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DISSERTATION

THE EFFICIENCY OF THE BANKING SYSTEM IN JORDAN

1990-1996

Submitted by

Taha Khaled Ahmad

Department of Economics

In partial fulfillment of the requirements

for the Degree of Doctor of Philosophy

Colorado State University

Fort Collins, Colorado

Fall, 2000

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY TAHA KHALED AHMAD ENTITLED "THE EFFICIENCY OF THE BANKING SYSTEM IN JORDAN 1990-1996" BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

Committee on Graduate Work

Adviser

Department Head

ABSTRACT OF DISSERTATION

THE EFFICIENCY OF THE BANKING SYSTEM IN JORDAN

1990-1996

This study is an attempt to examine the efficiency of the banking system in Jordan during the period of 1990-1996. The study presents a comparative analysis of the frontier cost efficiency methodologies by applying econometric and mathematical programming techniques to a data set consisting of 20 banks over the period between 1990-1996. The study also analyzes the profit efficiency of the Jordanian banks during the same period of time by estimating a non-standard profit function. Furthermore, the study examines several possible sources of inefficiency in the Jordanian banks.

For the panel data obtained during the period 1990-1996 for the Jordanian banks, Cobb-Douglas stochastic frontier was found to be an adequate representations of the data, given the specifications of the translog stochastic frontiers for banks in Jordan.

The results indicated that the choice of efficiency estimation techniques makes a significant difference in terms of the cost efficiency scores. Efficiency scores obtained from the linear programming approach were found to be higher than the efficiency scores obtained from the econometric approach. The rankings were less well preserved between the econometric and the linear programming methodologies (rank correlation is 67.2%). Furthermore, the findings indicated that the average overall cost efficiency during the

period of 1990-1996, which was 77.5% or 73.5% based on the econometric frontier approach and the mathematical programming approach respectively, can be improved substantially by improving both the technical and allocative efficiencies, which were 76.6% and 96.1%, respectively.

Since the technical inefficiency dominates allocative inefficiency, cost inefficiency in the banking system in Jordan may, to a greater extent, be attributed to underutilization or wasting of inputs rather than choosing the incorrect input combinations. Technical inefficiency could be an indicator of the weak market forces induced by the market structure or the regulation that allows bank management to become remiss and continue their inefficient behavior. Foreign banks were found to be more efficient than national banks and small banking firms were more efficient than medium size and large banks. The scale inefficiency for large banks was found to be dominating the pure technical inefficiency, whereas, pure technical inefficiency was found to be dominating scale inefficiency for small and medium size banks.

Furthermore, the study found that the overall estimated alternative profit inefficiency averaged 0.674, large banks are more profit efficient than other categories of banks, as they averaged 0.767, followed by medium size banks and then by small banks.

The findings of the second stage regression indicated that banks with fewer employees per total assets, lower ratio of branch per total deposits, higher asset and higher salaries to total assets ratios were most cost efficient banks. The non-linear factors were found to be significant indicating the nonlinear effect of theses variable on the cost efficiency. The profit efficiency was found to be positively correlated with the age of the bank, size of the bank and the growth in bank total assets. However, the profit efficiency

was found to be negatively correlated with the ratios of branch to total deposits, number of employees to total assets, salaries to total assets and risks

The research recommends some reforms in present policy towards the banking system. These changes include adopting a policy of encouraging foreign direct investment in the banking sector and eliminating all barriers facing this investment if any exist. Also, the study recommends that closer attention be given to credit risk by both bank management and the Central Bank of Jordan. Moreover, the study recommends that any banking reform in Jordan be aimed at increasing competitiveness in the banking system and achieving any increase in the capital of banks by means other than merger and consolidation, because mergers in a highly concentrated banking system may lead to fewer banks, which in turn will generally lead to less competitive performance.

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1 CHAPTER 1: INTRODUCTION

1.1 Introduction

The importance of studying the efficiency of the banking system has increased tremendously in the last twenty years. It is important for bankers and policymakers to know whether and how the financial sector is becoming more efficient. As efficiency improves, financial services will improve, and as such, higher volumes of funds become available in the market. The higher level of funds will improve the financial positions of banks and contributes positively to the economic development of the country.

Banking markets of different countries are becoming increasingly integrated globally. The market for large syndicated loans, for large notes and bond underwriting, and other wholesale products have long been integrated. Even the retail banking markets are being internationalized. This makes the banking markets more increasingly competitive. Despite this fact, comparisons of banking productivity across countries are, to a large extent, missing in the literature, especially in developing countries.

Furthermore, the efficiency of commercial banks is important for at least two reasons. First, efficiency measures are indicators of success by which the performance of individual banks and the industry as a whole, can be gauged. Efficiency becomes an important factor for financial institutions to successfully maintain their business with increasing competition in the financial markets and rapid technological advances in

banking operations and services. In their study in 1992, Berger and Humphrey found that during the 1980s banks in the U.S. with higher total costs experienced higher rates of failure than banks with lower total costs due to increased efficiency. Similarly, in a study of bank failures during 1920s, Wheelock and Wilson (1995) found that the less technically efficient a bank was, the greater its likelihood of failure.

A second reason to analyze the efficiency of banks is the potential impact of the government policies on efficiency. One may look at the effect of the regulatory changes impact on the efficiency of the financial sector. Rhodes (1993) found that bank merger regulations have not positively affected efficiency. However, Fixler and Zieschang (1993) reached the opposite conclusion. Shaffer, (1993), on the other hand, evaluated the same issue and concluded that bank mergers could significantly improve efficiency in many banks with less than $10 billion of assets (Wheelock and Wilson, 1995.) So, efficiency is a critical aspect of banking, which enables us to distinguish between banks that will survive and prosper from those that will have problems serving their customers and remaining competitive.

1.2 Statement of the Problem

This study will analyze the efficiency and the cost structure of the banking system in Jordan. The importance of this exercise will be better appreciated in light of the following facts:

First, as in most developing countries, licensed banks overwhelmingly dominate the financial system in Jordan. Total assets of the licensed banks constitute 70% on average of the total assets of the financial system. Since the financial system in Jordan is

under financial reform, which entails an alteration of the economic environment in which banks must operate, the way the licensed banks adapt to the new environment becomes a crucial factor in maintaining the stability of the financial system. Analyzing bank costs is important, since instability and inefficiency in the banking sector can easily translate into serious negative impacts on the rest of the economy.

Second, the recent structural and regulatory changes that took effect as part of the Jordanian financial reforms provided an opportunity to examine the impact of these changes on the costs and efficiency of the Jordanian banking system. Since most of the changes took place at the end of 1996 and early 1997, this study, which covers the period between 1990 and 1996, will serve as the baseline scenario for future studies, and also will give indications of whether these changes are justified.

Third, numerous studies to assess the efficiency of the banking system have been undertaken in developed countries. Similar studies in developing countries are relatively rare. For example, in Jordan, this study, which is the subject of this thesis, is the first of its kind that analyzes inefficiency by applying different estimation techniques to the same data set.

Fourth, the issue of efficiency takes on an added significance in the context of the Jordanian banks as they face increasing competition from new institutions, which offer limited financial services as well as from foreign institutions in the West Bank and the Gaza Strip, where Jordanian banks also have been operating alongside the Palestinian and Israeli banks after the peace process.

Fifth, although it is very important to study the relationship between costs and output in the Jordanian banking system, studying the efficiency of this banking sector can

provide some policy implications, for issues such as mergers and increasing or decreasing the number of branches.

1.3 Hypothesis

The major objective of this dissertation is to investigate the incidence and the magnitude of the efficiency of the Jordanian banking system. Towards that goal, attention will be focused on the following questions:

1) Can banking production in Jordan be characterized adequately by the Cobb-Douglas specification? To avoid the specification error related to the functional form, a LaGrange Multiplier (LM) test will be conducted. The purpose of the test is to determine whether the functional form of the cost function is of Cobb-Douglas technology or of translog functional form.
2) Does the Jordanian banking system, taken as a whole, show any evidence of inefficiency? A t test will be conducted to test the null hypothesis that the banking system in Jordan is completely efficient against the alternative hypothesis that the average efficiency of the banking system is less than 100%.
3) Do all bank groups exhibit the same degree of overall, technical, and allocative efficiencies? In this regard, the banks will be grouped into different groups and the different efficiency concepts will be compared.
4) Or do the differences in bank sizes; bank ownership (foreign vs. local,) or estimation methodologies (parametric vs. non-parametric), profit efficiency

and cost efficiency methodologies have an impact on the efficiency of the banks?

5) Did estimates of efficiency improve during the 1990-1996 time span? A number of changes took place during that period, such as:

   a. Relaxing the constraints on the interest rates and eventually, adopting a floating interest rate system, where interest rates are determined by the market forces.

   b. A set of measures was introduced to promote a liquid interbank market by removing the need to hold reserves against interbank deposits.

   c. The abolition of direct credit controls on banks.

   d. The need to ensure appropriate supervisory and prudential monitoring of the banking system in place.

1.4 The Purpose of the Research

In investigating and measuring the efficiency of the banking system in Jordan, this study will try to accomplish the following:

1) Estimate and evaluate the cost structure of the banking sector in Jordan by estimating cost frontier function for the period 1990-1996. To avoid the specification error, a LaGrange Multiplier test will be conducted to choose between the Cobb-Douglas and translog functional forms.

2) Evaluate the performance of the banking system in Jordan by applying a parametric and non-parametric frontier approaches. The overall cost and profit efficiency will be calculated for the Jordanian banks during the period

1990-1996. A statistical test will be conducted to test whether the banking system in Jordan is perfectly efficient or not.

3) Compare the average efficiency levels between large banks and small banks, between foreign banks and national banks, and between different approaches used in the analysis.

4) Decompose the overall cost efficiency obtained from the noparametric approach into allocative efficiency and technical efficiency. The technical efficiency also will be decomposed into pure technical efficiency and scale efficiency to check whether the scale efficiency dominates the pure technical efficiency for the Jordanian banks.

5) Analyzing the sources of the cost efficiency by estimating a second stage regression between the efficiency index which will be calculated in this study and a set of economic, structural and financial variables. A Spearman correlation coefficient between the profit efficiency and the set of variables mentioned earlier will be calculated to analyze the profit inefficiency sources.

1.5 Outline of the Study

The dissertation is organized in the following manner:

Chapter 1: This chapter gives a brief introduction, explains, and justifies the proposed study. It gives a brief summary of the statement

of the problem, the hypothesis and the purpose of the research.

Chapter 2: This chapter is a literature review and gives the proposed study its relevance by including a summary of existing literature on the efficiency of banking systems using stochastic frontier cost function, data envelopment analysis, and nonstandard profit function, as well as summarizing the previous efficiency studies about the financial system in Jordan. This chapter will also discuss the research methodologies used in this study, the specification of bank cost, output and input.

Chapter 3: This chapter introduces the banking system in Jordan, the historical background, the structure and development of this sector.

Chapter 4: This chapter measures the efficiency of the banking system in Jordan by estimating a stochastic cost and nonstandard profit frontier functions, as well as using Data Envelopment Analysis (DEA) (from the non-parametric approach) on the same set of data. Variables, assumptions used and the empirical findings will be reported. The cost efficiency estimates from the parametric and the nonparametric approaches will be analyzed

and compared. An analysis of the sources of the cost efficiency will be made by estimating a second stage regression, in which the relationship between the efficiency index which will be calculated in this study and a set of economic structural and financial variables will be explored. The sources of the profit inefficiency will be looked at by calculating the spearman correlation coefficient between the profit efficiency and the same set of factors mentioned earlier.

Chapter 5: This chapter is the summary and conclusion, which summarizes the key findings of the research and proposes further future research.

2 *CHAPTER TWO: REVIEW OF THE LITERATURE AND RESEARCH METHODOLOGY*

2.1 Review of the Literature

In the past two decades ample research has been conducted to study the efficiency of the financial sector. The literature in existence is both large and recent. Of this literature, 116 studies out of 130, reviewed by Berger and Humphrey (1997,) were written and published during the last five years. A good representation of this literature can be found in studies conducted by Sherman and Gold (1985), Parkan(1987), Rangan, Grabowski and Pasurka (1988), Farrier and Lovell(1990), Aly, Grabowski and Rangan (1990), and Berger and Humphrey(1991, 1996 and 1997).

Frontier[1] efficiency has been used extensively in measuring the inefficiency of the financial institution. A good summary of the literature on frontier production and cost function and their relationship to the problem of efficiency measurement can be found in Schmidt(1985/86). Five main frontier approaches have been used in these studies. These methods are grouped into two categories, the non-parametric linear programming approaches and the parametric approaches. The non-parametric approach is composed of the Data Envelopment Analysis (DEA) and the Free Disposal Hull (FDH). The parametric approach is composed of the Stochastic Frontier Approach (SFA), the Thick

Frontier Approach (TFA), and the Distribution Free Approach (DFA)[2]. These methods differ mainly in the assumptions made about the functional form, whether or not random errors have been accounted for and the probability distribution assumed for inefficiency if the random error is accounted for (e.g. half normal, truncated normal or exponential.) There is no consensus among researchers on the best method for measuring efficiency. These methods differ mainly in the assumption made regarding the error term and the shape of the efficient frontier. Looking at the empirical studies, one can notice that these approaches yield different efficiency measures when used for the same data set.

After surveying the work of 130 studies that apply efficiency analysis to depository financial institutions and insurance companies, Berger and Humphrey (1997) concluded that the efficiency estimates from non-parametric approach (DEA and FDH (69 studies)) studies are similar to those from parametric approach models (SFA, TFA and DFA (60 studies)). However, as can be easily seen from the results of these studies, the estimates of the non-parametric approach generally give lower mean efficiency estimates and seem to have greater dispersion than the results of the parametric approach. The mean and median efficiencies for the non-parametric approach are 0.72 and 0.74 respectively, compared with 0.84 and 0.85 for the parametric approach. This is because both approaches differ in their assumption about the error terms. Authors using the parametric approach to banking usually find the average inefficiency to be 20-25% of costs, while authors using non-parametric approach find results ranging from less than 10% to over 50%. The non-parametric approach assumes no random error, so any

[1] The frontier represents the standard against which efficiency is measured. Cost frontier is the lowest possible level of expenses at which a bank can still produce its chosen output. In order to say that bank (A) is producing 90% of its potential output, given it's input usage, the maximal output or the minimal cost needs to be known.
[2] For more details on these methods refer to Lovell (1993), Green (1993), Ali and Seiford(1993)and Berger and Humphrey(1997).

deviation from the frontier is due to the inefficiency, while the parametric approach assumes that the error term can be decomposed of two components; one represents the inefficiency and the other one represents the random error.

Simon H. Kwan and Robert A. Eisenbeis (1994) estimated a stochastic cost efficient frontier following the works of Aigner, Lovell and Schmidt (1977), which is based on a multi product trans-log cost function. Semi-annual data for a sample of 254 bank holding companies from 1986-1991 are grouped into size-based quartiles to allow for different production technologies and separate cost functions are estimated for each quartile. Then controllable firm-specific cost efficiency estimates are derived following the method explained by Jondrow, Lovell, Materov and Schmidt (1982)

They found that cost inefficiencies in banking are quite large. They also found that cost inefficiencies and their cross-sectional variation are, on average, smaller for large banking firms than for smaller firms, and inefficient bank firms tend to stay inefficient. The authors found that there is a strong association between cost inefficiency and bank risk taking, regardless of the bank size. In their estimates they assumed that the error term consisted of two components; the random error ε_n which is distributed $N(0,\sigma_n^2)$ and Ω_n is independently distributed half normal $N(0,\sigma_n^2)$ which is truncated from below at zero.

Operating costs are considered as the dependent variable. Book value of investment securities, book value of real estate loans, book value of consumer loans, off-balance sheet commitments and contingencies and book value of commercial and industrial loans are taken as output. Three input prices are utilized. These are: the unit price of capital, measured as total occupancy expenses divided by fixed plant and equipment; the unit cost

of funds, defined as total interest expenses divided by total deposits, borrowed funds and subordinated notes and debentures; and the unit price of labor, defined as total wages and salaries divided by the number of full time equivalent employees. Linear homogeneity is imposed by normalizing total cost and input prices by the price of labor.

Humphrey (1991) and Berger (1993) used deviation from a thick frontier to measure efficiency in banking. They divided the sample into size classes and then they estimated cost curves for the highest and the lowest quartiles. They assumed that cost differences among firms in the lowest quartile are due to random errors, while differences between quartiles for a given size firm are due to inefficiencies. Despite the ad-hoc nature of their size grouping and the selection of cost quartiles they found that inefficiencies are quite significant in banking.

Simon Kwan (1997) provided an overview of the findings of the research on the efficiency of U.S. banking firms. On the scale efficiency, which refers to relationship between the firm's per unit average production cost and their production volume, prior research on scale efficiency in banking found that the average cost curve was a relatively flat U-shaped curve (see the survey by Humphrey 1990, p 48). However, the location of the optimal scale remains unclear. The structure of the banking system in the U.S. makes it difficult to estimate the average cost curve precisely. Studies that excluded large banks reported that the average cost was minimized at about $ 100-$ 300 million in total assets, whereas research on large banks found that their optimal cost was minimized at about $ 2 and $10 billion in total assets. Many studies included only banks with assets less than $1 billion, banks of all sizes, or banks of over $ 100 million in assets. The common conclusion was that the average cost to be minimized at assets between $ 75 million and

$ 300 million (A.N. Berger et al. (1987), Farrier and Lovell(1990), Berger and Humphrey (1991), Bauer et al. (1992)).

Hunter and Timme (1986,1991), Noulas et al. (1990), Hunter et al. (1990) used banks with assets over $1 billion. They found that the average minimum cost was minimized at assets between $ 2 billion and $ 10 billion. A.N. Berger et al. (1990) concluded that the functional form used in these studies may not be capable of incorporating the technologies of both small and large banks in a single model, or some important factors that vary with bank size are excluded from the model.

A similar conclusion was reached by McAllister and McManus(1993.) They suggested that the commonly used trans-log cost function gave a poor approximation when applied to banks of all sizes. To fix that, they suggested using one of the several nonparametric estimation procedures. Also, they add a missing factor, risk, to the calculations of scale efficiency. In their empirical work they found substantial scale inefficiencies for small banks. Full scale efficiency was reached with $500 million in assets, and nearly constant average costs thereafter up to $ 10 billion in assets, which was the upper limit of their study.

A new shift in the research is investigating the X-efficiency rather than the scale efficiency. That is instead of looking at whether the bank has the right size (scale efficiency), researchers are looking at whether the bank is producing as efficiently as possible, given the bank size (X-efficiency). The X-efficiency is defined as the deviation from the cost efficient frontier that depicts the lowest production cost for a given level of output.

Studies in this regard found that X-efficiency varied across banks and the deviation from the minimum cost was found to range from 20 to 25 % of total cost and the X-efficiency seemed to dominate the effect of scale inefficiency.

Studies reviewed by Simon Kwan (1997) attributed the causes of X-inefficiency in banks to three factors:

1) The size of the bank; on average, operating costs of larger banks are found to be closer to their minimum cost curve than those of smaller banks.
2) Risk taking; inefficient banks are found to take higher risks. Maybe this is attributable to managers of inefficient banks making loans with higher yields and higher risks to compensate for their operating inefficiency.
3) Financial conditions; banks with more problem loans tend to be less efficient than those with less problem loans.

He concluded that it is better to achieve efficiency gains by doing things right rather than by searching for the right scale.

The major economic problem lies in distinguishing X-inefficiency from random error. Four different approaches are used in evaluating bank data. The difference among these approaches is in the assumptions made regarding the probability distributions of the random error term and the X-inefficiency differences.

DeYoung, (1994) using thick frontier approach estimated the X-Efficiency for 11,060 FDIC-insured commercial banks in 1992, the analysis performed suggested that banks that produce relatively large amounts of fee-based products and services have been more cost efficient than their peers over the past decade. DeYoung, Hassan, and Kirchhoff (1997) used a Fourier flexible functional form to examine the out of state entry

and the cost efficiency of local commercial banks. According to their study the cost inefficiency ranged between 0.0282 and 0.9527 with a mean of 0.3380. The authors used the econometric frontier approach to generate annual estimates of cost efficiency for each bank in each year.

Allen Berger, Diana Hancock and David Humphrey (1993) derived efficiency estimates for the U.S. banking using the profit function instead of the cost function. They derived input and output inefficiencies from the profit function and decomposed it into technical and allocative efficiency.

The advantage of the profit function is that it allows for the measurement of inefficiencies on the output side as well as the input side of the firm. The standard cost function neglects the output inefficiencies, while using revenue treats input as given and neglects input inefficiencies. Berger, Hancock and Humphrey et. al. (1993) specified the Fuss functional form for the profit function, which has the advantage over the trans-log form of easily allowing for negative profits and zero values for the fixed netput, but still imposing linear price homogeneity. Data used in their study consisted of annual observations from 1984 to 1989 of banks in three different regulatory environments. The variable outputs used were business loans (commercial, industrial and real estate loans) and consumer loans (installment loans.) The two variable inputs were labor (number of employees) and purchased funds (deposits > $100, 000) and other non-deposit funds. The fixed netput was core deposits (deposits < $ 100,000) and physical capital. They concluded that the inefficiency in the U.S. banks was quite large. The industry appeared to lose about half of its potential variable profits to inefficiency and technical inefficiency dominated allocative efficiency. More than half of all inefficiencies were in the form of

deficient revenues rather than excessive costs. Another result of their study was that larger banks were more efficient than the smaller banks. As for testing their new concept of optimal scope economies, they found that joint production was optimal for most banks, but that specialization was optimal for others.

Berger and Mester (1997) examined the sources of the differences in measured efficiency. They investigated several possible sources including differences in efficiency concepts, measured methods, and a number of bank, market, and regulatory characteristics. The authors examined three economic efficiency concepts: cost, standard, and alternative profit efficiency. They concluded that the measures of profit efficiency are not positively correlated with cost efficiency. Their results suggest that future researchers might consider measuring all three concepts to be sure that any conclusions about which firms are most efficient or which potential correlates succeed in explaining efficiency are robust with respect to all three economic efficiency concepts.

DeYoung and Hassan (1998) used a Fourier flexible nonstandard profit function to examine the profit efficiency of US banks chartered between 1980 and 1994. Their results suggested that profit efficiency improved rapidly at a typical de novo bank during its first three years of operation, but on average takes about nine years to reach established bank levels. Low nonstandard profit efficiency was associated with excess branch capacity, reliance on large deposits and affiliation with a multi-bank holding company. According to their study, overall estimated profit efficiency averaged 0.5113.

Berger et al (1995), DeYoung and Nolle (1996) and Akhavein et al (1997) each found profit inefficiency that ,if eliminated, would at least double return on assets at the average bank Humphrey and Pully (1997) found it equal 15-20% of return on assets.

Berg, Hjalmarsson and Suominen(1993) applied the DEA approach to analyze the productivity of the banking industry in three Nordic countries. Output was represented by a vector of three variables: total loans to other than financial institutions, total deposits from other than financial institutions and the number of branches. Two inputs were used: labor measured in man-hours per year and capital defined as book values of machinery and equipment.

The authors concluded that the large banks from each country were most likely to start operating outside their national market and their relative efficiency was a question of particular interest. They found that the largest Swedish banks were among the most efficient units in the Nordic pooled sample. Decreasing return to scale along the frontier was found in the data.

Humphrey (1990) listed seven reasons why estimates of bank scale economies and efficiency differed. He concluded that the believable scale economy estimates should have been based on models using total costs rather than operating costs. The study also concluded that a quadratic functional form, such as the trans-log that permits a U-shaped cost curve to be estimated if it exists in the data, was always favored over a linear function, such as the Cobb-Douglas. He also concluded from his reviews of bank scale economies that the average cost curve reflected a relatively flat U-shape with significant diseconomies associated with the largest banks. He inferred from these results some practical conclusions. Those were:

1) There would seem to be little benefit of a cost reducing nature from an increase in the size of the bank alone, although there would be a benefit from loan diversification.

2) The measured scale or cost economies are small in comparison to the existing differences in cost levels between similarly sized banks.

Farrier and Lovell (1990) used an econometric approach to estimate a cost frontier and a series of linear programming to calculate a production frontier. They concluded that modest scale economies conferred a potential cost advantage to large banks. Cost inefficiencies in banks were roughly 20-30% for all but the smallest size classes, and hence, the effects of scale economies were sustained as bank size increased. The allocative component of cost inefficiency was due to over utilization of labor and under utilization of capital.

Berger and Humphrey (1990) applied a TFA using 1980 data for all insured commercial banks in the US. They concluded that inefficiencies were mostly operational caused by overuse of labor and physical capital.

Akhavein, Swamy and Taubman (1994) developed a new method of estimating the inefficiencies of firms. The method, which made a consistent set of general assumptions, was applied in the analysis of annual data for the period of 1984-1989 for US commercial banks. The results of the paper showed that the residual, which the previous studies attributed to technical inefficiencies, included: the effects of excluded variables, inaccuracies in the specified functional forms and using inconsistent parameter estimates. They also showed that once these effects were subtracted from the residual, the measured inefficiencies were substantially reduced.

As for the previous studies of efficiency of the financial system in Jordan, a team of experts from the International Monetary Fund (1996) studied the banking competition in Jordan during the period of 1990-1994(June.) In their unpublished study, they

estimated the trans-log cost function using the Distribution Free Approach, and they also estimated a profit function using the Fuss functional form. They concluded that investment and small commercial banks in Jordan were not as cost efficient as other banks, and that the large banks seemed to display a cost advantage when deposits counted as an output rather than an input.

By estimating the profit function, the model suggested that banks were very similar in terms of the character of their inefficiencies and that the major source of inefficiencies was allocative resulting from their failure to make enough loans. The degree of inefficiency in Jordanian banks was not out of the line with the degree of inefficiency found in U.S. banks.

The above discussion points out clearly that the existing literature is both large and recent, and also shows that there is no consensus among economist on the best methods to use to for measuring the efficiency of the banking system. Furthermore, the empirical studies have been limited to some extent to the developed countries, because out of the 130 studies surveyed by Berger and Humphrey (1997), only 6 studies were on developing countries.

The primary focus of the study conducted for this dissertation is empirical. Specifically, it will apply the stochastic frontier approach, by estimating the cost function and the nonstandard profit function, as well as using the Data Envelopment Analysis with the purpose of adding to the limited information available about the Jordanian banking efficiency. In the following section the methodology used in this dissertation will be discussed.

2.2 Research Methodology

There are three likely questions of importance and interest to bankers and policy makers. These questions are:

1) Are financial institutions efficient?

2) If so, then what structure would allow financial institution to be efficient?

3) If not, then what can be done to improve the efficiency of these institutions?

To answer these questions it is important to evaluate the incidence and the magnitude of economic efficiencies as well as the level of technical and allocative efficiencies. If banks are inefficient, then one can look at policies in place and regulations that aim to increase the level of efficiency in the system. This section, thus, introduces the analytical approach adopted by this study to investigate the following questions in the context of the Jordanian Financial System:

1) How can the production technology of Jordanian banks be characterized?

2) How can we measure the incidence and the magnitude of economic efficiency?

3) Are there factors affecting this level of efficiency?

4) Are these measures similar across different size groups of banks, different bank ownership and different estimation approaches?

5) How did these measures evolve over the time period 1990-1996?

In the light of the above issues, various criteria can be used to evaluate the different types of the financial institutions. My focus, for the most part, will be confined to evaluate the efficiency factor.

As mentioned earlier, two basic frontier approaches have been employed by the various studies surveyed to measure the efficiency of the financial institutions. Those were the parametric approach and the non-parametric approach. Within those two approaches, researchers used the production, cost or the profit functions. Given the objectives of this dissertation, the cost function framework was chosen as the operational tool for the analysis for the following arguments:

1) Banks are assumed to be cost minimizing decision units. This assumption is not as strong as that of profit maximization, which would be required for the profit function analysis.
2) Data, which is a major obstacle especially in developing countries, required for cost function (input prices and quantities of output) are most likely to be observed. Also, factor prices are likely to be exogenously determined, which makes the estimation of the cost function relatively easier and more feasible.
3) The definition of output prices in the banking industry, which are required for the estimation of the profit function, are not easy to observe.
4) The profit function requires that banks be price takers in both the input and the output markets, which is not the case in the Jordanian banking system, since certain banks have market power. That is if banks are not price takers in both the input and the output markets, then it becomes very difficult to derive any meaning from the estimates obtained. Before proceeding further, it is important to define efficiency in more details.

2.3 Definition of Efficiency

Farrell (1957, PP 254-255) developed a measure for overall cost inefficiency and then decomposed it into technical and allocative inefficiencies. He explained his ideas using a simple example involving firms which use two inputs *(x1, x2)* to produce a single output *(y)* and assuming constant returns to scale[3].

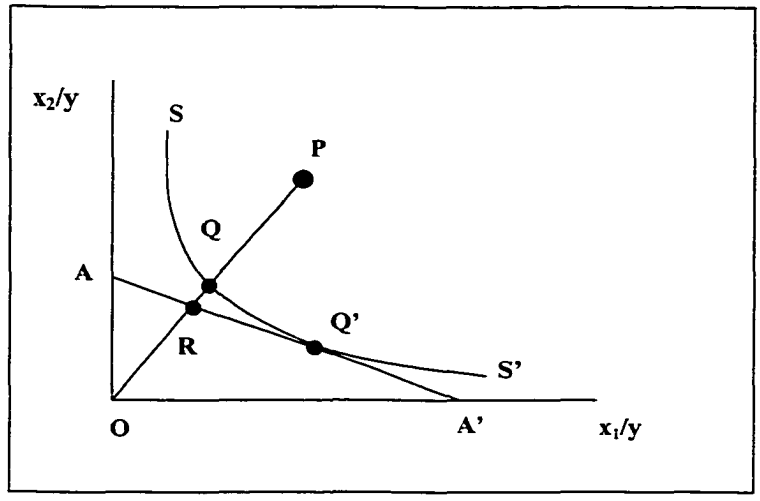

Figure 2.1: Technical and Allocative Efficiencies

The **SS'** curve in Figure (2.1) represents the unit isoquant of the fully efficient firm. If a given firm uses quantities of inputs, defined by the Point **P,** to produce a unit of output. Technical inefficiency for that firm could be represented by the distance **QP/OP**. This means that inputs could be proportionally reduced by the ratio **QP/OP** without a reduction in output. The technical efficiency (***TE***) of a firm is:

$$TE = 1 - QP/OP = (OP-QP)/OP = OQ/OP$$

If input prices are known and represented by the price line **AA**, then allocative efficiency (***AE***) could be calculated as:

$$AE = OR/OQ$$

If production took place at **Q'** instead of point **Q**, then cost could be reduced by the distance **RQ**. The overall efficiency or the cost efficiency (***EE***) is defined as

$$EE = OR/OP = TE * AE = OQ/OP * OR/OQ$$

The above discussions on the efficiency measures[4] addresses the question: By how much can input quantities be proportionally reduced without changing the output quantities produced (input orientated measure.) We can ask the question by how much can output quantities be increased without changing the input quantities. This is the output-orientated measure as opposed to the input-orientated measure. The constant return to scale is shown in the following figure where production involves two outputs y_1 and y_2 and a single input x_1.

where:

ZZ': is the unit production possibility curve in two dimensions

DD': is the isorevenue line

Point **A** corresponds to an inefficient firm

Accordingly to Farrell, output orientated technical efficiency (**TEo**) is the ratio:

$$TEo = OA/OB,$$

that is the amount by which outputs could be increased without increasing inputs.

Allocative efficiency is the ratio

$$AEo = OB/OC$$

And overall economic efficiency is

$$EEo = (OA/OB) * (OB/OC) = OA/OC$$

---

[3] This assumption allows for representing the technology using a unit isoquant.
[4] For more details on these measures refer to Coelli (1996)

These measures assume that the production function or the cost function of the fully efficient firm are known. In reality, this is not the case and efficient isoquant or isocost must be estimated from the sample. As mentioned earlier, researchers in this area suggested either:

1) Parametric approach or
2) A non-parametric approach, this study will use both approaches. The following section is a brief introduction of the chosen methodology.

2.4 Econometric Approach

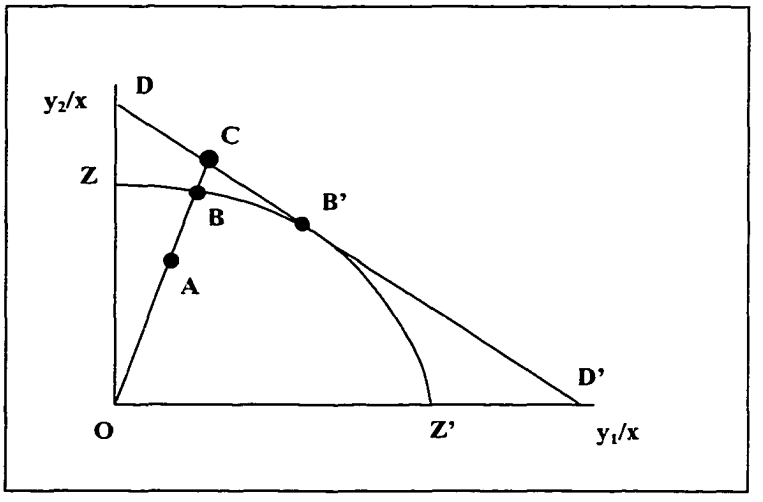

Figure 2.2: Technical and Allocative Efficiencies from an Output Orientation

As mentioned earlier, the primary advantage of this approach is its ability to accommodates random errors in the efficiency estimation. Within this approach, the statistical frontier approach is chosen. According to the SFA, the deviations of a firm's actual cost from predicted costs are assumed to be due to random errors and inefficiency, each of which is assumed to have a particular statistical distribution. This approach

specifies a functional form for the cost, profit, revenue, and production relationships to input, output and environmental factors. The error term in this model can be represented as a composite error, where one term includes the statistical noise and the other contains the inefficiency. Thus

$$E_i = V_i + U_i$$

where E_i is the total error of the regression analysis and the V_i is a typical two sided error term describing the usual uncertainty associated with regression analysis. It is assumed to follow a symmetric distribution (usually standard normal.) U_i is considered to be a one-sided random variable. It is assumed to follow an asymmetric distribution (usually the half-normal.) A financial institution is considered to be 100 percent efficient, if its value of U_i is zero. Both the inefficiency and the random error term are assumed to be orthogonal to the input, output or environmental variables specified in the estimating equation.

The first step in any parametric empirical application is to select an appropriate functional form for the cost function. Given the limited number of observations and to avoid the specification error related to the functional form, a LaGrange Multiplier (LM) test will be conducted. The purpose of the test is to determine whether the functional form of the cost function is of Cobb-Douglas technology or of translog functional form. Cobb-Douglas is easy to estimate and mathematically manipulate.

The trans-log functional form is not as restrictive as the Cobb-Douglas, but it is more difficult to mathematically manipulate and can suffer from degrees of freedom and multicolinearity problems.

It is assumed that a bank uses inputs $x=(x_1, x_2 \ldots x_n) \in R_+^N$, which are available at fixed prices $w=(w_1, w_2 \ldots w_n) \in R_+^N$, to produce output $y=(y_1, y_2 \ldots y_m) \in R_+^M$ in an environment characterized by variables $z=(z_1, z_2 \ldots z_k) \in R_+^K$. The bank is assumed to produce y given z at a minimum cost. If the minimum total cost function is $c(y,w,z)$, then a bank's observed total cost in logarithmic form may be written as:

$$\ln(TC_{it}) = \ln[c(y_{it}, w_{it}, \beta)] + u_{it} + v_{it} \qquad (1)$$

where:

$ln(TC_{it})$: is the total cost for $bank_i$ at time t

y_{it} : is the output levels produced by $bank_i$ at time t

w_{it} : is the input prices for $bank_i$ at time t

u_{it} : is an efficiency factor

v_{it} : is the random error term

β : is the vector of coefficients that need to be estimated

The general procedure for estimating efficiency using equation (1) is to estimate β and the composite error term $\varepsilon_{it} = u_{it} + v_{it}$ and then to calculate the efficiency for each observation in the sample as the conditional expectation[5] $E(\exp(-u_{it}/\varepsilon_{it}))$, providing an estimate of the ratio of frontier costs to actual costs.

Since we are imposing a distributional assumption on the error terms, this approach involves finding the density function $h(\varepsilon_{it})$ of the joint error term ε_{it} and the joint density function $f(u_{it}, \varepsilon_{it})$ and then obtaining an expression for the conditional mean of $\exp(-u_{it})$ based on the distribution of $f(u_{it}, \varepsilon_{it})$.

[5] See Green (1993)

v_{it} is assumed to be normally distributed. It is also assumed u_{it} has an exponential, truncated normal or half normal distribution. Linear homogeneity is imposed by normalizing total cost and input prices by the price of capital. In this study, we estimate equation (1) using maximum likelihood estimation (MLE).[6]

The nonstandard profit frontier has been formulated and estimated by Pulley and Braunstein (1992) , Berger, Cummins, and Weiss (1996), Berger and Mester (1997), Hassan and Hunter (1996), Humphrey and Pulley (1997), and Lozano Vivas (1997), DeYoung and Hassan (1998). Each used a single- equation model, although, a variety of functional forms have been specified and different estimation techniques have been employed (Kumbhakar and Lovell, 2000).

The function uses the same independent variables used in the estimation of the cost function. The standard neoclassical profit function assumes that prices are exogenous and that producers seek to maximize profit by choosing the quantity of outputs and inputs under their control (Kumbhakar, and Lovell, 2000). The exogeneity of prices is justified by the assumption that producers operate in competitive markets.

The nonstandard profit function may provide useful information on how well the bank was in using the input to produce output relative to the best-practice firm if one of the following conditions holds[7]:

1) There are a substantial unmeasured differences in the quality of banking services;
2) Outputs are not completely variable, so that a bank cannot achieve economies of scale and scope.
3) Banks have some market power over the prices they charge; and

[6] The likelihood function for equation (1) can be found n Green (1995)

4) Output prices are not accurately measured, so that they do no provide accurate guides to opportunities to earn revenues and profits in the standard profit function. The alternative profit function in log form can be written as[8]:

$$\ln(\Pi_{it} + \theta_2) = \alpha + \beta_1 \ln(W_1) + \beta_2 \ln(W_2) + \beta_3 \ln(Y_1) + \beta_4 \ln(Y_2) + \beta_5 \ln Branch + \ln u + \ln \varepsilon \qquad 4.3$$

Where:

Π_{it} = The profits before tax for the Jordanian banks.

W_{it} = A vector of input prices.

Y_{it} = A vector of output quantities.

Branches = The number of branches.

U = The error term due to the profit inefficiency.

ϵ = The random error term.

θ = A constant added to every bank's profit so that the natural log is taken of a positive number.

The alternative profit efficiency was defined as the ratio of predicted actual profits to the predicted maximum profits for the best practice bank.[9]

$$Alt\,\Pi\,EFF^b = \frac{\Pi\hat{}^b}{\Pi\hat{}^{\max}} = \frac{\left\{\exp\left[f\hat{}\left(w^b, y^{b\cdot}, z^b\right)\right] \times \exp\left[\ln u\hat{}^b{}_{a\Pi}\right]\right\} - \theta}{\left\{\exp\left[f\hat{}\left(w^b, y^{b\cdot}, z^b\right)\right] \times \exp\left[\ln u\hat{}^{\max}{}_{a\Pi}\right]\right\} - \theta} \qquad (4.4)$$

Where $\Pi\hat{}^{\max}$ is the maximum value of $\Pi\hat{}^b$ in the sample (Berger A. and L. Mester (1997)).

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[7] A good discussion on the justification of the use of the Nonstandard profit function can be found in Berger and Mester (1997).

[8] The estimated function was not restricted to be homogeneous of degree one in prices, because the function does not contain output prices.

2.5 Mathematical Programming Approach

As stated earlier, the study will also use the Data Envelopment Analysis (DEA). The notation and behavioral assumptions are unchanged from the parametric approach described in the previous section. However, the analytical strategy is changed. Rather than using econometric techniques to estimate a stochastic parametric cost frontier beneath the cost-output observations, we now solve a linear programming problem to fit a non-stochastic non-parametric production frontier above the input-output observations This approach is a linear programming technique, where the set of best-practice or frontier observations are those for which no other decision making unit or linear combination of units has as much or more of every output (given input) or as little or less of every input (given output.)

The approach was first used by Charnes, Cooper and Rhodes (1978). They proposed a model which had an input orientation and assumed constant return to scale (CRTS.) Subsequently, a paper by Banker, Charnes and Cooper (1984) proposed variable return to scale model (VRTS), and subsequently modified by Byrnes, Fare and Grosskopf (1984) and Thiry and Tulkens (1988.)

DEA can be used to estimate technical and scale efficiency without requiring input and output prices. Therefore, this approach has been used extensively in the regulated sectors (e.g., Banker, Conrad, and Strouss, 1986,) and the non-profit sector

[9] A. Berger and L. Mester (1997).

(e.g., Lewin, Morey, and Cook, 1982.) If input prices are available, cost efficiency also can be measured using DEA (e.g., Aly, et. al. 1990) and Ferrier and Lovell, 1990.)

The calculated production frontier shows the relationship between efficient cost and output and provides information on technical efficiency as well. Allocative efficiency is calculated using a second linear programming problem.

This study applies two of the three conventional DEA models, i.e. the constant (CRS), and the variable (VRS) models to estimate cost efficiency. The mathematical programming approach (MP) estimates the cost efficiency of a firm using a two-step procedure. For $\boldsymbol{Bank_i}$, denote $w_i=(w_{1i}\ ,\ w_{2i}\ \ldots\ w_{si}\ )^T$ as the input price vector corresponding to the input vector $x_i=(x_{1i}\ ,\ x_{2i}\ldots\ x_{si})^T$ where:

$\boldsymbol{T}$: denotes the vector transpose

$\boldsymbol{S}$: is the number of inputs

then we first solve the following Linear programming problem:

$$\min_{Xi} \quad \sum_{s=1}^{S} W_{si} X_{si} \qquad (2)$$

Subject to

$$X_{si} \geq \sum_{j} \lambda_j X_{sj}. \qquad S = 1, 2, \ldots S$$

$$Y_{mi} \leq \sum_{j} \lambda_j Y_{mj}. \qquad M = 1, 2, \ldots M$$

$$\lambda_j \geq 0, \qquad J = 1, 2, \ldots N$$

Where,

$\boldsymbol{N}$: is the number of firms

$\boldsymbol{M}$: is the number of output

$\boldsymbol{Y_{mi}}$: is the $\boldsymbol{m^{th}}$ output volume for $firm_i$ and,

λi : is the intensity coefficient of $firm_j$ with respect to $firm_i$. The solution vector X_i^* is the cost minimizing input vector for the input price vector w_i and the output vector Y_i.

The objective of this linear programming problem is to minimize total cost of banks subject to the feasibility or the production possibilities constraints. These constraints indicate that Bank i cannot produce more output than the best firms in the industry (including itself) by using less of the inputs than used by the best banks.

After obtaining the solution vector X_i^*, cost efficiency of $bank_i$ can be measured by calculating the ratio $\eta_i^* = w_i^T x_i^* / w_i^T x_i$. A returns to scale assumptions can be imposed or the convexity assumption relaxed by using one of the following additional constraints

No further restrictions on λi (CRS).....(3)

$\Sigma \lambda i = 1$ (VRS).....(4)

The problems are solved under each set of alternative constraints for each firm in the sample $i = 1,2, \ldots N$ and for each time period. One of the benefits of this approach is to easily decompose the measure for cost efficiency into its technical and allocative components. To calculate the measure of technical efficiency for $firm_i$, four additional programming models are solved for each firm.

$$Min_{\theta,\lambda}\ \theta \qquad (5)$$

Subject to

$$\theta_i X_i \geq \sum_i \lambda_i X_{mi}, \qquad n = 1,2,\ldots S$$
$$Y_{mi} \leq \sum_i \lambda_i Y_{mi}, \qquad m = 1,2,\ldots M$$
$$\lambda_i \geq 0 \qquad j = 1,2,\ldots N$$

Where S is the number of inputs, with the additional constraints (3) and (4) above. With the cost efficiency measure η_i^* from (2) above and the technical efficiency measure θ_i, from (5), the allocative efficiency measure of each $bank_i$ can be obtained by η_i^* / θ_i. The DEA problem in equation (5) has a nice intuitive interpretation. essentially, the problem takes the i_{th} firm and then seeks to radially contract the input vector, X_i, as much as possible, while still remaining within the feasible input set. The inner-boundary of this set is a piece-wise linear isoquant determined by the observed data points (i.e. all the banks in the sample). The radial contraction of the input vector Xi produces a projected point ($\lambda_i X_{mi}, \lambda_i Y_{mi}$) on the surface of this technology. This projected point is a linear combination of these observed data points. The constraints in equation (5) ensure that this projected point cannot lie outside the feasible set.

Moreover, as discussed below, the comparisons of the two measures for technical efficiency (solutions to CRT & VRS) reveals the potential scale economies for each firm (Coelli, 1996). By conducting both a CRS and a VRS DEA upon the same data, one can decompose the ***TE*** scores from CRS DEA into two components: one due to scale inefficiency and one due to pure technical inefficiency. If the ***TE*** scores from CRS are different from the ***TE*** score form VRS, then this indicates that the bank has scale inefficiency, and that the scale inefficiency can be calculated from the difference between the VRS ***TE*** scores and the CRS ***TE*** scores.

$$TE_{i,CRS} = TE_{i,VRS} * SE_i$$

To determine whether the bank is operating in an area of increasing or decreasing returns to scale, an additional DEA problem with non-increasing return to scale (NIRS) is imposed. This can be done by changing the VRS constraint to

$\Sigma\lambda i \leq 1$ (NIRS)

If the TE_{NIRS} score is equal to the TE_{VRS} score, then decreasing return to scale applies; and if they are not equal, then increasing return to scale exists for that bank.

2.6 Specification of Bank Cost, Output and Input

This section discusses the proxies that are used to measure the variables for the model to be estimated. As the variables comprise bank output and input, they have to be properly identified. Proxies for bank cost, output and input prices will be discussed.

Total Cost (TC): The study will use total cost rather than operating cost, because operating costs only comprise 25% of the total costs on average. Total cost is defined as interest expenses plus operating costs. Humphrey (1990) concluded that the proper measure is total cost rather than operating cost.

Bank Output: For output, we will use the intermediation approach. According to this approach, banks are viewed as producers of services related directly to their role as an intermediator in the financial market. That is, they are viewed as collecting deposits and purchasing funds to be subsequently intermediated into loans and other assets, so deposits are treated as inputs along with capital and labor. Whereas the dollar values of earning assets are treated as a measures of output, costs are defined as interest plus non-interest costs.

The production approach, on the other hand, views banks as producers of loan and deposit accounts using capital and labor. Under this approach, it follows that the number of accounts of each type are the appropriate definition of outputs. Total costs are defined

as interest costs. In our study, total loans and other investments (investments in bonds and securities plus deposits at foreign banks) will be treated as output following what many other researchers have done. The reason is that both activities are highly resource consuming with substantial value added.

Input prices (W_{it}): Price of labor, the wage rate, will be approximated by salaries and benefit expenses divided by the number of employees at the end of each year. Price of capital will be approximated by the interest paid by banks on interest-bearing liabilities at the end of each year.

Other variables: Other variables will be the number of branches for each bank. In addition, there is a set of dummy variables to capture the type of banks (commercial and foreign banks) and the size of banks (large, medium and small banks).

Cost functions will be estimated first to measure the cost efficiency followed by the application of the linear programming approach to calculate the cost efficiency, technical inefficiency and the allocative inefficiency. And then, the study will estimate a nonstandard profit function to evaluate the profit efficiency for the Jordanian banks. Finally, an analysis of the sources of the cost will be made by estimating a second stage regression in which the relationship between the efficiency index calculated in this study and a set of economic, structural and financial variables will be explored. As for the sources of the profit inefficiency sources, the Spearman correlation coefficient between the profit inefficiency scores and the same set of economic, structural and financial variables mentioned earlier will be analyzed.

2.7 Data

Data for this study was obtained from the 1990-1996 annual data produced by the Central Bank of Jordan on Jordanian banks. The reasons behind using this period is due to the availability of the variables needed for the study, and the fact that it came after the economic crisis and the collapse of two major banks in Jordan. As the result of the crisis, the country adopted an adjustment program sponsored by the IMF and the World Bank and a government imposed financial reform started gradually after 1990.

The following chapter introduces the banking system in Jordan, the historical background, structure and development of this sector. The focus of this chapter will be directed to the factors that have a direct impact on the efficiency of the banking system in Jordan. It is important to consider the institutional factors which have an important role in the performance of banks in Jordan.

3 *CHAPTER THREE: THE BANKING SECTOR IN JORDAN*

3.1 Historical Developments

The history of the banking sector in Jordan is relatively short. The first recorded full-fledged bank was the Ottoman bank (it became known as Grindlays bank since the sixties), which started its activities in 1925. Soon after, the Arab Bank, the first local bank, was established in Jerusalem in 1930. It opened its first branch in Jordan in 1938. After the 1948 Arab-Israeli War, the bank moved its headquarters to Amman.[10]

Jordan National Bank was founded in 1956. Subsequently, a number of banks have been established, bringing the total to 21 banks in 1996. Some of these banks are fully owned and managed by Jordanians, while others have full or partial foreign ownership. Of these banks, five are foreign commercial banks.

Out of the 21 banks in Jordan, seven are investment and the rest are commercial banks. Table 3.4 lists and classifies all banks in Jordan.

In January 1, 1996 the Central Bank of Jordan (CBJ), as an effort to improve the competition in the banking sector, introduced regulations to liberalize the Jordanian banks and to move them towards the universal system. This allowed banks to undertake all banking transactions, provided that the bank abides by the following conditions: 1) The bank 's capital must not be less than JD 20 Million. 2) The bank must not have any

[10] The Financial Structure in Jordan, Research and Studies Department, Central Bank of Jordan, October, 1989, Amman, Jordan

deficiencies in the required provisions. 3) There must exist an efficient management and firm internal control system within the bank such as an auditing committee appointed from the members of the bank board of directors.[11]

It is worth mentioning that the universal banking in this sense refers to the ability of institutions to combine both commercial and investment banking. However, licensed banks can not engage in the insurance business without the approval of the Insurance Department in the Ministry of Industry and Trade as well as the approval of the CBJ.

Banks in Jordan operate under the supervision and regulation of the Central Bank of Jordan, which was established in 1964 to replace the Jordan Currency Board (JCB), which in turn was established in 1950. The JCB's functions were confined to maintaining Sterling assets against the issue of local currency. Consequently, it neither had a role in controlling the money supply nor credit issuance nor supervising banks.[12]

The primary responsibilities of the CBJ are to maintain monetary stability in the Kingdom as well as ensuring the convertibility of the Jordanian Dinar. In addition CBJ is responsible for promoting a sustained economic growth of the national economy in accordance with the general economic policy of the government.

In May 1971, the banking law was first introduced. This law requires banks to be licensed by the Central Bank of Jordan. They must also comply with the CBJ regulations with respect to their activities and practices as well as the ratios set by the CBJ for credit liquidity, cash resources and capital.

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[11] Central Bank of Jordan's Memorandum No. 330/95 to the Licensed Banks and dated 12/30/1995.

[12] The Financial Structure in Jordan, The Financial Structure in Jordan, Research and Studies Department, Central Bank of Jordan, October, 1989, Amman, Jordan.

No licensed bank may open a new branch in any city or town in the country or outside the country without the explicit permission of the CBJ. The approval of the CBJ must be granted before a licensed bank terminate or discontinue its operation.[13]

Foreign banks can open branches in Jordan with the approval of the Central Bank of Jordan. These banks have to appoint a resident of Jordan as the regional manager for their branches in the Kingdom. This manager is held fully responsible to the Jordanian authorities for all operations of the banks.

Local banks are usually established by a group of individuals who form a sponsoring committee for the bank to be established, and who own a percentage not exceed 75% of the bank shares. The remaining are then offered to the public.

The banking law includes a number of provisions regarding the establishment of commercial banks, most important of which are:

- No license shall be granted for the establishment of a bank except for a public shareholding company. Branches of foreign banks, however, are exempted from this provision.
- Working capital of any bank in Jordan shall not be less than JD 5 million at any time. This minimum capital was raised in 1996 to JD 20 million. Branches of foreign banks are exempted from this increase. However, these banks were told by the CBJ to raise their capital to JD 10 million, or have the volume of their operation be restricted to a level consistent with their capital. The increase in capital could be reached by a merger between two or more banks, by issuing new

[13] Central Bank of Jordan, Banking Legislation in Jordan, Chapter 2, Article 9, p44 .

shares or by capitalizing their reserves up to 50% of the increase needed in their capital.[14]

3.2 The Structure of the Banking System in Jordan

Information on the banking system in Jordan during the period 1990-1996 is given in Table 3.5 . The data show that the population per bank is 197.8 thousand on average during the period. This is up from 173.4 thousand/bank in 1990 to 222.1 thousand/bank in 1996. These figures are higher than those for the US (23.5 thousand/bank), the EU (142.3 thousand/bank) and the G-10 countries (52.8 thousand/bank). However, the Jordanian ratios are less than other countries like Japan (831.8 thousand/bank in 1993[15]). On the other hand, when we examine banking offices (main bank office plus branch offices) rather than just the main banks, the figures drop to 10.8 thousand/bank office on average during the same period. This is down from 12.8 thousand/bank office in 1990 to 9.98 thousand/bank office in 1996. This is compares to 3.7 thousand/bank office for the EU, 4.8 thousand/bank office for the G-10 countries and 3.96 thousand/bank office for the US. This may indicate that a country's need for banking services depends on its level of economic development. Developed countries require vast arrays of advanced banking services for which developing economies have no demand. The other reason for this high population per bank is that there seems to be administrative restrictions on establishing new banks or branches.

The number of staff per banking office in Jordan is 29 on average during the 1990-1996 period, which is higher than the EU, G-10 and USA. As banks increasingly

[14] Central Bank of Jordan's Memorandum to the Licensed Banks, Memorandum 330/95 dated 12/30/1995.
[15] Commercial Banking Structure, Regulation and Performance. An International Comparison, James R.

compete, not only with one another, but also with other financial institutions both domestically and across national borders, it becomes very important for them to work efficiently. In Jordan, the high figure for staff per banking office indicates that efficiencies could be gained through staff reduction[16]. Table 3.6, also gives information on the extent to which deposits are the funding sources for assets and loans, the primary balance sheet assets of banks. Jordanian banks fund a large share of their assets with deposits. This ratio fluctuates between 65% in 1990 and 80% in 1994. The low ratio of 1990, compared to other years, could be attributed to the low confidence in the banking system in 1990 after the failure of two large banks, the economic crisis in 1989 and the Gulf War when people preferred to keep their money in the form of cash rather than deposits.

Loans account for 43% of assets on average during the same period. Moreover, the data shows that the banking market in Jordan is highly concentrated. This can be shown by either looking at the share of the largest banks, which account for 58% of total assets on average during the same period, or by looking at the Herfindahl-Hirschman index (Tables 3.3 and3.6). Bank shares of the total assets of the financial system, which includes specialized credit institutions and financial companies in addition to the licensed banks, is 70% on average during the same period.[17]

[16] Commercial Banking Structure, Regulation and Performance. An International Comparison, James R. Bonce, Daniel E. Nolle and Tara N. Rice, Working Paper 97-6 march 1997
[17] Central Bank of Jordan, Monthly Statistical Bulletin, Different Issues.

3.3 Permissible Activities, Ownership Opportunities, and Branching Restrictions

An important factor affecting the performance and efficiency of banks is the type and extent of activities in which they are permitted to engage. If certain activities are restricted, this will limit the opportunities of banks to diversify their portfolios and to select from various return and risk portfolios available in the marketplace.

Table 3.6 provides detailed information about the permissible securities, insurance and real estate activities of banks in Jordan in 1996. Security activities are unrestricted in Jordan, since the Central Bank of Jordan decided to introduce the universal banking system as of the beginning of 1996. In the memorandum No. 330/95 dated 12/30/ 1995 the CBJ allows the commercial banks to be involved in the investment banking business and the investment banks are allowed to engage in the commercial banking business.

Insurance activities are prohibited. Real estate activities are restricted. Table 3.7 also presents information about the extent to which banks are unrestricted with respect to investing in non-financial firms. This type of investment is restricted in Jordan. On the other hand, non-financial firms have restricted access to bank ownership. Foreign investments in Jordanian banks may not exceed 50%.

As for branch banking, there are no legal restrictions, but certain prior regulatory approval is required. Information in Table 3.7 shows that the licensed banks are operating under a restrictive regulatory regime.

3.4 Supervisory Practices and Capital Standards

There is no doubt that supervisory practices and capital standards, like regulatory constraints and deposit insurance schemes, affect the performance and the efficiency of banks. Moral hazard and adverse selection problems may flourish, if bank supervision is weak and capital standards are inadequate. This may result in excessive risk taking by banks leading to the possibility of greater losses associated with bank failures. If, on the other hand, supervision and capital standards are on the other extreme (overly restrictive and burdensome), the financial position of banks will be weakened in comparison to their non-bank competitors. That is why these issues are important to discuss [18].

Table 3.7 presents selected information on supervisory practices and capital standards in Jordan. The principal supervisory authority is the Central Bank of Jordan. The responsibilities of the CBJ are to maintain the monetary stability, to ensure the convertibility of the Jordanian Dinar and to promote sustained economic growth of the economy in accordance with the general economic policies of the government.

The CBJ supervises licensed banks to ensure the soundness of their financial positions and the protection of depositors and shareholders rights. On-site examination is conducted at least once a year. The banking law states that the CBJ must examine the books and audit the accounts of each bank at least once a year. The main objectives of these inspections are to assess the condition of the bank and the quality of management, to verify compliance with laws and regulations, and to identify areas where corrective action is required. The CBJ's examination has become more extensive in recent years. Particular attention is paid to the loan portfolios of the bank. The inspectors examine

70% to 80% of loans[19]. As the case in many countries, the examination report is not publicly disclosed.

The banking law requires every bank to appoint an authorized external auditor to examine its annual financial statements. The auditor may not have a loan with the bank, or any interest in the bank. However, he may have holdings that do not exceed 5% of the share capital of the bank. The auditor must submit directly to the CBJ copies of the annual audit reports. The CBJ may request from the auditor any additional information regarding the condition of the bank. The report of the external examiner is publicly disclosed.

Consumer protection laws do not exist in Jordan, and the country places limits or restrictions on foreign activities of banks. A domestic bank requires CBJ's approval to deal in foreign loans or investments or to hold foreign securities. Foreign currency loans may be extended for pre-export finance or to companies with self-generating foreign currency cash flows without having the CBJ's prior written approval.

Rates paid on deposits or charged on loans are determined by market forces rather than by regulatory fiat in Jordan. Jordan does establish lending limits to address various types of risk exposure, especially in the case of loans to single borrowers, persons connected with the bank, and large exposures.[20]

One of the important issues in regulating and supervising banks is the capital standards. In July 1988, Basle committee on Banking Supervision (comprised of representatives of the central banks and supervisory authorities from the G-10 countries

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[18] Commercial Banking Structure, Regulation and Performance. An International Comparison, James R. Bonce, Daniel E. Nolle and Tara N. Rice, Working Paper 97-6 march 1997

[19] Central Bank of Jordan, Bank Supervision Department, The Financial System in Jordan, Unpublished study

[20] Central Bank of Jordan, Banking Legislation in Jordan, Chapter 3, Article 11, page 46.

and Luxembourg) adopted the Basle Accord. The accord is non-compulsory and applies to internationally active banks only. It is composed of four basic elements:

1. An agreed upon definition of core capital (or Tire 1), which consists of common stockholders' equity and non-cumulative perpetual preferred stocks.
2. Additional components of capital (Tire 2).
3. A general framework for assigning assets and off-balance sheet items to broad risk categories and procedures for calculating a risk-based capital ratio, and
4. A schedule for achieving, by the end of 1992, a minimum ratio of total capital to risk-weighted assets of eight percent[21].
5. In the case of Jordan, a licensed bank must have a paid-up capital of at least JD 20 million for the Jordanian banks and at least JD 10 million for the foreign banks that operate in Jordan. The Bank's ratio of capital to deposits must be at least 7.5%. Jordan adopted the capital guidelines of the Bank of International Settlements (BIS) since January 1993 and the CBJ issued a regulation relating capital to risk weighted assets, the ratio of capital to risk-weighted assets was increased gradually from 8% to 12% effective June 1997[22]

3.5 The Performance of the Banking System in Jordan

This section will focus on analyzing the licensed banks data. The analysis will be based on the balance sheet and the revenue and cost details for all licensed banks during

[21] Benston (1992) International Bank Capital Standards in Emerging Challenges for the International Financial Services Industry, pp51-73

[22] Central Bank of Jordan, Memorandum to the licensed banks, Memorandum 150/93 dated 7/7/1993 and Memorandum 293/93 dated 12/29/1993.

the period of 1990-1996. All different categories of banks will be considered. On the other hand, licensed banks will be divided into three categories; large (assets >JD500 million), medium size banks (JD250-500 million) and small banks (<JD 250 million).

3.5.1 Total Assets

Total assets of the licensed banks increased from JD 3343.4 million in 1990 to JD 7665.2 million in 1996. Table 3.1 below shows the relative proportion of total assets of the sample that belong to all banks in each different category, over the last seven years. As mentioned earlier, the two measures of market concentration presented in Tables 3.5 and 3.8 show that there is a high degree of concentration in the banking system in Jordan. This is measured by the share of total assets of the largest three banks, and the Herfindahl index. The U.S. Department of Justice anti-trust guidelines defines markets with a Herfindahl index less than 1000 as unconcentrated, see Salop (1987). In the case of Jordan, the HHI increased from 1601.7 in 1990 to 1680.7 in 1996. The three largest banks account for 59% and the top 7 banks nearly 77% of total assets. Medium size banks account for nearly 18% with an average size of 4.5%. Small banks[23] accounts for 23% with an average size of 1.8%. The averages of both, medium and small banks are less than the industry averages.

Of the small banks, five are foreign, which account for 9.3% of the total assets of the banking system, or JD 108 million. Among the large banks, there is only one bank, The Arab Bank PLC, which accounts for nearly 35% of the total assets of the banking system on average during the period 1990-1997.

[23] 13 Banks out of the 20 banks in the country are categorized as small banks

Table 3.1: Relative Proportion of Total Assets (%)						
	Large	**Medium**	**Small**	**Foreign**	**Investments**	**Commercial**
90	0.582945	0.184936	0.232119	0.114071	0.10235	0.89765
91	0.605798	0.180826	0.213376	0.097118	0.081068	0.918932
92	0.601046	0.168133	0.230821	0.092453	0.094345	0.905655
93	0.58565	0.169136	0.245213	0.086834	0.111393	0.888607
94	0.572425	0.180268	0.247307	0.08626	0.11165	0.88835
95	0.586876	0.185347	0.227777	0.087916	0.093534	0.906466
96	0.58155	0.192598	0.225852	0.090983	0.09003	0.90997
Averag	0.588041	0.180178	0.231781	0.093662	0.097767	0.902233

3.5.2 Total Loans

Total loans consist of bill discounted, overdraft and loans and advances. Data shows that this item increased from JD 1554 million in 1990 to JD 3479.7 million in 1996. That is 14.5% yearly. On average 55.6% of loans were made by the large banks, of which 24.5% was made by the Arab Bank and 11.9% was made by the Islamic bank. Medium size banks accounted for 20.7% of total loans on average during the same period. Small banks accounted for 23.3%. Of which, 9.3% were made by the foreign banks. Commercial banks accounted for 90.5% on average during the period 1990 through 1996.

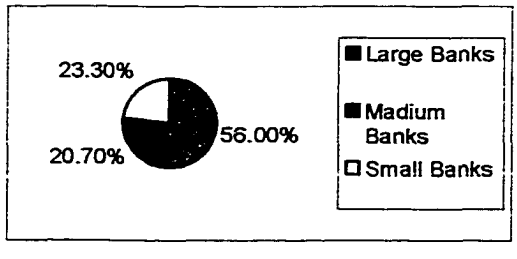

Figure 3.1: Average Total Loans According to Bank Size

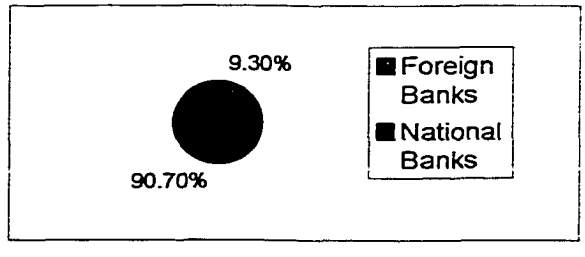

Figure 3.2: Average Total Loans According to Nationality

3.5.3 Loans to Deposit Ratio

A bank capability is judged by its deposit utilization. Deposits utilization is measured by computing the loans to deposit ratio and the net foreign assets to deposit ratio. The first ratio shows how a bank is fully loaned up. A high ratio means that the bank has a large proportion of its assets in loans and a small proportion in other investments. The high ratio also means the bank has low liquidity, since loans cannot be liquidated as readily as other forms of investments.

The net foreign assets to deposit ratio measures the bank tendency to invest abroad. A higher ratio means that the bank utilizes most of its assets outside its parent country, while a low ratio means the opposite.

Figure 3.3 shows the percentage of the two ratios for the licensed banks as a whole. The graph shows that the loan to deposit ratio reached its highest level in 1990, 70.1%, but it decreased to 46.7% in 1992. Then after 1992 this ratio averaged 61.3%, which means that approximately 61.3% of the total deposits were utilized domestically during the period 1993-1996. The high ratio in 1990 can be attributed to the low confidence in the banking system in 1990 in the aftermath of the economic crisis and the instability in the region due to the Gulf War. The net foreign assets to deposits ratio showed smaller fluctuations compared to the other ratio. It averaged 32.7% during 1990-1992 and then the average decreased to 22.6% during the period 1993-1996. This shows that the Jordanian banks utilize most of their assets inside the country.

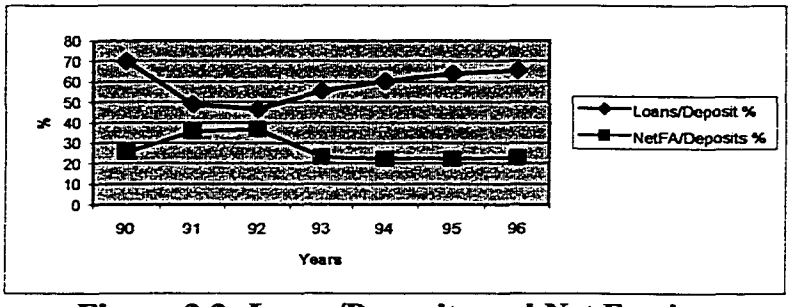

Figure 3.3: Loans/Deposits and Net Foreign

3.5.4 Profitability of the Licensed Banks in Jordan

The total before and after tax profit of the public shareholding companies listed in Amman Financial Market including the banking and financial sector for the period 1990-1996 is shown in the Table 3.9. The table shows that total profit before tax for all sectors increased from JD 209.9 million JD 316.3 million in 1996. But as a ratio of shareholders' equity it decreased from 19.2% to 13.4 % in 1996. The before-tax profit for the banking sector increased from JD 93.2 to JD 179.1 million in 1996, and as a ratio of the shareholders' equity it decreased from 20% in 1990 to 16.2 in 1995 and then increased to 21.3% in 1996 (Figure 3.4). This indicates that the banking sector performed better than the other sectors in the economy.

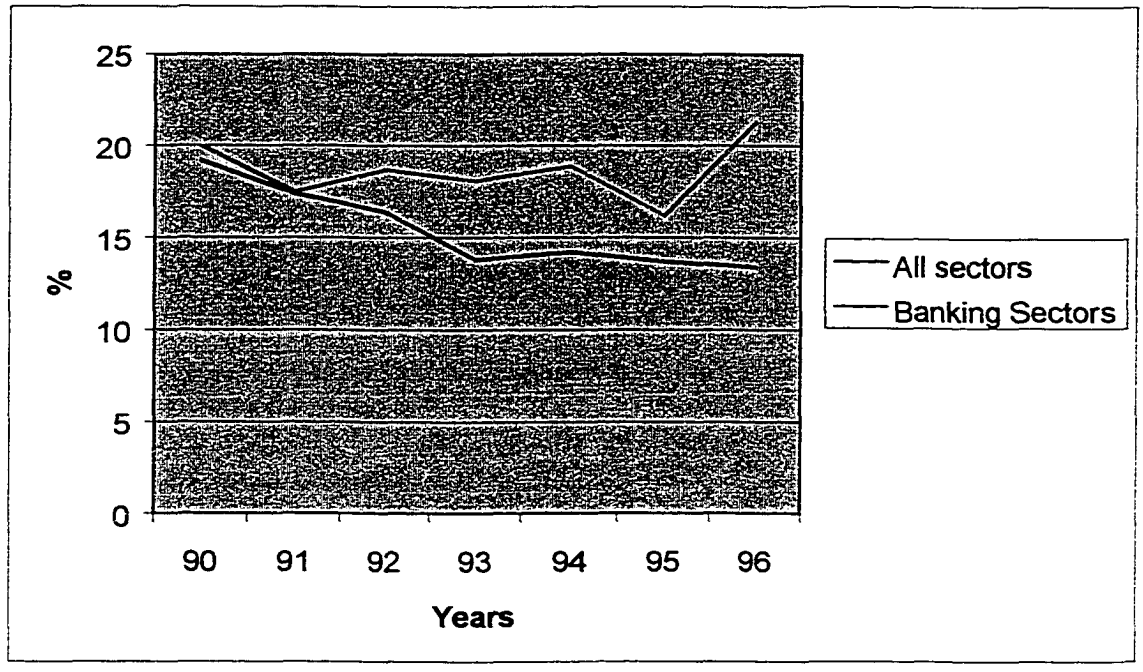

Figure 3.4: Pre Tax Profit /Equity for Banking Sector VS. All Sectors in the Economy for Companies whose Shares are traded in Amman Financial

3.5.5 Return on Equity Ratio

The return on equity ratio gives an indication of the profitability of the licensed banks. A comparison among the different categories of banks in Jordan is shown in Table 3.2 below. It is clear from this table that large banks and foreign banks (all are small banks) have performed well and almost the same on average during the period 1990-1996. Medium banks came third. Their profitability increased from 6.5% in 1990 to 14.1% in 1996.

If foreign banks were to be excluded from the small bank classification, then domestic small banks would perform poorly. That is mainly due to the fact that this group included newly established banks, as well as troubled ones. If the commercial banks were compared with investment banks, then the commercial banks would perform

better. A similar picture can be seen if we look at the return on assets (ROA). One can conclude in such case that large banks performed better than other categories of banks. Commercial banks and foreign banks achieved higher returns on equity than investment banks and national banks respectively.

Table 3.2: Return on Equity Ratio (ROE)						
	Large	**Medium**	**Small**	**Foreign**	**Investments**	**Commercial**
90	28.7	6.5	8.5	15.7	12.6	21.1
91	19.9	6.2	12.1	28.5	15.3	20.3
92	18.7	13.7	19.3	26.1	24.7	22.0
93	18.3	13.8	13.1	24.9	14.2	20.4
94	22.7	8.2	9.3	20.4	8.3	19.9
95	27.7	13.7	6.7	22.1	5.3	23.3
96	26.6	14.1	1.1	20.3	3.5	24.0
Average	22.8	10.9	10.0	22.6	12.0	21.6

Table 3.3: Return on Assets Ratio (ROA)						
	Large	**Medium**	**Small**	**Foreign**	**Investments**	**Commercial**
90	3.8	0.6	0.6	1.5	0.8	1.3
91	2.9	0.4	0.6	1.4	0.5	2.1
92	3.0	0.9	0.9	1.8	0.6	2.0
93	4.2	1.1	0.8	1.4	0.8	2.0
94	4.1	0.6	0.6	0.8	0.8	1.6
95	4.8	1.1	0.4	0.5	1.0	1.7
96	4.9	1.1	0.1	0.4	1.0	1.9
Average	4.0	0.8	0.6	1.1	.8	1.8

Source: Central Bank of Jordan, Research and Studies Department.

3.6 Cost Ratios

Cost ratios are traditionally used by bankers to measure the cost efficiency of banks. In this section the non-interest expenses to total assets ratios will be analyzed. The non-interest expenses refer to the expenditures on labor and physical capital (wages, benefits, materials and physical capital). This ratio relates these expenses to the total

assets (DeYoung (1997)). Figure 3.5 displays the average of the non-interest expenses as a percentage of the total assets for the banking system in Jordan during the period 1990 through 1996. The trend in this ratio is up-ward sloping. This suggests that on average the banking system in Jordan has become inefficient overtime. Spending over 15.5% on labor and physical capital in 1996 than seven years ago. DeYoung (1997) correctly argues that this ratio is misleading because it does not control for the increase in the in fee-based activities (data processing, letter of credits, financial advice and mutual fund sales).

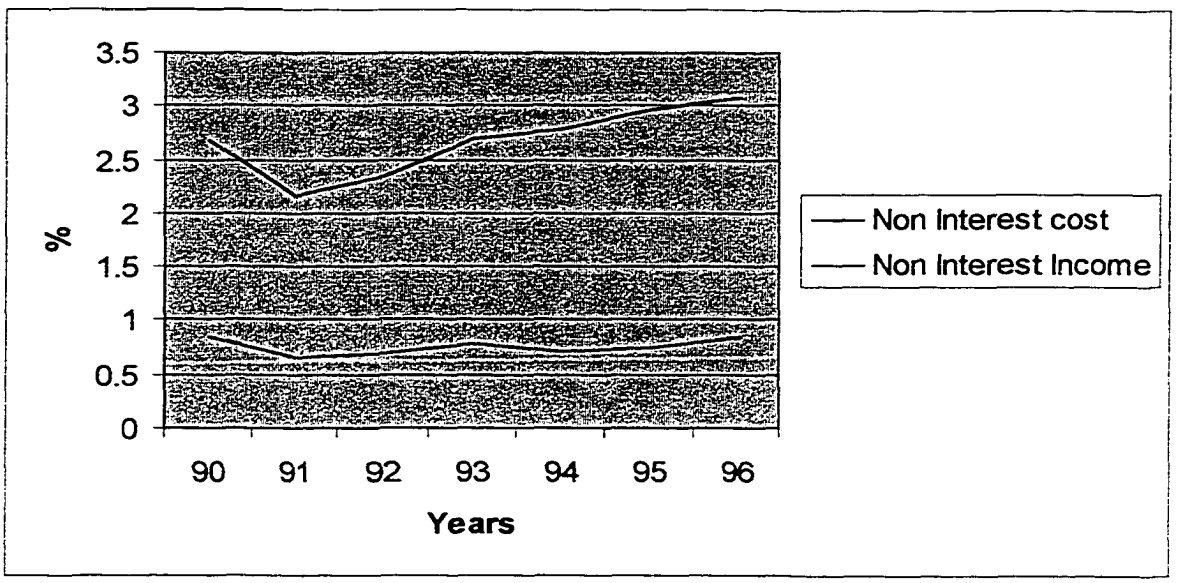

Figure 3.5: Overhead Costs to Assets

The average non-interest income to total assets ratio line in the graph leads one to conclude that this increase in the non-interest costs is due to fee based activities in the Jordanian banks, sine the non-interest income to the total assets increased only by 1.2% during the same period. However, high levels of spending on labor and physical capital

do not necessarily indicate inefficiency, and cutting such expenditures could possibly lower the quality of services and portfolio quality; and in turn lower the bank's earnings. Therefore, the use of accounting based ratios needs to be analyzed carefully, and an alternative to such method has to be found. In this regard, the frontier analysis provides such an alternative. Therefore, the cost frontier analysis will be used in this study to evaluate and determine the efficiency of the banking system in Jordan. In the next chapter we will proceed with estimating the efficiency of the banking system in Jordan using a parametric and a non-parametric frontier approaches.

Table 3.4: The Banking System in Jordan

Commercial Banks					
National Banks			**Foreign Banks**		
1930	Arab Bank PLC	30	1949	The British Bank	05
1956	Jordan National Bank	37	1981	Arab Land Bank	19
1960	Bank of Jordan	37	1957	Rafidain Bank	03
1960	Cairo Amman Bank	23	1969	ANZ Grindlays Bank	14
1977	Jordan Kuwait Bank	21	1974	Citibank	02
1978	Jordan Gulf Bank	27			
1989	Arab Banking Corp. (Jordan)	15			
1991	Business Bank	11			
Investment Banks			**Islamic Banks**		
1878	Arab Jordan Investment Bank	08	1979	Jordan Islamic Bank for Finance & Investment	33
1989	Jordan Invest. and Finance Bank	04	**Specialized Credit Institutions**		
1990	Amman Bank for Investment	06			
1991	Union Bank for Saving & Invest	12	1974	Housing Bank	113
1993	Philadelphia Invest. Bank	06			
1994	Middle East Invest. Bank	19			

Source: Central Bank of Jordan. Annual Report, 1996.

Table 3.5: Banking Structure in Jordan:1990-1996							
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Office and Staff							
Licensed Banks	20	20	19	21	21	20	20
Branch Offices	251	308	323	364	389	410	425
Banking Offices	271	328	342	385	410	430	445
Population (000s)	3468.0	3701.0	3844.0	3993.0	4139.4	4291.0	4441.2
Population per Bank	173.4	185.1	202.3	190.1	197.1	214.6	222.1
Population per Bank office	12.8	11.28	11.24	10.37	10.1	9.979	9.98
Staff	8305	9015	9893	10717	11948	12666	12750
Staff per Bank	415.3	450.8	520.7	510.3	569	633.3	637.5
Staff per Banking Office	30.65	27.48	28.93	27.84	29.14	29.46	28.65
Balance-Sheet Composition							
Total Assets (mil. JD)	4090	5599.1	6311.1	6752.2	6747.5	7527.8	8430.4
Banking Assets /JD of GDP	1.53	1.96	1.81	1.77	1.79	1.81	1.72
Deposits (mil. of JD)	2642.6	4022.1	4749	4939.4	5391.5	5787.5	5988.8
Deposit-to-Asset Ratio (%)	.646	.718	.752	.732	.799	.769	.71
Loans (mil. of JD)	1863.5	1965.8	2218.3	2741.3	3248.4	3705.7	3920.3
Loan-to-Asset Ratio	.456	.351	.351	.406	.481	.492	.465
Concentration of Banking Assets							
3-Firm Concentration (%)	.567	.595	.595	.577	.562	.574	.567
HHI	1601.7	1793.7	1696.7	1627.3	1574.1	1665.3	1680.7

Source: Central bank of Jordan.

Table 3.6-a: Permissible Banking Activities and Bank Ownership in Jordan: 1996			
Bank supervisor	**Securities** [1]	**Insurance** [2]	**Real Estate** [3]
Central Bank of Jordan	*Unrestricted:* conducted either directly by a bank or its subsidiary. Firewalls are mandated [4]	Prohibited	*Restricted*, a bank may not acquire real estate, except as may be necessary for the conduct of its business and for the housing and amenities of its staff or in settlement of an overdue debt. In the later case the bank must sell the real estate within two years. Leasing is permitted with approval of the CBJ. Real estate financing in all its forms is allowed.

1) Security activities include underwriting, dealing and brokering of all kinds of securities
2) Insurance activities include underwriting and selling of insurance products and/or services as a principal activity and as an agent.
3) Real Estate activities include investment, development and management.
4) Limit qualifying investments to no more than 10% of any single non-financial firm's capital and to no more than 75% of the banks working capital and its reserves in Jordan on aggregate, with the exception of investments approved by the CBJ.

Table 3.6-b: Permissible Banking Activities and Bank Ownership in Jordan: 1996				
Licensed Bank Investment in Non-Financial Firms	**Non-Financial Firm Investment in a Licensed Bank**	**Branching Restrictions**		
		Domestic Banks	**Non-Domestic Banks**	**Prior Regulatory Approval Required**
Restricted, No licensed bank shall contribute to, or buy shares or bonds of any commercial, industrial, agricultural or other enterprise for amounts totaling more than 75% of its working capital and its reserves in Jordan, with the exception of what is approved by the CBJ and of investments resulting from the collection of its overdue debts. The latter investment shall be disposed of within a period not to exceed two years. Banks are limited to an investment not to exceed 10% of the capital of any non-financial firm	*Restricted*, The Companies Law prohibits a single investor from owning more than 10% of a bank's share capital, without the approval of the Ministry of Industry and Trade. Foreign investment in a Jordanian bank may not total more than 49.9%.	None	None	*Required*, a bank must make an application to the CBJ to open a new branch. The bank needs to comply with CBJ's regulation. The bank must have a sound financial position and specifically the capital adequacy ratio is not less than 10%. The profit and loss statement of the bank for the last year must show that the bank is making a profit and must satisfy other conditions as specified by the CBJ in its memo No. 7020/68 dated 1/2/96

Table 3.7: Commercial Bank Supervisory Practice in Jordan: 1996		
Components of Capital for Meeting the Capital Standards or Requirements		
	YES	**NO**
A) Primary Capital (should be at least 6% of the risk-weighted assets)		
Paid up capital	✓	
Current year profit added		✓
Current year loss deducted	✓	
Disclosed reserves (elective and legal reserves).	✓	
B) Supplementary Capital (1)		
Undisclosed reserves (2)	✓	
Hybrid capital instruments (including cumulative perpetual preferred stock) (3)	✓	
Subordinated loans (4)	✓	
Fixed asset revaluation reserves (6)	✓	
Latent, or hidden, revaluation reserves (7)	✓	
General loan loss reserves and allowances (8)	✓	
Investment in the capital of other banks and financial institutions (9)		✓
Examination and / or Inspections:		
On- Site	✓	
Banks pay exams		✓
External Audits		
Required external audits	✓	
Information Publicly Disclosed:		
Bank examination or inspection		✓
External auditor report	✓	

Consumer Protection Laws		
Consumer protection laws exist		✓
Domestic Bank Activities Abroad:		
Specific authorization required	✓	
Limits or restrictions on domestic banks' activities	✓	
Rates Paid on Deposits or Charged on Loans:		
Restrictions or controls		✓
Lending Limits		
A single borrower	✓	
A person connected with the bank	✓	
A particular sector		✓
Country risk exposure (11)		✓
Large exposures	✓	

Source: Central Bank of Jordan, different memorandums to the licensed banks

1) Supplementary capital is supposed not to exceed the Primary capital
2) Undisclosed reserves are portions of accumulated after-tax retained earning not identified in the published balance sheet or otherwise disclosed, except banking supervisors.
3) Hybrid-capital instruments including cumulative preferred stock are equities that combine the characteristics of equity capital and of debt, and should meet the following requirements: unsecured, subordinated, and fully paid-up; not redeemable at the initiative of the holder or without prior consent of supervisory authority; available to participate in losses without the bank being obliged to cease trading (unlike conventional subordinated debt); and all service obligations to be deferred where the profitability of the bank would not support payment.

4) A subordinated loan is normally not available to participate in losses of a bank that continues operating (included in capital only if minimum original maturity of five years) and should not exceed 50% of the primary capital

5) Limited life redeemable preference shares are the same as immediately above.

6) Fixed asset revaluation reserves represent a formal revaluation, carried through to the balance sheet, of a bank's own premises.

7) Latent, or hidden, revaluation reserves are the difference between the market value and historic cost book value of long-term holdings of equity securities.

8) General loan loss reserves are reserves that are held against future and presently unidentified losses and are freely available to meet losses that may subsequently materialize.

9) Any investments in banks and financial institutions must be subtracted from the total capital

10) A+B mustn't be less than 12% of the risk-weighted assets. ,

11) But CBJ handles every case buy itself depending on the prevailing supervisory regime and regulations in the host country.

Table 3.8: Jordanian Bank Industry Statistics: Herfindahl-Hirschman Index				
Year	**Number of Banks**	**Total Assets[1]**	**Average Assets[1]**	**HHI**
1990	18	3343.4	185.7	1601.7
1991	18	4884.8	271.4	1793.7
1992	18	5603.9	311.3	1696.7
1993	20	5912.4	295.6	1627.3
1994	20	6581.3	329.1	1574.1
1995	19	7261.5	382.2	1665.3
1996	19	7665.2	403.4	1680.7

Source: Derived from the Jordanian banks' annual reports.

[1] Million J

Table 3.9: The Profitability of Jordanian Public Shareholding Companies							
All Sectors **Net Profit (Million JD)**							
	1990	1991	1992	1993	1994	1995	1996
-Pre Tax	209.9	208.7	217.1	209	256.9	295.4	316.3
-After Tax	170.2	150.6	158.3	138.9	180.3	192.5	226.4
Net profit /Shareholders' equity %							
-Pre Tax	19.2	17.4	16.4	13.8	14.2	13.7	13.4
-After Tax	15.5	12.5	12	9.2	10	9	9.6
Banking and Financial Institutions Sector **Net Profit (Million JD)**							
-Pre Tax	93.2	88.1	105.7	119.6	140.7	138.1	179.1
-After Tax	72.8	67.4	79.7	87.5	100.6	94.7	127.3
Net profit /Shareholders' equity %							
-Pre Tax	20	17.5	18.7	18.1	18.9	16.2	21.3
-After Tax	15.6	13.4	14.1	13.2	13.5	11.1	15.1

Source: Central Bank of Jordan, Annual Report 1996.

4 CHAPTER FOUR: EMPIRICAL ANALYSIS AND RESULTS

4.1 Introduction

This chapter presents and analyzes the main findings of the magnitude and the incidence of the efficiency of the Jordanian banking system. These findings were obtained by three different methods. In the first method, measurements to assess the average cost efficiency were obtained through the estimation of a cost function for the Jordanian banks (19 banks) during the period of 1990-1996. In the second method, the same set of measurements was also derived by using the mathematical programming approach. Finally, profit efficiency was examined by estimating a non-standard profit function

The chapter is organized as follows: The stochastic cost frontier model estimates are presented. Then, the efficiency estimates from both the stochastic frontier approach and from the data envelopment analysis approach are analyzed and compared. The non-standard profit frontier model and efficiency estimates derived from this model are then presented. Finally, an analysis of the sources of the cost inefficiency are made by estimating a second stage regression (Haw, Hunter and Yang (1998)), in which the relationship between the efficiency index calculated in this study and a set of economic, structural and financial variables are explored. As for the profit inefficiency sources, spearman correlation coefficients between the profit inefficiency and the same set of economics, structural and financial mentioned earlier variables are analyzed

4.2 Stochastic Cost Frontier Model Estimation

To avoid the specification error related to the form of the function, a LaGrange Multiplier (LM) test was conducted. The purpose of the test was to determine whether the functional form of the cost function is of Cobb-Douglas technology against the alternative hypothesis, which has the following translog functional form:

$$\begin{aligned}\ln(C/W_2) = {} & \alpha + \beta_1 \ln(W_1/W_2) + 1/2\beta_2 \ln(W_1/W_2)\ln(W_1/W_2) \\ & + \beta_3 \ln(Y_1) + \beta_4 \ln(Y_2) + 1/2\beta_5 \ln(Y_1)\ln(Y_1) + 1/2 \\ & \beta_6 \ln(Y_2)\ln(Y_2) + 1/2\beta_7 \ln(Y_1)\ln(Y_1) + \beta_8 \ln(Y_1) \\ & \ln(W_1/W_2) + \beta_9 \ln(Y_1)\ln(W_1/W_2) + \beta_{10} \ln Branch \\ & + \ln u + \ln \in \end{aligned} \qquad (4.1)$$

Where:

C	=	The total cost
W_{it}	=	A vector of input prices
Y_{it}	=	A vector of output quantities.
Branches	=	The number of branches
U	=	The inefficiency error term
$\in$	=	The random error term.

Under the null hypothesis $\beta_2 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$. If this hypothesis is not rejected, then this means that it favors the simple Cobb-Douglas functional form, which is a special case of the above model. Since the χ^2 statistic was equal to 2.52, rejection of

the null hypothesis at any conventional level of significance failed; and hence, the following Cobb-Douglas technology was adopted:

$$\ln(C/W_2) = \alpha + \beta_1 \ln(W_1/W_2) + \beta_3 \ln(Y_1) + \beta_4 \ln(Y_2) + \beta_5 \ln Branch + \ln v_{it} + \ln u_{it} \qquad (4.2)$$

Equation (4.2) was estimated. It contains two banking outputs (loans and other investments), two inputs of production (labor and capital), and one other variable (number of branches). The linear homogeneity assumption was imposed on the estimated equation by normalizing total cost and output prices by the price of capital. Table (4.1) presents summary statistics for the variables used to estimate the cost function in equation (4.2). The abovementioned cost equation was estimated to derive estimates of lnv_{it} and lnu_{it}. The variable lnu_{it} measures cost inefficiency; the efficiency on the other hand is simply equal to $Exp(-lnu_{it})$ (Battese, G, Heshamati, A. and Hjalmarsson (1998), DeYoung, (1997)).

Table (4.2) illustrates the estimated parameters and their asymptotic t-ratios along with measures of the overall goodness of fit. Since the logarithmic specification of the cost functions is being used, the estimated parameters represent the elasticities of cost of banks in Jordan with respect to the respective variables. As shown in Table (4.2), the responsiveness of the percentage change in the total cost of the banking system in Jordan during the period 1990-1996 as a result of a change in the quantity produced of total loans is 0.625. Thus, if total loans are to increase by 100%, then total cost will increase by 62.5% assuming all other factors remaining constant. The elasticity of total cost to other investments by the Jordanian banking system equals 0.259. This implies that if the Jordanian banking system other investments are to increase by 100%, then total cost will increase by 25.9% assuming other things remaining the same. As for input prices, the

elasticities are 48.2% and 51.8% for labor and capital respectively. This means that if the price of labor (wages, salaries, and other benefits) is to increase by 100% total cost will increase by 48.2%. But if the price of capital is to increase by 100%, then total cost will increase by 51.8% assuming all factors remaining constant. The figures in Table (4.2) provide a reasonable representation of the cost structure of the banking system in Jordan. The magnitude of the coefficients of the variables used to run the regression and their directions were as expected. Overall, the results were quite satisfactory. The high explanatory power could support the appropriateness of modeling banks as multi-product firms. It could also be due to the close relationship between total cost and total loans in a cross section of banks of different sizes. $\boldsymbol{Lny_{it}}$ and $\boldsymbol{lnw_{it}}$ were positive and highly significant, indicating the importance of selecting these variables in the model.

4.3 Efficiency Estimates

The average cost efficiency estimates and their descriptive statistics are presented in Table (4.3). The grand mean efficiency score for the 125 observations is 77.5% and 73.5% based on the econometric and the linear programming approaches respectively. This suggests that 22.5% and 26.5% of cost were wasted on average, relative to the best-practice bank during the period 1990-1996 according to the above-mentioned approaches, respectively.

Table 4.1 Descriptive Statistics of the Cost Frontier Regression Variables					
Variable	**Mean**	**Std.Dev.**	**Minimum**	**Maximum**	**Cases**
Y1	119.524	158.6039	3.3	882.8	125
Y2	91.3944	181.178	3.5	1054.4	125
Branches	18.232	23.59406	1	113	125
X1	514.432	598.6702	37	2402	125
X2	255.1288	428.4033	18.9	2373.8	125
W1	6.13E-03	2.26E-03	2.51E-03	1.53E-02	125
W2	5.44E-02	1.75E-02	7.25E-03	0.124464	125
TC	20.264	28.93268	0.7	172	125
Profit	6.898	5.712	.01	46.4	125

Outputs:

Y1: Total loans (M JD)

Y2: Other Investments (Investment in bonds and securities +Deposits at foreign banks) (M JD)

Inputs:

X1: Number of full time workers

X2: Total deposits (M JD)

Input Prices:

W1: Price of labor

W2: Price of capital (Interest payments/interest-bearing liabilities)

Other Variables:

Branches: Number of branches

TC: Total cost (interest and non-interest cost) (M JD)

Profits: Total pretax profit adjusted to avoid any negative number (M JD)

Table 4.2 MLE of Cobb-Douglas Stochastic Cost Frontier of the Jordanian Banks			
Variable	**Estimates**	**Standard Error**	**Level of significance**
Constant	2.44	0.17	*
LY_1	0.625	0.005	*
LY_2	0.259	0.004	*
LW_1	0.482	0.004	*
LW_2	0.518		*
L Branches	0.124	0.004	
Log Likelihood Function = 34.99			

* Indicates significant at 95%level of significance.

As for the yearly average of cost efficiencies, there were minor fluctuations in these figures, which are not statistically different from the overall average. Efficiency scores calculated in this study are within the range found in the literature for other countries, (Berger and Humphrey (1997)). One can explain the inefficiency in the Jordanian banking system by the fact that banks in Jordan operated in a highly concentrated environment and generally faced quantitative constraints on their balance sheet growth. Consequently, banks seem to be satisfied with this level of profit and have enjoyed some kind of monopoly profits; hence had a little incentive to minimize costs or to devote much attention to sales and marketing functions.[24]

The main null hypothesis to be tested after producing these estimates is that the banking system in Jordan is completely efficient. This means that the average inefficiency is equal to zero. A choice of one of the following hypothesis is to be made:

$$H_0 : EFF = 1$$
$$H_A : EFF < 1$$

Where:

H_0 is the null hypothesis that the banking system in Jordan perfectly efficient

H_A is the alternative hypothesis that the banking system in Jordan is not perfectly efficient.

EFF is the average efficiency of the banking system during the period 1990-1996

Since the t statistics equals to 3.0, this leads to the rejection of the null hypothesis at the 1% level of significance that the banking system in Jordan is fully efficient in favor of the alternative hypothesis, that is, the average efficiency of the banking system in Jordan is less than one.

When the sample was segmented into foreign banks and national banks, (4.4) the average level of cost efficiency obtained from the data envelopment analysis for foreign banks (excluding Rafidain[25] bank) and national banks were 77.2% and 74.2% respectively. This reveals that on average, foreign banks are more efficient than the national banks in Jordan by 3%. As for the statistical frontier approach, the average efficiency levels for the two groups of banks were 80.0% and 78.5% respectively, that is foreign banks are more efficient than national banks by 1.5%.

[24] Due to this fact of high concentration we will analyze later in this chapter the nonstandard profit efficiency for the Jordanian banking system.
[25] Iraqi bank, which is severely affected in the aftermath of the Gulf War in 1990.

Table 4.3 Average Efficiency for the Banking System in Jordan During the period 1990-1996				
1990	**XE**	**CE**	**TE**	**AE**
Average	0.773	0.7338	0.7799	0.942
Medium	0.8008	0.745	0.782	0.969
Stdev	0.115	0.1705	0.1728	0.0728
Max	0.8571	1	1	1
Min	0.369	0.258	0.272	0.768
1991	**XE**	**CE**	**TE**	**AE**
Average	0.7832	0.7547	0.7829	0.9635
Medium	0.7958	0.762	0.768	0.987
Stdev	0.0653	0.1551	0.1571	0.0446
Max	0.8744	1	1	1
Min	0.6171	0.465	0.468	0.868
1992	**XE**	**CE**	**TE**	**AE**
Average	0.7716	0.7165	0.7469	0.9614
Medium	0.7901	0.703	0.713	0.968
Stdev	0.0651	0.1134	0.1276	0.0386
Max	0.8326	0.946	1	0.999
Min	0.5572	0.476	0.521	0.871
1993	**XE**	**CE**	**TE**	**AE**
Average	0.7809	0.7454	0.7681	0.9715
Medium	0.7833	0.738	0.748	0.985
Stdev	0.0542	0.1062	0.1126	0.0314
Max	0.8744	1	1	1
Min	0.5986	0.575	0.583	0.887
1994	**XE**	**CE**	**TE**	**AE**
Average	0.7893	0.7431	0.7664	0.9709
Medium	0.7943	0.728	0.737	0.989
Stdev	0.047	0.1005	0.1046	0.0396
Max	0.8744	1	1	1
Min	0.6514	0.613	0.632	0.84
1995	**XE**	**CE**	**TE**	**AE**
Average	0.7721	0.7272	0.7556	0.9664
Medium	0.7858	0.7085	0.7235	0.978
Stdev	0.0602	0.0821	0.1039	0.0493
Max	0.8441	0.921	0.983	1
Min	0.6261	0.611	0.624	0.788
1996	**XE**	**CE**	**TE**	**AE**
Average	0.756	0.7228	0.7631	0.9512
Medium	0.7747	0.7355	0.7835	0.9665
Stdev	0.0946	0.1227	0.1397	0.0663
Max	0.8437	0.915	1	0.998

Note:

TE: Technical Efficiency (DEA)

AE: Allocative Efficiency (DEA)

CE: Cost Efficiency (DEA)

XE: Cost Efficiency (SFA)

The most striking aspect about Table (4.4) is that regardless of the methodology used to estimate the efficiency, foreign banks appear to be more efficient than national banks. With respect to the technical efficiency from the DEA foreign banks are more efficient than national banks by 3%. This is not necessarily a surprise as it may simply be a reflection of the greater flexibility in the production technology adopted by foreign banks, while the national banks show more rigidity and thus less responsiveness in terms of adjusting factor inputs to changes in their relative prices. A difference of mean test was performed to test the null hypothesis that the mean efficiency of the foreign banks equals to the mean efficiency of national banks. A choice of one of the following hypothesis is to be made:

$$H_0 : \mu_n - \mu_f = 0$$
$$H_A : \mu_n - \mu_f \neq 0$$

Where

μ_n = Average efficiency of national banks.

μ_f =Average efficiency of foreign banks.

Since the value of the t-test statistics was 2.2, the null hypothesis could be rejected at 0.01 level of significance in favor of the alternative hypothesis. Thus on

average foreign banks are more cost efficient than national banks. One possibility for this significant difference is that the average efficiency is not a very good summary measure because it is skewed by outliers; i.e., by banks with very high costs relative to the most efficient bank. However, this is not the case in Jordanian banks since the median value of efficiency is also higher for foreign banks than national banks.

Table 4.4
Efficiency Estimates of Foreign Banks V.S. National Banks During the Period 1990-1996

	XE	CE	TE	AE
Foreign Banks Excluding Rafidain Bank				
Average	0.8	0.7716	0.8	0.965
Median	0.811	0.765	0.813	0.956
Stdev	0.042	0.1	0.094	0.033
Max	0.854	1	1	1
Min	0.708	0.604	0.637	0.89
National Banks				
Average	0.785	0.742	0.771	0.962
Median	0.791	0.731	0.749	0.988
Stdev	0.042	0.106	0.12	0.055
Max	0.874	1	1	1
Min	0.626	0.465	0.468	0.716

Note:
TE: Technical Efficiency (DEA)
AE: Allocative Efficiency (DEA)
CE: Cost Efficiency (DEA)
XE: Cost Efficiency (SFA)

To investigate the relationship between efficiency and bank size, the average cost efficiency measures classified by assets size are presented in Table (4.6) as well as the correlation coefficient between the efficiency scores and the assets. Small banks (excluding Rafidain bank) appear to be more efficient than large banks, regardless of the measurement approach used. This may be due to the fact that all foreign banks, which are more efficient banks, are small banks. Medium size banks come in the third place according to the data envelopment analysis approach, whereas they appear to be more

efficient than small and large banks according to the statistical frontier approach. The net cost advantage of eliminating X-inefficiency and scale inefficiency for small banks in Jordanian currency compared to other categories of banks was calculated. Using the nonparametric approach, the overall cost efficiency was decomposed into technical and allocative efficiency. The technical efficiency was also decomposed into scale and pure technical efficiency. Figure (4.3) explains theoretically the idea behind this decomposition.

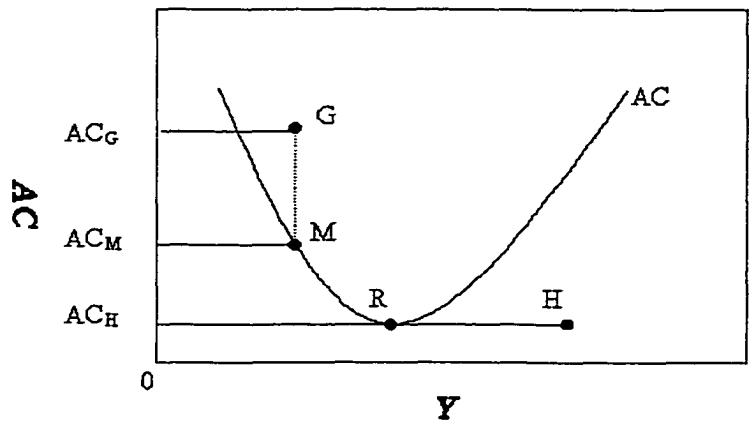

Figure 4.1: Pure Technical Efficiency and Scale Inefficiency in terms of Cost

In figure (4.3) points *R* and *H* each correspond to constant return to scale, and therefore correspond to minimum points on the average cost relationships. Total saving from eliminating technical inefficiency is equal to AC_H / AC_G. The bank corresponding to point G is technically inefficient for two reasons. First, there is pure technical inefficiency resulting from the underutilization of inputs, which means that the bank is above the average total cost. If inputs were fully utilized this level of output could be produced with lower cost corresponding to point M, that is, AC_M. Therefore, the pure

technical inefficiency is equal to AC_M / AC_G, which is equal to the total saving from eliminating this type of efficiency.

Second, at this point there is increasing returns to scale or decreasing average cost. The increase in cost due to scale inefficiency can be measured as AC_H / AC_M, which represents the scale economy disadvantage for not producing at the constant return to scale. That is, cost saving from growing from the actual size to the minimum efficient scale.

For the Jordanian banks it was found that for large banks the scale inefficiency dominates the pure technical inefficiency. That is, if large banks eliminate the scale inefficiency these banks could have saved JD20.3 millions on average during the period of 1990-1996. Whereas, if the pure technical inefficiency were eliminated, these banks will save JD3.0 millions. For medium and small banks, the pure technical inefficiency dominates the scale inefficiency. Table (4.5) below, shows the gains from eliminating the scale inefficiency and the pure technical inefficiency.

Table: (4.5)
Scale and Pure Technical Inefficiency Disadvantages in JD (Million)

		Scale Inefficiency	Pure Technical Inefficiency.
Large Banks	**Average**	20.3	3.03
	Stdev.	7.6	5.71
	Max.	40.5	20.25
	Min.	11.85	0
Medium Banks	**Average**	2.6	3.67
	Stdev.	1.5	2.84
	Max.	5.7	12.04
	Min.	0	0
Small Banks	**Average**	0.7	1.11
	Stdev.	0.5	.89
	Max.	3.6	4.03
	Min.	0	0

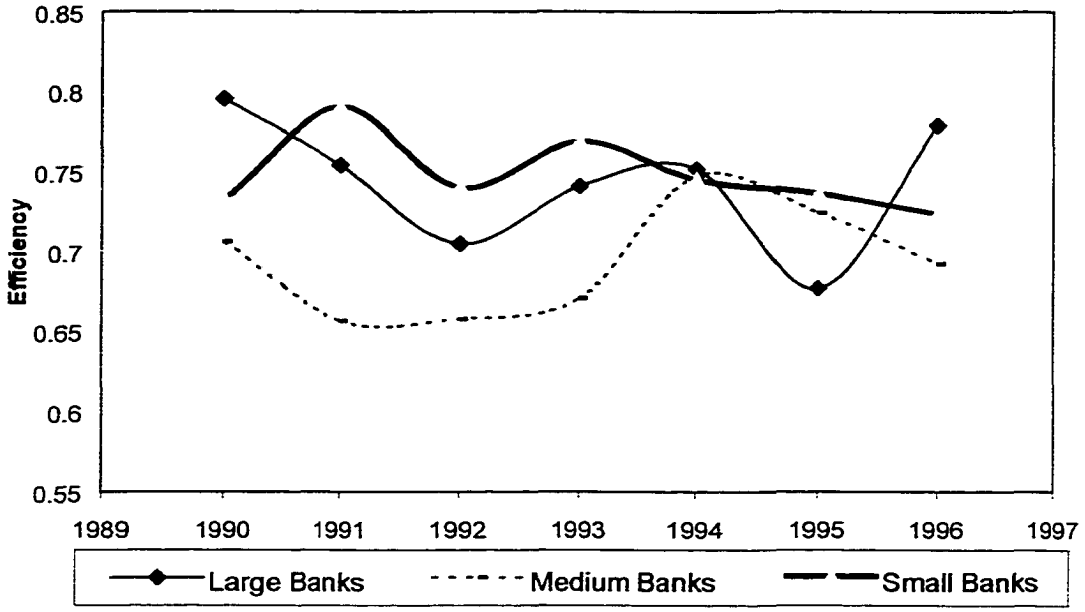

Figure 4.2: Cost Efficiency According to Bank Size (DEA)

Table 4.6 Efficiency Estimates According to Bank Size				
Large Banks (2 Banks)				
	XE	**CE**	**TE**	**AE**
Average	0.7789	0.7434	0.75	0.9913
Median	0.8008	0.7445	0.7485	0.996
Stdev	0.0598	0.0516	0.0514	0.0093
Max	0.8421	0.846	0.849	0.999
Min	0.6261	0.64	0.644	0.968
Medium Banks(4 Banks)				
Average	0.7938	0.6936	0.7071	0.9818
Median	0.8002	0.681	0.706	0.9915
Stdev	0.0348	0.0971	0.0995	0.0269
Max	0.8636	1	1	1
Min	0.7009	0.465	0.468	0.883
Small Banks Excluding Rafidain Bank(12 Banks)				
Average	0.7888	0.7703	0.8119	0.9511
Median	0.791	0.767	0.803	0.968
Stdev	0.0409	0.1084	0.1168	0.0572
Max	0.8744	1	1	1
Min	0.6756	0.575	0.583	0.716
All Banks				
Average	0.7753	0.7349	0.7661	0.9613
Median	0.7911	0.734	0.75	0.981
Stdev	0.0733	0.1215	0.1298	0.0504
Max	0.8744	1	1	1
Min	0.369	0.258	0.272	0.716

4.4 Comparing the Results

The two approaches measure the efficiency of the Jordanian banks relative to different frontier, a stochastic parametric cost frontier and a non-stochastic non-parametric cost frontier. For this reason and as most studies showed that differences in efficiency scores are to be expected, but the two approaches are desired to be consistent. As shown in Table (4.3), there are differences in the magnitudes of the efficiency between the two approaches, and since the linear programming model is non-stochastic,

the normal error term is regarded as inefficiency. Therefore, it is to be expected that the cost inefficiency will be greater relative to a non-stochastic cost frontier than to a stochastic cost frontier. This expectation is met in this study[26]. The average efficiency of the Jordanian banks during the period 1990-1996 obtained from the statistical frontier approach and the data envelopment analysis was 77.5% and 74.5%, respectively.

As for the consistency issue, the two cost efficiency rankings are positively correlated and are statistically significant, since the correlation coefficient is 67.2%. The following graph shows economic efficiency obtained from both approaches.

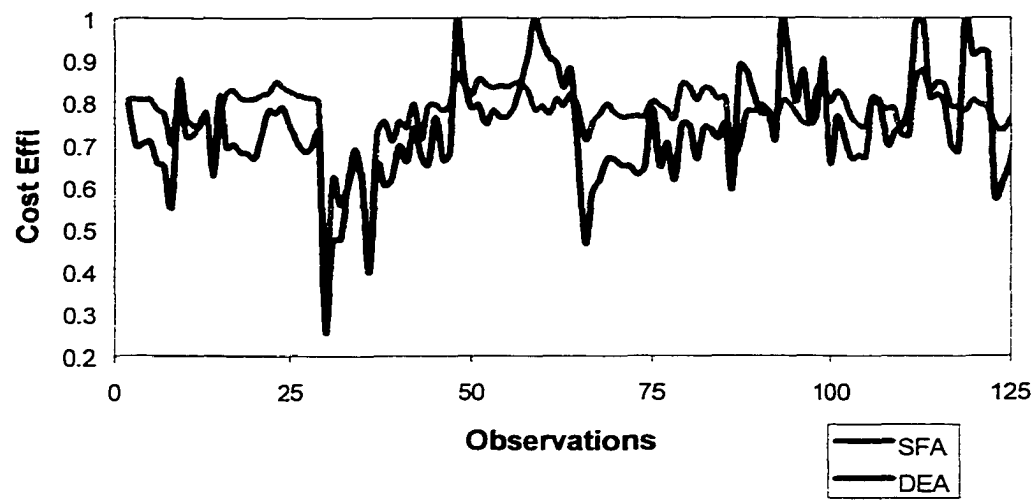

Figure 4.3: Cost Efficiency (DEA VS. SFA)

[26] Ferrier and Lovell in their study " Measuring cost efficiency in banking. Econometric and linear programming evidence found that efficiency scores obtained from the DEA is higher than that obtained from the SFA.

4.5 Decomposing Overall Cost Efficiency into Allocative and Technical Efficiency

For the purpose of decomposing the overall cost efficiency into technical and allocative efficiency, the nonparametric approach was used as explained in the research methodology. Evidence on the cost of technical and allocative efficiencies is summarized in Table (4.3). The cost of technical inefficiency is 23.4% on average during the period of the study, being smallest for the foreign banks (excluding Rafidain bank). As for bank sizes, small banks (excluding Rafidain bank) are the most technically efficient banks compared to large size and medium size banks. Allocative inefficiency[27] also raises cost by 3.9% on average during the period 1990-1996. This result is consistent with other studies for other countries, which found this type of efficiency to be less than five percent. Allocative inefficiency, although relatively minor, is directly induced by regulation. For example during the period 1990-1996, Jordanian banks were subject to many restrictions because of the credit ceiling imposed on the country by the International Monetary Fund in the aftermath of the financial crisis in Jordan in 1989 and the adoption of the structural adjustment program administered by the IMF and the World Bank. Technical inefficiency, which represents the inefficient level of both input and output, is the main source of inefficiency in the Jordanian banks. This inefficiency, while following different trend from the overall efficiency, excessive use of labor,

[27] Other studies concluded that allocative inefficiency is typically found to be relatively minor; usually less than five percent. See Evanoff and Israilevich (1991).

demonstrated by the high ratio of staff per banking office in Jordan[28], and the underutilization of materials is responsible for this inefficiency[29].

The following graph shows the overall efficiency decomposed into technical and allocative efficiency. The overall picture that is derived from the nonparametric cost frontier approach is one of high relatively technical inefficiency and modest allocative inefficiency. The most efficient banks are foreign banks, which belong to the small bank class. The efficiency advantage enables them to compete despite the potential cost disadvantage they suffer due to the structure of efficient technology

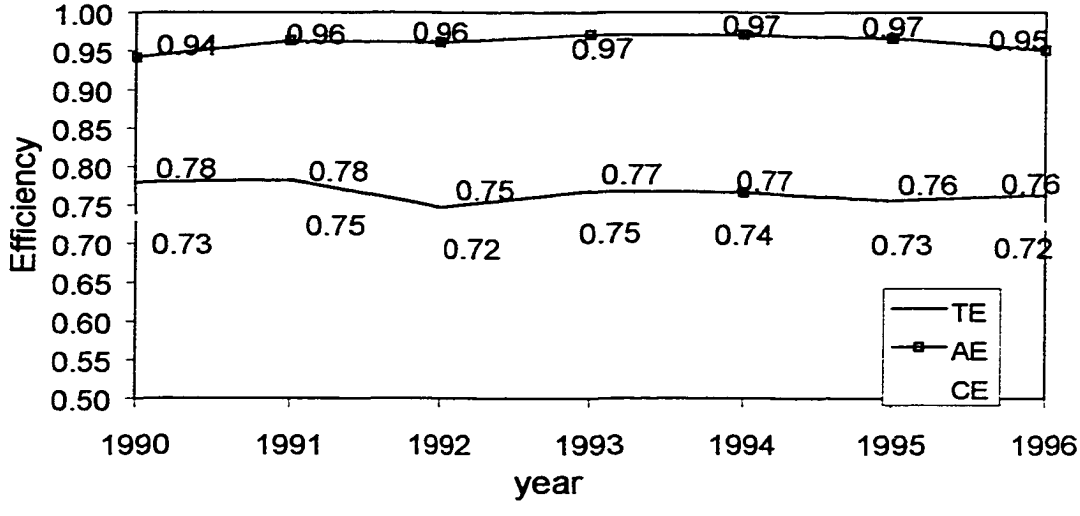

Figure 4.4: Cost Efficiency, Allocative Efficiency and Technical Efficiency

[28] Staff per office in Jordanian banks is higher than that of the US, EU and Japan. See Bonce, J , Nolle, D., and Rice, T.(1997)

[29] Evanoff and Israilevich (1991)

4.6 Stochastic Alternative Profit Frontier Model Estimation

A Cobb-Douglas alternative profit function[30] was specified and estimated for the Jordanian banks during the period 1990-1996. The function is using the same variable used in the estimation of the cost function. The standard neoclassical profit function assumes that banks are price takers in both input and output markets. The alternative profit function assumes that banks can set the output prices. Therefore, the alternative profit function is specified in terms of the input prices and the output quantities like the cost function.

The alternative profit function in log form is[31]:

$$\ln(\Pi_{it} + \theta_2) = \alpha + \beta_1 \ln(W_1) + \beta_2 \ln(W_2) + \beta_3 \ln(Y_1) + \beta_4 \ln(Y_2) + \beta_5 \ln Branch + \ln u + \ln \varepsilon \qquad 4.3$$

Where:

Π_{it}	= The profits before tax for the Jordanian banks.
W_{it}	= A vector of input prices.
Y_{it}	= A vector of output quantities.
Branches	= The number of branches.
U	= The error term due to the profit inefficiency.
ϵ	= The random error term.
θ	= A constant added to every bank's profit so that the natural log is taken of a positive number.

[30] Translog alternative profit function was tried, but, the model did not converge. So the Cobb-Douglas specification was chosen.

The alternative profit efficiency was defined as the ratio of predicted actual profits to the predicted maximum profits for the best practice bank.[32]

$$Alt\,\Pi\,EFF^{b} = \frac{\Pi\hat{}^{b}}{\Pi\hat{}^{\max}} = \frac{\left\{\exp\left[f\hat{}\left(w^{b}, y^{b\cdot}, z^{b}\right)\right] \times \exp\left[\ln u\hat{}^{b}{}_{a\Pi}\right]\right\} - \theta}{\left\{\exp\left[f\hat{}\left(w^{b}, y^{b\cdot}, z^{b}\right)\right] \times \exp\left[\ln u\hat{}^{\max}{}_{a\Pi}\right]\right\} - \theta} \qquad (4.4)$$

Where $\Pi\hat{}^{\max}$ is the maximum value of $\Pi\hat{}^{b}$ in the sample (Berger A. and L. Mester (1997)).

Descriptive statistics for estimated alternative profit efficiency are displayed in Table (4.7). Overall estimated alternative profit efficiency averaged 0.674, had standard deviation of 0.14 and ranged from 0.352 to 0.841. This means that, the average Jordanian bank during the period 1990-1996 could have increased its profits by almost 0.50 of the current level of profit, or equivalently wastes 32.5% of its profit relative to a best - practice bank facing the same conditions.

Large banks in Jordan are more profit efficient than other categories of banks, as they achieved 0.767 average alternative profit efficiency score. Medium size banks occupied the second place with 0.737 and small banks came third with 0.664 average alternative profit efficiency score. If the efficiency scores were segmented by the nationality, national banks and foreign banks are almost the same.

[31] The estimated function was not restricted to be homogeneous of degree one in prices.
[32] A. Berger and L. Mester (1997).

Table 4.7 Alternative Profit Efficiency Estimates for the Jordanian Banks During the Period 1990-1996					
	Average	Stdev	Max	Min	# Of Banks
Large Banks	.767	.009	.776	.757	2
Medium Banks	.737	.047	.805	.677	4
Small Banks	.638	.152	.841	.352	12
Small Banks Excluding Rafidain Bank	.664	.13	.841	.403	11
National Banks	.692	.094	.805	.443	13
Foreign Banks Excluding Rafidain Bank	.695	.198	.841	.403	4
All Banks	.674	.14	.841	.352	18

To summarize, the result of this study showed that the Cobb-Douglas functional form is an adequate representation for the data of the Jordanian banks during the period 1990-1996. The grand mean cost efficiency scores for the Jordanian banks were found to be 77.7% and 73.5% based on the econometric and linear programming approaches. This deviation from the frontier was found to be statistically significant. As expected, the inefficiency scores obtained from the data envelopment analysis were found to be higher than the inefficiency scores obtained from the econometric approach, but the two cost efficiency ranking were positively correlated.

Foreign banks were found to be more cost efficient than national banks. On the other hand, small banks appeared to be more cost efficient than large and medium size banks. The main source of inefficiency for the Jordanian banks was found to be the technical inefficiency. The cost of technical inefficiency for the average bank during the period 1990-1996 was found to be 23.4% compared to 3.9% for the allocative inefficiency. Foreign banks were the most technically efficient banks compared to the national banks, and small banks were the most technically efficient banks among the

different bank sizes. When the technical inefficiency was decomposed into pure technical inefficiency and scale inefficiency, pure technical inefficiency for large banks was dominated by the scale inefficiency. For medium and small banks, pure technical inefficiency dominated the scale inefficiency.

The results from the profit stochastic frontier showed that the nonstandard profit efficiency averaged 67.4%, unlike the results obtained from the cost approach, large banks were found to be more profit efficient than other categories of banks, followed by the medium size banks. In the following section the determinants of efficiency will be investigated by regressing the efficiency scores obtained from the cost approach on a set of economic, structural and financial variables and calculating the spearman correlation coefficient between the nonstandard profit efficiency scores and the same set of variables.

4.7 Empirical Investigation of the Potential Determinants of Efficiency

This section relates the efficiency estimates derived in this study to a set of economic, structural and financial variables that are potential correlates of efficiency. A second stage multiple regression was performed to study the correlation between the cost efficiency estimates and the same factors mentioned above. The alternative profit efficiency scores was correlated with the same factors mentioned above using the Pearson correlation coefficient. First, the second stage regression specification is presented followed by the results and analysis of these results. Finally, the Pearson correlation coefficient is analyzed.

4.7.1 The Second Stage Regression

To investigate the correlation of efficiency with other variables, a nonlinear least square regression was estimated (Berger, A. and L. Mister (1997) and Hao, Hunter and Yang (1998)). It is very important to mention that the regresses provide information on correlation only and not on causality. The correlation should be interpreted with care as one could argue that the significant correlates should be included in the cost model from which the efficiency measurements were derived. This model is specified as:

$$Effi = f(ONE, AGE, AGE2, TA, TA2, ETA, GROW, STA, STA2, BTD, BTD2, DDTD, DDTD2, RISK, DRAFIDAIN, DS, DN, DL) \quad (4.7)$$

Where:

Effi The cost efficiency index calculated in this study.

AGE The number of years a bank existed in logarithm. This variable is included to distinguish between the new banks and the established ones. It is expected that this variable is positively related to the efficiency, as costs in banking are very significantly influenced by the risk of doing business with the client. This in turn is determined by the information the bank has about each customers' credit worthiness, banking needs, banking habits and performance ...etc. Accumulation of such information, however, is costly and most often requires repeated dealings with clients over many years. It is argued that established banks should have good customer base and have a good operative strategies to achieve a higher level of

efficiency following the concept of learning by doing.

AGE2 The square of ***AGE*** and is used to account for the nonlinear effect.

Risk The bank risk, defined as the ratio of the doubtful loans plus doubtful portfolio losses to total loans. Similar studies have used this variable in an attempt to control the differences in efficiency across banks due to differences in credit risk. The coefficient of this variable is expected to be negative.

GROW The growth rate of bank assets over the previous year. This variable is used in many studies as a measure of bank performance. The coefficient of this variable is expected to be positive as more efficient banks grow faster.

BTD The ratio of the number of branches to total deposits. Some studies found this variable to be negatively related to efficiency as it accounts for overhead expenses. However, this variable could have a positive coefficient due to branches playing the role of a selling outlet for financial services.

BTD2 The square of ***BTD*** and is used to account for the nonlinear effect.

TA The total assets. This variable is included in this analysis as a control for the size of the banks and its impact on efficiency.

TA2 The square of ***TA*** and is used to account for the nonlinear effect.

STA The ratio of salaries to total assets. This variable is included to account for the impact of overhead expenses on efficiency. It is expected that this variable will be negatively related to efficiency.

STA2	The square of ***STA*** and is used to account for the nonlinear effect.
ETA	The ratio of the number of employees to total assets. This is included to account for the effect of labor force size on efficiency. The coefficient of this variable is expected to be negative.
DDTD	The ratio of demand deposits to total deposits. This variable was included to capture the impact of composition of deposits on efficiency.
DDTD2	The square of ***DDTD*** and is used to account for the nonlinear effect.
DN	Dummy variables for national banks.
DS	Dummy variables for small banks.
DL	Dummy variables for large banks
DRAFIDAIN	Dummy variables for Rafidain bank

The following logistic functional form was employed, (Hao, Hunter and Yang(1998)):

$$f(y) = e^{y} / 1 + e^{y} = e^{X\beta} / 1 + e^{X\beta} \qquad [8]$$

Equation [8] was estimated using a nonlinear ordinary least square.

4.7.2 Results of the second stage regression

Table (4.7) shows the summary statistics for the variables employed in this regression model. The maximum likelihood estimates of this regression are presented in Table (4.8). As can be seen from the table, the number of employees to total assets (***ETA***), total assets (***TA***), the square of total assets ***(TA2)***, salaries to total assets (***STA***),

the square of salaries per total assets ***(STA2)***, the ratio of the number of branches to total deposits ***(BTD)***, the square of the ratio of the number of branches to total deposits ***(BTD)***, ***(DM)***, ***(DL)***, ***and (DRAFIDAIN)*** all had a statistically significant impact on efficiency in Jordanian banks.

The coefficient estimate for ***ETA*** is negative as expected. This implies that the larger the number of bank employees per million Jordanian Dinar (JD) of total assets, the less efficient the bank. As we explained in chapter two, the number of staff per office is 29 on average during the period 1990-1996, which is higher than the US, G-10, and the EU countries. This high ratio for staff per banking office in Jordan indicates that efficiency is frequently being gained through staff reduction. The coefficient estimated for ***TA*** is positive, but it is statistically significant at 15% level of significance. Indicating the importance of scale on efficiency. This is inconsistent with the findings of this study that small banks are more efficient than large and medium size banks.

As expected, the overall effect of the number of branches per total deposits (***BTD***) was found to be negatively related to efficiency. As mentioned earlier, this could account for the overhead expenses. As the number of branches increases, overhead cost increase, and therefore, efficiency decreases. A 1% increase in the number of branches leads to .54% decrease in the efficiency. The overall effect of ***STA*** was found to positively related to efficiency. This is so, because the efficient banks try to attract good quality employees by offering higher wages and benefits. A 1% increase in ***STA*** increase cost efficiency by 0.142%.

Bank sizes were found to be positively related to efficiency. The coefficient of the dummy variable of large banks is higher than the coefficient of the dummy variable

of medium banks. This finding is consistent with the results of this study, that large banks are more efficient than medium banks. The coefficient of the dummy variable of Rafidain bank is found to be negative. This result is consistent with the results of this study. The coefficient of the variables ***(AGE2), (TA2), (STA2),*** and ***(BTD2)*** are found to be significant indicating the nonlinear effect of these variables on the efficiency.

Table 4.8
Descriptive Statistics

Variable	Mean	Std.Dev.	Minimum	Maximum	Cases
ETA	1.97146	1.131652	0.302391	5.970636	125
AGE	21.56	17.19546	1	67	125
TA	303.014	486.3773	29.3	2711.4	125
GROW	0.16309	0.20108	-0.41022	0.987315	125
STA	9.69E-03	4.02E-03	1.81E-03	2.47E-02	125
STA2	1.10E-04	9.15E-05	3.28E-06	6.09E-04	125
DDTD	0.22939	0.204237	0	0.949474	125
RISK	9.82E-02	9.49E-02	0	0.545455	125
BTD	0.115	0.109307	1.17E-02	0.734694	125
DN	0.72	0.450806	0	1	125
DS			0	1	125
DL			0	1	125
DRAFIDAIN			0	1	125

Note:

ETA Employee to total assets

AGE The number of years a bank exited in logarithm

TA Total assets in logarithm

GROW Growth rate of bank assets

STA Salaries to total assets

DDTD Demand deposits to total deposits

RISK Bank risk (doubtful loans plus doubtful portfolio losses to total

	loans)
BTD	Branch to total deposits
ROA	Return on assets.
DN	Dummy variable for national banks
DS	Dummy variable for small banks
DL	Dummy variable for large banks
DRAFIDAIN	Dummy variable for Rafidain bank

4.7.3 Empirical Investigation of the Potential Correlates of Profit Inefficiency

This section of the analysis relates the nonstandard profit inefficiency score to some of the variables that are used in the previous section that are potential correlates of profit inefficiency; i.e., factors that may explain some of the efficiency in the banking system in Jordan. A Spearman correlation coefficient between the nonstandard profit inefficiency and the factors mentioned in the previous section was performed. The correlation coefficients show that profit efficiency is positively correlated with ***AGE*** of the bank, ***TA*** of banks and ***GROTH*** in bank total assets, size of the banks. The direction of the correlation coefficient was as expected. We were expecting that established banks would be more efficient than new banks; therefore, efficiency was expected to be positively correlated with the age of the bank. The ***GROTH*** variable was also expected to be positively related to efficiency as more efficient banks grow faster. Total assets were also expected to be positively related to the efficiency as large banks were expected to be more cost efficient and thereby more profit efficient. The correlation between large

banks and efficiency was found to be larger than the correlation coefficient for smaller banks.

Alternative profit efficiency is negatively related to the ***BTD, ETA, STA, RISK,*** and the dummy variable of the Rafidain bank. As the ratio of the number of branches to total deposits increases, efficiency decreases. Some studies found this variable to be negatively related to the efficiency as it accounts for the overhead expenses, but some other studies found it to be positively related to efficiency. In this section of the study it is found to be negatively related to efficiency. The ratio of the number of employee to total assets and the ratio of salaries to total assets, which account for the effect of labor force size and the overhead expenses on efficiency, both are negatively related to the efficiency.

Table 4.9
Maximum Likelihood Estimates of the Second Stage Regression

Variable	Coefficient	Level of significance
Constant	0.40	
AGE	-0.12	
AGE2	0.54	*
ETA	-0.286	*
TA	0.516	*
TA2	-0.08	
GROW	-0.113	
STA	41.48	*
STA2	-1551.17	*
DDTD	0.692	
DDTD2	-0.882	
RISK	-0.093	
BTD	-4.91	*
BTD2	5.246	*
DN	0.115	
DM	0.188	*
DL	0.737	*
DRAFIDAN	-1.6	*
Adjuster $R^2 = 78.5\%$		

*: Indicates significant at 5%level of significance.

The results are consistent with the expectations for those variables. Finally, profit efficiency is found to be negatively related to the bank risk as more inefficient banks take more risk as shown in Table (4.9).

Table 4.10
Spearman Correlation Coefficient between the Nonstandard Profit Efficiency and Other Variables

ETA	-0.65
AGE	0.2134
TA	0.425
GROW	0.088
STA	-0.643
DDTD	-0.043
RISK	-0.232
DN	-0.007
DS	0.12
DM	-0.34
DL	0.27
DRAFIDAIN	-0.22
DF	.007
BTD	-0.798

5 *CHAPTER FIVE: SUMMARY AND CONCLUSIONS*

5.1 Conclusions and Policy Recommendation

The primary objective of this dissertation was to undertake an in-depth study of the efficiency of the banking system in Jordan during the period between 1990 to 1996. Two basic frontier approaches have been employed in this study. Those were the parametric and the nonparametric approach. Within the parametric approach the study used the cost and the nonstandard profit stochastic frontier. From the nonparametric approach data envelopment analysis was chosen .

The study first estimated the cost function for the Jordanian banks during the period between 1990-1996. Different functional forms could be adopted to estimate the cost function. To avoid the specification error related to the form of the function, a LaGrange Multiplier (LM) test was conducted. The purpose of the test was to determine whether the functional form of the cost function is of Cobb-Douglas technology against the alternative hypothesis, that the functional form is of translog form. The result of the test showed that the Cobb-Douglas functional form was found to be adequate representation for the data. The study then used the estimated cost frontier to calculate the efficiency score for the Jordanian banking system. Cost efficiency was also calculated using the data envelopment analysis. The study also estimated a nonstandard profit function for the Jordanian banks during the period between 1990-1996 to calculate the profit efficiency. Finally the study analyzed the sources of the cost and profit inefficiencies.

The findings of the study indicated that the choice of efficiency estimation makes a significant difference in terms of the estimated cost efficiency values. Data envelopment analysis estimates exhibited lower average cost efficiency and larger variation than the statistical frontier estimates. The empirical findings confirmed that a substantial cost inefficiency exists in the Jordanian banking system. In addition, several interesting properties of cost efficiency were detected. For example, the study found that the small banking firms on average are more cost efficient than large and medium size banks.

The findings also showed that foreign banks are more efficient than national banks. Furthermore, average cost efficiency appeared to have minor fluctuations over the period of the study. The results indicated that the technical inefficiency component is relatively more important than the allocative component as a source of overall inefficiency. Thus, inefficiency in the Jordanian banks may be to a greater extent attributed to underutilization or wasting of input, rather than choosing the incorrect input combinations.

The percentage increase in observed cost over minimum cost due to overall inefficiency was found to range from 12.6% to 63.1% with an overall mean of 22.5% and from 0 to 74.2% with an overall mean of 26.5% according to the econometric frontier approach and the data envelopment analysis respectively. The percentage increase in observed cost over minimum cost due to technical inefficiency and allocative inefficiency separately were found to range from 0 to 73.2% and 0 to 28.4% with an overall means of 23.6% and 3.9% respectively.

The results from the nonstandard profit efficiency showed that average bank in Jordan is about 32.6% profit inefficient. The average large bank is 23.3% profit

inefficient compared to 26.3 and 33.6% for medium and small banks respectively. profit efficiency scores for national banks are almost the same as those of the foreign banks.

Using the cost efficiency scores estimated in this study a second stage efficiency regression was estimated. The findings of the second stage regression indicated that banks with less employees per total assets, lower ratio of branch per total deposits, higher asset and higher salaries to total assets ratios were the most cost efficient banks, the non linear factors were found to be significant, indicating the nonlinear effect of theses variable on the cost efficiency.

A Spearman correlation coefficient between the nonstandard profit inefficiency and a set of economic, structural, and financial factors was performed. The profit efficiency was found to be positively correlated with the age of the bank, size of the bank and the growth in bank total assets. However, the profit efficiency were found to be negatively correlated with the ratios of branch to total deposits, number of employees to total assets, salaries to total assets and risks

The study found a strong correlation between inefficiency and bank risk taking. Specifically, inefficient banks exhibited higher credit risks. Therefore, the degree of risk taking by the banks deserves closer attention and monitoring by both the bank management and the Central Bank of Jordan (the supervisory agency).

The major sources of inefficiency in the banking system in Jordan were found to be caused by technical inefficiency. When technical inefficiency was decomposed into pure technical inefficiency and scale inefficiency, pure technical inefficiency for small and medium size banks dominated scale inefficiency. For large banks, scale inefficiency

dominated the pure technical inefficiency. As Evanoff and Israilevich[33] suggested that the major sources of inefficiency are the banking regulations. They further concluded that the allocative inefficiency and the pure technical inefficiency resulting from not producing the optimal combinations of output are both induced by regulations. However, the major source of inefficiency, the pure technical inefficiency, is managerially induced, thus underlying the influence of the banking regulations. Therefore, any banking reform in Jordan has to aim at increasing competitiveness this will contribute to eliminating inefficiencies related to regulations. The increased competitive pressure will force banks to operate more efficiently. However, pure technical inefficiency is directly under the control of banks themselves and only the bank management must seek methods to eliminate it.

Since there is a substantial technical inefficiency, which exists in the banking system in Jordan, there is at least some scope for decreasing banking cost through improvements in technical efficiency without resort to improved technologies.

As we noticed from Chapter Three, the banking system in Jordan is highly concentrated, therefore, any banking reform in Jordan aimed at increasing competitiveness in the banking system should be conducted through means other than mergers and consolidations, because mergers will lead to fewer banks in the market, which in turn will generally lead to less competitive performance and conduct. Furthermore, due to the fact that foreign banks are more efficient than national banks the study suggests adopting a policy of encouraging the direct foreign investments in the banking sector and eliminating all barratries facing this investment if any exist.

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[33] production efficiency in banking, Douglas R. Evanoff and Philip R. Israilevich, Federal Reserve Bank of Chicago, Economic Perspective.

5.2 Suggestions for Future research

There are a number of directions in which the research of this study can be extended. First, this study worked with data obtained prior to 1997; therefore, the Jordanian financial reforms, which started at the end of 1996, must be analyzed in depth. Jordan adopted a number of measures aiming at promoting efficiency and competition in the banking sector, strengthening the prudential framework, and developing the financial markets. Hence, analyzing the impact of the changes caused by deregulations on the cost structure of the Jordanian banking system is very important for researchers and policy makers.

A study to estimate a system of cost equations to decompose the overall cost efficiency into allocative and technical efficiency can be conducted. The results of such a study can be compared to the finding of this dissertation which uses the data envelopment analysis. In spite of the findings of this dissertation, such an exercise would be worth trying to reinforce the findings presented here by using the nonparametric approach.

A third direction for future research would be to perform an in-depth investigation of the existence and the magnitude of economies of scale and scope in the operations of the Jordanian banking system.

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