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What Drives the Efficiency of Selected MENA Banks?

A Meta-Frontier Analysis

Samy Ben Naceur
IMF Institute, International Monetary Fund
sbennaceur@imf.org

Hichem Ben-Khedhiri
Université de Paris X Nanterre, France
bkhichem@voila.fr

Barbara Casu
Cass Business School, City University
b.casu@city.ac.uk

What Drives the Efficiency of Selected MENA Banks? A Meta-Frontier Analysis

Samy Ben Naceur[1], Hichem Ben-Khedhiri[2] and Barbara Casu[3]

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Abstract:

This study examines the effect of financial-sector reform on bank performance in selected Middle Eastern and North African (MENA) countries in the period 1993−-2006. We evaluate bank efficiency in Egypt, Jordan, Morocco, and Tunisia by means of Data Envelopment Analysis (DEA) and we employ a meta-frontier approach to calculate efficiency scores in a cross-country setting. We then employ a second-stage Tobit regression to investigate the impact of institutional, financial, and bank specific variables on bank efficiency. Overall, the analysis shows that, despite similarities in the process of financial reforms undertaken in the four MENA countries, the observed efficiency levels of banks varies substantially across markets, with Morocco and Tunisia outperforming Egypt and Jordan. Differences in technology seem to be crucial in explaining efficiency differences. To improve banking sector efficiency, policies should be aimed at giving banks incentives to improve their capitalization and liquidity. Improvements in the legal system and in the regulatory and supervisory bodies would also help to reduce inefficiency. Finally, increased investments and upgrading of the stock markets in the region would help banks improve their performance.

1IMF Institute, International Monetary Fund. E-mail: sbennaceur@imf.org
2 Université de Paris X Nanterre, France. E-mail: bkhichem@voila.fr
[3] Cass Business School, City University, 106 Bunhill Row, London, EC1Y 8TZ.
Email: b.casu@city.ac.uk

1. Introduction

A large number of developed and developing countries have deregulated their banking systems over the past two decades. The primary objective of such reforms was to improve productivity, efficiency, and profitability of the banking systems and also to increase international competitiveness. In particular, developing countries, mostly following International Monetary Fund (IMF) and/or World Bank inspired programs, have sought to improve the performance and efficiency of their financial sectors to enhance their overall economic performance. Indeed, a strong and stable banking system has been advocated as being the cornerstone in many liberalization programs (Saunders and Sommariva, 1993).

Governments of some Middle Eastern and North African (MENA) countries have instituted reforms to establish a market-based financial sector. Such programs have boosted competition in the banking sector via improved mobilization of savings, in order to enhance market-based allocation of resources and to foster more efficient risk-management capabilities.

The conventional wisdom relating to the positive effect of reforms on financial sector performance is, however, not always validated by empirical studies (Berger and others, 2000). Indeed, the outcome of deregulation policies seems to reflect several country-specific demand and supply conditions of the banking industry prior to deregulation.

This study attempts to shed some light on these issues by examining the effect of institutional development, financial structure and bank-specific characteristics on the efficiency of the banking sector in Egypt, Jordan, Morocco, and Tunisia. These MENA countries share similarities in terms of economic structure—the order of implementation of structural adjustment programs, the liberalization of state-owned companies, the attraction of direct foreign investments and resource-scarcity in relation to population. Despite the substantial transformation of the countries' banking and financial sectors in recent years and the fact that the regulatory requirements imposed by national regulators are now in line with international standards, there is still a lack of empirical studies investigating the impact of financial and institutional reforms on bank performance and efficiency. This paper contributes both to the international debate on the impact of deregulation on the banking system of developing countries and whether the reform process is translating into more efficient

and sound banking systems. It also contributes to the understanding of the dynamics of economic development of the MENA region.

The rest of the paper is organized as follows. Section 2 discusses the existing literature on the effects of financial reforms on banks performance and efficiency. Section 3 describes the methodology, the data, and the variables used. The empirical results are illustrated in Section 4, and Section 5 concludes.

2. Literature Review

There is a vast literature on the use of frontier techniques to evaluate bank efficiency, using both parametric and non-parametric methodologies. While earlier studies focused on one methodological approach and on individual countries[4], in recent years both the number of cross-country studies and the number of studies focusing on developing countries has increased, mainly owing to the unprecedented economic reforms implemented in such countries (see, among others, Fries and Taci, 2005; Grigorian and Manole, 2006).

Most cross-country studies assume that banks in different countries can access the same banking-production technology. In other words, in order to be able to compare efficiency results across borders, they assume a common production frontier for all countries. The interpretation of the resulting efficiency scores relies significantly on the validity of this assumption. In some cases this is a major drawback, as the production technology is substantially different among countries, particularly if countries are at different levels of financial development. Bank efficiency estimates may be influenced by factors not generally included in the efficiency analysis, such as differences in bank type, ownership, and other bank specific conditions. In such cases, the assumption of a common frontier may be misleading. Further, the assumption of a common frontier can lead to biased efficiency results if it ignores differences in regulatory, competitive, and economic conditions that are beyond a bank's control (Dietsch and Lozano-Vivas, 2000; Chaffai and others, 2001).

Bos and Kool (2006) indicate that if environmental factors that are not appropriately controlled for, efficiency estimates may be biased. Recent empirical studies have attempted to overcome this problem by integrating country-specific

[4] Early bank efficiency studies investigate mainly the US and EU countries (see for a review of the early literature see Berger and Humphrey, 1997, and Goddard and others, 2001). For a review of recent literature, see Berger (2007) and Goddard and others (2007).

environmental variables in the efficiency estimation. There are various ways to incorporate environmental variables in the estimation of bank efficiency, the most commonly used are the one-step and the two-step approach.[5]

In the one-step approach, environmental variables are included directly in the estimation of efficiency whereas in the two-step approach efficiency scores obtained in the first stage of analysis are then regressed on a number of country-specific environmental variables. Both approaches are employed in the literature. The one-step approach seems to be the preferred choice if using a parametric approach to the efficiency evaluation[6], following the maximum likelihood procedure of Battese and Coelli (2005). A one-step approach is used, among others, by Zhao and others (2009) to evaluate the impact of financial reforms on Indian banking.

The two step approach, on the other hand seems to be the favoured approach if efficiency is estimated by means of Data Envelopment Analysis (DEA). In a typical two-stage study, the relative efficiency of each institution is first evaluated and then regressed (as the dependent variable in an ordinary least squares or a Tobit regression) on various explanatory variables to identify the factors whose impact on efficiency is statistically significant.

Departing from the standard two stage approach, Battese and others (2004) and O'Donnell and others (2008) recently proposed a so-called "meta-frontier" as method to estimate country or regional-specific frontiers and obtain comparable efficiency scores, as the meta-frontier results from the envelopment of regional specific frontiers. Bos and Schmiedel (2007) apply the meta-frontier methodology to eight European banking markets for the period 1993–2000. The authors conclude that for most countries included in the study, profit efficiency in particular improves significantly when estimated using a meta-frontier instead of a common frontier arguing that this may be evidence of the importance of local market circumstances.

While the meta-frontier approach develops a formal theoretical framework for making meaningful efficiency comparisons across groups of firms in different countries, it provides us with little information on the determinants of the differences

[5] For more details on the one-stage and two-stage approaches, see Coelli and others (2005).

[6] Fries and Taci (2005) review the advantages of using a one-step estimation of the determinants of inefficiency over the alternative two-step estimation. Specifically, performing a two-step analysis in a parametric setting violates the assumption made in the first step that the bank inefficiency components of the error terms from the cost efficiency frontier are independently and identically distributed. See also Kumbhakar and Lovell (2003) for a complete methodology review on incorporating exogenous influence on efficiency in a parametric setting.

in efficient frontiers among countries. In second stage analysis, we therefore attempt to measure the impact of local (country-specific) market and regulatory variables. This approach allows us to improve on the current literature by testing the significance of each of these variables as well as their combined impact on efficiencies derived from the meta-frontier analysis.

3. Methodology

In this study, we follow the non-parametric Data Envelopment Analysis (DEA) approach to measure inefficiency. The choice of using a DEA is based on several considerations: it works well even with a small sample size and it does not require any assumption about the functional form of the frontier or of the inefficiency component. We adopt an input-minimization orientation, based on the assumption that during periods of regulatory changes and increased competition market participants strategically focus on cutting costs. Therefore we would expect changes in inputs use to be closely associated with the changes in market structure. The existing literature (see Goddard and others, 2001; Berger, 2007) has traditionally focused on the estimation of input or cost based efficiency, assuming that bank management has more control over costs rather than over outputs.

DEA is a mathematical linear programming technique developed by Charnes, Cooper, and Rhodes in 1978 (CCR) which identifies the efficient frontier from the linear combination of those units/observations that (in a production space) use comparatively fewer inputs to produce comparatively more outputs. The CCR model assumes constant returns to scale (CRS), which is the optimal scale in the longrun. Banker, Charnes, and Cooper (1984) (or BCC model) include an additional convexity constraint (λ) to allow for variable returns to scale (VRS). In particular, if at any time t there are N firms that use a vector of inputs $X = (x_1, x_2, ..., x_k)$ to produce a vector of outputs $Y = (y_1, y_2, ..., y_m)$, the input-oriented BCC measure of efficiency of a particular firm is calculated as:

$$
\begin{aligned}
&\min_{\theta,\lambda} \theta_i \\
&s.t. \quad \sum_{r=1}^{N} y^t{}_{mr} \lambda^t{}_r \geq y^t{}_{mi} \\
&\qquad \sum_{r=1}^{N} x^t{}_{kr} \lambda^t{}_r \leq \theta_i x^t{}_{ki} \\
&\qquad \lambda^t{}_r \geq 0 \\
&\sum_{r=1}^{N} \lambda = 1
\end{aligned}
\tag{1}
$$

where $\theta_i \leq 1$ is the scalar efficiency score for the i-th unit. If θ_i=1 the i-th firm is efficient as it lies on the frontier, whereas if $\theta_i < 1$ the firm is inefficient and needs a (1- θ_i) reduction in the inputs levels to reach the frontier. [7]

It is important to recall that DEA efficiency scores measure the performance of firms relative to the sample. Technically, firms make choices from a set of feasible input-output combinations (technology sets). These technology sets may differ across regions/countries because of differences in available stocks of physical, human, and financial capital, economic infrastructure, and any other characteristics of the physical, social, and economic environment in which firms operate.

To accommodate the potential country variation of available banking technology and to obtain comparable technical efficiencies for the counties in our sample, we follow the the meta-frontier approach proposed by Battese and others (2004) and O'Donnell and others (2008). If we consider the available technology to be a state of knowledge in existence at a given point of time, we can define the meta-technology as the totality of the regional/country specific technologies. The meta-frontier production function is therefore a frontier function that envelops all frontiers of individual countries/groups. Figure 1 presents an illustration of a meta-frontier in the simple case of one input and one output.

< Figure 1 about here>

To apply the meta-frontier approach with DEA, it is necessary to solve separate models (equation 1) for each country in order to specify the country-specific frontiers

[7] For an introduction to DEA methodology see, among others, Thanassoulis (2001); Coelli and others (2005). See Thanassoulis and others (2008) for an extensive review of this literature.

and one for the joint data set for solving the meta-frontier.[8] Efficiencies measured relative to the meta-frontier can be decomposed into two components: a component that measures the distance from an input-output point to the group frontier (the common measure of technical efficiency); and a component that measures the distance between the group frontier and the meta-frontier (representing the restrictive nature of the production environment). The meta-technology ratio (DEA-MTR), that is the relative productivity of technologies, can be obtained as the ratio between meta-frontier (in)efficiency (DEA-M) and the country specific (in)efficiency (DEA-C).

While the meta-frontier approach allows us to calculate efficiency scores in a cross-country setting, it provides us with little information on the determinants of the differences in efficiency among countries. To assess the impact of contextual variables on bank efficiency we therefore use a two-step approach. Banker (2008) indicates that a two-step DEA-based procedure with OLS, maximum likelihood, or Tobit estimation in the second stage performs considerably better than one-stage parametric methods. In this study, we use a Tobit regression model in the second-stage analysis.

4. Data and Variables

4.1 Data

Our data set is primarily drawn from BankScope, a global database published by Bureau Van Dijk. Data are collected for a sample of 644 observations, relative to annual information from unconsolidated bank statements of a balanced panel of 46 banks operating in Egypt (22 banks), Jordan (7 banks), Morocco (6 banks), and Tunisia (11 banks) over the period 1993 to 2006. We limit our analysis to publicly traded commercial banks. We focus on this banking category as the services they offer are reasonably homogeneous and comparable across countries.

The institutional data are taken from the International Country Risk Guide (ICRG) Researchers Dataset, which provides a comprehensive analysis of risk ratings of developed and emerging countries, based on their financial, economic, and political

[8] For more details on the meta-frontier approach applied to DEA, see Battese and others (2004) and O'Donnell and others (2008). Other approaches to the estimation of the meta-frontier have been proposed in recent studies, see, among others Sipiläinen and others (2008).

environment. The financial structure data was drawn from the updated Beck and others database (2007 update), which is published by the World Bank.

4.2 Input and Output Definition

There are two main approaches to the definition of inputs and outputs of financial institutions: the production approach and the intermediation approach. Both approaches are widely used in the literature and there is no consensus on the superiority of one or the other. In this study we follow a variation of the intermediation approach (Sealey and Lindley, 1977). This approach views financial institutions as mediators between the supply and the demand of funds. As a consequence, deposits are considered as inputs, and interest on deposits is a component of total costs, together with labor and capital. In the cross-country setting of the present study, the need for comparable data from different countries imposes strong restrictions on the variables one is able to use, not least because of the various accounting criteria used in the four countries under investigation. To minimize possible bias arising from different accounting practices the broad definition of variables as presented by Bankscope was chosen. Specifically, the input variable used in this study is Total Costs (Personnel Expenses + Other Administrative Expenses + Interest Paid + Non-Interest Expenses) whereas the output variables capture both the traditional lending activity of banks (total loans) and the growing non-lending activities (other earning assets).

We aggregate the cost expenditure into a single input to minimize the well- known dimensionality problem associated with DEA. In small samples, if we have a high number of variables relative to the number of observations, units can be wrongly identified as efficient because too many constraints have been specified. Observations tend to become incomparable and hence figure on the frontier owing to the inability of DEA to indentify peers. One way around this, commonly used in the literature, is to aggregate the input variables in a single monetary value. Table 1 reports the descriptive statistics of the input/output variables.

< Table 1 around here>

4.3 Environmental Variables

In this section we introduce our contextual variables and our proxies for the institutional and regulatory environment in the four MENA countries under study. We utilize proxies for institutional development, financial structure, and specific bank characteristics. Specifically, proxies for institutional development are: Bureaucracy Quality (BC), Corruption (C), Democratic Accountability (DA), Government Stability (GS), Investment Profile (I), Law and Order (LO), and Socioeconomic Conditions (SC). Proxies for financial structure are: stock market capitalisation (MCAP); stock market turnover (TURNOVER), total shares traded (VTRADED), and concentration (CONC). Finally, the bank specific variables of interest are: the ratio of equity over total assets (EQTA); the ratio of net loans over total assets (NETLOANS), and the liquidity ratio (LIQ). The reminder of this section provides a rationale for the inclusion of these variables in our second stage analysis.

Institutional Development

According to the literature, official government power hampers bank development in countries with a closed political system (Barth and others, 2003). To test this hypothesis we include various institutional indexes to reflect the political stability of the countries in our sample and allocate risk points to a pre-set group of factors, termed political risk components. The minimum number of points that can be assigned to each component is zero, while the maximum number of points depends on the fixed weight that component is given in the overall political risk assessment. The lower the risk point total, the higher the risk, and vice versa.

To ensure consistency, both between countries and over time, points are assigned by the International Country Risk Guide (ICRG) on the basis of a series of pre-set questions for each risk component. For example, the institutional strength and quality of the bureaucracy (BC) is considered a shock absorber that tends to minimize revisions of policy when governments change. Therefore, high points are given to countries where the bureaucracy has the strength and expertise to govern without drastic changes in policy or interruptions in government services. In low-risk countries, the bureaucracy tends to be somewhat autonomous from political pressure and to have an established mechanism for recruitment and training.

The corruption (C) within the political system distorts the economic and financial environment, reduces the efficiency of government and business by enabling people to assume positions of power through patronage rather than ability, and introduces an inherent instability into the political process. The most common form of corruption met directly by business is financial corruption in the form of demands for special payments and bribes connected with import and export licenses, exchange controls, tax assessments, police protection, or loans. Such corruption can make it difficult to conduct business effectively, and in some cases might force the withdrawal or withholding of an investment. For instance, Barth and others (2004) argued that powerful supervision may lead to corruption or distortions and/or hinder banking operations. Our study takes such index into account in order to control the risk to foreign business.

Democratic Accountability (DA) is a measure of how responsive the government is to its people, on the basis that the less responsive it is, the more likely it is that the government will fall, peacefully in a democratic society, but possibly violently in a non-democratic one. The points in this component are given on the basis of the type of governance enjoyed by the country in question.

Government Stability (GS) is an index of the government's ability to carry out its declared program(s), and its ability to stay in office. The risk rating assigned is the sum of government unity, legislative strength, and popular support. A score of 4 points equates to very low risk and a score of 0 points to very high risk.

Investment Profile (I) proxies the factors affecting the risk to investment that are not covered by other political, economic, and financial risk components. The risk rating assigned is the sum of three subcomponents: contract viability/expropriation, profits repatriation, and payment delays. Each element has a maximum score of four points and a minimum score of 0 points. A score of 4 points equates to very low risk and a score of 0 points to very high risk.

Law and Order (LO) are assessed separately, with each sub-component comprising zero to three points. The Law element is a measure of the strength and impartiality of the legal system, while the Order element is an assessment of popular observance of the law. Thus, a country can enjoy a high rating in terms of its judicial

system, but a low rating if it suffers from a very high crime rate or if the law is routinely ignored without effective sanction.

Socioeconomic Conditions (SC) assesses the socioeconomic pressures at work in the society that could constrain government action or fuel social dissatisfaction. The risk rating assigned is the sum of three subcomponents: unemployment, consumer confidence, and poverty. Each element can take a maximum score of four points (very low risk) and a minimum score of 0 points (very high risk).

Financial Structure

Following the recent literature which links financial development to economics efficiency and productivity growth (see, among others, Kasman and Yildirim, 2006) we specify the following variables to proxy the countries' financial structure: stock market capitalisation (MCAP); stock market turnover (TURNOVER), total shares traded (VTRADED), and concentration (CONC).

The level of stock market development can be proxied by the index stock liquidity, measured by the ratio of the value of total shares traded to average real market capitalization (TURNOVER), or by the ratio of market capitalization of the stock exchange over GDP (MCAP). Dey (2005) shows a positive relationship between high turnover stock portfolios and returns. We expect a positive link between TURNOVER and bank efficiency levels. Besides, a positive impact of MCAP on bank efficiency is expected if the banking sector and capital market are complementary and a negative impact in case of competition between them.

We use also the ratio of total shares traded to GDP (VTRADED). A rise in the trading value of shares on an exchange is indicative of interest in the security or the stock market. The trading volume and value reflect the level of liquidity, the efficiency of the infrastructural facilities and the investment culture of the general investors. A well-developed stock market eases the access of banks to more sources of liquidity, which can be translated into higher efficiency levels.

Concentration (CONC) in the banking industry can have a wide range of long-lasting implications for financial sector efficiency, bank stability, and competition. The empirical evidence about the effects of concentration in the banking sector is mixed. On one hand, concentration increases market power and hence might prevent competition and efficiency. On the other hand, if economies of scale drive bank

mergers and acquisitions, then increased concentration may lead to efficiency improvements (Demirguc-Kunt and Levine, 2000; Casu and Girardone, 2009). We proxy concentration as the percentage of assets held by the three largest commercial relative to the total assets of all commercial banks (CR3).

Banks Characteristics

Finally, to control for differences in bank specific characteristics; we use the following proxies: the ratio of equity over total assets (EQTA), the ratio of net loans over total assets (NETLOANS), and the liquidity ratio (LIQ).

The ratio of equity over total assets (EQTA) controls for capital strength. High levels of equity mitigate the risk of insolvency and, ultimately, the cost of borrowed funds. Bank with larger capitalization are less likely to become insolvent. We expect a positive relationship between efficiency and capitalization.

NETLOANS is defined as the ratio of net loans to total assets. Banks with higher volume of loans are more exposed to credit risk but also have higher net interest margins. We expect a negative relationship between efficiency and credit risk which can be explained by managers under estimating the implicit risk of borrowers. In other words, it would equate to bad management (inefficiency).

Finally, LIQ is defined as the ratio of liquid assets to deposits and short-term funding. This ratio represents the risk of not having sufficient cash to satisfy unexpectedly high withdrawals or new loan requests. Lack of liquidity may also force banks to borrow funds at excessive cost. Regarding the sign of the coefficients of this explanatory variable, we do not have a priori expectations.

4. Empirical Results

This section presents the results of the application of Data Envelopment Analysis (DEA) to evaluate the efficiency of banks in selected MENA countries and the results of the two-stage procedure to investigate the impact of environmental variables on bank efficiency.

4.1 DEA Efficiency Results

DEA estimates of the country frontiers and the meta-frontier were obtained using DEAP 2.1 (Coelli, 1996). All results were obtained using the VRS input-orientated DEA. Table 2 reports descriptive statistics of efficiency scores for Egypt, Jordan, Morocco, and Tunisia as well as estimates for all countries combined (meta-frontier). Technical efficiencies and meta-technology ratios were estimated for each of the four MENA countries in each of fourteen years analysis, relative to a balanced panel data set rather than relative to yearly frontiers, which makes analysis of the evolution of efficiency over time meaningful.

<Table 2 around here>

The average annual efficiency scores of banks of each country relative to each country's frontier (DEA-C) reveal a general improvement for Moroccan, Tunisian, and Jordanian banks and a slight decline in overall efficiency levels for Egyptian banks. The mean efficiency score of Moroccan and Tunisian banks is 95.2 percent and 92.3 percent, respectively; the average for Egypt 80.3 percent and for Jordan 91.9 percent. These efficiency levels are within the range of the scores recorded in the literature on developed countries (efficiency levels range between 0.55 percent and 0.95 percent). Recall that these efficiencies are calculated relative to each country's frontier; the boundaries of these frontiers are restricted technology sets, where the restrictions derive from the available economic infrastructure and other characteristics of the production environment, as discussed above.

We now move to the measurement of efficiency relative to a common meta-frontier, defined as the boundary of an unrestricted technology set. It is interesting to note that in all countries, the country-specific frontiers were at least partially tangent to the meta-frontier. This is the case when at least one observation from each country lies both on the country and on the meta-frontier and it is therefore positioned in the point of tangency between the country and the meta-frontier (see Figure 1). This indicates that the meta-frontier closely envelops the country specific frontiers and that the value of the technological gap ratio equals the maximum value of one for at least one observation in each of the sample countries. The technological gap or meta-technology ratio (DEA-MTR), is calculated as the ratio between meta-frontier

(in)efficiency (DEA-M) and the country specific (in)efficiency (DEA-C) and it indicates the relative productivity of technologies. The higher the ratio, the closer a country's production technology is to the "best practice" in the region. Vice versa, the lower the ratio, the bigger is the technology gap.

Looking at the efficiency scores derived from the estimation of the meta-frontier, Moroccan and Tunisian banks dominate the region, with average efficiency scores of 85.5 percent and 85.4 percent respectively. Jordan and Egypt are lagging behind with average efficiency scores of 55 percent and 56.5 percent over the period. The region's average efficiency score is 66.9 percent, which indicates that MENA countries banks could, on average, reduce costs (inputs) by 33.1 percent and still produce the same outputs. Figure 2 illustrates the trend of efficiency levels over the period 1993-2006. For all countries, it is possible to note an improvement in efficiency levels in the early stages of the analysis. However, the improvement is short lived both in Egypt and in Jordan, where efficiency levels decline steadily over the mid to late 1990s. During this period, their meta-technology ratio is also decreasing, thus indicating a lagging behind from the best available technology in the region. Jordanian banks efficiency levels seem to improve steadily from 2000 onwards, but remain below the average for the region. On the other hand, efficiency levels in the region seem to deteriorate in the early 2000, when Moroccan and Tunisian banks display an increase in input wastage from 1999-2000 onwards resulting in lower average efficiencies.

<Figure 2 around here>

Figure 3 illustrates the evolution of the meta-technology ratios for the four MENA countries. Tunisia and Morocco display the highest ratios, thereby indicating that they operate close to the meta-frontier. In Egypt and Jordan, the meta-technology ratio was steadily decreasing over the mid-to-late 1990s, thus indicating a period of lagging behind from the best available technology in the in the region. Jordan's banks MTR improves from the year 2000 onwards, but still remain substantially low.

<Figure 3 around here>

Estimates of the gap between country frontiers and the meta-frontier can be used to design programs for performance improvement, which would involve changes to

the production environment, such as deregulation (O'Donnell and others, 2008). In the next section, we investigate the determinants of difference in efficiency levels.

4.2 Tobit Regression Results

To test the impact of the institutional and financial sector variables on bank efficiency we use a Tobit regression model, as DEA efficiency scores fall between 0 and 1, thus making the dependent variable a limited dependent variable.

We estimate several specifications of the Tobit model. For each specification, we examine the impact of each institutional related variable on bank efficiency to preserve degrees of freedom and reduce the potential for multicollinearity.

The regression results obtained with different sets of institutional and control variables are presented in Tables 3 to 5. In each table, seven specifications are displayed depending on the institutional variables used.

< Insert table 3 to 5 around here >

All results in the different specifications indicate that highly capitalized and liquidity banks tend to have higher efficiency, which is in line with previous studies (Berger and Mester, 1997, and Reda and Isik, 2007). Indeed, banks with sound capital position face lower bankruptcy costs, which reduce their cost of funding. The positive relationship between efficiency and bank capitalization may also indicate that shareholders of less capitalized banks might have lower incentives to monitor bank management, as there is less capital at stake.

Liquidity seems to have a positive impact on bank efficiency; this could be explained by the fact that more liquid banks are less involved in financing risky loans (that turn to be nonperforming) in the region and are therefore more efficient. However bank risk (measured by net loans over total assets) has no significant impact on bank efficiency.

We now turn to the effect of concentration and financial structure on bank efficiency. The negative and significant impact of credit to private sector over GDP is consistent with the evidence that the relationship between banking sector development and economic growth in the MENA region is negative (see Ben Naceur and Ghazouani, 2007). The excessive availability of funds in the region and the lack of

strong supervisory and governance structure contribute to overinvestment in projects with low profitability and this in turn decreases banking efficiency.

In line with previous literature (Kasman and Yildirm, 2006, Pasiouras, 2008), we find that all stock market development measures have a positive and significant impact on bank efficiency scores. As stock markets develop, improved information availability increases the potential pool of borrowers and makes it easier for banks to identify and monitor them. This in turn has a positive impact on bank efficiency. The positive relationship between stock market development and bank efficiency also confirms the complementary effect between equity and bank financing and justifies the move toward a market base financial structure followed by the governments of the countries in our sample.

Higher concentration results in lower cost efficiency. This result is consistent with Berger (1995) and with Athanasoglou and others (2008), who claim that a more competitive banking sector contributes to improve the efficiency and performance of banks.

Turning now to the institutional explanatory variables, we find that the only one that has a positive and significant impact on bank efficiency is Law and Order (LO). This variable measures the quality of the judicial system and a better legal system could provide banks with efficient means to recover their loans in case of defaults and restrain borrowers from investing on excessively risky projects. Bank efficiency levels are not influenced by lower bureaucracy or corruption, but by a well functioning legal system with contract enforcement.

5. Conclusion

This study attempts to examine the effect of deregulation policies on the performance of selected Middle Eastern and North African (MENA) countries banking industries, covering the period 1993-2006. Despite the enormous potential of policy reforms, the analysis of the effect of these initiatives on bank efficiency and performance in MENA countries has been limited. We evaluate bank efficiency in Egypt, Jordan, Morocco, and Tunisia by means of Data Envelopment Analysis (DEA) and we employ a meta-frontier approach to calculate efficiency scores in a cross-country setting. We then employ a second-stage Tobit regression to investigate the impact of institutional, financial, and bank specific variables on bank efficiency.

The first-stage analysis indicates that Morocco and Tunisia have more efficient banking systems compared with the other selected MENA countries, although banks in Jordan seem to slowly catch up with best practice from 2000 onwards. Banks in Egypt and Jordan have lower meta-technology ratios, which indicate a bigger technology gap between the technology adopted and the best available technology in the in the region. This gap increases from the mid-1990s onwards and persists in Egypt, while banks in Jordan are displaying some catching up.

The analysis of the technological gap between country frontiers and the meta-frontier can be used to design programs for performance improvement and changes to the production environment. For this reason, it is of interest for policy makers to understand what drives the differences in bank performance and efficiency among countries in order to improve strategic decision-making.

The empirical results of the second-stage analysis show a robust association of some environmental measures with cost efficiency. In this context, our results reveal that bank efficiency is influenced by the quality of the legal system. Our results also indicate that well capitalized and liquid banks display higher efficiency scores. We also find that banking sector development in a low-regulated environment tends to reduce bank efficiency. However, the impact of stock market development is positive and significant in all specifications, confirming the complementary role of bank and capital market. Furthermore, a highly concentrated banking sector seems to have a significantly negative effect on bank efficiency.

Overall, the analysis shows that, despite similarities in the process of financial reforms undertaken in the four MENA countries, the observed efficiency levels of banks varies substantially across markets. Differences in technology seem to be crucial in explaining efficiency differences. To improve banking sector efficiency, policies should be aimed at giving banks incentives to improve their capitalization and liquidity. Improvements in the legal system and the regulatory and supervisory bodies would also help to reduce inefficiency. Finally, increased investments and upgrading of the stock markets in the region would help banks improve their performance.

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Table 1. Summary Statistics of Input and Output Variables[a]

	Mean	*Median*	*St.dev.*	*Min*	*Max*
Total loans	4,962.82	1,173.70	9,148.12	4.00	7,1291.20
Other earning assets	5,033.80	808.70	12,261.08	13.20	2,995,110.82
Total costs	653.71	137.00	1,289.26	1.70	12,691.70

Note: Values are in USD.

Table 2. DEA Estimates

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Egypt	DEA-M	0.453 *(0.120)*	0.653 *(0.167)*	0.681 *(0.159)*	0.703 *(0.122)*	0.659 *(0.119)*	0.655 *(0.122)*	0.613 *(0.144)*	0.500 *(0.144)*	0.525 *(0.151)*	0.567 *(0.181)*	0.509 *(0.190)*	0.452 *(0.199)*	0.469 *(0.202)*	0.467 *(0.186)*
	DEA-C	0.818 *(0.155)*	0.827 *(0.135)*	0.866 *(0.147)*	0.889 *(0.119)*	0.924 *(0.088)*	0.889 *(0.114)*	0.859 *(0.132)*	0.884 *(0.121)*	0.857 *(0.137)*	0.856 *(0.143)*	0.811 *(0.159)*	0.788 *(0.166)*	0.838 *(0.172)*	0.803 *(0.191)*
	DEA-MTR	0.553 *(0.095)*	0.792 *(0.150)*	0.783 *(0.093)*	0.792 *(0.098)*	0.712 *(0.096)*	0.736 *(0.091)*	0.712 *(0.102)*	0.563 *(0.118)*	0.612 *(0.127)*	0.661 *(0.158)*	0.623 *(0.157)*	0.564 *(0.165)*	0.545 *(0.179)*	0.579 *(0.147)*
Jordan	DEA-M	0.624 *(0.140)*	0.646 *(0.184)*	0.643 *(0.211)*	0.523 *(0.064)*	0.463 *(0.083)*	0.529 *(0.058)*	0.479 *(0.071)*	0.435 *(0.086)*	0.499 *(0.089)*	0.522 *(0.166)*	0.552 *(0.167)*	0.553 *(0.139)*	0.642 *(0.174)*	0.588 *(0.092)*
	DEA-C	0.941 *(0.118)*	0.898 *(0.166)*	0.888 *(0.193)*	0.977 *(0.060)*	0.931 *(0.094)*	0.950 *(0.082)*	0.926 *(0.094)*	0.891 *(0.156)*	0.898 *(0.146)*	0.877 *(0.153)*	0.900 *(0.164)*	0.904 *(0.170)*	0.906 *(0.126)*	0.973 *(0.048)*
	DEA-MTR	0.667 *(0.135)*	0.725 *(0.162)*	0.724 *(0.159)*	0.535 *(0.051)*	0.497 *(0.065)*	0.557 *(0.035)*	0.516 *(0.043)*	0.487 *(0.036)*	0.558 *(0.053)*	0.589 *(0.122)*	0.617 *(0.146)*	0.620 *(0.131)*	0.704 *(0.134)*	0.603 *(0.084)*
Morocco	DEA-M	0.770 *(0.237)*	0.881 *(0.173)*	0.868 *(0.252)*	0.969 *(0.058)*	0.886 *(0.156)*	0.906 *(0.170)*	0.871 *(0.226)*	0.836 *(0.236)*	0.848 *(0.226)*	0.858 *(0.233)*	0.814 *(0.239)*	0.752 *(0.250)*	0.830 *(0.176)*	0.883 *(0.193)*
	DEA-C	0.877 *(0.139)*	0.954 *(0.076)*	0.977 *(0.037)*	0.995 *(0.010)*	0.957 *(0.067)*	0.983 *(0.029)*	0.973 *(0.067)*	0.949 *(0.080)*	0.976 *(0.047)*	0.973 *(0.043)*	0.934 *(0.076)*	0.881 *(0.132)*	0.922 *(0.088)*	0.973 *(0.044)*
	DEA-MTR	0.893 *(0.262)*	0.927 *(0.179)*	0.891 *(0.261)*	0.974 *(0.059)*	0.928 *(0.160)*	0.923 *(0.175)*	0.896 *(0.221)*	0.884 *(0.243)*	0.870 *(0.231)*	0.885 *(0.242)*	0.878 *(0.257)*	0.867 *(0.271)*	0.907 *(0.191)*	0.910 *(0.202)*
Tunisia	DEA-M	0.733 *(0.172)*	0.844 *(0.109)*	0.849 *(0.126)*	0.880 *(0.105)*	0.918 *(0.091)*	0.914 *(0.086)*	0.923 *(0.094)*	0.882 *(0.128)*	0.872 *(0.115)*	0.868 *(0.122)*	0.885 *(0.105)*	0.804 *(0.120)*	0.807 *(0.122)*	0.772 *(0.147)*
	DEA-C	0.884 *(0.142)*	0.892 *(0.113)*	0.870 *(0.123)*	0.909 *(0.106)*	0.935 *(0.087)*	0.940 *(0.076)*	0.948 *(0.069)*	0.968 *(0.044)*	0.948 *(0.075)*	0.904 *(0.107)*	0.941 *(0.090)*	0.930 *(0.105)*	0.943 *(0.089)*	0.914 *(0.124)*
	DEA-MTR	0.837 *(0.164)*	0.950 *(0.087)*	0.977 *(0.049)*	0.970 *(0.050)*	0.982 *(0.037)*	0.973 *(0.042)*	0.973 *(0.049)*	0.912 *(0.134)*	0.923 *(0.116)*	0.959 *(0.066)*	0.945 *(0.099)*	0.869 *(0.111)*	0.859 *(0.121)*	0.849 *(0.133)*
MENA-4		**0.587** ***(0.202)***	**0.728** ***(0.184)***	**0.740** ***(0.191)***	**0.753** ***(0.173)***	**0.721** ***(0.193)***	**0.730** ***(0.184)***	**0.700** ***(0.213)***	**0.625** ***(0.236)***	**0.646** ***(0.221)***	**0.670** ***(0.226)***	**0.645** ***(0.240)***	**0.591** ***(0.236)***	**0.623** ***(0.236)***	**0.613** ***(0.229)***

Notes: DEA-M = efficiencies estimated with respect to the meta-frontier; DEA-C = efficiencies estimated with respect to the country frontier; DEA-MTR = meta-technology ratio. St.dev. in brackets.

Table 3. The impact of institutional, financial structure and specific variables on bank efficiency in Egypt, Jordan, Morocco and Tunisia (controlling for market capitalization as a measure for stock market development) – Tobit regression results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	EFF						
EQTA	0.416	0.419	0.409	0.380	0.364	0.434	0.415
	(3.21)***	(3.02)***	(3.05)***	(2.93)***	(2.67)***	(3.11)***	(2.89)***
LIQ	0.230	0.196	0.195	0.200	0.168	0.146	0.208
	(3.91)***	(3.15)***	(3.13)***	(3.25)***	(2.89)***	(2.53)**	(3.42)***
NETLOANS	-0.031	-0.033	-0.031	-0.026	-0.049	-0.023	-0.017
	(0.63)	(0.65)	(0.63)	(0.51)	(0.98)	(0.47)	(0.34)
CREDITPR	-0.481	-0.508	-0.496	-0.503	-0.446	-0.487	-0.486
	(3.83)***	(4.08)***	(4.28)***	(3.33)***	(3.77)***	(4.27)***	(4.03)***
CONC	-0.473	-0.475	-0.456	-0.468	-0.524	-0.177	-0.432
	(2.44)**	(2.43)**	(2.40)**	(2.29)**	(2.67)***	(0.82)	(1.90)*
MARKETCAP	0.064	0.066	0.066	0.066	0.057	0.094	0.066
	(1.90)*	(2.10)**	(2.11)**	(2.04)**	(1.76)*	(2.86)***	(2.11)**
BC	-0.012						
	(0.30)						
C		-0.006					
		(0.41)					
DA			0.003				
			(0.55)				
GS				-0.002			
				(0.09)			
I					0.009		
					(1.28)		
L&O						0.059	
						(2.77)***	
SC							-0.004
							(0.23)
JOR	0.436	0.442	0.426	0.422	0.437	0.312	0.414
	(5.51)***	(4.83)***	(5.18)***	(4.57)***	(5.44)***	(3.02)***	(4.21)***
MAR	0.326	0.329	0.266	0.317	0.225	0.217	0.316
	(4.89)***	(4.55)***	(6.69)***	(4.78)***	(5.17)***	(2.58)***	(4.34)***

TUN	0.366	0.344	0.347	0.332	0.291	0.321	0.245
	(7.98)***	(6.81)***	(7.02)***	(7.67)***	(5.78)***	(6.39)***	(5.13)***
Y1994	0.134	0.135	0.134	0.134	0.135	0.101	0.134
	(5.37)***	(5.40)***	(5.40)***	(5.41)***	(5.47)***	(3.65)***	(5.35)***
Y1995	0.156	0.158	0.158	0.158	0.159	0.110	0.156
	(6.07)***	(6.15)***	(6.18)***	(6.06)***	(6.27)***	(3.55)***	(6.07)***
Y1996	0.168	0.165	0.173	0.171	0.172	0.124	0.168
	(6.11)***	(5.62)***	(6.21)***	(5.66)***	(6.36)***	(3.84)***	(6.12)***
Y1997	0.147	0.146	0.154	0.153	0.138	0.117	0.147
	(4.90)***	(4.58)***	(5.02)***	(3.95)***	(4.32)***	(3.58)***	(4.85)***
Y1998	0.146	0.148	0.158	0.156	0.125	0.119	0.148
	(4.45)***	(4.44)***	(4.72)***	(3.13)***	(3.11)***	(3.47)***	(4.48)***
Y1999	0.125	0.127	0.137	0.136	0.100	0.100	0.127
	(3.50)***	(3.57)***	(3.83)***	(2.15)**	(2.26)**	(2.74)***	(3.58)***
Y2000	0.060	0.063	0.072	0.073	0.032	0.032	0.062
	(1.63)	(1.73)*	(1.97)**	(1.03)	(0.70)	(0.85)	(1.68)*
Y2001	0.097	0.100	0.109	0.111	0.077	0.064	0.098
	(2.56)**	(2.72)***	(2.91)***	(1.40)	(1.78)*	(1.65)*	(2.46)**
Y2002	0.138	0.138	0.149	0.151	0.126	0.104	0.138
	(3.54)***	(3.53)***	(3.89)***	(1.77)*	(3.17)***	(2.61)***	(3.35)***
Y2003	0.222	0.221	0.221	0.235	0.211	0.190	0.222
	(6.00)***	(5.84)***	(6.06)***	(2.59)***	(5.59)***	(5.01)***	(5.48)***
Y2004	0.065	0.063	0.073	0.079	0.051	0.030	0.064
	(1.83)*	(1.70)*	(2.07)**	(0.73)	(1.39)	(0.81)	(1.61)
Y2005	0.066	0.063	0.073	0.079	0.055	0.020	0.065
	(1.87)*	(1.70)*	(2.05)**	(0.70)	(1.51)	(0.50)	(1.61)
Y2006	0.132	0.132	0.138	0.148	0.124	0.042	0.127
	(2.65)***	(2.64)***	(2.75)***	(1.04)	(2.47)**	(0.71)	(2.16)**
Constant	0.855	0.875	0.829	0.873	0.857	0.488	0.838
	(5.60)***	(5.71)***	(6.49)***	(3.33)***	(6.64)***	(2.69)***	(6.52)***
Wald chi2 (23)	328.06***	280.95***	294.61***	310.76***	284.37***	369.69***	275.12***
Log Likelihood	238.23	238.14	238.62	238.26	241.10	242.26	236.65
Observations	593	593	593	593	593	593	593
Number of banks	45	45	45	45	45	45	45

Table 4. The impact of institutional, financial structure and specific variables on bank efficiency in Egypt, Jordan, Morocco and Tunisia (controlling for valued traded as a measure for stock market development) – Tobit regression results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
EQTA	0.388	0.421	0.405	0.400	0.384	0.416	0.435
	(2.99)***	(3.02)***	(2.95)***	(2.96)***	(2.96)***	(3.09)***	(3.09)***
LIQ	0.199	0.206	0.197	0.199	0.209	0.193	0.158
	(3.20)***	(3.37)***	(3.18)***	(3.41)***	(3.41)***	(3.11)***	(2.58)***
NETLOANS	-0.036	-0.036	-0.034	-0.036	-0.038	-0.037	-0.026
	(0.71)	(0.70)	(0.67)	(0.70)	(0.78)	(0.74)	(0.52)
CREDITPR	-0.420	-0.444	-0.437	-0.475	-0.402	-0.420	-0.403
	(3.67)***	(3.76)***	(4.01)***	(3.17)***	(3.64)***	(3.69)***	(3.74)***
CONC	-0.513	-0.519	-0.506	-0.528	-0.562	-0.487	-0.266
	(2.83)***	(2.81)***	(2.81)***	(2.84)***	(3.00)***	(2.25)**	(1.33)
VTRADED	0.060	0.062	0.062	0.061	0.050	0.062	0.084
	(1.97)**	(2.17)**	(2.18)**	(2.15)**	(1.63)	(2.17)**	(2.83)***
BC	-0.010						
	(0.27)						
C		-0.005					
		(0.36)					
DA			0.003				
			(0.51)				
GS				-0.010			
				(0.46)			
I					0.008		
					(1.04)		
SC						-0.002	
						(0.13)	
L&O							0.056
							(2.66)***
JOR	0.464	0.468	0.450	0.482	0.470	0.443	0.358
	(6.17)***	(5.28)***	(5.88)***	(5.76)***	(5.87)***	(4.73)***	(3.60)***
MAR	0.339	0.334	0.327	0.298	0.339	0.275	0.229
	(4.88)***	(4.54)***	(4.59)***	(6.60)***	(4.59)***	(5.82)***	(2.74)***

TUN	0.332	0.337	0.326	0.334	0.332	0.325	0.303
	(7.38)***	(7.26)***	(6.92)***	(7.82)***	(7.27)***	(6.83)***	(6.00)***
Y1994	0.135	0.135	0.135	0.135	0.134	0.135	0.102
	(5.43)***	(5.41)***	(5.41)***	(5.45)***	(5.39)***	(5.41)***	(3.70)***
Y1995	0.158	0.157	0.158	0.159	0.155	0.157	0.111
	(6.14)***	(6.13)***	(6.16)***	(6.13)***	(6.10)***	(6.14)***	(3.58)***
Y1996	0.171	0.165	0.172	0.175	0.167	0.170	0.125
	(6.22)***	(5.62)***	(6.20)***	(5.80)***	(6.16)***	(6.21)***	(3.87)***
Y1997	0.148	0.143	0.152	0.160	0.134	0.148	0.114
	(4.99)***	(4.54)***	(4.99)***	(4.13)***	(4.16)***	(4.91)***	(3.50)***
Y1998	0.148	0.145	0.155	0.167	0.121	0.149	0.115
	(4.58)***	(4.39)***	(4.68)***	(3.37)***	(2.96)***	(4.55)***	(3.37)***
Y1999	0.125	0.122	0.132	0.151	0.095	0.126	0.093
	(3.59)***	(3.47)***	(3.75)***	(2.40)**	(2.11)**	(3.59)***	(2.57)**
Y2000	0.058	0.055	0.065	0.088	0.026	0.058	0.023
	(1.63)	(1.55)	(1.81)*	(1.25)	(0.56)	(1.61)	(0.61)
Y2001	0.094	0.092	0.101	0.128	0.069	0.093	0.054
	(2.57)**	(2.55)**	(2.77)***	(1.64)	(1.60)	(2.39)**	(1.40)
Y2002	0.133	0.130	0.141	0.170	0.118	0.133	0.094
	(3.56)***	(3.41)***	(3.78)***	(2.02)**	(3.02)***	(3.28)***	(2.38)**
Y2003	0.219	0.215	0.217	0.258	0.206	0.218	0.183
	(6.07)***	(5.78)***	(6.01)***	(2.91)***	(5.50)***	(5.45)***	(4.86)***
Y2004	0.066	0.062	0.072	0.113	0.052	0.065	0.031
	(1.88)*	(1.69)*	(2.06)**	(1.08)	(1.38)	(1.64)	(0.83)
Y2005	0.065	0.060	0.070	0.112	0.054	0.063	0.019
	(1.83)*	(1.61)	(1.96)*	(1.04)	(1.49)	(1.56)	(0.47)
Y2006	0.142	0.139	0.146	0.198	0.131	0.138	0.060
	(2.94)***	(2.87)***	(3.01)***	(1.50)	(2.69)***	(2.40)**	(1.05)
Constant	0.875	0.885	0.854	0.946	0.825	0.863	0.536
	(5.98)***	(5.90)***	(6.87)***	(3.89)***	(6.63)***	(6.95)***	(3.08)***
Wald chi2 (23)	291.07***	300.24***	283.76***	347.75***	316.70***	297.02***	293.10***
Log Likelihood	238.64	238.42	238.375	238.688	239.82	238.56	241.88
Observations	593	593	593	593	593	593	593
Number of banks	45	45	45	45	45	45	45

Table 5. The impact of institutional, financial structure and specific variables on bank efficiency in Egypt, Jordan, Morocco and Tunisia (controlling for turnover as a measure for stock market development) – Tobit regression results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
EQTA	0.433	0.397	0.417	0.433	0.429	0.450	0.425
	(3.15)***	(3.07)***	(3.01)***	(3.22)***	(3.12)***	(3.25)***	(3.05)***
LIQ	0.197	0.199	0.216	0.204	0.225	0.107	0.214
	(3.17)***	(3.24)***	(3.79)***	(3.33)***	(4.45)***	(2.12)**	(3.40)***
NETLOANS	-0.045	-0.040	-0.026	-0.034	-0.034	-0.031	-0.042
	(0.88)	(0.80)	(0.52)	(0.66)	(0.70)	(0.63)	(0.82)
CREDITPR	-0.411	-0.370	-0.437	-0.471	-0.388	-0.373	-0.378
	(3.65)***	(3.14)***	(4.05)***	(3.15)***	(3.59)***	(3.50)***	(3.34)***
CONC	-0.611	-0.578	-0.615	-0.637	-0.646	-0.450	-0.501
	(3.69)***	(3.37)***	(3.73)***	(3.74)***	(3.88)***	(2.54)**	(2.41)**
TURNOVER	0.151	0.165	0.161	0.148	0.133	0.165	0.160
	(2.89)***	(3.16)***	(3.24)***	(3.03)***	(2.68)***	(3.39)***	(3.20)***
BC	0.003						
	(0.07)						
C		0.011					
		(0.79)					
DA			0.008				
			(1.32)				
GS				-0.014			
				(0.60)			
I					0.009		
					(1.19)		
L&O						0.047	
						(2.35)**	
SC							-0.014
							(0.87)
JOR	0.489	0.465	0.488	0.517	0.484	0.465	0.447
	(6.70)***	(5.53)***	(6.84)***	(6.18)***	(6.88)***	(5.96)***	(4.36)***
MAR	0.342	0.343	0.337	0.355	0.281	0.284	0.353
	(4.87)***	(4.90)***	(4.82)***	(4.87)***	(6.17)***	(3.10)***	(7.36)***

TUN	0.323	0.328	0.241	0.340	0.224	0.300	0.348
	(6.93)***	(7.40)***	(5.57)***	(7.57)***	(5.40)***	(5.95)***	(7.16)***
Y1994	0.122	0.121	0.120	0.123	0.121	0.094	0.123
	(4.86)***	(4.87)***	(4.83)***	(4.94)***	(4.91)***	(3.40)***	(4.97)***
Y1995	0.144	0.143	0.143	0.147	0.142	0.106	0.146
	(5.57)***	(5.64)***	(5.64)***	(5.67)***	(5.62)***	(3.43)***	(5.73)***
Y1996	0.159	0.168	0.163	0.166	0.156	0.122	0.158
	(5.85)***	(5.79)***	(5.99)***	(5.54)***	(5.86)***	(3.81)***	(5.92)***
Y1997	0.125	0.133	0.132	0.139	0.111	0.095	0.118
	(4.31)***	(4.35)***	(4.44)***	(3.61)***	(3.69)***	(2.94)***	(4.00)***
Y1998	0.134	0.141	0.143	0.155	0.102	0.105	0.124
	(4.31)***	(4.40)***	(4.44)***	(3.14)***	(2.74)***	(3.10)***	(3.91)***
Y1999	0.100	0.107	0.109	0.130	0.066	0.072	0.089
	(3.00)***	(3.14)***	(3.19)***	(2.07)**	(1.63)	(1.99)**	(2.58)***
Y2000	0.031	0.036	0.039	0.065	-0.004	-0.002	0.018
	(0.89)	(1.04)	(1.11)	(0.93)	(0.10)	(0.05)	(0.49)
Y2001	0.083	0.090	0.094	0.123	0.054	0.048	0.067
	(2.36)**	(2.55)**	(2.62)***	(1.58)	(1.34)	(1.26)	(1.74)*
Y2002	0.126	0.137	0.137	0.170	0.107	0.089	0.109
	(3.48)***	(3.63)***	(3.76)***	(2.02)**	(2.89)***	(2.28)**	(2.74)***
Y2003	0.211	0.223	0.197	0.259	0.195	0.177	0.193
	(6.02)***	(6.00)***	(5.59)***	(2.92)***	(5.45)***	(4.73)***	(4.87)***
Y2004	0.054	0.065	0.064	0.112	0.038	0.020	0.035
	(1.57)	(1.79)*	(1.85)*	(1.08)	(1.05)	(0.55)	(0.89)
Y2005	0.038	0.046	0.046	0.098	0.027	-0.001	0.017
	(1.04)	(1.22)	(1.25)	(0.91)	(0.73)	(0.03)	(0.40)
Y2006	0.142	0.144	0.148	0.213	0.125	0.083	0.111
	(3.01)***	(3.11)***	(3.17)***	(1.64)	(2.59)***	(1.55)	(1.91)*
Wald chi2 (23)	287.93***	298.26***	280.88***	313.32***	303.63***	291.84***	325.65***
Log Likelihood	240.51	241.18	240.15	241.36	240.16	243.18	241.27
Observations	593	593	593	593	593	593	593
Number of banks	45	45	45	45	45	45	45

Figure 1. A Meta-Frontier Model

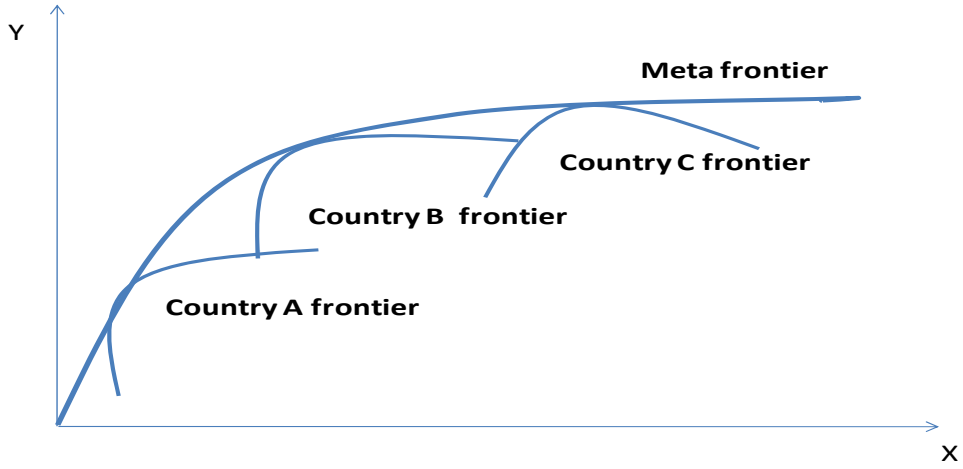

Figure 2. DEA Efficiency Scores

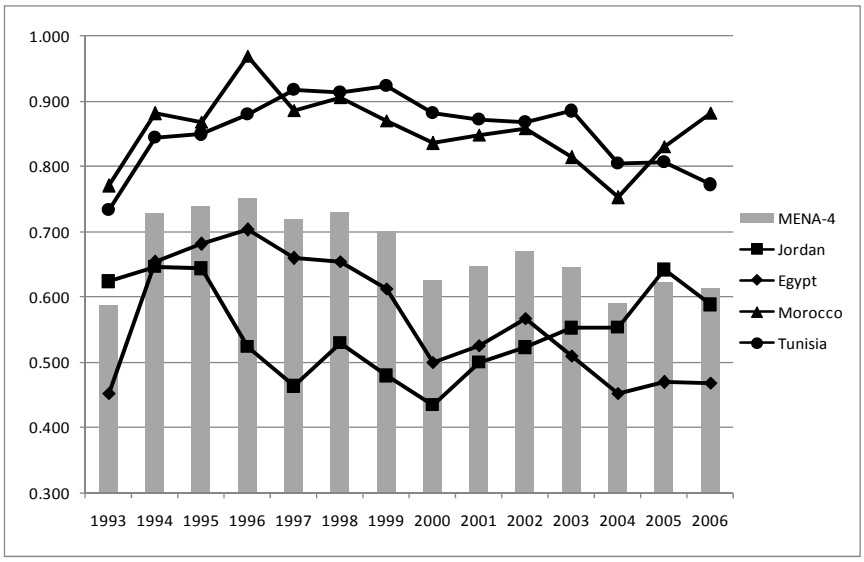

Figure 3. Meta-technology Ratios