994	**28**	**1**	**6**	**19**	**2**	**6**	**5**	**8**	**5**	**4**
1995	31	14	2	2	13	1	9	6	13	2
1996	31	6	10	6	9	4	11	7	6	3
3. For_Fou_Tr										
1993	9	3	0	1	5	1	1	4	2	1
1994	**9**	**1**	**1**	**3**	**4**	**2**	**0**	**5**	**1**	**1**
1995	7	3	0	0	4	2	0	4	1	0
1996	7	3	0	1	3	2	0	3	1	1
4. For_Brn_Tr										
1993	11	6	1	0	4	2	0	5	0	4
1994	**11**	**2**	**1**	**3**	**5**	**1**	**1**	**5**	**2**	**2**
1995	11	2	3	0	6	3	0	3	3	2
1996	11	3	3	1	4	3	0	3	2	3

Notes: Productivity GROWTH because of Technological Progress: TFPCH>1, and TECCH>1 and EFFCH; Productivity GROWTH because of Efficiency Increase: TFPCH>1, and EFFCH> 1and TECCH; Productivity LOSS because of Technological Regress: TFPCH<1, and TECCH<1 and EFFCH; Productivity LOSS because of Efficiency Decrease: TFPCH<1, and EFFCH<1 and TECCH; Efficiency INCREASE because of PTE Increase: EFFCH>1, and PEFFCH>1 and SCH, Efficiency INCREASE because of SE Increase: EFFCH>1, and SCH>1 and PEFFCH; Efficiency DECREASE because of PTE Decrease: EFFCH<1 and PEFFCH<1 and SCH, Efficiency DECREASE because of SE Decrease: EFFCH<1, and SCH<1 and PEFFCH.

Table 8: Productivity Change Indexes by Size [total assets]

YR/ Size	# of Bnks	Productivity Change (TFPCH)	Technology Change (TECHCH)	Efficiency Change (EFFCH)	Pure Efficiency Change (PEFFCH)	Scale Efficiency Change (SCH)
A. 1993						
Small	26	0.990	1.093	0.906	0.925	0.979
Medium	13	1.085	1.148	0.945	1.011	0.935
Large	15	1.084	0.963	1.126	1.000	1.126
B. 1994						
Small	31	0.882	0.940	0.938	0.964	0.973
Medium	12	0.922	0.876	1.053	1.008	1.045
Large	11	1.007	0.926	1.088	0.987	1.102
C. 1995						
Small	26	1.172	1.577	0.743	0.848	0.876
Medium	15	1.091	1.243	0.878	1.009	0.870
Large	13	1.038	1.029	1.009	0.988	1.021
D. 1996						
Small	24	1.180	1.135	1.040	1.117	0.931
Medium	11	1.110	0.955	1.162	1.157	1.004
Large	19	1.234	0.963	1.281	1.058	1.211

Notes: 1992 is the reference year, and Small ≤ 300; 300 < Medium ≤ 1,000; Large >1,000 $ million.

Table 9: Spearman's Rank Correlation Coefficients between Size (total assets) and Productivity Indexes of the Banking Firms

Ind./ YR	Productivity Change (TFPCH)	Technology Change (TECHCH)	Efficiency Change (EFFCH)	Pure Efficiency Change (PEFFCH)	Scale Efficiency Change (SCH)
1993	0.116	-0.185	0.314[b]	0.095	0.191
1994	0.126	0.035	0.102	0.027	0.123
1995	0.064	-0.217	0.349[b]	0.142	0.229[c]
1996	0.285[b]	-0.093	0.386[a]	0.149	0.407[a]

Notes: [a, b, c] indicate statistical significance at the 1, 5, and 10 percent level, respectively.

Table 10: The Source of Productivity Growth or Loss with Respect to Total Assets Size Categories

Yr-Size/ Ind.	# of Bnks	# of banks with Productivity Growth because of :						# of banks with Productivity Loss because of :					
		Technological Progress			Efficiency Increase			Technological Regress			Efficiency Decrease		
		#	r %	c %	#	r %	c %	#	r %	c %	#	r %	c %
A. 1993													
Small	26	11	42.3	52.4	2	7.7	20.0	3	11.5	60.0	10	38.5	55.6
Medium	13	6	46.2	28.6	0	0.0	0.0	1	7.7	20.0	6	46.2	33.3
Large	15	4	26.7	19.0	8	53.3	80.0	1	6.7	20.0	2	13.3	11.1
Total	54	21	38.9	100	10	18.5	100	5	9.3	100	18	33.3	100
B. 1994													
Small	31	5	16.1	71.4	4	12.9	44.4	13	41.9	52.0	9	29.0	69.2
Medium	12	1	8.3	14.3	3	25.0	33.3	8	66.7	32.0	0	0.0	0.0
Large	11	1	9.1	14.3	2	18.2	22.2	4	36.4	16.0	4	36.4	30.8
Total	54	7	13.0	100	9	16.7	100	25	46.3	100	13	24.1	100
C. 1995													
Small	26	9	34.6	47.4	3	11.5	37.5	0	0.0	0.0	14	53.8	60.9
Medium	15	7	46.7	36.8	2	13.3	25.0	0	0.0	0.0	6	40.0	26.1
Large	13	3	23.1	15.8	3	23.1	37.5	4	30.8	100	3	23.1	13.0
Total	54	19	35.2	100	8	14.8	100	4	7.4	100	23	42.6	100
D. 1996													
Small	24	6	25.0	50.0	6	25.0	35.3	3	12.5	37.5	9	37.5	52.9
Medium	11	2	18.2	16.7	2	18.2	11.8	4	36.4	50.0	3	27.3	17.6
Large	19	4	21.1	33.3	9	47.4	52.9	1	5.3	12.5	5	26.3	29.4
Total	54	12	22.2	100	17	31.5	100	8	14.8	100	17	31.5	100

Notes: Small ≤ 300; 300 < Medium ≤ 1,000; Large >1,000 $ million.