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Efficiency in Arabian Banking

Idries Al-Jarrah and Philip Molyneux *

ABSTRACT

This study investigates the efficiency levels of the Jordanian, Egyptian, Saudi Arabian and Bahraini banking systems. The study sample comprises information on 82 banks operating in Jordan, Egypt, Saudi Arabia and Bahrain over the 1992-2000 period. We utilized the Fourier-flexible stochastic frontier approach to estimate cost and profit efficiency levels in the banking systems under study. Cost efficiency estimates averaged around 95% over the 1992-2000 period. Standard and alternative profit efficiency estimates averaged 66% and 58%, respectively. Islamic banks are found to be the most cost and profit efficient while investment banks are the least (cost and profit efficient). Large banks, in assets terms, appear to be relatively more cost and profit efficient. Geographically, Bahrain banks are found to be the most efficient while Jordanian banks are the least efficient.

Keywords: Arabian Banking, Parametric and Non-parametric techniques, Cost Efficiency, Technical Efficiency, Allocative Efficiency, Pure Technical Efficiency, Intermediation Approach, Productive Approach, Profit Efficiency.

1. INTRODUCTION

Financial sectors in the developing countries, including the Arabian systems, have traditionally been characterized by relatively high levels of government controls where regulatory authorities maintained a protected banking environment that inhibited competition. However, market conditions in banking have undergone extensive changes over the last two decades or so. On the demand side, customer preferences have changed substantially, becoming more sophisticated and price conscious. On the supply side, the globalization of financial markets has been accompanied by governmental deregulation, financial innovation and automation.

To assist banks in confronting the new challenge, financial authorities throughout the world have become more aware of the importance of financial deregulation to promote competition in the market, the aim being to concurrently increase both the efficiency and soundness of banking systems.

In this respect, Arabian countries, including those under study-namely Jordan, Egypt, Saudi Arabia and Bahrain, have passed a substantial body of legislation (over the last few years) aimed at liberalizing their financial systems. The liberalization process has been accompanied by financial deregulation through the reduction of direct government control, at the same time, it is associated with upgrades of prudential regulations.

The aim of this paper is to explore efficiency levels in various Arabian banking industries and to examine the impact of economic and financial reforms which have taken place in these countries over the past two decades. There are various reasons for examining efficiency levels in Arabian banking systems. First, little empirical work has been undertaken to investigate efficiency levels in Arabian banking, and as such an empirical investigation may yield interesting insights that could be of use to policy makers operating in these countries and to the financial institutions themselves. Furthermore, this study

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attempts to reveal the determinants of Arabian banks' efficiency by examining various factors that help explaining Arabian banking sector efficiency and reveal the characteristics of efficient banks. The study further seeks to assess, for instance, whether there is a link between bank's size, and cost and profit efficiency levels. If we find a positive size and efficiency relationship, there will be a tendency towards a continued consolidation and concentration in the industry. In particular, the paper evaluates whether such factors as asset quality, capital levels and other environmental variables (such as bank size, market characteristics, geographic position and liquidity ratios) influence bank's efficiency levels (Mester, 1996; Berger and Mester, 1997; Berger and DeYoung, 1997; and Altunbas et al., 1997). Finally, in general, the study ultimately aims to extend the established literature on bank efficiency in the developing countries.

The results of the present study generally reveal that the cost efficiency averaged around 95% for the banks under study over the 1992-2000 period. Given the standard and alternative profit function, technical efficiency averaged 66% and 58% respectively over the same period. Islamic banks are found to be the most cost and profit efficient, while investment banks are the least (cost and profit efficient).

Another major finding of this study is that there is little evidence to suggest that the major economic and financial reforms undertaken in Jordan, Egypt, Saudi Arabia and Bahrain over the last decade have had a noticeable impact on improvement in banking sector efficiency.

2. LITERATURE REVIEW

This section reviews some selective efficiency studies that have enriched the bank efficiency literature and those that have addressed the productive efficiency in banking in particular.

Banking Studies That Use the Parametric Approach to Study Productive Efficiency

Leibenstein (1966) was the first to identify X-efficiency[(1)]. He stated that while microeconomic theory focused on the possibilities of optimal allocative efficiency, it must also focus on the identification of X-efficiencies that reveal the differences in costs and revenues between firms. Efficiencies that are not related to size (scale) and product-mix (scope) are X-efficiencies.

Utilizing the distribution-free approach for measuring banking efficiency derived from profit function estimates, Berger et al. (1993) found that larger US banks are more X-efficient, in general, than smaller banks (efficiency estimates ranged from 0.52 to 0.66) over the period 1984-1989.

Allen and Rai (1996) used both the Stochastic-Frontier Approach (SFA) and Distribution-Free Approach (DFA) on a sample of 194 banks from 14 countries (including 9 in the European Union) for the period 1988-1992. Large banks operating in the countries that prohibited the functional integration between commercial and investment banking had the largest inefficiency measures, amounting to 27.5% of the total costs.

Dietsch and Weill (1998) used unconsolidated accounting data of 661 commercial, mutual and savings banks from 11 EU countries covering the period from 1992-1996, to estimate changes in efficiency and productivity. The results suggest an increase in efficiency using both a cost and a profit frontier. This trend, however, was not observed in all countries (France, Italy, Luxembourg and UK experienced decreasing levels of efficiency).

Maudos et al. (1999) examined efficiency for a sample of banks from 11 EU countries with data covering the period 1993–96, using both cost and profit frontiers and taking into account firms' specializations in the measurement of efficiency. Using the cost frontier, the average efficiency score for the whole sample was 0.44, compared with 0.74 when estimation of separate frontiers was carried out.

[1] X-efficiency is a loose term used to explain various sources of efficiency (X means here unknown or inexact source of efficiency). Later on, X-efficiency was further decomposed into various forms of efficiencies.

Banking Studies That Use the Non-Parametric Approach to Study Productive Efficiency

Aly et al. (1990) explored various measures of efficiency for 322 randomly chosen independent US banks in 1986. Employing three inputs (i.e., labour, capital, and loanable funds) and five outputs (i.e., commercial and industrial, consumer, real estate, and other loans; and demand deposits), they discovered that scale inefficiency is a minor problem when compared to pure technical inefficiency. In the second-stage regression analysis, bank size and efficiency are positively related while product diversity and efficiency are negatively related.

Elyasiani and Mehdian (1990) investigated bank efficiency, as well as technological change, for a sample of 191 US banks with assets in excess of $300 million in both 1980 and 1985. Employing a four-input (i.e., labour, capital, demand deposits, and savings and time deposits) and four-output (i.e., commercial and industrial, real estate, and other loans; and investments) approach, they find that because of technological progress between 1980 and 1985, the same level of output can be produced with 10.45 to 22.29% fewer inputs.

Yue (1992) evaluated the efficiency of the 60 largest Missouri banks for the period 1984 through 1990. Employing four inputs (i.e., interest and non-interest expense, and transactions and non-transactions deposits) and three outputs (i.e., interest and non-interest income, and total loans), he reports that pure technical inefficiency provides the major source of technical inefficiency.

Berg et al. (1993) utilized DEA to study bank efficiency in Finland, Norway and Sweden in 1990. Within countries, efficiency differences between banks were most important in Finland and Norway and least important in Sweden. The largest Swedish banks were among the most efficient units in the pooled sample, whereas only one large Finnish bank and no large Norwegian bank had efficiency scores above 0.90.

Berg et al. (1995) used DEA to investigate efficiency in the banking sectors of Denmark, Finland, Norway and Sweden. The study found that the largest Danish and Swedish banks were among the most efficient units in the pooled sample. Danish and Swedish banks appeared to be in the best position to expand in a common Nordic banking market.

Grabowski et al. (1994) considered the efficiency for a group of 670 US banks in 1979, 1983 and 1987. Employing three inputs (i.e., labour, capital, and loanable funds) and five outputs (i.e., commercial and industrial, consumer, and real estate loans; securities; and demand deposits), they conclude that pure technical inefficiency provides the main source of technical inefficiency. In addition, efficiency was the highest in 1983 for the various measures considered, except for scale efficiency that remained constant over the three years of observation. Finally, banks with deposits in excess of $1 billion had the highest technical efficiency.

Pastor et al. (1995) analyzed efficiency and differences in technology using non-parametric methods for eight European countries in 1992. France, Spain and Belgium appeared to have the most efficient banking sectors (with average efficiency scores of 0.950, 0.822 and 0.806m, respectively), while UK (0.537), Austria (0.608) and Germany (0.650) were the least efficient.

Elyasiani et al. (1995) employed a flexible non-parametric approach to measure the productive efficiency of a sample of small and large banks to examine the relationship between size and productive performance in banking industry and to check the progress in relative efficiency over 80s. Their findings suggest that in the pre-deregulation period, small banks were more efficient, while in the deregulated, small and large banks are equally efficient. Moreover, the dispersion in the efficiency measures of the small banks was found to have increased substantially, while that of large banks changed little over the sample period.

Wheelock and Wilson (1995) undertook DEA estimation by two specifications; the intermediation and production approach. They used the production approach but replaced the number of deposits and loans accounts with their dollar amounts to check if this affects the estimated efficiency scores. They found that efficiency scores are the same applying both input/output specifications.

To summarize the findings of the previous two subsections, while there are differences in productive

efficiency estimates at the level of individual markets, it is safe to say that the results of the above studies concur with Evanoff and Israilevich (1991) who surveyed the productive efficiency literature in the US and found that mean inefficiency levels typically range between 13-51%. This general finding also concurs with later reviews, such as the extensive Berger and Humphrey (1997) survey of 130 efficiency studies that found that average bank efficiency of studies that use DEA and other non-parametric methods are typically around 0.70 while those studies that employ parametric methods report overall mean efficiencies of 0.84 in US banking. On the other hand, the European efficiency studies, in particular, disagree somehow about the levels of X-inefficiency depending on the study period and the countries concerned; but most studies suggest that cost X-inefficiency is around 20%.

3. METHODOLOGY: MEASURES OF EFFICIENCY AND PRODUCTIVITY

The stochastic frontier, with the Fourier-flexible functional form, is the main methodology employed to derive efficiency measures in the countries under study. This section presents the main features of the Fourier-functional form.

The most widely used functional form in the bank efficiency literature is the translog; however, it is subject to certain limitations, namely it does not necessarily fit well the data that are far from the mean in terms of output size or mix.

The Fourier-flexible functional form is preferred over the translog because its better approximates the underlying cost function across broad range of outputs as suggested by Spong et al. (1995), Mitchell and Onvural (1996). Finally, the Fourier-Flexible (FF) has several appealing properties in terms of modelling bank cost or profit structures as pointed out by Williams and Gardener (2000).

The Fourier-flexible Functional Form

The stochastic cost model for a sample of N firms can be written as:

$$InTC_i = InTC(y_i, w_i, z_i; B) + u_i + v_i, \quad i = 1, ..., N,$$

where TC_i is observed as the cost of bank i, y_i is the vector of output levels and w_i is the vector of input prices for bank i. z_i represents a vector of control variables which in the case of our estimates includes the quality of bank's output (q_i), the level of its financial capital (k_i) and the time trend (Ti). B is a vector of parameters, *vi* is a two-sided error term representing the statistical noise (assumed to be independently and identically distributed and to have a normal distribution with mean 0 and variance σ_v^2).

u_i are non-negative random variables that account for technical inefficiency.

In order to estimate our cost and profit efficiencies we adopt the two approaches suggested by Battese and Coelli (1992 and 1995). In the case of Battese and Coelli's (1995) model, u_i are assumed to be independently distributed as truncations at zero of the N (m_i, σ_u^2) distribution; where $m_i = \delta_i d$, where δ_i is a set of environmental variables which are employed to control for firm's specific factors that may contribute to explain the differences in the efficiency estimates, and d is a vector of parameters to be estimated. For the Battese and Coelli (1992) model, u_i are assumed to be iid as truncations at zero of the $N(\mu_I, \sigma_u^2)$ distribution.

4. DATA

Our data comprises a representative sample of the banks operating in Jordan, Egypt, Saudi Arabia and Bahrain and consists of 82 banks over the 1992-2000 period. This sample represents around 78%, 88%, 63% and 52% of the financial systems of these countries, respectively (excluding the assets of foreign branches and central banks). Table (1) shows the details.

Table (2) shows the specialization of the banks included in the sample. The number of commercial banks comprises around 66% of the total sample. The Persent of commercial banks operating in each country varies; ranging from 44% in Bahrain to 77% in Saudi Arabia.

Table (1): The size of the study sample as% of the respective banking systems in the countries under study over 1992-2000.

Year/ Country	Bahrain	Egypt	Jordan	Saudi Arabia
1992	44	84	75	60
1993	50	89	74	58
1994	50	92	75	58
1995	54	92	77	60
1996	55	88	79	60
1997	54	87	81	64
1998	49	85	81	65
1999	54	86	80	71
2000	54	90	77	73
Average	**55**	**88**	**78**	**63**

Source: The total assets were extracted from the annual financial reports of the monetary agencies in the countries under study (the consolidated financial statements of the banks) while the sample was drawn from the London Bankscope database (January, 2000 and 2002).

Table (2): Specialization of banks under study, 1992-2000.

% of total	Bahrain	Egypt	Jordan	Saudi Arabia	All
Commercial	44	76	57	77	66
Investment	28	8	29	8	16
Islamic	17	5	7	0	7
Other	11	11	7	15	11
Total Number of banks	18	37	14	13	82

Source: Bankscope (January, 2000 and 2002).

Table (3) shows that the size of total assets of all the banks included in the present study increased from about US$ 180 billion in 1992 to about US$ 310 billion in 2000 and averaged about US$ 235 billion over the whole period. Dividing these financial institutions into nine size categories, the share of the largest banks (with assets size greater than US$ 5 billion) constituted around 70% of the total assets of all the banks over the period 1992-2000.

This study employs the intermediation approach, as indicated earlier, for defining bank inputs and outputs. Following Aly et al. (1990), the inputs used in the calculation of the various efficiency measures are deposits (w_1), labour (w_2) and physical capital (w_3). The deposits include time and savings deposits, notes and debentures, and other borrowed funds. The price of loanable funds was derived by taking the sum of interest expenses of the time deposits and other loanable funds divided by loanable funds. Labour is measured by personnel expenses as a% of total assets[2]. Bank physical capital is measured by the book value of premises and fixed assets (including capitalized leases). The price of capital was derived by taking total expenditures on premises and fixed assets divided by total assets. The three outputs used in the study including total customer loans (y_1), all other earning assets (y_2), and off-balance sheet items (y_3), are measured in millions of US dollars.

The off-balance sheet items (measured in nominal terms) were included as a third output. Although the latter are technically not earning assets, these constitute an increasing source of income for banks and therefore should be included when modelling the banks' cost

[2] As staff numbers were not available for the banks in the sample, we used this measure instead. This measure for staff costs has been used in various previous studies including Altunbas et al. (1996) and (1999).

characteristics; otherwise, total banks' output would tend to be understated (Jagtiani and Khanthavit, 1996).

Table (3): The share of banks, based on assets size, in the banking systems under study over 1992-2000 (% of total assets in the respective countries).

	1992	1993	1994	1995	1996	1997	1998	1999	2000	Avg. ($US, mil.)
1-99.9	0.11	0.08	0.14	0.16	0.14	0.10	0.06	0.02	0.02	202
100-199.9	1.16	1.05	0.78	0.35	0.31	0.18	0.21	0.29	0.27	1,073
200-299.9	1.76	1.35	1.10	1.78	1.04	0.80	0.67	0.36	0.32	2,173
300-499.9	3.78	4.08	3.47	2.79	2.92	2.75	2.49	2.04	1.58	6,422
500-999.9	2.56	2.73	4.64	4.57	4.51	3.53	3.67	3.47	3.29	8,569
1,000-2,499.9	11.87	11.50	9.89	13.09	10.02	11.31	11.84	10.51	10.15	25,911
2,500-4,999.9	8.29	8.56	4.68	4.94	7.12	6.65	6.50	7.66	8.26	16,470
5,000-9,999	18.22	19.28	24.51	26.23	24.40	26.82	14.88	19.13	9.28	46,196
10,000+	52.26	51.37	50.78	54.22	49.54	47.85	59.67	56.53	66.83	129190
T. Assets (US$, mil., nominal values)	179,033	186,975	197,046	213,044	225,426	250,325	267,943	292,855	313,209	

Source: Bankscope (Jan. 2000 and 2002).

Table (4): Descriptive statistics of the banks' inputs and outputs for Jordan, Egypt, Saudi Arabia and Bahrain over 1992-2000.

Variables	Description	Mean	St. Dev	Min.	Max.
TC	Total cost (includes Interest expense, Personnel expense, Commission expense, Fee expense, Trading expense, other operating expense) (US$ millions).	170	300	0	1,720
W1	Price of funds (%) (total interest expense/ total customer deposits (demand, saving and time deposits)).	0.07	0.09	0.00	1.98
W2	Price of labour (%) (total personnel expense/total assets).	0.02	0.01	0.00	0.21
W3	Price of physical capital (Non-interest expense/Average assets).	0.01	0.01	0.00	0.21
Y1	The US $ value of total aggregate loans (all types of loans) (US$ millions).	1,260	2,280	1	15,060
Y2	The US $ value of total aggregate other earning assets (short-term investment, equity and other investment and public sector securities (US$ millions)).	1,390	2,470	1	13,600
Y3	The US $ value of the off-balance sheet activities (nominal values, US$ millions).	1,320	3,510	1	26,740
p1	Price of loans (%) (total earned interest/ Total loans).	0.15	0.07	0.01	0.87
p2	Price of other earning assets (%) (Trading income and other operating income excluding commission and fees income/Other earning assets).	0.05	0.04	0.01	0.33
P3	Price of off-balance sheet items (%) (Commission and fees income/ off-balance sheet items).	0.01	0.02	0.00	0.20

Source: Bankscope (Jan. 2000 and 2002).

The definitions, means, standards of deviation of the input and output variables used in the stochastic frontier estimations are reported in table (4). The table shows th-at the average bank had US$ 1.26 billion in loans, US$ 1.39 billion other earning assets and US$ 1.32 billion of balance sheet items over 1992-2000. The cost of input variables averaged about 7.0% for purchased funds, 2.0% for labour and 1.0% for physical capital over the period 1992-2000. On the other hand, the prices of banks output averaged about 15.0% for loans [(3)]; 5.0% for other earning assets and 1.0% for off-balance sheet items over the same period.

In addition to the above input and output variables, the present study employs a variety of control and environmental variables to rule out the effect of other factors that might explain differences among efficiency estimates for the banks under study. The three control variables included in our model include the size of loan loss reserves as a percent of bank's credit portfolio, the capital adequacy ratio, and a time trend (see table (5) for details). The loan loss reserves as a proportion of gross loans ranged between 0.01 and 19.68%, the latter figure suggests that some banks faced substantial credit quality problems. The total banks' capital as a present age of total assets averaged around 14.0% with a standard deviation of 12.0%, this reflects sizeable differences in the capital adequacy of the banks under study.

The size of loan loss reserves as a proportion of gross loans is added to the model to control for the bank's risk structure. Studies on bank failures suggest a positive relationship between operating inefficiency and failure rates (for example, Cebenoyan, Cooperman, and Register, 1993; Hermalin and Wallace, 1994; Wheelock and Wilson, 1995).

Another important aspect of efficiency measurement is the treatment of financial capital. A bank's insolvency risk depends on the financial capital available to absorb portfolio losses, as well as on the portfolio risk themselves. Clark (1996) included capital in a model of economic cost and found that it eliminated measured scale diseconomies in production costs alone.

The environmental variables were also added to the model to investigate the reason for the differences in efficiency scores across banks under study. These include variables that control for market structure and organizational characteristics, geographical segmentation and bank liquidity. We identify variables to account for bank specialization, bank size and concentration in the respective banking industries. Financial institutions are divided into four categories; commercial, investment, Islamic and other financial institutions. Furthermore, we employ the 3-firm asset concentration ratio that is widely used to test for monopoly characteristics. Furthermore, we include a dummy variable to control for bank geographical (country) location. Table 5 shows descriptive statistics of the control and environmental variables.

The total assets variable is used to control for bank size where bank size should be strongly associated with efficiency as size may be required to utilize scale and (maybe) scope economies (if large banks are more diversified). Furthermore, larger banks may have more professional management teams and/or might be more cost conscious due to market discipline from owners concerning the bottom line profits (Evanoff and Israilevich, 1991). Berger et al. (1993) found that most of the efficiency differences among large banks was on the output side as larger banks might be better able to reach their optimal mix and scale of outputs.

The 3-firm concentration ratio and market share variables were included to control for oligopoly behaviour along the lines of the traditional structure-conduct-performance paradigm (Molyneux et al., 1996).

Dummy variables for bank specialization are also included in the model so as to control for the product diversity as efficiency might be associated with firm's strength in carefully targeting its market niches. Aly et al. (1990) found a negative relationship between product diversity and cost efficiency. Ferrier, Grosskopf, Hayes and Yaisawarng (1993) found that banks with greater product diversity tend to have lower cost efficiency.

Finally, the liquidity ratio is included to account for

[(3)] This may be an over statement as interest earned on bonds is also included in this figure.

bank's liquidity risk. Banks that hold more liquidity may be expected to have lower liquidity risk but may be less profit efficient as liquid assets tend to yield lower returns. In contrast, as liquid assets are controlled in outputs, one would expect banks with higher liquid assets (all other things being equal) to be more cost efficient.

Table (5) Descriptive statistics of the banks' control and environmental variables for Jordan, Egypt, Saudi Arabia and Bahrain over 1992-2000.

Variables	Description	Mean	St. Dev	Min	Max
The control Variables					
K	Capital Adequacy (%) (Total equity/ Total Assets)	0.14	0.12	0.01	0.72
S	Asset quality (Loan Loss Reserve / Gross Loans)	0.22	0.81	0.01	19.68
T	Time Trend	5.00	2.58	1.00	9.00
The Environmental Variables					
TA	Total Assets (US$ millions)	2,881	4,966	35	26,700
B	Dummy variable for Bahrain	0.22	0.41	0.00	1.00
J	Dummy variable for Jordan	0.17	0.38	0.00	1.00
E	Dummy variable for Egypt	0.45	0.50	0.00	1.00
Com.	Dummy variable for commercial banks	0.66	0.47	0.00	1.00
Inv.	Dummy variable for investment/ securities banks	0.16	0.37	0.00	1.00
Isl.	Dummy variable for Islamic banks	0.07	0.26	0.00	1.00
L	Liquidity ratio (%) (Total liquid assets/ Total Assets)	0.14	0.16	0.00	0.71
3-FCR	Three firm concentration ratio (%) (the largest 3 banks total assets of /Total assets of all banks in the bank country for the respective years)	0.62	0.14	0.48	0.81
MS	Bank assets market share (%) for each year	0.05	0.10	0.00	0.68

Source: Bankscope (Jan., 2000, 2002).

5. RESULTS: EFFICIENCIES AND PRODUCTIVITY CHANGES

This section presents the steps undertaken to obtain the preferred cost, standard and alternative profit models. This includes employing different models utilized in the banking efficiency literature based on different assumptions concerning the distribution of efficiency terms. In addition, various hypotheses are tested, given different combination of control and environmental variables, to arrive at the preferred models based on maximum likelihood estimation.

The Preferred Stochastic Model Based On the Specification of the Cost Function

There are three stages undertaken to arrive at the preferred model for our cost function estimates. The first stage involves utilizing Battese and Coelli's (1995) approach that allows us to include the efficiency correlates directly in the model estimation. The second stage involves utilizing Battese and Coelli's (1992) time-varying efficiency approach that gives flexibility to examine different assumptions concerning the distribution of efficiency terms, comparing time-variant versus time-invariant models. Finally, stage 3 compares the best specified models in stage 1 and stage 2 to arrive at a single preferred model from the two stages and provides the basis for the model choice.

Stage 1: Estimating the Cost Frontier Models that Include Efficiency Correlates

This stage estimates the stochastic frontier for the cost

function, given the Fourier-flexible functional form that includes efficiency correlates. This stage follows Dietsch and Lozano-Vivas (2000) who emphasized the importance of including country and other specific information in common frontier estimations of bank efficiency. This stage is conducted using the approach suggested by Battese and Coelli's (1995) technical inefficiency effects model that allows us to include firm-specific (and country-specific) variables directly into the model as these might explain some of the efficiency differences between banks as well as the variation in bank inefficiency overtime.

In order to derive the bank efficiency model that includes firm-specific variables, we employ the control and environmental variables detailed earlier. The control variables include the loan loss reserves as a% of loans, capital strength and a time trend. The loan loss reserve as a% of gross loans is included to control for asset quality. Capital strength is measured by the ratio of equity to total asset ratio. A time trend variable is included in the model (table (5)) shows descriptive statistics of these variables).

Environmental variables are employed, as a set of explanatory variables, to control for organisational characteristics and geographical location. We identify three ratios to test these characteristics; dummy variables for bank specialization, bank market share and concentration in the pertinent banking systems. The banks in each country are divided into four categories; commercial, investment, Islamic and other financial institutions. Furthermore, we employ the 3-firm concentration ratio that is widely used to test for monopoly characteristics in the pertinent market. Furthermore, we include dummy variables to control for bank geographical (country) location.

To reach the best-specified model in this stage, we undertook the following steps:

Step 1: Estimating the Fourier-truncated with Different Combination of Control Variables

1.1. The unrestricted Fourier-flexible model is estimated assuming inefficiency to be truncated. This model includes all the control variables and all the efficiency correlates (the environmental variables).

1.2. The Fourier-truncated model that includes the efficiency correlates is estimated but without the time parameters. Next, we estimate the model but without the capital parameters. Then, we estimated the model without the risk (bank's asset quality) parameters. Based on the log-likelihood one-sided ratio, only the model that is without time-parameters is the best specified model and is accepted at the critical value of 5%.

1.3. The Fourier-truncated model that includes the efficiency correlates is estimated without time and capital parameters simultaneously. Next, the model is estimated without time and risk parameters. Then, the model is estimated without risk and capital parameters. Based on the log-likelihood ratio, all these models are rejected in favour of the model estimated in the previous step.

1.4. The Fourier-truncated that includes the efficiency correlates is estimated but without any of the control variables (capital, risk and time) in the model. This model is compared with the models estimated earlier. Based on the maximum likelihood ratio, this model is not rejected.

Step 2: Comparing Fourier Specification with Translog Specification: In this step, the best Fourier specifications concluded from ***step 1*** were compared with identical translog specifications. Based on the log-likelihood ratio, the translog is rejected at the 5% significance level.

Step 3: Examining the Impact of Efficiency Correlates: The best specified model up to ***step 1*** and ***2*** above is the Fourier-truncated that includes the efficiency correlates (environmental variables) but does not include any of the control variables. In the following, we estimate the Fourier-truncated model without efficiency correlates. The log-likelihood ratio rejected this model in favour of the alternative model that necessitates the existence of such variables in the model.

Step 4: Examining the Impact of Inefficiency-terms on the Model Specification

In this step, the best specified model selected until ***step 3*** will be compared with the model that excludes the inefficiency term from the model. The model that excludes efficiency correlates is rejected and so, the model which accounts for technical inefficiency is warranted in these instances.

On this basis, the best specified model from ***stage 1*** is the Fourier-truncated model that excludes the control variables (time trend, capital adequacy and asset quality) but includes the efficiency correlates.

Stage 2: Estimating the Cost Frontier Models that Excludes Efficiency Correlates

This stage estimates the stochastic frontier, given the Fourier-flexible functional form that excludes efficiency correlates. The models in this stage are estimated utilizing Battese and Coelli's (1992) time-varying approach. This approach gives some flexibility concerning the distribution of inefficiency term in the frontier; truncated or half normal. Furthermore, it allows us to examine the time-varying efficiency model against the time-invariant model.

In our search for the best model specification utilizing this model, we follow studies that assume no restriction to be imposed on the distributional features of the inefficiency term. These studies include Cebenoyan et al. (1993) who used the truncated normal model, Stevenson (1980) and Greene (1990) who used the normal and gamma distribution, respectively. Then, we restricted Mu (μ) to be zero to obtain Pitt and Lee's (1981) half-normal model. Next, we restricted both Mu (μ) and Eta (η) to be zero to get the time-invariant model as outlined in Battese, Coelli and Colby (1989).

The following steps summarize the procedures followed to arrive at the preferred model specifications in this stage:

Step 1: Comparing the Fourier-truncated Time-Variant with Time-Invariant Model: the null hypothesis in this step states that the specification of Fourier-truncated time-invariant model is better than the time-variant model. The null hypothesis in this step is rejected, as the time-invariant model cannot be specified.

Step 2: Fourier Truncated Time-Variant Versus Half-Normal Time Variant Model: Here, the null hypothesis states that the half-normal time-variant model specification is better than the specification of the truncated time-variant model. Utilizing the log-likelihood ratio, the null hypothesis is rejected.

Step 3: Fourier-truncated with Different Combinations of Control Variables: The Fourier-truncated time-variant model is estimated with different combinations of control variables. Comparing the estimated models in this step and based on the log-likelihood ratio, the most appropriate model is the Fourier-truncated time-variant model without the control variables.

Step 4: Comparing the Fourier-specification with Translog Specification: here we compare the Fourier-truncated model specifications selected in ***step 3*** above with the translog form given an identical specification. The preferred model in this stage is the translog-truncated without the control variables.

Stage 3: Comparing the Models from Stage 1 and Stage 2

It should be noted that we cannot formally compare directly the results of ***stage 1*** and ***stage 2*** above because we utilize Battese and Coelli's (1995) approach in the first stage and Battese and Coelli's (1992) approach in the second stage. The two model specifications are non-nested and hence no set of restrictions can be defined to permit a test of one specification versus the other.

However, the second approach suffers from a main weakness; the technical inefficiency effects of different firms at any given time period, t, are equal to the same exponential function $(\exp[-\eta(t-T)] = \exp[T-t])$ of the corresponding firm-specific inefficiency effects at the last period of the panel (the u_u s). Thus, the model does not account for situations in which some firms may be relatively inefficient initially but become relatively more efficient in subsequent periods.

Therefore, if the above two stages lead more or less to the same model specifications, we will take the efficiency estimates of the first stage. However, if the two stages

lead to different preferred model specifications, we will report the results of the two stages and then compare the efficiency estimates resulted from each stage.

In the case of the cost function, the first stage leads us to select the Fourier-truncated without control variables but with efficiency correlates and the second stage leads to select the translog-truncated without control variables as well. As such, it is plausible to assume that the inclusion of efficiency correlates in the first stage is the reason for the selection of the Fourier over translog in the first stage. Thus, we will choose the result of ***stage 1*** as the cost preferred model; the Fourier-truncated model excluding control variables (capital, risk and time trend) but including all the efficiency correlates.

The Preferred Models Based on the Specification of the Standard and Alternative Profit Functions

Following similar procedures to those of the cost function discussed above, the preferred model for both the standard and alternative profit functions is the Fourier-truncated model that includes both the control variables (capital, risk and time trend) as well as the efficiency correlates.

Estimated Levels of Cost and Profit Efficiency

Inefficiency estimates for the cost, standard and alternative profit efficiency, derived from the preferred models, are summarized in tables (6), (7) and (8).

Given the preferred cost function, efficiency estimates for banks in the countries under study averaged 95% and these estimates have slightly varied over time from 95% in 1992 to 94% in 2000. This suggests that the same level of output could be produced with approximately 95% of current inputs if banks under study were operating on the most efficient frontier. This level of technical inefficiency is somewhat less than the range of 10-15% for the 130 studies surveyed by Berger and Humphrey (1997)[4] and Berger and DeYoung (1997). These results are also less than the level of inefficiency found in European studies including Carbo et al.'s (2000) whose findings for a sample of banks, from twelve countries, show mean cost inefficiency of around 22% for the period from 1989 to 1996.

Referring to table (6), the average efficiency based on bank specialization ranged from 93% for investment banks to 98% for Islamic banks. The efficiency scores based on geographical location ranged from 89% in Jordan to 99% in Bahrain. Finally, based on asset size, the differences among technical efficiency scores are not significant where optimal bank size is between US$ 2.5-5.0 billion and the largest banks seems to be somehow more efficient.

As indicated earlier, the bank efficiency literature considers the estimation of both cost and profit efficiencies to reveal more accurate information about firm-level performance (see Berger and Mester, 1999). Referring to tables (7) and (8), the standard and alternative profit functions results show average technical efficiency estimates that are around 66% and 58% respectively over the period 1992-2000. It should be noted that this level of efficiency is somehow similar to the typical range of profit efficiency found in US studies which is about half of the industry's potential profits, according to Berger and Humphrey (1997). Profit inefficiencies in Arabic banking are less than those found in European banking. For instance, William's and Gardener (2000) estimated profit efficiency to be 79.7% in European banking during the 1990s. The mean profit efficiency given the standard profit function suggests that banks under study lose around 34% of profits that could be earned by a best-practice institution. The profit efficiency given both the standard profit and alternative profit function has witnessed volatility over the period 1992-2000. While over the period 1993-99, the efficiency estimates derived from both profit function specifications fluctuate slightly around their average, the year 2000 exhibits fall in profit efficiency across banks under study. This might reflect the response of economic and financial activities to the instability in the oil prices and the political instability aroused from recent conflict aggravation in Palestine and the Gulf.

Given the standard profit function, profit efficiency

[4] Of these, 60 parametric studies found that the mean technical inefficiency is smaller than 15 percent.

ranged from around 61% in Jordan to 68% in Bahrain. Based on specialization, the results show that the efficiency scores ranged from 56% for investment banks to 75% for the Islamic banks. This result might explain the increase in Islamic banking activities especially in Bahrain over the past few years; as the cost of funds for Islamic banks is relatively cheaper than the cost of funds for other financial institutions. The Islamic banks, in general, do not pay interest but rather a mark-up which is a profit margin based on the way in which the funds are utilized. Given the geographical location, Jordan is a relatively much poorer country compared to Saudi and Bahrain (oil-producing countries) and banks may be able to sell higher profit-generating products in these markets. This might explain why the Jordanian banks are relatively less profit efficient than the banks in other countries under study.

Table (6): Cost efficiency in Jordan, Egypt, Saudi Arabia and Bahrain banking over 1992-2000.

	1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**All**
Bahrain	100	100	100	100	100	99	99	99	99	99
Egypt	94	94	94	94	94	93	93	93	93	94
Jordan	90	89	89	89	89	89	89	88	88	89
Saudi Arabia	97	97	97	97	97	97	97	97	96	97
Commercial	95	95	95	95	94	94	94	94	94	94
Investment	93	93	93	93	93	93	93	93	93	93
Islamic	98	98	98	98	99	99	98	98	98	98
Other	97	96	96	96	96	96	96	96	96	96
All	95	95	95	95	95	94	94	94	94	95

Asset Size (US$ million)

	1-199	**200-299**	**300-499**	**500-999**	**1,000-2,499**	**2,500-4,999**	**5,000-9,900**	**10000+**		**All**
Bahrain	100	99	100	99	99	99	99	99		99
Egypt	95	94	94	94	94	93	92	90		94
Jordan	88	87	88	91	90			91		89
Saudi Arabia				98	98	98	98	95		97
All	95	93	94	95	95	96	96	94		95

Asset Size (US$ million)

	1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**All**
1-199.9	94	94	95	95	96	96	95	96	95	95
200-299	93	94	92	93	92	92	95	95	95	93
300-499	95	95	95	95	94	94	92	92	91	94
500-999	96	94	94	94	94	95	96	95	96	95
1,000-2,499	96	96	95	96	96	94	94	94	94	95
2,500-4,999	95	96	99	96	96	96	96	96	96	96
5,000-9,999	98	98	97	96	96	96	95	96	95	96
10000+	95	95	94	94	94	93	94	93	94	94
All	95	95	95	95	95	94	94	94	94	95

Source: Author's own estimation

Based on the size of assets, apart from the smallest banks (US $ 1-199 millions) which are the most profit efficient, larger banks seem to be more profit efficient, in general. This result supports the theory that large banks enjoy several advantages compared to small banks. These advantages include the ability of large banks to utilize more efficient technology with less cost, the ability of these banks to prepare more specialized staff for the most profitable activities and their ability to provide higher quality output resulting in higher prices.

Similar results are obtained from the alternative profit function estimates where profit efficiency ranges from 49% in Jordan to 61% in Bahrain. Based on specialization, Islamic banking is again the most profit efficient while investment banking is the least efficient. Based on asset size, the largest banks also seem to be the most efficient. Overall, the results of both the standard and alternative profit functions, while varying in absolute efficiency levels, are exactly identical in terms of profit efficiency ranking in terms of country, specialization and bank asset size.

Table (7): Standard profit efficiency in Jordan, Egypt, Saudi Arabia and Bahrain banking over 1992-2000.

	1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**All**
Bahrain	69	78	67	71	66	72	67	68	57	68
Egypt	66	64	66	70	66	64	65	73	63	66
Jordan	84	60	61	61	63	56	56	59	50	61
Saudi Arabia	67	68	66	69	69	65	59	63	63	65
Commercial	70	67	68	72	69	65	62	68	62	67
Investment	65	69	55	55	48	51	57	60	43	56
Islamic	83	73	78	79	75	80	67	67	76	75
Other	64	58	57	61	64	73	74	78	55	65
All	70	67	65	68	66	65	63	68	59	66

Asset Size (US$ million)

	1-199	**200-299**	**300-499**	**500-999**	**1,000-2,499**	**2,500-4,999**	**5,000-9,900**	**10000+**	**All**
Bahrain	75	67	71	62	66	66	78	56	68
Egypt	74	59	60	70	69	70	58	72	66
Jordan	53	66	56	73	53			68	61
Saudi Arabia				43	62	65	68	68	65
All	70	63	62	68	65	67	67	67	66

Asset Size (US$ million)

	1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**All**
1-199.9	72	68	75	70	65	70	76	70	56	70
200-299	65	75	60	65	62	60	57	63	44	63
300-499	71	65	60	60	58	63	59	64	55	62
500-999	61	66	62	76	71	64	63	75	66	68
1,000-2,499	78	62	64	66	65	67	66	67	56	65
2,500-4,999	59	49	79	79	78	63	64	77	62	67
5,000-9,999	65	73	71	72	64	60	61	70	64	67
10000+	70	73	64	73	76	71	60	61	63	67
All	70	67	65	68	66	65	63	68	59	66

Source: Author's own estimation.

Table (8): Alternative profit in Jordan, Egypt, Saudi Arabia and Bahrain Banking over 1992-2000.

	1992	1993	1994	1995	1996	1997	1998	1999	2000	All
Bahrain	58	72	60	66	58	64	51	61	58	61
Egypt	65	58	60	62	59	60	56	68	55	60
Jordan	59	51	54	53	49	39	42	52	46	49
Saudi Arabia	56	56	54	51	61	59	51	61	61	57
Commercial	60	59	61	63	63	58	53	62	56	60
Investment	55	61	52	50	43	46	46	62	44	51
Islamic	76	57	60	64	54	63	51	55	78	62
Other	69	62	47	53	48	63	56	67	47	57
All	61	60	58	60	58	57	52	62	55	58

Asset Size (US$ million)

	1-199	200-299	300-499	500-999	1,000-2,499	2,500-4,999	5,000-9,900	10000+	All
Bahrain	63	66	59	54	55	59	86	68	61
Egypt	59	55	54	63	64	61	64	78	60
Jordan	42	46	46	59	43			74	49
Saudi Arabia				23	50	65	56	63	57
All	56	55	54	59	57	62	61	69	58

Asset Size (US$ million)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	All
1-199.9	61	47	57	68	49	62	63	55	48	56
200-299	56	72	47	58	57	45	46	59	46	55
300-499	58	64	56	52	50	57	44	53	44	54
500-999	62	53	55	61	63	55	51	70	56	59
1,000-2,499	70	57	63	54	49	57	50	64	53	57
2,500-4,999	58	50	66	66	64	52	55	73	66	62
5,000-9,999	58	55	67	64	64	58	63	65	56	61
10000+	62	80	62	74	84	77	60	62	68	69
All	61	60	58	60	58	57	52	62	55	58

Source: Author's own estimation.

To summarize the main findings, cost efficiency levels averaged around 95% over the period 1992-2000 without noticeable change over the 1992-99 period; but have experienced a fall in 2000. On the other hand, both standard (and alternative) profit efficiency averaged around 66% (and 56%) over the sample period. Standard profit and alternative profit efficiency of Arabic banking systems have not witnessed significant changes over the 1993-99 but have also experienced a fall in 2000. That is profit efficiency has recently fallen.

Profit efficiency estimates for the Arabic banks under study are not noticeably different from those observed from previous studies on the US and European banking industries. Islamic banks are found to be the most cost and profit efficient while investment banks are the least efficient. This result may partially explain the motives behind the increase in Islamic banking activities over the past few years; as the cost of funds for Islamic banks is

relatively cheaper than the cost of funds for other financial institutions. On the other hand, intense competition between investment and commercial banks might explain the competitive disadvantages of the investment banks in terms of their market share and expose the motives for increased mergers and consolidation activity between such banks.

Based on assets size, large banks seem to be relatively more cost and profit efficient, in general. This result suggests that large banks enjoy several advantages compared to small banks. These include the ability of large banks to utilize more efficient technology with less cost, the ability of these banks to set up more specialized staff for the most profitable activities and their ability to provide better quality output and therefore charge higher prices. Geographically, Bahrain has the most cost and profit efficient banking systems while Jordan has the least cost and profit efficient.

Finally, while the countries under study have implemented many economic and financial reforms over the last twenty years or so as indicated earlier, these reforms do not appear to have had much impact on banking sector efficiency. Given our findings, it seems that more reform may be needed to improve (especially) their profit efficiency. Perhaps the move to create a single Gulf Countries Council (GCC) market may help to facilitate these developments as the creation of a similar European Single market appears to have had a positive impact on European bank efficiency (see European Commission (1997)).

6. CONCLUSION

A major aim of this study is to estimate efficiency levels in various Arabic banking sectors by applying various statistical analyzes to a data set on Jordan, Egypt, Saudi Arabia and Bahrain.

As pointed out by Berger and Humphrey (1997), there have been many studies that investigate banking sector efficiency using varying data periods, methodologies and countries but, at the same time, there is no consensus on the sources of the sizeable variation in the measured efficiency. This study, in its turn, employs three distinct economic efficiency concepts (cost, standard profit, and alternative profit efficiencies), using a number of different measurement methods (including the stochastic frontier approach, specification of the Fourier-flexible functional form versus the translog form, and inclusion of bank's asset quality and financial capital in a number of different ways) to a single data set.

Based on these preferred models for cost, standard profit and alternative profit, different efficiency measures are reported for the banks in the countries under study. Given cost efficiency, the preferred model is the Fourier-truncated form that excludes the control variables (capital adequacy, asset quality and the time trend) but includes all the environmental variables. Given the standard and alternative profit function, the preferred model is the Fourier-flexible which includes the control as well as the environmental variables.

Overall, this study finds that efficiency levels differ according to the three various efficiency concepts that are used (cost, profit and alternative profit) and each method adds some independent informational value. A somewhat interesting result is that the choices made concerning the efficiency measurement method leads to somewhat similar model specifications.

Based on the chosen preferred model, cost efficiency averaged around 95% over the 1992-2000 period. Given the standard and alternative profit function, technical efficiency averaged 66% and 58% respectively over the same period. Islamic banks are found to be the most cost and profit efficient, while investment banks are the least (cost and profit efficient). Based on bank asset size, large banks seem to be relatively more cost and profit efficient. Geographically, Bahrain banks are the most cost and profit efficient while Jordan's are the least (cost and profit efficient). It should be noted that these results, in general, are similar to those found in other US and European banking studies.

Another major finding of this study is that there is little evidence to suggest that the major economic and financial reforms undertaken in Jordan, Egypt, Saudi Arabia and Bahrain over the last decade have had a noticeable impact

on the improvement in banking sector efficiency. The main policy recommendation from this study, therefore, is that these countries need to continue the reform process in order to enhance financial sector performance.

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كفاءة البنوك العاملة في العالم العربي

إدريس محمد الجرّاح وفيليب مولينوكس*

ملخص

استهدفت هذه الدراسة تقصي مستويات الكفاءة للبنوك العاملة في الاردن ومصر والسعودية والبحرين. شملت عينة الدراسة معلومات عن 82 بنكاً تعمل في الاردن ومصروالسعودية والبحرين خلال الفترة من 1992–2000. استخدمنا طريقة المنحنى المرن الذي يسمح بالخطأ العشوائي لتقدير مستويات الكفاءة للكلفة والربحية للبنوك العاملة بالاجهزة المصرفية تحت الدراسة. أظهرت النتائج التي تم التوصل اليها أن متوسط مستويات الكفاءة المقدرة للكلفة كان بحدود الـ 95% تقريبا للفترة من 1992–2000. كما أن متوسط مستويات الكفاءة للربح المعياري والربح البديل كان بحدود 66% و58% على التوالي خلال نفس الفترة. أظهرت النتائج التي تم التوصل اليها أن البنوك الاسلامية هي الاكثر كفاءة بالكلفة والربحية بينما كانت البنوك الاستثمارية هي الاقل كفاءة. كما بينت النتائج ان البنوك الكبيرة الحجم من حيث حجم الموجودات هي نسبيا أكثر كفاءة بالكلفة والربحية من البنوك الاصغر حجما وأظهرت النتائج أيضا أن البنوك التي تعمل في البحرين هي الاكثر كفاءة بالكلفة والربحية بينما كانت البنوك الأردنية هي الاقل كفاءة.

الكلمات الدالة: البنوك العربية، اساليب التحليل القياسي والخطي لتقدير الكفاءة، كفاءة الكلفة، الكفاءة الفنية، كفاءة التوزيع، الكفاءة الفنية الصافية، مدخل الوساطة المالية، مدخل الانتاجية، كفاءة الربحية.

Idries Al-Jarrah
Department of Financing,
Faculty of Business Administration, The University of Jordan.

Philip Molyneux
Department of Financing,
Faculty of Business Administration, The University of Jordan.

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