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Efficiency and Determinants in Libyan Banks

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Abstract

This paper provides a comparative analysis regarding the performance of 17 Libyan banks over the period 2004 up to 2010. According to the relevant literature, there are few studies that combine both the Data Envelopment Analysis (DEA) technique and Tobit model for assessing the efficiency levels and subsequently examining the determinants of efficiency for the banking sector in Libya. For this study, the DEA technique was used to estimate cost, allocative, and technical efficiency of sampled banks by using DEAP software. In the second stage, Tobit regression model was used to identify potential determinants of efficiency by using Stata10 software. The results showed that the specialized banks have exhibited higher mean cost efficiency relative to commercial and private banks. The results of efficiency determinants showed positive relationship between bank efficiency, and return on investment (ROA); risk; and size of operation (SO). This paper concludes with some policy implications of the results.

Keywords: Efficiency, data envelopment analysis, specialized banks, commercial banks, private banks.

INTRODUCTION

The financial industry usually plays an important role in the progress of a country and its economic development. In this regard, banks as financial intermediaries play a key role in transforming deposits into financial assets (Mohammed, 2002). The banking sector as one leading sector in modern economies has also become the criterion for measuring the safety of the national economy of any country (Berger & De Young, 1997). Nevertheless, technological innovation; deregulation of financial services sector; and international competition have affected the roles played by banks. More importantly, these changes have affected the performance of banks on the aspect of production efficiency.

Libya's banking system is dominated by four banks which are owned in full or have majority stake in them by Libyan Central Bank (Aljumhoria Bank, Wahda Bank, Sahara Bank and the National Commercial Bank). These banks constitute almost ninety percent of Libya's banking sector assets. All of these banks have capital of at least 100 million Libyan Dinars (76.923 million USD), and two of them (Wahda Bank and Sahara Bank), were in the process of being privatized in 2006. In November 2007, five foreign banks were short listed for the privatization of Wahda Bank. These branches are France, Italy, Jordan, Bahrain and Morocco institutions. Arab Bank of Jordan was selected. They bid on a 19% of the share of Wahda Bank, with the option to increase their ownership to 51% in three to five years. France's BNP Paribas acquired 19% of Libya's Sahara Bank

in July 2007, and took operational control of the bank. The deal also includes an option allowing BNP Paribas to purchase additional shares up to 51% of Sahara's capital over the next three to five years.e availability of financing on the local market was weak. Libyan banks offer limited financial products, loans are often made on the basis of personal connections (rather than business plans), and public bank managers lack clear incentives to expand their portfolios. Clearly, there is lack of financial support that halts Libya's development. The Libyan banking system is currently undergoing a substantial modernization program to upgrade available services/products, deal with large numbers of nonperforming loans, establish a functioning national payments system, facilitate the use of non-cash payment instruments, and institute new standards of accounting and training. While foreign banks are technically able to enter the Libyan market under the Banking Law of 2005, the Central Bank has sought to delay their entry until the reform process is completed (Mireles et al., 2009).

The banking sector in Libya encountered large and very important changes with the installation of a new national payments system, a program which was implemented in 2005 following consultation with the World Bank (Panorama Report, 2008). This shows that previously the banking sector in Libya was a local, heavily regulated, and restricted business, resulting in a closed and uncompetitive bank sector. After 2003, the industry has embarked on a series of economic reforms to establish free market to be more competitive and open. With these reforms, interest and foreign exchange rates were freed, and new financial products and institutions were permitted. In addition to that, the mixed economy of the country, where all sizes and types of banks (commercial, private, and specialized) compete with each other, makes the Libyan banking industry a significant case for measuring the efficiency levels of the different types of banks. These banks face serious challenges in the face of liberalization. The banking system in Libya was affected by this challenging environment because, with banking liberalization, any inefficient banks will be forced out of the market by the more efficient banks. A review of the literature has revealed that very little effort have been made to determine the banking efficiency in developing countries (Hassan, Al-Sharkas, Samad, 2004). Therefore, it appears that there are no sufficient studies that have been conducted for Libyan banking.

For this reason, this paper provides a comparative analysis of the performance of banking sector in Libya over the period 2004 to 2010 by following a two stages approach: estimating efficiency scores in the first stage, and using Tobit regression model for identifying efficiency determinants in the second stage. The paper unfolds as follows. Section 1 provides an overview of the banking system in Libya, section 2 provides a review of the literature, and section 3 provides an overview of DEA and the types of efficiency measures, followed by section 4 on the methodology, data, and variables. Section 5 provides discussion on the results while section 6 is the conclusion.

LITERATURE REVIEW

In a rapidly changing financial market worldwide, bank regulators; managers; and investors are concerned about how efficiently banks transform their expensive inputs into various financial products and services. According to Berger, Forsund, Hjalmarsson, and Suominen (1993), although rapid changes in the financial services industry have been taking place all around the globe, the efficiency research has not kept pace with these changes. In their excellent international survey paper, Berger and Humphrey (1997) also focused their attention regarding the imbalance of thefocus in the literature after reviewing 130 efficiency studies from 21 countries. They reported

that the large majority of the studies on banking efficiency focus on the banks of developed countries.

Resti (1997) evaluated the cost efficiency of the Italian banks using DEA of 270 Italian banks over period 1988 to 1992. Results showed that the average values of the productive efficiency indexes (econometric model) between 69.4 percent in 1988 and 69.8 percent in 1992. And results found that the average values of the productive efficiency indexes (DEA models) for CRS model between 66.5 percent in 1988 and 69.2 percent in 1991. Also for VRS model between 73.4 percent in 1992 and 75.5 percent in 1989, from the results, the efficiency of Italian banks did not increase over the period 1988 – 1992.

Fiorentino, Karmann and Koetter (2006) investigated the consistency of efficiency scores derived with two competing frontier methods in the financial economics literature: Stochastic Frontier and Data Envelopment Analysis. 34,192 observations for all German universal banks were chosen and analyzed whether efficiency measures yield consistent results according to five criteria between 1993 and 2004. Results found that non-parametric methods are particularly sensitive to measurement error and outliers. Furthermore, results showed that accounting for systematic differences among commercial, cooperative and savings banks is important to avoid misinterpretation about the status of efficiency of the total banking sector.

Havrylchyk (2006) aimed to estimate cost, allocative, technical, pure technical and scale efficiency for Polish banks from 1997 to 2001. The results found that the average efficiency was 59.92 percent for the domestic banks and 73.23 percent for the foreign banks. Also, found that the efficiency in the banking system in Poland did not improve during the period of the study.

Mostafa (2007) aimed to measure the relative efficiency of the top 100 Arab banks. The sensitivity of the results was also investigated. Top 100 Arab banks over the period 2005 – 2006 were chosen for this study. His results indicated that the performance of several banks was sub-optimal, suggesting the potential for significant improvements. Separate benchmarks were derived for possible reductions in resources used, and significant savings were possible on this account.

On Mokhtar, Abdullah and Al - Habashi (2008), this study aimed to empirically investigate the efficiency of the fully fledged Islamic banks and Islamic windows in Malaysia. The study used 288 panel data from the banks' financial statement of 20 Islamic Windows, 2 full-fledged Islamic banks and 20 conventional banks from 1997 to 2003. Their findings showed that, on average, the efficiency of the overall Islamic banking industry has increased during the period of study. The study also revealed that, although the fully fledged Islamic banks were more efficient than the Islamic windows, they were still less efficient than the conventional banks. Finally, Islamic windows of the foreign banks were found to be more efficient than Islamic windows of the domestic banks.

Adjei-Frimpong, Gan and Hu (2014) analyzed the efficiency of the banking industry in Ghana over the period of 2001–2010 using the data envelopment analysis. The study investigated the impact of size, capitalization, loan loss provision, inflation rate and GDP growth rate on Ghana's bank efficiency using both static and dynamic panel data models.The static model was estimated by the fixed effects estimator whereas the dynamic model was estimated by the two steps system GMM estimator. The results suggested that Ghana banks were inefficient. This study revealed that well-

capitalized banks in Ghana were less cost efficient. In addition, bank size had no influence on bank cost efficiency suggesting that larger banks in Ghana had no cost advantages over their smaller counterparts. The findings also exhibited that loan loss provision ratio had no effect on bank efficiency in Ghana. This study found GDP growth rate negatively influences bank cost efficiency and that lagged cost efficiency tended to persist from year to year.

Kamarudin et al. (2019) examined the revenue efficiency of the Malaysian Islamic banking sector. The study also seek to investigate the potential internal (bank specific) and external (macroeconomic) determinants that influence the revenue efficiency of Malaysian domestic Islamic banks. The domestic and foreign Islamic banks operating in Malaysia was chosen as a sample for this study during the period of 2006 – 2015. The revenue efficiency is computed by using DEA. Furthermore, a panel regression analysis framework based on Ordinary Least Square (OLS) was used to examine the potential determinants of revenue efficiency. The results indicated that the level of revenue efficiency of foreign Islamic banks is more compared their domestic Islamic banks. Also, results showed that bank market power, liquidity, and management quality significantly influence the improvement in revenue efficiency of the Malaysian domestic Islamic banks during the period under study.

This study differs from previous studies in variables. Also, the time of previous studies were conducted between 1997 and 2019, while this study will conduct in 2020. Finally, previous studies did not address cost efficiency in Libyan banks.

RESEARCH METHODOLOGY

DEA can be defined as a mathematical method using linear programming to measure the relative efficiency of a number of administrative units (decision-making units) through the identification of the optimal mix of inputs and outputs which are grouped based on their actual performance (Zhu, 2003; Manadhar and Tang, 2002). The most important models of DEA are the CCR (Charnes, Cooper, and Rhodes) model and the BCC (Banker, Charnes, and Cooper) model. The CCR was developed by Charnes, Cooper, and Rhodes (1978). This model gives an evaluation of efficiency and identifies the source and amount of inefficiency. The BCC model is attributed to Banker, Charnes, and Cooper. This model is based on the CCR model and gives an estimate of the technical efficiency according to the scale of operation in the unit needed to provide services to beneficiaries at the time of measurement, i.e., the efficiency is associated with a certain size of operation (Norman & Stoker, 1991).

A cost efficient firm will choose its inputs and mixes according to their prices so as to minimize total cost. Cost inefficiency may arise from two different sources. One is deficiency in applying the technology (technical inefficiency) and another one is sub-optimal allocation of resources (allocative inefficiency). Thus, total overall cost efficiency can be presented as the product of technical efficiency and allocative efficiency:

Overall cost efficiency = allocative efficiency × technical efficiency

As cited by Cummins and Zi (1996) the cost efficiency is the act of saving money by making a product or performing an activity in a better way.

The sample for this study is 17 Libyan banks that comprise four commercial, five specialized banks that work in a specialized area such as agriculture, real estate, and foreign investments., and eight private banks, these banks are owned by people, whether they are normal or legal persons who take over the management of its affairs and will be responsible for all legal and financial activities of the bank.

This paper covers the period from 2004 to 2010. This span of time was chosen because the privatization of Libyan economy has started after United Nations and United States removed their sanctions on Libya in 2003, and 2011 was excluded because the revolution has started in Libya. In February 2011, the Libyan people revolted against Muammar Gaddafi's regime, which led to a war in Libya continued until the end of October 2011. This war has affected Libyan's economy. So, in this paper the year 2011 was excluded from this study as an exceptional year and the results that are obtained from the year 2011 will negatively affect on the full results of the study and may give an incorrect picture of the operations of Libyan banks, for this reason this paper covers the period from 2004 to 2010. The data were obtained from the Libyan central bank statistical bulletin, Libyan stock market, and annual reports from banks. Table (1) shows the types and the names of Libyan banks.

Table (1): Types of Libyan Banks

	Commercial Banks	**Specialized Banks**	**Private Banks**
1	Wahda Banks	Agriculture Bank	Commercial and Development Bank
2	Aljumhoria Bank	Real Estate Investment Bank	Mediterran Bank
3	Sahara Bank	Development Bank	Alsary Bank
4	National Commercial Bank	Libyan Foreign Bank	Alejmaa Alarabi Bank
5		Alrefi Bank	United Bank
6			Amman Bank
7			Al Wafa Bank
8			Al Waha Bank

Input and Output Definition

It is generally recognized that the selection of variables in efficiency studies significantly affects the results. Two approaches dominate the banking theory literature: the production and intermediation approaches (Sealey and Lindley, 1977).

The production approach views banks as primarily services producing for customers. The banks generate transactions and process documents for customers as an output, such as loans applications, credit reports, checks, or other payment instruments, while the input includes only the physical variables, such as the number of employees and the physical capital. The

intermediation approach treats the work of banks as primarily intermediating funds between savers and investors (depositors and borrowers). The banks use operating and interest expenses to produce major assets. For instance, they use labour and capital as inputs to produce loans, investments, and other means of financing as outputs. Under the intermediation approach, a deposit is treated as an input.

To calculate the technical efficiency we are able to collect data on two outputs, three inputs and three inputs prices namely: loan income (y_1) (Drake, Hall, and Simper, 2009), profit after tax (y_2) (Mostafa, 2007), No. of labours (X_1) (Wu, Yang, Liang, 2006), total fixed assets (X_2) (EL Moussawi and Obeid, 2011), deposits (X_3) (Sufian, 2007; Sufian, 2009; and Sufian, 2011), Price of labours ($W)_1$ (Kamarudin et al., 2019), price of total fixed assets (W_2) (Kamarudin et al., 2019), and price of deposits (W_3) (Kamarudin et al., 2019) Variables y_1, y_2, X_2, and X_3 measured in millions of Libyan Dinar. And we are using DEAP software to analyze the data that are obtained of inputs and outputs.

Environmental Variables

To further investigate the determinants of Libyan bank efficiency we follow a two-step approach, as suggested by Coelli et al. (1998). Using the efficiency measures derived from the DEA estimations as the dependent variable, we then estimate the following Tobit regression model using Stata10 software:

$$\boldsymbol{TE = \beta_1 ROA + \beta_2 Risk + \beta_3 SO + \beta_4 MSD + +\beta_5 OFFBALANCE + \beta_6 Crisis + \varepsilon_0}$$

The determinants of the above model are elaborated below:

1. Return on Assets (ROA)

ROA is used to measure the profitability of banks. We expect a positive relationship with bank efficiency (Sufian, 2009). Our hypothesis is suggested below:

H_0 : Profitability is negatively related to bank efficiency, and
H_a : Profitability is positively related to bank efficiency.

2. Risk

Our study also considered risk associated with capital structure as one of the factors that affect of the banking efficiency. Specifically, the level of capital measured by the ratio of equity capital to total assets reflects the bank's management efficiency and risk preference (Kamaruddin, 2007).

H_0 : Large capitalized banks are less efficient and more risky, and
H_a : Large capitalized banks are more efficient and less risky.

3. Size of Operations (SO)

It is used to measure the bank size to get the possible cost advantages associated with size (Sufian, 2009). We develop the following hypothesis in relation to size of operation and bank efficiency:

H_0 : Large size is not positively related to efficiency, and
H_a : Large size is positively related to efficiency.

4. Market Share in Deposit (MSD)

It is used to refer to the deposit market share of commercial banks and savings and loan organizations (Gulati, 2011). We develop the following hypothesis:

H_0: Market Share in Deposit is not positively related to efficiency, and
H_a: Market Share in Deposit is positively related to efficiency.

5. Exposures to Off-Balance Sheet Activities (OFFBALANCE)

It is used to refer to activities that do not involve loans and deposits but generate fee income to the banks (Gulati, 2011). Our hypothesis are:

H_0: Off-Balance Sheet Activities is not positively related to efficiency, and
H_a: Off-Balance Sheet Activities is positively related to efficiency.

6. Crisis

It is used to refer to global financial crisis; it is equal 1 in 2008 and 2009, and 0 otherwise. Our hypothesis is suggested below:

H_0: Crisis is not positively related to efficiency, and
H_a: Crisis is positively related to efficiency.

Table (2) below contains information on the potential efficiency determinant variables.

Table (2): Explanatory Variables and Measurements

Variable	Measurement
Return on Assets (ROA)	$\frac{Net\ Income}{Total\ Assets}$
Risk	$\frac{Equaty\ Capital}{Total\ Assets}$
Size of Operations (SO)	$Natural\ Log\ of\ Total\ Assets$
Market Share in Deposit (MSD)	$\frac{Deposit\ of\ the\ Bank}{Total\ Deposit\ of\ the\ Bank\ During\ 7\ Years} \times 100$
Exposures to Off-Balance Sheet Activities (OFFBALANCE)	$\frac{Non-\ Interest\ Income}{Total\ Assets} \times 100$
Crisis	*Dummy variable that takes a value of 1 in 2008 and 2009, and 0 otherwise*

EMPIRICAL RESULTS

In this section, we will discuss the cost efficiency of Libyan banks, measured by the DEA method and its decomposition into allocative efficiency and technical efficiency components.

Efficiency of Libyan Banks

Table (3) presents the mean efficiency score of the Libyan banks for the years 2004 (Panel A), 2005 (Panel B), 2006 (Panel C), 2007 (Panel D), 2008 (Panel E), 2009 (Panel F), 2010 (Panel G), and All years (Panel H).

The Libyan banks' mean cost efficiency has been on unstable, it decreased during 2004 – 2005, then has been increased in 2006, and continue to increase from 2006 to 2010. It is clear from Table (3) that during the period of study, the Libyan banks have showed mean cost efficiency of 28.3 percent. The results suggest that the Libyan banks could have saved 71.7 percent of the inputs to produce the same amount of outputs that it produced. In other words, the Libyan banks could have produced the same amount of outputs by using only 28.3 percent of the amount of inputs used.

Table (3): Summary Statistics of Efficiency Scores

Efficiency measures	Mean	Min	Max	SD
Panel A: All Banks 2004				
Cost efficiency	0.258	0.001	1.000	0.365
Allocative efficiency	0.375	0.002	1.000	0.350
Technical efficiency	0.662	0.015	1.000	0.355
Panel B: All Banks 2005				
Cost efficiency	0.231	0.001	1.000	0.275
Allocative efficiency	0.456	0.001	1.000	0.352
Technical efficiency	0.664	0.024	1.000	0.377
Panel C: All Banks 2006				
Cost efficiency	0.243	0.000	1.000	0.370
Allocative efficiency	0.381	0.000	1.000	0.367
Technical efficiency	0.556	0.034	1.000	0.391
Panel D: All Banks 2007				
Cost efficiency	0.249	0.016	1.000	0.338
Allocative efficiency	0.396	0.072	1.000	0.286
Technical efficiency	0.521	0.117	1.000	0.358
Panel E: All Banks 2008				
Cost efficiency	0.252	0.003	1.000	0.304
Allocative efficiency	0.363	0.094	1.000	0.280
Technical efficiency	0.534	0.016	1.000	0.359
Panel F: All Banks 2009				
Cost efficiency	0.253	0.022	1.000	0.325
Allocative efficiency	0.409	0.059	1.000	0.343
Technical efficiency	0.501	0.072	1.000	0.344
Panel G: All Banks 2010				
Cost efficiency	0.274	0.054	1.000	0.277
Allocative efficiency	0.419	0.054	1.000	0.317
Technical efficiency	0.691	0.16	1.000	0.287
Panel H: All Banks all years				
Cost efficiency	0.283	0.001	1.000	0.320
Allocative efficiency	0.468	0.001	1.000	0.333
Technical efficiency	0.586	0.015	1.000	0.355

The decomposition of cost efficiency into its allocative and technical efficiency components suggests that allocative inefficiency dominates technical inefficiency of the Libyan banks during all years.

Table (4) presents the results of the commercial banks in Libya. It is clear that the commercial banks' efficiency was unstable, it was 6.7 percent in 2004 and continue increasing to 2006 to reach 44.8 percent, the declined in 2007 and increased again, after that decline again in 2009 after that increased again in 2010.

Table (4): Summary Statistics of Efficiency Scores

Efficiency measures	Mean	Min	Max	SD
Panel A: Commercial Banks 2004				
Cost efficiency	0.067	0.016	0.138	0.053
Allocative efficiency	0.070	0.016	0.138	0.050
Technical efficiency	0.900	0.600	1.000	0.173
Panel B: Commercial Banks 2005				
Cost efficiency	0.123	0.036	0.239	0.073
Allocative efficiency	0.335	0.036	0.914	0.346
Technical efficiency	0.663	0.262	1.000	0.340
Panel C: Commercial Banks 2006				
Cost efficiency	0.448	0.033	1.000	0.421
Allocative efficiency	0.544	0.033	1.000	0.453
Technical efficiency	0.754	0.298	1.000	0.287
Panel D: Commercial Banks 2007				
Cost efficiency	0.101	0.047	0.179	0.052
Allocative efficiency	0.363	0.244	0.594	0.137
Technical efficiency	0.272	0.184	0.408	0.091
Panel E: Commercial Banks 2008				
Cost efficiency	0.115	0.033	0.343	0.132
Allocative efficiency	0.211	0.094	0.348	0.094
Technical efficiency	0.437	0.204	0.987	0.323
Panel F: Commercial Banks 2009				
Cost efficiency	0.071	0.022	0.189	0.069
Allocative efficiency	0.258	0.059	0.656	0.235
Technical efficiency	0.280	0.177	0.390	0.076
Panel G: Commercial Banks 2010				
Cost efficiency	0.259	0.072	0.558	0.183
Allocative efficiency	0.415	0.105	0.961	0.331
Technical efficiency	0.669	0.581	0.784	0.076
Panel H: all commercial banks all years				
Cost efficiency	0.169	0.016	1.000	0.226
Allocative efficiency	0.314	0.016	1.000	0.307
Technical efficiency	0.568	0.177	1.000	0.317

The results seem to suggest that the commercial banks have showed mean cost efficiency of 16.9 percent, suggesting that mean input waste was 83.1 percent. This implies that the commercial banks in Libya could have produced the same amount of outputs by only using 16.9 percent of the amount of inputs they employed. From Table 4 it is also clear that allocative inefficiency outweighs

technical inefficiency in determining the total cost efficiency of the commercial banks in Libya during the period of study.

We next discuss the specialized and private banks results in Tables (5) and (6) respectively. Similar to commercial banks' peers, the results from Table (5) seem suggest that the specialized banks in Libya have showed to decrease during from 2004 to 2006, after that they increased again during the period 2007 – 2009, then decline again in 2010.

Table (5): Summary Statistics of Efficiency Scores

Efficiency measures	Mean	Min	Max	SD
Panel A: Specialized Banks 2004				
Cost efficiency	0.551	0.001	1.000	0.450
Allocative efficiency	0.558	0.002	1.000	0.442
Technical efficiency	0.837	0.456	1.000	0.218
Panel B: Specialized Banks 2005				
Cost efficiency	0.379	0.001	1.000	0.378
Allocative efficiency	0.379	0.001	1.000	0.378
Technical efficiency	1.000	1.000	1.000	0.000
Panel C: Specialized Banks 2006				
Cost efficiency	0.255	0.001	1.000	0.376
Allocative efficiency	0.313	0.001	1.000	0.363
Technical efficiency	0.761	0.341	1.000	0.295
Panel D: Specialized Banks 2007				
Cost efficiency	0.611	0.072	1.000	0.361
Allocative efficiency	0.621	0.072	1.000	0.361
Technical efficiency	0.985	0.924	1.000	0.030
Panel E: Specialized Banks 2008				
Cost efficiency	0.619	0.249	1.000	0.320
Allocative efficiency	0.619	0.249	1.000	0.320
Technical efficiency	1.000	1.000	1.000	0.000
Panel F: Specialized Banks 2009				
Cost efficiency	0.667	0.174	1.000	0.312
Allocative efficiency	0.667	0.174	1.000	0.312
Technical efficiency	1.000	1.000	1.000	0.000
Panel G: Specialized Banks 2010				
Cost efficiency	0.357	0.054	1.000	0.333
Allocative efficiency	0.357	0.054	1.000	0.333
Technical efficiency	1.000	1.000	1.000	0.000
Panel H: all Specialized Banks all years				
Cost efficiency	0.491	0.001	1.000	0.392
Allocative efficiency	0.502	0.001	1.000	0.386
Technical efficiency	0.940	0.341	1.000	0.167

The results seem to suggest that the specialized banks have showed mean cost efficiency of 49.1 percent, suggesting mean input waste 50.9 percent. This implies that the specialized banks in Libya could have produced the same amount of outputs by using 49.1 percent of the amount of inputs they employed.

Table (6): Summary Statistics of Efficiency Scores

Efficiency measures	Mean	Min	Max	SD
Panel A: Private Banks 2004				
Cost efficiency	0.083	0.009	0.162	0.054
Allocative efficiency	0.453	0.338	0.618	0.102
Technical efficiency	0.206	0.015	0.378	0.132
Panel B: Private Banks 2005				
Cost efficiency	0.157	0.021	0.378	0.133
Allocative efficiency	0.677	0.377	0.859	0.184
Technical efficiency	0.245	0.024	0.482	0.170
Panel C: Private Banks 2006				
Cost efficiency	0.022	0.008	0.047	0.015
Allocative efficiency	0.302	0.090	0.562	0.173
Technical efficiency	0.102	0.034	0.250	0.088
Panel D: Private Banks 2007				
Cost efficiency	0.231	0.016	0.651	0.202
Allocative efficiency	0.574	0.133	1.000	0.266
Technical efficiency	0.355	0.117	0.651	0.174
Panel E: Private Banks 2008				
Cost efficiency	0.156	0.003	0.523	0.151
Allocative efficiency	0.440	0.209	1.000	0.228
Technical efficiency	0.292	0.016	0.523	0.150
Panel F: Private Banks 2009				
Cost efficiency	0.203	0.037	0.702	0.204
Allocative efficiency	0.633	0.135	1.000	0.321
Technical efficiency	0.299	0.072	0.702	0.167
Panel G: Private Banks 2010				
Cost efficiency	0.317	0.120	1.000	0.273
Allocative efficiency	0.630	0.270	1.000	0.237
Technical efficiency	0.508	0.161	1.000	0.280
Panel H: All Private Banks all years				
Cost efficiency	0.189	0.003	1.000	0.204
Allocative efficiency	0.539	0.090	1.000	0.265
Technical efficiency	0.315	0.015	1.000	0.216

From Table (6) it is also clear that technical inefficiency outweighs allocative inefficiency in determining the total cost efficiency of the specialized banks in Libya during the period of study.

Table (6) seems to suggest that the private banks in Libya have showed unstable during the period of study. During the years, the private banks in Libya have showed mean cost efficiency of 18.9 percent (commercial banks 16.9 percent and specialized banks 49.1 percent). It is also clear from Table (6) that technical inefficiency outweighs allocative efficiency in determining the total cost inefficiency of the private banks in Libya.

Determinants of Libyan Banks' Efficiency

In addition to estimating the DEA efficiency scores in stage one; we constructed an econometric regression model based on the efficiency scores as dependent variable to detect the relationship between efficiency and some of determinants. We estimated our model using Tobit regression onto a vector of explanatory variables in order to explain the variation in the efficiency scores obtained from stage one.

Table (7) used Tobit regression to give the estimated results during 2004 – 2010. The second column of this table revealed estimated coefficients and standard errors from Tobit regression for regression cost efficiency change on the vector of explanatory variables. We examine the effect of factors on cost efficiency scores as in the following model:

$$\boldsymbol{CE = \beta_1 ROA + \beta_2 Risk + \beta_3 SO + \beta_4 MSD + +\beta_5 OFFBALANCE + \beta_6 Crisis + \varepsilon_0}$$

Table (7): Determinants of Cost Efficiency

	CE
C	-0.444
ROA	3.590 (0.081)
RISK	0.819 (0.000)
SO	0.024 (0.126)
MSD	0.163 (0.443)
OFF-BALANCE	0.249 (0.803)
CRISIS	0.038 (0.559)
R-Squared	0.209
Adjusted R-Squared	0.161

In Table (7), according to Asteriou and Hall (2007) the fixed effects method relating to regression is used because Adjusted R-squared > 0.05. From table (7), we find that ROA and risk are positive significant, while other factors are not significant at 5 percent confidence level. So, based on these findings we reject the null hypothesis and we accept the alternative hypothesis for ROA and risk. ROA has coefficient estimate of 3.590 this suggest that 3.590 percent change in the ROA will increase cost efficiency by 1 percent. Also, risk has coefficient estimate 0.819 this suggest that 0.819 percent change in risk will increase cost efficiency by 1 percent.

Table (8): Determinants of Allocative Efficiency

	AE
C	0.938
ROA	3.208 (0.152)
RISK	0.264 (0.200)
SO	-0.030 (0.081)
MSD	0.364 (0.118)
OFF-BALANCE	-0.363 (0.740)
CRISIS	0.034 (0.640)
R-Squared	0.133
Adjusted R-Squared	0.081

From Table (8), SO is a negative significant related to allocative efficiency at 10 percent confidence level. So, we accept the alternative hypothesis for SO. SO has a negative coefficient estimate of -0.030 that means 0.030 percent decrease in SO will increase allocative efficiency by 1 percent.

Table (9): Determinants of Technical Efficiency

	TE
C	-1.613
ROA	2.962 (0.145)
RISK	0.877 (0.000)
SO	0.098 (0.000)
MSD	-0.061 (0.772)
OFF BALANCE	0.852 (0.392)
CRISIS	-0.078 (0.232)
R-squared	0.370
Adjusted R-squared	0.332

Based on Table (9), risk and SO are positive significant related to technical efficiency at 5 percent confidence level. Based on these results, we reject the null hypothesis, and we accept the alternative hypothesis for risk and SO. Risk has coefficient estimate of 0.877 suggesting that 0.877 percent change in the risk will increase technical efficiency by 1 percent. Also, SO has coefficient estimate 0.098 this suggest that 0.098 percent change in SO will increase technical efficiency by 1 percent.

According to the profitability ratios (ROA and ROE), the results suggested that the ROA was positively related to bank efficiency, and the coefficient had a positive statistically significant relation to the cost efficiency score at a 10% level. This result is consistent with the findings of Casu and Molyneux (2003). Also the findings about profitability indicate that the more profitable banks tend to exhibit lower inefficiency, which corroborates similar findings of some previous studies (Isik and Hassan, 2002; Hasan and Marton, 2003; Miller and Noulas, 1996)**.** Banks reporting higher profitability ratios are usually preferred by clients and therefore attract the biggest share of deposits as well as the best potential creditworthy borrowers. Such conditions create a favourable environment for the profitable banks to be more efficient from the point of view of intermediation activities.

In this paper the relationship between risk banks and efficiency is positive related to cost efficiency and significant of the regression model. However, Kamarudin et al. (2019) estimated the risk linked banks and efficiency and they suggested that estimated coefficients entered the regression models with a positive sign. The SO is positive coefficient related to allocative and technical efficiency and significant of the regression model. Sufian (2009) estimated the SO structure in Malaysian banks and he imply that the regression model positively and is statistically significant in the value added approach regression models. Most of his findings showed that the banks with controlling share of foreign ownership are likely to be more efficient compared to their domestically owned counterparts.

CONCLUSION AND POLICY IMPLICATIONS

In this paper, we examined the efficiency of the Libyan banks during the period 2004-2010. The efficiency estimates of individual banks were evaluated by using the non-parametric DEA approach.

The empirical findings suggest that during the period of study, technical inefficiency outweighs allocative inefficiency in the Libyan banking sector, implying that the private and some of commercial banks have been managerially inefficient in exploiting their resources to optimal levels. The empirical findings seem to suggest that the specialized banks have exhibited higher cost efficiency compared to commercial banks and private banks. During the period of study we found that technical inefficiency has greater influence in determining the total cost inefficiency of commercial banks, Also technical inefficiency has greater influence in determining the cost inefficiency of specialized and private banks.

The findings suggest that cost efficiency is positively and significantly associated with return on assets, risk and size operation banks with efficiency. In future, this paper can be extended as follows. First, the scope of this study can be extended to investigate changes in relative, operation, and profitability efficiencies over time. Second, future studies could also examine the production

function to compare with the intermediation function. Finally, future studies should capture changes in productivity over time as a result of technical change, technological progress, or regression by using the Malmquist Total Factor Productivity Index. Despite these limitations, the findings of this study are expected to extend the literature relating to the operating efficiency of Libyan banking. The policy implications relate to banks' specific management. Respective banks should strive to attain optimal utilization of the capacities that they have like inputs or resources, and improve their managerial expertise particularly on exercising efficient allocation of scarce resources. By doing these, they can easily achieve economies of scale for their banks. Eventually, those efforts may facilitate sustainable competitiveness for the commercial banks, private banks and specialized banks in Libya.

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