Efficiency and Productivity Growth of the Arab Commercial Banking Sector: A Non-Parametric Approach

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Abstract

The last 25 years have seen significant structural change in the Arab financial market. New policies based on financial liberalization and restructuring were implemented with the main objective of fostering competitiveness and enhancing the efficiency and productivity of the banking sector. Using a non-parametric approach, a DEA-type Malmquist Index, which consists of applying the data envelopment analysis (DEA) to obtain DEA Malmquist Index, this paper investigated the impact of these reforms on the development of the performance and productivity of commercial banks operating in 11 Arab countries over the period 1994-2004. The Malmquist Index was divided into pure technical change, technological change, and efficiency scale change to investigate the sources of productivity changes, if any. The majority of banking sectors involved in this study have maintained or improved their efficiency measures. It should be noted that these improvements are mainly due to positive technological changes and innovations. The scale efficiency measures do not show any significant influence on these improvements. However, results show a decline in the total factor productivity (TPF) over the study period in all countries. A regression of efficiency scores on some environmental and managerial factors was used to investigate the determinants of Arab banking sector efficiency.

الكفاءة والإنتاجية في القطاع المصرفي التجاري العربي

وداد سعد
شوقي الموسوي

ملخص

شهدت السنوات الـ 25 الماضية تغييراً هيكلياً كبيراً في الأسواق المالية العربية، حيث تم وضع سياسات جديدة مرتكزة على تحرير القطاع المالي وإعادة هيكليته وذلك بهدف تعزيز القدرة التنافسية وزيادة الكفاءة والإنتاجية في القطاع المصرفي. وبإستخدام المؤشر القياسي malmquist، الذي يرتكز في تطبيقه على (Data Envelopment Analysis)، يعمل هذا البحث على دراسة تاثير هذه الاصلاحات على تطوير الأداء والإنتاجية في المصارف التجارية العاملة في 11 بلداً عربياً على مدى الفترة الواقعة بين عامي 1994 و 2004. لقد تم تقسيم مؤشر malmquist إلى كل من التغيير التقني البحت والتغيير التكنولوجي والتغيير في كفاءة الحجم وذلك من اجل التحقق من مصادر التغيرات الإنتاجية، إن وجدت. غالبية القطاعات المصرفية المشمولة في هذه الدراسة قد حافظت او حسنت من كفاءتها. وتجدر الإشارة إلي ان هذه التحسينات الإيجابية ترجع أساساً إلي التغيرات التكنولوجية والابتكارات الحديثة. من الملفت ان كفاءة الحجم لا تظهر اي تاثير يذكر على هذه التحسينات. ومع ذلك، فقد اظهرت النتائج انخفاضا في الإنتاجية الكلية لعوامل الإنتاج على مدى فترة الدراسة في جميع البلدان. واخيراً تم استخدام نموذج قياسي اقتصادي لمعرفة المحددات والعوامل البيئية والإدارية المؤثرة في كفاءة القطاع المصرفي العربي.

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Introduction

Over the last two decades, Arab countries have taken significant measures to strengthen and develop their financial sectors. Domestic reforms and deregulation have been implemented with a focus on greater dependence on market forces, liberalization of financial services, fostering organization and supervisory frameworks, and enhancing competition to be in line with international financial standards and to meet the demands of globalization.

Until the 1970s, the Arab banking system suffered from many factors that contributed to its weakness such as the monopoly of public sector banks (especially in Egypt, Iraq and Syria), the deterioration of the quality of services, distorted macroeconomic framework mainly reflected in negative real interest rates and chronic balance of payments deficit, intervention of governmental authorities in the allocation of credit, the substantial intervention of central banks in the determination of services charges and tariffs, and administrative inefficiency that manifested its features in the lack of highly skilled personnel and over-staffing.

In the late 1970s, several Arab countries started to adopt new policies towards economic liberalization and reliance on the private sector with an intense focus on greater dependence on market forces. Hence, various reforms were introduced in the banking system such as: (a) giving more autonomy to central banks by providing them the only authority to determine the monetary policy without the intervention of executive or legislative authority and by insuring the stability of the local currency and general price level; (b) introducing competition by granting licenses to new banks both national and foreign; for instance, the number of commercial banks in Egypt has increased from 4 to 50 banks; (c) introducing reforms to public sector accompanied by a process of privatization; (d) implementing deregulation of tariffs and charges; (e) imposing a minimum level of capital to meet the requirement of the changing conditions; and (f) shifting to prudential supervision on commercial banks by implementing several steps including capital adequacy ratios according to the "Basle Accord"(1), liquidity ratios, etc.

Domestic financial institutions have responded positively to changes in financial policies. The banking sector has witnessed sustained growth in its overall activity since the beginning of the 1990s in line with the reforms and deregulation. They have accommodated modern developments in the financial sector, enhanced capitalization, introduced new products and services, applied new technologies, developed their frameworks and ventured into new financial businesses.

It is worth indicating at this point that 100 Arab banks were included in the Banker's List of the Top 1000 International Banks as of July 2004 in terms of tier-1 capital(2). These included 9 Bahraini banks, 16 Egyptian banks, 18 Emirate banks, 4 Jordanian banks, 7 Kuwaiti banks, 10 Lebanese banks, 5 Omani banks, 10 Saudi Arabian banks, 6 Qatari banks, 7 Tunisian banks, 5 Moroccan banks, 2 Libyan banks, and 1 Syrian bank.

As a reflection of the various reforms and deregulation, the Arab banking sector should foster its efficiency and accelerate its development. Therefore, in light of the implemented reforms, there is a need to examine the development of the efficiency and productivity of the Arab banking sector, assess the effectiveness of the implemented financial measures and inspect whether these measures serve to increase competition and enhance the drive for better performance. Moreover, it is important to study the determinants of efficiency since they are extremely useful for policymakers to implement, if needed, appropriate regulatory environment.

In this paper, the focus lies on commercial banks pertaining to 11 Arab countries which were chosen for their data availability. The objective of this paper is to investigate and compare their productivity growth during the deregulation and reform period from 1994 to 2005. This study uses a non-parametric approach, a DEA-type Malmquist Index, which consists of applying the data envelopment analysis (DEA) to obtain Malmquist Index. Productivity growth has also been decomposed into technological change, or change in best practice, and efficiency change to reveal the qualitative productivity improvements. In this paper, the determinants of efficiency of Arab commercial banks are also investigated using second stage regressions.

Literature Review

The last two decades have witnessed revolutionary changes in the financial institutions all over the world. This phenomenon was translated into a considerable number of theoretical and empirical studies that focused on the impact of deregulation, privatization, and globalization, among others, on the efficiency and productivity of financial institutions.

Although policymakers believe that improving the efficiency and performance of financial institutions is better implemented through regulatory reforms aimed at increasing bank competition on price, product, services, and territorial rivalry (Smith, 1997), the empirical evidence on the effect of such initiatives has been mixed. This phenomenon may be attributed to the use of different approaches to estimate the best practice frontiers - parametric or non-parametric approaches - or to the approach adopted to define input and output variables (e.g. production, intermediation approaches, etc.).

Among the studies that focus on a single country, a number of studies that have explored the effects of deregulation and liberalization on a specific banking sector may be referred to. Some of these studies found that banks experienced productivity growth in a more liberal environment. The empirical research of Berg, Forsund, and Jansen (1992) is one of the initial studies that have introduced the Malmquist Index to measure the productivity in the banking industry. They focused their study on the Norwegian banking system over the period 1980-1989. They found that productivity increased when deregulation took place. The same results were found in other countries such as in Korea (Gilbert and Wilson, 1998); Taiwan (Chen, Liou, and Wu, 2004); India (Bhattacharya et al., 1997); Spain (Grifell-Tatje and Lovell, 1996).

In some cases, deregulation has a negative impact on the productivity of the banking industry. For instance, Wheelock and Wilson (1999) examined the productivity change for all US banks during the period 1984-1993. They found that a decrease in productivity over this period. Another study on US securities industry between 1980 and 2000 (Elyasiani and Mekdian, 1995) indicated significant and substantial productivity gains and declines in managerial efficiency. Humphrey and Pulley (1997) examined Turkish banking efficiency before and after liberalization and found that liberalization programs were followed by an observable decline in efficiency. Moreover, a study on the effect of deregulation on the performance of Spanish savings banks (Grifell-Tatje and Lovell, 1997; Kumbhakar et al., 2001) also showed declining levels of output along with a significantly high rate of technical progress. However, this decline in technical efficiency was accompanied by an increasing trend in productivity growth. On the other hand, it was found that in Tunisia (Cook et al., 2000) and in Turkey (Yildirim, 2002), liberalization and deregulation do not effect efficiency.

Similarly, a number of studies have focused on a group of countries to investigate their productivity growth over a period of time. The results of these studies are spread between finding positive or negative effects on the productivity of the banking sectors. For instance, the study of Williams (2001) on European saving banks reported that deregulation resulted in an increase in productivity of these banks over the period 1990-1998. Casu and Molyneux (2003) investigated the efficiency and productivity of European banking systems and discovered an improvement of these measures over the period 1993-1997. Many other European studies have addressed this issue and found a positive impact on productivity such as those of Maudos et al. (2002), Altumbus et al. (2004), and Casu, Girardone, and Molyneux (2004). However, several studies showed a decline in the productivity the banking sectors such as that of Lozano-Vivas, Pastor, and Pastor (2002) who examined the efficiency in ten European countries.

Some studies showed inter-country productivity differences such as that of Bikker (2001) who studied the productivity of a sample of European countries and concluded that some countries showed an improvement in their banking system productivity, whereas others demonstrated a decline in the productivity of their banks.

Methodology

Two methods are applied in this study: Data Envelopment Analysis (DEA) and the Malmquist productivity change index. These procedures are commonly used techniques to measure the efficiency and the productivity change of firms. The second-stage regressions were also used to investigate the determinants of efficiency in Arab commercial banks.

Data Envelopment Analysis

According to Farrell (1957), efficiency is defined as the actual productivity of a firm in relation to its maximum-potential productivity. The latter, which is also called “best practice” is materialized by the production frontier. Hence, efficiency measurement implies measuring the distance to this frontier. There are two techniques to quantify the production frontier: (a) a parametric approach, through stochastic analysis or (b) a non-parametric approach through Data Envelopment Analysis, DEA, which is a procedure pioneered by Charnes et al. (1978) and extended by Banker et al. (1984).

In order to construct the non-parametric frontier which could be used as a benchmark for efficiency measures, it is assumed that there are K inputs an M outputs for each of N banks and for each period of time t = 1,…, T. The column vectors $x_{i,t} \in R^{K}_{+}$ and $y_{i,t} \in R^{M}_{+}$ represent the inputs and outputs of bank i at time t. The K × N input matrix, X_t, and the M × N output matrix, Y_t, represent the data for all N banks at time t.

An input-oriented DEA model is defined as follows:

$$\begin{aligned} & Min_{\theta,\lambda}\ \theta \\ & S.t.\quad X_t\lambda - \theta x_{i,t} \le 0 \\ & \qquad Y_t\lambda \ge y_{i,t} \\ & \qquad \lambda \ge 0 \end{aligned} \qquad \text{(Model 1)}$$

Where θ is a scalar that represents the technical efficiency score (TE_i) for the i-th firm at time t and λ is an N × 1 vector of constants. The obtained value of θ is bounded by zero and unity ($0 \le \theta \le 1$), with a value of 1 indicating a point on the frontier and hence technically efficient firm. The set of efficient banks constitute the production frontier over the data. Efficiency measures are then calculated relative to this frontier. Firms with efficiency scores less than 1 are considered to be technically inefficient. For each year t the linear programming Model 1 must be solved N times, once for each firm in the sample. Hence, a value of θ is obtained for each firm.

Malmquist Index of Productivity Growth

To estimate the productivity change for Arab commercial banking sectors, the DEA Malmquist Index(3) was used. The Malmquist Index was originally introduced in the theory of consumer by Malmquist (1953). It consists of a ratio between two proportional scaling factors or distance functions. It identifies productivity differences between two firms or one firm over two-time periods. Shephard (1953, 1970) provided a theoretical base for the Malmquist productivity index. Caves, Christensen and Diewert (1982) were the pioneers in developing and presenting it as theoretical index by using distance functions in productivity analysis. They proposed two types of productivity, namely: output-based and input-based indices.

To illustrate the measurement of Malmquist Index and its decomposition, consider the production possibility set which is defined by $S_t=\{(x_t,y_t)/x_t$ can produce y_t at time t$\}$. The technology at period t is expressed by the input requirement set $L_t(y_t)$ as follows:

$$L_t(y_t) = \{x_t / (x_t, y_t) \in S_t\} \quad t = 1,\ldots,T. \tag{1}$$

This set provides all the feasible input vectors, $x_{i,t} \in R^K_+$, that can produce the output vector, $y_{i,t} \in R^M_+$. Defining $G^t_i(x_t,y_t)$ as the input-oriented Farrell measure, and $d^t_i(x_t, y_t)$ as Shephard's input-oriented distance function at period t with constant returns to scale, results in the following:

- $G^t_i(x_t, y_t) = min\{\theta / (\theta x_t, y_t) \in L_t(y_t)\}$, which measures the minimum possible expansion of x_t, given y_t,
- $d^t_i(x_t, y_t) = max\{\theta / (x_t / \theta, y_t) \in L_t(y_t)\}$, which estimates the maximum possible contraction of x_t, given y_t. Alternatively, the input distance function can be written as the reciprocal to Farrell's (1957) measure of technical efficiency.

$$d^t_i(x_t, y_t) = (min\{\theta / (\theta x_t, y_t) \in L_t(y_t)\})^{-1} \tag{2}$$

Technical efficiency TE is therefore defined as: $TE = \frac{1}{d^t_i(x_t, y_t)}$ or $(d^t_i(x_t, y_t))^{-1} = TE$

Taking t as the base period, the input-oriented Malmquist Index proposed by Caves et al. (1982) can be defined as:

$$M_i^{t,t+1}(x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{d^t_i(x_{t+1}, y_{t+1})}{d^t_i(x_t, y_t)}\right] \tag{3}$$

Similarly, taking (t+1) as the base period, the input-oriented Malmquist Index can be defined as:

$$M_i^{t+1,t}(x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{d^{t+1}_i(x_{t+1}, y_{t+1})}{d^{t+1}_i(x_t, y_t)}\right] \tag{4}$$

A graphical presentation of these distances is illustrated in Figure 1 which depicts constant returns to scale frontiers F_t(CRS) and F_{t+1}(CRS) relative to periods t and (t + 1) and involves a single input and a single output. Let points α and β represent a bank A in periods t and t + 1, respectively. In each period, this bank is technically inefficient since it is operating below the efficient frontier for that period. Thus, Equations 3 and 4 may be expressed in terms of input distances on the x-axes in Figure 1 as follows:

$$M_i^{t,t+1} = \frac{y_{t+1}\beta / y_{t+1}c}{y_t\alpha / y_t g} \quad \text{and} \quad M_i^{t+1,t} = \frac{y_{t+1}\beta / y_{t+1}a}{y_t\alpha / y_t e} \tag{5}$$

Färe et al. (1990 and 1992) defined Malmquist productivity index as a geometric mean of the two Malmquist indices (Equations 4 and 5) that are suggested by Caves et al. (op cit.). These indices are expressed in distance functions and equivalent to the reciprocal to Farrell's (1957) measures of technical efficiency. Färe et al. (1994) developed empirical models to calculate the Malmquist index using Farrell's (op cit.) deficiency indicators.

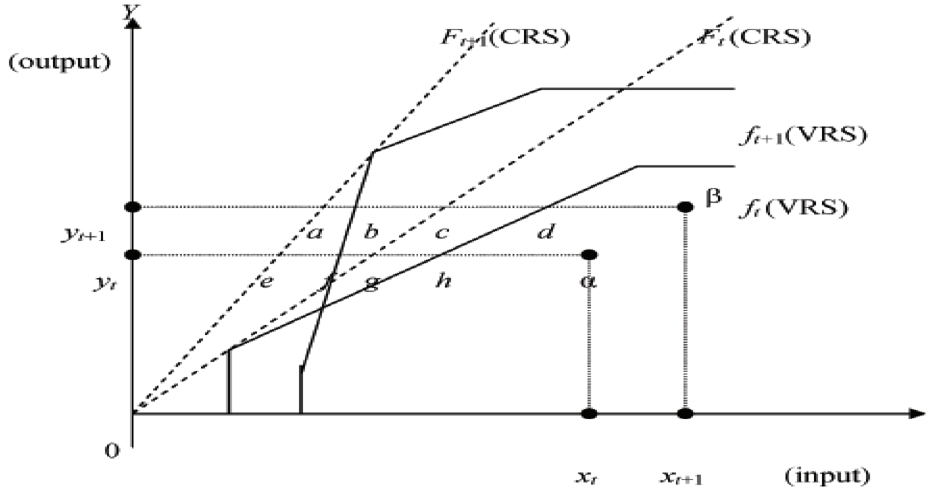

Figure 1. Measurement of the Malmquist productivity index.

Thus, the input-oriented Malmquist productivity change index M_i between period t and period (t + 1) may be defined using distance functions representing the four combinations of adjacent time periods:

$$M_i(x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{d_i^t(x_{t+1}, y_{t+1})}{d_i^t(x_t, y_t)} \times \frac{d_i^{t+1}(x_{t+1}, y_{t+1})}{d_i^{t+1}(x_t, y_t)} \right]^{1/2} \quad (6)$$
$$= \quad M_{i1} \quad \times \quad M_{i2}$$

where M_{i1} represents the Malmquist Index evaluated with respect to F_t(CRS) frontier and M_{i2} is the Malmquist Index that is calculated relative to F_{t+1}(CRS). All other variables are as previously defined. Therefore, M_i may take a value greater than, equal to, or less than 1 depending on whether the bank i experiences productivity growth, stagnation, or productivity decline. Equation 6 is written, in terms of input distances on the x-axes in Figure 1 as:

$$M_i^{t,t+1} = \left[\frac{y_{t+1}\beta / y_{t+1}c}{y_t\alpha / y_t g} \times \frac{y_{t+1}\beta / y_{t+1}a}{y_t\alpha / y_t e} \right]^{1/2} \quad (7)$$

To determine the source of productivity change, Färe et al. (1992) decomposed this productivity index into two components: the technical efficiency change and the technological change. Thus, the Malmquist total factor productivity index (TFP) is written as:

$$M_i(x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{d_i^{t+1}(x_{t+1}, y_{t+1})}{d_i^t(x_t, y_t)}\right] \times \left[\frac{d_i^t(x_{t+1}, y_{t+1})}{d_i^{t+1}(x_{t+1}, y_{t+1})} \times \frac{d_i^t(x_t, y_t)}{d_i^{t+1}(x_t, y_t)}\right]^{1/2} \quad (8)$$
$$= \quad TEC_i \quad \times \quad TC_i$$

where TEC_i is the technical efficiency change that measures how close is the bank i gets to the efficient frontier (catching up effect) and TC_i represents the technological change and indicates how much the production frontier shifts (innovation or shocks). The first (TEC_i) component could be greater than, equal to, or less than 1 if the bank is becoming closer, unchanging, or moving away from the production frontier. Similarly, the second components (TC_i) may take a value greater than, equal to, less than 1 the technological best practice is getting better, unchanged, or worsening, respectively. Equation 8 is written, in terms of input distances on the x-axes in Figure 1, as:

$$M_i(x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{y_{t+1}\beta / y_{t+1}a}{y_t\alpha / y_t g}\right] \times \left[\frac{y_{t+1}\beta / y_{t+1}c}{y_{t+1}\beta / y_{t+1}a} \times \frac{y_t\alpha / y_t g}{y_t\alpha / y_t e}\right]^{1/2} \quad (9)$$
$$= \quad TEC_i \quad \times \quad TC_i$$

Technical efficiency change= $TEC = \dfrac{y_{t+1}a / y_{t+1}\beta}{y_t g / y_t \alpha}$ (10)

Technical efficiency change= $TC = \left[\dfrac{y_{t+1}\beta / y_{t+1}c}{y_{t+1}\beta / y_{t+1}a} \times \dfrac{y_t\alpha / y_t g}{y_t\alpha / y_t e}\right]^{1/2}$ (11)

All the previous calculations are done under the assumption constant returns to scale (CRS). Färe et al. (1994) relaxed the (CRS) assumption and adopted the variable returns to scale (VRS) in order to decompose the (CRS) efficiency change index in Equation 10 into its pure technical efficiency change (PTE_i) and scale efficiency change (SEC_i) components. The latter captures changes in deviation between the VRS and CRS technologies. The efficient frontiers under the (VRS) assumptions for the t and (t + 1) periods are f_t(VRS) and f_{t+1}(VRS) in Figure 1.

The generalized form of the Malmquist productivity index or the

Malmquist TFP may be written as follows:

$$M_i(x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{d_{i,V}^{t+1}(x_{t+1}, y_{t+1})}{d_{i,V}^{t}(x_t, y_t)}\right] \times \left[\frac{d_{i,C}^{t}(x_{t+1}, y_{t+1})}{d_{i,C}^{t+1}(x_{t+1}, y_{t+1})} \times \frac{d_{i,C}^{t}(x_t, y_t)}{d_{i,C}^{t+1}(x_t, y_t)}\right]^{1/2} \quad (12)$$

$$\times \left[\frac{d_{i,C}^{t+1}(x_{t+1}, y_{t+1}) / d_{i,V}^{t+1}(x_{t+1}, y_{t+1})}{d_{i,C}^{t}(x_t, y_t) / d_{i,V}^{t}(x_t, y_t)}\right]$$

where the first factor in Equation 13 represents the pure technical efficiency change, $PTEC_i$, the second factor is the technological change, TC_i, and the third factor represents the scale change, SEC_i. The subscripts C and V in Equation 13 indicate that distance functions are measured under CRS and VRS assumptions respectively. If SEC_i is equal to, less than 1, the bank is operating at the optimal of suboptimal scale, respectively. Figure 1 illustrates these concepts. Hence, Equation 12 is written, in terms of input distances on the x-axes, as:

$$M_i(x_t, y_t, x_{t+1}, y_{t+1}) = \left[\frac{y_{t+1}\beta / y_{t+1}b}{y_t\alpha / y_t h}\right] \times \left[\frac{y_{t+1}\beta / y_{t+1}c}{y_{t+1}\beta / y_{t+1}a} \times \frac{y_t\alpha / y_t g}{y_t\alpha / y_t e}\right]^{1/2} \quad (13)$$

$$\times \left[\frac{(y_{t+1}\beta / y_{t+1}a)/(y_{t+1}\beta / y_{t+1}b)}{(y_t\alpha / y_t g)/(y_t\alpha / y_t h)}\right]$$

Under the CRS assumption, the calculations of the Malmquist productivity index and its components involve solving four different functions, which are the reciprocal to the Farrell (1957) technical efficiency measures. The DEA technique is used to assess the frontier functions, upon which the radial measures of bank efficiency is evaluated.

Thus, under the CRS assumption, four distance functions must be calculated. For each bank, in order to measure the productivity change between two periods t and (t + 1). For the i-th bank theses models are written as follows:

- Efficiency of bank in period t + 1

$$\begin{aligned} Min_{\phi,\lambda} \quad & \theta = \left[D_i^{t+1}(x_{t+1}, y_{t+1})\right]^{-1} \\ S.t. \quad & X_{t+1}\lambda - \theta x_{i,t+1} \leq 0 \\ & Y_{t+1}\lambda \geq y_{i,t+1} \\ & \lambda \geq 0 \end{aligned} \quad \text{(Model 2)}$$

where θ represents the relative efficiency of a bank i in period t + 1 compared to the period t + 1 frontier.

- Efficiency of bank in period t

$$\begin{aligned} &Min_{k,\lambda} \quad \theta = \left[D_i^t(x_t, y_t)\right]^{-1} \\ &S.t. \quad X_t\lambda - \theta x_{i,t} \le 0 \\ &\qquad Y_t\lambda \ge y_{i,t} \\ &\qquad \lambda \ge 0 \end{aligned} \qquad \text{(Model 3)}$$

where θ represents the relative efficiency of a bank i in period t compared to the period t frontier.

- Efficiency of a bank i in t period relative to the t + 1 period

$$\begin{aligned} &Min_{k,\lambda} \quad \theta = \left[D_i^{t+1}(x_t, y_t)\right]^{-1} \\ &S.t. \quad X_{t+1}\lambda - \theta x_{i,t} \le 0 \\ &\qquad Y_{t+1}\lambda \ge y_{i,t} \\ &\qquad \lambda \ge 0 \end{aligned} \qquad \text{(Model 4)}$$

where θ represents the relative efficiency of a bank i in period t compared to the period t + 1 frontier.

- Efficiency in of a bank i in t + 1 period relative to the t period

$$\begin{aligned} &Min_{\theta,\lambda} \quad \theta = \left[D_i^t(x_{t+1}, y_{t+1})\right]^{-1} \\ &S.t. \quad X_t\lambda - \theta x_{i,t+1} \le 0 \\ &\qquad Y_t\lambda \ge y_{i,t+1} \\ &\qquad \lambda \ge 0 \end{aligned} \qquad \text{(Model 5)}$$

where θ represents the relative efficiency of a bank i in period t + 1 compared to the period t frontier.

This approach provides constant returns to scale technical efficiency. To get variable returns to scale the constraint: $\sum_{j=1}^{n} \lambda_j = 1$ is added

The addition of this constraint to the models allows the computation of the two distance functions relative to each bank under the VRS assumption.

It is important to note that in the above linear programming models (LP), where production points are compared to best practice frontiers from different time periods, the θ parameter is not necessary to be less than or equal to one, as it must be when computing Farrell input-based technical efficiencies. The data points could lie above the production frontier. This may occur in Model 4 when a production point from period (t + 1) is to a frontier from an earlier period t. If technical progress is observed than a value of $\theta > 1$ is possible. This may also occur in Model 5 if technical regress is observed, but this is less likely to happen.

Second-Stage Regressions

To further investigate whether the regulatory policies and liberalization or the environmental conditions improved the efficiency of Arab commercial banks and to understand what managers can do to increase the efficiency of their banks, a two-stage procedure was employed based on studies done by Berger et al. (1993), Allen and Rai (1996), and Mester (1993). This procedure consists of obtaining the efficiency scores for banks for each year in the sample period derived from the DEA calculations (first stage), and then regressing the resultant scores on a set of relevant variables (second stage) that describes the economic environmental factors and managerial factors being examined. The model used may be written as follows:

$$ET = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + \varepsilon \tag{14}$$

Where ET is the technical efficiency of banks, X_i is the vector of explanatory variables, and ε is the error term.

The internal determinants are from accounting documents of the bank, such as the profit and loss account, balance sheet and off-balance sheet. They may be classified as managerial or microeconomic variables. On the other hand, external conditions reflect the economic environment (financial and legal environment) that is likely to affect the performance of banks.

Data Description and Variable Definitions

A key assumption in Data Analysis Development is that banks examined have to be relatively homogenous, provide similar services and use similar resources. For this reason, the authors concentrated on 125 commercial banks pertaining to 11 Arab countries during the period 1994-2004. The data consist of annual observations and obtained from financial statements of banks and from the Fitch-IBCA Ltd Bankscope CD Rom. Arab countries included in this study and the number of commercial banks considered in each country is presented in Table 1.

Table 1. Number of Observed Commercial Banks in each Arab Country

Country	Lebanon	Saudi Arabia	Qatar	Kuwait	Jordan	AEU	Tunisia	Bahrain	Oman	Morocco	Egypt
Number of banks	38	9	4	6	8	14	8	6	5	7	20

However, numbers of commercial banks in these Arab countries exceed the number of banks used in this study. This is because the authors were constrained by the availability of data over the whole period from 1994 to 2004. As a result, sample usable data for 125 commercial banks that cover a period of 11 years were used.

The definition of input and output variables in banking modeling behavior is a controversial issue (Berger and Humphrey (1997). The main disagreement focuses on whether deposits should be considered as inputs or outputs. However, two main approaches that guide the choice of input and output variables are found in the banking literature: (a) the production approach, and (b) the intermediation approach (see Athanassoupoulus, 1997; and Cinca, et al., 2002). The production approach treats banks as producers of fee based services to customers using various resources. Thus, according to this approach, deposits and loans are considered as outputs in the model (Zenios, et al., 1999; and Drake, 2001). In the contrast, under the intermediation approach, banks are considered as financial intermediaries that collect funds in the form of deposits and other loanable funds and lend them out as loans or other assets earning an income. Therefore, the values of the various interest bearing assets on the balance-sheet are defined as outputs and deposits and borrowed funds, capital and labor are considered as inputs (Miller and Athanasios, 1996; Drake, 2001).

However, there is no consensus on the specification of bank outputs and no approach can be considered as superior to others. In this study, the analysis is carried out using the intermediation approach. Consequently, the output variables are defined as: total earning assets (TEA), other earning asset (OEA), and off balance sheet activities (OBS); whereas the input variables are defined as: deposits (DEP), personal expenses (PEX), and fixed assets (FAS). The three inputs and three outputs are expressed as monetary variables, in millions of dollars.

Table 2 presents a summary of descriptive statistics for outputs and inputs across the commercial banks of each country and each year. Sample means, maximums, minimums, standard deviations, and coefficients of variation for each Arab country are reported over the period 1994-2004. Table 2 presents the results for variability, measured as standard deviation and coefficient of variation. Despite a slight decrease in the coefficient of variation (σ/m), it may be noted that the dispersion (σ) of the data is relatively constant over the considered period. Besides, this dispersion is relatively homogenous among the different variables. In fact, the coefficient of variation, established for each input and each output , remains in a narrow interval: [0.16, 1.14] for Lebanon; [0.62, 1.04] for Kuwait; [0.46, 1.77] for Qatar; [0.5, 1.77] for Bahrain; [0.31, 0.69] for Oman; [0.24, 1.03] for Saudi Arabia; [0.31, 1.10] for Egypt; [0.18, 0.50] for Tunisia; [0.44, 0.92] for Morocco; [1.04; 1.84] for Jordan; and [0.12, 0.93] for UAE.

Table 2. Descriptive Statistics for Input and Output Variables

		Total Earning Asset		Deposit		Off Balance Sheet		Other Earning Asset		Fixed Asset		Personnel Expenses	
		1994	2004	1994	2004	1994	2004	1994	2004	1994	2004	1994	2004
Lebanon	Max	2275913	16120464	2073092	13621134	223454	8321109	1881406	13993142	53799	603965	20752	136156
	Min	1184668	7082174	1055669	6161165	152359	941030	810465	5243368	18684	152704	11257	50842
	Mean	1720290	12148021	1539858	10327400	195287	3072549	1210386	9834885	33254	325423	15744	82849
	σ	461971	4230262	416414	3700654	31179	3511683	467712	3867792	17050	211875	4166	36963
	σ/m	0.27	0.35	0.27	0.36	0.16	1.14	0.39	0.39	0.51	0.65	0.26	0.45
Kuwait	Max	12797548	18117408	7384713	15822192	2920498	5297251	8685859	8803868	138944	138785	67973	116729
	Min	2633613	5635562	1666333	4361384	451819	582287	1976210	2335596	24657	21378	13661	24432
	Mean	4899041	7982242	3094096	6748501	938125	2379878	3704574	3729442	69195	63963	27045	46545
	σ	3928609	4987741	2148664	4493630	977086	1707924	2502194	2500544	44059	40157	20267	34823
	σ/m	0.80	0.62	0.69	0.67	1.04	0.72	0.68	0.67	0.64	0.63	0.75	0.75
Qatar	Max	4165659	9912940	2102610	8727280	6577582	7858516	1458077	2607885	17198	145165	31126	50604
	Min	343462	1136566	314368	910357	131071	588764	104643	739643	4478	7500	4203	8187
	Mean	1466889	4314107	890282	3662205	1797101	2785481	524719	1557432	11566	66985	12802	27390
	σ	1807726	3850476	821143	3459469	3188471	3405536	627669	775331	5294	62663	12418	17510
	σ/m	1.23	0.89	0.92	0.94	1.77	1.22	1.20	0.50	0.46	0.94	0.97	0.64
Bahrain	Max	18238000	18678900	16100000	10814500	26040000	8960000	7813000	13392600	433000	143000	231000	121000
	Min	523138	3614894	448138	3046543	238298	655851	186436	1581117	6649	17800	5851	35372
	Mean	6954777	11083174	6227582	7624411	7135730	3303413	3179101	7076579	121200	64458	69669	73118
	σ	8101332	6683089	7154873	3797421	12629101	3843967	3513522	5006492	208134	54899	107856	39180
	σ/m	1.16	0.60	1.15	0.50	1.77	1.16	1.11	0.71	1.72	0.85	1.55	0.54
Oman	Max	758388	4621847	706632	3474642	340442	880104	189857	1164369	24707	30949	15605	67100
	Min	254616	1303251	206762	1109493	154486	240832	49415	246034	2341	9103	7282	17425
	Mean	579844	2358388	533810	1898700	248440	575878	133680	597269	13199	20221	11509	35371
	σ	225144	1523875	225525	1067077	77665	303584	67365	400722	9154	9196	3530	21829
	σ/m	0.39	0.65	0.42	0.56	0.31	0.53	0.50	0.67	0.69	0.45	0.31	0.62

Table 2. Continuation

		Total Earning Asset		Deposit		Off Balance Sheet		Other Earning Asset		Fixed Asset		Personnel Expenses	
		1994	2004	1994	2004	1994	2004	1994	2004	1994	2004	1994	2004
Saudi Arabia	Max	16518798	32518719	16037731	30100480	26208090	5741629	8142323	16596635	888171	386782	216636	287076
	Min	7482403	14681789	7206115	14989720	5555434	2493191	4517730	7912016	95140	102109	93218	151909
	Mean	12024166	22446002	11362424	20740527	15407510	4820227	6666435	11482150	359860	251449	138418	216322
	σ	3815938	7722125	3685773	6816440	8458539	1555502	1631041	3719005	368955	131818	54880	56295
	σ/m	0.32	0.34	0.32	0.33	0.55	0.32	0.24	0.32	1.03	0.52	0.40	0.26
Egypt	Max	11840118	20317194	10327729	18531123	7309735	14095704	6330678	10808753	705015	78580	1077286	1178000
	Min	5086431	4503530	4240413	5472770	1108850	639267	3135988	2269794	4130	11018	10619	371847
	Mean	8417552	10537691	7561136	10935661	2757818	4320132	4832625	5356278	194322	48802	645929	717831
	σ	3414343	6934421	3181737	6190086	3036202	6525470	1515278	3805612	341579	29546	480362	394375
	σ/m	0.41	0.66	0.42	0.57	1.10	1.51	0.31	0.71	1.76	0.61	0.74	0.55
Tunisia	Max	2449758	3241788	1843220	2389528	1557910	1724446	250202	797232	40254	83625	30165	62615
	Min	885795	2332416	453692	1579040	713176	1109638	145884	375938	18866	26513	10997	33767
	Mean	1453567	2814220	1171484	2133838	1127604	1454623	193503	567367	29485	51922	23305	52130
	σ	706448	431169	581588	374845	351791	294780	51467	174481	9408	24757	8502	13178
	σ/m	0.49	0.15	0.50	0.18	0.31	0.20	0.27	0.31	0.32	0.48	0.36	0.25
Morocco	Max	4833419	10840211	4626111	11287197	2643232	3384013	3372070	6253575	205835	546601	76727	162600
	Min	926035	3250046	822961	3456466	460489	973284	335528	808973	30504	103423	21836	49649
	Mean	2532147	7993715	2462822	8216843	1122835	1642481	1338143	3633563	93082	267895	43102	113736
	σ	1739251	3517851	1740807	3692989	1028565	1164977	1397258	2232781	78312	195565	25983	50132
	σ/m	0.69	0.44	0.71	0.45	0.92	0.71	1.04	0.61	0.84	0.73	0.60	0.44
Jordan	Max	9220000	25179400	11923600	22884900	6146000	9189700	4111600	14405200	94700	259000	118500	269900
	Min	407275	848096	401997	1205360	117974	87447	135806	369817	8417	25106	8274	21862
	Mean	2877825	7795414	3501014	7212445	1637035	2891924	1279434	4521998	33804	102444	38006	88279
	σ	4246818	11626303	5625144	10472149	3006001	4230516	1896652	6619082	41085	106120	53805	121221
	σ/m	1.48	1.49	1.61	1.45	1.84	1.46	1.48	1.46	1.22	1.04	1.42	1.37
UAE	Max	7177036	13941076	5796595	12574296	5788859	13502819	4988586	5627992	29147	110306	42354	91110
	Min	3255680	9736992	1928385	7023091	553827	1952076	1511387	2055031	21711	48795	22684	53070
	Mean	4853644	10911845	3784555	9474527	3163219	5716297	2636462	3533792	26137	78291	35522	70905
	σ	1910124	2027551	1763880	2305282	2642291	5306616	1617910	1736212	3165	31040	9087	17282
	σ/m	0.39	0.19	0.47	0.24	0.84	0.93	0.61	0.49	0.12	0.40	0.26	0.24

Results

Efficiency and Productivity Results

To demonstrate the time-varying efficiency in each Arab banking sector during a period of deregulation and liberalization, DEA methodology was used on panel data pertaining to each country separately. Table 3 provides the results of productivity (TFP) and efficiency measures (TE) of banks from 11 Arab countries for each year over the period 1994 to 2004 together with the decomposition into pure technical efficiency (PTEC), technological efficiency (TEC), and scale efficiency (SEC). The software used to estimates these measures is DEAP developed by Coelli (1996).

It is observed that efficiency has not been uniform in all countries. While almost all countries have maintained or increased their technological level and their level of technical efficiency, it is not the same for their level of scale efficiency.

As to productivity measures, there are two directions to construct the Malmquist Index for a panel data set namely the adjacent and the fixed-based periods. The former consists of calculating the Malmquist Index for each period, e.g. for adjacent periods t + 1, t; for adjacent periods t + 2, t + 1, and so on. In the latter, the Malmquist Index is calculated for all periods to a relative fixed base period. In this study, the adjacent time periods were adopted.

The results show a decline in the total factor productivity (TPF) over the study period in all countries. the average scores of the TPF indicates that the Kuwaiti banking sector is the most productive throughout the period, followed by the Moroccan, Bahraini Omani banking sector with a score of productivity higher than 7%. A second group composed of Saudi Arabian, Tunisian and Emirati banking sectors has a score of productivity between 3% and 4%. The third group of banking systems (Lebanese and Egyptian) has experienced a poor score of productivity between 0% and 1.5%. Finally, it may be noted that the Jordanian banking sector has seen a sharp decline in its total factor productivity compared to other Arab banking systems. A possible explanation of this loss in productivity is that the introduction of new technologies necessitates, in certain countries, an adaptation period to the new technology that is characterized by a reduction in productivity before having a positive impact on it (Dietsch, Ferrier and Weill, 1998).

The change in the productivity of Arab banks could be decomposed into a variation related to the integration of technological progress, a variation linked to the pure technical change, a change linked to the scale efficiency, and a variation linked to technical efficiency. The index of technological progress is not neutral and has an influence on the change in productivity - with the same level of input, the bank can produce more output. Indeed, the introduction of technological progress changes the form of the production function.

This was the case of the Moroccan banking institutions. The Moroccan banks have become more productive, and therefore, harvested the fruits of their investments in new technology - an improvement of 8.7% recorded over the period for this sector which is far greater than the scores registered by other countries. Tunisia ranks second with a score of technological progress variation of 1%. For other banking systems, productivity changes related to technological changes ranged from 0.3% for Lebanon, 0% for Bahrain, Qatar and the Emirates and -1% for Jordan, Saudi Arabia, Oman and Egypt, whose banks are behind their Arab peers.

The proper use of technology in a bank is reflected in the level of output. However, producing a certain level of output may be seen as inefficient if it necessitates a too big quantity of input, which is considered as waste in resources. Results show that most of Arab banking systems have recorded an improvement in their technical efficiency. The results also reveal that the average value of efficiency is quite high, around [0.78; 0.94], which means that the inefficiency lies in average around [22%; 6%]. With a score of 0.94 of the technical efficiency, Qatar and Jordan lie in second place behind Lebanon and Bahrain to record the highest score for technical efficiency (0.94). The Lebanese and Bahraini banks could then improve their productive efficiency of 6%. By comparison, the results show that Emirati banks present the lowest level of technical efficiency (0.78).

Thus, the Arab banking sectors may be classified into three groups. The first group comprises Lebanon, Bahrain and Qatar, whose scoring efficiency is greater than 93%. The second group consists of Jordan, Egypt, Kuwait, and Morocco whose efficiency scores lie between 89% and 92%. The latter group includes successively the rest of the sample whose efficiency scores vary between 78% and 86%. These discrepancies are due to the quality of management of the physical flow or the financial transactions. These sectors are technically efficient because they better master the technical aspects of the banking production and therefore manage to offer maximum services with a minimum of resources.

As to scale efficiency, a value for this index greater than unity indicates that a change in the bank's scale of production impacts positively the productivity change. A positive contribution to productivity results from expansion under increasing returns to scale or contraction of production under decreasing returns to scale. A change in the scale of production contributes to a decline in productivity change if it is away from the direction of the technically optimal scale. Finally, when the value of the scale index = 1, the firm does not profit (endure) from scale economies (diseconomies) as when constant returns to scale prevail over the input range ($x_{i,t}$, $x_{i,t+1}$). Thus, it is quite likely that while the evaluated firm gets closer to the base period optimal scale, this latter optimum also moves, rendering such attempt to improve its scale performance futile.

It may be seen that the average scale efficiency change is the lowest (0.99) in Egypt. However, SEC of other banking sectors are equal to 1 indicating constant returns to scale. This does not necessarily imply that Arab banks are operating at their optimal scale. It is possible that these banks exploit likewise their inputs within the framework of their actual scales. Alternatively, if optimal scale moves, the productivity differential due to an inefficient scale ($x_{i,t}$, $y_{i,t}$) with regard to the highest productivity at optimal scale is the same in both periods and there is no change in scale efficiency.

The results in Table 4 indicate that the share of scale efficiency in explaining the productivity is very low. Lebanon is in the first place, followed by Saudi Arabia, Bahrain, and Qatar (the scale efficiency score is between 0.3% and 0.5%), with an improvement in scale efficiency of 0.6%. However, Emerati and Egyptian banks have a score close to 0.1%. Finally, the other sectors have very poor scale inefficiency scores, around 1%. If the size effect is not apparent as having a significant impact on the productivity and efficiency of banks, it cannot be concluded that the size reached by the Arab Banks is such that there is no possible economies of scale. The lack of size effect in this area does not mean that the banks are at their optimum size. It simply means that, on average, banks (with almost the same efficiency) operate in the same manner the production opportunities offered by their current size. It is therefore possible that Arab banks are really in a situation of increasing returns of scale (i.e., inadequate size) that does not enable them to exploit all of economies of scale or the decreasing returns to scale. In other words, a portion of their inefficiency comes most likely from an inadequate size.

Table 3. Developments in Means of TE, TC, SEC, and TFP in Arab Countries, 1994-2004

		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	*Mean
LEBANON	TE	0.94	0.92	0.93	0.94	0.94	0.93	0.93	0.96	0.95	0.96	0.97	0.94
	TEC	-	1.12	1.088	1.014	1.006	1.048	1.023	0.771	0.984	1.008	1.037	1.005
	PTEC		0.981	1.012	1.011	1.004	0.982	1.005	1.032	0.993	1.002	1.014	1.003
	SEC	-	1.071	1.058	0.977	1.01	0.984	0.97	1.067	0.984	0.989	0.96	1.006
	TFP	-	1.176	1.165	1.001	1.02	1.013	0.997	0.849	0.961	0.998	1.01	1.015
KUWAIT	TE	0.95	0.95	0.92	0.93	0.91	0.93	0.92	0.96	0.98	0.98	1.00	0.90
	TEC	-	1.481	1.219	1.112	1.055	1.052	1.101	1.08	1.066	1.039	1.093	1.124
	PTEC		1	1	0.985	1.015	1	1	1	1	0.972	0.99	0.996
	SEC	-	0.999	0.976	1.021	0.996	1	0.975	0.99	1.002	1.004	1.005	0.997
	TFP	-	1.48	1.19	1.118	1.067	1.052	1.073	1.069	1.068	1.014	1.087	1.116
QATAR	TE	0.88	0.91	0.95	0.90	0.93	0.83	0.89	0.92	1.00	0.98	1.00	0.93
	TEC	-	1.28	1.076	0.941	1.163	0.832	0.986	1.013	1.119	0.931	0.803	1.005
	PTEC	-	1	1	0.995	0.955	1.014	1.024	1	1.013	0.986	1.014	1
	SEC	-	0.984	1.016	1.036	0.981	1.019	1	1	1	1	0.999	1.003
	TFP	-	1.259	1.093	0.971	1.09	0.86	1.01	1.013	1.134	0.919	0.813	1.008
BAHRAIN	TE	0.94	0.91	0.92	0.93	0.94	0.92	0.93	0.92	0.94	0.98	0.99	0.94
	TEC	-	1.113	1.036	1.122	1.009	1.08	0.96	1.153	1.081	1.108	1.027	1.067
	PTEC	-	1	1	0.995	1.003	0.993	1.002	1	1.006	0.999	1.005	1
	SEC	-	1.027	1.004	0.995	1.006	0.993	1.012	0.995	1.015	0.991	1	1.004
	TFP	-	1.143	1.04	1.111	1.018	1.065	0.974	1.147	1.103	1.097	1.033	1.072
OMAN	TE	0.73	0.69	0.76	0.83	0.86	0.93	0.95	0.91	0.92	0.91	0.94	0.86
	TEC	-	1.207	1.111	0.999	1.2	1.095	1.091	1.012	1.05	1.074	0.943	1.075
	PTEC	-	1	1	1	1	1	1	1	0.982	0.984	0.975	0.994
	SEC	-	1.009	1.037	1.021	1	0.994	0.999	0.957	1.035	0.982	0.983	1.001
	TFP	-	1.217	1.153	1.02	1.2	1.089	1.09	0.968	1.067	1.037	0.904	1.07
SAUDI ARABIA	TE	0.78	0.77	0.75	0.78	0.81	0.83	0.83	0.86	0.90	0.94	0.98	0.84
	TEC	-	1.102	0.942	1.088	1.089	0.971	1.241	0.841	1.065	1.112	1.013	1.041
	PTEC	-	0.979	1.003	0.974	0.994	1.007	1.026	1.016	0.985	0.994	1.003	0.998
	SEC	-	0.991	0.978	1.019	1	1.006	1.01	1.01	1.035	0.977	1.02	1.005
	TFP	-	1.07	0.924	1.08	1.082	0.984	1.287	0.863	1.085	1.08	1.037	1.044
EGYPT	TE	0.88	0.89	0.88	0.89	0.92	0.94	0.92	0.92	0.91	0.88	0.93	0.91
	TEC	-	0.931	0.993	1.02	1.051	1.062	1.017	1.004	1.014	0.968	1.002	1.006
	PTEC	-	1.016	1.01	0.992	0.993	0.994	0.998	1.001	0.989	0.984	0.982	0.996
	SEC	-	1.031	0.984	1.024	0.998	0.989	0.986	0.987	0.982	1.003	1.001	0.998
	TFP	-	0.976	0.987	1.036	1.042	1.043	1.001	0.992	0.985	0.955	0.985	1
TUNISIA	TE	0.80	0.79	0.82	0.83	0.73	0.70	0.76	0.80	0.83	0.86	0.94	0.80
	TEC	-	1.152	1.126	1.17	0.84	1.119	0.895	1.111	0.977	1.04	0.931	1.03
	PTEC	-	1.028	1.072	1.002	1.014	1.023	1.007	0.985	1.001	0.982	0.988	1.01
	SEC	-	1.002	0.966	0.991	0.972	0.853	1.153	0.998	1.018	0.963	1.065	0.996
	TFP	-	1.187	1.166	1.163	0.828	0.977	1.039	1.092	0.995	0.984	0.98	1.035

Table 3. Continuation

		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	*Mean
MOROCCO	TE	0.86	0.81	0.83	0.84	0.88	0.90	0.88	0.90	0.93	0.95	1.00	0.89
	TEC	-	1.285	1.293	1.146	1.169	1.131	0.914	0.991	0.991	0.997	1.022	1.087
	PTEC	-	1	1	1	1	1	0.998	0.992	1.004	0.998	1.006	1
	SEC	-	0.982	0.95	1.005	1.031	0.967	1.009	1.033	1	0.996	0.986	0.996
	TFP	-	1.262	1.227	1.152	1.206	1.093	0.921	1.015	0.995	0.991	1.014	1.082
JORDAN	TE	0.91	0.92	0.93	0.93	0.96	0.90	0.90	0.90	0.90	0.90	0.90	0.92
	TEC	-	1.185	1.04	0.76	1.025	0.917	1.066	1.114	0.896	1.11	0.963	1
	PTEC	-	0.983	1.019	0.998	1.011	0.999	0.999	0.983	1.017	0.999	1.003	1.001
	SEC	-	1.005	1.034	0.988	1.003	0.98	0.917	1.063	1.044	0.993	0.953	0.997
	TFP	-	1.171	1.096	0.75	1.039	0.898	0.976	1.164	0.951	1.101	0.92	0.998
UAE	TE	0.76	0.72	0.71	0.68	0.73	0.81	0.81	0.78	0.78	0.85	0.91	0.78
	TEC	-	1.087	1.014	0.937	1.125	1.24	1.019	0.966	0.934	1.008	1.029	1.032
	PTEC	-	0.989	1.048	0.997	0.994	0.975	1.045	0.957	0.974	1.056	0.97	1
	SEC	-	0.995	0.993	1.041	1.005	0.968	0.972	1.021	1.021	0.991	1.007	1.001
	TFP	-	1.069	1.055	0.973	1.124	1.169	1.035	0.944	0.929	1.056	1.005	1.033

*All the means calculated in this table are geometric means. Technical Efficiency = TE; Technological Change = TC; Scale Efficiency Change = SEC; and Total Factor Productivity of Malmquist Index = TFP.
N.B. It may be noted that maximum DEA technical scores are not necessarily 1 - which can be viewed as surprising results as DEA determines a linear frontier on the top of the observations. This is simply the result of the fact that scores are average efficiency scores by country for the period of the study.

In conclusion, the average scores of the productive performance conceal a chaotic evolution of the various components of the productivity of Arab banks. In fact, the average change in productivity reflects deterioration in the productivity of Arab banks over the period 1994-2004. This shift in productivity has been accompanied by a drop of pure technical efficiency, a decrease of technological progress, a decrease of efficiency of scale, on one hand, and by improving technical efficiency on the other hand.

This empirical validation of an inverse relationship between productivity and efficiency requires broadening the scope of the study to identify some factors explaining the productive performance of Arab banks. To this end, a statistical adjustment by ordinary least squares (OLS) was used with the efficiency score as a dependent variable. The explanatory variables of the model are supposed to be factors beyond the control of managers.

Determinants of Bank Efficiency: Second-Stage Regression Results

To examine the determinants of commercial banks efficiency in each country, a linear econometric model and was used and the ordinary least squares method was applied was used to estimate it. Two types of factors were used as explanatory variables in this model: (a) Environmental factors that are exogenous to management of the bank and fall in the economic, legal, and regulatory environment; and (b) Factors pertaining exclusively to managerial strategy of the bank, that production factors did not capture in the estimation of the technological frontier. These factors help explaining the managerial behavior at all levels of the production process.

There is a large number of variables that may be included in the model. For convenience, the choice was restricted to the following six variables:

- Economic growth rate (GDP),
- Capital adequacy ratio measured by the ratio of shareholders' equity and net income to total deposit and non deposit funds (CAP).
- Assets taken as the logarithm of the total assets (LnASSET). This variable is used to measure the bank size,
- Credit risk is proxied by the ratio of provisions for doubtful debts to total loan (RISK)(4),
- Total cost is represented by the ratio of the sum of the financial and non-financial costs to assets (COST), and
- Return on assets is calculated as the ratio of net profit to total assets (ROA).

Using the software EVIEWS, the technical efficiency was regressed on the six explanatory variables for each sector of the 11 Arab banking sectors. The estimations of these equations are presented in Table 4.

Table 4 shows that the relationship between efficiency and the size of the banks is positive in 7 samples. This indicates that larger banks have more opportunity to make profits by reducing prices. Hence, this includes the ability of large banks to use more efficient technology with less cost and their ability to hire more specialized staff for more profitable activities and to provide better quality output.

As to the relationship with capital adequacy, it seems to be significant in 7 samples. However, this link cannot identify homogenous behavior in all countries - it is either positive (Lebanon, Saudi Arabia, Morocco, Tunisia, AUE, Egypt, and Oman) or negative (Bahrain, Kuwait, and Qatar). This asymmetry may be explained by the requirement to maintain a certain ratio between the amount of equity and the risks inherent in the operations undertaken. According to Basel guidelines and European directives, this ratio should be maintained at 8%. The positive correlation between efficiency and this ratio indicates that these banks have a strong risk aversion, while the negative correlation indicates that these banks are largely involved in activities at risk.

The explanation of the efficiency by economic growth rate seems to be insignificant in 9 out of 11 samples. Credit risk seems to be an important determinant of the efficiency in Tunisia, the Emirates, Egypt, Kuwait, Jordan and Saudi Arabia. These results show that the banks with low risk portfolios are likely to be less efficient.

Finally, the significantly positive coefficient of the ROA in many countries reflects another important relationship between profitability and efficiency. Therefore, higher profitable banks have higher efficiency. By contrast, the coefficient of the ratio of total cost to total assets is significantly negative for only six samples. In theory, a good cost efficiency, which reflects a good organization of production, should correspond to good profitability. Therefore, good profitability should lead to the same result. In addition, efficiency and profitability should be positively correlated, good cost control is an important determinant of a good price policy and banking margins. These results are consistent with the theory, to the extent that the banks that operate with high costs are less profitable and less efficient.

Table 4. Regression Estimations Relative to 11 Arab Banking Sectors

	C	CAP	COST	GDP	LnASSET	RISK	ROA	R^2
Lebanon	0.7881 (0.31)	0.0099 (0.52)	0.0006 *(1.65)	0.0018 ***(5.02)	0.0110 ***(6.02)	0.0276 (1.51)	0.0276 (0.17)	0.69
Kuwait	3.0929 ***(2.77)	-0.0794 ***(-2.67)	-2.5192 ***(-3.77)	-0.0006 (-0.53)	-0.1368 **(-1.96)	0.9205 **(4.51)	2.9747 *(1.79)	0.44
Qatar	1.3402 ***(2.81)	-0.4934 **(1.99)	-1.0103 **(-1.97)	0.0016 (0.90)	-0.0219 (-0.68)	0.0136 (0.09)	0.5800 (0.84)	0.42
Bahrain	1.0209 ***(12.89)	-0.2102 *(-1.93)	-1.83E-08 **(-1.97)	0.0005 (0.25)	-0.0038 (-0.74)	0.0567 (1.56)	0.2201 *(1.74)	0.70
Oman	-1.9946 ***(-6.05)	2.8374 ***(7.28)	0.9649 (1.05)	0.0002 (0.07)	0.1720 ***(8.37)	0.2324 (1.22)	2.0114 *(1.87)	0.77
Saudi Arabia	-1.4507 **(-2.39)	0.4836 (1.14)	-2.2657 ***(-3.66)	0.0020 (1.24)	0.1468 ***(3.94)	0.5772 ***(2.79)	-1.4029 (-1.03)	0.81
Egypt	0.1586 (1.11)	0.3908 ***(4.54)	-1.06E-07 ***(-4.93)	-0.0025 (-1.11)	0.0422 ***(3.99)	0.2683 ***(5.57)	0.6757 **(2.29)	0.75
Tunisia	-2.9563 ***(-4.05)	0.5522 *(1.80)	1.0595 (0.96)	-0.0020 (-0.70)	0.2539 ***(5.40)	5.0850 **(2.35)	6.2358 ***(2.96)	0.82
Morocco	-0.4309 (1.36)	1.1143 (1.34)	1.4E-07 (0.83)	0.0010 (0.65)	0.0768 ***(3.34)	0.1060 (1.36)	-3.4675 (-1.47)	0.68
Jordan	-0.1486 (-0.58)	0.0908 (1.53)	0.2165 (0.91)	0.0037 (1.02)	0.0730 ***(4.19)	0.2584 ***(2.83)	0.4073 (1.22)	0.59
UAE	0.2903 (0.73)	0.9821 ***(3.93)	-1.6545 ***(-5.51)	0.0008 **(2.21)	0.0146 (0.60)	0.3447 ***(3.69)	1.2598 **(2.10)	0.90

N.B. Numbers in parentheses are t-tests. * represents 10% level of significance; ** represents 5% level of significance; and *** represents 1% level of significance.

Conclusion

For more than two decades Arab countries have undertaken liberalization policies and structural reforms to improve the performance and competitive viability of banking sectors.

This paper aimed to study the source of productivity and efficiency developments in commercial banking sectors pertaining to 11 Arab countries. Using a non-parametric Malmquist Index approach, the initial changes in the productivity and efficiency of these banks were investigated in an era of financial liberalization and deregulation. The country-level information is reported for the 11 Arab banking sectors over the period 1994-2004.

The results of this study show that deregulation and financial liberalization have not had a beneficial effect on the productive performance of Arab banks. Indeed, the evolution of their productivity is primarily affected by technological progress, pure technological change, and scale efficiency of and not because of their technical efficiency, that is, their organizational and managerial performance.

Furthermore, the factors that may influence efficiency have been identified in this study and could aid banks and policymakers in establishing suitable strategies. It was observed that the large banks have higher efficiency and banks with low risk portfolios are less efficient.

Several other key points should be addressed. Firstly, the results obtained in this paper are sensitive to the selection of the sample. Therefore, these results should be compared with other samples. Secondly, the non - parametric approach used assumes that the data are perfectly measured. Other methods should be used like the bootstrap method to decide whether the estimates of the effectiveness and productivity are significant (Simar and Wilson, 1996). Finally, the authors' approach does not take into account the adverse impact of undesirable outputs and fixed inputs on productive efficiency. The use of a directional function of distance, developed recently by Färe and Grosskopf (2000), Devaney and Weber (2002) and Färe et al. (2004), makes it possible to integrate, for instance, non-performing loans as undesirable outputs banking and capital as fixed input in the production function. This methodology may be used to study the productive efficiency of Arab banks taking into account their preferences for risk, their vulnerability to risk and the impact of banking regulations on these preferences. In other words, the function of directional distance allows obtaining measurements of productive inefficiency (managerial and organizational ones) of banks and controlling the risk preferences for the manager by specifying a direction involving an increase in good outputs and reducing the bad outputs in the production process according to the different scenarios attitude to risk and with taking into account the capital of the bank.

All in all, it may be concluded that reforms and deregulations did not help to enhance the productivity of Arab banking sectors and managers did not take advantage of innovations and new technologies.

This study gives further insight regarding the relative productivity of Arab banking sectors. It allows comparing themselves to competitors, identifying the best, endeavoring to learn from them, adjusting the other's plans of development so as to apply them for their own improvement.

Footnotes

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(3) Purpose of the original 1988 Basle accord was twofold. Firstly, it aimed at creating a "level playing field" among banks by raising capital ratios, which were generally perceived as too low in many countries; and secondly, it also aimed at promoting financial stability by adopting a relatively simple approach to credit risk with the potential to distort incentives for bank risk-taking. The guidelines of the Basle Accord were originally adopted by central banking authorities from 12 developed countries (all G-10 countries plus Luxembourg and Switzerland) in July, 1988. Implementation started in 1989 and was completed four years later in 1993.

(4) The Banker: "Arab banks set to smash profits record again", November 2005. Available at: www.thebanker.com

(5) For more details, see Forsund, Lovell and Schmidt (1980) and Lovell (1993).

(6) See Abrams and Huang (1987), Berger and De Young (1997), and Resti (1997)

References

Abrams, B.A. and Huang, C. J. 1987. Predicting bank failures: The role of structure in affecting recent failure experiences in the USA. Applied Economics 19: 1291-1302.

Allen, L. and Rai, A. 1996. Operational efficiency in banking: An international comparison. Journal of Banking and Finance 20: 655-672.

Altunbas, Y., S. Carbo, E.P.M. Gardener and P. Molyneux. 2004. Examining the relationships between capital, risk and efficiency in European banking. Kiel Institute for World Economics, February, 27-28.

Athanassopoulos, A.D. 1997. Service quality and operating efficiency synergies for management control in the provision of financial services: Evidence from Greek bank branches. European Journal of Operational Research 98: 300-313.

Banker, R.D., A. Charnes and W.W. Cooper. 1984. Some models for estimating technical and scale inefficiencies in data envelopment analysis. Management Science 30: 1078–1092.

Bhattacharrya, A., C.A.K. Lovell and P.S. Sahay. 1997. The impact of liberalisation on the productive efficiency of Indian commercial banks. European Journal of Operational Research 98: 332-345.

Berg, S.A., F. Forsund and E. Jansen. 1992. Malmquist indices of productivity during the deregulation of Norwegian banking, 1980-89. Scandinavian Journal of Economics 94: 211-228.

Berger, A. N., F. Forsund, L. Hjalmarsson. and M. Souminen. 1993. Banking efficiency in the Nordic countries. Journal of Banking and Finance 17: 371-388.

__________ and D.B. Humphrey. 1997. Efficiency of Financial Institutions: International Survey and Directions for Future Research. European Journal of Operational Research 98: 175-212.

__________ and R. DeYoung. 1997. Problem loans and cost efficiency in commercial banks. Journal of Banking and Finance 21, 849-870.

Bikker, J. 2001. Efficiency in the European Banking Industry: An exploratory analysis to rank countries. Cahiers Economiques de Bruxelles 172: 3-28.

Casu, B. and P. Molyneux. 2003. A comparative study of efficiency in European banking. Applied Economics 35: 1865-1876.

___________, C. Girardone and P. Molyneux. 2004. Productivity change in European Banking: A comparison of parametric and non-parametric approaches. Journal of Banking and Finance, 28 (10): 2521-2540.

Caves, D.W., L.R. Christensen and W.E. Diewert. 1982. The economic theory of index numbers and the measurement of input, output and productivity. Econometrica 50: 1393-1413.

Cinca, C.S., C.M. Molinero and F.C. Garcia. 2002. Behind DEA efficiency in financial institutions. Working Paper, University of Zaragoza, mimeo.

Charnes, A., W.W. Cooper and E. Rhodes. 1978 . Measuring the efficiency of decision making units. European Journal of Operational Research 2: 429–444.

Chen, C., C. Liou and Y. Wu. 2004. The performance measurement of local banks in the era of the financial liberalization on Taiwan. Information of Management Sciences 15(4): 89-104.

Coelli, T. 1996. A Data Envelopment Analysis (Computer) Program. Centre for Efficiency and Productivity Analysis. University of New England, Armidale, NSW, 2351. Australia.

Cook, W.D, M. Hababou, and G.S. Roberts. 2000. The effect of financial liberalization on Tunisian banking industry: A non-parametric approach. Working Paper, York University, mimeo.

Devaney, M., and W. Weber. 2002. Small business lending and profit efficiency in commercial banking. Journal of Financial Service Research 22: 225-246.

Dietsch, M., G. Ferrier, and L. Weill. 1998. Integration and banking performance in the European Union: Productivity, technical efficiency, scale efficiency, cost efficiency, and profit efficiency. Université Robert Schuman, Strasbourg (mimeo).

Drake, L. 2001. Efficiency and productivity change in U.K banking. Applied Financial Economics 11: 557-571.

Elyasiani, E. and S. Mehdian. 1995. The comparative efficiency performance of small and large US commercial banks in the pre-and post deregulation eras. Applied Economics 27: 1069-1070.

Färe, R., S. Grosskopf, S. Yaisawarng, S.K. Li and Z. Zhang. 1990. Productivity growth in Illinois electricity utilities. Resources and Energy 12: 383-398.

__________, __________, B. Lindgren and P. Roos. 1992 . Productivity changes in Swedish pharmacies 1980-89: A nonparametric Malmquist approach. .Journal of Productivity Analysis 3: 85-101.

__________, __________, M. Norris and Z. Zhang. 1994. Productivity growth, technical progress, and efficiency changes in industrialized countries. American Economic Review 84(1): 66-83.

Fare, R. and S. Grosskopf. 2000. Theory and application of directional distance functions. Journal of Productivity Analysis 13: 93-103.

Fare, R., S. Grosskopf, and W. Weber. 2004. The effect of risk-based capital requirements on profit efficiency in banking. Applied Economics 36: 1731-1743.

Farrell, M.J. 1957. The measurement of productive efficiency. Journal of the Royal Statistical Society Series A (General) 120: 253–289.

Forsund, F. R., C. A. Knox Lovell, and Peter Schmidt. 1980. A survey of frontier production functions and of their relationship to efficiency measurement. Journal of Econometrics 13: 5-25.

Gilbert, R.A. and P.W. Wilson. 1998. Effects of deregulation on the productivity of Korean banks. Journal of Economics and Business 50: 133-155.

Grifell-Tatjé, E., and K. Lovell. 1996. Deregulation and productivity decline: The case of Spanish savings banks. European Economic Review 40: 1281 - 1303.

__________ and __________. 1997. The sources of productivity change in Spanish banking. European Journal of Operational Research 98: 364 - 380.

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

Kumbhakar, S.C., A. Lozano-Vivas, C.A.K. Lovell and I. Hasan. 2001. The effects of deregulation on the performance of financial institutions: the case of Spanish savings banks. Journal of Money, Credit and Banking 33: 101–120.

Lovell. K. 1993. Production frontiers and productive efficiency. In: The Measurement of Productive Efficiency Techniques and Applications. Edited by H. Fried, K. Lovell, and S. Schmidt. New York: Oxford University Press.

Lozano-Vivas, A. J. T. Pastor, and J. M. Pastor. 2002. An efficiency comparison of European banking systems operating under different environmental conditions. Journal of Productivity Analysis 18: 59-77.

Malmquist, S. 1953. Index numbers and indifference curves. Trabajos de Estatistica 4(1): 209-242.

Maudos, J., J. Pastor, F. Perez and J. Quesada. 2002. Cost and profit efficiency in European banks. Journal of International Financial Markets, Institutions and Money 12 (1): 33-58.

Mester, L.J. 1993. Efficiency in the savings and loan industry, Journal of Banking and Finance 17: 267-286.

Miller S. M. and G.N. Athanasios. 1996. The technical efficiency of large bank production. Journal of Banking and Finance 20: 495-509.

Resti, A. 1997. Evaluating the cost-efficiency of the Italian banking system: What can be learned from the joint application of parametric and nonparametric techniques. Journal of Banking and Finance 21: 221-250.

Shephard, R. W. 1953. Cost and Production Functions. Princeton: Princeton University Press.

__________. 1970, Theory of Cost and Production Functions. Princeton: Princeton University Press.

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

Simar, L and P. Wilson. 1996. Estimating and Bootstrapping Malmquist Indices. Discussion Paper, 9660, Centre for Operations Research and Econometrics, Université Catholique de Louvain.

Smith, R.Todd. 1997. Banking Competition and Macroeconomic Performance. Working paper,University of Alberta.

Wheelock, D.C. and P.W. Wilson. 1999. Technical progress, inefficiency and productivity change in US banking, 1984-1993. Journal of Money, Credit and Banking 31: 213–234.

Williams, J. 2001. Financial deregulation and productivity change in European banking. Revue Bancaire et Financière 8: 470–477.

Yildirim, C. 2002. Evolution of banking efficiency within an unstable macroeconomic environment: The case of Turkish commercial banks. Applied Economics 34: 2289-2301.

Zenios, C.V., A.S. Zenios, K. Agathocleous and A. Soteriou. 1999. Benchmarks of the efficiency of bank branches. Interfaces 29: 37-51.